

IPPU SECTOR INVENTORY









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ABBREVIATIONS AND ACRONYMS

AD	Activity Data
CFCs	Chlorofluorocarbons
CO2	Carbon dioxide
DEPC	Department of Environment Protection and Conservation
DOCC	Department of Climate Change
EF	Emission Factor
GHG	Green House Gas
GWP	Global Warming Potentials
HCFC	Hydrochlorofluorocarbons
HFCs	Hydrofluorocarbons
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial processes and product Use
NACC	Nations Framework Convention on Climate Change
ODS	Ozone-depleting substances
OLP	Ozone Layer Policy
PFCs	Fluorocarbons
QA/QC	Quality Assurance/Quality Control
RAC	Refrigeration and Air-conditioning
RTI	Right to Information
SF6	Sulfur hexafluoride
VCIR	Vanuatu Customs & Inland Revenue
VNSO	Vanuatu National Statistics Office







2.1 SECTOR OVERVIEW

2.1.1. 2.F.1a CATEGORY OVERVIEW

The Refrigeration and stationary air conditioning (RAC) category (2.F.1.a) in the 2006 IPCC methodological Guidelines for national GHG inventories $(2006 \text{ IPCC})^1$ plays a vital role in addressing the ozone-depleting substances (ODS) emitted from the industrial processes and product use sector (IPPU). (RAC) systems may be classified into up to six sub-application domains or categories:

(i) Domestic (i.e., household) refrigeration,

(ii) Commercial refrigeration including different types of equipment, from vending machines to

centralized refrigeration systems in supermarkets,

(iii) Industrial processes including chillers, cold storage, and industrial heat pumps used in the food, petrochemical, and other industries,

(iv) Transport refrigeration including equipment and systems used in refrigerated trucks, containers, reefers, and wagons,

(v) Stationary air conditioning including air-to-air systems, heat pumps, and chillers for building and residential applications,

(vi) Mobile air-conditioning systems used in passenger cars, truck cabins, buses, and trains.

For all these sub-applications, different hydrofluorocarbons (HFCs) are progressively replacing chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs). Many blends containing HFCs and/or PFCs are being used in Refrigeration and Air Conditioning applications. The tables with the list of HFCs and the commercial blends used to include their global warming potentials (GWPs) as well as the table with blend composition for the most commonly used blends in Vanuatu are included in Annex 1 to this document.

Regarding Vanuatu, the 2.F.1.a category which covers refrigeration and steady air conditioning, is the most appropriate one based on data availability.

¹ https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/3_Volume3/V3_7_Ch7_ODS_Substitutes.pdf







2.1.2 REFRIGERATION AND AIR CONDITIONING in VANUATU

Refrigeration and air conditioning in Vanuatu mainly focus on residential and commercial applications; examples include conditioning systems in hotels, resorts, and government buildings and refrigeration systems for food storage. A large portion of the sector is run by HCFCs and HFCs, which extend their use in a variety of applications. Regardless of the uses of these ODS, they are categorized as potent greenhouse gases with high global warming potential (GWP). Consequently, there is a need to acquire a sustainable alternative to these substances that can deliver the same but better performance while trying to diminish Environmental impact.

The primary imports into Vanuatu are mixes of R-134A, R404A, R-407C, R-507C, and R-410A. R404A has a composition of (44.0/52.0/4.0) and is made up of HFC-125, HFC-143a, and HFC-134a. Conversely, R-407, which has a composition of (44.0/52.0/4.0), makes up HFC-125/HFC-143a/HFC-134a¹. Thus, HFC-32, HFC-125, HFC-143a, and HFC-134a are the specific gases that Vanuatu uses the most.

The most often released fluorinated gas in Vanuatu is HFC-134a, a refrigerant. Hydrofluorocarbons (HFCs) like HFC-134a are commonly found in air conditioning and refrigeration systems. When released into the atmosphere, it has a large global warming potential (GWP) and greatly contributes to climate change.

In the year of 2015, Vanuatu completed a project aided by the United Nations and the Multilateral Fund for the implementation of the Montreal Protocol, to replace HCFCs in its air conditioning and refrigeration systems with HFCs (Roberts, 2023).

The transition away from ODS in refrigeration and air conditioning to adopting the use of HFC has proven to be one of the key categories. HFCs lack chlorine which is a primary ozone-depleting component in CFCs and HCFCs (National Research Council, 1996). Though HFCs do not deplete the ozone layer, they are still potent greenhouse gases with a high global warming potential (Ravishankara et al., 2011). Therefore, ongoing research is still on the way to finding alternative HFCs that are friendly and energy efficient. One of the categories that is most significant has shown to be the shift from ODS to HFC in air conditioning and refrigeration. Chlorine, the main ozone-depleting compound in CFCs and HCFCs, is absent in HFCs (National Research Council, 1996). HFCs are strong greenhouse gases with a high potential for global warming even though they do not destroy the ozone layer (Ravishankara et al., 2011). Consequently, continued study is needed to identify safe and energy-efficient replacements for HFCs.

The DEPC currently encourages the importing of environmentally friendly gases like R600 and R290. Vanuatu prohibits the shipment of any regulated substances, including CFCs, due to the Ozone Layer Policy (OLP) Act Regulation Order No. 20 (Roberts, 2023)

The phase-out of ODS in refrigeration and air conditioning systems requires a comprehensive approach that involves not only finding suitable substitutes but also addressing issues related to system design, energy efficiency, leak prevention, and proper disposal of old equipment containing ODS.







2.2. REFERENCE MANUAL

2.2.1. Data Collection

Data requirement for simplified Tier 1 a/b approach:

- Information on domestic production, import, and export of fluorinated agents in the year to be reported. Information should include total mass of agents (e.g., tonnage), where available.
- > Introduction year of the refrigerant.
- Growth rate in sales of new equipment (usually assumed linear across the period of assessment).
- > Assumed **equipment lifetime** (IPCC default is 15 years for household equipment)
- **Remaining agent** in retired equipment (set at **0** if unknown)
- > **Destruction of agent** in retired equipment (set at 0 if unknown)
- **Release of agent** from retired equipment (set at 0 if unknown)

Minimum Data requirements per agent in Vanuatu's market:

- > Year of introduction of agent
- > **Domestic production** of agent (tonnes) in current year
- > Imports of agent (tonnes) in current year
- **Export** of agent (tonnes) in current year
- **Growth rate** of equipment sales that uses the agent.

Data needed for baseline and further reporting. For HFCs,

- Data from the GHG inventory, specifically HFC blends² or/and individual chemicals used in Vanuatu.
- Actual or modeled data for HFC consumption (as individual chemicals or blends) for the complete period of 2005 2022.
- Data on the composition of blends imported in Vanuatu (per blend, if any), otherwise use default values from the blend composition table shown on Table 2.2.1.1 and Table 2.2.1.2. (Refer to Annex).

2.2.2. Data Sources (Departments, Stakeholders)

The Country's specific data can be collected from:

- Vanuatu Customs & Inland Revenue (VCIR)
- Vanuatu National Statistics Office
- Department of Environmental Protection and Conservation (DEPC)
- Department of Climate Change (DOCC)

² Refrigerant blends contain a mixture of one or more refrigerant type.







Once a data set is selected, a more detailed formal specification of data should be created. A clear clarity of data requirements will allow data that is requested to be delivered upon expectation. The specification should include details such as:

- Definition of the data set (e.g., time series, sectors and sub-sector detail, national coverage, requirements for uncertainty data, emission factors and/or activity data units).
- The format (e.g., spreadsheet) and structure (e.g., what different tables are needed and their structure) of the data set,
- Description of any assumptions made regarding national coverage, the sectors included, representative year, technology/management level, and emission factors or uncertainty parameters.
- Identification of the routines and timescales for data collection activities (e.g., how often is the data set updated and what elements are updated).
- Reference to documentation and QA/QC procedures.
- Contact name and department/ organization.
- Date of availability.

(Goodwin, Woodfield, Ibnoaf, Koch, & Yan, 2006)

Flowchart 2.2.2.1: Flowchart of sources and access to required data









Table 1: Detailed Information of Collecting Data from Sources.

Department/ Organization	Roles and Responsibility	Dates	Relevant Governing	Contact Person	Comments				
Vanuatu Customs and inland Revenue (VCIR)	To provide data on imports and exports of F- gases (ODS Substitutes – Refrigerants) to DOCC	2 nd of April every year – 1 st week of May	Arrangement Memorandum of understanding or Right to Information (RTI) between VCIR and DOCC	Customs Revenue Section, Port Vila Email: <u>customsrevenue</u> @vanuatu.gov.v <u>u</u> Tel: +678 33091	DOCC needs to send a prompt letter to VCIR 1-2 months prior. A follow-up email or call is crucial as well.				
Vanuatu National Statistics Office	Provide statistical data and information on import products containing refrigerants to DOCC	2 nd of April every year – 1 st week of May	Memorandum of understanding or Right to Information (RTI) between the Vanuatu National Statistics Office and DOCC	Vanuatu National Statistics Office Tel: (678) 22110 / 22111 / 33040 Email: <u>stats@va</u> <u>nuatu.gov.vu</u> Name: Mento Susie (Senior Statistician - Disaster & Environment) Email: Tel: Leo Charlington (Principal Statistician Social & Environment) Email: Tel:	DOCC needs to send a prompt letter to Vanuatu National Statistics Office 1-2 months prior. A follow-up email or call is crucial as well.				
Department of Environmental Protection & Conservation	Provide information on products containing refrigerants and data related to environmental impact	2 nd of April every year – 1 st week of May	Memorandum of understanding or Right to Information (RTI) between the Department of Environmental Protection &	The Environmental Protection Unit. Roselyn Bue Senior Officer (Chemical and Ozone)	DOCC needs to send a prompt letter to the Department of Environmental Protection & Conservation 1- 2 months prior.				







	assessments, regulations, and policies regarding the usage of refrigerants.		Conservation and DOCC	Email: <u>rbue@va</u> <u>nuatu.gov.vu</u> Richard Petterson Ozone Assistant Officer Project (s): IS (Ozone) Email: <u>rpetterson</u> @vanuatu.gov.v <u>u</u>	A follow-up email or call is crucial as well.
Department of Climate Change (DOCC)	DOCC is responsible to send a formal letter requesting relevant data to the Vanuatu Customs and Inland Revenue, The National Statistics Office and The Environmental Protection and Conservation.	February – March every year	Provide a Memorandum of understanding or Right to Information (RTI) to the Vanuatu Customs and Inland Revenue, the National Statistics Office and the Environmental Protection and Conservation	Nelson Kalo Director of Climate Change Email: nekalo@vanuatu .gov.vu	DOCC is responsible for doing a follow- up to the departments or organization for the required data to be delivered upon schedule.

2.2.3. Data Assumptions

- A hybrid Tier 1a/b approach can use these assumptions for air conditioning and refrigeration in Vanuatu. The following assumptions were made: (See 2006 IPCC Guidelines, Volume 3 Chapter 7, Emissions of fluorinated substitutes for ozone depleting substances, Section 7.5.2 for discussion on *Methodological issues*)
- HFCs and PFCs are not produced nor exported from Vanuatu.
- Assumed percentage of new equipment exported for Vanuatu is 0%.
- Assumed percentage of new equipment imported for Vanuatu. (To be determined)
- Emissions from banked refrigerant average is **15%** annually through every RAC application area (Default value from IPCC Guideline).
- Equipment servicing does not commence until **3 years** after installation of equipment.
- In a mature market, 2/3 (67%) of refrigerant sales are used for servicing while 1/3 (33%) are used to charge for new equipment. (Default value from IPCC Guideline)
- Across all sub applications, the average equipment lifetime is **15 years.** (Default value from IPCC Guideline).

The HFC emissions from air conditioning and refrigeration did not occur until 2005(Ashford, et al., 2006)







2.3 ESTIMATING GREENHOUSE GAS EMISSIONS



Figure 1.0: displays the decision tree employed for selecting the method approach for actual emissions from the refrigeration and air conditioning (RAC) application. The decisions implemented during this operation are indicated by the red arrows.

(See 2006 IPCC Guidelines, Vol. 3, Figure 7.6)

Note: Due to the national circumstances (lack of resources) Vanuatu does not have yet reliable country-specific emission factors and parameters and therefore, is applying the default parameters and Tier 1 methods to estimate emissions from the 2.F.1.a category.







2.3.1 METHODOLOGY CHOICE

Vanuatu mostly imports specific RAC applications as the nation does not manufacture or export refrigeration and air conditioners (RAC). The following justifies the adoption of the IPCC guideline's Tier 1a/b hybrid approach. First off, only fixed air conditioners and refrigeration in domestic and commercial properties will be examined in this analysis. Accordingly, we won't be looking into the other RAC areas, which include transport refrigeration and mobile air conditioning systems. Additionally, government agencies offer country-specific data at the application level (RAC), which can be obtained. Furthermore, Vanuatu does not have a country-specific composite emission factor available, so the IPCC Default composite emission factor will be applied. To aid in the selection process, the decision tree about real emissions from Refrigeration and Air Conditioning (RAC) applications that were extracted from (2006 IPCC Guidelines, Vol. 3, Figure 7.6) is shown in Figure 1.0. The decisions made in this method are shown by the red arrows.

Boxes 1.1 and 1.2, respectively, provide the formulas for calculating the Annual Emissions of a Chemical from an Application with Banks and the Net Consumption of a Chemical in a Specific Application.

BOX 1.1

IPCC (2006) EQUATION 7.2B

CALCULATION OF EMISSIONS OF A CHEMICAL FROM AN APPLICATION WITH BANKS

Annual Emissions = Net Consumption x Composite EF_{FY} + Total Banked Chemical x Composite EF_B

Where:

Net Consumption = Production + Imports – Exports – Destruction (Refer to equation 7.1 below)

Composite EF_{FY} = composite emission factor for the application for the first year (see 2006 IPCC Guidelines, Vol. 3, pg. 7.14, EQUATION 7.2b).

Total Banked Chemical = bank of the chemical for the application (see 2006 IPCC Guidelines, Vol. 3, pg. 7.14, EQUATION 7.2b).

Composite EF_B = composite emission factor for the bank application (see 2006 IPCC Guidelines, Vol. 3, pg. 7.14, EQUATION 7.2b). BOX 1.2

IPCC (2006) EQUATION 7.1

CALCULATION OF NET CONSUMPTION OF A CHEMICAL IN A SPECIES APPLICATION

Net Consumption = Production + Imports – Exports - Destruction

(See 2006 IPCC Guidelines, Vol. 3, pg. 7.14, EQUATION 7.1)







2.3.2 STEP – BY – STEP CALCULATION, DOCUMENTING RESOURCES USED

Table 2: a list of steps to perform to calculate the Total Tonne of each agent, starting with activity data obtained.

	STEPS	DESCRIPTION	EQUATION OR DEFAULT VALUE	IPCC GUIDELINES TO FIND TABLE OR EQUATION
1	Activity Data Based on Imports Data (1 of 2)	Collect data from the customs department in Vanuatu on the commodity which includes the Refrigerators, freezers, and other refrigerating or freezing equipment.		
1.1	Activity Data Based on Imports Data (2 of 2)	Collect data on the Annual Imports (VT Million) remember to record the source, where the data was collected.		
1.2	Refrigerators and Refrigerating Assumptions (1 of 2)	collect data on the Unit price and find the average price per unit (assuming that there is a 2% annual inflation) then Calculate the number of <u>new units imported</u> by using the following equation	Number of new units imported = total import \$ / unit \$	
1.3	Refrigerators and Refrigerating Assumptions (2 of 2)	Calculate the number of new units imported for Air Conditioning and Refrigerators by multiplying the number of new imports by the percentage (%) of applications within Vanuatu.		
	Refrigerator and AC	Record the sources of where the following data have been collected from:		
1.4	Assumptions (1 of 2)	- Percentage of households that have an (A/C) system		
		- Percentage of households that have one or more refrigerators		
1.5	Refrigerator and AC Assumptions (2 of 2)	use the information collected from step 6 to find Acquisition Assumption (% of New Units Imported)	Percentage of commercial AC = 100% - percentage of household (domestic)	
	Total New Units by	Calculate the total new units by equipment	(Total New units by Equipment Type) X (Acquisition assumption)	
1.6	Equipment Type and End User	type and end-user by:	Equipment charge Value (Table 1) in manual	(2006 IPCC Defaults (Volume 3, Chapter 7, Table 7.9)
1.7	Calculated Total Tonnes of HFC	To calculate the total tonnes of HFC we use the following formula	HFC (kg) = Number of Units * Equipment Type charge (KG)	The Equipment Type charge (see 2006 IPCC Defaults (Volume 3, Chapter 7, Table 7.9)
1.8	Calculating individual chemical kg within a HFC blend	To calculate individual chemicals (Kg) the following equation is used	HFC (kg) = Total HFC Blend (kg) * HFC (% of blend	blends containing HFCs and/or PFCs (see 2006 IPCC Defaults, Volume 3, Chapter 7, Table 7.8)
1.9	Calculating kg per HFC type	Use the equation in step 1.7 to calculate each HFC type	HFC (kg) = Number of Units * Equipment Type charge (KG)	
2	TOTAL HFC TONNES	Add up all the blend compositions for each year.		

Note: Challenges may arise due to inaccuracies in the unit price and total expenditure figures thus leading to discrepancies in the estimated number of units imported. The uncertainty can be high when dealing with various types of equipment and chemicals that may have fluctuating prices or varying quantities used across the different sectors. Therefore, In the near future







Vanuatu should strive to collect precise data on both the number of equipment item and the specific chemicals used in each application. This should help to minimize uncertainty in the evaluation of imports, as well as in the greenhouse gas (GHG) estimations within the industrial processes and product use (IPPU) sector.

Values for unit price assumptions can be obtained from the statistics single window^{$\frac{3}{2}$}.

Table 3: Assumptions table with default values of Equipment type and its sub-applications together with their equipment charge in Kg extracted from the IPCC Guide

EQUIPMENT TYPE	SUB-APPLICATION	EQUIPMENT CHARGE (KG)
Air Conditioning	Residential and Commercial AC	10
Refrigeration	Commercial Refrigeration	28
	Domestic Refrigeration	0.5

Note: The stand-alone application has a value of 6 and the Medium and large commercial Refrigeration has a lower value of 50, a midpoint of 28 will be used.

(See 2006 IPCC Defaults, Volume 3, Chapter 7, Table 7.9)

³ https://singlewindow.gov.vu/portal/services/swApprovedAppliances/appliances.jsf







USING EXCEL TO CALCULATE THE EMISSIONS FROM THE TOTAL TONNES OF AGENTS using file S2_V3_An1_Calculation_example_for_2F1_HFC125

1. 1 Select the "DATA" tab (illustrated by the red arrow)



1.2 Enter "VANUATU" as a country in yellow Cell C2 (see red arrow)

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10	Exports in current year															
11	Total new agent to domestic market	0	0	0	0	0	0	0	0							
12	Year of introduction	2	8													
13	Growth rate in new equipment sales	9	8													
14	Tier 1 Defaults	40	45	45	45	45	45	45	15							
10	Assumed equipment inetime (years)	15	15	15	15	15	15	10	15							
10	Emission Factor from Installed base	15%	15%	15%	15%	15%	15%	15%	15%							
18	% destroyed at end of life	0%	0%	0%	0%	0%	0%	0%	0%							
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20																
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1.3 Enter the relevant year (2023) in yellow cell C3 (see illustration in step 1.2)

1.4 Enter 0 in yellow cells C8 to J8 as none of the agents are produced in Vanuatu, (see red arrow in the figure below)



1.5 Enter the total imports for each of the individual HFC agents that Vanuatu imported into the yellow cells C9 through J9 (note: ensure that the total HFC agent is in "TONNES"). (See red arrow below illustrated in the figure below)

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13	Growth rate in new equipment sales												
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15	Assumed equipment lifetime (years)	15	15	15	15	15	15	15	15				
16	Emission Factor from installed base	15%	15%	15%	15%	15%	15%	15%	15%				
17	% destroyed at end of life	0%	0%	0%	0%	0%	0%	0%	0%				
18													
19													
20													
21	Data for previous years												
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25	1991												
26	1992												
27	1993												







1.6 Enter 0 in yellow cells C10 to J10 as none of the HFC agents are exported from Vanuatu (see red arrow below illustrated in the figure below)

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19															
20	Data for previous years														
22	Year	HF	C-23		HFC-32			HFC-125			HFC-134a			HFC-143a	
23		Production	Import Export	Production	Import	Export	Production	Import	Export	Production	Import	Export	Production	Import	
24	1990														
20	1991														

1.7 Enter 2005 yellow cells C12 through J12 (See red arrow illustrated in the figure below). The introduction year might change depending on what year was recorded as the introduction year.

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1									0	IX.	-					
2	Country		Vanuatu													
3	Current Year		2023													
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5					Ag	ent										
6		HFC-23	HFC-32	HFC-125	HFC-134a	HFC-143a	HFC-152a	HFC-227ea	HFC-236fa							
7	Use of Agent in Current Year															
8	Production in current year															
9	Exports in current year															
11	Total new agent to domestic market	0	0	0	0	0	0	0	0		_					
12	Year of introduction			0	0	0	0		0			Enter 20	005 for all	Agents (Th	e introduct	ion
13	Growth rate in new equipment sales											year mi	ght change	depending	ç on what y	ear
14	Tier 1 Defaults											was rec	orded as in	e miroauc	non year.	_
15	Assumed equipment lifetime (years)	15	15	15	15	15	15	15	15							
16	Emission Factor from installed base	15%	15%	15%	15%	15%	15%	15%	15%							
17	% destroyed at end of life	0%	0%	0%	0%	0%	0%	0%	0%							
18																
19																
20	Date for any income															
21	Data for previous years		HEC 23			HEC 32			HEC 125			HEC 13/a			HEC 1/3a	_
23	Tear	Production	Import	Export	Production	Import	Export	Production	Import	Export	Production	Import	Export	Production	Import	Exp
24	1990															
25	1991															







1.8 Add 2% to cells C13 through J13.



1.9 Insert 15 in the yellow cells C15 to J15.









2.0 Insert 15 in the yellow cells C16 to J16 (See red arrows in the illustration below)



2.1 Enter 0 in the yellow cells C17 through J17 (See red arrow below illustrated in Figure 7) reason being that Vanuatu does not have any destruction facility.

File Pasto	$\begin{array}{c c} \underline{Home} & \text{Insert} & \text{Page Layout} & \Pi \\ \hline \\ \hline \\ \hline \\ \hline \\ \hline \\ \hline \\ \hline \\ \hline \\ \hline \\$	Formulas $A^* = \frac{1}{2}$	Data F	Review V ~ 원 Wra 프 현 Mer	iew Help p Text ge & Center	Genera ~ \$ ~	al % 9 1	• _00 0 →0 Cor Form	nditional For natting ~ Ta	rmat as Cell able ~ Styles	I Insert	Delete Form	∑ Au J Fill ot Cle	toSum × A × Z so ar × Filt	t & Find & ter ∽ Select ~	Ŝ Share
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5					Ag	ent										
6		HFC-23	HFC-32	HFC-125	HFC-134a	HFC-143a	HFC-152a	HFC-227ea	HFC-236fa							
7	Use of Agent in Current Year															
8	Production in current year															
9	Imports in current year															
10	Exports in current year															
11	Total new agent to domestic market	0	0	0	0	0	0	0	0							
12	Year of introduction															
14	Tior 1 Defaulte															
14	Assumed equipment lifetime (years)	15	15	15	15	15	15	15	15							
16	Emission Eactor from installed base	15%	15%	15%	15%	15%	15%	15%	15%							
17	% destroyed at end of life	0%	0%	0%	0%	0%	0%	0%	0%			Enter 09	6 fo r all Ag	ents as Var	iuatu	
18	w destroyed at end of me	070	070	070	070	070	070	070	070			current	y has no d	estruction f	acility	
19																
20																
21	Data for previous years															
22	Year		HFC-23			HFC-32			HFC-125			HFC-134a			HFC-143a	
23		Production	Import	Export	Production	Import	Export	Production	Import	Export	Production	Import	Export	Production	Import	Exp
24	1990															
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4	Instructions Calc Data	Do Not F	dit (i	9		:	4									
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2.2 Locate the table with the title "Data for previous years" by scrolling down on the "Data for previous years" tab (see red arrow illustrated below).



2.3 that the cells that cross over to rows Z24 to Z38 and that descend from C24 to C38 are gray (i.e., cannot be filled in).

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2.4 Enter value Zero in the yellow cells C39, F39, I39, L39, O39, R39, U39, and X39 (HFC agents are not produced in Vanuatu).

2.5: Enter the total number of agents in Tonnes in yellow cells D39, G39, J39, M39, P39, S39, V39, and Y39.

2.6: Complete the following procedures for the remaining years starting from 2006 to 2022, leaving out the current year 2023 given that you have previously inputted each agent's total tonnes (See red arrow illustrated below)



2.7 - Select the "Calc" tab located at the bottom of the Excel sheet (See red arrow in illustration below)

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1 Tier 1 Refrigeration 2 0 - HFC-125 4 Country: 0 4 Agent: HFC-125 6 Year: 0 7 Emission: #REF! 9 In Bank: #REF!	
10 Current Year 0	
11 Data Used 0	
Ready	115%







2.8 - Select the preferred chemical agent by clicking on cell B7 (See red arrow in illustration below)

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Data Used 14 Data Used 15 Use in current year - 2023 (tonnes) Here 16 Production of HFC-125 0.00 17 Imports in current Year 0.00 18 Exports in current Year 0.00 19 Total new agent to domestic market 0.00 20 Year of Introduction of HFC-125 2005 21 Year of Introduction of HFC-125 2005 23 Growth Rate in New Equipment Sales 2% 24	0 9 08 07 06 05 04 00 00 00 00 00 00 00 00 00 00 00 00	
Instructions Calc Data Do_Not_Edit ①		
Ready		III III + 115%

2.9 - Select the required year by clicking on cell C10.

3.0-Go to cell F7, where a green summary box displays the total emission of the specified chemical agent in tones over the chosen year (See red arrow in illustration below).

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12 13 14 15 Use in current year - 2023 (tonnes) 16 Production of HFC-125 17 Imports in current year 18 Exports in current year 19 Total new agent to domestic market 20 Year of Introduction of HFC-125 21 Year of Introduction of HFC-125 23 Growth Rate in New Equipment Sales 24 Total new Section of HFC-125	Data Used Here 0.00 0.00 0.00 2005 2%		1 0.9 0.8 - 0.7 - 0.6 - 0.5 - 0.4 - 0.3 - 0.2 - 0.4 - 0.3 - 0.4 - 0.3 - 0.4 - 0.3 - 0.4 - 0.3 - 0.4 - 0.3 - 0.4 - 0.3 - 0.4 - 0.3 - 0.4 - 0.3 - 0.4 - 0.3 - 0.4 - 0.4 - 0.3 - 0.4 - 0.4 - 0.3 - 0.4 - 0.4 - 0.3 - 0.4 - 0.4 - 0.3 - 0.4 - 0.4 - 0.3 - 0.4 - 0.4 - 0.4 - 0.3 - 0.4						
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3.1 Continue scrolling down to see a graph that displays trends related to emissions. A backcalculation of emissions from prior years is also displayed (See red arrow in illustration below).



ALTERNATIVE METHOD TO CALCULATING EMISSIONS FROM EACH AGENT OF HFC USING THE VER. 2.901 IPCC INVENTORY SOFTWARE - 32BIT

- 1.1 Launch the IPCC software ver. 2.901 IPCC Inventory software 32bit for national GHG inventories.
- 1.2 Type in your password and username.
- 1.3 Type in the year of your choosing or the current inventory year.
- 1.4 Locate the long, rectangular bar labeled "IPCC categories" on the left side of the page.







🍘 IPCC Inventory Software - ANITAKAY - [Worksheets]										-	D	\times
💀 Application Database Inventor	Adminis	strate Worksh	eets Tools Ex	port/Import	Reports Windov	v Help						- 1	ðх
2006 IPCC Categories		Ga	s Parameters - Tier	2 F-Gas Emiss	ions - Tier 2a F-0	Gas Emissions - Tie	er 2b						
2.C.5 - Lead Production 2.C.6 - Zinc Production 2.C.7 - Other (please specify) • Non-Energy Products from Fuels and 2.D.1 - Lubricant Use D.2 - Parafin Vax Use	Sector: Category: Subcategory: Sheet:	Industrial Proc Product Uses : 2.F.1.a - Refrij HFC-134a (CH	esses and Product as Substitutes for O geration and Station I2FCF3) Emissions -	Use zone Depleting Sul ary Air Conditioning Tier 1	bstances							2023	3
2.D.3 - Solvent Use	Subdivision	Unspecified	√ Gas	HFC-134a (CH2	FCF3) V	Chemical Dat	a						
2.D.4 - Other (please specify)	1	1000			(1) () 1	E EE (%)	15 0.1	1.00					
- Electronics Industry	Intro Year	1993 Gr	owth Rate (%)	Lifetir	ne (d) (years)	0 EF (%)	15 Destroy	red (%) U					
2 E 2 - TET Elat Panel Display							uation 7.2						
2.E.3 - Photovoltaics 2.E.4 - Heat Transfer Fluid 2.E.5 - Other (please specify) - Product Uses as Substitutes for Ozone	Year	Production (tonnes)	Exports (tonnes)	Imports (tonnes)	Total new agent to domestic market (tonnes)	Agent in retired equipment (tonnes)	Destruction of agent in retired equipment (tonnes)	Release of agent from retired equipment (tonnes)	Bank (tonnes)	Emissions (tonnes)			
2.F.1 - Refrigeration and Air Conditionin 2.F.1.a - Refrigeration and Stationar	t ∆⊽						F = E ^ (Recovery/100 ?)						
- 2.F.1.b - Mobile Air Conditioning	2019	0	0	16.4	16.4	0.57828	0	0.57828	82.33718	12.92886			
2.F.2 - Foam Blowing Agents	2020	0	0	17.11	17.11	0.6307	0	0.6307	86.46591	13.60058			
2 F 4 - Aerosols	2021	0	0	17.83	17.83	0.68398	0	0.68398	90.64204	14.28029			
2.F.5 - Solvents	2022	0	0	18.55	18.55	0./3814	0	0./3814	94.85/59	14.966/8			Ľ.,
2.F.6 - Other Applications (please specif	2023	U	U	19.27	19.27	0.7923	0	0.7923	99.10665	10.6083		7 👗	
Other Product Manufacture and Use 2.G.1 - Electrical Equipment 2.G.1 - Manufacture of Electrical E											Uncerta	inties	
- 2.G.1.b - Use of Electrical Equipmen	User notes					▼ [2.F.1.a - Time Se	ries				,	, ų
- 2.G.1.c - Disposal of Electrical Equi								H	FC-134a (CH2FCF3) Emissions (Gq CO2 Equivalents)			
2.G.2 size and Prost toth Outer Houd 2.G.2.b. Accelerators 2.G.2.b. Accelerators 2.G.2.b. Accelerators 2.G.2.b. Accelerators 2.G.3.a. Medical Applications 2.G.3.b. Propellant for pressure and 2.G.3.c. Other (Please specify)		20 10 10 10 10 10 10 10 10 10 1											
Worksheet notes 2006 IPCC Guidelines	eet notes 2006 IPCC Guidelines Save Gas HFC-134a (CH2FCF3) V												

Country/Territory: Vanuatu Inventory Year: 2023 Base year for assessment of uncertainty in trend: 1990 CO2 Equivalents: AR5 GWPs (100 year time horizon) Database file: (C:\ProgramData\PCC2006Software\ipcc2006.accdb)

1. 5 Scroll Down the category list till you get to 2. F: Product Uses as Substitutes for Ozone

Depleting Substances (See red arrow illustrated below)

🟟 IPCC Inventory Software - ANITAKAY -	[Worksheets]										– o ×			
🖳 Application Database Inventor	ry Year Admin	istrate Workshe	eets Tools Ex	port/Import F	Reports Window	/ Help					_ 8 ×			
2006 IPCC Categories	F-Gas Emissio	ons-Tier1 F-Ga	s Parameters - Tier	2 F-Gas Emiss	ions - Tier 2a F-G	as Emissions - Tie	er 2b							
2.C.5 - Lead Production	Worksheet													
2.C.6 - Zinc Production	Sector:	Industrial Proc	esses and Product l	Jse							2023			
2.C.7 - Other (please specify)	Category:	Product Uses	as Substitutes for Oz	one Depleting Sub	ostances									
- Non-Energy Products from Fuels and	Subcategory	2.F.1.a - Refrig	peration and Stationa	ary Air Conditioning										
2.D.1 - Lubricant Use	Sheet:	HFC-134a (CH	12FCF3) Emissions -	Tier 1										
2.D.2 - Paraffin Wax Use	Data													
2.D.3 - Solvent Use	Subdivision	Unspecified	✓ Gas	HFC-134a (CH28	FCF3) ~	Chemical Dat	ta							
2.D.4 - Other (please specify)							-							
- Electronics Industry	Intro Year	- 1993 Gn	owth Rate (%) 1	Lifetin	ne (d) (years) 15	EF (%)	15 Destroy	ed (%) 0						
2.E.1 - Integrated Circuit or Semiconduc	Equation 7.2													
2 E 3 - Photovoltaics					Total new agent		Destruction of							
2 E.4 - Heat Transfer Fluid		Production	Exports		to domestic	Agent in retired	agent in retired	agent from	Bank					
2.E.5 - Other (please specify)	Year				market	equipment (toppes)	equipment	equipment	(tonnes)					
- Product Uses as Substitutes for Ozone					(tonnes)		(tonnes)	(tonnes)						
2.F.1 - Refrigeration and Air Conditionin							F=E^							
- 2.F.1.a - Refrigeration and Stationar					D = A - B + C		(Recovery/100 🦈		H = H(t-1) - I(t-1) + D - E					
2.F.1.b - Mobile Air Conditioning				16.4	16.4	0.57828	0	0.57828	82.33718	12.92886	1			
2.F.2 - Foam Blowing Agents	2020	0	0	17.11	17.11	0.6307	0	0.6307	86.46591	13.60058	2			
2.F.3 - Fire Protection	2021	0	0	17.83	17.83	0.68398	0	0.68398	90.64204	14 28029	2			
2.F.4 - Aerosols	2022	0	0	18.55	18.55	0 73814	0	0 73814	94.85759	14 96678				
2.F.5 - Solvents	> 2023	0	0	19.27	19.27	0 7923	0	0 7923	99 10665	15 6583				
2.F.6 - Other Applications (please specif		-					-							
- Other Product Manufacture and Use											Uncertainties			
2.G.1 - Electrical Equipment														
 2.G.1.a - Manufacture of Electrical E 	<u>.</u>													
2.G. I.D - Use of Electrical Equipmen	User notes					• I	Z.F. I.a - Time Sei	les			₩ ₩			
2.G.2 - SF6 and PECs from Other Produ								н	FC-134a (CH2FCF3) Emissions (C	3q CO2 Equivalents)				
- 2.G.2.a - Military Applications														
- 2.G.2.b - Accelerators							20							
2.G.2.c - Other (please specify)							10							
2.G.3 - N2O from Product Uses														
- 2.G.3.a - Medical Applications							0 0 -				0.4 0 0 0 0 0 0			
- 2.G.3.b - Propellant for pressure and							661	661 661 661			02 02 02 00 0			
- 2.G.3.c - Other (Please specify)							*							
							" Base year for asse	issment of uncertaint	y in trend: 1990					
Worksheet notes 2006 IPCC Guidelines	Save						Gas HFC-1	34a (CH2FCF3)			~			
Country/Territory: Vanuatu Inventory Ye	ear: 2023 Base	year for assessme	nt of uncertainty in	n trend: 1990 0	CO2 Equivalents:	AR5 GWPs (100 y	(ear time horizon) D	atabase file: (C:	\ProgramData\IPCC2006So	ftware\ipcc2006.accdb)				







1.6 Click on Refrigeration and stationary Air Conditioner. (2.F.1.a) (See red arrow illustrated above)

1.7 To make sure you are utilizing the Tier 1 approach, click the F-Gas Emission-Tier 1 tab in the upper right corner (See red arrow in illustration below).

2006 IPCC Categories	F-Gas Emissio	ns-Tier1 F-Ga	Parameters - Tier	2 F-Gas Emiss	ions - Tier 2a F-0	Gas Emissions - Tie	er 2b					
2.C.5 - Lead Production 2.C.6 - Zinc Production 2.C.7 - Other (please specify) - Non-Energy Products from Fuels and 2.D.1 - Lubricant Use	- Worksheet Sector: Catego Subo Sheet.	Industrial Proc Product Uses 5.1.a - Refrig un c-134a (CH	esses and Product 1 as Substitutes for O eration and Station 2FCF3) Emissions -	Use zone Depleting Sul ary Air Conditioning Tier 1	ostances							2023
2.D.2 - Paraffin Wax Use	Data	e e e e e e e e e e e e e e e e e e e		1150 124- (0112	FCF2)	Character J Dat						
2.D.4 - Other (please specify)	Subdiv	nspecmed	✓ Gas	HFC-134a (CH2	rcr3) V	Chemical Dat	a					
- Electronics Industry	Intro	93 Grt	with Rate (%)	Lifetir	ne (d) (years) 1	5 EF (%)	15 Destroy	ed (%) 0				
2.E.1 - Integrated Circuit or Semiconduc						Eq	uation 7.2					
2.E.2 - IFI Flat Panel Display 2.E.3 - Photovoltaics 2.E.4 - Heat Transfer Fluid 2.E.5 - Other (please specify) - Product Uses as Substitutes for Ozone	Year	Production (tonnes)	Exports (tonnes)	Imports (tonnes)	Total new agent to domestic market (tonnes)	Agent in retired equipment (tonnes)	Destruction of agent in retired equipment (tonnes)	Release of agent from retired equipment (tonnes)	Bank (tonnes)	Emissions (tonnes)		
2.F.1 - Refrigeration and Air Conditionin 2.F.1.a - Refrigeration and Stationar	t ≙⊽		в				(Recovery/100 ?)					
- 2.F.1.b - Mobile Air Conditioning	2019	0	0	16.4	16.4	0.57828	0	0.57828	82.33718	12.92886	3	
2.F.2 - Foam Blowing Agents	2020	0	0	17.11	17.11	0.6307	0	0.6307	86.46591	13.60058		
2.F.3 - Fire Protection	2021	0	0	17.83	17.83	0.68398	0	0.68398	90.64204	14.28029		
2.F.4 - Aerosols	2022	0	0	18.55	18.55	0.73814	0	0.73814	94.85759	14.96678		
2.F.D - Solvents 2.F.S Other Applications (please specif	▶ 2023	0	0	19.27	19.27	0.7923	0	0.7923	99.10665	15.6583		🤊 🗙
- Other Product Manufacture and Use 2.G.1 - Electrical Equipment - 2.G.1.a - Manufacture of Electrical E			- '								Uncert	ainties
2.G.1.b - Use of Electrical Equipmen	User notes					- I	2.F.1.a - Time Se	ries				-
2.G.2 - SE6 and PECs from Other Produ								н	FC-134a (CH2FCF3) Emissions (C	3q CO2 Equivalents)		
2 G.2.a - Military Applications 2 G.2.b - Accelerators 2 G.2.c - Other (please specify) 2 G.3.a - N2O from Product Uses 2 G.3.a - Medical Applications 2 G.3.b - Propellant for pressure and 2 G.3.c - Other (Please specify)							20 10 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		v in trend: 1990	2019 2011 2011 2011 2013 2014 2015 2015 2017	2018 2019 2020	2022 2023 2024 2024 2025
												-

1.8 Select Unspecified by clicking on the empty button next to the Subdivision tab (See red

arrow in illustration below)

🖳 Application Database Inventory	y Year Admini	istrate Workshe	ets Tools E	xport/Import F	eports Window	v Help						- 8 ×
2006 IPCC Categories	F-Gas Emissio	ons-Tier1 F-Gas	Parameters - Tie	r 2 F-Gas Emiss	ions - Tier 2a F-0	as Emissions - Tie	er 2b					
2.C.5 - Lead Production	Worksheet											
2.C.6 - Zinc Production	Sector:	Industrial Proce	esses and Product	Use							2	023
2.C.7 - Other (please specify)	Category:	Product Uses a	as Substitutes for O	zone Depleting Sub	istances							
 Non-Energy Products from Fuels and 	Subcategory	r: 2.F.1.a - Refrig	eration and Station	ary Air Conditioning								
2.D.1 - Lubricant Use	Sheet:	HFC-134a (CH	2FCF3) Emissions -	Tier 1								
2.D.2 - Paraffin Wax Use	Data											
2.D.3 - Solvent Use	Subdivision	Unspecified	~		\sim	Chemical Dat	ta					
2.D.4 - Other (please specify)		Unspecified										
- Electronics Industry	Intro Year	1993 Grt	wth Rate (%)	1 Lifetin	ne (d) (years) 1	5 EF (%)	15 Destroy	ed (%) 0				
2.E.1 - Integrated Circuit or Semiconduc						50	unition 7.2					
2.E.2 - TFT Flat Panel Display						-4	Gauon 7.2					
2.E.3 - Photovoltaics					Total new agent			Release of				
2.E.4 - Heat Transfer Fluid	Voor		Exports	Imports		Agent in retired	agent in retired	agent from				
2.E.5 - Other (please specify)	real				market	(tonnes)	equipment	equipment				
- Product Uses as Substitutes for Ozone					(tonnes)		(tonnes)	(tonnes)				
2.F.1 - Refrigeration and Air Conditionin							F=E					
- 2.F.1.a - Refrigeration and Stationar	t ≙⊽				D = A - B + C		(Recovery/100 🦈		H = H(t-1) - I(t-1) + D - E	I = H * (EF/100) + G		
2.F.1.b - Mobile Air Conditioning	2019	0	0	16.4	16.4	0.57828	0	0.57828	82 33718	12 92886	7	
2.F.2 - Foam Blowing Agents	2020	0	0	17.11	17.11	0.6307	0	0.6307	86 46591	13 60058	7	
2.F.3 - Fire Protection	2021	0	-	17.83	17.83	0.68398	-	0.68398	90.64204	14 28029	7	
2.F.4 - Aerosols	2027	0	0	18.55	18.55	0.73814	0	0.73814	94 85759	14.96678	-	
2.F.5 - Solvents	> 2022	0	0	10.00	19.33	0.70014	0	0.70014	99,10005	15.0070		~
2.F.6 - Other Applications (please specif	2025			13.27	13.27	0.7525	0	0.7525	33.10005	15.6565		<u> </u>
- Other Product Manufacture and Use											Uncertaintie	8
2.G.1 - Electrical Equipment												
- 2.G.1.a - Manufacture of Electrical E												
- 2.G.1.b - Use of Electrical Equipmen	User notes						2.F.1.a - Time Ser	ies				- 4
2.G.1.c - Disposal of Electrical Equi												
2.G.2 - SF6 and PFCs from Other Produ								н	FC-134a (CH2FCF3) Emissions (C	3q CO2 Equivalents)		
- 2.G.2.a - Military Applications							20					
- 2.G.2.b - Accelerators							20					
2.G.2.c - Other (please specify)							10					
2.G.3 - N2O from Product Uses												
- 2.G.3.a - Medical Applications							0	1 1 10 10 10 00	0 - N M * D 0 N 00	1 0 H N M T U V N	N 1- 0 2 C	0 1 T 10
- 2.G.3.b - Propellant for pressure and							199	199 199		201 201 201 201 201 201 201 201 201 201	201 202 202 202 202	202
2.G.3.c - Other (Please specify)							*					
							* Base year for asse	essment of uncertainty	y in trend: 1990			
Worksheet notes 2006 IPCC Guidelines	Save						Gas HFC-	34a (CH2FCF3)				~
Country/Territory: Vanuatu Inventory Yes	ar: 2023 Base	year for assessmer	t of uncertainty i	in trend: 1990 0	O2 Equivalents:	AR5 GWPs (100)	(ear time horizon) D	atabase file: (C:)	ProgramData\IPCC2006So	ftware\ipcc2006.accdb)		







1.9 Click on the "Chemical Data" tab (see illustration below)



2.0 In the Chemical data table Enter:

Country / Territory: Vanuatu

Subdivision: Unspecified

Gas: Choose the Gas imported by the Country (Vanuatu)

Data Year of Introduction: select the year of introduction of the particular agent selected in the

"Gas" section.

Growth rate in New Equipment Sales: 2%

Assumed Equipment Lifetime (years): 15

Emission Factor from installed base: 15%

% of Gas Destroyed at End of Life: 0







(See illustration below)

			×
2		Chemical Data	
	Country/Territory	Vanuatu	
	Category	2.F.1.a - Refrigeration and Stationa	ary Air Conditioning
	Subdivision	Unspecified	~ +
	Gas	HFC-134a (CH2FCF3)	~
	Data Year of Introduction	2005 🗢	
	Growth Rate in New	Equipment Sales	_2.00% 🖨
	Assumed Equipment	Lifetime (years)	_15 ≑
L	Emission Factor from	installed base	15.00% 🗢
	% of Gas Destroyed a	at End of Life	0.00% 🗢
		Save	Close

2.1 Refer to the table and enter 0 for each year in the Production (tonnes) and Export(tonnes) column (see red arrow in illustration below).

🖷 Application Database Inventory	Year Adminis	trate Workshe	ets Tools E	xport/Import I	Reports Windo	w Help					_ & ×
2006 IPCC Categories	F-Gas Emission	ns - Tier 1 F-Gas	Parameters - Tie	er 2 F-Gas Emiss	sions - Tier 2a F-	Gas Emissions - T	ïer 2b				
2.C.5 - Lead Production	Worksheet										
2.C.6 - Zinc Production	Sector:	Industrial Proce	sses and Product	Use							2023
2.C.7 - Other (please specify)	Category:	Uses a	is Sub or O	Dzone Depleting Sul	bstances						
- Non-Energy Products from Fuels and	Subcategory:	Refrig	eratio tior	nary Air Conditioning	1						
2.D.1 - Lubricant Use	Sheet:	la (CH	2FCF: ns	- Tier 1							
2.D.2 - Paraffin Wax Use	Data										
2.D.3 - Solvent Use	Subdivision	10 A.		HFC-134a (CH2	FCF3) V	Chemical D	ata				
2.D.4 - Other (please specify)	· · · · ·		N								
- Electronics Industry	Intro Year	Gro	wth	2 Lifetir	ne (d) (years)	5 EF (%	15 Destroy	ved (%) 0			
2.E.1 - Integrated Circuit or Semiconduc						-	austion 7.2				
2.E.2 - TFT Flat Panel Display											
2.E.3 - Photovoltaics			•		Total new agent			Release of			
2.E.4 - Heat Transfer Fluid	Vear					equipment	agent in retired	retired			
2.E.5 - Other (please specify)	roai				market	(tonnes)	equipment	equipment			
- Product Uses as Substitutes for Ozone					(tonnes)		(tonnes)	(tonnes)			· · · ·
2.F.1 - Refrigeration and Air Conditionin				_							
2.F.1.a - Refrigeration and Stationar	t ≏¥				D = A - B + C		(Recovery/100				
2.F.1.b - Mobile Air Conditioning	2005	0	0	0.69	0.69	0	0	0	0.69	0.1035	2
2.F.2 - Foam Blowing Agents	2006	0	0	1.41	1.41	0	0	0	1,9965	0.29948	2
2.F.3 - Fire Protection	2007	0	0	2.15	2.15	0	0	0	3.84703	0.57705	2
2.F.4 - Aerosols	2008	0	0	2.92	2.92	0	0	0	6 18997	0.9285	2
2.F.5 - Solvents	2009	0	0	3.72	3.72	0	0	0	8 98148	1 34722	7
2.F.6 - Other Applications (please specif	2000			0.72					0.00110		
- Other Product Manufacture and Use											Uncertainties
2.G.1 - Electrical Equipment											
- 2.G.1.a - Manufacture of Electrical E											
- 2.G.1.b - Use of Electrical Equipmen	User notes					•	4 2.F.1.a - Time Se	ries			▼ ₽
- 2.G.1.c - Disposal of Electrical Equi									IEC 124+ (CU2ECE2) Emissions (C	- COO E-minelente)	
2.G.2 - SF6 and PFCs from Other Produ							20		rc-134a (Ch2rCr3) Emissions (C	d COS Ednivalents)	
2.G.2.a - Military Applications							20				
- 2.G.2.b - Accelerators							15				
···· 2.G.2.c - Other (please specify)							10			0 0 1	
2.G.3 - N2O from Product Uses							5				
2.G.3.a - Medical Applications							858	5 4 9 9 5 8 1 8 4 9 9 5 8 1	88488788	1 1 2 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	25 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
- 2.G.3.b - Propellant for pressure and							195	1991		2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	202 202 202 202 202 202 202 202 202 202
···· 2.G.3.c - Other (Please specify)							* Rasa year for an	essment of uncortain	v in trand: 1990		
	L						Dase year for ass	essanent or uncertain	y menundi 1000		
Worksheet notes 2006 IPCC Guidelines	Save						Gas HFC	134a (CH2FCF3)			~

2.3 Select the Imports column and enter the data that was gathered for the total HFC agent (gas selected in step 2.0) in tones for every year.

2.4 Select each of the green cells adjacent until you get to the Emissions cell.

Banked and Emissions have now been calculated for you and you can record the data







2.5 Locate the graph labeled 2.F.1a - time series at the bottom of the table. The graph depicts the emissions in Gg of CO2 equivalent (Gg CO2 Equivalent) (see red arrow in illustration below)



Country/Territory: Vanuatu Inventory Year: 2023 Base year for assessment of uncertainty in trend: 1990 CO2 Equivalents: AR5 GWPs (100 year time horizon) Database file: (C\ProgramData\PCC2006Software\ipcc2006.accdb)

2.6 Depending on which year you selected, move the cursor over the green bars in the graph to determine their (Gg CO2 Equivalent).

2.7 Repeat step 1.9 to 2.6 for the other Specific agents Imported by Vanuatu.







2.3.3 TIME SERIES Note On Consistency (Method, EF, Data Collection Method)

According to the Vanuatu National Communication to the Conference of the Parties to the United Nations Framework Convention on Climate Change (1998), page 11, the NACC has designated 1994 as the baseline year for Vanuatu concerning the Green House Gas Inventory and COP.

So far, three reports on national communication have been produced. Because activity data documentation is lacking in all three reports, no estimations of emissions from the IPPU sector have been provided. Thus, no methodology, Emission factor (EF), or techniques for collecting data have been specified.

Following the (2006 IPCC guideline, Vol.3, Figure 7.6), Tier 1a/b will be used for this inventory.

Regarding the EF, the sub-application equipment charge (kg) will be calculated using the default value found in the 2006 IPCC Defaults (Volume 3, Chapter 7, Table 7.9). The methodology for gathering data will only concentrate on the ozone-depleting replacements found in imported refrigerants and in stationary air conditioning and domestic and commercial refrigeration.

The Vanuatu Customs and Inland Revenue is responsible for clearance, tariffs, and revenue collection for imported goods therefore the department may have import records and specific information on items or products containing refrigerants. Therefore, the Director of the Department of Customs and Inland Revenue and the Information Management Team. Additionally, The Department of Environmental Protection & Conservation oversees environmental protection and regulation. The department can have information on products containing refrigerants and data related to environmental impact assessments, regulations, and policies regarding the usage of refrigerants. Hence communications will be extended to the Director of the Department of Environmental Protection & Conservation Environmental Protection Unit upon request for Activity data. Last but not least The Vanuatu Statistics Office oversees collecting, analyzing, and issuing statistical data and information on import products thus the office can provide information on items containing refrigerants. As a result, the Social and Environment Statistics Section will be requested to provide the information and data needed.

The channels for requesting activity data meetings are the Electronic Single Window, emails, dialogues, and interviews. Consultants may ask the Prime Minister's Office for a Confidential Agreement or Right to Information (RTI) in specific situations where data is unavailable.

Emissions for the entire time series will be estimated using the Tier Hybrid Tier 1a/b approach, the IPCC default EF (which was addressed above), and the new data collection technique. Historical data, if any, and the current year 2023 will also be used.







Table Of the Time-Series

Table 2.3.3.1. i	Time series HFC- 143a (Trifluoroethane): 1994 - 2	2003
------------------	-------------------------	-----------------	-------------	------

Item	Units	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Emissions	kt CO2- e	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
EF	%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Method	NA	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b

Table .3.3.1. iiTime series HFC- 143a (Trifluoroethane): 2004 - 2013

Item	Units	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Emissions	kt CO2- e	NO	0.1455	0.27218	0.38285	0.47992	0.56543	0.64112	0.70845	0.76868	0.88888
EF	%	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Method	NA	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b

Item	Units	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Emissions	kt CO2- e	1.13654	1.23606	1.34915	1.35378	1.39671	2.2142	2.0184	1.88447	1.87872	1.87872
EF	%	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
METHOD	NA	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b

NO = not occurring – this notation key was used for all years before the chemical was introduced in Vanuatu

The year of chemical introduction was not recorded and from 2005 to 2023 the emissions were calculated using T1/b IPCC methodology with default IPCC parameters and EF.

Table 2.3.3.2.i

Time Series HFC – 32 (Difluoromethylene): 1994 - 2003

Item	Units	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Emissions	kt CO2- e	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
EF	%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
METHOD	NA	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b





Table 2.3.3.2.ii	HFC – 32 (Difluoromethylene): 200	04 - 2013
------------------	------------	-------------------------	-----------

Item	Units	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Emissions	kt CO2- e	NO	0.0405	0.07643	0.10696	0.13442	0.15775	0.17909	0.19723	0.21414	0.24802
EF	%	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
METHOD	NA	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b

Table 2.3.3.2.iii HFC – 32 (Difluoromethylene): 2014 - 2023

Item	Units	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Emissions	kt CO2- e	0.26182	0.31555	0.34321	0.37432	0.3751	0.38633	0.61338	0.56145	0.5202	0.52221
EF	%	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
METHOD	NA	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b

NO = not occurring – this notation key was used for all years before the chemical was introduced in Vanuatu

The Year of Chemical introduction was not recorded and from 2005 to 2023 the emissions were calculated using T1/b IPCC methodology with default IPCC parameters and EF.

Table 2.3.3.3.iHFC – 125 (Pentafluoroethane): Year 1994 - 2003

Item	Units	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Emissions	kt CO2- e	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
EF	%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
METHOD	NA	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b

Table 2.3.3.3.iiHFC – 125 (Pentafluoroethane): Year 1994 - 2003

Item	Units	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Emissions	kt CO2- e	NO	0.1665	0.31103	0.43687	0.54834	0.64609	0.73218	0.80985	0.87887	1.01704
EF	%	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
METHOD	NA	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b

Table 2.3.3.3.iiiHFC – 125 (Pentafluoroethane): Year 2014 - 2023

Item	Units	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Emissions	kt CO2- e	1.07599	1.30159	1.41685	1.54632	1.55137	1.60067	2.53657	2.31056	2.15663	2.15666
EF	%	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
METHOD	NA	T1a/b									







NO = not occurring - this notation key was used for all years before the chemical was introduced in Vanuatu

The year of chemical Introduction was not recorded and from 2005 to 2023 the emissions were calculated using T1/b IPCC methodology with default IPCC parameters and EF.

Table 2.3.3.4.i	HFC – 134a (Tetrafluoroethane): 1994 - 2003
	- (,

Item	Units	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Emissions	kt CO2- e	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
EF	%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
METHOD	NA	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b

Table 2.3.3.4.ii HFC – 134a (Tetrafluoroethane): 2004 - 2013

Item	Units	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Emissions	kt CO2- e	NO	0.1065	0.19853	0.27975	0.35028	0.41174	0.46698	0.51543	0.55962	0.64818
EF	%	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
METHOD	NA	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b

Table 2.3.3.4.iiiHFC – 134a (Tetrafluoroethane): 2014 - 2023

Item	Units	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Emissions	kt CO2- e	0.68595	0.82906	0.9027	0.98479	0.98707	1.01751	1.61539	1.46805	1.37562	1.36824
EF	%	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
METHOD	NA	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b	T1a/b

NO = not occurring - this notation key was used for all years before the chemical was introduced in Vanuatu

The year of chemical introduction was not recorded and from 2005 to 2023 the emissions were calculated using T1/b IPCC methodology with default IPCC parameters and EF.







Identifying Trends, Big Variations, And Outliers with A Transparent Explanation

When it comes to identifying trends and outliers, as previously explained, no previous estimations of F-gases have been calculated, hence no graphs were produced.

However, we may anticipate a steady rise in F-gases utilized in air conditioners from the year of introduction in 2005 to the present inventory year of 2023. F-gas emissions may have increased as a result of Vanuatu's growing population, influx of investors, and development of businesses. The only anomaly in the trend could be the absence of data from 2022 because of a hack in the government system that resulted in the loss of all the data and information for that year. Another outlier might result from COVID-19, a ban on imports, and the lockdown-related closure of companies.

2.3.3. QUALITY CONTROL/ QUALITY CHECK

QUALITY CONTROL METHOD

Table 4: The QC activities and procedures that will be followed are indicated in the table below. The three consultants will handle the QC and Procedures based on the color in the table, Anita-Pink, Florencza- Green and Zechariah Bani- Blue.

QC activity	Procedures
	• Confirm that estimates are reported for all categories and for all years from the appropriate base year to the period of the current inventory.
Check the Assumptions and criteria for the	• For subcategories, confirm that entire category is being covered.
selection of activity data, emissions factor	• Provide clear definition of 'Other' type categories.
and other estimation parameters	• Check that known data gaps that result in incomplete estimates are documented, including a qualitative evaluation of the importance of the estimate in relation to total emissions (e.g., subcategories classified as 'not estimated', see Chapter 8, Reporting Guidance and Tables).
	• Confirm that bibliographical data references are properly cited in the internal documentation.
input and references	• Cross-check a sample of input data from each category (either measurements or parameters used in calculations) for transcription errors.
	• Reproduce a set of emissions and removals calculations.
Check that emissions and removals are calculated correctly	• Use a simple approximation method that gives similar results to the original and more complex calculation to ensure that there is no data input error or calculation error.







	• Check that units are properly labelled in calculation sheets.
Check that parameters and units are correctly recorded and that appropriate	• Check that units are correctly carried through from beginning to end of calculations.
conversion factors are used.	Check that conversion factors are correct.
	• Check that temporal and spatial adjustment factors are used correctly.
	• Examine the included intrinsic documentation (see also Box 6.4) to:
	1. Confirm that the appropriate data processing steps are correctly represented in the database.
Check the integrity of database files	2. Confirm that data relationships are correctly represented in the database.
	3. Ensure that data fields are properly labelled and have the correct design specifications.
	4. Ensure that adequate documentation of database and model structure and operation are archived.
Check for consistency in data between categories.	Identify parameters (e.g., activity data, constants) that are common to multiple categories and confirm that there is consistency in the values used for these parameters in the emission/removal calculations.
Check that the movement of inventory	• Check that emissions and removals data are correctly aggregated from lower reporting levels to higher reporting levels when preparing summaries.
data among processing steps is correct.	• Check that emissions and removals data are correctly transcribed between different intermediate products.
	• Check that the qualifications of individuals providing expert judgement for uncertainty estimates are appropriate.
Check that uncertainties in emissions and	• Check that the qualifications, assumptions and expert judgements are recorded.
removals are estimated and calculated correctly.	• Check that calculated uncertainties are complete and calculated correctly.
	• If necessary, duplicate uncertainty calculations on a small sample of the probability distributions used by Monte Carlo analyses (for example, using uncertainty calculations according to Approach 1).
Check time series consistency.	• Check for temporal consistency in time series input data for each category.





	• Check for consistency in the algorithm/method used for calculations throughout the time series.
	• Check methodological and data changes resulting in recalculations.
	• Check that the effects of mitigation activities have been appropriately reflected in time series calculations.
	• Confirm that estimates are reported for all categories and for all years from the appropriate base year to the period of the current inventory.
	For subcategories, confirm that entire category is being covered.
Check Completeness	• Provide clear definition of 'Other' type categories.
	• Check that known data gaps that result in incomplete estimates are documented, including a qualitative evaluation of the importance of the estimate in relation to
	total emissions (e.g., subcategories classified as 'not estimated', see Chapter 8, Reporting Guidance and Tables)
	• Confirm that estimates are reported for all categories and for all years from the appropriate base year to the period of the current inventory.
	• Check value of implied emission factors (aggregate emissions divided by activity data) across time series.
Trend Check	 Do any of the year's show outliers that are not explained?
	2. If they remain static across time series, are changes in emissions or removals being captured?
	• Check if there are any unusual and unexplained trends noticed for activity data or other parameters across the time series.
	• Check that there is detailed internal documentation to support the estimates and enable reproduction of the emission, removal and uncertainty estimates.
Review of internal documentation and archiving.	• Check that inventory data, supporting data, and inventory records are archived and stored to facilitate detailed review.
	• Check that the archive is closed and retained in secure place following completion of the inventory.
	• Check integrity of any data archiving arrangements of outside organizations involved in inventory preparation







(TABLE 6.1 GENERAL INVENTORY QC PROCEDURES, volume 1, 2006 IPCC Guidelines for National Greenhouse Gas Inventories).

Table 5: Quality control method, the Responsibilities carried out by which particular party, and the timeline stating how long it would take for the party to complete the task.

Quality Control Method		Timeline for
Quality Control Method		Completion
GHG Inventory Team Members (Consultants)	 Check the Assumptions and criteria for the selection of activity data, emissions factor and other estimation parameters Check for transcriptions Errors in the data input and references Check that emissions and removals are calculated correctly Check that parameters and units are correctly recorded and that appropriate conversion factors are used. Check that parameters and units are correctly recorded and that appropriate conversion factors are used. Check the integrity of database files Check that the movement of inventory data among processing steps is correct Check that uncertainties in emissions and removals are estimated and calculated correctly. Check time series consistency. 	2 months
TWGs (Technical Working Groups): specialized groups consisting of experts and professionals	 Technical review of sub-category activity data, emission factors, estimation parameters, and calculations method. Final Check of report 	2 - 3 weeks
The Department of Environmental Protection & Conservation	The department for environmental Protection & Conservation oversees environmental protection and regulations. The department should have information on products containing refrigerants and data related to environmental impact	2 weeks upon request for Data







	assessments, regulations and policies regarding the usage of refrigerants	
Vanuatu Customs and Inland Revenue	The Vanuatu Customs and Inland Revenue is responsible for clearance, tariffs and revenue collection for imported goods therefore the department may have imported records and specific information of items or products containing refrigerants	2 weeks upon request for Data

Note: Detailed explanations of the GHG Inventory team member's tasks are stated in the Quality control method.







2.3.4 UNCERTAINTIES

UNCERTAINTIES

Vanuatu does not have the capacity to provide quantitative assessment of uncertainty and will there for be implemented into the improvement plan. Tier 1a/b will be used this leading to high Uncertainties. The contributing factors to the high uncertainty would stem from the following

- 1. Default Emission factor of 15%: Emission factors are used to estimate GHG emissions from a specific activity or process. Tier 1a/b methods rely on default emission factors provided by the IPCC. However, these default emission factors may not accurately represent the actual emissions from a particular process or activity. This discrepancy can lead to uncertainties in the estimated GHG emissions.
- 2. Assumptions used in the calculations may also lead to uncertainties within the estimated Emission values. For instance:
- HFCs and PFCs are not produced nor exported from Vanuatu.
- Assumed percentage of new equipment exported for Vanuatu is 0%
- Assumed percentage of new equipment imported for Vanuatu can be collected from the single window⁴
- Emissions from banked refrigerant average is 15% annually through every RAC application area.
- Equipment charge using the default values
 - Residential and Commercial AC is 10kg
 - Commercial Refrigeration is 28kg
 - Domestic refrigeration is 0.5kg
- Equipment servicing does not commence until 3 years after installation of equipment.
- In a mature market, 2/3 (67%) of refrigerant sales are used for servicing while 1/3 (33%) are used to charge for new equipment.
- Across all sub applications, the average equipment lifetime is 15 years.
- The HFC emissions from air conditioning and refrigeration did not occur until 2005.
- The complete transition to a new refrigerant technology will take place over a 10-year period. From experiences to date, this assumption is believed to be valid for a single chemical in a single country.

⁴ https://singlewindow.gov.vu/portal/services/swApprovedAppliances/appliances.jsf







2.4 IMPROVEMENT PLAN

2.4.1: Vanuatu's Current Inventory Process.

The national Greenhouse Gas (GHG) inventory of anthropogenic (human- caused) GHG emissions and removals were estimated for the Republic of Vanuatu under the first, second, and third (draft) National Communications for 1994, 2000, and 2015 (Srikanth Subbarao, Subbarao Consulting Services, Naveen Pawar, Subbarao Consulting Services, 2020). However, according to these reports, emissions from IPPU sector and fluorocarbons (PFCs), Hydro fluorocarbons (HFCs) and Sulfur hexafluoride (SF6) were not estimated and considered negligible, as the products containing these gases are not produced in the country (Ministry of Climate Change, 2020).

2.4.2: Areas Identified for Improvement and Identified Gaps.

Since there is no record of any Inventory processes regarding IPPU sector, improvements will mean taking into account the construction of the whole inventory process for the very first time. This will be the only identified gap that is to be addressed.

2.4.3: Proposed Improvement Actions

From the year 1994 to 2023, there is no record of estimation calculated thus there is no report to base improvement actions on. However, in constructing the whole inventory process this table shows detailed information on the data sources, how to access it, who is responsible and the relevant time it needs to collect data sets. These are the improvement actions that the consultants should take into consideration while constructing the inventory. There is also a great need to collect data on tonnage of each gas that will make reporting more accurate and transparent. Currently Vanuatu's data is based on VT data of equipment imported which leads to substantially high uncertainty in our Inventory.

Department/	Roles and	Dates	Relevant	Contact Person	Comments
Organization	Responsibility		Governing		
			Arrangement		
Vanuatu	To provide data	2 nd of April	Memorandum of	Customs	DOCC needs to
Customs and	on imports and	every year – 1 st	understanding or	Revenue	send a prompt
inland	exports of F-	week of May	Right to	Section, Port	letter to VCIR
Revenue	gases (ODS		Information (RTI)	Vila	1-2 months
(VCIR)	Substitutes –		between VCIR	Email:	prior.
	Refrigerants) to		and DOCC	customsrevenue	
	DOCC			@vanuatu.gov.v	A follow-up
				<u>u</u>	email or call is
				Tel: +678 33091	crucial as well.

Table 6: Improvement Actions for Consultants.







Vanuatu National Statistics Office	Provide statistical data and information on import products containing refrigerants to DOCC	2 nd of April every year – 1 st week of May	Memorandum of understanding or Right to Information (RTI) between the Vanuatu National Statistics Office and DOCC	Vanuatu National Statistics Office Tel: (678) 22110 / 22111 / 33040 Email: <u>stats@va</u> <u>nuatu.gov.vu</u> Name: Mento Susie (Senior Statistician - Disaster & Environment) Email: Tel: Leo Charlington (Principal Statistician Social & Environment) Email: Tel:	DOCC needs to send a prompt letter to Vanuatu National Statistics Office 1-2 months prior. A follow-up email or call is crucial as well.
Department of Environmental Protection & Conservation	Provide information on products containing refrigerants and data related to environmental impact assessments, regulations, and policies regarding the usage of refrigerants.	2 nd of April every year – 1 st week of May	Memorandum of understanding or Right to Information (RTI) between the Department of Environmental Protection & Conservation and DOCC	The Environmental Protection Unit. Roselyn Bue Senior Officer (Chemical and Ozone) Email: <u>rbue@va</u> <u>nuatu.gov.vu</u> Richard Petterson Ozone Assistant Officer Project (s): IS (Ozone) Email: <u>rpetterson</u> @vanuatu.gov.v <u>u</u>	DOCC needs to send a prompt letter to the Department of Environmental Protection & Conservation 1- 2 months prior. A follow-up email or call is crucial as well.







Department of	DOCC is	February –	Provide a	Nelson Kalo	DOCC is
Climate	responsible to	March every	Memorandum of	Director of	responsible for
Change	send a formal	year	understanding or	Climate Change	doing a follow-
(DOCC)	letter requesting		Right to	Email:	up to the
	relevant data to		Information (RTI)	nekalo@vanuatu	departments or
	the Vanuatu		to the Vanuatu	.gov.vu	organization for
	Customs and		Customs and		the required
	Inland Revenue,		Inland Revenue,		data to be
	The National		the National		delivered upon
	Statistics Office		Statistics Office		schedule.
	and The		and the		
	Environmental		Environmental		
	Protection and		Protection and		
	Conservation.		Conservation		







REFERENCE

National Research Council (US) Subcommittee to Review Toxicity of Alternatives to Chlorofluorocarbons. Toxicity of Alternatives to Chlorofluorocarbons: HFC-134a and HCFC-123. Washington (DC): National Academies Press (US); 1996. 1, Introduction. Available from: https://www.ncbi.nlm.nih.gov/books/NBK231526/

Ravishankara, A. R., Velders, G. J. M., Miller, M. K., & Molina, M. (2011). HFCs: A Critical Link in Protecting Climate and the Ozone Layer A UNEP Synthesis Report [ADVANCE COPY]. https://wedocs.unep.org/bitstream/handle/20.500.11822/8014/-HFCs_%20A%20Critical%20Link%20in%20Protecting%20%20Climate%20and%20the%20Oz one%20Layer-20111072.pdf

Roberts, A. (2023, May 9). Vanuatu to share progress in implementing the Montreal Protocol. Vanuatu Daily Post. <u>https://www.dailypost.vu/news/vanuatu-to-share-progress-in-implementing-montreal-protocol/article_48c2a03f-ca2c-569a-afe6-95eb92fa56c9.html</u>

- Ashford, P., Baker, J. A., Clodic, D., Devottar, S., Godwin, D., & Irving, W. (2006). 2006 IPCC GUIDELINES FOR NATIONAL GREENHOUSE GAS INVENTORY CHAPTER 7: EMISSIONS OF FLUORINATED SUBSTITUTES FOR OZONE DEPLETING SUBSTANCES. Institute for Global Environmental Strategies (IGES).
- Goodwin, J., Woodfield, M., Ibnoaf, M., Koch, M., & Yan, H. (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Chapter 2: Approaches to Data Collection. Institute for Global Environmental Strategies (IGES).
- Ministry of Climate Change. (2020). *The Republic of Vanuatu Third National Communication to the The United Nations Framework Convention on Climate Change*. Port Vila.
- Srikanth Subbarao, Subbarao Consulting Services, Naveen Pawar, Subbarao Consulting Services. (2020). VANUATU'S ENHANCED NATIONALLY DETERMINED CONTRIBUTIONS (NDC) 2020-2030, Enhancing and Fast-tracking Implementation of Vanuatu's Nationally Determined Contribution (NDC). UNDP, New York.
- (1998). VANUATU NATIONAL COMMUNICATION OF THE PARTIES TO THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE.







ANNEX

TABLE 1: showing blends, their Constituents and their Composition (%)

TABLE 7.8 Blends (many containing HFCs and/or PFCs)						
Blend	Constituents	Composition (%)				
R-400	CFC-12/CFC-114	Should be specified ¹				
R-401A	HCFC-22/HFC-152a/HCFC-124	(53.0/13.0/34.0)				
R-401B	HCFC-22/HFC-152a/HCFC-124	(61.0/11.0/28.0)				
R-401C	HCFC-22/HFC-152a/HCFC-124	(33.0/15.0/52.0)				
R-402A	HFC-125/HC-290/HCFC-22	(60.0/2.0/38.0)				
R-402B	HFC-125/HC-290/HCFC-22	(38.0/2.0/60.0)				
R-403A	HC-290/HCFC-22/PFC-218	(5.0/75.0/20.0)				
R-403B	HC-290/HCFC-22/PFC-218	(5.0/56.0/39.0)				
R-404A	HFC-125/HFC-143a/HFC-134a	(44.0/52.0/4.0)				
R-405A	HCFC-22/ HFC-152a/ HCFC-142b/PFC-318	(45.0/7.0/5.5/42.5)				
R-406A	HCFC-22/HC-600a/HCFC-142b	(55.0/14.0/41.0)				
R-407A	HFC-32/HFC-125/HFC-134a	(20.0/40.0/40.0)				
R-407B	HFC-32/HFC-125/HFC-134a	(10.0/70.0/20.0)				
R-407C	HFC-32/HFC-125/HFC-134a	(23.0/25.0/52.0)				
R-407D	HFC-32/HFC-125/HFC-134a	(15.0/15.0/70.0)				
R-407E	HFC-32/HFC-125/HFC-134a	(25.0/15.0/60.0)				
R-408A	HFC-125/HFC-143a/HCFC-22	(7 0/46 0/47 0)				
R-409A	HCFC-22/HCFC-124/HCFC-142b	(60.0/25.0/15.0)				
R-409B	HCFC-22/HCFC-124/HCFC-142b	(65.0/25.0/10.0)				
R-410A	HEC-32/HEC-125	(50.0/50.0)				
R-410R	HFC-32/HFC-125	(450/550)				
R-411A	HC-1270/HCEC-22/HEC-152a	(15.6,55.6)				
R-411R	HC-1270/HCFC-22/HFC-152a	(3.0/94.0/3.0)				
R-411C	HC-1270/HCFC-22/HFC-152a	(3.0/95.5/1.5)				
R-412A	HCFC-22/PFC-218/HCFC-142b	(70.0/5.0/25.0)				
R-413A	PFC-218/HFC-134a/HC-600a	(90/880/30)				
R-414A	HCFC-22/HCFC-124/HC-600a/HCFC-142b	(51 0/28 5/4 0/16 5)				
R-414B	HCFC-22/HCFC-124/HC-600a/HCFC-142b	(50.0/39.0/1.5/9.5)				
R-415A	HCFC-22/HFC-152a	(82.0/18.0)				
R-415B	HCFC-22/HFC-152a	(25.0/75.0)				
R-416A	HFC-134a/HCFC-124/HC-600	(59.0/39.5/1.5)				
R-417A	HFC-125/HFC-134a/HC-600	(46.6/50.0/3.4)				
R-418A	HC-290/HCFC-22/HFC-152a	(1.5/96.0/2.5)				
R-419A	HFC-125/HFC-134a/HE-E170	(77.0/19.0/4.0)				
R-420A	HFC-134a/HCFC-142b	(88.0/12.0)				
R-421A	HFC-125/HFC-134a	(58.0/42.0)				
R-421B	HFC-125/HFC-134a	(85.0/15.0)				
R-422A	HFC-125/HFC-134a/HC-600a	(85.1/11.5/3.4)				
R-422B	HFC-125/HFC-134a/HC-600a	(55.0/42.0/3.0)				
R-422C	HFC-125/HFC-134a/HC-600a	(82.0/15.0/3.0)				
R-500	CFC-12/HFC-152a	(73.8/26.2)				
R-501	HCFC-22/CFC-12	(75.0/25.0)				
R-502	HCFC-22/CFC-115	(48.8/51.2)				
R-503	HFC-23/CFC-13	(40.1/59.9)				
R-504	HFC-32/CFC-115	(48.2/51.8)				
R-505	CFC-12/HCFC-31	(78.0/22.0)				
R-506	CFC-31/CFC-114	(55.1/44.9)				
R-507A	HFC-125/HFC-143a	(50.0/50.0)				
R-508A	HFC-23/PFC-116	(39.0/61.0)				







R-508B	HFC-23/PFC-116	(46.0/54.0)		
R-509A	HCFC-22/PFC-218	(44.0/56.0)		
¹ R-400 can have various proportions of CFC-12 and CFC-114. The exact composition needs to be specified, e.g., R-400 (60/40).				

TABLE 2: showing the different HFCs, their chemical name, Chemical Formula and their Global Warming Potential

Reference sheet: GWPs for HFCs and HFC blends according to the IPCC AR4, 100 years					
horizon					
Code	Substance	Chemical Name	Chemical	GWP (AR4)	
	Name		Formula		
R-125	HFC-125	Pentafluoroethan	CHF ₂ CF ₃	3,500	
		e			
R-134A	HFC-134a	Tetrafluoroethan	CH ₂ FCF ₃	1,430	
		е			
R-143A	HFC-143a	Trifluoroethane	CF ₃ CH ₃	4,470	
R-152A	HFC-152a	Difluoroethane	CH ₃ CHF ₂	124	
R-227EA	HFC-227EA	Heptafluoroprop	CF ₃ CHFCF ₃	3,220	
		ane			
R-23	HFC-23	Trifluoromethan	CHF ₃	14,800	
		e / Fluoroform			
R-236CB	HFC-236CB		CH ₂ FCF ₂ CF ₃	1,340	
R-236EA	HFC-236EA		CHF ₂ CHFCF ₃	1,370	
R-236FA	HFC-236FA	Hexafluoropropa	CF ₃ CH ₂ CF ₃	9,810	
		ne			
R-245CA	HFC-245CA		CH ₂ FCF ₂ CHF ₂	693	
R-245FA	HFC-245FA	Pentafluoroprop	CHF ₂ CH ₂ CF ₃	1,030	
		ane			
R-32	HFC-32	Difluoromethane	CH ₂ F ₂	675	
R-365MFC	HFC-365MFC	Pentafluorobutan	CF ₃ CH ₂ CF ₂ CH ₃	794	
		e			
R-41	HFC-41	Fluoromethane	CH ₃ F	92	
		(or Methyl			
		fluoride)			
R-43-10MEE	HFC-43-10MEE	Decafluoropenta	CF ₃ CHFCHFCF	1,640	
		ne	$_2CF_3$		







TABLE 3: showing the different HFC Blends and their Global Warming Potential (GWP).

Code	HFC Blend Name	GWP (AR4)
R-32	HFC-32	675
R-404A	HFC-404A	3,922
R-407A	HFC-407A	2,107
R-407B	HFC-407B	2,804
R-407C	HFC-407C	1,774
R-407D	HFC-407D	1,627
R-407E	HFC-407E	1,552
R-407F	HFC-407F	1,825
R-407G	HFC-407G	1,463
R-410A	HFC-410A	2,088
R-410B	HFC-410B	2,229
R-413A	HFC-413A	2,053
R-417A	HFC-417A	2,346
R-417B	HFC-417B	3,027
R-417C	HFC-417C	1,809
R-419A	HFC-419A	2,967
R-419B	HFC-419B	2,384
R-421A	HFC-421A	2,631
R-421B	HFC-421B	3,190
R-422A	HFC-422A	3,143
R-422B	HFC-422B	2,526
R-422C	HFC-422C	3,085
R-422D	HFC-422D	2,729
R-422E	HFC-422E	2,592
R-423A	HFC-423A	2,280
R-424A	HFC-424A	2,440
R-425A	HFC-425A	1,505
R-426A	HFC-426A	1,508
R-427A	HFC-427A	2,138
R-428A	HFC-428A	3,607
R-429A	HFC-429A	13
R-430A	HFC-430A	94
R-431A	HFC-431A	36
R-434A	HFC-434A	3,245
R-435A	HFC-435A	26
R-437A	HFC-437A	1,805
R-438A	HFC-438A	2,264
R-439A	HFC-439A	1,983
R-440A	HFC-440A	144







R-442A	HFC-442A	1,888
R-444A	HFC-444A	87
R-444B	HFC-444B	293
R-445A	HFC-445A	129
R-446A	HFC-446A	459
R-447A	HFC-447A	582
R-447B	HFC-447B	739
R-448A	HFC-448A	1,386
R-449A	HFC-449A	1,396
R-449B	HFC-449B	1,411
R-449C	HFC-449C	1,250
R-450A	HFC-450A	601
R-451A	HFC-451A	146
R-451B	HFC-451B	160
R-452A	HFC-452A	2,139
R-452B	HFC-452B	697
R-452C	HFC-452C	2,219
R-453A	HFC-453A	1,765
R-454A	HFC-454A	236
R-454B	HFC-454B	465
R-454C	HFC-454C	145
R-455A	HFC-455A	145
R-456A	HFC-456A	684
R-457A	HFC-457A	136
R-458A	HFC-458A	1,650
R-500	HFC-500	8,077
R-503	HFC-503	14,560
R-507A	HFC-507A	3,985
R-508A	HFC-508A	13,214
R-508B	HFC-508B	13,396
R-512A	HFC-512A	189
R-513A	HFC-513A	629
R-513B	HFC-513B	593
R-515A	HFC-515A	386