VATICAN CITY STATE'S
FIRST BIENNIAL TRANSPARENCY REPORT

December 2024


IN HONOREM PRINCIPIS APOST PAVLVS V BVRGHESIVS ROMANVS

CONTENTS

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IN COLLABORATION WITH

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SECRETARIAT OF STATE OF THE HOLY SEE

As a non-Annex I Party to the United Nations Framework Convention on Climate Change (UNFCCC), the Holy See, is required to submit, on behalf of the Vatican City State (VCS), a Transparency Report every two years (BTR).

This First BTR presents the VCS's Greenhouse Gas (GHG) Inventory from 2011 to 2022, the projections on GHG emissions and removals up to 2040, as well as the mitigation actions that the VCS intends to adopt and implement up to 2040.

This document was prepared in accordance with the UNFCCC Modalities, Procedures and Guidelines (MPGs) for the Enhanced Transparency Framework (Annex to decision 18/CMA.1).

FOREWORD

The Holy See and the Vatican City State are committed to promoting sustainable development through environmental policies to safeguard our common home, as well as through educational initiatives in favour of an integral ecology aimed at stimulating new lifestyles, based on fraternity, sustainability, and the covenant between the human person and the environment.

On 24 May 2015, Pope Francis issued his Encyclical Letter *Laudato Si' on Care for Our* Common Home[1], in which he noted that the «challenge to protect our common home includes a concern to bring the whole human family together to seek a sustainable and integral development, for we know that things can change»[2]. He urgently appealed «for a new dialogue about how we are shaping the future of our planet»[3].

Later, on 12 December 2020, in a Video-Message to the High Level Virtual Climate Ambition Summit, Pope Francis underscored that a strategy is necessary to reduce net emissions to zero (net-zero emission), and announced that the Holy See intended to join others in this effort by taking action at two different levels:

1. «On the one hand, Vatican City State is committed to reducing net emissions to zero before 2050, intensifying the efforts at environmental management that have already been in process for some years, and which make possible the rational use of natural resources such as water and energy, energy efficiency, sustainable mobility, reforestation, and the circular economy also in waste management.

2. On the other, the Holy See is committed to promoting education in integral ecology. Political and technical measures must be united with an educational process that favours a cultural model of development and sustainability based on fraternity and the alliance between human beings and the environment»[4].

On 4 July 2022, the Holy See, acting in the name and on behalf of Vatican City State, acceded to the United Nations Framework Convention on Climate Change (UNFCCC) as a non-Annex I Party and on 4 September 2022 to the Paris Agreement. Those instruments entered into force for the Holy See on 4 October 2022.

[1] Cf. Pope Francis, Encyclical Letter *Laudato Si' on Care for Our Common Home*, 24 May 2015.
[2] Ibidem, n. 13.
[3] Ibidem, n. 14.
[4] Pope Francis, Video-Message for the High-Level Virtual Climate Ambition Summit, 12 December 2020.

When acceding to those instruments, the Holy See declared its intention «to contribute to the efforts of all States to work together in solidarity, in accordance with their common but differentiated responsibilities and respective capabilities, in an effective response to the challenges posed by climate change to humankind and to our common home»[5].

Pope Francis has observed that the challenges posed by climate change have «not only environmental, but also ethical, social, economic and political relevance, affect[ing] above all the life of the poorest and most fragile. In this way they appeal to our responsibility to promote, through collective and joint commitment, a culture of care, which places human dignity and the common good at the centre»[6]. Posed with the question «What kind of world do we want to leave to those who come after us, to children who are now growing up?»[7], Pope Francis has expressed his hope that the Convention and the Paris Agreement would help to promote «a remarkable convergence on the urgent need for a change of direction, a *decisive resolve to pass from the "throwaway culture" prevalent in our societies to a "culture of care" for our common home and its inhabitants, now and in t*he future […]. Humanity possesses the wherewithal to effect this change, which calls for a genuine conversion, individual as well as communitarian, and a decisive will to set out on this path. It will entail the transition towards a more integral and integrating model of development, based on solidarity and on responsibility»[8]. These core-values are at the basis of the implementation of both the Convention and the Paris Agreement, and guide the efforts of the Holy See and the Vatican City State in this process.

In order to avoid potential misunderstandings, at the moment of accession the Holy See also declared that, in acceding to the Convention and the Paris Agreement only in the name and on behalf of Vatican City State, it committed itself to apply their provisions exclusively within the territory of the Vatican, as circumscribed by the Leonine Walls[9].

The accession to the UNFCCC and the 2015 Paris Agreement constitutes a bridge between the jurisdiction's past and current environmental policies (as expressed, inter alia, through the implementation of the Montreal Protocol on Substances that Deplete the Ozone Layer and the relative Kigali Amendment) and the intention to achieve climate neutrality by 2050, declared by the Holy Father in December 2020.

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[5] Cf. Declaration annexed to the Instrument of Accession of the Holy See, acting in the name and on behalf of Vatican City State, to the United Nations Framework Convention on Climate Change, 4 July 2022.
[6] Pope Francis, Video-Message for the Climate Ambition Summit, 12 December 2020.
[7] Pope Francis, *Laudato Si'*, n. 160.
[8] Pope Francis, *Message to UNFCCC's COP26*, 29 October 2021.
[9] Cf. Declaration annexed to the Instrument of Accession of the Holy See, acting in the name and on behalf of Vatican City State, to the United Nations Framework Convention on Climate Change, 4 July 2022.

Transparency is the basis of effective and credible climate action. The Enhanced Transparency Framework (ETF) represents a strong instrument to maintain every country on track to achieve emissions reduction objectives and the first Biennial Transparency Report (BTR) is a fundamental part of ETF.

Therefore, this document highlights the progress made and the efforts undertaken to meet emission reduction commitments and to ensure a greener world for future generations.

EXECUTIVE SUMMARY

On 4 July 2022, the Holy See, acting in the name and on behalf of Vatican City State, acceded to the United Nations Framework Convention on Climate Change (UNFCCC) as a non-Annex I Party, and on 4 September 2022 to the Paris Agreement. At the moment of accession, in order to avoid any potential misunderstandings, the Holy See declared that, in acceding to those treaties only in the name and on behalf of Vatican City State, it committed itself to apply their provisions exclusively within the territory of the Vatican, as circumscribed by the Leonine Walls[10].

To pursue the objective of sustainable development alongside environmental protection, the Vatican City State intends to implement projects to reduce greenhouse gas emissions. To this end, it will intensify its environmental management efforts in favor of the rational use of natural resources such as water and energy, energy efficiency, the redevelopment of its technological heritage, sustainable mobility, circular economy as waste management. For many years the Vatican City State has been committed to promoting sustainable development through environmental and energy policies such as the use of renewable energy sources (through the construction of photovoltaic and solar-cooling systems), as well as through the redevelopment of the thermal power plants and the related thermoregulation systems aimed at obtaining better performance in terms of energy efficiency and polluting emissions into the atmosphere. Important progress has also been achieved in the optimization of the use of water resources, in the reduction of common waste, in the development of a tree register and in the promotion of responsible consumption (in 2019 the sale of single-use plastic was phased out). Other significant aspects are those concerning the start of a process of revising its fleet of automobiles, introducing more electric or hybrid cars and emphasizing the concept of recovery and reuse in the field of waste management.

National Circumstances

The Vatican City State is the world's smallest State, both in terms of population and territory, consisting of 0.44 square kilometers, and is an enclave surrounded by the territory of the Italian Republic.

Due to Vatican City State's small size, there are challenges to using alternative energy sources such as wind, solar and geothermal energy. Nevertheless, solar remains the most

[10] Cf. Declaration annexed to the Instrument of Accession of the Holy See, acting in the name and on behalf of Vatican City State, to the United Nations Framework Convention on Climate Change, 4 July 2022.

viable source of renewable energy in Vatican City State, and the aim is to accelerate the deployment of solar energy despite challenges arising from national circumstances.

Institutional Arrangements

The Department of Infrastructures and Services (DIS) of the Governorate has been assigned the role of coordinating GHG Inventory compilation and UNFCCC reporting; in this role it collaborates with the General Secretariat of the Vatican City State Governorate (Legal Office) and with the Secretariat of State of the Holy See (Section for Relations with States and International Organizations).

Greenhouse Gas (GHG) Inventory

Vatican City State's GHG emissions for 2022 are 15.89 kilotons (kt) CO_2 equivalent. Carbon dioxide (CO_2) accounted for 92% of total emissions. Non-CO_2 gases such as methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), accounted for the remaining 8% of total emissions. This includes HFCs emissions from the refrigeration and air-conditioning (RAC) sector.

Mitigation Measures

In December 2020 Vatican City State pledged to achieve net zero emissions by 2050, contingent on technological capacities and effective international cooperation. In its first National Determined Contributions (NDCs), the Vatican City State committed to reduce its greenhouse gases to 20% below 2011 level by 2030.

A key pillar of Vatican City State’s strategy to mitigate GHG emissions is to deal with different sectors, including by implementing the following measures:

- use of cleaner fuels for district heating, abandoning the use of diesel oil in favor of exclusively using natural gas (methane);
- sustainable mobility (electric or hybrid traction vehicles);
- use of refrigerants with less impact on the environment.

Concluding Remarks

The Holy See and Vatican City State remain committed to caring for our common home, pursuing sustainable development and taking decisive steps towards reaching net zero by 2050. Therefore, the Holy See and Vatican City State intend to continue to support global collective efforts to address the challenges of climate change.

Chapter 1

NATIONAL CIRCUMSTANCES AND INSTITUTIONAL ARRANGEMENTS

A. Introduction

On 4 July 2022, the Holy See, acting in the name and on behalf of Vatican City State, acceded to the United Nations Framework Convention on Climate Change (UNFCCC) as a non-Annex I Party, and on 4 September 2022 to the Paris Agreement. At the moment of accession, and in order to avoid any potential misunderstandings, the Holy See declared that, in acceding to those instruments only in the name and on behalf of Vatican City State, it committed itself to apply their provisions exclusively within the territory of the Vatican City State, as circumscribed by the Leonine Walls[11].

The Vatican City State (VCS) is the world's smallest State, both in terms of population and territory, consisting of 0.44 square kilometers, and is an enclave surrounded by the territory of the Italian Republic in the city of Rome. Its territory comprises St. Peter's Basilica and the buildings connected to it, surrounding the Vatican hill, on the edge of the historic centre of Rome. It houses also the Vatican Museums, which represent one of the most important art collections in the world, as well as the Apostolic Library and Archive. Since 1984, the whole territory has been designated as a UNESCO World Heritage Site.

The VCS was created by the 1929 Treaty between the Kingdom of Italy and the Holy See (The Lateran Treaty) "in order to assure the absolute and visible independence of the Holy See" while "recognizing the full ownership and the exclusive and absolute power and sovereign jurisdiction of the Holy See over [the Vatican City State] "[12]. Therefore, the VCS should not be confused with the Holy See. The Holy See is a sovereign subject of international law possessing full international legal personality with the same rights and obligations as other States. It should be noted that the Holy See does not exercise jurisdiction, as that term is understood in international law, over individual Catholics and institutions located outside the territory of the VCS. Each member of the Catholic Church is subject to the laws of the respective State in which he or she lives.

The population of the VCS consists of those who reside there permanently for reasons of office or employment. Nonetheless, the number of people who cross the borders of the State on a daily basis for reasons of work, study, art and culture, etc. is considerably higher.

[11] Cf. Declaration annexed to the Instrument of Accession of the Holy See, acting in the name and on behalf of Vatican City State, to the United Nations Framework Convention on Climate Change, 4 July 2022.
[12] Treaty between the Holy See and Italy of 11 February 1929, Preamble.

To date, there are 889 people residing in the territory of the VCS. While the number of the residents is not statistically significant, goods and services in the VCS are provided mostly to a large number of non-residents. In addition to residents and citizens who reside there permanently for reasons of work, access is allowed to other people who are not citizens or do not have residence in the State. The transient population of the State is approximately 6.000 people, not including those (family members, pensioners, beneficiaries of the Health Fund and professional collaborators) who use the goods and services provided by the State.

Unlike other States, the VCS does not have a productive sector. Due to its specific nature, there is no ‘gross value’ of the economic activities carried out within the VCS. Its national income is essentially made up of asset management and the income generated by services provided and goods sold to residents, citizens and others.

Energy use in the VCS depends almost entirely on energy imports, as the State has neither fossil fuel sources, nor energy production plants, with the exception of a negligible amount of energy produced from renewable sources.

This chapter of the first Biennial Transparency Report (BTR) explores the national context of the VCS, delving into crucial aspects of a cross-cutting nature, and depicting the jurisdiction's current circumstances and pertinent considerations. The report offers detailed insights, incorporating relevant subsections as needed.

Figure 1: The Vatican City State is a landlocked City-State on the Italian peninsula in the city centre of Rom

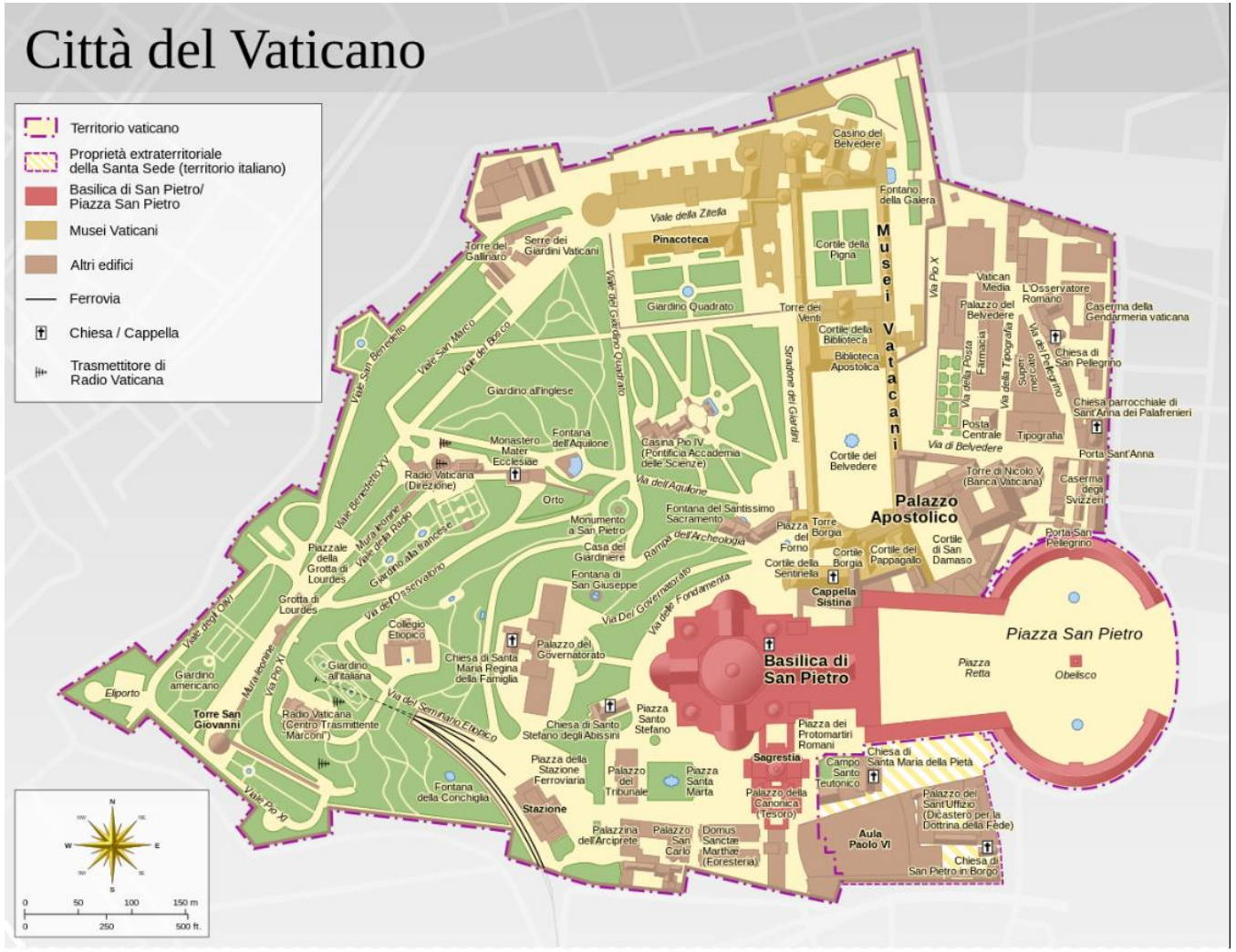


Figure 2: Territory of the Vatican City State

B. Administrative Structure

The organ of executive power is the Governorate of the VCS, which provides for the functioning and administration of the State with its Departments and Central Offices.

The organ of legislative power is the Pontifical Commission for the VCS, composed exclusively of Cardinals, one of whom is its President. All of them are appointed by the Pope.

The organs of judicial power are the Tribunal of First Instance, the Tribunal of the Roman Rota and the Supreme Tribunal of the Apostolic Signatura.

C. Geography and Topography

The State is located on the Vatican Hill, which has a maximum elevation of 75 metres. Approximately half of the territory is comprised of the Vatican Gardens, while the rest contains St. Peter's Basilica and the other buildings and monuments. The VCS is located near the right bank of the Tiber River, on a small hill that covers part of the Montes Vaticani (Vatican Hills). The State's territory is partly surrounded by walls and includes Saint Peter's Square up to the marble strip where the Colonnade meets the ground, thus delimiting the confines of the State with the boundaries of the Square. There are five entrances into the State, monitored by the Pontifical Swiss Guard and by the Gendarmerie Corps of VCS.

D. Climate Profile

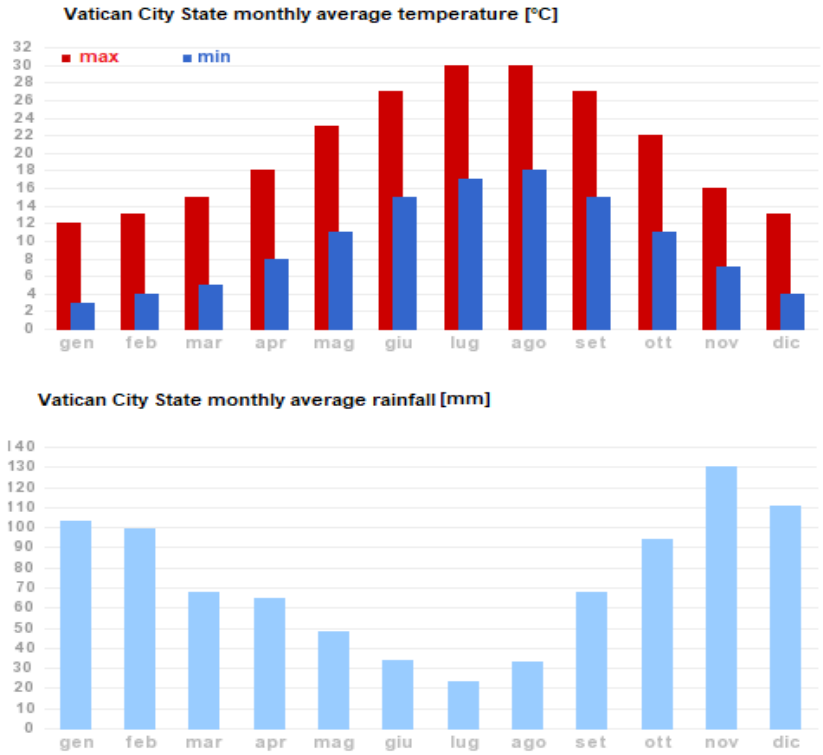
The climate in the VCS is temperate, with mild, rainy winters and hot, dry summers. The average annual rainfall is approximately 750 mm, distributed over 79 days on average.

Temperatures vary depending on the season, with peak temperatures in July and August (up to 32°C) and a significant drop from November to March (with temperatures as low as 3°C in January and February).

The 'winter period' runs from October to the end of April and results in lower temperatures than the rest of the year (3 to 13 °C in January) and stronger winds and precipitation, up to 149 mm of precipitation in November.

The wettest seasons are spring and autumn, mainly in November. The summer is hot, humid and tends to be dry, except for the occasional afternoon thunderstorm that may spill over into the city from the mountainous areas of the province, while the winter is generally mild

and rainy, but with notable and sudden cold peaks and rare snowfall. In general, the climate is often windy with a prevalence of northerly winds such as the tramontana and southwesterly winds such as the scirocco, or the ponentino, coming from the area to the west of the city.



Graph 1: Average temperature and rainfall in the VCS during the year

The weather data is monitored by a station located within the State on the terrace of the Vatican Railway Station.

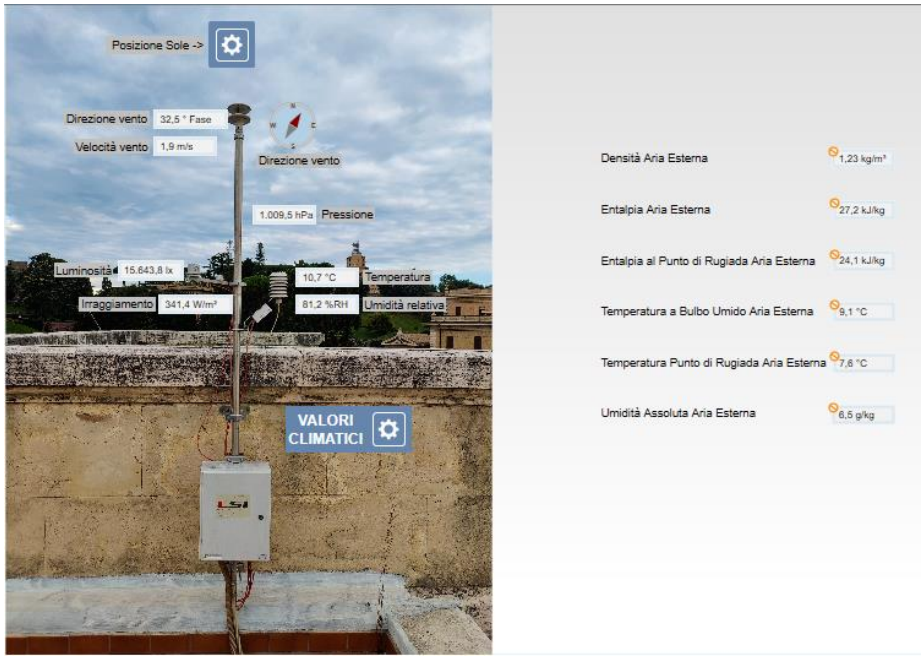


Figure 3: Vatican weather station

E. Population

The population of the VCS (comprising both citizens and residents) amounts to less than a thousand people of different nationalities and consists of those who reside in the VCS permanently by reason of office or employment, provided that such residence is prescribed by law and authorised by the competent authorities.

Vatican citizenship is granted to persons who have permanent residence in the VCS by reason of their dignity, office, or employment. It is regulated by Article 1 of the 2011 Vatican Sources Law N. CXXXI and Article 9 of the 1929 Lateran Pacts.

Accordingly, pursuant the aforesaid law, the following shall be considered citizens of the VCS:

- Cardinals residing in the VCS or in Rome;
- members of the Holy See's diplomatic corps;
- those who reside permanently in the VCS by reason of their office or employment, when such residence is prescribed by law or by regulation, or when duly authorized;
- those who, even independently of the conditions envisaged in the preceding bullet points, are authorised by the Supreme Pontiff to reside permanently in VCS;
- the spouse, children, parents and siblings of a Vatican citizen are also entitled to Vatican citizenship, provided they live with him/her and are authorized to reside in the VCS, in accordance with the law.

The population of the VCS (citizens and residents) is currently 889 people.

F. Energy

As already mentioned, energy use in the VCS depends almost entirely on energy imports.

Electricity, gas and water supplies are ensured through contracts and conventions that the Governorate of the VCS has stipulated with various energy companies:

- for electricity there are no. 3 supply points: power plant at the industrial centre, Paul VI Hall, Porta Pertusa;
- for natural gas there are several supply points for industrial (heating plants) and residential users (cooking). The main medium-pressure supply is that of the thermal

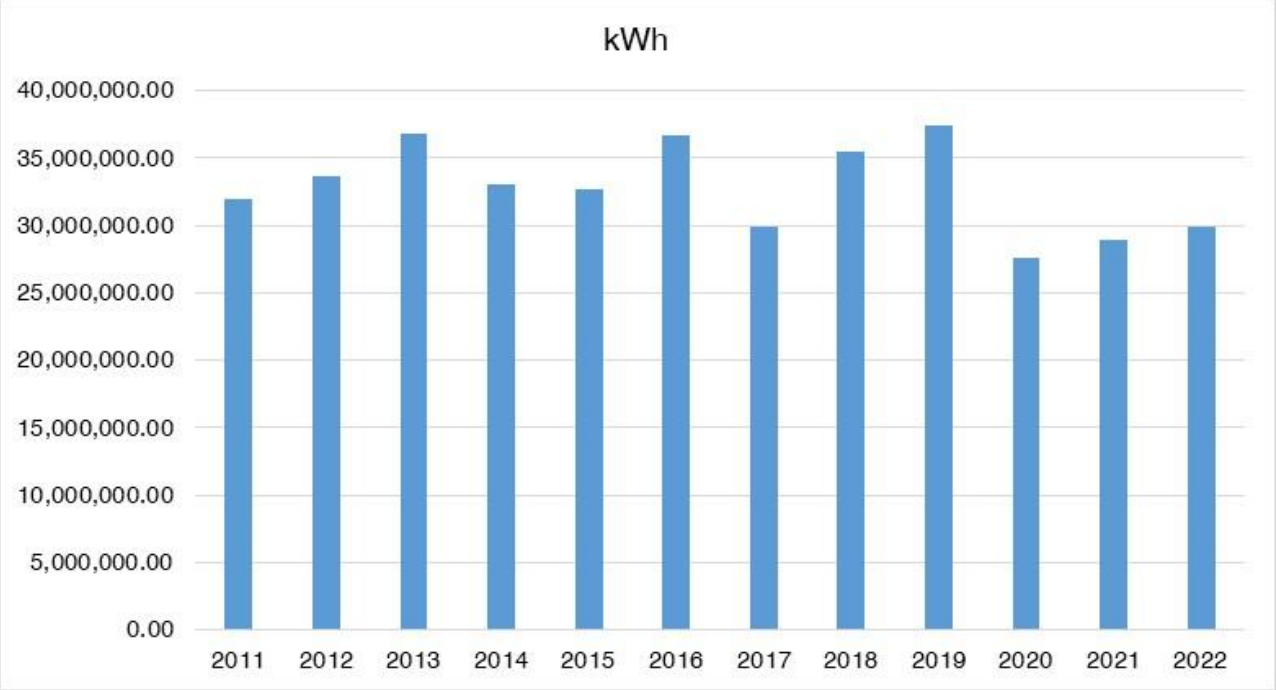
power station at the Industrial Centre (district heating). Another important supply is provided by the thermal plant of the Vatican Museums;

- for water there are 3 metered supplies and 10 metered outlet supplies.

Electricity distribution in the VCS currently consists of 3 medium voltage supply points and 21 MV/LV transformer stations. Currently, all of the energy imported is renewable.

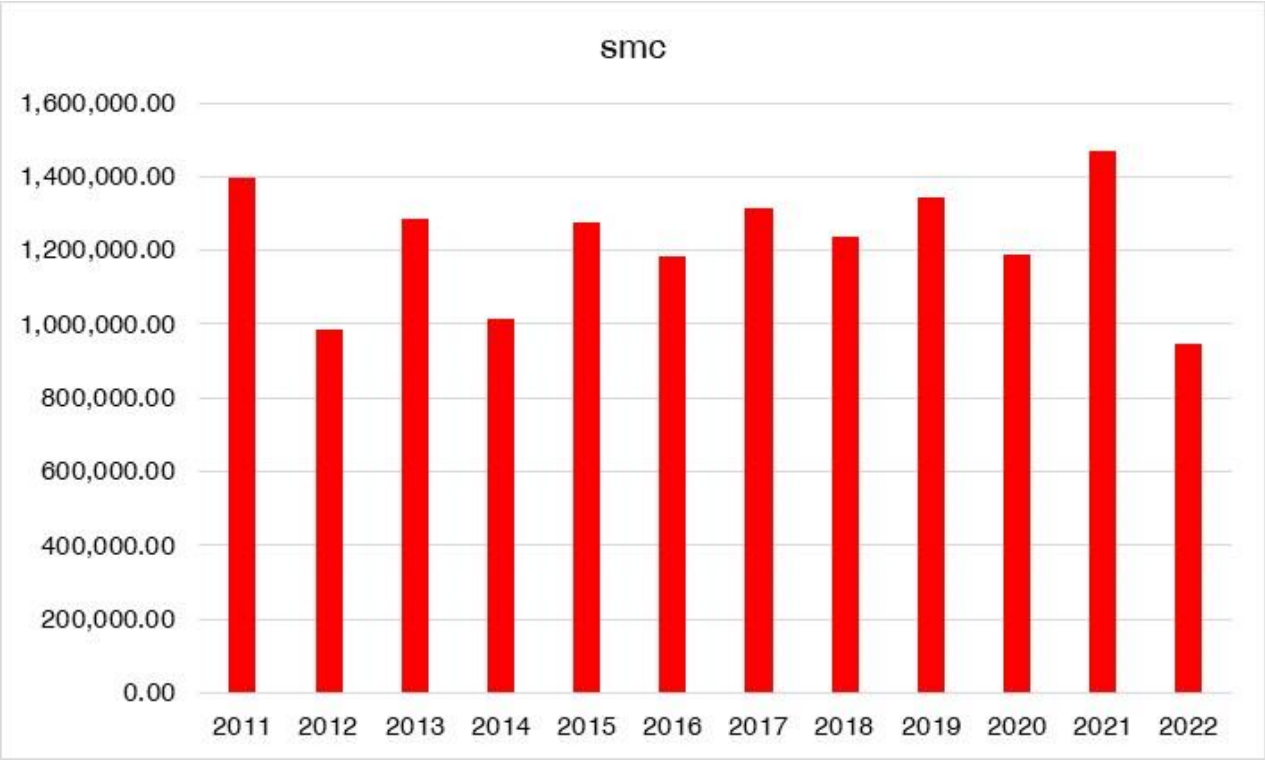
Electricity consumption shows a stable trend during the period 2011-19 with an average of 34,170,00.00 kWh/year.

From 2019 to 2022 there was a reduction in electricity consumption (- 20%) due to the pandemic.



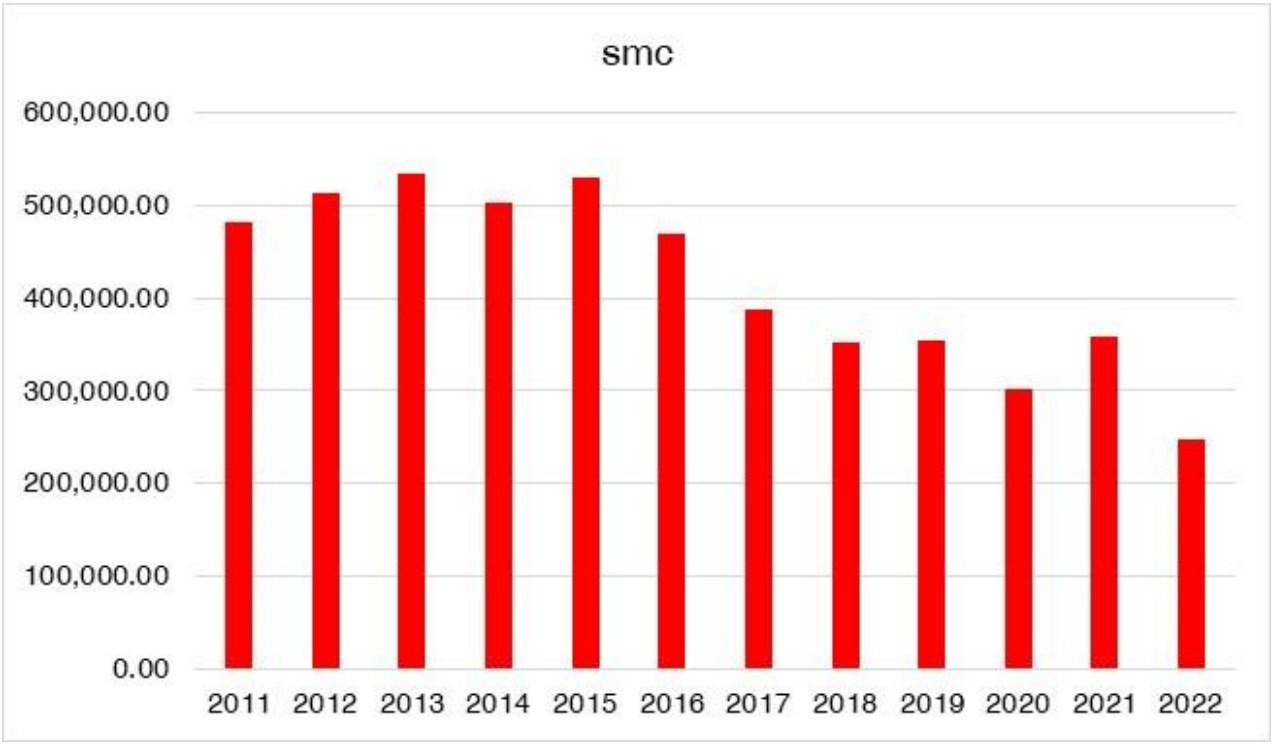
Graph 2: Annual electricity consumption in the Vatican City State

In the period 2011 – 2022, the annual natural gas consumption of the VCS district heating plant averaged 1,220,000.00 smc with a percentage change of approximately ± 20%. This fluctuation depends on many factors such as the trend of external temperatures, the duration of the season, etc.



Graph 3: Annual natural gas consumption of the Vatican City State district heating

A significant percentage of total energy consumption is also linked to the thermal power plant of the Vatican Museums, which is active all year round. Consumption has decreased in recent years, from a 470,000.00 smc in 2016 to 248,000.00 smc in 2022 (- 47 %).



Graph 4: Annual natural gas consumption of the Vatican Museum thermal plant

Alternative Energy Disadvantage

The VCS has a limited surface area, a relatively flat terrain, a high urban density, low wind speed, and no near-surface geothermal resources or major river systems. Therefore, the exploitation of alternative energy sources such as wind or geothermal energy is unfortunately not a realistic possibility. Although solar energy is the most viable option for domestic renewable energy in the VCS, competing land uses severely limit access to solar energy on a large scale. These difficulties in the transition to alternative energy are recognised by the UNFCCC under Articles 4.8i and 4.10: nevertheless, the VCS will continue to pursue available opportunities.

Solar

Solar energy is the most viable source of renewable energy for the VCS. However, the constraints of its territory limit its capacity for large-scale deployment. In addition, the VCS's high cloud cover and substantial urban shading pose problems such as intermittency. In spite of these constraints, the Governorate continues to pursue solar energy deployment, employing innovative technologies and projects where possible to exploit its full potential (e.g. solar installations atop buildings where possible).

Geothermal

There are no adequate near-surface geothermal resources that would allow the implementation of conventional geothermal systems in the VCS. Deep geothermal energy has emerged in recent years as a potential option, although the technical and economic feasibility remains a challenge. A study for the use of geothermal heat pumps is currently underway, although it is limited by the archaeological areas present in the Vatican territory.

G. Climate Change Policy and Institutional Framework

International Environmental Agreements

In 2008, the Holy See ratified, in the name and on behalf of the VCS, the Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer with its first four Amendments. In 2020 it ratified, in the name and on behalf of the VCS, the Kigali Amendment to the Montreal Protocol.

On 4 October 2022, the UNFCCC and the Paris Agreement entered into force for the jurisdiction, as a non-Annex I Party.

Environmental and energy policies

On 24 May 2015, Pope Francis issued the Encyclical Letter *Laudato Si' on Care for Our* Common Home. On 12 December 2020, in a Video-Message to the High Level Virtual Climate Ambition Summit, Pope Francis underscored that a strategy is necessary to reduce net emissions to zero (net-zero emission), and announced that the Holy See intended to join others in this effort by achieving net-zero emissions by 2050.

The VCS's commitment to sustainable development is evident through various strategic frameworks and policies.

The following are the main areas for past and future interventions:

- energy engineering projects;
- optimization of water resource use;
- waste and green management;
- mobility;
- rational use of energy;
- climate change.

The main policies, strategies and development plans being implemented in accordance with the VCS's first National Determined Contribution (NDC) published in 2023 are related to the State's priorities and objectives in the areas indicated. Each area is strategically aligned with national and global sustainability goals, reflecting the jurisdiction's commitment to promoting environmental sustainability and climate resilience.

The common denominator of the indicated areas of implementation is the impact of energy and production systems on the environment.

Today, energy is at the crux of the interaction between science, technology and society: it represents a complex relationship that will only achieve future scenarios of sustainability and stable equilibrium if it is supported by intentional technical, social and political choices.

In fact, controlling energy and environmental factors entails short, medium and long-term investments and commitments to implement energy saving policies, diversification of sources, adoption of low environmental impact technologies, and to spread greater education and awareness for environmental protection and issues related to integral ecology.

Chapter 2

NATIONAL INVENTORY REPORT OF ANTHROPOGENIC EMISSIONS BY SOURCES AND REMOVALS BY SINKS OF GREENHOUSE GASES

A. Foreword

Monitoring GHG emissions is a critical component of any jurisdiction's planning and emissions reduction strategies, although the Vatican City State's (VCS) contribution to global emissions is negligible.

This chapter serves as the National Inventory Report (NIR) of anthropogenic emissions by sources and their removals by sinks of greenhouse gases, in line with the Modalities, Procedures, and Guidelines (MPGs) as specified in the decision 18/CMA.1.

B. Definitions and scope

As per the MPGs, Parties are required to report on seven gases: CO_2, methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6) and nitrogen trifluoride (NF_3). However, thanks to the total absence of industrial activities in the territory of the VCS some gases are not occurring. GHGs covered in this inventory are summarized in the following table.

GHG gases	Inventory coverage
Carbon dioxide (CO_2)	✓
Methane (CH_4)	✓
Nitrous oxide (N_2O)	✓
Hydrofluorocarbons (HFCs)	✓
Perfluorocarbons (PFCs)	NOT OCCURING
Sulphur hexafluoride (SF_6)	NOT OCCURING
Nitrogen trifluoride (NF_3)	NOT OCCURING

Table 1

The present inventory spans a period of 11 years, starting from the base year 2011 and extending to the inventory year 2022. It encompasses the four sectors outlined in the 2006 IPCC (Intergovernmental Panel on Climate Change) Guidelines, namely Energy, Industrial Processes and Product Use (IPPU), Agriculture, Land use, land-use change and forestry (LULUCF), and Waste.

Primary and secondary economic sectors – such as industry, mining, agriculture, livestock or animal farming – are not present in the VCS, due to its specific characteristics.

Moreover, due to its limited territory, the associated GHG emissions removals from the LULUCF are negligible compared to other sectors. In the absence of waste management facilities, the totality of waste produced in the VCS is transported and properly disposed of in Italy; consequently, emissions from the waste sector are not occurring.

Therefore, the VCS's emissions for CO_2, CH_4, N_2O, HFCs have been estimated only for the following two sectors:

1. Energy
1.A. Fuel combustion
1.A.3. Transport
1.A.4. Other sectors
2. Industrial processes and product use
2.F. Product uses as substitutes for ODS (Ozone Depleting Substances)

Table 2

The contribution of the LULUCF sector was considered insignificant based on the study conducted by ISPRA (Italian Higher Institute for Environmental Protection and Research) in the 2023 Report LULUCF Vatican Emissions – Vatican City emissions/absorption project.

The analysis was based on all available information on the trees present in the Vatican Gardens, including the number of trees/shrubs, type of species, age, etc.

The calculated emissions are -25.31 t CO_2 eq/year with an uncertainty of 3.32%.

C. Use of Flexibility Provisions from the MPGs

In this BTR, the VCS utilises the flexibility provisions provided under the MPGs. Flexibility has been applied in specific areas, as outlined in Table 3. Further details on the use of these provisions, along with plans to address them in future reports, are explained in a dedicated section to ensure clarity and transparency.

MPG flexibility provision	Year	Sector	Category	Gas
Para. 57 of decision 18/CMA.1 (Annual time series)	1990-2010	All	All	All
Para. 32 of decision 18/CMA.1 (Insignificance threshold)	All	All	All	All
Para. 29 of decision 18/CMA.1 (Uncertainty assessment)	All	All		

Table 3

D. Methodologies

Emissions were not directly measured by individual sectors; instead, they were derived using activity data collected from the respective sectors following a sectoral approach. This data was compiled to create a national GHG inventory, with emissions calculated using methods outlined in the 2006 IPCC Guidelines for National GHG Inventories. The Tier 2 methodology and country specific emissions factors were applied to all sectors, as shown below, for more detailed estimates.

Furthermore, to ensure completeness, the national GHG inventory uses notation keys where numerical data are not available. These notation keys include:

- "NO" (not occurring): Used for categories or processes, including recovery, under a particular source or sink category that do not occur within a Party.
- "NE" (not estimated): Used for activity data and/or emissions by sources and removals by sinks of GHGs that have not been estimated but for which a corresponding activity may occur within a Party.
- "NA" (not applicable): Used for activities under a given source/sink category that do occur within the Party but do not result in emissions or removals of a specific gas.
- "IE" (included elsewhere): Used for emissions by sources and removals by sinks of GHGs estimated but included elsewhere in the inventory instead of under the expected source/sink category.

E. Sources of Activity Data and Bibliography

The following table summarizes the principal sources of activity data used for each sector.

Category	**Type of data**	**Data source**
1.A.3 Transport	Amount of fuel consumption (litres of gasoline and diesel oil)	Direct fuel sales records given by the VCS Governorate – Economics Department
1.A.4 Other Sectors	Amount of fuel consumption (litres for liquid fuel or scm for gaseous fuel)	Direct meter reading by ESCO (Energy Service Company)
2.F. Product uses as substitutes for ODS	Amount of HFCs purchased (kg)	Purchase order register by the VCS Governorate – Infrastructures and Services Department

Table 4

To the extent possible, country-specific activity data was used for inventory elaboration. Values relating to the characteristics of the fuels used – such as density, lower calorific value (LCV) and emission factor (EF) – were obtained for each of the greenhouse gases from published statistics for Italy, as appearing in peer-reviewed or official publications[13]. In years/sectors where data gaps were detected, statistical techniques such as interpolation or extrapolation were applied to address these issues.

F. Overview and breakdown of GHG emissions

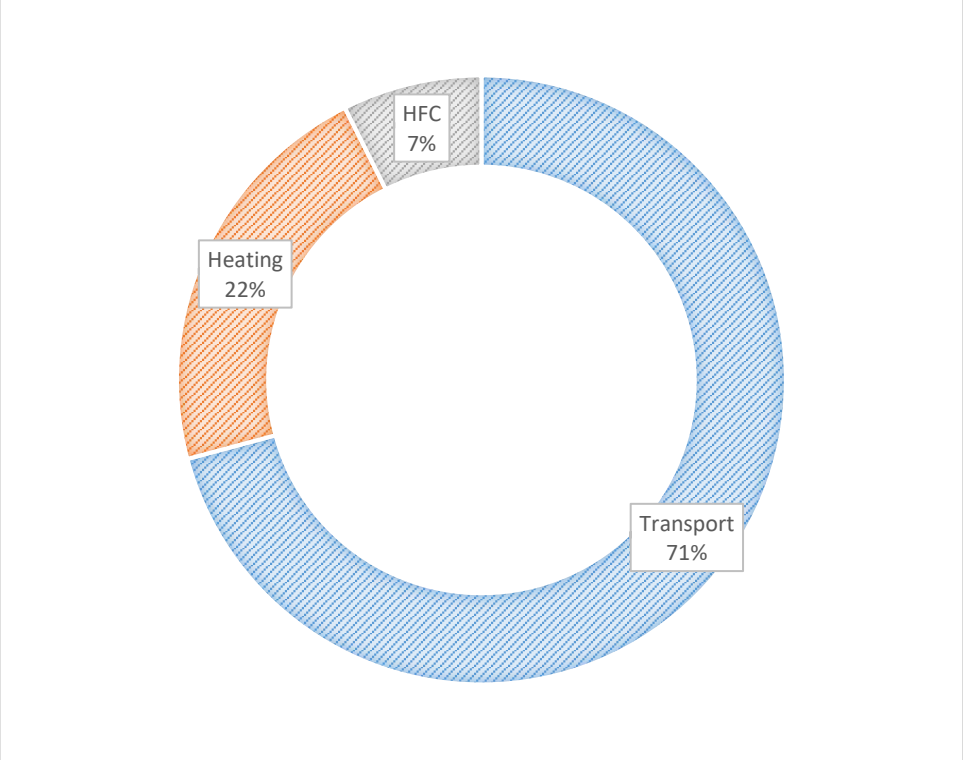
In 2022, the energy sector represented 93% of total emissions in the VCS, transport being the largest source of GHG emissions in the jurisdiction followed by the heating sector, as illustrated in Graph 5.

Description	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Total CO_2 equivalent emissions	19,33	17,20	18,08	17,65	17,30	16,50	17,04	16,03	15,90	15,95	15,38	15,89
1. Energy (kt CO_2 eq.)	17,70	17,20	17,10	15,81	16,18	15,31	15,44	14,81	14,92	12,73	14,57	14,71
2. IPPU (kt CO_2 eq.)	1,63	0	0,98	1,83	1,12	1,19	1,60	1,22	0,98	3,22	0,82	1,18
GHG emissions totals	**19,33**	**17,20**	**18,08**	**17,65**	**17,30**	**16,50**	**17,04**	**16,03**	**15,90**	**15,95**	**15,38**	**15,89**
CO_2 (kt)	17,56	17,06	16,96	15,69	16,06	15,19	15,33	14,70	14,81	12,65	14,47	14,60
CH_4 (kt CO_2 eq.)	0,05	0,05	0,04	0,04	0,03	0,03	0,03	0,03	0,03	0,02	0,03	0,03
N_2O (kt CO_2 eq.)	0,09	0,10	0,09	0,09	0,09	0,08	0,08	0,08	0,08	0,06	0,07	0,08
HFCs (kt CO_2 eq.)	1,63	NO	0,98	1,83	1,12	1,19	1,60	1,22	0,98	3,22	0,82	1,18

Table 5

[13] Relevant publications and bibliographical sources:

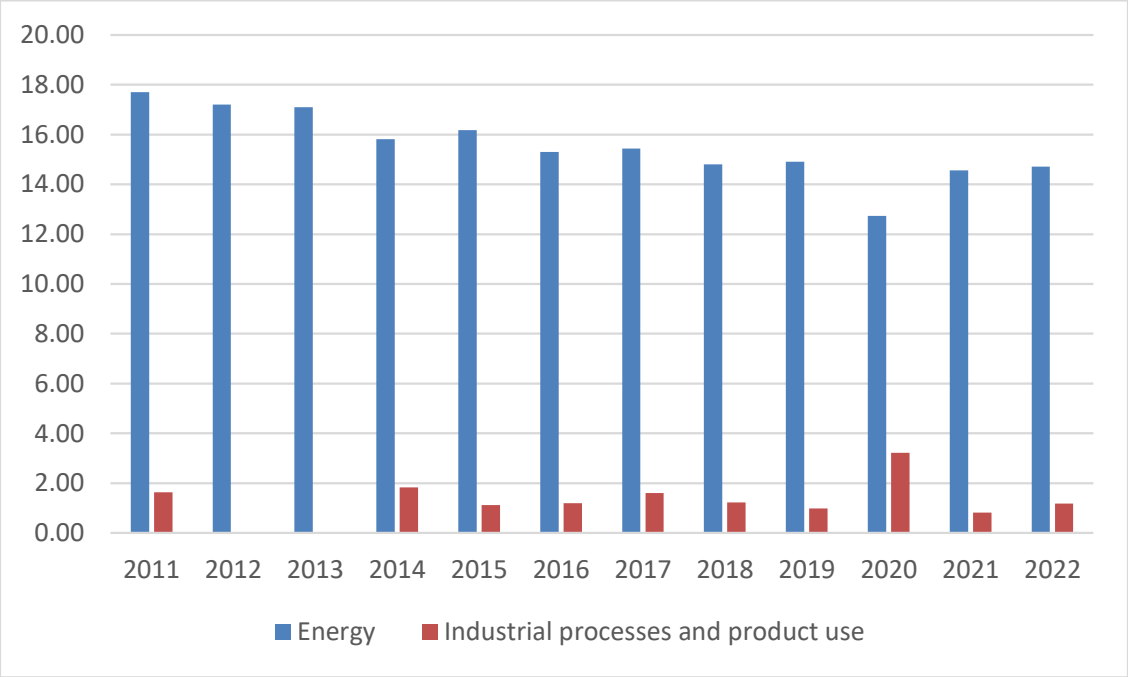
i. EMEP/EEA, 2019. Air Pollutant Emission Inventory Guidebook. EEA. Technical report No 13/2019 (EF CH_4 and N_2O for heat and energy production boilers).
ii. EMISIA SA, 2024. COPERT 5 v.5.7.3, Computer programme to calculate emissions from road transport. http://www.emisia.com/copert/ (model used to calculate Italian road transport EFs).
iii. Innovhub, several years. Report on the physico-chemical characterization of fossil fuels used in Italy. Fuel Experimental Station (characteristics of transport and heating fuels for the calculation of Italian CO_2 EF of gasoline and diesel oil).
iv. IPCC 2006, 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds). Published: IGES, Japan.
v. ISPRA, 2024. Italian Greenhouse Gas Inventory 1990-2022. National Inventory Report 2024. March 2024, https://emissioni.sina.isprambiente.it/inventario-nazionale/ (CO2 EF and other Italian GHGs and calculation methodologies).



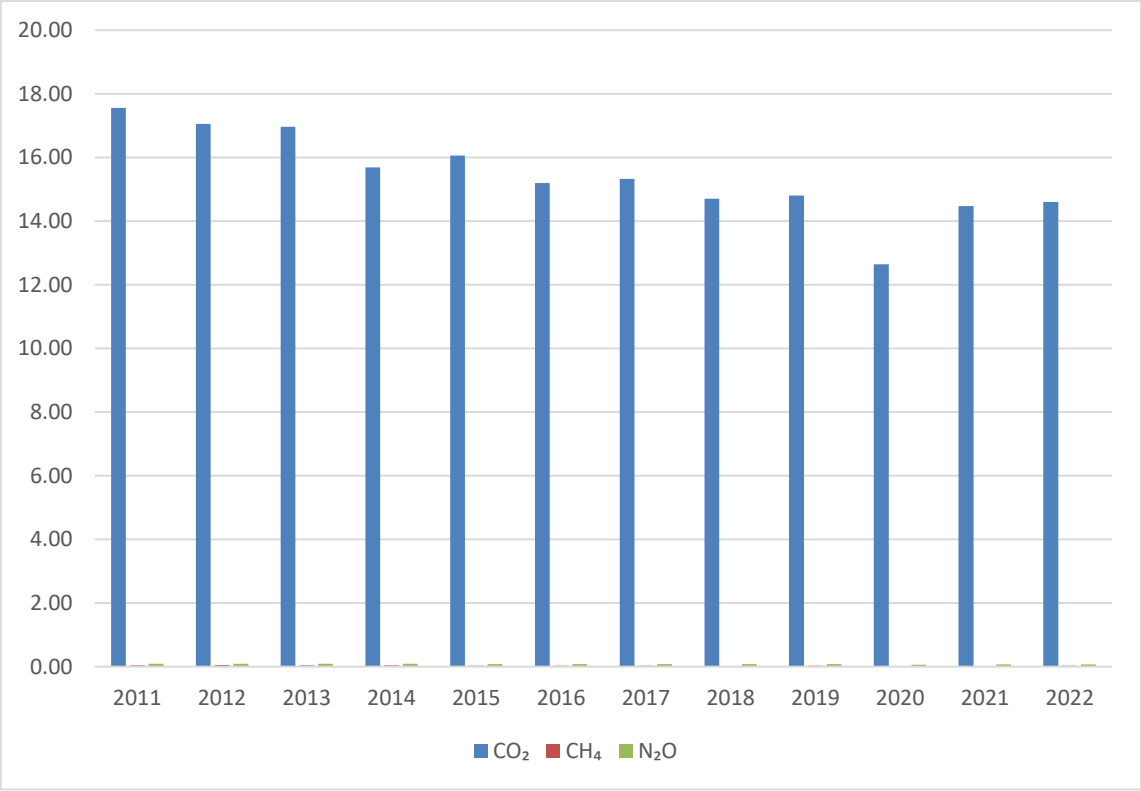
Graph 5: Summary of sectorial emissions

The VCS's GHG emissions for 2022 totalled 15.89 kt CO_2 eq. The overview of emissions and breakdown by type of gas and sector is shown in table 5 and in the graphs below.

The most significant GHG emitted in the VCS is CO_2, primarily produced by the burning of fossil fuels used by the building heating systems and transport sectors. CH_4 and N_2O are present to a much lower extent (see graph 7).



Graph 6: GHG emissions by sector (kt CO2 eq.)



Graph 7: GHG emissions by gas (kt CO2 eq.)

G. Energy: Transport (1.A.3.)

The usage of road vehicles is based on a small population consisting of both employees and residents who purchase fuel at the fuel stations located within the territory. A smaller portion of the fuel is used to power work-vehicles such as executive cars, vans, internal tourist buses, small cranes, fire department vehicles, etc.

In the territory, water-borne transportation are not present.

The calculation methodology and assumptions used to determine the emissions resulting from the use of liquid fuels for road transport are as follows:

- Only gasoline and diesel oil are dispensed by the fuel station; LPG is not occurring.
- The vehicle fleet circulating within the territory, or that has access to the sale of fuel, is comprised almost exclusively of cars; emissions due to transportation by light/heavy trucks or motorcycle is assumed to be almost negligible (and therefore the related fuel consumption was indicated, in the ETF, as “included elsewhere”).
- The basic data is the quantity in liters dispensed by fuel stations within the territory. This data (see also “data source” section) is measured periodically by certified and calibrated meters, and therefore has an almost negligible degree of uncertainty.
- Fuel consumption, given in energy units (TJ - terajoules), is calculated as a product of Net Calorific Value (NCV) and fuel mass. The NCV values and average density data for each type of fuel is provided from historical series (see para E.).

Year	Density	NCV	Emissions factors (EF)			Stoichiometric Factors			biomass %
	kg/l	GJ/t	CO_2 (t/TJ)	CH_4 (kg/GJ)	N_2O (kg/GJ)	CO_2	CH_4	N_2O	
2011	0.7370	43.735	71.864	17.14174524	1.368299422	1	28	265	1.14%
2012	0.7370	43.735	71.864	17.96523601	1.293731342	1	28	265	1.19%
2013	0.7429	42.817	73.338	17.60866789	1.264531369	1	28	265	0.90%
2014	0.7429	42.817	73.338	17.12455766	1.19865492	1	28	265	0.12%
2015	0.7429	42.817	73.338	16.70516826	1.127705195	1	28	265	0.31%
2016	0.7429	42.817	73.338	15.97093613	1.055879724	1	28	265	0.43%
2017	0.7429	42.817	73.338	15.46402996	1.008420529	1	28	265	0.45%
2018	0.7429	42.817	73.338	14.7972297	0.961505948	1	28	265	0.44%
2019	0.7429	42.817	73.338	15.11241332	0.919124016	1	28	265	0.40%
2020	0.7429	43.128	73.081	15.41101163	0.886467239	1	28	265	0.33%
2021	0.7404	43.128	73.081	14.2204275	0.815985183	1	28	265	0.37%
2022	0.7404	43.128	73.081	13.63748008	0.787400147	1	28	265	0.43%

Table 6: gasoline

Year	Density	NCV	Emissions factors (EF)			Stoichiometric Factors			biomass %
	kg/l	GJ/t	CO_2 (t/TJ)	CH_4 (kg/GJ)	N_2O (kg/GJ)	CO_2	CH_4	N_2O	
2011	0.8350	42.920	73.892	1.743	2.499	1	28	265	5.50%
2012	0.8350	42.920	73.892	1.744	2.522	1	28	265	5.66%
2013	0.8355	42.786	73.648	1.400	2.645	1	28	265	5.44%
2014	0.8355	42.786	73.648	1.241	2.696	1	28	265	4.59%
2015	0.8355	42.786	73.648	1.015	2.738	1	28	265	5.07%
2016	0.8355	42.786	73.648	0.915	2.790	1	28	265	4.49%
2017	0.8355	42.786	73.648	0.777	2.838	1	28	265	4.82%
2018	0.8355	42.786	73.648	0.731	2.799	1	28	265	5.45%
2019	0.8355	42.786	73.648	0.700	2.835	1	28	265	5.55%
2020	0.8343	42.850	73.510	0.674	2.841	1	28	265	6.71%
2021	0.8343	42.850	73.510	0.610	2.864	1	28	265	6.12%
2022	0,8343	42,850	73,510	0,588	2,859	1	28	265	5,78%

Table 7: diesel oil

H. Energy: Other sectors (1.A.4.)

The “other sectors” concerns emissions relating to the use of fuel for heating buildings which represents the second largest source of GHG emissions in the territory. Two categories of heating systems are identified in the VCS:

- 1.A.4.a. Commercial/institutional: this item groups the main VCS district heating station which produces hot water distributed to almost all the buildings in the territory as well as the various peripheral thermal power plants. Fuels adopted include gaseous (natural gas) and liquid (diesel oil for heating up to year 2021 and subsequently dismissed).
- 1.A.4.b. Residential: this item groups domestic users (typically cooking stoves).

The calculation methodology and assumptions used to determine the emissions resulting from the use of liquid fuels is as follows:

- The basic data is the quantity (in smc) dispensed by Italian ESCO to the VCS through several calibrated meters within the territory. This data (see also “data source” section) is measured periodically and registered, and therefore has an almost negligible degree of uncertainty.
- Fuel consumption, given in energy units (TJ), is calculated as a product of Net Calorific Value (NCV) and fuel mass. The NCV values and average density data for each type of fuel is provided from historical series (see para E.).

Year	Density	NCV	Emission Factors (EF)			Stoichiometric Factors		
	kg/smc	GJ/t	CO_2 (t/TJ)	CH_4 (kg/GJ)	N_2O (kg/GJ)	CO_2	CH_4	N_2O
2011	0.7142	48.013	57.427	0.0025	0.0010	1	28	265
2012	0.7193	47.673	57.702	0.0025	0.0010	1	28	265
2013	0.7172	47.812	57.447	0.0025	0.0010	1	28	265
2014	0.7199	47.634	57.473	0.0025	0.0010	1	28	265
2015	0.7156	47.918	57.633	0.0025	0.0010	1	28	265
2016	0.7189	47.696	58.140	0.0025	0.0010	1	28	265
2017	0.7161	47.881	58.000	0.0025	0.0010	1	28	265
2018	0.7129	48.100	57.846	0.0025	0.0010	1	28	265
2019	0.7105	48.264	57.746	0.0025	0.0010	1	28	265
2020	0.7121	48.156	57.910	0.0025	0.0010	1	28	265
2021	0.7141	48.019	58.504	0.0025	0.0010	1	28	265
2022	0.7157	47.924	58.918	0.0025	0.0010	1	28	265

Table 8: natural gas

Year	Density	NCV	Emissions factors (EF)			Stoichiometric Factors		
	kg/l	GJ/t	CO_2 (t/TJ)	CH_4 (kg/GJ)	N_2O (kg/GJ)	CO_2	CH_4	N_2O
2011	0.838	42.650	74.438	0.007	0.002	1	28	265
2012	0.838	42.650	74.438	0.007	0.002	1	28	265
2013	0.8377	42.877	73.578	0.007	0.002	1	28	265
2014	0.8377	42.877	73.578	0.007	0.002	1	28	265
2015	0.8377	42.877	73.578	0.007	0.002	1	28	265
2016	0.8377	42.877	73.578	0.007	0.002	1	28	265
2017	0.8377	42.877	73.578	0.007	0.002	1	28	265
2018	0.8377	42.877	73.578	0.007	0.002	1	28	265
2019	0.8377	42.877	73.578	0.007	0.002	1	28	265
2020	0.8456	42.873	73.927	0.007	0.002	1	28	265
2021	0.8456	42.873	73.927	0.007	0.002	1	28	265
2022	0.8456	42.873	73.927	0.007	0.002	1	28	265

Table 9: diesel oil for heating

I. Product uses as substitutes for ODS (2.F.)

Refrigerant gases (HFC) used in the VCS are used in air conditioning systems and industrial refrigeration systems (supermarket refrigerated counters).

The gases used and falling under sections 2.F.1f Stationary air-cond and 1.F.1.a. Comm. Refrig. in the period 2011 – 2022 are:

- R422D
- R134a
- R410a
- R407c
- R404a
- R507c
- R448a
- R32

Of the individual gases, the four pure gas components are R125, R134a, R32 and R143a; the following table shows the percentages of the mixture components.

For the calculation of CO_2 eq. emissions, the assumption is to consider the quantities imported in one year as corresponding to the losses on the plants in the same year, attributing the following values of GWP (Global Warming Potential) to the individual gases.

Mix	R125 (%) GWP=3170	R134a (%) GWP=1300	R32 (%) GWP=677	R143a (%) GWP=4800
R422D	65	32		
R134a		100		
R410a	50		50	
R407c	25	52	23	
R404a	44	4		52
R507c	50			50
R448a	26	21	26	
R32			100	

Table 10: Percentages of the mixture components in HFCs

There is no refrigerant gas storage in the VCS territory and gas from decommissioned plants, even small room conditioners, is fully recovered.

Chapter 3

INFORMATION NECESSARY TO TRACK PROGRESS MADE IN IMPLEMENTING AND ACHIEVING NATIONALLY DETERMINED CONTRIBUTIONS UNDER ARTICLE 4 OF THE PARIS AGREEMENT

A. Introduction

The United Nations Framework Convention on Climate Change (UNFCCC) underpins the current reporting system for global intergovernmental action to combat climate change. As stipulated in Article 12, the Convention requires all Parties to report information relevant to the implementation of the Convention to the Conference of the Parties (COP). This is a key element that supports the submission of reliable, transparent and complete information and allows for the assessment of progress in the implementation of the Convention.

Over the years, national reporting arrangements have evolved into a more comprehensive Measurement, Reporting and Verification (MRV) framework. This MRV approach has been expanded and strengthened under the Enhanced Transparency Framework (ETF) of the 2015 Paris Agreement, which aims to provide a clear understanding of the Parties' climate change action, including good practices, priorities, needs and gaps.

The ETF includes new reporting requirements that are further defined in the Modalities, Procedures and Guidelines (MPGs). The MPGs define the set of rules for reporting and reviewing information submitted by Parties under the Paris Agreement ETF and outline in detail the reporting requirements for all developed and developing country Parties to the Paris Agreement.

It is important that all countries make decisions on the institutionalization of their MRV frameworks to ensure their ability to provide high quality data in the right formats and at the right times.

However, it is also important to note that MPGs provide flexibility to non-Annex I countries.

B. The National MRV Framework of the Vatican City State

The Governorate of the VCS has strengthened its national MRV framework for climate change reporting. The establishment of a national MRV framework has provided the VCS with a unique opportunity to conform to the requirements of the relevant ETF and begin to incorporate institutional arrangements that encompass all MRV sections essential for implementing the Paris Agreement.

Over the past two years, the VCS has built its capacity and implemented various policies that serve as the foundation for the enhanced reporting framework: these efforts will play a

crucial role in ensuring compliance with the existing framework for reporting international progress on a continuous basis.

C. Institutional Arrangements

The core components of a national MRV framework hinge on structured institutional arrangements that ensure the flow of information from various stakeholders, including Departments and Offices of the Vatican Governorate, Energy Service Companies and foreign partners (e.g. the Italian Ministry of the Environment and Energy Security – MASE, the Italian Higher Institute for Environmental Protection and Research – ISPRA). These arrangements constitute a clear framework for the flow of data and information.

In the VCS the National Focal Point (NFP) for the UNFCCC is the Section for Relations with States and International Organizations of the Secretariat of State of the Holy See: in this role, it has the responsibility to coordinate the VCS's international reporting requirements.

The Inventory Focal Point, the ETF Focal Point and the roles of Expert (Energy, IPPU – Industrial Processes and Product Use –, Tracking Progress, Projections, Mitigation Policies and Measures, etc.) are delegated to the technical offices of the Infrastructure and Services Department of the Governorate and are responsible for the elaboration of the greenhouse gas Inventory and emission Projections.

The VCS is developing and finalizing an MRV framework with clear processes and procedures in order to:

- build on existing foundations, with an emphasis on exploiting existing processes and procedures to form the basis of the MRV framework;
- create easy-to-follow systems that exploit synergies between the various reporting components, ensuring efficiency and consistency;
- define separate roles and responsibilities to simplify the operation of the MRV framework;
- ensure data flows through diversified tools;
- ensure stakeholder involvement from the conception phase of the MRV framework to build trust among stakeholders and encourage seamless data provision, as well as to build the technical capacity to continuously update and improve data;
- gradually implement and continuously improve the MRV framework to meet all ETF requirements.

To ensure the preparation and reporting of the national GHG inventory, the VCS is working on establishing a GHG inventory MRV framework that encompasses all relevant sectors: Energy and IPPU. This should enable the jurisdiction to have complete and accurate information to estimate GHG emissions in all the relevant Intergovernmental Panel on Climate Change (IPCC) sector categories, sub-categories and sources of the national GHG inventory. The VCS will therefore be able to take informed policy decisions at the national level and to communicate to the UNFCCC reliable, transparent, and comprehensive information in the GHG inventory, in order to meet the enhanced reporting requirements under the Paris Agreement.

National coordination and reporting

The Department of Infrastructures and Services (DIS) has been assigned the role of coordination and reporting. The DIS has been designated as the national ETF focal point (ETF NFP) in the VCS. Hence, the GHG Inventory compilation and UNFCCC reporting fall under this Department, which collaborates with the General Secretariat of the Governorate (Legal Office) and the Secretariat of State of the Holy See (Section for Relations with States and International Organizations).

Sectoral data collection and estimation

Sectoral data collection and estimation involves taking charge of gathering data for a specific sector. The objective is to streamline communication with pertinent stakeholders, ease reporting, and assume the responsibility of estimating emissions and removals for the corresponding subsector.

D. Description of a Party's nationally determined contribution under Article 4 of the Paris Agreement, including updates

The VCS submitted its National Determined Contribution (NDC) in May 2023 to the UNFCCC Secretariat. In compliance with the Paris Agreement (Article 3 and Article 4, paragraph 2), which requires each Party to prepare, communicate and maintain successive NDCs that it intends to achieve, the VCS's NDC outlined domestic contributions to the global effort to combat climate change.

By communicating its first NDC, the VCS expressed its intention to reduce greenhouse gases to 20% below 2011 levels by 2030 (the VCS's NDC objectives will be benchmarked using year 2011 data as a baseline).

The indicated reduction target should be achieved by the end of the year 2030, through the adoption of a strategy employing a progressive commitment over the indicated period, involving the following sectors: energy and transport, industrial processes and product use.

The VCS intends to achieve its national emission reduction targets through national measures. However, if domestic reductions prove insufficient to achieve the set objectives, the use of international mechanisms could be considered in the future.

Target(s) and description, including target type(s), as applicable	Absolute economy-wide emission reduction target compared with a base year. By 2030, emissions should be reduced by 20% of the 2011 level.
Target year(s) or period(s), and whether they are single-year or multi-year target(s), as applicable	Vatican City State's NDC is a single-year target, with target year of 2030.
Reference point(s), level(s), baseline(s), base year(s) or starting point(s), and their respective value(s), as applicable	Vatican City State's NDC objectives will be benchmarked using year 2011 data as a baseline.
Time frame(s) and/or periods for implementation, as applicable	The indicated reduction target should be achieved by the end of the year 2030 through the adoption of a strategy employing a progressive commitment over the indicated period.
Scope and coverage, including, as relevant, sectors, categories, activities, sources and sinks, pools and gases, as applicable	- Absolute economy-wide emission reduction target compared with a base year. - Geographical scope: Vatican City State. - Controlled substances: all greenhouse gases not controlled by the Montreal Protocol (CO2, CH4, N2O, HFC). - Sectors involved: energy, and in particular district heating, and transportation, industrial processes and product use, land use and land use change.
Intention to use cooperative approaches that involve the use of ITMOs under Article 6 towards NDCs under Article 4 of the Paris Agreement, as applicable	NA
Any updates or clarifications of previously reported information, as applicable	NA

Table 11: Vatican City State's nationally determined contribution under Article 4 of the Paris Agreement

The VCS's planning processes includes the following sectors: energy (heating gas, gasoline e diesel oil for transport) and IPPU (HFC).

Several environmental management projects have been planned and implemented within the VCS, each carried out in accordance with the guidelines presented in *Laudato Si'*. The

aim of these projects has been to reduce energy consumption, optimize the management of water resources, reduce emissions of substances harmful to global warming and the ozone layer, manage waste production in a sustainable manner, and encourage recovery and recycling.

The principles and guidelines indicated have led and will lead the VCS to the development of additional projects aimed at promoting:

- rational use of natural resources (water and energy);
- energy efficiency and the improvement of the State's technological assets;
- sustainable mobility;
- energy diversification and the supply of less polluting or alternative energy products for motor vehicles;
- waste disposal;
- development of reforestation projects.

It should be noted, nonetheless, that margins for further improvement are minimal when considering the small size of its territory and the fact that VCS has already moved decidedly in the direction of sustainability, encouraging mitigation and increasing its energy efficiency.

Nevertheless, these policies will continue to be developed and implemented in the coming years, with a focus on the coordination of climate-relevant measures within the VCS's current approach to energy, transport and environmental policy in order to:

- address the regulation of energy and environmental factors, increasing energy efficiency, the diversification of sources and the adoption of low environmental impact technologies;
- promote greater education and awareness related to environmental protection and integral ecology;
- encourage global and synergistic action that is both comprehensive and ambitious in favor of the climate;
- accelerate the energy transition.

Although the VCS contributes to global emissions in an insignificant way, it is nonetheless committed to investing in quality emission reduction projects as well as in integral ecology education initiatives, not only to mitigate greenhouse gases emissions, but also to encourage ethical behaviour and generate social benefits.

E. Information necessary to track progress made in implementing and achieving nationally determined contributions under Article 4 of the Paris Agreement

NDC Definitions

The VCS's NDC is economy-wide and covers the sectors of Energy and Industrial process and other use (IPPU). Its emission reduction target is compared with a base year (2011).

Indicators

The VCS uses net GHG emissions as an indicator to track progress towards the implementation and achievement of its NDC. This approach is in line with the NDC being an absolute GHG emissions limitation target.

Indicator	**Description**
Net GHG emissions	
Information for the reference point(s), level(s), baseline(s), base year(s) or starting point(s)	Since the Vatican City State's NDC is an economy-wide absolute GHG emissions limitation target, only the target of reduction to 20% below 2011 level by 2030 shall be used as a reference point to track progress towards the implementation and achievement of its NDC.
Updates in accordance with the GHG inventory, if any	NA
Definitions needed to understand indicator	NA
Relation to NDC	Vatican City State's NDC is a 2030 target for its net emission.
Most recent information	Vatican City State's total GHG emissions in 2022 was 15.89 kt CO_2 eq.

Table 12: Description of selected indicator

Methodologies and Accounting Approaches

The methodological approaches used to estimate and account for anthropogenic greenhouse gas emissions and their abatement employ standard methods. More specifically, VCS's emissions were calculated using the standard methods and procedures employed by the 2006 IPCC Guidelines for National Greenhouse Gas Inventories as adopted by the UNFCCC and using common metrics as agreed upon in the Paris Agreement considering the Global Warming Potential on a 100 timescale in accordance with IPCC's 5th Assessment Report.

Emissions estimates were based on the sectoral approach. Most emissions estimates were derived using Tier 1 methodology provided in the 2006 IPCC Guidelines. Where default conversion and emission factors were used, they were taken from the 2006 IPCC Guidelines as well, unless otherwise stated.

Chapter 2 of this BTR provide further details on the accounting approaches and methodologies.

As such, the VCS's NDC accounting is consistent with Article 4, paragraphs 13 and 14. To the extent possible, in accounting for its emissions, the VCS promoted environmental integrity, transparency, accuracy, completeness, comparability and consistency, and ensure the avoidance of double counting.

Refer to Chapter 3 for the methodologies used to track progress arising from the implementation of policies and measures.

Tracking Progress Towards NDC

The VCS is on track to meeting its 2030 NDC. The indicator of net GHG emissions was 15.95 kt CO_2 eq, 15.38 kt CO_2 eq and 15.89 kt CO_2 eq in 2020, 2021 and 2022 respectively (without LULUCF). The VCS is expected to reduce emissions to around 14.47 kt CO_2 eq in 2030.

F. Mitigation policies and measures, actions and plans, including those with mitigation co-benefits resulting from adaptation actions and economic diversification plans, related to implementing and achieving a nationally determined contribution under Article 4 of the Paris Agreement

Introduction

The VCS has declared, as indicated in its NDC, the intention to reduce emissions in 2030 by approximately 3.5 kt CO_2 eq below 2011 business-as-usual (BAU) levels. The VCS also raised its national climate target to achieve net zero emissions by 2050.

While these are challenging targets given the limited potential of the VCS to develop alternative energy sources that could significantly reduce emissions, the jurisdiction is nonetheless on track to meet its first 2030 NDC.

Over the past 15 years, the VCS has been actively engaging in a variety of strategies, actions and plans to address climate change. These activities have been primarily aligned with the goals and objectives outlined in the jurisdiction's main climate change policies, the VCS's NDC.

Mitigation actions include activities in the transport sector. This is in line with the VCS's NDC sector coverage, which focuses primarily on the energy sector, where the majority of the jurisdiction's current and historical emissions are produced.

The VCS is using Hydrofluorocarbons (HFCs) as substitutes for phasing out Chlorofluorocarbons (CFCs), and, ultimately, hydrochlorofluorocarbons (HCFCs) under the Montreal Protocol. The Holy See, acting in the name and on behalf of the VCS, acceded to the Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer on May 5, 2008, and subsequently ratified the Kigali Amendment, on June 17, 2020. This commitment contributes to emission reductions in the Industrial Processes and Product Use (IPPU) sector by utilising HFCs as substitutes for ozone-depleting substances.

Vatican City State's Approach to Reducing Emissions

Energy is a strategic resource for the VCS that is completely reliant on the import of electric energy and gas for its energy needs.

Since 2021, the VCS has taken steps to use cleaner fuel for thermal plant and district heating, switching completely from fuel oil to natural gas.

To further reduce emissions, the VCS is pursuing sustainable mobility through the installation of electric car charging stations and the transition to a more ecological fleet.

Methodologies

The VCS's emissions projections were developed with sector-specific methodologies. Each of the sectors' projections included projections by gas. As such, the methodologies for the VCS's emissions projections by gas are covered within each sectors' individual projections methodologies, detailed in this section.

Measures to Reduce Emissions

Measure 1 – Banning of gasoil for heating

The VCS has opted to operate its multi-fuel plants exclusively with natural gas, abandoning the use of gasoil.

In calculating the effect of banning gasoil for heating, and in the absence of any additional energy-saving measures, the presumption is that consumption of gasoil fuel for heating would have been constant for the entire period considered [2022 – 2030] and equal to the "average" recorded consumption in the past. Hence, the effect of implementing the switch from gasoil to natural gas remains constant from 2022 to 2030. In this projection, the quantity of energy produced by gasoil has been replaced by an equal quantity of energy produced by natural gas.

In the following table, the difference in CO_2 eq emissions has been calculated considering the values of the emission factors for heating gasoil and natural gas, taking into account the average consumption of gasoil during the period 2011-2019.

The value of this difference is approximately 0.04 $ktCO_2$ eq.

gasoil (l)	density	gasoil (kg)	gasoil (t)	NCV			CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	
l	kg/l	kg	t	GJ/t	GJ	TJ	t/TJ	kg/GJ	kg/GJ	kt	kt	kt	kt CO_2eq
68,874.22	0.8377	57.695,94	57.70	42.827	2.470,918	2.470918	73.769	0.007	0.002	0.182277	0.0000173	0.000005	0.184071
natural gas						2.470918	57.713	0.0025	0.0010	0.142603	0.0000000	0.000000	0.142603
Difference in emissions between gasoil and natural gas for the same amount of energy produced (kt CO_2 eq)													
										0.039674			**0.041468**

Table 13: Avoided emissions by gasoil/natural gas conversion

For the projections of natural gas consumption used in thermal power plants and for residential use in the following years 2025, 2030, 2035 and 2040, an average of consumption for the period [2011 – 2023] has been considered, assuming no change in the number of thermal consumers and no substantial changes in technology.

Measure 2 – Shifting Travel Demand to Low-Emission Modes and Reducing Vehicular Emissions through the installation of electric charging stations

The VCS is working on adoption of green vehicles with the aim to reduce or phase out pure internal combustion engine (ICE) vehicles and have all vehicles of its fleet running on cleaner energy. The VCS is introducing policies and initiatives to encourage the adoption of electric vehicles (EVs) with the installation of several charging points (ECP) throughout the territory by 2030 in tandem with EV adoption.

The mitigation measures in the transport sector are projected to achieve 0.44, 1.55 and 3.45 kt of CO_2 eq abatement, respectively, in 2025, 2030, 2035 and 2040 compared to 2022.

Since the VCS is surrounded by Italian territory, the forecast data for 2025, 2030 and 2040 were determined, using the same hypotheses and assumptions as the Italian BTR.

For the calculation of GHG emission projections, the variation coefficients of Italy have been used.

This approach has been applied also to the biomass fraction contained in automotive fuels.

Period	Gasoline	Diesel oil
2025 – 2022	0.8923	1.0298
2030 – 2022	0.8922	0.8315
2035 – 2022	0.5855	0.8422
2040 – 2022	0.6272	0.7608

Table 14: Year based variation factor of automotive fuel consumption

The installation in the VCS of electric charging stations expected by 2030 is an endogenous factor that will support policies for accelerating the ecological transition in the automotive sector.

The following table calculates the reduction of CO_2 eq emissions associated with the installation and activation by 2030 of N. 60 electric charging stations under the following assumptions:

- medium cars
- km travelled per year = 8,568.74
- single charging time = 3 hours
- N vehicles/day = recharges/charging column = 12 hours/3 hours = 4
- GHG g/v km 2022 (Italy's Inventory) = 156

In absence of this measure, considering a business-as-usual (BAU) scenario, transport sector's GHG emissions in 2030 would be 9.70 + 0.32 = 10.02 ktCO_2 eq.

The reduction due to the measure contributes to the overall reduction of transport emissions. Therefore, the 0.32 kt CO_2 eq are already included in the difference between the WAM (With Additional Measures) and WM (With Measures) scenarios.

1.A.3.b.i-iv Road Transport Appendix 4 Emission Factors 2022			[km/year]	Charging duration [h]	auto/day	GHG g/v km 2022 (Italy's Inventory)	GHG g /ECP year	Number of ECP	GHG t/year fully operational in 2030
Passenger Cars	Petrol PHEV ~ Electricity	Medium	8,568.74	3	4	156	5,333,695.31	60	320.02

Table 15: Projection of reducing GHG emissions due to the installation of electric car charging stations

Measure 3 – Reducing GHG emissions from the use of refrigerants in RAC sector (adherence to the Kigali Amendment)

The VCS has implemented a series of measures to reduce the emissions arising from the use of hydrofluorocarbons (HFCs) in the refrigeration and air-conditioning (RAC) sector.

In 2020, with the ratification of the Kigali Amendment to the Montreal Protocol, the VCS put in place global warming potential (GWP) limits to phase out RAC equipment that use high-GWP refrigerants.

The VCS also intends to provide training courses for household air-conditioner and refrigeration technicians. The training and certification scheme aims to raise competencies within the industry on the proper handling of refrigerants during installation, maintenance and decommissioning of RAC equipment.

E-waste recyclers, which take in household RAC equipment for recycling, are prohibited from venting spent refrigerants and have to properly collect and treat spent refrigerants from decommissioned RAC equipment.

Since the VCS is subject to the Italian market trends for refrigerant gases, the forecast data for 2025, 2030, 2035 and 2040 were determined using the projections and assumptions used in the Italian BTR.

For the year 2022, the four pure refrigerant gases used in the VCS (R125, R134a, R32, R143A) were examined and, for each of them, the weighted average was calculated, considering their percentages in the mixture of origin (HFCs), obtaining the weight of imported product [t].

The simplified assumption is made that the amount of gas imported in the reference year is equivalent to the losses found on the plants in the same year. In future BTRs, an attempt will be made to employ a more accurate methodology (TIER1) to calculate emission reductions in the RAC sector.

The overall variation factor for individual years (2025, 2030, 2040) is the weighted average of the individual reduction factors, assuming the weight of the 4 gases in terms of quantity and GWP.

In the calculation of the GHG emission projections, the reduction factors of Italy were used, considering the constraints imposed by the Kigali Amendment.

	2022	2025	2030	2035	2040
Total ODS in kt CO_2 eq. (without HFO, Hydrocarbons, CO_2)	1.0	0.7	0.29	0.19	0.16

Table 16: Reduction factors for HFCs per year

With this measure, in 2030 the reduction in GHG emissions in the RAC sector is equal to approximately 0.34 ktCO_2 eq.

Without this measure and considering a 2030 business-as-usual (BAU) scenario, GHG emissions are increased by 8.3%, a value obtained by comparing the ISPRA (Italian Higher Institute for Environmental Protection and Research) scenarios with the adoption of the latest F-gas Regulation and the previous one based on the 2016 Regulation.

The difference between emissions WAM and WM is approximately 0.03 ktCO_2 eq.

List of Mitigation Measures

The following summary tables present information that tracks progress on the VCS's NDC contributions.

	Most recent year in the Party's national inventory report	Projections of GHG emissions and removals			
	(kt CO_2 eq)[c]	(kt CO_2 eq)[c]			
	2022	2025	2030	2035	2040
Sector[d]					
Energy	3.46	4.43	4.43	4.43	4.43
Transport	11.25	10.81	9.70	8.02	7.80
Industrial processes and product use	1.18	0.82	0.34	0.22	0.19
Agriculture	NO	NO	NO	NO	NO
Forestry/LULUCF	NO	NO	NO	NO	NO
Waste management/waste	NO	NO	NO	NO	NO
Other (specify)					
Gas					
CO_2 emissions including net CO_2 from LULUCF	14.60	15.14	14.04	12.38	12.16
CO_2 emissions excluding net CO_2 from LULUCF	14.60	15.14	14.04	12.38	12.16
CH_4 emissions including CH_4 from LULUCF	0.03	0.03	0.03	0.02	0.02
CH_4 emissions excluding CH_4 from LULUCF	0.03	0.03	0.03	0.02	0.02
N_2O emissions including N_2O from LULUCF	0.08	0.08	0.06	0.06	0.06
N_2O emissions excluding N_2O from LULUCF	0.08	0.08	0.06	0.06	0.06
HFCs	1.18	0.82	0.34	0.22	0.19
PFCs	NO	NO	NO	NO	NO
SF_6	NO	NO	NO	NO	NO
NF_3	NO	NO	NO	NO	NO
Other (specify)					
Total with LULUCF	15.89	16.06	14.47	12.68	12.42
Total without LULUCF	15.89	16.06	14.47	12.68	12.42

Table 17: Information on projections of greenhouse gas emissions and removals under a 'with measures' scenario [a, b]

[a] Each Party shall report projections pursuant to paras. 93–101 of the MPGs; those developing country Parties that need flexibility in the light of their capacities are instead encouraged to report such projections (para. 92 of the MPGs).

[b] Those developing country Parties that need flexibility in the light of their capacities with respect paras. 93–101 of the MPGs can instead report using a less detailed methodology or coverage (para. 102 of the MPGs).

[c] Projections shall begin from the most recent year in the Party's national report and extend at least 15 years beyond the next year ending in zero or five; those developing country Parties that need flexibility in the light of their capacities with respect to this provision have the flexibility to instead extend their projections at least to the end point of their NDC under Article 4 of the Paris Agreement (para. 95 of the MPGs).

[d] In accordance with para. 82(f) of the MPGs.

Mitigation Action	Description	Objectives	Type of instrument	Status	Sector(s) affected	Gases affected	Start year of implementation	Implementing entity or entities	Progress Indicators	Methodologies and Assumptions	Estimates of GHG emission reductions as of 2022 (kt CO_2 eq)	2030 Abatement Target (kt CO_2 eq)
Banning of gasoil for heating	Operating the multi-fuel plants with natural gas, abandoning the use of gasoil	To increase the amount of natural gas in the operation of heating systems	Infrastructure	Adopted	Energy	CO_2 CH_4 N_2O	2021	DIS of the VCS's Governorate	NA	The carbon abatement achieved by this measure is based on the difference between emission factors of the natural gas and the gasoil for the same amount of energy generated	0.04	0.04

Table 18: Banning of gasoil for heating

Mitigation Action	Description	Objectives	Type of instrument	Status	Sector(s) affected	Gases affected	Start year of implementation	Progress Indicators	Methodologies and Assumptions	Estimates of GHG emission reductions as of 2022 (kt CO_2 eq)	2030 Abatement Target (kt CO_2 eq)
Installation of electric charging stations	Reducing Vehicular Emissions through the sustainable mobility (EVs)	Replacing the current Internal Combustion Engine (ICE) fleet with cleaner energy cars	Infrastructure	Ongoing	Transport	CO_2 CH_4 N_2O	2024	Cleaner energy fleet take-up rate	Mitigation effect is calculated based on the number of electric charging stations and the difference between the average carbon emissions of a normal ICE cars and those of a cleaner energy cars	-	0.32
Electrification of light duty vehicles	Implementing schemes that limit the number of ICE light duty vehicles and rolling out various initiatives that encourage take up of electric vehicles (EVs)	To encourage take up of electric light duty vehicles which release less emissions than are more energy efficient over ICE vehicles	Infrastructure	Ongoing	Transport	CO_2 CH_4 N_2O	2024	Electric light duty vehicle take-up rate	Mitigation effect is calculated based on the number of electric vehicles EVs and the difference between the average carbon emissions of a normal car and those of an electric vehicle EV		

Table 19: Shifting Travel Demand to Low- Emission Modes and Reducing Vehicular Emissions through the installation of electric charging stations

Mitigation Action	Description	Objectives	Type of instrument	Status	Sector(s) affected	Gases affected	Start year of implementation	Implementing entity or entities	Progress Indicators	Methodologies and Assumptions	Estimates of GHG emission reductions as of 2022 (kt CO_2 eq)	2030 Abatement Target (kt CO_2 eq)
Reducing RAC emissions through the use of low-GWP refrigerants	To encourage improvements from the RAC sector	To phase out RAC equipment that use high-GWP refrigerants	Infrastructure	Ongoing	IPPU	HFCs	2020 (adherence to the Kigali Amendment)	DIS of the VCS's Governorate	HFCs import data	The abatement is calculated by the difference between the BAU emission values and the emission values after Amendment has been implemented	-	0.03

Table 20: Reducing GHG emissions from the use of refrigerants in RAC sector (ratification of Kigali Amendment)

G. Projections of greenhouse gas emissions and removals

Overview

The VCS projected its emissions under a ‘with measures’ scenario for 2025, 2030 and 2040.

The VCS’s 2030 emissions are projected to be reduced by least of 25% compared with 2011 levels, which is in line with its 2030 NDC.

The VCS is currently developing capabilities to project and report emissions across the indicated timeframe. These capabilities are being developed on a sectoral basis in order to ensure greater confidence in the projections reported.

The VCS’s emissions projections are reported on a sectoral basis as well as by gas (Energy, Transport and IPPU).

Should there be changes to the sectors covered in future BTRs, the sectoral projections will be updated to align with those changes as well.

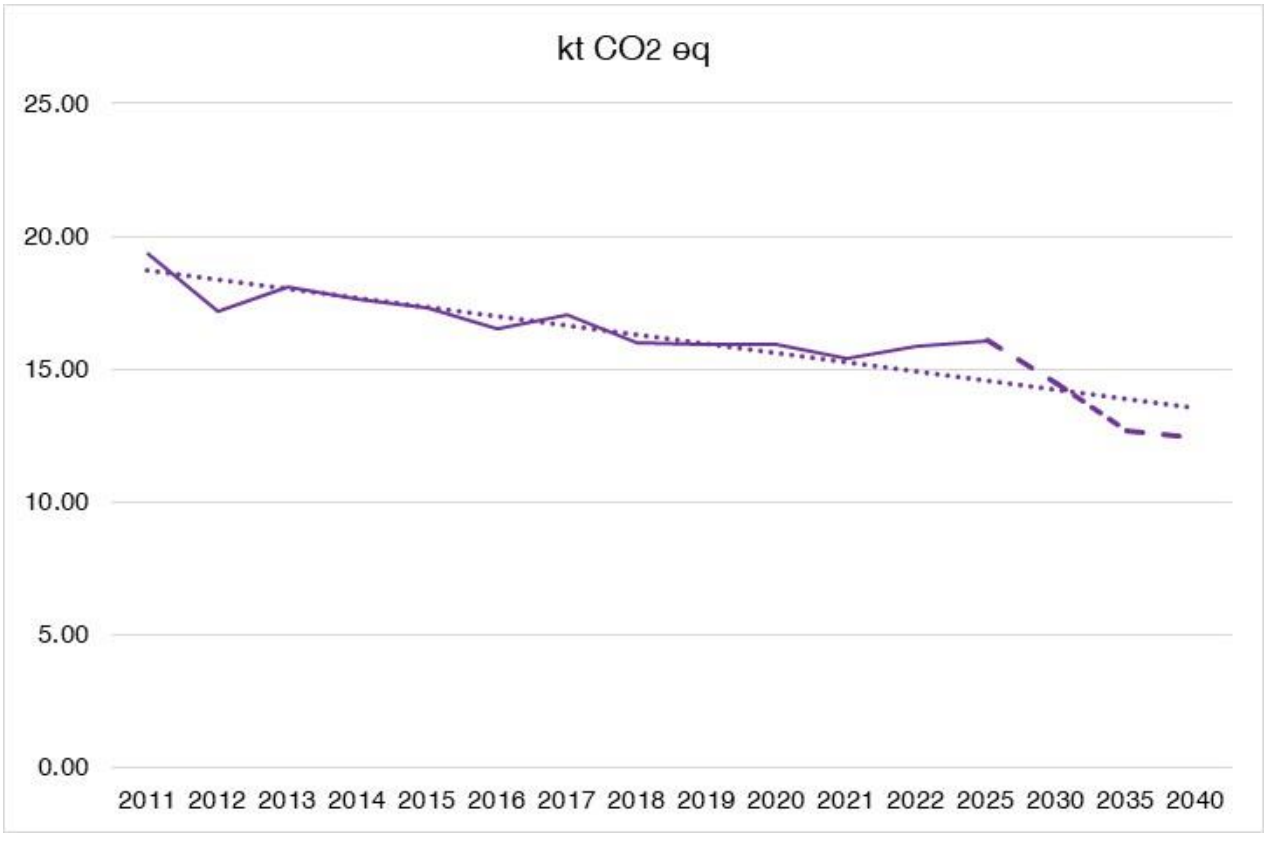
As the VCS’s indicator to track its progress towards its NDC is net GHG emissions and removals, the projection of its total emissions can also be taken as a projection of its indicator.

Overall Projected Emissions

The VCS’s overall emissions in 2022 were 15.89 kt CO_2 eq without LULUCF. Under a ‘with measures’ scenario, the VCS’s projected 2025 emissions are estimated to be 16.06 kt CO_2 eq, which is 1.08% higher than 2022. The VCS projects that its emissions would reduce at around 14.47 kt CO_2 eq in 2030 before reaching 12.68 kt CO_2 eq and 12.42 kt CO_2 eq in 2035 and 2040, respectively.

	2011	2012	2013	2014	2015	2016	2017	2018
Total	19.33	17.20	18.08	17.65	17.30	16.50	17.04	16.03
Energy	5.09	4.21	4.92	4.29	4.95	4.58	4.67	4.35
Transport	12.60	12.99	12.17	11.53	11.23	10.73	10.77	10.45
IPPU	1.63	0.00	0.98	1.83	1.12	1.19	1.60	1.22
	2019	**2020**	**2021**	**2022**	**2025**	**2030**	**2035**	**2040**
Total	15.90	15.95	15.38	15.89	16.06	14.47	12.68	12.42
Energy	4.56	4.61	4.93	3.46	4.43	4.43	4.43	4.43
Transport	10.35	8.13	9.64	11.25	10.81	9.70	8.02	7.80
IPPU	0.98	3.22	0.82	1.18	0.82	0.34	0.22	0.19

Table 21: Overall projected emissions (kt CO2 eq)



Graph 8: Projections of Vatican City State's overall emissions

Projected Emissions by Sector

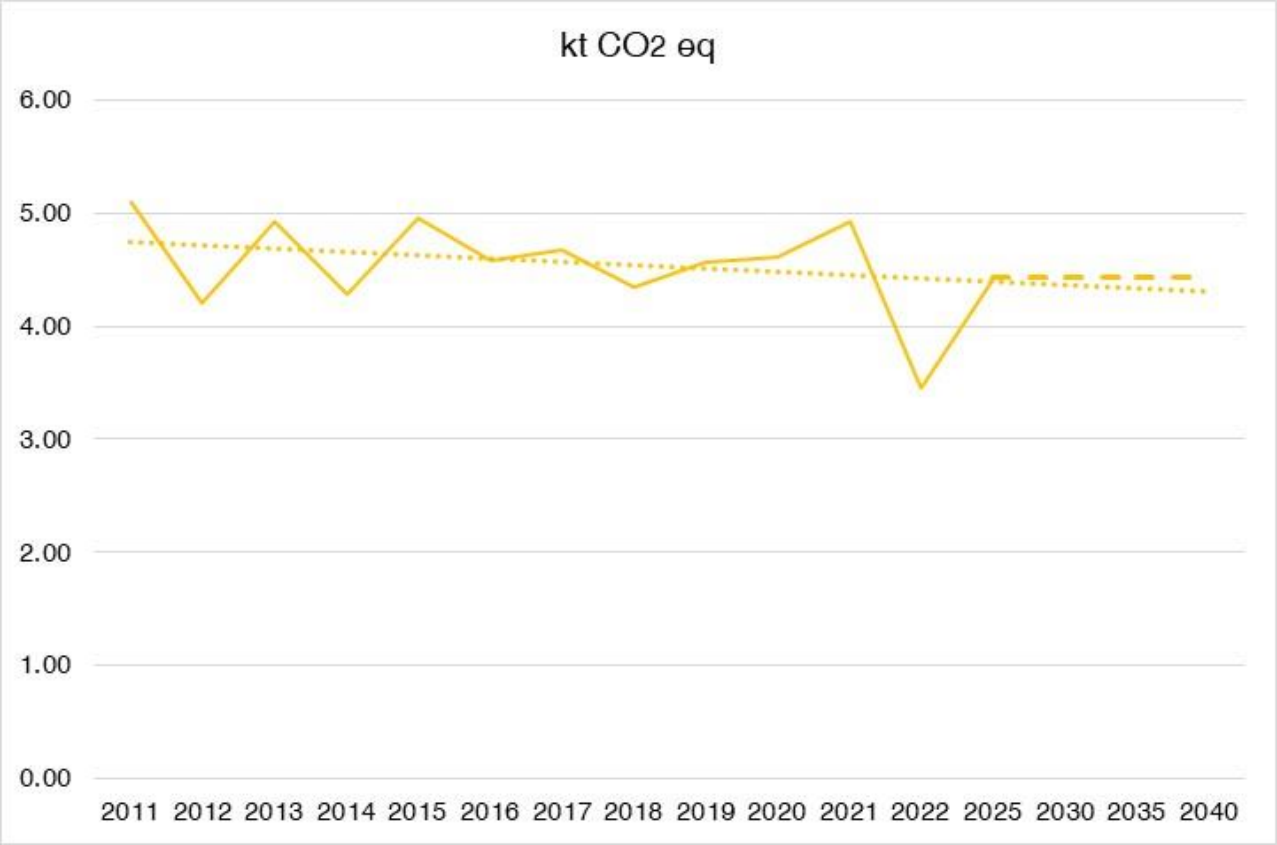
The projections in this section cover three sectors: Energy, Transport and IPPU.

Energy

The VCS's Energy sector emissions in 2022 were 3.46 kt CO_2 eq while the same emissions are estimated to be 4.43 kt CO_2 eq in the following years 2025, 2030, 2035 and 2040, i.e. 28.03% higher than 2022, assuming no change in the number of thermal consumers and no substantial changes in technology (district heating).

	2011	2012	2013	2014	2015	2016	2017	2018
Energy	5.09	4.21	4.92	4.29	4.95	4.58	4.67	4.35
	2019	**2020**	**2021**	**2022**	**2025**	**2030**	**2035**	**2040**
Energy	4.56	4.61	4.93	3.46	4.43	4.43	4.43	4.43

Table 22: Projected emissions from Energy sector (without measures)



Graph 9: Projected emissions from Energy sector (without measures)

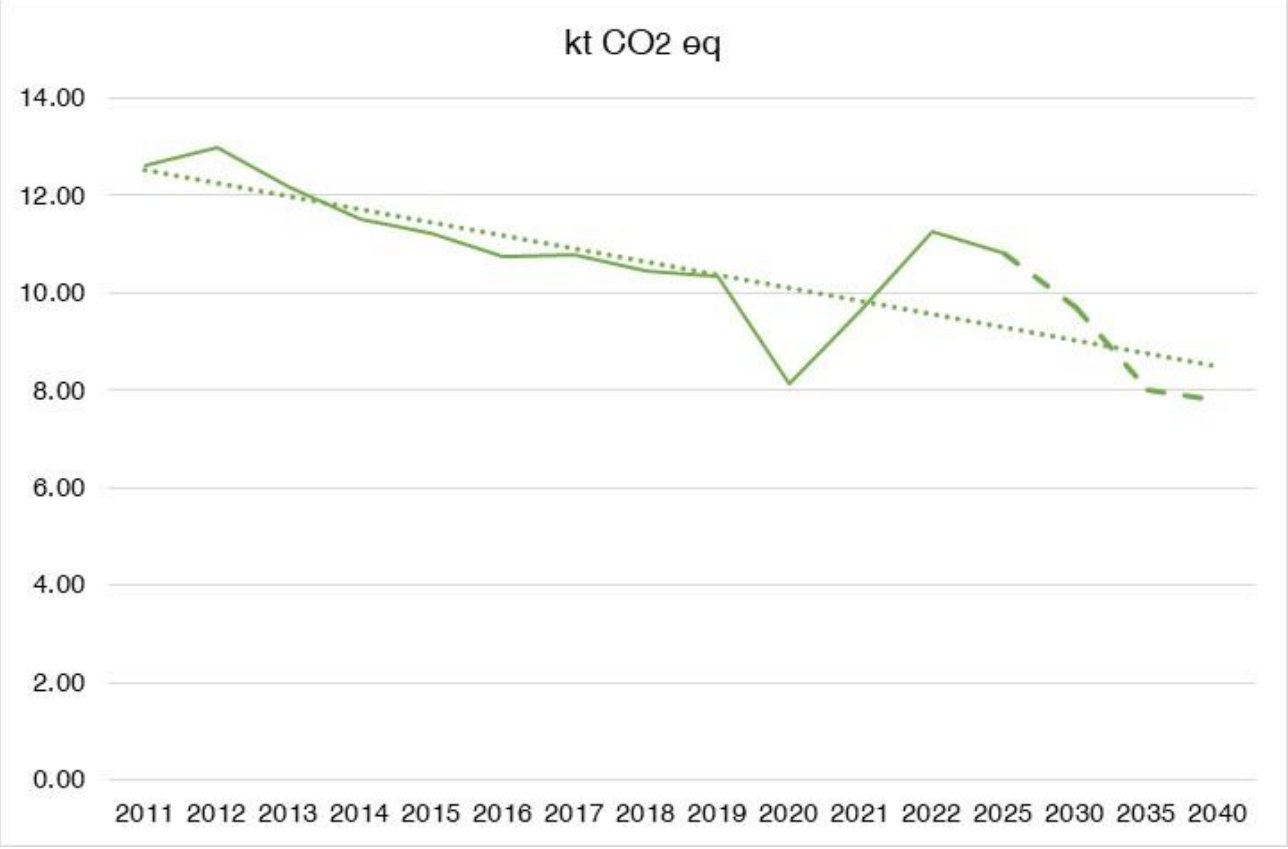
Transport

The VCS's Transport sector emissions in 2022 were 11.25 kt CO_2 eq.

Under a 'with measures' scenario, the VCS's projected 2025 Transport sector emissions are estimated to be 10.81 kt CO2 eq, i.e. 3.91% lower than 2022. Estimated emissions in the transport sector for 2030, 2035 and 2040 are 9.70 kt CO_2 eq, 8.02 kt CO_2 eq and 7.80 kt CO_2 eq, respectively.

	2011	2012	2013	2014	2015	2016	2017	2018
Transport	12.60	12.99	12.17	11.53	11.23	10.73	10.77	10.45
	2019	**2020**	**2021**	**2022**	**2025**	**2030**	**2035**	**2040**
Transport	10.35	8.13	9.64	11.25	10.81	9.70	8.02	7.80

Table 23: Projected emissions from Transport sector (with measures)



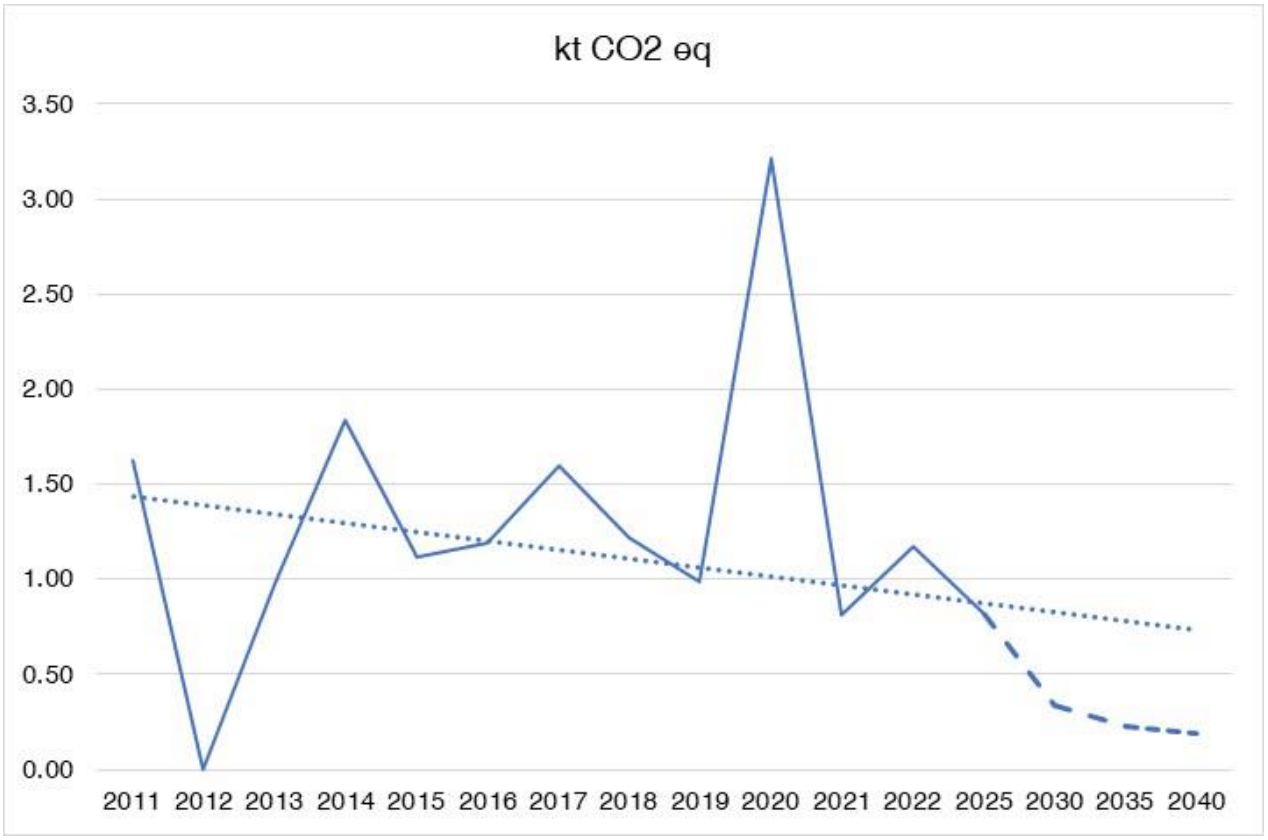
Graph 10: Projected emissions from Transport sector (with measures)

IPPU

The VCS's IPPU sector (RAC sector) emissions in 2022 were 1.18 kt CO_2 eq. Under a 'with measures' scenario, the VCS's projected 2025 IPPU sector emissions are estimated to be 0.82 kt CO_2 eq, i.e. 30.51% lower than 2022. Estimated emissions in the IPPU sector for 2030, 2035 and 2040 are 0.34 kt CO_2 eq, 0.22 kt CO_2 eq and 0.19 kt CO_2 eq, respectively.

	2011	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
IPPU	1.63	0.00	0.98	1.83	1.12	1.19	1.60	1.22
	2019	**2020**	**2021**	**2022**	**2025**	**2030**	**2035**	**2040**
IPPU	0.98	3.22	0.82	1.18	0.82	0.34	0.22	0.19

Table 24: Projected emissions from IPPU sector (with measures)



Graph 11: Projected emissions from IPPU sector (with measures)

Projected Emissions by Gas

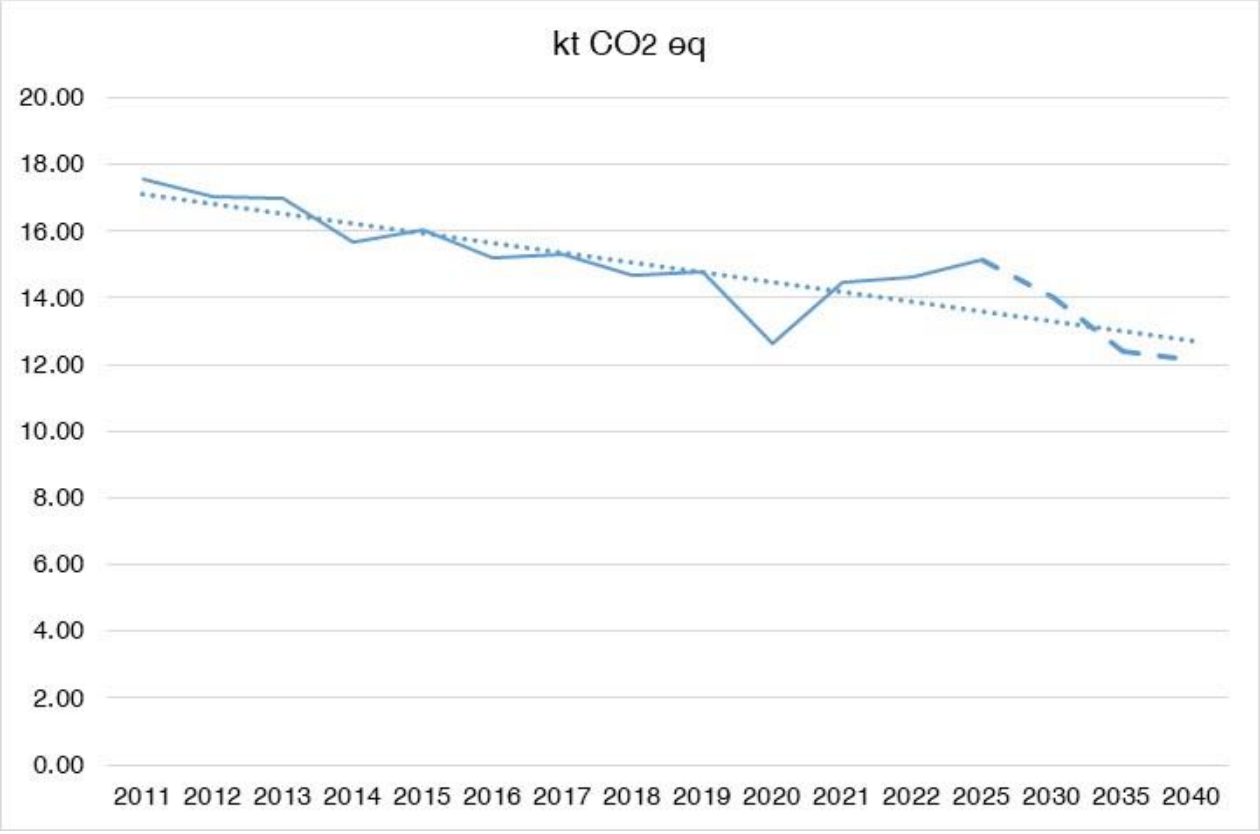
The projections in this section cover the four gases CO_2, CH_4, N_2O and HFCs.

CO_2

The VCS's CO_2 emissions in 2022 were 14.60 kt CO_2 eq. Under a 'with measures' scenario, the VCS's projected 2025 CO_2 emissions are estimated to be 15.14 kt CO_2 eq, i.e. 3.7% higher than 2022. CO_2 emissions in 2030, 2035 and 2040 are estimated to be 14.04 kt CO_2 eq, 12.38 kt CO_2 eq and 12.16 kt CO2 eq, respectively.

	2011	2012	2013	2014	2015	2016	2017	2018
CO_2	17.56	17.06	16.96	15.69	16.06	15.19	15.33	14.70
	2019	**2020**	**2021**	**2022**	**2025**	**2030**	**2035**	**2040**
CO_2	14.81	12.65	14.47	14.60	15.14	14.04	12.38	12.16

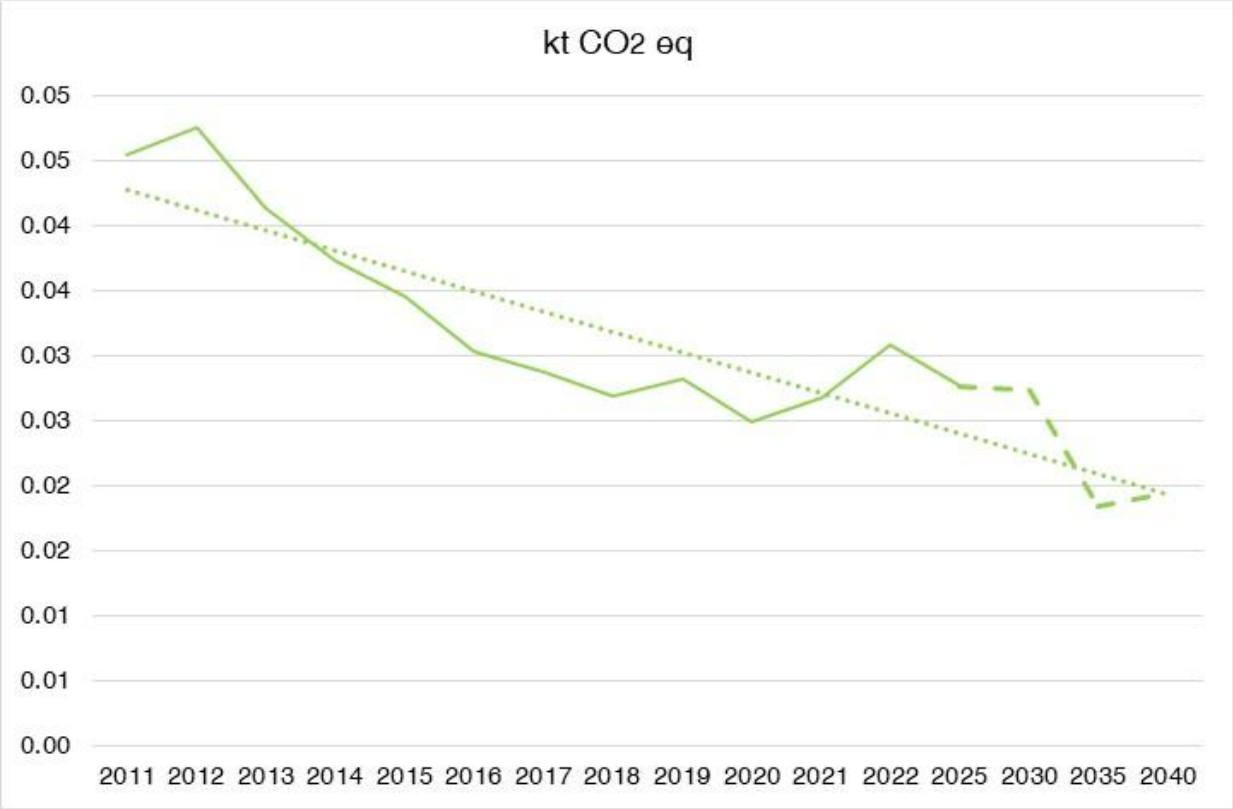
Table 25: Projected CO2 emissions (with measures)



Graph 12 : Projected CO2 emissions (with measures)

CH_4

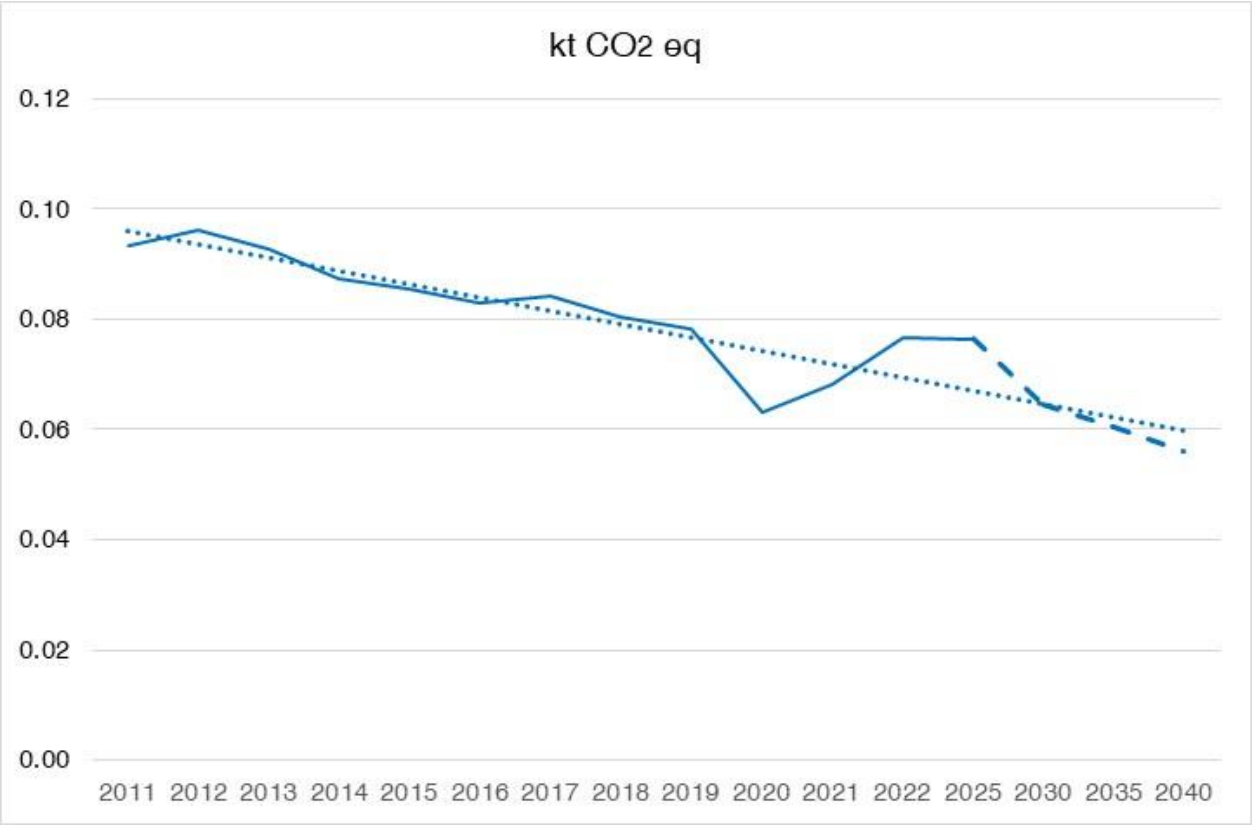
The VCS's CH_4 emissions in 2022 were 0.0307 kt CO2 eq. Under a 'with measures' scenario, the VCS's projected 2025 CH_4 emissions are estimated to be around 0.0276 kt CO_2 eq, i.e. 10.1% lower than 2022. CH_4 emissions in 2030, 2035 and 2040 are estimated to be 0.0274 kt CO_2 eq, 0.0183 kt CO_2 eq and 0.0194 kt CO_2 eq, respectively.



Graph 13: Projected CH4 emissions (with measures)

N_2O

The VCS's N_2O emissions in 2022 were 0.0766 kt CO_2 eq. Under a 'with measures' scenario, the VCS's projected 2025 N_2O emissions are estimated to be 0.0764 kt CO_2 eq, i.e. 0.26% lower than 2022. N_2O emissions in 2030, 2035 and 2040 are estimated to be 0.0645 kt CO_2 eq, 0.0603 kt CO_2 eq and 0.0559 kt CO_2 eq, respectively.



Graph 14: Projected N2O emissions (with measures)

HFCs

The VCS's HFCs emissions in 2022 were 1.18 kt CO_2 eq. Under a 'with measures' scenario, the VCS 's projected 2025 HFCs emissions are estimated to be 0.82 kt CO_2 eq, which is 30.5% lower than 2022. HFCs emissions in 2030, 2035 and 2040 are estimated to be 0.34 kt CO_2 eq, 0.22 kt CO_2 eq and 0.19 kt CO_2 eq, respectively (Table 24 and Graph 11).

ANNEX TO FIRST BIENNIAL TRANSPARENCY REPORT

Annex I

Common reporting tables of the national inventory report of anthropogenic emissions by sources and removals by sinks of greenhouse gases

The common reporting tables (CRTs) will be reported electronically.

VAT-CRT-2024-V0.2-20241218-150748_awaiting approval (zip file – xlsx file)

VAT-CRT-2024-V1-0-DataEntry-20241218-151108 (json file)

Annex II

Common tabular formats

This section covers the information necessary to track progress in implementing and achieving nationally determined contributions under Article 4 of the Paris Agreement.

Similar to the common reporting tables the Common Tabular Formats (CTFs) will be reported electronically.

VAT-CTF-NDC-2024-V0.1-20241218-144701_started (xlsx file)

VAT-CTF-NDC-2024-V1-0-DataEntry-20241218-145038 (json file)

GLOSSARY

BAU Business-As-Usual
BTR Biennial Transparency Report
CH_4 Methane
CO_2 Carbon Dioxide
CO_2 eq Carbon Dioxide Equivalent
DIS Infrastructures and Services Department
ECP Electric Charging Point
ETF Enhanced Transparency Framework
EVs Electric Vehicles
Gg Gigagram
GHG Greenhouse Gas
GWP Global Warming Potentials
HFCs Hydrofluorocarbons
ICE Internal Combustion Engine
IPCC Intergovernmental Panel on Climate Change
IPPU Industrial Processes and Product Use
ISPRA Itaian Higher Institute for Environmental Protection and Research
kg Kilogram
kt Kilotonne
LULUCF Land Use, Land-Use Change and Forestry
MASE Italian Ministry of the Environment and Energy Security
MPGs Modalities, Procedures, and Guidelines
MRV Measurement, Reporting and Verification
N_2O Nitrous Oxide
NC National Communication
NDC Nationally Determined Contribution
NCV Net Calorific Value
NOx Nitrogen Oxides
PFCs Perfluorocarbons
QA Quality Assurance
QC Quality Control
RAC Refrigeration and Air Conditioning
SF_6 Sulphur Hexafluoride
SO_2 Sulphur Dioxide
tCO_2 eq Tonne of Carbon Dioxide Equivalent
UNFCCC United Nations Framework Convention on Climate Change
VCS Vatican City State