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PREPARED UNDER

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IPPU

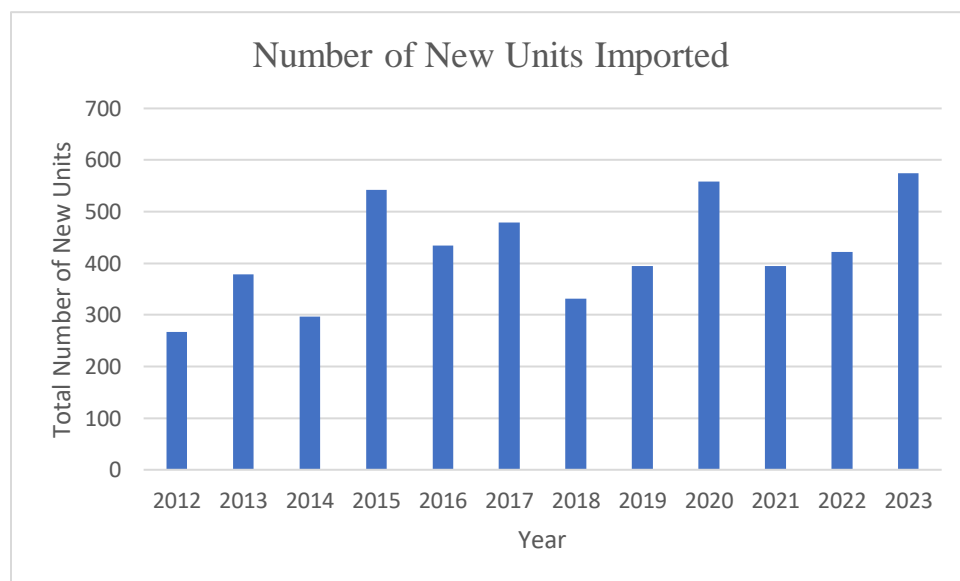
Under the IPPU Sector, the primary subsectors that contribute to greenhouse gas (GHG) emissions are those associated with refrigeration and air conditioning. Vanuatu possesses data that can facilitate the calculation of emissions in these areas.

The method used consisted of the Tier 1 approach, using Default parameters as Vanuatu does not possess country specific values for the parameters. Hence estimations are made upon default values.

According to Urban Household Appliance & Energy Use Survey: Port Vila & Luganville, Vanuatu (2013) 10% of household in Vanuatu have air conditioning while 90% of commercial business have air conditioning in their buildings. On the other hand 43% of household contain refrigerators while 57% of commercial businesses bestow a refrigerator.¹

The importation of New refrigerations and Air conditioning annually fluctuates from year to year as seen in figure 1.

Figure 1: Number of New Units Imported on an annual basis.



Assuming an average inflation rate of 2% on the price per unit, the imports of refrigeration and air conditioning commodities vary annually. This fluctuation may result from incomplete data collection. **Notably, imports decreased during the COVID-19 pandemic years of 2021 and 2022**

The statistics office lacks data on the specific types of HFC refrigerants and air conditioning units imported into the country. Therefore, experts have made assumptions regarding the most commonly used HFCs in domestic refrigeration and air conditioning. In domestic refrigeration,

¹ https://vanuatu-data.sprep.org/system/files/CCCPIR-Vanuatu_Urban%20Household%20Appliance%20%26%20Energy%20Use%20Survey%20Main%20Report.pdf

HFC-134a is typically utilized, while R-407c is prevalent in domestic air conditioning systems and also found in commercial air conditioners. Furthermore, commercial refrigeration employs a different gas mixture known as R-404A.

These Mixtures of gases contain different percentages of HFC's within them. For instance, R-407c uses HFC-32 (23%), HFC-125 (25%) and HFC- 134a (52%). On the other hand R- 404A uses HFC- 125 (44%), HFC- 143a (52%), HFC – 134a(4%). The common gases used in these appliances are therefore HFC – 134a , HFC – 125, HFC- 143a, HFC- 32.

According to calculations, HFC-143a is the leading gas in emissions, accounting for 48% from 2005 to 2023, as shown in figures 2 and 3. HFC-143a has a high Global Warming Potential (GWP) of approximately 4470 times that of CO₂ over a century, indicating that even minimal amounts can significantly impact global warming compared to gases with lower GWPs.

The second highest contributor is HFC-125, which accounts for 40% of emissions from the stationary refrigeration and air-conditioning subsector. HFC-125 has a GWP of about 3500 and is found in refrigerant blends like R-407C and R-404A at higher concentrations than HFC-143a (44% in R-404A). Although its GWP is lower than that of HFC-143a, its prevalence in refrigerants results in substantial overall emissions.

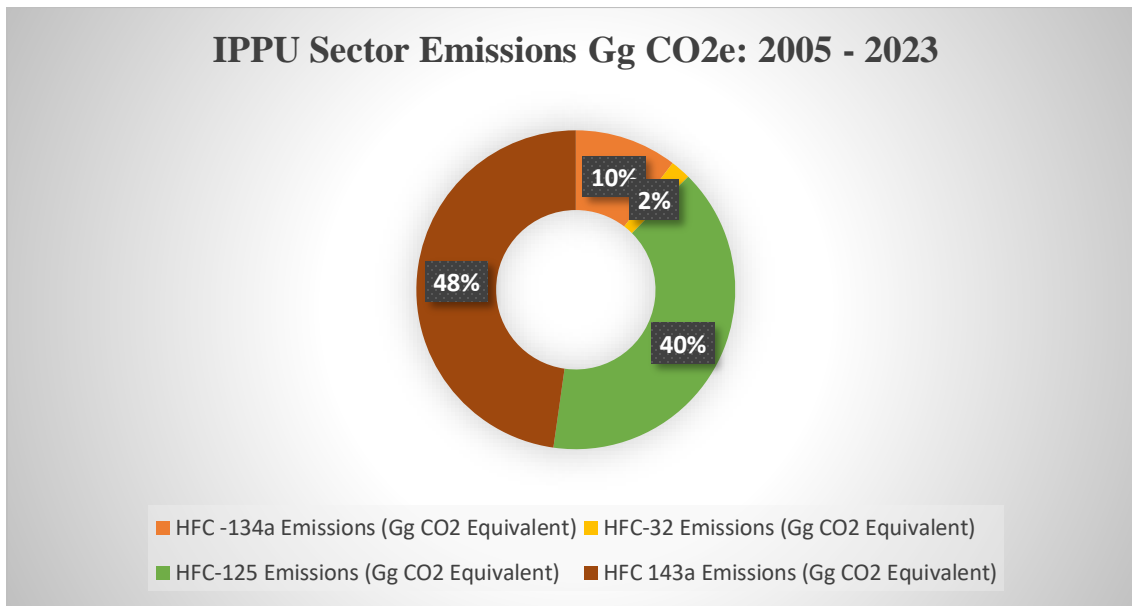
The second least contributing HFC is HFC-134a, which accounts for 10% of emissions, as illustrated in figures 2 and 3. With a Global Warming Potential (GWP) of approximately 1300, HFC-134a is commonly used in automotive air conditioning and domestic refrigerators. Despite having a lower GWP than HFC-125 and HFC-143a, its widespread application results in considerable cumulative emissions.

Additionally, HFC-32 contributes to 2% of emissions. It has the lowest GWP among the compounds mentioned, at around 675; however, it is less frequently utilized compared to alternatives like R-404A or R-407C due to its flammability risk.

A table summarizing emissions (in Gg CO₂ equivalent) from each HFC type alongside the total CO₂-e produced by the stationary air conditioning and refrigeration sector is available.

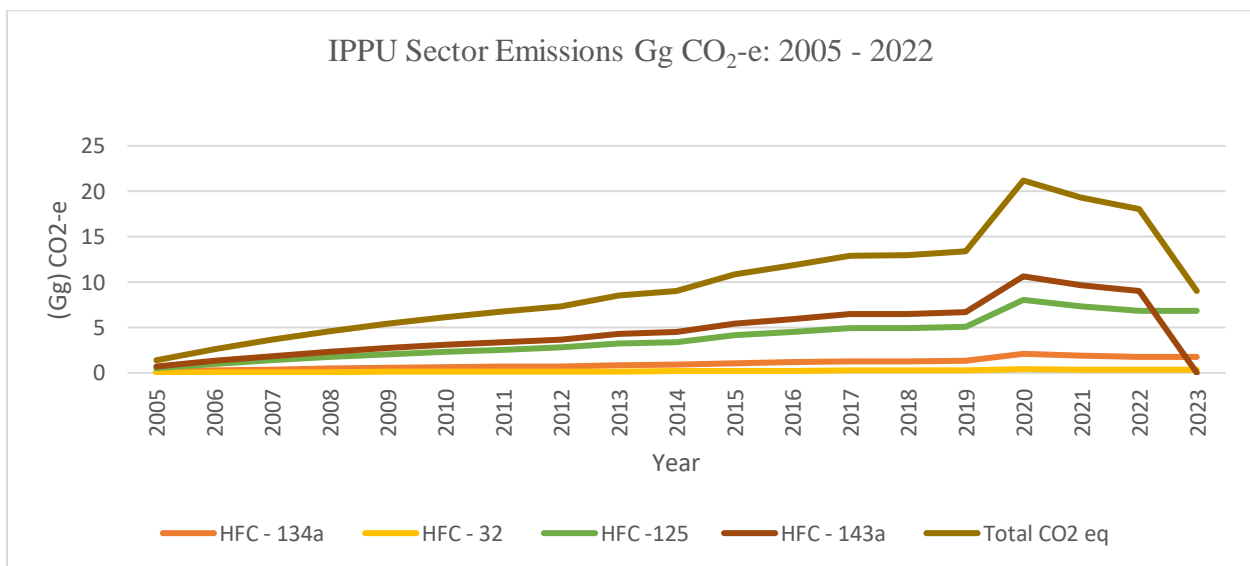
Emissions rose from 2005 to 2020, then gradually declined from 2020 to 2022 due to COVID-19 lockdown in Vanuatu. This trend is illustrated in Figure 3, which shows total CO₂ equivalent emissions by gas type from 2005 to 2023. Figure 4 highlights the total CO₂ equivalent produced by the stationary air conditioning and refrigeration subsector.

Figure 2: IPPU Sector Stationary Refrigeration and Airconditioning Emissions Gg CO₂e



This figure illustrates the CO₂e emissions contributed by various gases. HFC-143a has the highest contribution due to its significant Global Warming Potential (GWP). Following this, HFC-125 accounts for 40% of emissions, largely because of its widespread use in appliances. HFC-134a contributes a smaller share at 10%, while HFC-32 has the least impact at 2% due to its lower GWP.

Figure 3: IPPU Sector Emissions Gg CO₂e: 2005 - 2022



This figure illustrates the trend of emissions from the base year of 2005 to 2023. HFC-143a has the highest emissions due to its significant Global Warming Potential (GWP), followed by HFC-

125, which is commonly used in appliances and has a high GWP. HFC-134a ranks third with a lower GWP, while HFC-32 has the lowest GWP among these gases. The trend indicates that emissions rose from 2005 to 2020 but began to decline slowly from 2020 to 2022, likely due to COVID-19 lockdowns in Vanuatu.

Table 1.1 IPPU Sector GHG Emissions (Gg CO₂-e): 2005 - 2013

	2005	2006	2007	2008	2009	2010	2011	2012	2013
HFC -134a Emissions (Gg CO2 Equivalent)	0.1385	0.2581	0.3637	0.4554	0.5353	0.6071	0.6701	0.7275	0.8426
HFC-32 Emissions (Gg CO2 Equivalent)	0.0274	0.0517	0.0724	0.091	0.1068	0.1212	0.1335	0.145	0.1679
HFC-125 Emissions (Gg CO2 Equivalent)	0.5278	0.9859	1.3849	1.7382	2.0481	2.321	2.5672	2.786	3.224
HFC 143a Emissions (Gg CO2 Equivalent)	0.6984	1.3064	1.8377	2.3036	2.7141	3.0774	3.4006	3.6897	4.2666
TOTAL CO2 eq	1.3921	2.6021	3.6587	4.5882	5.4043	6.1267	6.7714	7.3482	8.5011

Table 1.2 IPPU Sector GHG Emissions (Gg CO₂-e): 2014 - 2023

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
HFC -134a Emissions (Gg CO2 Equivalent)	0.8917	1.0778	1.1735	1.2802	1.2832	1.3228	2.1	1.9085	1.7883	1.7787
HFC-32 Emissions (Gg CO2 Equivalent)	0.1773	0.2136	0.2324	0.2534	0.2539	0.2615	0.4153	0.3801	0.3522	0.3535
HFC-125 Emissions (Gg CO2 Equivalent)	3.4109	4.126	4.4914	4.9018	4.9179	5.0741	8.0409	7.3245	6.8365	6.8366
HFC 143a Emissions (Gg CO2 Equivalent)	4.5122	5.4554	5.9331	6.4759	6.4981	6.7042	10.6282	9.6883	9.0454	0.0179
TOTAL CO2 eq	8.9921	10.8728	11.8304	12.9113	12.9531	13.3626	21.1844	19.3014	18.0224	8.9867

Figure 4: Annual emissions from stationary frefrigeration and airconditioning

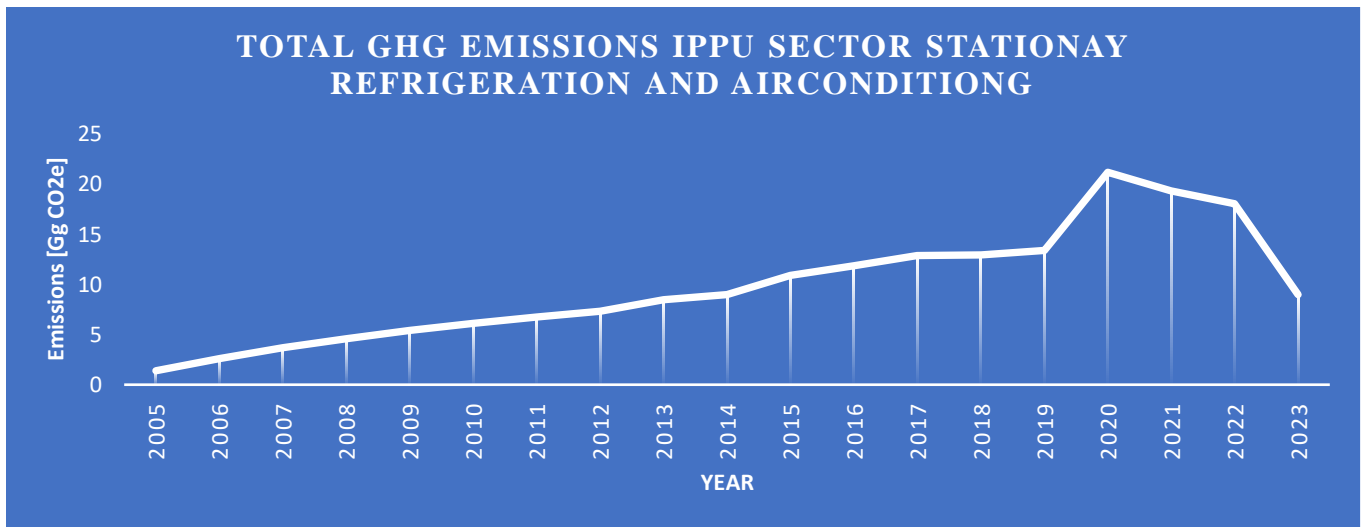


Figure 4 highlights the total CO2 equivalent produced by the stationary air conditioning and refrigeration subsector. Emissions rose from 2005 to 2020, then gradually declined from 2020 to 2022 due to COVID-19 lockdowns in Vanuatu