HELLENIC REPUBLIC
MINISTRY OF HEALTH
GENERAL HOSPITAL OF SYROS "VARDAKEIO & PROIO"

General Hospital of Syros "Vardakeio & Proio"

Carbon Management Programme

Carbon Management Plan (CMP)

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EXECUTIVE SUMMARY

As a Public Hospital, we recognize the need to reduce our carbon emissions. Such emissions have, for long, contributed to climate change to a great extent so as to refer to 'climate crisis'. The global consequences, which are already visible for mankind, are: increased average temperatures, severe and more frequent floods, geographically extended droughts and seasonal variations. Locally, we experience milder winters, droughts and hot summers. Climate crisis results in direct health impacts such as allergies, skin cancer and respiratory problems.

Reducing our Hospital's carbon emissions will help minimize the climate crisis. National drivers, such as government targets, as well as global drivers and collaborations (e.g. the Global Green and Healthy Hospitals - GGHH - network), encourage us to manage our carbon emissions.

Our aim

Our vision is to provide high quality healthcare services in an environmentally sustainable manner, through effective use of resources and climate alliances' forming. Our institution will become a Regional Leader in the provision of low carbon health services.

To achieve this vision, we will need to focus on five strategic options:

1. *Self-awareness:* We will collect all carbon emissions related data and create a data centre. We will form a Carbon Management Team. We will identify all potential emissions' sources and try to prioritize the required measures to minimize effects. All of this is necessary to implement our Carbon Management Plan.
2. *Tackle emissions:* We will invest in improvement opportunities in existing buildings and operations. We will consider measures for energy consumption reduction, minimization of water usage and better waste management.
3. *Maximising environmental performance:* We will install carbon reduction measures in existing and new buildings. We will consider such solutions in all new tender processes and procurements.
4. *Form alliances:* We will work collaboratively with local, national and global partners to decrease our operation's environmental impact. It is necessary to improve public health.

5. *Social awareness:* We will communicate our CMP to staff, residents and visitors of Syros and our partners. Then, we will evaluate progress midterm and long term.

We have set an ambitious carbon reduction target:

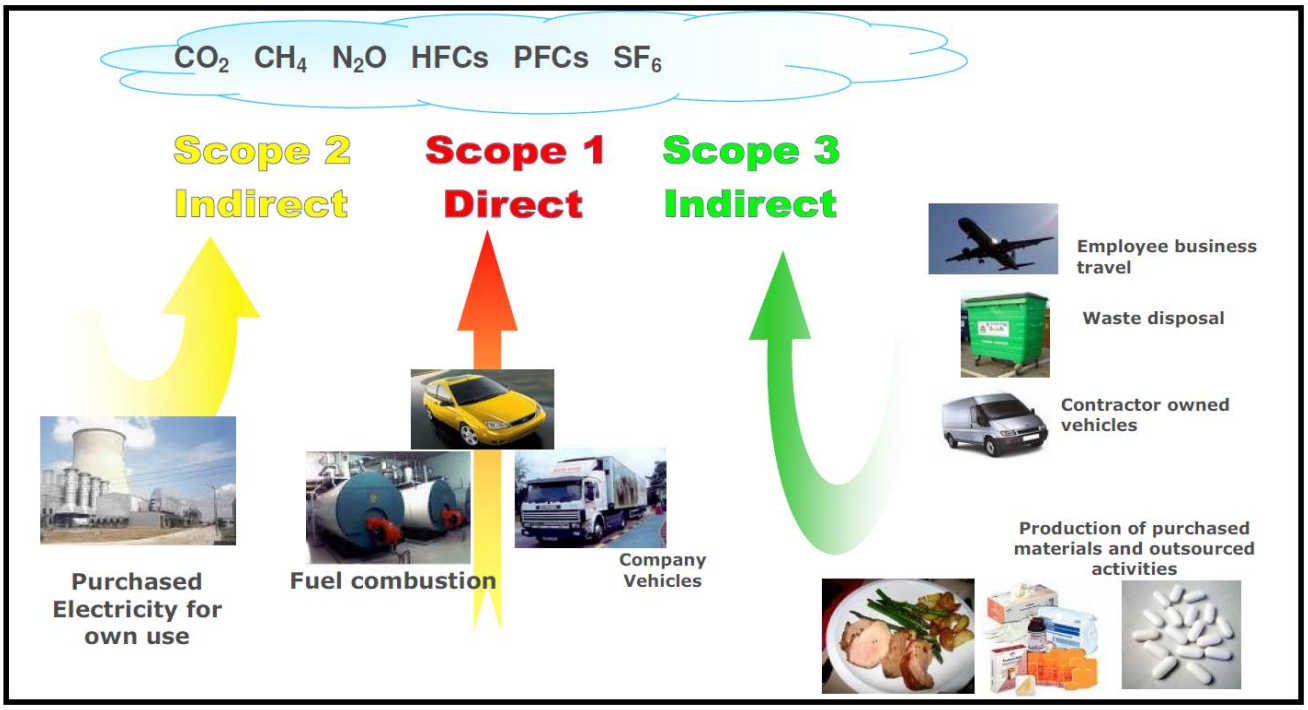
The General Hospital of Syros PCT will reduce the CO_2e emissions from our activities by at least **33%** for scopes 1+2, and **19%** for scope 3, compared to the **2019** baseline, by **2030**.

Alongside this, we aim to:

- *be a leader in carbon management in healthcare*
- *contribute to the Race to Zero Initiative*
- *become a zero emissions Hospital by 2050.*

Our carbon footprint

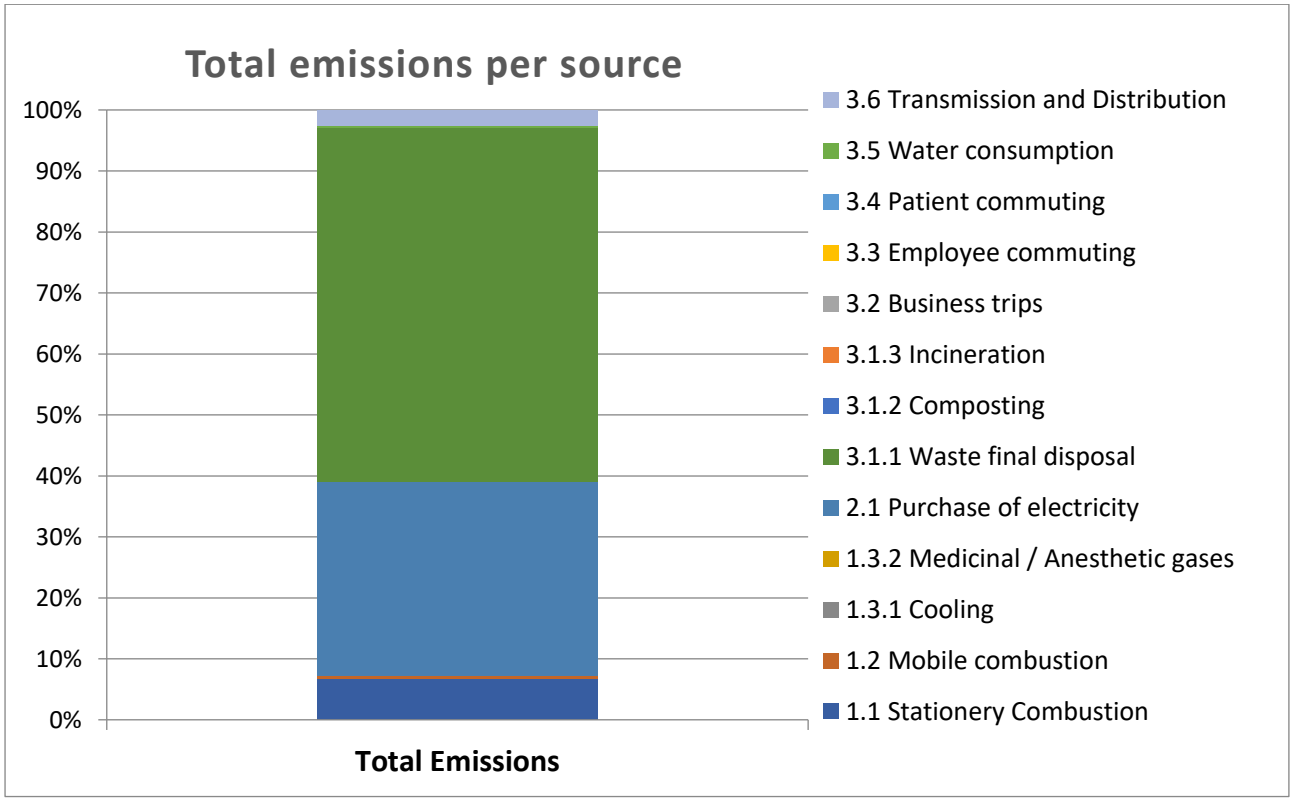
The first step in reducing carbon emissions is to measure our current emissions. The majority of our carbon emissions production activities are shown below:



It is not currently possible to develop data collection mechanisms for all the activities above, so we have limited the scope of our carbon footprint to energy consumption in buildings, waste generation, water consumption, gas consumption, refrigerant and anaesthetic gases. We have excluded procurement, business travel, public transport and staff/patient commuting.

We are committed to increasing the scope by including business travel, staff and patient commuting, in future years. Procurement is likely to account for a large proportion of our carbon footprint. Gradually, we will develop policies to reduce our procurement emissions.

Our carbon footprint for 2019, our baseline year, was **2,087.96 tonnes** of CO_2e. The graph below illustrates the components of our footprint in terms of carbon dioxide equivalent emissions. Waste is the major source of our emissions.



We commit to collecting all relevant data on a yearly basis, calculating our emissions and monitoring their variation over time. We are dedicated to implementing strategic emissions reduction projects.

Our carbon reduction projects

We have identified carbon reduction projects to achieve our reduction target by 33% for scopes 1+2, and by 19% for scope 3:

A. Feasibility study for energy efficiency

Funded by European Framework Incentive, a €60,000 feasibility study will be completed in October 2021. This study has identified all potential emissions sources. Furthermore, solutions will be suggested to the Executive Board.

B. Energy efficiency upgrade project

With a €3,200,000 secured investment cost and funded by European Framework Incentive, an overall energy efficiency project will commence in 2022. This will include: PV cells installation on the Hospital's roof, the replacement of all cooling generators, the replacement of heaters, the total replacement of lamps with LEDs and automation systems, the installation of thermal/hydro insulation, the replacement of window glazing and frames etc.

C. Participation in global climate alliances

The Hospital was admitted to the GGHH in 2020. In 2021, we were recognized as founding members of UNFCCC's Race to Zero Incentive.

D. Overall replacement of IT equipment

A €1,600,000 investment, from European and National funds, has been completed in 2021 to renew all IT equipment in the Hospital etc.

E. Zero paper use policy

Upon the completion of project D, we established a Hospital "zero paper use" policy within the establishment. All examinations are ordered, treated and sent electronically, all documents are circulated electronically etc.

F. Awareness

We have started collecting relevant data and exploring new possibilities to manage them.

G. Recognition

GGHH has awarded us the Silver Climate Resilience Award for 2020. The Ministry of Health of the Hellenic Republic has declared us as a '... novel digital Hospital'.

Our financial plan

Following a 12-year austerity period, in Greece, we have limited self-investment opportunities. To tackle this challenge, we participate in all major European Funded programmes to fulfil our initiatives. Once the energy efficiency project is completed, in 2023, we will be able to deliver monetary target allocations to our goals.

Our plans for embedding carbon management

To ensure we meet our carbon reduction target, it is essential that we include carbon management in the daily operation of our Hospital. We will achieve this by updating our policies to ensure they reflect our carbon reduction goal. We will make carbon management an integral part of the daily professional routine for our staff. We will continue to manage our data effectively and to organize it so that we can easily update our carbon footprint. We will develop training and communication policies, so as to raise awareness of our carbon management programme and to further encourage staff's involvement. Finally, we will monitor our progress regularly to ensure that we are on track to meeting our carbon reduction target. To that end, we will continue to hold regular carbon management team meetings and to refer to the Executive Board to gain official support.

With the carbon reduction projects, we have identified and with the embedding actions we have listed above, we are confident that we will achieve our target of reducing our carbon emissions by 33% for scopes 1+2, and by 19% for scope 3.

FOREWORD FROM GENERAL HOSPITAL OF SYROS "VARDAKEIO & PROIO"

Our Executive Board have made a solid, pioneering commitment, by national standards, to developing a new environmental and carbon reduction strategy, that will result in our Hospital being a leader in providing low-carbon health services, in South East Europe.

We strongly commit to reduce the carbon emissions of our Hospital. It is not only a legal and moral obligation, but it is a social engagement of our organization with the local community. Moreover, it is sensible for our business interests. A continuous investment in reducing carbon output will result in saving money, which will, then, be invested back into further improvements to hospital services. Thus, we will contribute to the national, European and global effort to avert the climate crisis.

We believe in a socially responsible operational framework to ensure General Hospital of Syros is considered a national climate leader and to further enhance our status as the largest provider of health services in our Region.

ACKNOWLEDGEMENTS

This carbon management plan (CMP) has been developed as part of the Low-carbon healthcare in the Mediterranean region project, coordinated by Health Care Without Harm (HCWH) Europe.

This project is part of the European Climate Initiative (EUKI). EUKI is a project financing instrument by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU). The EUKI competition for project ideas is implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. It is the overarching goal of the EUKI to foster climate cooperation within the European Union (EU) in order to mitigate greenhouse gas emissions.

1. INTRODUCTION

Carbon management is an important aspect of tackling climate change. This carbon management plan outlines how we, General Hospital of Syros 'Vardakeio & Proio', will manage our sources to reduce our emissions and, thereby, save money and invest it in ameliorating other sections of our operations. The plan covers the period from 2021/22 onwards.

This plan is the outcome of our participation in the project 'Low-carbon healthcare in the Mediterranean region', coordinated by Health Care Without Harm (HCWH) Europe. It has been developed by our CM Team members. This is a five-step programme as shown below:

2. CARBON MANAGEMENT STRATEGY

General Hospital of Syros is a public hospital and the largest healthcare services provider in Cyclades, Greece. The vast majority of our operations are based in the Hermoupolis Campus, Syros, where we provide care to both medical, surgical and external patients. The patients are residents of Syros, of the insular region of Cyclades or, potentially, any visitor from all over the world. In Syros, we have 150 beds deployed and we employ 350 members of staff. Overall, we are the largest employer - both public and private - in our region. Thus, we have a crucial role in minimizing our operational carbon footprint in the regional environment of Cyclades by implementing this plan.

2.1 Context and drivers for Carbon Management

2.1.1 Climate crisis - a global imperative

General Hospital of Syros is late in joining the international race against climate change. Thus, we choose to refer to 'climate crisis' in recognition of the urgent character of this matter. Climate change is caused by the release of greenhouse gases (carbon dioxide, methane, etc.) into the Earth's atmosphere through, primarily, the burning of fossil fuels. Those gases trap the solar radiation within the lower atmosphere layers. This phenomenon is commonly accepted to cause climatic change, including a projected rise in global average temperature of 2-5^{o}C, by the end of 21st century. Climate change may also result in both local and international cases of desertification, floods, forest wildfires etc.

The climate crisis is also a health crisis and has impacted, and continues to do so, our lives and operation in various ways:

- Sharp increase of weather-related illnesses, allergies and deaths
- Increase of all types of cancer
- Food poisoning
- Respiratory difficulties
- Miscarriages

Climate change is the largest public health threat of the 21st century (Lancet Countdown, 2009). The climate crisis is present and it is real. It has devastated populations and natural habitats around the world. Governments have signed agreements to reduce greenhouse gas emissions. In Greece, major carbon savings are required from public to private businesses to our individual households. Carbon management can help tackle the problem of climate crisis by reducing carbon emissions. The health sector is, in general, a significant producer of carbon emissions.

Thus:

- Carbon management will help reduce carbon emissions and, as a consequence, the above-mentioned health problems could be addressed
- Our energy costs will decrease and we will be able to divert resources (financial and human) to other activities, e.g. patient treatment
- Health inequalities could be addressed and avoided

This carbon management plan addresses the way in which our organization will reduce its emissions by 33% for scopes 1+2, and by 19% for scope 3, compared to 2019, by 2030. Finally, a broader scope of a zero-emissions operation is negotiated.

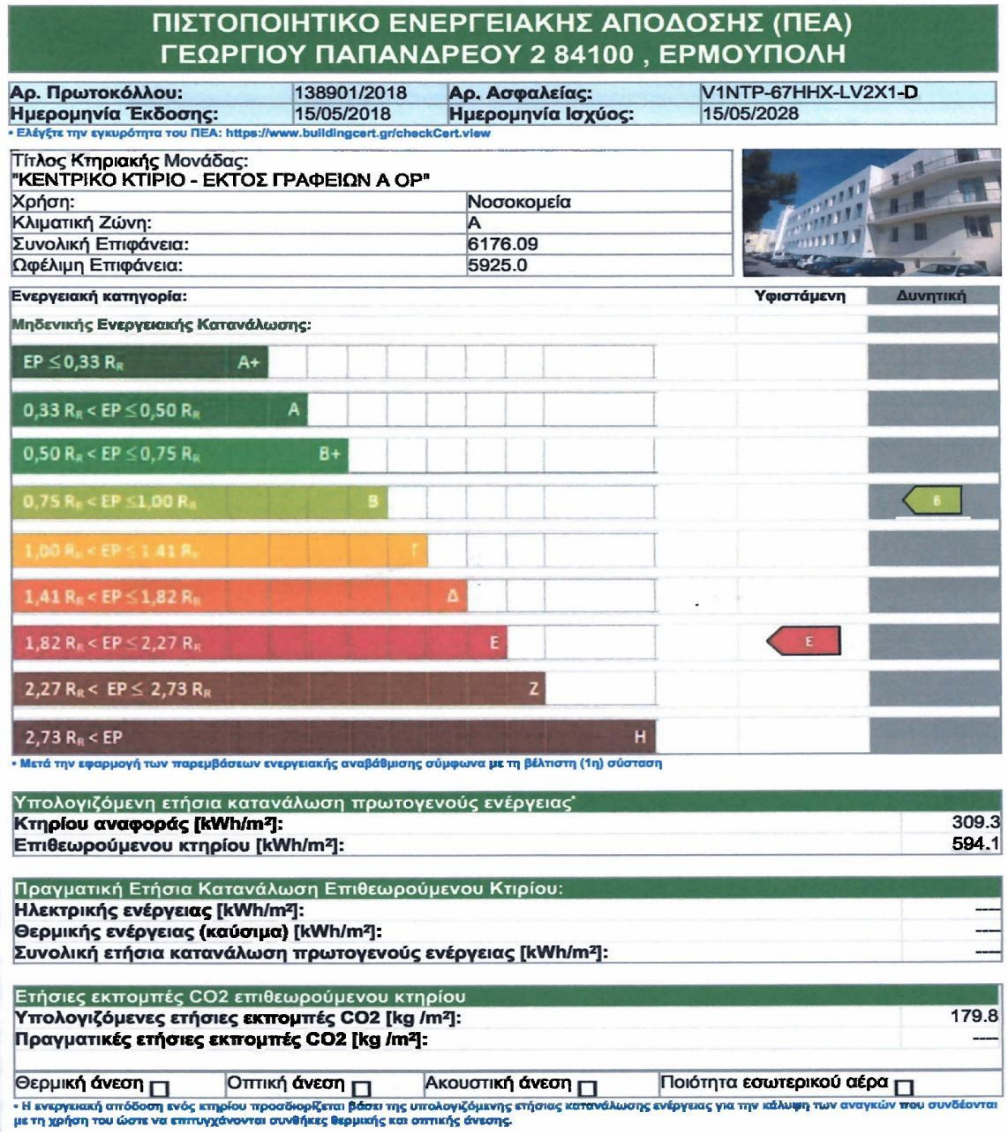
2.1.2 National drivers for carbon management

- Government targets
- Ministry of Health targets

2.1.3 Local drivers for carbon management

- *Global Green and Healthy Hospitals Network*: Our organization joined the GGHH Network in 2020, and pledged a reduction of 33% for scopes 1+2, and 19% for scope 3 carbon emissions, by 2030.
- *Health Care Climate Challenge and Race to Zero*: Our organization has joined United Nations' Initiative *'Race to Zero'*, in 2021, and pledged for zero carbon emissions by 2050.
- *Display Energy Certificates (DECs):* Since 2012, all public sector buildings - irrespective of their surface (floor area)- have been legally required to show a Display Energy Certificate in a prominent place, clearly visible to the public. The DEC shows the energy consumption

of the building as recorded by electricity and other operational indicators. Our organization has completed a DEC for all its premises. Carbon management will improve the DEC rating by reducing energy consumption.



ΠΙΣΤΟΠΟΙΗΤΙΚΟ ΕΝΕΡΓΕΙΑΚΗΣ ΑΠΟΔΟΣΗΣ (ΠΕΑ)
ΓΕΩΡΓΙΟΥ ΠΑΠΑΝΔΡΕΟΥ 2 84100 , ΕΡΜΟΥΠΟΛΗ

Αρ. Πρωτοκόλλου:	138901/2018	**Αρ. Ασφαλείας:**	V1NTP-67HHX-LV2X1-D
Ημερομηνία Έκδοσης:	15/05/2018	**Ημερομηνία Ισχύος:**	15/05/2028

• Ελέγξτε την εγκυρότητα του ΠΕΑ: https://www.buildingcert.gr/checkCert.view

Τίτλος Κτηριακής Μονάδας: "ΚΕΝΤΡΙΚΟ ΚΤΙΡΙΟ - ΕΚΤΟΣ ΓΡΑΦΕΙΩΝ Α ΟΡ"	
Χρήση:	Νοσοκομεία
Κλιματική Ζώνη:	A
Συνολική Επιφάνεια:	6176.09
Ωφέλιμη Επιφάνεια:	5925.0

Ενεργειακή κατηγορία:	**Υφιστάμενη**	**Δυνητική**
Μηδενικής Ενεργειακής Κατανάλωσης:		
EP ≤ 0,33 R_R A+		
0,33 R_R < EP ≤ 0,50 R_R A		
0,50 R_R < EP ≤ 0,75 R_R B+		
0,75 R_R < EP ≤ 1,00 R_R B		B
1,00 R_R < EP ≤ 1,41 R_R Γ		
1,41 R_R < EP ≤ 1,82 R_R Δ		
1,82 R_R < EP ≤ 2,27 R_R E	E	
2,27 R_R < EP ≤ 2,73 R_R Z		
2,73 R_R < EP H		

• Μετά την εφαρμογή των παρεμβάσεων ενεργειακής αναβάθμισης σύμφωνα με τη βέλτιστη (1η) σύσταση

Υπολογιζόμενη ετήσια κατανάλωση πρωτογενούς ενέργειας	
Κτηρίου αναφοράς [kWh/m²]:	309.3
Επιθεωρούμενου κτηρίου [kWh/m²]:	594.1

Πραγματική Ετήσια Κατανάλωση Επιθεωρούμενου Κτιρίου:	
Ηλεκτρικής ενέργειας [kWh/m²]:	---
Θερμικής ενέργειας (καύσιμα) [kWh/m²]:	---
Συνολική ετήσια κατανάλωση πρωτογενούς ενέργειας [kWh/m²]:	---

Ετήσιες εκπομπές CO2 επιθεωρούμενου κτηρίου	
Υπολογιζόμενες ετήσιες εκπομπές CO2 [kg /m²]:	179.8
Πραγματικές ετήσιες εκπομπές CO2 [kg /m²]:	---

Θερμική άνεση ☐	Οπτική άνεση ☐	Ακουστική άνεση ☐	Ποιότητα εσωτερικού αέρα ☐

• Η ενεργειακή απόδοση ενός κτηρίου προσδιορίζεται βάσει της υπολογιζόμενης ετήσιας κατανάλωσης ενέργειας για την κάλυψη των αναγκών που συνδέονται με τη χρήση του ώστε να επιτυγχάνονται συνθήκες θερμικής και οπτικής άνεσης.

- *Cost saving*: Carbon management will reduce energy consumption and allow money to be spent elsewhere. This will ensure that public money is spent more effectively.
- Public health benefit
- Reputation-Social Responsibility-Code of Ethics

2.2 Our low carbon vision

Our vision is to provide high quality healthcare services in an environmentally sustainable manner, through effective use of resources and cooperative working with partners.
We will become a leader in the provision of low - carbon health services.

General Hospital of Syros is a public organization in an insular region of worldwide interest. We strongly favour the provision of high-quality healthcare services to all in need of them, with an uncompromising minimization of our environmental footprint. We are in line with international trends and targets to limit our carbon emissions.

2.3 Strategic themes

A. *Self-awareness*: We will collect all carbon emissions related data and create a data centre. We will form a Carbon Management Team. We will identify all potential emissions sources and try to prioritize the required measures to minimize effects. It is necessary to establish a Carbon Management Plan.
B. *Tackle emissions*: We will invest in improvement opportunities in existing buildings and operations. We will consider measures for energy consumption reduction, water use minimization and better waste management.
C. *Maximizing environmental performance*: We will install carbon reduction measures in existing and new buildings. We will consider such solutions in all new tender processes and procurements.
D. *Form alliances*: We will work closely in collaboration with local, national and global partners to decrease our operational environmental impact. It is necessary to ameliorate the public health level.
E. *Social awareness*: We will communicate our CMP to staff, residents and visitors of Syros, and our partners. Then we will evaluate progress midterm and long term.

2.4 Targets and aims

The General Hospital of Syros PCT will reduce the CO_2e emissions from our activities by at least **33%** for scopes 1+2, and **19%** for scope 3, compared to the **2019** baseline, by **2030**.

The scope to which this carbon reduction target applies is analysed further on in the plan.

General Hospital of Syros aims to:

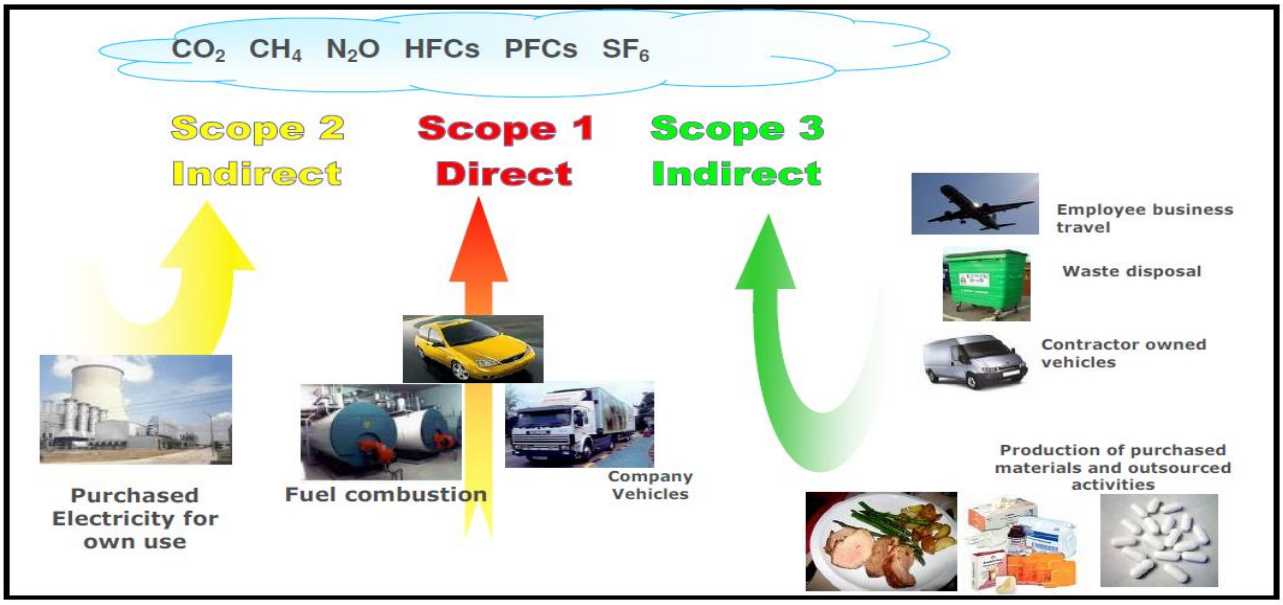
- be a regional, national and global leader in carbon management in healthcare
- fulfil all its carbon targets
- be an active member of international climate initiatives and coalitions

3. EMISSIONS BASELINE AND PROJECTIONS

3.1 Scope

3.1.1 Emissions sources

General Hospital of Syros' carbon emissions result from various activities, which are shown below:



The Hospital's calculated footprint includes emissions sources, for which data are available, and has excluded emissions where data were not available or were not ready to be investigated. Table 1 contains an analysis of these sources.

Included in the carbon footprint	Excluded from the carbon footprint
Energy consumption in buildings: - electricity - gas - oil - diesel Waste Water consumption Fleet transport Refrigerants	Procurement Business travel in staff-owned vehicles and public transport Staff commuting Patient travel

Table 1. Scope of our carbon footprint

The scope of the footprint will be increased in the next few years, so as to include some of the excluded emission sources. Patient and staff travel commuting, business travel and fleet management are identified emissions sources, which should indicate a better understanding of our carbon management and help us develop reduction policies. Furthermore, indirect carbon emissions from procurement, goods deliveries to our campus and third-party commuting are crucial to our operational routine. Thus, specific policies and actions will need to be implemented to also measure these activities and collect the respective data.
We are committed to expanding the scope of our baseline on a yearly basis.

3.1.2 Locations

The carbon footprint includes data from our main Hospital Campus and the Centre of Physical Medicine, which is situated on campus.

3.2 Baseline

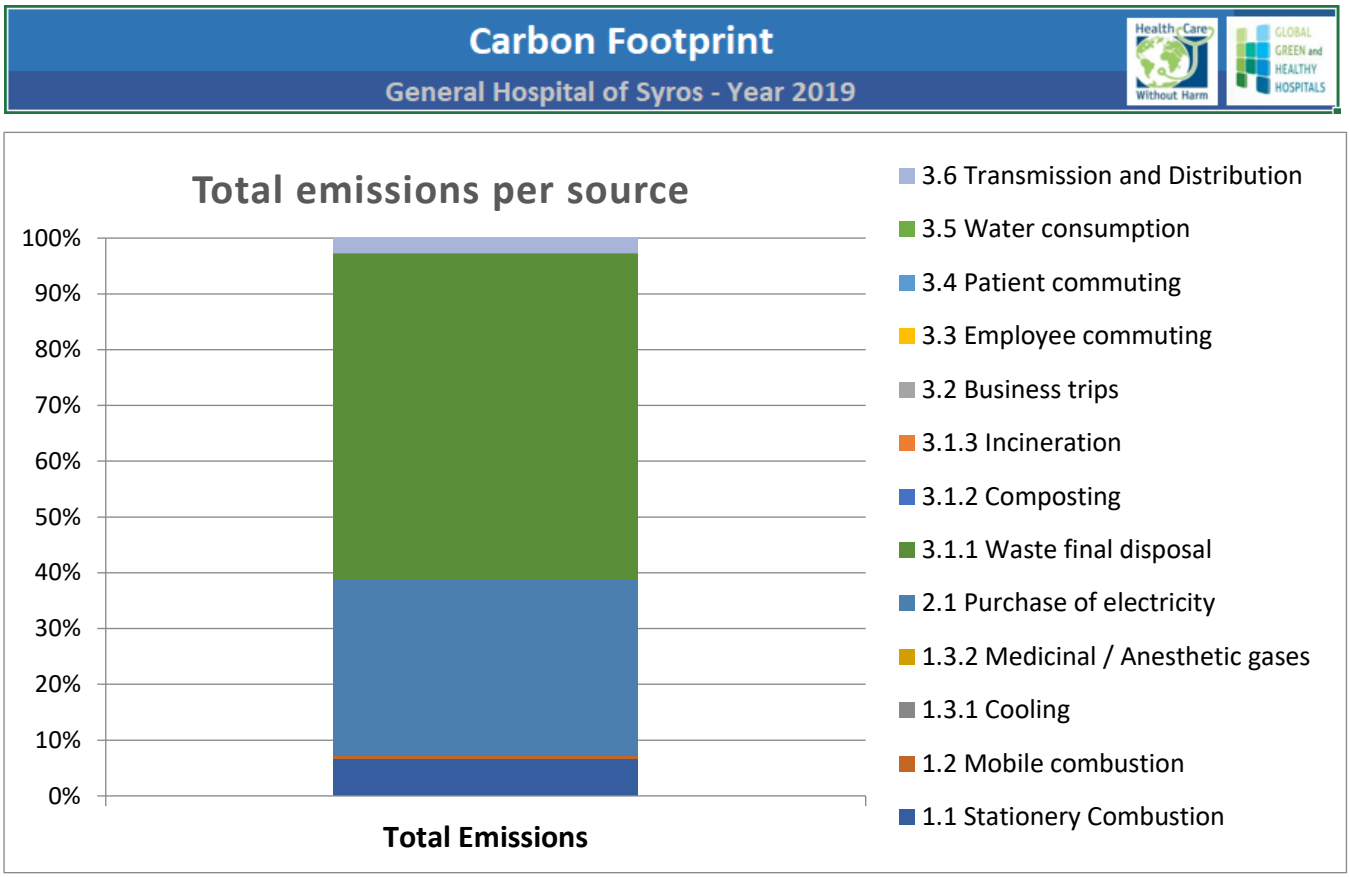
3.2.1 Baseline carbon emissions

General Hospital of Syros has calculated its baseline carbon emissions using data from 2019. The Hospital produced **2.087,96 tonnes** of carbon dioxide equivalent, which breaks down by scope as follows:

Scope 1:	152,05 tCO_2e
Scope 2:	662,95 tCO_2e
Scope 3:	1.272,95 tCO_2e

Table 2. Carbon emissions by scope

The biggest emissions source is waste management. Electricity consumption also contributes significantly to our carbon footprint.



3.2.2 Data sources, quality and assumptions

Our carbon footprint is based on high quality data, i.e. supplier records, bills and in-house records. We used supplier records and bills for electricity, water and gasoline / petrol. We used our procurement and logistics records for anaesthetic gases and types of refrigerants. Waste management data were collected from the Municipal Sanitary Landfill waste measurement records.

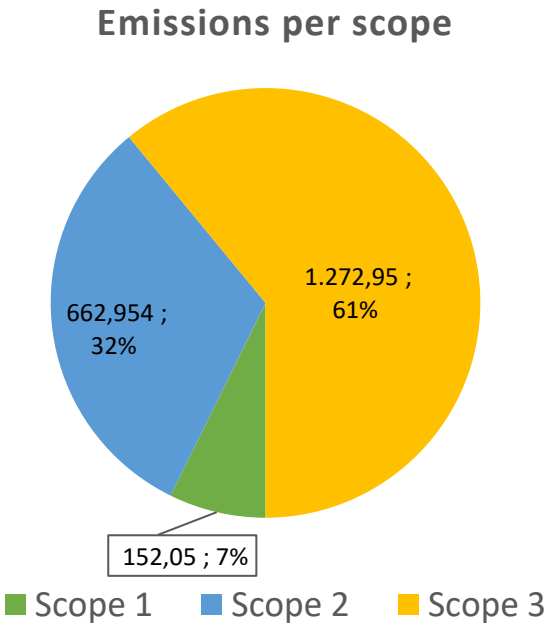
In setting the 2019 baseline, we opted to use only the available records and made no assumptions for missing emissions sources.

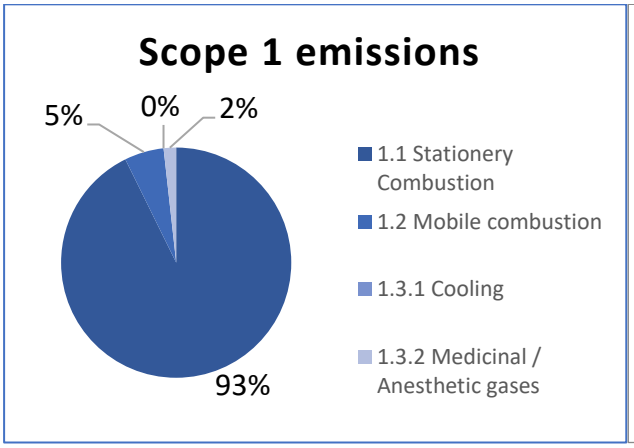
3.2.3 Carbon emission factors used

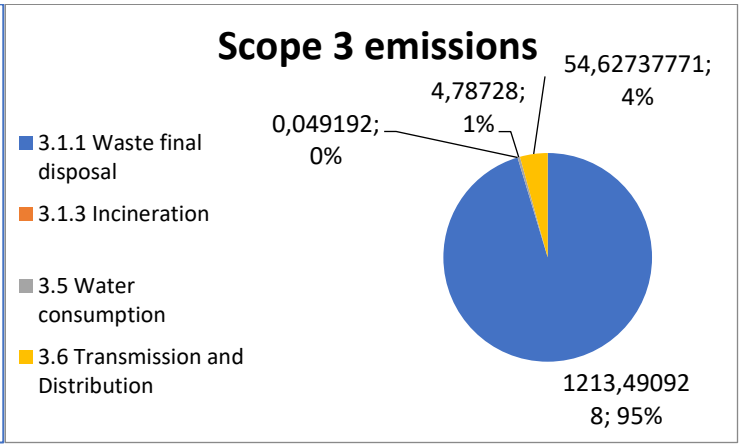
HCWH Europe and the consultancy Factor CO2 helped us use carbon emission factors to correlate our data to carbon emissions.

Carbon Footprint

General Hospital of Syros - Year 2019







The Climate Impact Checkup Tool, developed by HCWH, was used to calculate our carbon footprint estimates and we will continue to use this tool to track our progress.

3.3. Projections

The Paris Agreement was the first-ever universal, legally binding global climate change agreement, adopted at the Paris climate conference (COP21) in December 2015. It sets out a global framework to avoid dangerous climate change by limiting global warming to well below 2°C above pre-industrial levels and pursuing efforts to limit it to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risk and impacts of climate change. It also aims to strengthen countries' ability to deal with the impacts of climate change and support them in their efforts.

In 2018, the IPCC developed The Special Report on Global Warming of 1.5°C with 6,000 scientific references cited and the dedicated contribution of thousands of experts and government reviewers worldwide.

The key messages that came out very strongly from this report were that we are already seeing the consequences of 1°C of global warming through more extreme weather, rising sea levels and diminishing Arctic sea ice, among other changes. The report highlights a number of climate change impacts that could be avoided by limiting global warming to 1.5°C compared to 2°C, or more. For instance, by 2100, global sea level rise would be 10cm lower with global warming of 1.5°C compared with 2°C. This will have an important impact. The report also describes that limiting global warming to 1.5°C compared with 2°C would reduce challenging impacts on ecosystems, human health and well-being, making it easier to achieve the United Nations Sustainable Development Goals. To achieve this, GHG emissions must halve by 2030 – and drop to net-zero by 2050.

The first step to reducing the impact of climate change consists in measuring the carbon footprint of the baseline year. This allows us to set out reduction objectives and to monitor the future Carbon Management Plan. Taking as a base the results of the first study year, 2019, and following the worldwide expert opinion, this study will provide guidance on setting targets based on science, the so-called Science-based Targets.

Science-based targets provide companies with a clearly defined path to reduce emissions in line with the Paris Agreement goals. For this study, the methodology of Absolute Contraction of emissions is used.

This method uses the contraction of absolute emissions to set absolute targets. Using this approach, companies reduce their absolute emissions at the same rate, regardless of initial emissions performance. Consequently, an absolute emission reduction target is defined in terms of an overall reduction in the amount of GHG emitted into the atmosphere for the target year, relative to the base year.

This method consists of two scenarios, the first one was developed so that the temperature increase is below 2ºC, (Climate scenario aligned with a well-bellow 2-degree temperature goal, from now on 2ºC) and the second was built with the vision that the temperature increases 1.5ºC above pre-industrial levels. The minimum reduction necessary to meet the online objectives of scenario 2ºC is 2.5% in annual linear terms. However, companies, particularly those in developed countries, are strongly encouraged to adopt targets with a linear reduction of 4.2% per year that are in line with limiting warming to 1.5ºC.

The indications of Science-based Targets are applied in the definition of the reduction objectives. However, a slight adaptation has been included to better reflect the first period of implementation of the Carbon Management Plan, a period called "post-Covid". The pressure in hospitals during 2020 and the possible redistribution of financial resources in other areas of action during the first years (2021-2022) after the pandemic are also taken into consideration. Therefore, for the first scenario, scenario 2ºC, an annual reduction of 1% was applied for the period 2021-2022. On the other hand, for the second and more demanding scenario, scenario 1.5ºC, an annual reduction of 2.5% was considered.

Furthermore, the objectives are divided in two: those that come from the direct activity of the hospital (scopes 1 and 2) and those that come from the value chain (scope 3). The hospital should put more focus during the first years of the Carbon Management Plan in the first category, as it can have more decision making over those sources. Regarding scope 3 emissions, the road map

shows that the hospital can maintain the level of emissions of scope 3 until 2025. This is because the hospital shall focus on better measuring the most significant sources of Scope 3 rather than reduce them. For example, some sources that can have an enormous impact in scope 3 are the transport of patients and employees. The hospital shall focus on defining a methodology to collect data on these sources in order to calculate them. In 2025, once these sources have been included and scope 3 is better defined, the hospital shall start implementing reduction measures.

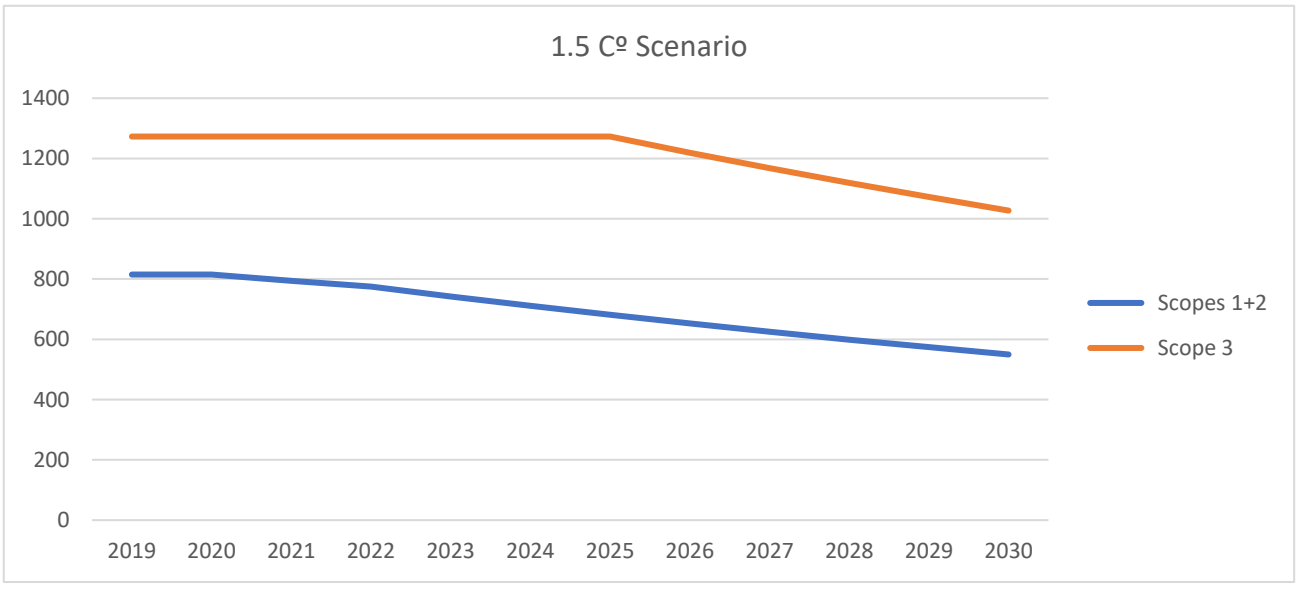
The following tables show the reduction objectives chosen for the General Hospital of Syros:

	1.5 Cº Scenario											
	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Scopes 1+2	815.00	815.00	794.63	774.76	742.22	711.05	681.19	652.58	625.17	598.91	573.76	549.66
Scope 3	1,272.95	1,272.95	1,272.95	1,272.95	1,272.95	1,272.95	1,272.95	1,219.49	1,168.27	1,119.20	1,072.20	1,027.17

	1.5 Cº Scenario		
	2019	2025	2030
Scopes 1+2	815.00	-16%	-33%
Scope 3	1,272.95	0%	-19%

Table 3 & 4. List of Reduction objectives in a 1.5ºC scenario (2019-2030).

Source: Factor CO_2.



This scenario is more demanding than the 2ºC scenario. However, the General Hospital of Syros decided to follow this scenario due to the positive example that the hospital will set out to the sanitary sector. In blue, emissions remain at their current value. In yellow, the reductions for the post-Covid period (2.5% annual reduction). In green, reductions based on science for this specific scenario (4.5% annual linear reduction). Below, the general targets for 2025 and 2030 following this 1.5ºC scenario. This scenario shows a clear milestone in 2025, in which the hospital will reduce its scope 1 and scope 2 emissions from 815.00 tCO_2e to 681.19 tCO_2e. This implies a 16% reduction by 2025. By 2030, the hospital should be able to further reduce these emissions to 549.66 tCO_2e, resulting in a reduction of 33%.

Regarding scope 3 emissions, as explained before, the hospital will focus during the first period (2020-2025) in improving the data collection of the most significant sources of the value chain and implement a plan to measure them. From 2025 onwards, the hospital will start reducing emissions until reaching a reduction of 19% by 2030.

4. CARBON MANAGEMENT PROJECTS

One of the main objectives of this study is the reduction of GHG emissions related to General Hospital of Syros' activities. The first calculation of the carbon footprint is made for the base year. After this first calculation, a study of successive years will be carried out to proceed to the comparison with the previous year.

The implementation of emission reduction plans and measures is an efficient way to improve results. Hence, in the first years, a reduction plan will be carried out in the areas and activities over which General Hospital of Syros has control. After its execution, these measures should be properly described as well as their scope within the organization. Indeed, the differences in emissions attributable to these measures should be documented by means of appropriate indicators.

During the series of workshops developed in December 2020, the General Hospital of Syros identified a list of measures with the objective of reducing the impact of the most significant flows of the carbon footprint. Likewise, it identified some measures to reduce the possible impact of sources that have not yet been included in the footprint but that may have a great influence in the future (paper consumption). Before showing the results of these estimates, information is provided on some of the methodologies that the hospital can use and apply in the future.

Area of action	Measure/Action	Additional info (implementation, funding, monitoring, department)	Scope 1	Scope 2	Scope 3
Illumination	Installation of LED bulbs and presence detection systems	Technical Dept		x	
Power production	Installation of Solar PV Panels	Technical Dept		x	
Hot water production	Installation of Solar Water Heaters	Technical Dept	x		
Heating	Replacement of old heating boiler	Technical Dept	x		

Paper use	Installation of Electronic Document Management System	IT Dept			**x**
Air-conditioning	Replacement of old main A/C Units	Technical Dept		**x**	
Building insulation	Replacement of frames (windows)	Technical Dept		**x**	
Building insulation	Installation of thermal insulation in the building	Technical Dept		**x**	
Power saving	Replacement of old PCs & Printers with new ones w/higher efficiency/higher power factor	IT Dept		**x**	

Table 5. List of potential reduction measures divided by scope.
Source: Factor CO_2.

Taking into account the information available to date, a quantitative study has been developed on some of the reduction measures to serve as the basis for a possible prioritization within the Carbon Management Plan. Estimates are presented in Appendix D.

We have grouped our carbon management projects under the strategic themes set for our Hospital.

4.1 Self awareness

4.1.1 Hospital's DEC

In accordance with national legislation, the Hospital was issued a DEC, by which it was rated in Category 'E'.

4.1.2 Carbon Management Team

A key objective of the 'Low-carbon healthcare in the Mediterranean region' project, in which our organization participated, was the assembly of a Carbon Management Team. This team was made up from members of staff of various backgrounds (MDs, engineers, procurement, IT etc.).

4.1.3 Data collection

We have explicitly stated that 2019 has been set as our baseline for carbon emissions sources data collection, the calculation of our footprint and all relevant measures to be taken. Thus, in 2020, a significant process was established by the members of CMT to identify, measure, quantify and correlate available carbon sources data from all available sources.

4.1.4 Data Centre and analysis

Based on that data collection and for the next few years, this process will be repeated in Semester 1, so as to keep track of all records and assess our carbon reduction process. Moreover, every year new data sources will be identified and measured, in order to expand the scopes of our planned actions.

4.1.5 Carbon Management Plan

The data collection has resulted in an open discussion about the Hospital's priorities and opportunities to minimize its carbon footprint. To achieve this and to fulfil another objective of *'Low carbon healthcare in the Mediterranean region'* project, the Hospital's Carbon Management Plan will be issued, by the CMT, and rectified, by the Executive Board. The CMP is the essential document in which the organization will declare its commitments, its policies and aspirations to move towards carbon neutrality.

4.1.6 Continuous evaluation and assessment

The Hospital's CMP and overall progress will be reviewed on an annual basis.

4.2 Tackle emissions

Our Hospital has a long and proven record in receiving funding from the European Union, from the Hellenic Republic or other similar sources. In this way, restricted monetary sources are dispensed on causes other than patient related. Therefore, we will invest in improvement opportunities in existing buildings and operations. We will consider measures for energy consumption reduction, minimization of water use and better waste management.

4.2.1 Feasibility study of energy efficiency upgrade project

Funded by the EU, and with a budget of €60,000, a six-month long feasibility study is under way for our Hospital. The study investigates all the potential solutions to increase the energy efficiency of its main Campus from DEC Category 'E' to 'B'. Those solutions will be presented to the Executive Board and proper solutions will be adopted for the project's next phase. The feasibility study is due for submission on 11.10.2021.

4.2.2 Energy Efficiency upgrade project

Funded by the EU, and with a budget of **€3,298,950.76**, a twelve-month long construction project is under way for our Hospital. The aim of this project is to tackle, mainly, scope 1 and scope 2 emissions while the Local Authority reshapes the island's waste management infrastructure. In doing so, we use EU funds to tackle our own emissions and then, at a local level, we will collaborate with other local stakeholders to address our scope 3 emissions. The project will include the following improvements to the environmental performance of existing buildings:

- Installation of thermal insulation shell
- Replacement of window frames and glazings
- Replacement of lighting
- Installation of solar heaters
- Upgrade of hot water boiler system and procurement of additional boiler
- Installation of PV cells for net metering
- Replacement of circulators
- Replacement of heating boiler
- Replacement of cooling systems
- The project is due for tender in Q2 2022.

4.2.3 Waste management

Solid and forward policies about recycling and minimization of waste on the Hospital's operation are in place.

4.2.4 Water management

Solid and forward policies about water recycling and minimization of waste on the Hospital's operation are in place.

4.2.5 IT

Funded by the EU, and with a budget of **€1,600,000.00**, the IT infrastructure of the Hospital has been upgraded from scratch. PCs, printers, data centre, patient queue management systems, WIFI 'everywhere' equipment etc have been procured and implemented in 2021. In recognizing the Hospital's implementation of this investment, the Hellenic Ministry of Health declared our organization as '*... a novel digital Hospital in Greece...*', in May 2021.

Furthermore, all IT procurement is based on multifunctionality and high energy efficiency standards. Finally, teleworking (working from home) is an option for the administrative staff and we encourage them to do so.

4.2.6 Zero paper use

An internal policy of zero paper use in administrative operation and in-patient examination results has been implemented. As a result of this policy, a sharp reduction in procurement of paper has been observed.

4.3 Maximizing environmental performance

We will install carbon reduction measures in existing and new buildings. We will consider such solutions in all new tender processes and procurement.

4.4 Form alliances

4.4.1 Local collaboration

Syros is an island and its natural resources are scarce. It is our strong belief that all local stakeholders:

- Local Authority of Syros-Hermoupolis
- Region of South Aegean
- General Hospital of Syros

- Industries
- SMEs

Work collectively to form strategic policies towards the reduction of the island's carbon footprint.

4.4.2 National collaboration

General Hospital of Syros has formed a strategic operational alliance with the Centre for Renewable Energy Sources (CRES), the sole national centre for environmental policies in Greece.

4.4.3 Global partnerships

Our Hospital is a member of GGHH Network. We participated in the 'Low carbon healthcare in the Mediterranean region' project, which is funded by the European Commission (EC)'s LIFE programme and The European Climate Initiative (EUKI) of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU). In 2021, we became founding members of the United Nations' initiative 'Race to Zero', which is part of the Health Care Climate Challenge. We commit to outward-looking action of our operation with minimum financial cost.

4.4.4 Recognition

In 2020, we received the *'Silver Climate Resilience Award'*, by Health Care Climate Challenge, for our environmental commitment.

4.5. Social awareness

In our carbon management journey, we are not alone. We need and we want to raise social awareness on the overall matter at hand.

4.5.1 Open policies

Our CMP will be communicated to all members of staff, patients and visitors. It will be available online on the Hospital's website: *https://vardakeio.gr*. Moreover, people will be invited/encouraged to suggest further improvements on it and/or new policy ideas.

4.5.2 Continuous public consultation and communication of results

Our carbon management journey is open to all potential public scrutiny and criticism. Thus, on a yearly basis our CMP results will be publicly announced and presented.

4.5.3 Networking and lobbying

The Hospital's management is an avid believer of teamwork. Therefore, we are open to new networking opportunities, lobbying events to promote our causes etc.

4.6 Accountability

The progress review of the CMP is a key responsibility for the members of the CM Team. The Heads of Departments are obliged to report on departmental progress of policies and mid-level projects.

The Hospital's Executive Board is the senior level of accountability for CMP's success or revision requirements.

4.7 Net-zero decarbonization strategy

In the Organization' s long term planning, achieving net-zero emissions, by 2050, is crucial. Our initial strategy is presented in Appendix C.

4.8 Carbon reduction opportunity calculator

Within the context of the 'Low carbon healthcare in the Mediterranean region' project, a carbon reduction opportunity calculator tool was devised for the participating Hospitals. We commit to using it in the months to come to further enhance our CMP.

5. CARBON MANAGEMENT PLAN FINANCING

The implementation of our Hospital's CMP requires the allocation of funds and the Executive Board's commitment to execute it.

Greece has suffered a twelve-year austerity period, in addition to the ongoing COVID-19 pandemic, and there is scarce public financing for investments. The public health sector has seen, from 2009, severe cutbacks in budgetary limits, staff salaries and availability of funds. Moreover, the competition for securing EU funds has grown significantly. As a public organization, General Hospital of Syros has also been affected by this reality. In spite of the fiscal crisis, we have an excellent proven record of EU as well as joint EU/National funding opportunities management.

To put it simply, for the past decade, all of our Hospital's investment projects have been financed in total by the EU or the Hellenic Republic. Thus, no capital cost was paid by the Hospital for the projects, which were described in the previous chapter, and we continue to look out for such investment opportunities. It is our strong belief that the Hospital's funding should be primarily allocated to patient care.

Having stated the above, we reasonably assume that the financial profit of our current/future projects and policies will be directed to improve our operation. So far, we have not been able to quantify the financial benefits and savings. We have reasonably estimated our carbon savings. For the purposes of the CMP's first edition - before we quantify the benefits - we have identified qualitative benefits:

- Excellent publicity opportunities, at no financial cost, and enhanced reputation by committing to reduce our carbon emissions
- Staff motivation and morale building by actively presenting to them that there is a continuous strive to improve the facilities
- Reduction of future costs
- Further improve users' feeling of comfort
- Contribute to local, national and global carbon reduction targets

Our current CMP will need to be revised in financial estimations and projections, as soon as the energy efficiency project is completed. We commit to doing so, irrespective of the yearly reporting phases.

6. CARBON MANAGEMENT PLAN AND OUR ORGANIZATION

Our commitment to devise a CMP, and to implement it, is not only a programme requirement in 'Low carbon healthcare in the Mediterranean region'. It is our Organization's expression to move forward to avert the climate crisis. However, our Organization is not merely its Executive Board or the CM Team. We need to embed the CMP to our Hospital as a whole (staff, patients, visitors).

6.1 Data management

By setting 2019 as our baseline, we measured an initial set of carbon emissions sources data. Our carbon footprint was calculated. As we declared in previous chapters, we commit to continue our data collection, data analysis and policy making. In doing so, we will be able to monitor our progress and identify successes and points of revision. We will manage our data better by:

- Identifying and measuring more scope 3 emissions sources
- Calculating our carbon footprint at least on a yearly basis and communicating it widely
- Monitoring fuel usage on vehicle fleet, monitoring electricity consumption and cutting back on excesses

6.2 Financial Services

In Chapter 5, the need of quantifying financially the CMP was expressed.

The Procurement Office is part of our Financial Services Directorate. Our colleagues there have achieved, especially during the COVID-19 pandemic, the following:

- Incorporate energy efficiency standards in procurement of equipment
- Joint procurement with Hospitals of the same Region
- Arrange deliveries en gross

6.3 Policy

Our Hospital's participation in GGHH Network and in UNFCCC's 'Race to Zero' clearly demonstrates our strong commitment in the fight against the climate crisis. CMP will be

incorporated in our policies, so as to have a direct impact on our decision making. The Hospital's policies, regarding climate crisis are:

- *Environmental policy:* It was renewed in 2019 and it is valid for five years
- *Operational guidelines of Departments and Directorates:* They were established and verified in 2021
- *Waste management*
- *Water management*
- *Infectious waste management:* It was approved in 2018 and it is valid for three years. Up for renewal until the end of 2021
- *Hospital acquired infections*: It was first approved in 2021 and it is valid for five years

As we commit to CMP's implementation, we will develop new policies regarding energy, procurement, travel/commuting and communication. Finally, we will evaluate our policies regularly and update them, if necessary.

6.4 Communication

The communication of our carbon related policies, both within the Hospital and externally to society, is vital for its success. The Hospital's community in its entirety will learn the proceedings and, perhaps, they could 'advertise' the action in their social surroundings for further climate action. So far, we have held departmental training sessions to encourage staff for climate action. We regularly make press announcements of our climate related news.

Our future activities will involve training of staff and patients on CMP, public appearances of the Hospital's management to publicise CMP and engage the people to it.

6.5 Individual responsibility

For CMP to be successfully implemented, it is vital that all parties (management, staff, patients and visitors of the Hospital) are held accountable for their role in it. CMP will become an integral part of everybody's daily routine. So far, only the Hospital's management and CMT members have an active role in the CMP. After the CMP's approval, all members of staff will be assigned

roles to fully activate the CMP. Moreover, CMT members will be assigned duties so as to report to the management (data collection, identifying opportunities etc).

6.6 Monitoring and evaluation

The CMP's progress monitoring and constant evaluation is essential for its success. So far, we have set up the CM team, we have prepared the CMP and started our journey on action against the climate crisis. We further commit on the following:

- Publicly announce (press releases and on our website) our carbon footprint
- Update it on a yearly basis
- Hold CM team meetings on a quarterly basis
- Report progress on Executive Board

7. CARBON MANAGEMENT PLAN PROJECT MANAGEMENT

Our Organization participated in the 'Low carbon healthcare in the Mediterranean region' programme, which is funded by EUKI. One of the programme objectives was for our Hospital to set up a Carbon Management Team. The Team's composition is presented below:

Carbon Management Team	
Name	Role
Michail Zouloufos	CEO, Project Sponsor
Dimitris Roussos	Head of IT Department, Project Leader
Ioannis Gavriil	Medical Doctor
Anna Kampani	Member of Procurement Department
Charalampos Xagoraris	Head of Biomedical Engineering Department
Michail Zamplakos	Member of Biomedical Engineering Department
Georgios Chatzantonakis	Member of Biomedical Engineering Department

Table 6. Carbon Management Team.

Another programme objective was to establish this Carbon Management Plan.

To achieve our reduction target of 33% for scopes 1+2, and 19% for scope 3, senior executive ownership of the Plan is required. We have achieved that with Mr. Zouloufos' sponsorship. Mr. Zouloufos' endorsement will be the link between the CMT and the Executive Board, which he presides over.

Therefore, the Project Leader will report to the Executive Board on a regular basis the CMP's progress review. As soon as the CMP is approved by the Board, all members of the CMT will be appointed deputies so as to avoid succession mishaps.

An annual progress review report will be issued and put forward for approval by the Executive Board. This report will incorporate the annual updates on data collection targets, the revised carbon footprint, the achieved reduction targets, new ideas on targets etc. The report will be publicly available to staff and on the Hospital's website: https://vardakeio.gr.

Appendix A: Sites included in the carbon footprint

Site Name	Included	Floor area (m^2)
General Hospital of Syros	Yes	6,879.42
Centre for Physical Medicine	Yes	1,693.60

Table 7. Sites included in the carbon footprint

Appendix B: Data Sources and Quality

Data	Source	Quality	Collected by
Electricity use in buildings	Establishment meter-Supplier bills	Excellent	Building Services
Oil use in buildings	Establishment meter-Supplier Delivery notes	Excellent	Building Services
Fuel use in fleet	Supplier bills	Reliable	Building Services
Water use in buildings	Establishment meter-Supplier bills	Excellent	Building Services
Waste	Municipality's measurements	Excellent	Building Services
Refrigerant gases	Hospital's pharmacy procurement records	Excellent	Pharmacy

Table 8. Data Sources and Quality

Appendix C: Net-zero emissions by 2050

In this CMP we have identified some of the measures that will take us to our reduction objectives by 2030 and that will put us on track to achieve net-zero emissions by 2050. Emission reduction objectives have been set for 2030 with progressive annual reductions each year based on a series of well identified carbon reduction initiatives. Based on a cost-effective analysis, these initiatives have been prioritised and will be put into practice, whilst other less urgent projects have been reserved for later years. At the moment, our hospital stands at a 1.5ºC global warming scenario, which would mean an approximate 4.2% annual reduction in CO_2 emissions until 2030.

However, not all ends here since our hospital has an ambition to reach net-zero emissions by 2050. To achieve this, substantial efforts must be made to implement this plan, and identify all emissions in all scopes within the next two years to fully grasp the challenge ahead.

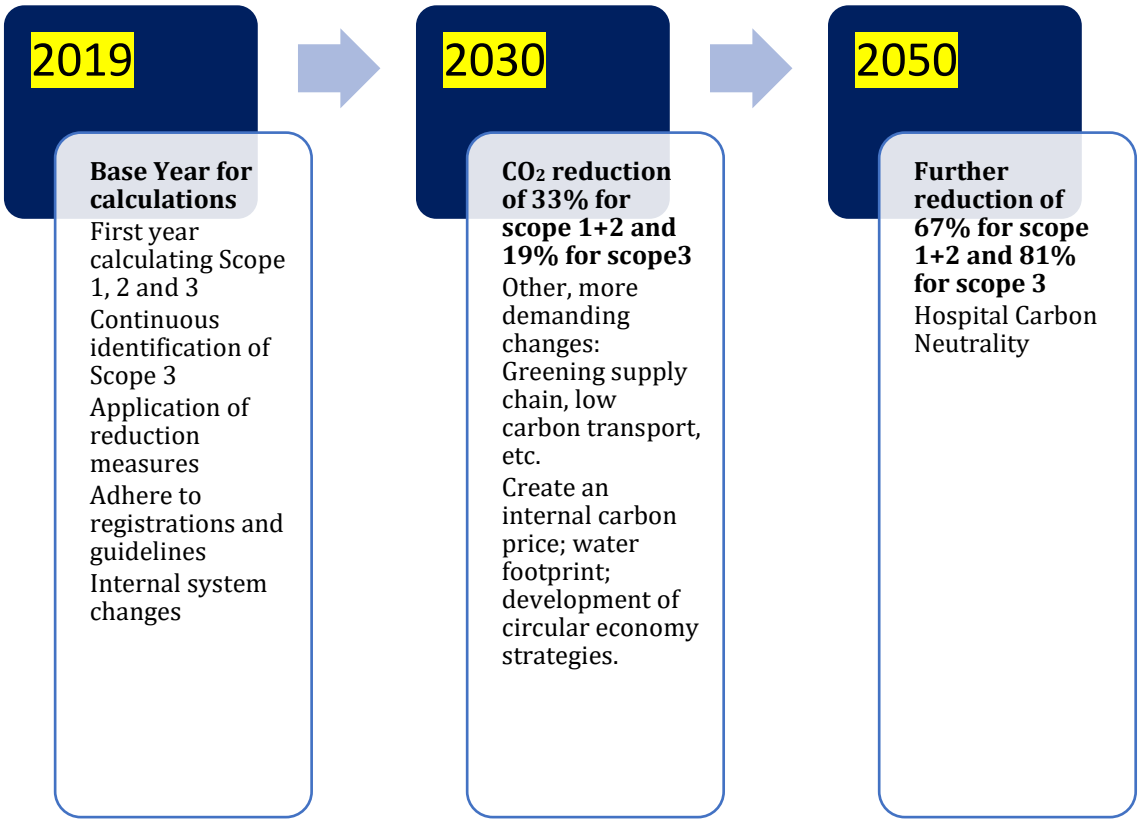
The tCO_2e gap between now and 2030 requires a CO_2e reduction of 33% for scopes 1 and 2 and 19% for scope 3 in the strictest scenario of 1.5ºC. To reach 2050 with a net-zero tCO_2e value, a further reduction of 67% for scopes 1 and 2 and 81% for scope 3 (against the 2019 baseline year) is required. In addition to the actions and measures already identified, prioritised, and analysed in this CMP as realistically achievable to implement in the hospital from here to 2025, there are many other options to reduce GHG emission sources in the following years. Some of the examples include the following:

- Continue with the scopes 1, 2 and 3 annual calculations, with the objective of identifying and quantifying all scope 3 emissions by 2025.
- Continue investigating the healthcare sector market and other sectors for sustainability best practices and initiatives. Additionally, apply cost-effective analysis, among other analysis techniques to understand implementation possibilities.
- Adhere to registrations and guidelines involving carbon footprints. For example, adherence to the science-based targets,
- Additional sustainability standards include registration to the national registry (in Spain the OECC), and Sustainable Development Goals.

- Additionally, and for the long-term commitment, create an internal carbon price, calculate the water footprint, and develop circular economy strategies.
- Other measures include internal system changes in the hospital, which are low-cost and high impact. These include creating a culture that values sustainability, financial incentives, and optimises collaboration across entities. More specifically, for example, create a Sustainability Manager position; divest completely from fossil fuels; require each facility to have a sustainability plan, track metrics and report annually; train staff and create staff performance evaluations; create a novel metric that determines carbon intensity of care per unit of health delivered; transparent reporting; tie departmental financial incentives to sustainability metrics; sharing best sustainability practices.
- Other, more challenging and financially demanding changes include greening the supply chain; integrate energy conservation into all operations; low carbon transportation – change fleet, electric charging stations, financial incentives for walking and cycling to work; telemedicine and teleworking; purchase low carbon foods and packaging, and minimise food waste; reduce overtreatment and overprescribing.

Despite all the efforts that our hospital may take to decarbonise, some residual emissions will remain, and we must make every effort to reduce these. The health sector should strive to ensure that these residual emissions are managed in a way that will support a healthier and more sustainable future. Related to this, and as the last option for the hospital, we will consider designing an offsetting strategy, striving to avoid carbon offsets as much as possible.

The figure below shows the steps to a 1.5 ºC scenario involving pertinent reduction measures for our hospital:


2019
Base Year for calculations
First year calculating Scope 1, 2 and 3
Continuous identification of Scope 3
Application of reduction measures
Adhere to registrations and guidelines
Internal system changes
2030
CO2 reduction of 33% for scope 1+2 and 19% for scope3
Other, more demanding changes:
Greening supply chain, low carbon transport, etc.
Create an internal carbon price; water footprint; development of circular economy strategies.
2050
Further reduction of 67% for scope 1+2 and 81% for scope 3
Hospital Carbon Neutrality

Appendix D: Methodologies for decision making.

Scientific analysis can aid environmental decision making by providing an objective set of criteria to inform decision makers. It is difficult to fully encapsulate environmental decisions in a formula, but the use of some methods has proven to be very helpful in planning long-term resource use. There are alternative methodologies that can be used to assess and prioritize actions related to climate change. Each of them requires different information, experts, and processes.

1. **Cost Benefit Analysis (CBA)** dates back to the 19th century. This method is based on an updated comparison between expected future costs and benefits. In evaluating public decisions, the CBA captures all the social costs and benefits involved, including externalities. As such, benefits are typically described as increases in human well-being (utility), while costs are primarily defined as reductions in human well-being. In this sense, the CBA will monetize all the costs and benefits of the actions, including externalities and non-commercial benefits. The values will be subsequently brought to the present through the use of discount rates.
2. Another indicator that may be useful when evaluating the measures economically is the discounted **Pay-Back or discounted recovery period**. Pay-Back is a dynamic investment evaluation method that determines when the money is recovered from an investment, considering the effects of time on the money. The pay-back is a liquidity criterion, which is equivalent to the simple recovery period or payback but discounting the cash flows. It is a matter of subtracting the discounted cash flows from the initial investment until the investment is recovered and that year it will be the discounted payback. In this sense, it represents the time it takes to recover the investment, taking into account the moment in which the cash flows occur. However, among the main drawbacks of discounted payback as a criterion for evaluating mitigation measures, we have that it does not assess the social or environmental impact of the actions and that this type of measures can also bring benefits over a longer period of time. It also has some problems, such as not considering the cash flows that occur from each period after having recovered the investment. Therefore, the CBA and the Pay-Back can provide a very

comprehensive analysis of the consequences of the application of human actions. However, when it comes to mitigating climate change, it is difficult to monetize the benefits due to the uncertainty of calculating a social cost of carbon and the complexity of the assumptions.

3. The good news is that the cost of reducing one ton of carbon dioxide can be assumed to be the same regardless of sector or geographic area. Because of this, **Cost Effectiveness Analysis (CEA)** has taken the lead as the most widely used tool for evaluating mitigation measures. Rather than assigning monetary values to emission reductions, CEA can combine physical and monetary information. The objective is to prioritize the different alternatives according to the quotient between the net present value of the application (public and / or private, depending on the context) and the amount of CO_2e reduced. The Net present value includes costs, but also market benefits (such as the benefits provided by energy efficiency measures). CEA results are usually expressed in so-called "McKinsey curves" that illustrate the unit cost of the measures and the result in terms of emission reductions.
4. There is a fourth method that is used many times in environmental decision-making: **Multi-criteria analysis (MCA)**. It is based on the need to consider multiple criteria in the decision-making process. With this method, any relevant information can be used, regardless of its nature (quantitative, qualitative, mixed) as long as it can be attributed to all alternative projects (a lowest common denominator) and can be expressed on a proportional or ordinal scale (criteria). The MCA makes it possible to assess the benefits and social values, as well as the indirect positive impacts of the measures. However, this analysis requires a large participatory process to achieve reduced uncertainty.

In this sense, in the analysis of the measures included in this report, a Cost Effectiveness Analysis (CEA) has been prioritized given that this is the analysis that will show objective and quantitative results for some measures, and therefore it will lead to future decision-making and more detailed analysis. Likewise, the Cost Benefit and Pay-back indicators will be calculated in a complementary manner.

Assessment of emission reduction initiatives

For this study, a series of estimates were made to assess the reduction potential of the previous identified measures. These estimates were made on four main measures since they had the necessary information for the calculations. These measures are:

- The installation of **solar water heaters** and the **replacement of old heating boilers**, which affect direct emissions of scope 1.
- The installation of **LED bulbs** and the installation of **photovoltaic panels**, which affect indirect emissions of scope 2.
- The installation of an **electronic document management system**, which affects the indirect emissions of scope 3.

The spreadsheet is available for review. It can also be adapted for other reduction measures when a minimum of information is available. It should be noted that for the estimation of some data such as the economic cost of implementation and maintenance of the measures, values found in external studies were assumed, since this information was not available.

The Cost-Effectiveness indicator is calculated considering the total discounted cost and subtracting the total discounted benefits. This number is then divided by the tons of CO_2 equivalent reduced, resulting in a cost per ton of CO_2 equivalent avoided. Therefore, negative results describe measures that have a net benefit. They do not only reduce GHG emissions, but they also provide economic benefits associated with these emission reductions.

Negative results mean that for every ton of CO_2 equivalent reduced, there is a positive economic return equal to the Cost-Effectiveness relationship.

In contrast, measures that have a positive result indicate that the measure has a net cost; the result shows the cost associated with reducing one ton of CO_2 equivalent by applying the measure.

Nº	Title	Total costs	Total benefits	Current net value	Effectivity cost	Cost-Benefit	Pay Back	tCO2e Avoided by 2030
E.1	Installation of LED technology	893,397.97	8,983.93	-884,414.04	19,951	0.01	Unrecoverable	44.33
E.2	Integration of solar panels	550,726.00	444,335.17	-106,390.83	43.03	0.81	Unrecoverable	2,472.54
E.3	Integration of solar water heaters	3,449.17	90,583.58	87,134.41	-301.68	26.26	1.02	288.83
E.4	Substitution of boiler to a more efficient one	4,500.00	63,851.02	59,351.02	-292.92	14.19	1.86	202.62
E.5	Paper reduction	13,000.00	7,318.17	-5,681.83	36.83	0.56	Unrecoverable	154.27

Table 9. Assessment of emission reduction initiatives.

Source: Factor CO2.

As it can be seen in the above Table, some measures have a negative value in the Cost-Effectiveness relationship, which means that they not only reduce GHG emissions, but they also provide economic benefits associated with these emission reductions. However, others show positive values, implying that in the short term (up to 2030) the emission reductions will not bring profitability.

In first place, the integration of solar water heaters is the most cost-effective measure, as it provides 301.68 euros of benefits per ton of CO_2e reduced. Indeed, the investment made for the implementation of this measure will be recovered almost in the same year of implementation.

Nonetheless, it should be noted that a complete substitution of a non-renewable source (diesel) to a renewable source, with the proposed installation power, does not produce as much energy as the diesel boiler due to solar energy capacity factor. Hence, it should be determined if such energy reduction (of about 76.18 kWh) could be assumed.

The cost-effectiveness indicator of the substitution of a boiler to a more efficient option was calculated considering a conservative objective of emission reduction (4% of annual reduction), and the results are also very positive, as the benefits earned would be 292.92 euros / tCO_2e. Also, the investment recovery would take place in the second year of implementation.

The emissions reduction through the paper reduction measure would not bring profitability by 2030. With the proposed annual objective (5% of annual paper reduction), the investment that would have to be made for the proper equipment will be higher, and the ton of CO_2 equivalent would cost 36.83 euros.

In addition, the installation of solar panels would not bring profitability until 2034, and each ton of CO_2 equivalent would imply a cost of 43.03 euros. But, regarding avoided CO_2 emissions, it can be observed that this measure, although not being cost-effective in 2030, has the highest potential to avoid net emissions by 2030, reaching a total of 2,472.54 tCO_2e from the year of implementation. In contrast, the other measures imply a much lower reduction of emissions.

Finally, the least cost-efficient measure is the replacement of lighting bulbs as there is a high cost per ton of CO_2 equivalent reduced (19,951 euros / tCO_2e in benefits). As the annual objective is not so ambitious (10 LED bulbs implemented annually), the annual energy savings would be very small, and so the money saved in the short term would not be as high as the investment that will have to be made.

All this information should be taken as a base for the prioritization of measures when designing and implementing the Carbon Management Plan. As mentioned previously, the spreadsheet is available for the review of all the estimates and assumptions. It can also serve as a template for future estimations.