TRAINING MATERIAL

Hotel Sector: How to reduce greenhouse gas emissions

Experiences from Greece, Cyprus, Germany and the EU

Hotels4Climate

On behalf of:

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

of the Federal Republic of Germany

European Climate Initiative EUKI

Hotel Sector: How to reduce greenhouse gas emissions

Experiences from Greece, Cyprus, Germany and the EU

Hotels4Climate

https://www.oeb.org.cy/drasis/hotels4climate/

Authors: Aris Ikkos (INSETE), Michalis Kyriakides (INSETE), Soteris Mylonas (INSETE), Nikos Sofianopoulos (INSETE), Anthi Charalambous (OEB), Panayiotis Kastanias (OEB), Andri Constantinou (OEB), Madeline Schneider (adelphi), Jessica Weir (adelphi), Anton Barckhausen (adelphi)

August 2020

Cover photo: A synthesis from Shutterstock photos n.345214205, 682370575 and 259055471.

Project: Hotels4Climate, Fostering GHG reduction in the Cypriot and Greek hotel industry

Deliverable number: A.II.1

Deliverable Name: Training material

© 2020 OEB | INSETE | adelphi

OEB

The Cyprus Employers and Industrialists Federation (OEB) was founded in 1960 by 19 pioneering entrepreneurs. Today, its members are active in all sectors of the economy and employ more than 60% of the private sector's workforce. OEB is a Pancyprian, independent non-profit organization comprising of 60 of the main professional/sectoral Associations as well as hundreds of companies from the Manufacturing, Services, Commercial, Construction and Agricultural Sectors. In total, OEB has more than 15.000 Member/Enterprises.

In particular, the Energy & Environment Department of OEB was founded in 2016 and its goals are to be pioneer on the topics of energy, environment and sustainability, through actions that can improve the competitiveness of renewable energy technologies, to remove administrative or other barriers for the promotion of energy efficiency, to support Cypriot manufacturers to maintain their global position in the installation of domestic solar thermal systems, to promote clean technologies for environmental protection and the 2030 targets for circular economy and climate change, to provide education and training, to promote efficient use of energy, to provide technical advisory support on sector related issues, to promote cooperation between academia and industry in the fields of energy and environment and in the development of research and innovation.

There are many projects have been developed by the Energy & Environment Department that aim for the promotion of eco-innovation, blue energy, GHG emission reduction, etc.

OEB operates in environmentally friendly manner. Since 2017 OEB is EMAS certified as well as produces on site renewable electricity through PV net metering system.

Anthi Charalambous

Director of Energy & Environment Department

acharalambous@oeb.org.cy

www.oeb.org.cy

INSETE

INSETE is a non-profit organisation founded in early 2013, on the initiative of the Greek Tourism Confederation (SETE), by four partners with intense activity in critical areas of the Greek tourism market: SETE (principal partner), the Hellenic Hoteliers Federation (HHF), the Hellenic Association of Travel & Tourist Agencies (HATTA) and the Confederation of Entrepreneurs of Rented Rooms and Apartments (SETKE).

The mission of INSETE is to contribute with well-substantiated ideas to promoting both public and private policies that will support, modernise and improve the Greek tourism sector and any other service sector which is directly or indirectly associated with it.

Specifically, INSETE supports the Greek Tourism Confederation with:

- documented and thought out interventions in social and public dialogue (positions, proposals, etc.) aimed at promoting policies to support, modernise and improve Greek tourism.
- implementing actions to research, inform and disseminate knowledge, to develop human resources and improve and certify quality of enterprises and the skills of professionals and workers in Greek tourism.

Furthermore, the main activities of INSETE are:

- To research, safeguard and promote the position and contribution of tourism to sustainable economic, social and cultural growth and development at both a national and European level.
- To support and promote entrepreneurship (both conventional and social) in the tourism sector, and in any other service sector which is directly or indirectly associated with it.
- To enhance Human Resources development policies and tools for the tourism sector and any other service sector which is directly or indirectly associated with it.
- To provide scientific, technical or other form of documentation and support to SETE on issues relevant to its activities and operations, and to help it achieve its objectives.

Aris Ikkos

Research Director

ikkos@insete.gr

https://sete.gr/el/poioi-eimaste/insete/

adelphi

adelphi is a leading independent think tank and public policy consultancy on climate, environment and development. Our mission is to improve global governance through research, dialogue and consultation. We offer demand-driven, tailor-made services for sustainable development, helping governments, international organizations, businesses and non-profits design strategies for addressing global challenges.

Our staff of more than 200 provides high-quality interdisciplinary research, strategic policy analysis and advice, and corporate consulting. We facilitate policy dialogue and provide training for public institutions and businesses worldwide, helping to build capacity for transformative change. Since 2001 we have successfully completed over 800 projects worldwide. Our work covers the following key areas: Climate, Energy, Resources, Green Economy, Sustainable Business, Green Finance, Peace and Security, International Cooperation and Urban Transformation.

Partnerships are key to the way we work at adelphi. By forging alliances with individuals and organizations, we help strengthen global governance and so promote transformative change, sustainable resources management and resilience. adelphi is a values-based organization with an informal culture based on excellence, trust and cooperation. Sustainability is the foundation of our internal and external conduct. Our activities are climate-neutral and we have a certified environmental-management system.

Madeline Schneider

Project Manager

schneider@adelphi.de

www.adelphi.de

Table of contents

List of tables

List of figures

List of boxes

List of abbreviations

AD:	Anaerobic Digestion
B(E)MS:	Building (Energy) Management System
CDDs:	Cooling degree days
CH_4:	Methane
CO_2:	Carbon dioxide
CO_2e:	Carbon dioxide equivalent
CDD:	Cooling Degree Days
CFR:	Council on Foreign Relations
DCF:	Discounted Cash Flow
DHW:	Domestic Hot Water
EC:	European Commission
EU:	European Union
EEA:	European Environmental Agency
EED:	Energy Efficiency Directive
EPA:	United States Environmental Protection Agency
EESI:	Environment and Energy Study Institute
EGD:	European Green Deal
EMAS	EU Eco-Management and Audit Scheme
EMEKA:	Committee for the Study of Climate Change
ETIS:	European Tourism Indicator System
€:	Euro
$GtCO_2e$:	Gigatons of Carbon dioxide equivalent
GHG:	Greenhouse gas
GSTC:	Global Sustainable Tourism Council
GW:	Gigawatt
GWh:	Gigawatt hour
GWP:	Global Warming Potential
HDD:	Heating Degree Days
HES:	Hotel Energy Solutions
HFCs:	Hydrofluorocarbons
HVAC:	Heating, Ventilation and Air Conditioning
IEA:	International Energy Agency
INSETE:	Hellenic Tourism Business Association
IPCC:	Intergovernmental Panel on Climate Change
kWh:	Kilo-Watt hour
LED:	Light Emitting Diode
LEED:	Leadership in Energy and Environmental Design

LNG:	Liquid Natural Gas
LPG:	Liquid Petroleum Gas
MJ:	Megajoule
Mt:	Megaton
NASA:	National Aeronautics and Space Administration
N_2O:	Nitrous oxide
NCEI:	National Centers of Environmental Information
NEM:	Net Energy Metering
NOOA:	National Oceanic and Atmospheric Administration
neZEH	Nearly zero energy hotels
NRDC:	Natural Resources Defense Council
nZEB	Nearly zero energy buildings
PFCs:	Perfluorocarbons
PPM:	Parts per million
PPB:	Parts per billion
PPT:	Parts per trillion
PV:	Photovoltaic system
PVC:	PolyVinyl Chloride
RCP:	Representative Concentration Pathway
OEB:	Cyprus Employers and Industrialists Federation
RES:	Renewable energy sources
ROI:	Return on Investment
SCOP:	Seasonal Coefficient Of Performance
SEER:	Seasonal Energy Effusion Ratio
SDGs:	Sustainable Development Goals
SETE:	Greek Tourism Confederation
SF6:	Sulphur hexafluoride
SME:	Small & medium-sized enterprises
SWH:	Solar Water Heater
tCO_2e:	Tonnes carbon dioxide equivalent
tWh:	Terawatt hours
UCDAVIS:	University of California – Davis
UNEP:	United Nations Environmental Programme
UNFCCC:	United Nations Framework Convention on Climate Change
UNWTO:	United Nations World Tourism organisation
USGS:	United States Geological Survey
WMO:	World Meteorological Organisation

Preface

The scientific evidence is overwhelming. Earth's average temperature is increasing and as a result, major changes in the climatic conditions around the world are already happening. As per the National Oceanic and Atmospheric Administration (NOOA, n.d.), the average temperature across global land and ocean surfaces in 2019 was 0,95°C above the twentieth-century average of 13,9°C, making it the second-warmest year on record. According to the special report on the impacts of global warming by the **Intergovernmental Panel on Climate Change** (IPCC, 2018), the planet is currently warming by 0,2 °C per decade. The National Aeronautics and Space Administration (NASA, n.d.) has estimated that the Arctic sea ice has been steadily declining in the last 40 years at an average rate of 12,85% per decade, while sea level has risen on average by more than 8 cm since 1993 (NOOA, n.d.-2). As reported by the European Union (EU, 2019), climate-related extremes such as forest fires, flash floods, typhoons and hurricanes are causing mass devastation and loss of lives, as well as economic damage. In 2017 alone, economic damage caused by weather-related disasters amounted to €283 billion globally.

Why is this happening?

As stated by the United States Geological Survey (USGS, n.d.), changes in Earth's climate are not uncommon. What it is of great concern worldwide today is the rapid rate and magnitude of this change, predominantly caused by the accelerated increase in the concentration of Greenhouse gases (GHGs) in the atmosphere at levels not seen in three million years. According to the European Environmental Agency (2019), the total concentration of all greenhouse gases, including cooling aerosols, reached a value of 454 ppm in CO_2eq in 2017 — an increase of more than 4 ppm compared with 2016, and 37 ppm more than 10 years ago. This surge is primarily attributed to human activity, especially after the Industrial Revolution, and is causing more heat retention; thus, all the impacts mentioned in the previous paragraph. As populations, economies and standards of living grow, so does the cumulative level of GHG emissions (United Nations, n.d.).

What should we do about climate change and what has been done already?

The United Nations organisation (UN) first recognized climate change as a serious issue at the ground-breaking Rio Earth Summit in 1992. Since then, several notable accords have been produced among countries, including the Kyoto Protocol in 1997 and the Paris Agreement in 2015. The urgent need for action to combat Climate Change and its impacts is also underpinned by the 2030 Agenda for Sustainable Development (SDG n.13), adopted by all UN Member States in 2015. Unfortunately, support from some of the most polluting countries in the world has been very reluctant and efforts so far have failed to slow global temperature rise (Council on Foreign Relations, 2020). The EU is showing the way by aiming to become climate-neutral by 2050 and to this end has submitted its long-term strategy to the United Nations Framework Convention on Climate Change (UNFCCC) in March 2020. The vital goal is to keep global temperature rise below 2°C and pursue efforts to keep it below 1,5°C. However, scientists and experts warn that greater action is required in order to achieve this. A "think globally, act locally" approach is more relevant than ever and all sectors and industries -travel and tourism included- must play their part in achieving the GHG reduction targets adopted by so many governments and international organisations.

Tourism can be considered an economic sector highly sensitive to climate change and it contributes to the emission of greenhouse gases (GHG), one of the causes of global warming. It is an industry affected by climate change, but it also makes a significant contribution to GHG emissions, especially due to transportation (passenger transport) and infrastructure (accommodation). Guest accommodation, restaurants and related services, natural and historic resources, cultural and special events all help to define the visitor experience. Climate change or climate variability may impact directly on capital stocks (buildings, infrastructure, heritage assets) or indirectly on the flow of goods and services, including those services provided by natural ecosystems and processes. Beaches, unique landscapes, wildlife, waterfalls, sulphur springs are all part of a rapidly growing eco or nature tourism experience in the region.

How to use this training manual

This training manual was developed as a core deliverable of the Hotels4Climate project. The project aims to reduce the greenhouse gas (GHG) emissions caused by the hotel industry in Cyprus and Greece through various activities such as reporting the current situation regarding energy consumption in the hotel sector, delivering education and training to hotel staff, raising awareness of gas emissions, identifying cost and energy saving opportunities, and facilitating the exchange of knowledge thematic visits and access to the financial sector.

This training manual was designed for the hotel industry, to provide the businesses key information on climate change and its influence on the hotel industry, and tools the businesses can use to develop the necessary skills, knowledge and competence to get ready for a carbon neutral economy.

Chapter 1 explains the main causing factors of Climate Change and emphases its impacts on tourism, followed by a review of the global action to combat this existential threat on Earth. In the same context, the concept of carbon footprint is also explained; what is carbon footprint, how to quantify it and why measuring it will benefit an organization.

Chapter 2 provides an overview of the basic principles of energy management and how it can be implemented effectively by the hospitality sector, in order to achieve maximum energy savings and GHG reduction. The main energy users found in accommodations are identified and the most available renewable energy sources are explained. Finally, some relevant best practices from the industry are shared.

Chapter 3 is dedicated in identifying opportunities for energy savings and GHG emissions reduction, whether they involve small or big investments in equipment and building infrastructure or simple behavioural changes from staff. Various energy efficient technologies are presented along with numerous every-day tips.

Chapter 4 presents the importance of proper waste prevention and waste management in reducing energy consumption and GHG emissions.

Chapter 5 is dedicated to sustainability awareness, eco-certification and CSR and provides the basic elements of creating an awareness campaign towards external stakeholders and how to communicate the green strategy in marketing plans.

Chapter 6 offers a basic understanding on the methodology and tools for monitoring performance and continual improvement in the context of energy management.

The **Annex** of this manual provides an indicative table for the knowledge, skills and competences per learning outcome and learning unit, as well as the suggested classroom learning hours.

1 Introduction to Climate Change

1.1 Climate change basics and GHG emissions

1.1.1 Climate and Weather

To understand the impact of climate change in our world, it is necessary to distinguish between certain notions. Firstly, it must be clear that **climate** and **weather** are two different things. Climate refers to the weather patterns expected to occur over a long period of time, while weather describes the actual short-term changes that happen in the atmosphere. In simple words, climate suggests the types of clothes to have in our closet, whereas the weather informs us about what to wear each day. Studying the climate of a certain region requires observations of various weather variables, such as precipitation, temperature, humidity, sunshine and wind, which occur in this geographical area over a long period of time (National Centers for Environmental Information, 2020).

Similarly, a distinction should be made regarding the climate variability and climate change. The climate variability involves data series that fluctuate considerably between observations but retain a relatively constant mean over the period of measurements, whereas the climate change refers to a periodic alteration or uniform trend in the underlying climate during the observed period.

Lastly, it should be emphasized that what we call climate is the result of a complex web of physical processes determined by a wide range of factors -some of which may seem totally unrelated- interacting with each other in numerous and often undetected ways. Moreover, each factor may assume a different significance depending on the time and place of taking part in these physical processes (Burroughs, 2007).

1.1.2 Human-induced Climate Change

The term '**climate change'** has been a buzzword in recent years and, as it will be demonstrated further below, for good reason. As a general definition, "climate change refers to significant changes in global temperature, precipitation, wind patterns and other measures of climate that occur over several decades or longer" (University of California - Davis, n.d.). Earth's climate has seen major changes during the last half a million years, mostly attributed to small variations in its orbit that change the amount of solar energy reaching our planet. Then, about 11,700 years ago, the abrupt end of the last ice age marked the beginning of the modern climate era and of human civilization (NASA, 2020). However, since the 1950s, emissions of GHG caused by human activities are growing at an unprecedented pace causing warming of the global climate system (IPCC, 2014).

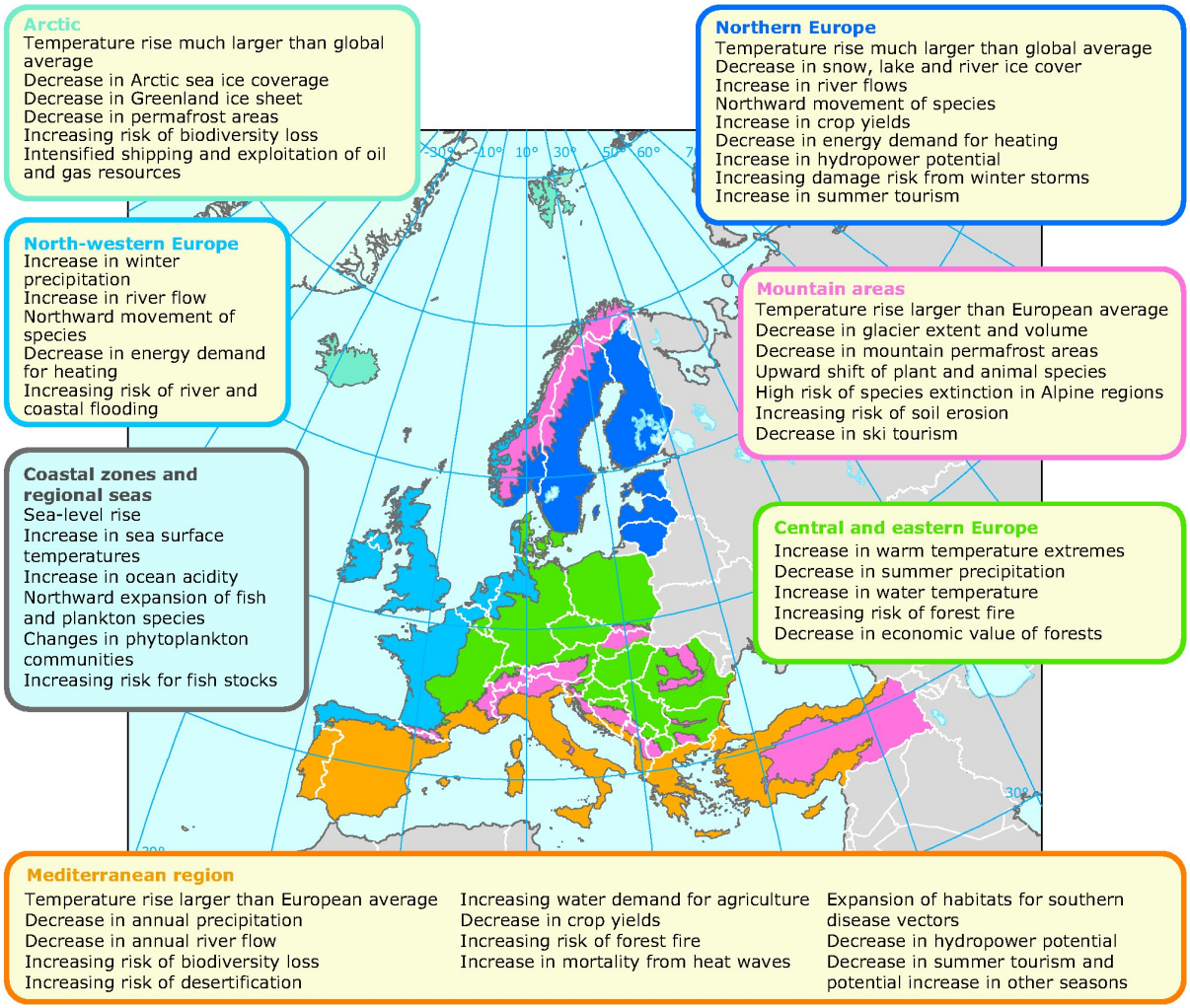
It becomes clear that the linkage between higher GHG emissions and global warming is key to understand the causes of human induced climate change. As a result, global temperatures have repeatedly broken several maximums in the past decade, with the last five years being the hottest on record, causing heatwaves, droughts, and wildfires across all Europe. Projections for the future are even more alarming. According to the IPCC's 5th Evaluation Report (2014), the average increase in surface temperature until the end of the current century is estimated between 1,0°C and 3,7°C, depending on the Representative Concentration Pathway (RPCs[1]) used in the climate simulation models.

Similarly, a rise of 26 to 77 cm in the global mean sea level is anticipated until the year 2100 (relative to 1986-2005). Rising temperatures are expected to be greater in the larger latitudes and more intense in the mainland compared to the oceans. In particular, the Arctic region will continue to heat up faster than

[1] Anthropogenic GHG emissions are mainly driven by population size, economic activity, lifestyle, energy use, land use patterns, technology and climate policy. The Representative Concentration Pathways (RCPs), which are used for making projections based on these factors, describe four different 21st century pathways of GHG emissions and atmospheric concentrations, air pollutant emissions and land use. The RCPs include a stringent mitigation scenario (RCP2,6), two intermediate scenarios (RCP4,5 and RCP6,0) and one scenario with very high GHG emissions (RCP8,5). Scenarios without additional efforts to constrain emissions ('baseline scenarios') lead to pathways ranging between RCP6,0 and RCP8,5. RCP2,6 is representative of a scenario that aims to keep global warming likely below 2°C above pre-industrial temperatures. The RCPs are consistent with the wide range of scenarios in the literature as assessed by WGIII5.

the global average. It is also very likely that heat waves will last longer and be more frequent. Nevertheless, winters with extreme cold conditions will continue to occur occasionally.

Figure 1 - Key observed and projected climate change and impacts for the main regions in Europe[2]



The Eastern Mediterranean and the Middle East is made up of two dozen countries with some 400 million inhabitants. On top of years of intense industrialization, rapid population growth and extensive land conversion, the region is expected to become a global climate change 'hot spot' based on results of global climate models. To understand the implications of shifting weather patterns and changing climate conditions in this region, we have carried out studies on a much finer spatial scale compared to global models. Results of our regional climate models provide insight into likely changes for the 21st century confirming and underlining the notion of an evolving 'hot spot' with much dryer and warmer climate conditions in the years to come[3].

[2] Source: https://www.eea.europa.eu

[3] Source: http://weather.cyi.ac.cy/en/climate/climate-change/

Figure 2 - Change (a) in average surface temperature, (b) average precipitation and (c) average sea level based on multi-model mean projections for 2081–2100 relative to 1986–2005 under the RCP2.6 (left) and RCP8.5 (right) scenarios[4]

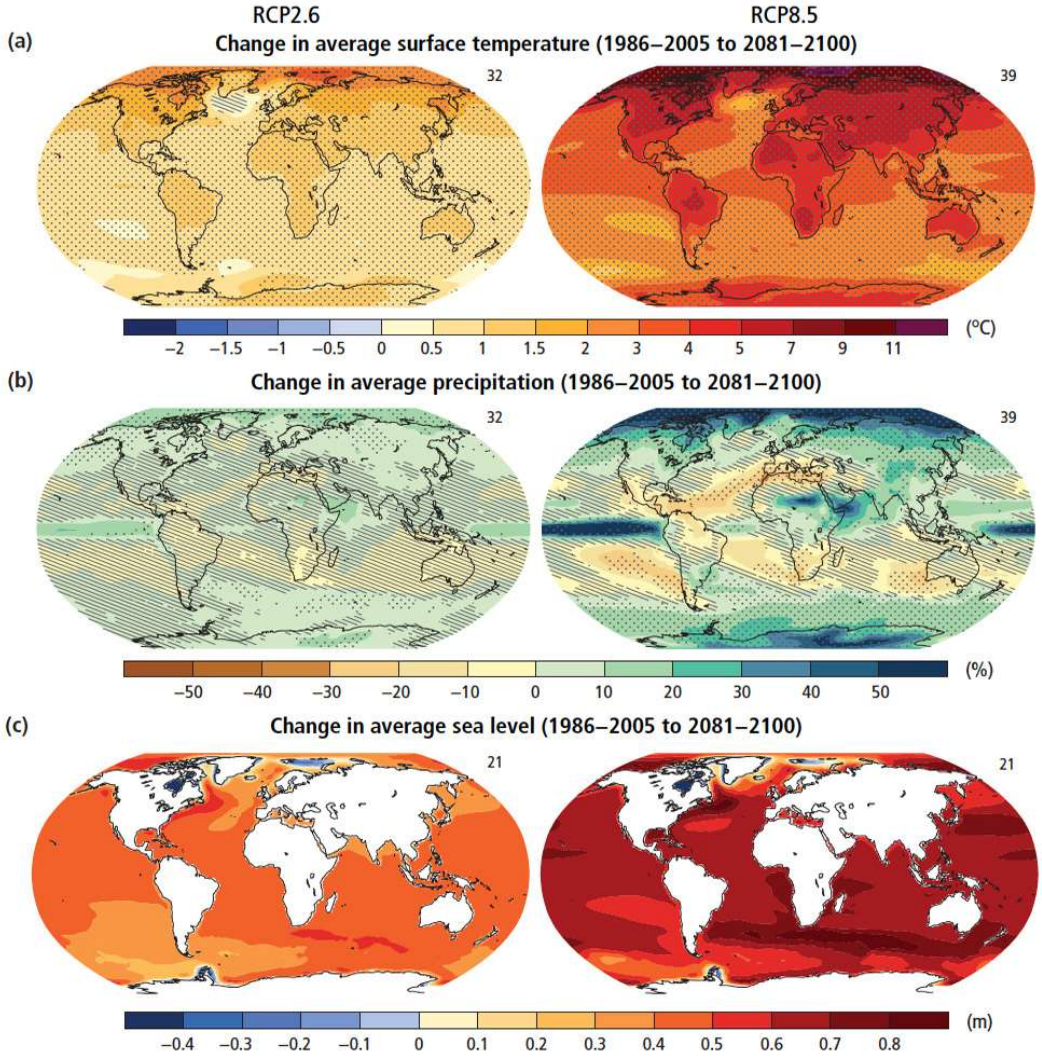
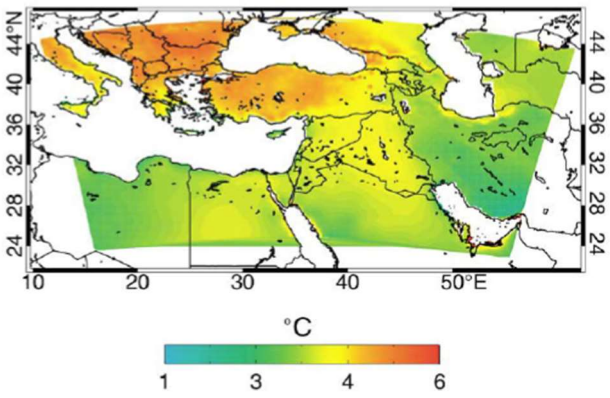
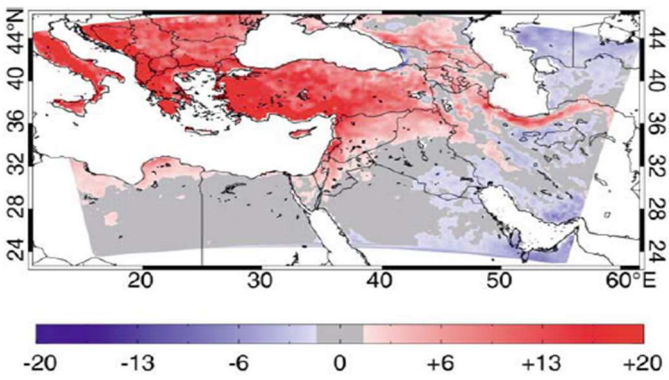


Figure 3 - Projected average change temperatures over one century in the meditterannean and middle east (left) and projected change in the number of dry days (per year) over a century (right), (Cyprus Institute, 2020)



Projected average change in temperatures over one century.

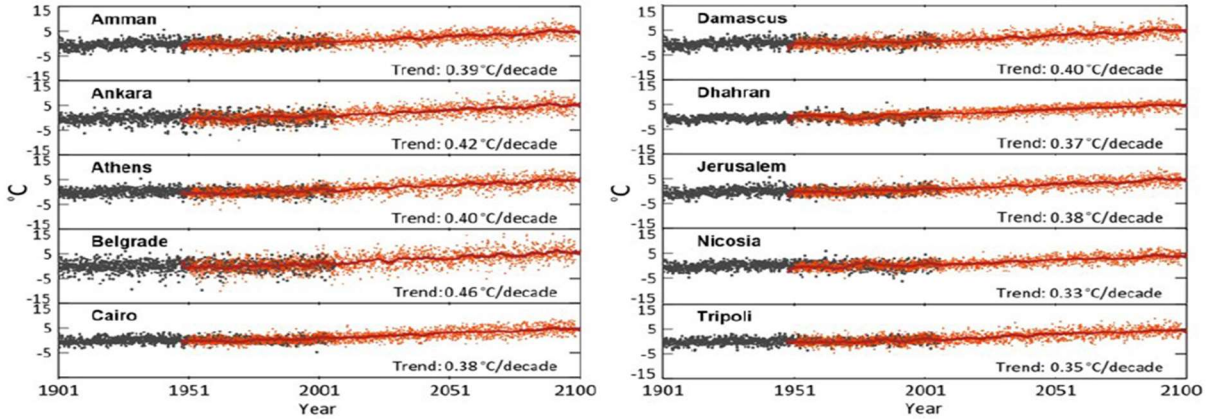


Projected change in the number of dry days (per year) over one century.

[4] Source: Figure SMP.7 in IPCC, 2014, p.12

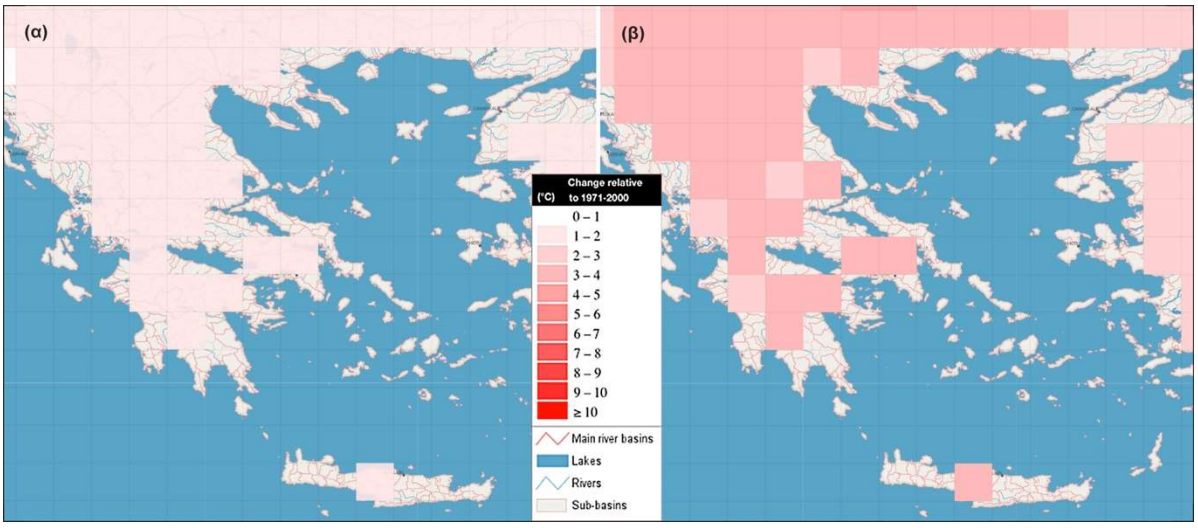
More explicitly, Cyprus Institute model output indicates mean temperature rises of about 1 to 3°C in the next three decades, of 3 to 5°C by mid-century and 3,5 to 7°C by the end of the century placing Eastern Mediterranean and the Middle East ahead of most other places on the globe in terms of projected temperature changes. To make matters worse, precipitation is expected to decline with reductions in mean annual rainfall of 10-50% in northern parts of the Middle East, Turkey, Greece and southern Italy. Most of the decrease in rainfall will be seen in the spring and summer seasons[5].

Figure 4: Mean temperature predictions until 2100 in Eastern Mediterranean and the Middle East



Based on the emission scenarios examined for the same time period by the Committee for the Study of Climate Change (EMEKA, 2011), on behalf of the Bank of Greece, the whole Southeast Mediterranean region is likely to see an increase in the average air temperature between 3,0°C and 4,5°C and a decrease, between 5% to 19%, in the average annual rainfall **in Greece**. At the same time, the number and intensity of extreme storm and flooding events are also expected to grow.

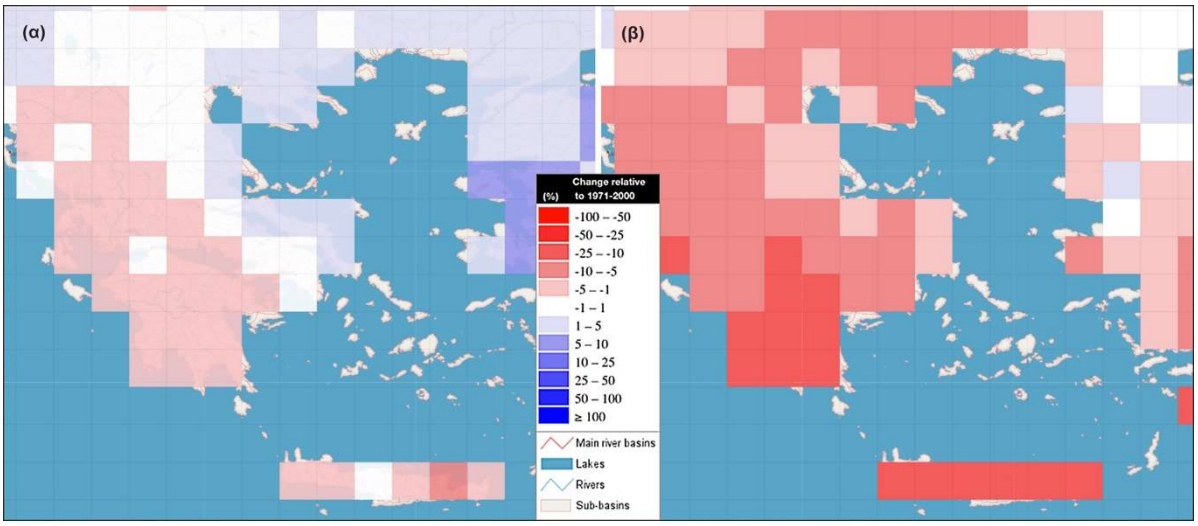
Figure 5: Expected change in the average annual temperature in Greece for the periods (a) 2011-2040 and (b) 2071-2100, in relation to the period 1971-2000 (spatial data analysis 0,5 degrees [50 km], average of RCPs scenarios[6].



[5] Source: http://weather.cyi.ac.cy/en/climate/climate-change/

[6] Source: http://swicca.climate.copernicus.eu/

Figure 6: Expected change in the average annual rainfall in Greece for the periods (a) 2011-2040 and (b) 2071-2100, in relation to the period 1971-2000 (spatial data analysis 0,5 degrees [50 km], average RCP script term)



Climatic changes have affected **Cyprus**. The changes are obvious in Precipitation and Temperature. The average annual Precipitation in the period 1991/ 92 - 2007/ 08 (17 hydrometeorogical years) is 457 mm or 9% lower than normal (503 mm, period 1961-1990). The average annual Temperature in the period 1991-2007 is 17,7°C or 0,5°C higher than normal (17,2°C, period 1961-1990). According to the above rate of changes it is expected that by 2030 Precipitation will decrease by 10 - 15% and Temperature will increase by 1,0 - 1,5°C compared to the normal values of the period 1961- 1990[7].

The urgency to drastically and permanently mitigate GHG emissions is apparent, especially if it is realised that even an immediate and complete halt of all GHG emissions would not stop the climate impacts that are already happening, and which are likely to continue for decades. Temporary decreases of GHG emissions, like those caused by the 2008-2015 financial crisis (or the current economic disruption from the Covid-19 pandemic) have little effect on the evolution of the planetary climate and can bounce back quickly (Monroe, 2020).

1.1.3 Greenhouse Effect

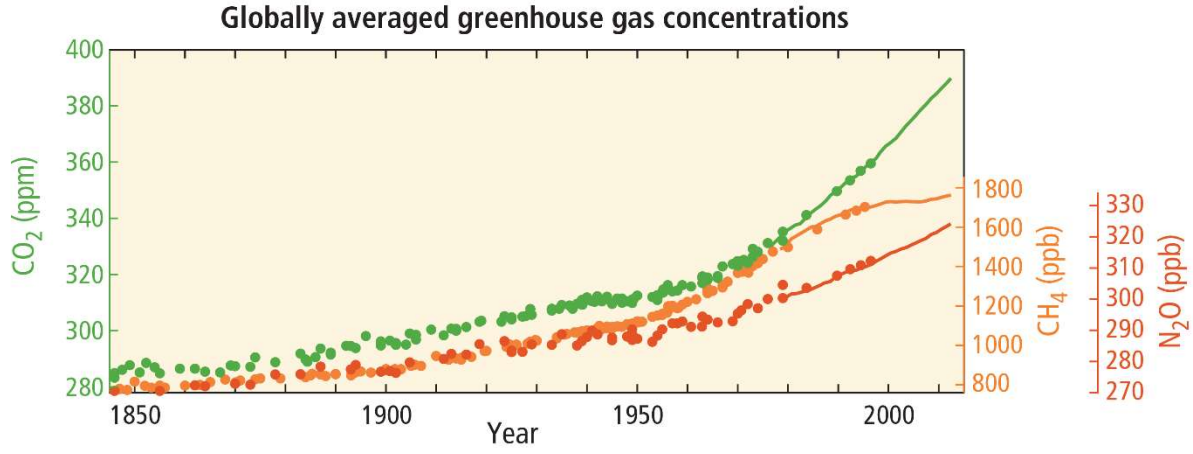
The greenhouse effect has been wrongly associated in a negative way to climate change. It is actually a very important natural mechanism, responsible for warming the planet to its comfortable global average of 15 degrees Celsius and making it a habitable place for numerous species, including humans. As explained by the Natural Resources Defense Council[8] (NRDC, 2020), approximately 30% of the solar energy emitted towards the Earth is reflected back to space, while the remaining 70% is absorbed by the land, oceans and atmosphere and heats the planet. This heat is then radiated back up in the form of invisible infrared light. Thanks to certain atmospheric gases, known as GHGs, some 90% of this heat gets absorbed by and redirected back towards the earth, causing further warming. Unfortunately, the extent use of fossil fuels for energy production following the industrial revolution, has skyrocketed the concentration of GHGs in the planet's atmosphere in less than 200 years. The amount of carbon dioxide (CO_2), for example, remained relatively steady throughout the last 800.000 years, between 180 and 280 parts per million[9] (ppm), but has surpassed 415 ppm in 2020 (Scripps Institution of Oceanography at UC San Diego).

[7] Source: http://www.moa.gov.cy/moa/ms/ms.nsf/DMLcyclimate_gr/DMLcyclimate_gr?OpenDocument

[8] The Natural Resources Defense Council works to safeguard the earth - its people, its plants and animals, and the natural systems on which all life depends.

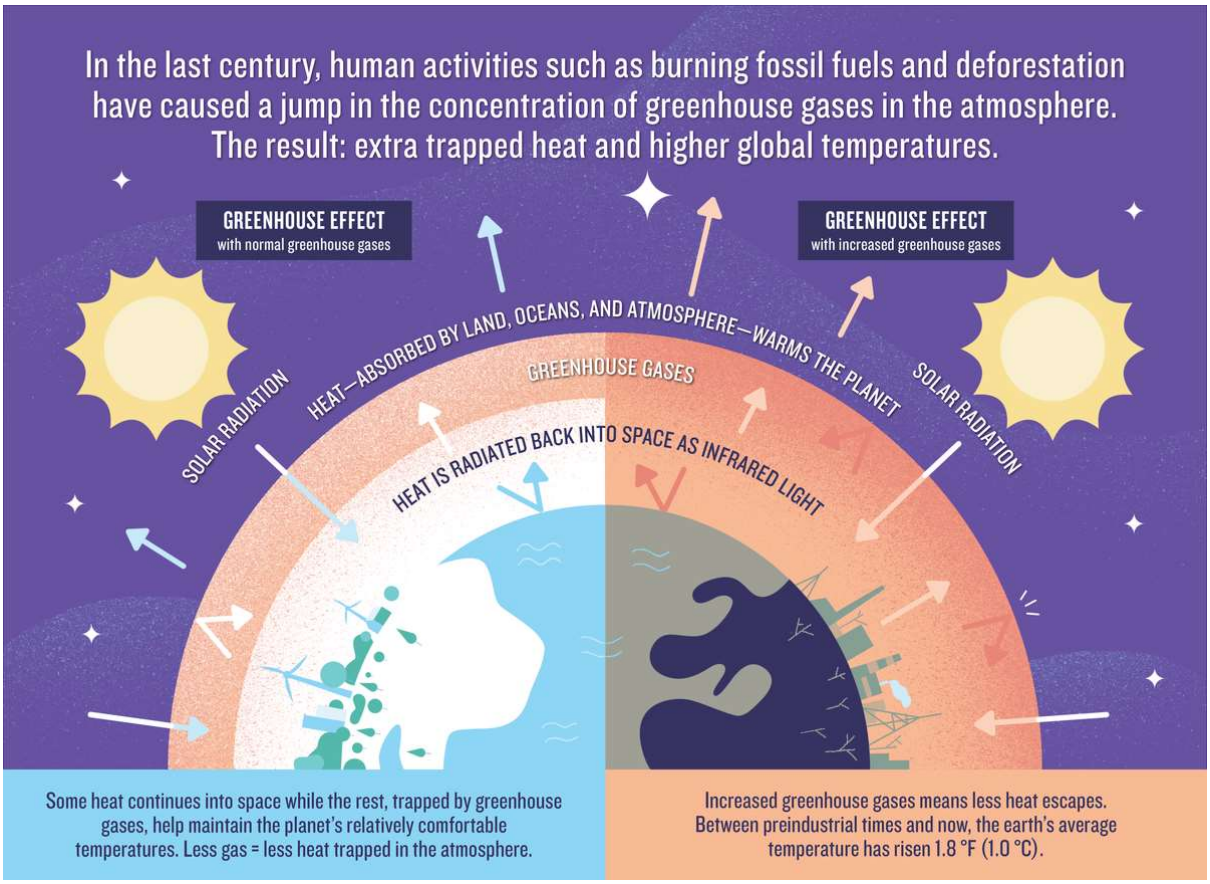
[9] In other words, there were 180 to 280 molecules of CO_2 per million molecules of air.

Figure 7: Cumulative concentrations of the main GHG in the atmosphere since 1850, i.e. carbon dioxide (CO2, green) in ppm, methane (CH_4, orange) and nitrous oxide (N_2O, red) in ppb, determined from ice core data (dots) and from direct atmospheric measurements (lines)[10]



The higher concentrations of GHGs -and CO_2 in particular- are artificially enhancing the natural greenhouse effect by allowing less heat to escape into space and as a result, the average global temperature increases. This global warming is in turn affecting the planet's climate systems in countless ways, many of which are not yet fully comprehended. The whole process -with and without anthropogenic interference- is clearly depicted in Figure 6 below.

Figure 8: The greenhouse effect with and without anthropogenic interference[11]



[10] Source: SMP.1 in IPCC, 2014, p.3.

[11] Source: Michal Bednarski for NRDC, from: https://www.nrdc.org/stories/greenhouse-effect-101#whatis

1.1.4 Greenhouse Gases

As stated by NRDC (2020), the main gases responsible for the greenhouse effect include CO_2, methane (CH_4), nitrous oxide (N_2O), and water vapour (which all occur naturally), and fluorinated gases (which are synthetic). GHGs have different chemical properties and are removed from the atmosphere through different processes over time. CO_2, for example, can be absorbed by plants, the soil, and the ocean, which are also known as carbon sinks. Fluorinated gases are destroyed only by sunlight in the far upper layers of the atmosphere.

Figure 9: Chemical structure of the greenhouse gases

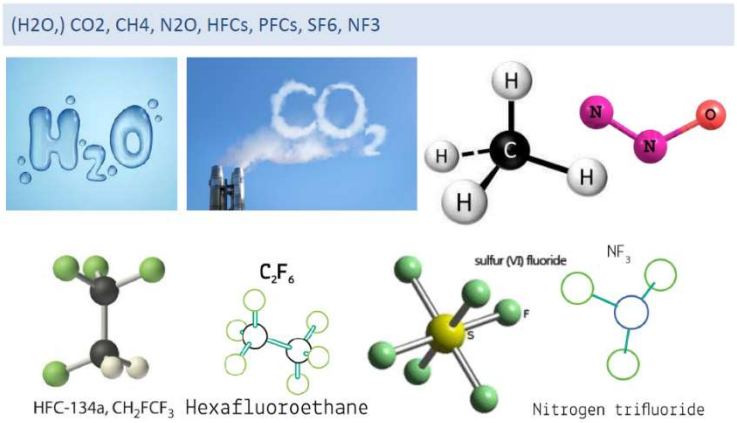


Table 1: The global warming potential (GWP) for each of the main gaseous pollutants according to its 4th Assessment Report of IPCC (AR4, 2007)

GHG	GWP (in CO_2e)
CO_2	1
CH_4	25
N_2O	298
HFCs, PFCs and SF_6	675 to 13.214

The influence of any one of these GHGs to global warming depends on some factors. **The amount of each gas in the atmosphere** is the first. This is measured in parts per million, billion (ppb), or even trillion (ppt) and practically means that there is one molecule of that gas in every million, billion or trillion molecules of air, respectively. Second is the **lifetime of each gas**, thus the amount of time that it is expected to remain in the atmosphere, and finally third is the effectiveness of each gas in trapping heat. This is also referred to as its global warming potential (GWP)[12], which is a "measure of the relative radiative effect of a given substance compared to CO_2, integrated over a chosen time horizon (usually 100 years)" (IPCC, 2001, p.46). More information about specific legal obligation concerning the use of fluorinated gases is provided in section 1.2.3.

[12] The Global Warming Potential (GWP) was developed to allow comparisons of the global warming impacts of different gases. Specifically, it is a measure of how much energy the emissions of 1 ton of a gas will absorb over a given period of time, relative to the emissions of 1 ton of CO_2. The larger the GWP, the more that a given gas warms the Earth compared to CO_2 over that time period. The time period usually used for GWPs is 100 years. GWPs provide a common unit of measure, which allows analysts to add up emissions estimates of different gases (e.g., to compile a national GHG inventory), and allows policymakers to compare emissions reduction opportunities across sectors and gases. As an example, Methane (CH_4) is estimated to have a GWP of 28–36 over 100 years while Nitrous Oxide (N_2O) has a GWP 265–298 times that of CO_2 for a 100-year timescale (EPA, n.d.).

1.1.5 The impacts of Climate Change on Tourism

As advocated in the joint report about Climate Change and Tourism: Responding to Global Challenges (2008), from the United Nations Environment Programme (UNEP), the World Tourism Organization (UNWTO) and the World Meteorological Organisation (WTO), both climate and the environment (natural and anthropogenic) are principal resources for tourism, as they codetermine the kind and seasonality of the tourism products that can be offered at each destination along with operating and insurance costs. Being so closely dependent on these resources, tourism is therefore highly vulnerable to a broad range of climate change consequences already evident at numerous destinations around the world.

The Mediterranean area is already suffering from extended heat waves, wildfires, droughts, and coastal erosion. At the same time, rainstorms, strong winds and floods are becoming more frequent and intense, affecting water quality and availability, as well as causing heavy damages, even deaths (EC, n.d.-2). Thus, changes in climatic variables, such as temperature, wind speed or snowfall, could undermine the attractiveness of several destinations to visitors and gradually alter tourism demand patterns. Such a development will have considerable effect on the profitability -or even existence- of the local tourism industry in these destinations. Moreover, as both the frequency and magnitude of extreme weather events are estimated to increase under the ongoing climate trends, tourism infrastructures will need to prepare for such emergencies in order to avoid significant damages and ensure business continuity (IPCC, 2014).

1.1.6 Global action to combat Climate Change

In 1994, the international community, through the United Nations Framework Convention on Climate Change (UNFCCC), has recognized for the first time the possible threat of climate change and set the objective to stabilize GHG concentrations "at a level that would prevent dangerous anthropogenic (human induced) interference with the climate system" within a sufficient time-frame (UNFCCC, 2020-a). Then in 1997, “The Kyoto Protocol” was adopted, but entered into force about seven years later due to a complex approval process, and most recently “The Paris Agreement” came into force on 4 November 2016. The former has placed a commitment to industrialized countries to limit and reduce GHG emissions in accordance with agreed individual targets (UNFCCC, 2020-b), while the latter brought all 195 countries into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects, with enhanced support to assist developing countries to do so.

The central aim of the Paris Agreement is to strengthen the global response to the threat of climate change by keeping the global temperature rise in the 21st century well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1,5°C (UNFCCC, 2020-c). Embracing the said agreement in its “Tourism and Climate Change Mitigation” report, the European Travel Commission (ETC, 2018) provided the first global analysis of the risks to the tourism industry from climate change and offered a roadmap towards a low-carbon tourism economy (see Box 1).

As per the ETC’s report, the accommodation sector could become zero-emissions for the 2035 sectoral target, provided that national governments rapidly develop clear and stable policy frameworks and building codes to facilitate necessary construction and refurbishment investment decisions.

Box 1: The ETC’s proposed action framework for decarbonisation (ETC report, 2018 p.30)

Differential actions and responsibilities are required to enable the travel and tourism sector to achieve significant emissions reductions. By stakeholder group, these could include:

Policymakers:

• define decarbonisation targets for the tourism sector, including aviation and shipping, on supranational (aviation/shipping) and national (accommodation, ground transport) levels

• introduce a price for carbon, with long-term price signal updated at each Paris Agreement stocktake cycle

• support research and development of alternative fuels for aviation and other low-carbon technologies germane to emissions reduction in the tourism sector

• work with the tourism industry to establish monitoring systems for tourism sector emissions.

Tourism industry:

• measure emissions

• introduce carbon shadow pricing
• improve eco-efficiencies to increase climate resilience and reduce emissions
• use low-carbon fuels, renewable electricity
• engage in energy co-production (renewables) with destination communities
• invest in high-quality carbon offsetting
• explore cross-sectoral partnerships to invest offsetting purchases in actions that decarbonise the tourism sector
• increase investment in research and development of alternative fuels for aviation.
Other tourism stakeholders:
• advocate for low-carbon legislation, support mitigation governance
• contribute to emissions measurement at global, national, business levels
• provide advice on deployment of new technologies
• develop models to assess cost of sector restructuring in a decarbonising economy
• share knowledge about best practice carbon disclosure, emissions reduction, and climate resilience strategies
• coordinate development of destination decarbonisation and adaptation strategies.

Furthermore, the historic agreement at the United Nations in 2015 on a universal 2030 Agenda for sustainable development set out a global framework aiming to achieve a better future for all and committed all countries to pursue a set of 17 SDGs and 169 corresponding SDG targets in an effort to end extreme poverty, fight inequality and injustice, and address climate change until 2030. Tourism as an economic powerhouse is the third highest world category in export earnings in 2015, representing 10% of world GDP, 30% of services exports and 1 out of every 10 jobs in the world.

Although, tourism is specifically mentioned only in Goals 8, 12 and 14, it has the potential to contribute, directly or indirectly, to all of the goals, including those linked to energy efficiency, GHG emissions, as well as environmental conservation and protection (see Box 2). Thus, the UNWTO (2020) has developed tourism4sdgs, a dedicated web portal to promote and support the connection between the SDGs and the tourism sector among all countries around the world.

Figure 10: Tourism and the 17 SDGs

Box 2: The relevance of SDGs to tourism[13]

SDG 1 – NO POVERTY

As one of the largest and fastest growing economic sectors in the world, tourism is well-positioned to foster economic growth and development at all levels and provide income through job creation. Sustainable tourism development, and its impact at community level, can be linked with national poverty reduction goals, those related to promoting entrepreneurship and small businesses, and empowering less favoured groups, particularly youth and women.

SDG 2 – ZERO HUNGER

Tourism can spur sustainable agriculture by promoting the production and supplies to hotels, and sales of local products to tourists. Agro-tourism can generate additional income while enhancing the value of the tourism experience.

SDG 3 – GOOD HEALTH AND WELL-BEING

Tax income generated from tourism can be reinvested in health care and services, improving maternal health, reduce child mortality and preventing diseases. Visitors fees collected in protected areas can as well contribute to health services.

SDG 4 – QUALITY EDUCATION

Tourism has the potential to promote inclusiveness. A skilful workforce is crucial for tourism to prosper. The tourism sector provides opportunities for direct and indirect jobs for youth, women, and those with special needs, who should benefit through educational means.

SDG 5 – GENDER EQUALITY

Tourism can empower women, particularly through the provision of direct jobs and income-generation from SMEs in tourism and hospitality related enterprises. Tourism can be a tool for women to become fully engaged and lead in every aspect of society.

SDG 6 – CLEAN WATER AND SANITATION

Tourism investment requirement for providing utilities can play a critical role in achieving water access and security, as well as hygiene and sanitation for all. The efficient use of water in tourism, pollution control and technology efficiency can be key to safeguarding our most precious resource.

SDG 7 – AFFORDABLE AND CLEAN ENERGY

As a sector, which is energy intensive, tourism can accelerate the shift towards increased renewable energy shares in the global energy mix. By promoting investments in clean energy sources, tourism can help to reduce GHG, mitigate climate change and contribute to access of energy for all.

SDG 8 – DECENT WORK AND ECONOMIC GROWTH

Tourism, as services trade, is one of the top four export earners globally, currently providing one in ten jobs worldwide. Decent work opportunities in tourism, particularly for youth and women, and policies that favour better diversification through tourism value chains can enhance tourism positive socio-economic impacts.

SDG 9 – INDUSTRY INNOVATION AND INFRASTRUCTURE

Tourism development relies on good public and private infrastructure. The sector can influence public policy for infrastructure upgrade and retrofit, making them more sustainable, innovative and resource-efficient and moving towards low carbon growth, thus attracting tourists and other sources of foreign investment.

SDG 10 – REDUCED INEQUALITIES

Tourism can be a powerful tool for reducing inequalities if it engages local populations and all key stakeholders in its development. Tourism can contribute to urban renewal and rural development by giving people the opportunity to prosper in their place of origin. Tourism serves as an effective mean for economic integration and diversification.

SDG 11 – SUSTAINABLE CITIES AND COMMUNITIES

Tourism can advance urban infrastructure and accessibility, promote regeneration and preserve cultural and natural heritage, assets on which tourism depends. Investment in green infrastructure (more efficient transport, reduced air pollution) should result in smarter and greener cities for, not only residents but also tourists.

SDG 12 – RESPONSIBLE CONSUMPTION AND PRODUCTION

[13] Source: http://tourism4sdgs.org/tourism-for-sdgs/tourism-and-sdgs/

The tourism sector needs to adopt sustainable consumption and production (SCP) modes, accelerating the shift towards sustainability. Tools to monitor sustainable development impacts for tourism including for energy, water, waste, biodiversity and job creation will result in enhanced economic, social and environmental outcomes.

SDG 13 – CLIMATE ACTION

Tourism contributes to and is affected by climate change. Tourism stakeholders should play a leading role in the global response to climate change. By reducing its carbon footprint, in the transport and accommodation sector, tourism can benefit from low carbon growth and help tackle one of the most pressing challenges of our time.

SDG 14 – LIFE BELOW WATER

Coastal and maritime tourism rely on healthy marine ecosystems. Tourism development must be a part of Integrated Coastal Zone Management in order to help conserve and preserve fragile marine ecosystems and serve as a vehicle to promote a blue economy, contributing to the sustainable use of marine resources.

SDG 15 – LIFE ON LAND

Rich biodiversity and natural heritage are often the main reasons why tourists visit a destination. Tourism can play a major role if sustainably managed in fragile zones, not only in conserving and preserving biodiversity, but also in generating revenue as an alternative livelihood to local communities.

SDG 16 – PEACE JUSTICE AND STRONG INSTITUTIONS

As tourism revolves around billions of encounters between people of diverse cultural backgrounds, the sector can foster multicultural and inter-faith tolerance and understanding, laying the foundation for more peaceful societies. Tourism, which benefits and engages local communities, can also consolidate peace in post-conflict societies.

SDG 17 – PARTNERSHIPS FOR THE GOALS

Due to its cross-sectoral nature, tourism has the ability to strengthen private/public partnerships and engage multiple stakeholders – international, national, regional and local – to work together to achieve the SDGs and other common goals. Public policy and innovative financing are at the core for achieving the 2030 Agenda. In this context, the UNWTO 2030 Tourism Roadmap for Inclusive Growth provides a new opportunity for partnerships for development. The projects proposals reflect UNWTO Member States needs to build a more resilient, sustainable and innovative tourism sector that generates jobs and promotes inclusive, low-carbon growth in line with all three dimensions of sustainable development: people, the planet and prosperity.

1.1.7 The road to the European Green Deal

The European Union (EU) has also adopted ambitious targets to combat climate change. In 2011, the European Commission (EC) published a roadmap for moving to a competitive low-carbon economy by 2050 and complemented this effort in 2014 by adopting the 2030 climate & energy framework, by establishing clear milestones for delivering a cut in domestic GHG emissions by at least 40% by 2030 and 80% by 2050 compared to 1990. In November 2018, the EC set out its vision for a climate-neutral EU, covering nearly all EU policies and sectors of the economy to offset, by 2050, not only any remaining CO_2 emissions but also any other GHG emissions, as set out in the Communication “A Clean Planet for all - A European strategic long-term vision for a prosperous, modern, competitive and climate-neutral economy”[14] and as confirmed by the “European Green Deal” Communication.

The European Council has set building a climate-neutral, green, fair and social Europe as one of the main four priorities in its Strategic Agenda for 2019-2024[15] and recognised the need to put in place an enabling framework as the transition will require significant public and private investments. In 2019, the EU completed a comprehensive update of its energy policy framework to facilitate the transition away from fossil fuels towards cleaner energy and to deliver on the EU’s Paris Agreement commitments[16] for reducing greenhouse gas emissions. This new energy rulebook called the Clean energy for all Europeans package[17] marked a significant step towards the implementation of the energy union strategy, published in 2015, and includes the three directives listed below that are particularly important for EU to achieve its energy and climate goals.

[14] COM (2018) 773 final.

[15] Source: https://www.consilium.europa.eu/media/39914/a-new-strategic-agenda-2019-2024-en.pdf.

[16] Ratified by the EU on 5 October 2016 and entered into force on 4 November 2016.

[17] Source: https://ec.europa.eu/energy/topics/energy-strategy/clean-energy-all-europeans_en

- The Energy Performance of Buildings Directive ((EU) 2018/844), which outlines specific measures for the building sector to tackle challenges, updating and amending many provisions from the Directive 2010/31/EU.
- The recast Renewable Energy Directive (2018/2001/EU) entered into force in December 2018 that has set an ambitious, binding target of 32% for renewable energy sources in the EU's energy mix by 2030.
- The amending Directive on Energy Efficiency ((EU) 2018/844) that has been in place since December 2018 and has set binding targets of at least 32,5% energy efficiency by 2030, relative to a 'business as usual' scenario. Prioritizing energy efficiency is a key objective in the package, as energy savings are the easiest way of saving money for consumers and for reducing GHG emissions.

Following the political agreement by the Council and the European Parliament (between May 2018 and May 2019) and the entry into force of the different EU rules, EU countries have 1-2 years to transpose the new directives into national law.

Finally, on 12th December 2019, the European Council, endorsed the objective of achieving a climate-neutral EU by 2050 by presenting the European Green Deal[18], Europe's new agenda for sustainable growth. It provides a roadmap with actions to boost the efficient use of resources by moving to a clean, circular economy, restore biodiversity and cut pollution. It outlines investments needed and financing tools available and explains how to ensure a just and inclusive transition. As one of the main blocks of the European Green Deal, the EC has also adopted a new Circular Economy Action Plan 2020, announcing initiatives along the entire life cycle of products, targeting for example their design, promoting circular economy processes, fostering sustainable consumption, and aiming to ensure that the resources used are kept in the EU economy for as long as possible. To further emphasize on its importance, the executive Vice-President for the European Green Deal, Frans Timmermans, said: "To achieve climate-neutrality by 2050, to preserve our natural environment, and to strengthen our economic competitiveness, requires a fully circular economy".

Figure 11: The EU Green Deal

[18] Source: https://ec.europa.eu/info/node/123797

As part of the European Green Deal, the Commission proposed on 4th March 2020 the adoption of the first European Climate Law[19], turning the political commitment into a legal obligation and a trigger for investments. Reaching this target will necessitate bold action by all economic sectors, including:

- investing in environmentally friendly technologies
- supporting industry to innovate
- rolling out cleaner, cheaper, and healthier forms of private and public transport
- decarbonising the energy sector
- ensuring buildings are more energy efficient
- working with international partners to improve global environmental standards.

As highlighted by the World Tourism Organization (UNWTO), the tourism industry can play a significant role in Europe's response to the climate change. Tourism industry, and the accommodation sector in particular, could greatly benefit by implementing any number of the aforementioned actions.

1.2 Introduction to Carbon Footprint and Accounting

Carbon footprint is the total greenhouse gas (GHG) emissions caused directly and indirectly by an individual, organisation, event, or product[20], and is expressed as a carbon dioxide equivalent (CO_2eq)[21]. A carbon footprint accounts for all six Kyoto GHG emissions:

- carbon dioxide (CO_2)
- methane (CH_4)
- nitrous oxide (N_2O)
- hydrofluorocarbons (HFC_s)
- perfluorocarbons (PFC_s)
- sulphur hexafluoride (SF_6)

Monitoring, measuring and reporting the carbon footprint emerging from all anthropogenic activities is a quite challenging and complex process, especially at a sectorial or national level, that requires a specific, well defined framework, often referred to as "carbon accounting". As parties to the UNFCCC and its Kyoto Protocol, all EU countries are required to monitor and report their emissions under the EU's Climate Monitoring Mechanism[22], which sets the EU's own internal reporting rules on the basis of internationally agreed obligations (EC, n.d.-3).

In the context of this manual, we are interested in the corporate or organisational carbon footprint that measures the GHG emissions produced directly and indirectly from a business or organisation's activities, including energy used in buildings, industrial processes and company vehicles, within an agreed set of boundaries. Also known as a GHG emissions assessment, it is a business tool that constructs information aiming be useful for understanding and managing climate change impacts.

[19] Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL establishing the framework for achieving climate neutrality and amending Regulation (EU) 2018/1999 (European Climate Law), (COM/2020/80 final).

[20] Source: https://www.carbontrust.com/resources/carbon-footprinting-guide

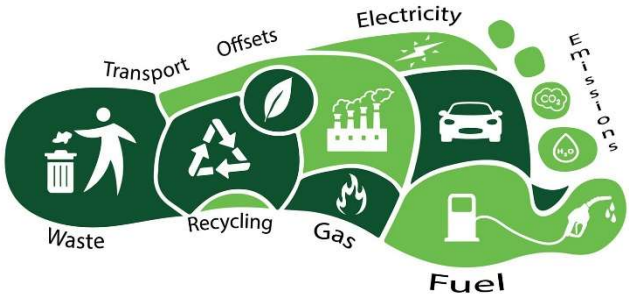
[21] Carbon dioxide equivalent (CO_2eq) is the unit of measurement which allows different greenhouse gases to be compared on a like on the basis of one unit of CO_2. CO_2eq emissions are calculated by multiplying the emissions of each of the six greenhouse gases by its 100-year GWP, as explained earlier.

[22] The Climate Monitoring Mechanism Regulation (comprised of regulations 525/2013, 749/2014 and 666/2014) is the relevant framework until 1 January 2021. From then onwards, it is repealed and replaced by the Regulation on the Governance of the Energy Union and Climate Action. The Regulation on the Governance updates the Climate Monitoring Mechanism, synchronises and brings it in line with the transparency requirements of the Paris Agreement, and makes it fit for tracking progress with the 2030 climate and energy legislation, while reducing administrative burden. It also requires Member States to prepare long-term strategies (https://ec.europa.eu/clima/policies/strategies/progress/monitoring_en).

1.2.1 Why measure the carbon footprint of your organization?

GHG emissions calculations will assist in identifying the key emission sources in your organisation or business, quantifying their contribution to climate change and revealing any opportunities for their reduction. It is basically the first step to develop a carbon reduction plan since it provides the necessary baseline in order to evaluate the progress of any reduction efforts. Another reason to measure your organisation's or business' carbon footprint is to be able to report it with accuracy to any interested parties -internally or externally- for marketing or corporate responsibility purposes, or to meet the requirements of climate change legislation. When you publicly disclose information about your carbon footprint or progress with its reduction, you might also consider obtaining independent certification or validation, which increases the confidence to all stakeholders that the methods have been used correctly and that the results are accurate.

Figure 12: How To Reduce The Carbon Footprint (World Culture Network, 2019)



Carbon accounting at organisational level refers to all the processes (described above) undertaken to "measure" the amounts of carbon dioxide equivalents emitted by an entity. Carbon accounting is usually used by states, corporations, and individuals to establish the demand for carbon credits in the context of a carbon offsetting[23] strategy or sustainability action plan in any type of organisation. Like sustainability measurement and reporting, carbon accounting is an essential tool to provide a factual ground for carbon-related decision-making.

1.2.2 Calculating an organisational carbon footprint

Quantification of GHG emissions is based on the **methodology of GHG protocol**[24] that sets out how to account for your GHG emissions. It categorises emissions into three groups or 'scopes':

[23] Carbon offsets are a way for businesses and consumers to compensate ('offset') their CO_2 or other GHG emissions by purchasing certificates generated by emissions-reduction projects elsewhere in the economy or another region. Offsets may be less expensive or more feasible and convenient than reducing an individual's or company's own emissions. The income from offset certificates enables the project to achieve further reductions and increases emissions reduction efficiencies economy wide. The Kyoto Protocol authorised offsets as a flexible mechanism to enable governments and private companies to earn carbon credits that can be traded in a marketplace. The Gold Standard for carbon offset projects is the most widely respected independent certification standard globally. The Gold Standard is currently supported by over 80 civil society groups around the globe and ensures that energy efficiency and renewable energy projects reduce emissions and provide benefits to the local population (ECT, 2018).

[24] The Greenhouse Gas Protocol (GHG Protocol) is an accounting tool used by business and governments. It was created in 2001, when the World Resources Institute and the World Business Council for Sustainable Development identified a need for consistency in how organisations accounted and reported emissions, and together introduced the new standard. Since then, it's been used by more than 1,000 businesses and organisations worldwide, including many Fortune 500 companies. You can find out more about it at: https://ghgprotocol.org

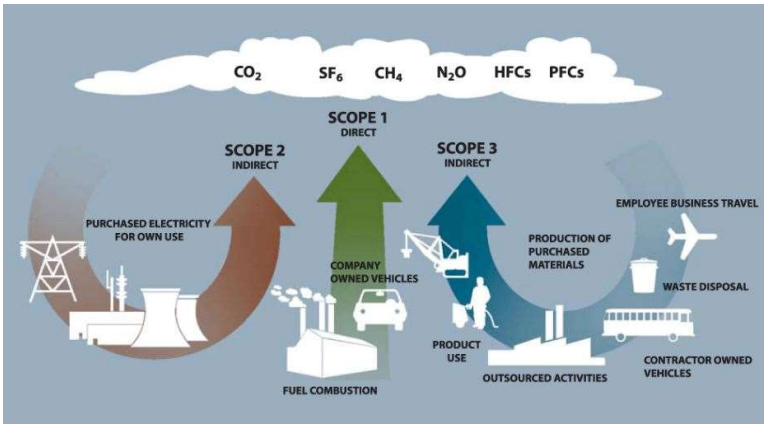
Scope 1: Direct emissions that result from activities within your organisation's control. This might include on-site fuel combustion manufacturing and process emissions refrigerant losses and company vehicles.

Scope 2: Indirect emissions from any electricity, heat or steam you purchase and use. Although you are not directly in control of these emissions, by using the energy you are indirectly responsible for the release of CO_2.

Scope 3: Any other indirect emissions from sources outside your direct control. Examples of scope 3 emissions include employee commuting and business travel, outsourced transportation, waste disposal and water consumption.

Under the GHG Protocol, all organisational footprints must include scope 1 and 2 emissions. There is more flexibility when choosing which scope 3 emissions to measure and report, and you can tailor these to reflect your environmental and commercial goals. The best approach depends on what you intend to use the footprint for, the data available to calculate it, what you want to monitor and which sources you can influence. Organisations commonly include waste sent to landfill and employee business travel from scope 3.

Figure 13: Scope 1, 2, and 3 emissions (Synergy Files, 2017)



The key steps in calculating an organisational carbon footprint are:

Step 1- Decide on the methodology

It is important to use a consistent method to ensure an accurate result, particularly if you will rely on several people to help collect and interpret data. The GHG Protocol is one of the most commonly used standards. It provides detailed guidance on methods, and is available free of charge online at: https://ghgprotocol.org/corporate-standard. Another recognised standard is from the International Organization for Standardization, ISO 14064, which builds on many of the concepts introduced by the GHG Protocol.

Step 2 - Define organisational and operational boundaries

Set clear, explicit boundaries on which parts of your organisation are included in the footprint. This can be complex if you have many subsidiaries, joint ventures or leased assets, but it is an important step. The operational boundary determines which emission sources will be quantified. It should include the full range of emissions from activities under your operational control. All material scope 1 and 2 emissions should be included, but you can choose which scope 3 emissions to include. Be realistic when choosing a boundary and make sure you consider the practicalities of collecting complete and accurate data. It may help to fit in with your other reporting periods and legislative requirements, or the requirements of schemes operated by third party certifiers, such as the Carbon Trust Standard.

Step 3 – Collect all relevant data

The accuracy of the footprint relies on collating consumption data for all of the emission sources within your established boundary. For gas and electricity, collect data in kilowatt hours (kWh) from meter readings or bills. You can record data for other fuels in a variety of units, such as litres, kWh or

megajoules[25] (MJ). For transport emissions, collect fuel consumption by fuel type where possible (from fuel cards etc.). Where this is not available, you can estimate consumption based on the mileage of the vehicles and fuel economy assumptions. It is important to clarify any gaps in the data and list any assumptions that have been made in calculating the footprint.

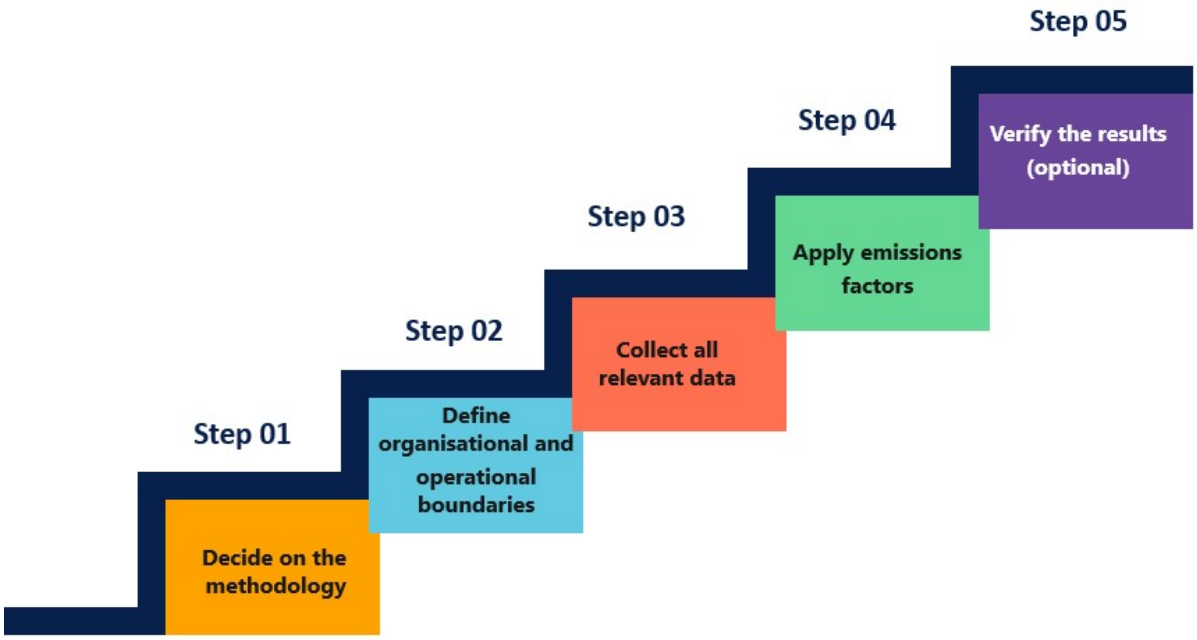
Step 4 - Apply emissions factors

The carbon footprint is measured in tonnes of CO_2 equivalent (tCO_2eq) and is calculated using the activity data collated multiplied by standard emissions factors, produced by several Governments. The most comprehensive set of emission factors is published every year by the Department for Business, Energy & Industrial Strategy[26].

Step 5 - Verify the results (optional)

You may choose to have a third party verify your carbon footprint and any actions to reduce it in order to add credibility and confidence to your carbon reporting for public disclosure.

Figure 14: Five steps to calculate an organisational carbon footprint



[25] Megajoule is a unit of energy equal to 1.000.000 joules.

[26] Source: https://www.gov.uk/government/collections/government-conversion-factors-for-company-reporting

Table 2: GHG reporting: conversion factors 2019

Fuel or source of energy	Unit	$kgCO_2eq$
LPG[23]	tonnes	2936,86
	litres	1,5226
Natural gas[23]	tonnes	2542,04
	cubic metres	2,0305
Diesel (average biofuel blend)[23]	tonnes	3088,23
	litres	2,5941
Gas oil[23]	tonnes	3229,86
	litres	2,7582
Petrol (average biofuel blend) [23]	tonnes	2997,50
	litres	2,2090
Electricity consumed: Greece*[27]	kWh	0,8100
Electricity consumed: Cyprus[28]	kWh	0,73521
Type of car[21]	**Unit**	**$kgCO_2eq$**
Small car	km	0,1421
	miles	0,2287
Medium car	km	0,1706
	miles	0,2746
Large car	km	0,2095
	miles	0,3371
Average car	km	0,1734
	miles	0,2790
Water use and treatment[21]	**Unit**	**$kgCO_2eq$**
Water supply	cubic metres	0,3440
	million litres	344,00
Water treatment	cubic metres	0,7080
	million litres	708,00
Waste type - Landfill[21]	**Unit**	**$kgCO_2eq$**
Municipal waste	tonnes	8,99
Organic: food and drink waste	tonnes	8,99
Organic: garden waste	tonnes	8,99
Organic: mixed food and garden waste	tonnes	8,99
Commercial and industrial waste	tonnes	75,49
Waste type - Recycling[21]	**Unit**	**$kgCO_2eq$**
Glass	tonnes	21,35
Batteries	tonnes	21,35
Plastics: average plastics	tonnes	21,35
Paper and board: mixed	tonnes	21,35

[27] Source: Covenant of Mayors for Climate and Energy: Default emission factors for local emission inventories (2017), Annex I.4 National and European Emission factors for Electricity consumption, p.43

[28] Source: Data obtained by Electricity Authority of Cyprus for 2018. Available at www.eac.org.cy

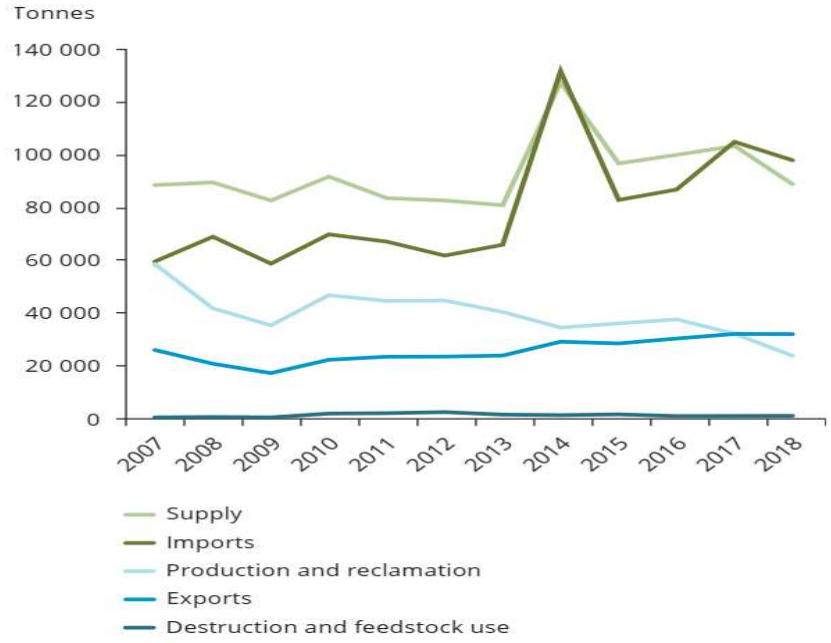
1.2.3 The relevance of fluorinated gases to the reduction of GHG emissions

This section focuses on the main fluorinated greenhouse gases and the legislative requirements of EU Regulation 517/2014 regulating the containment, use, recovery, and destruction of fluorinated gases. F-gases are a family of artificial gases used in a wide range of applications, mainly in the areas of refrigeration and air conditioning.

Fluorinated gases, together with CO_2, CH_4, and N_2O, form the group of gases known as GHG, whose emissions are controlled by the Kyoto Protocol in the framework of the UN Convention on Climate Change (UNFCCC). Although fluoride emissions today account for 2% of all GHG emissions, they are the only group of gases with a clear upward trend, while at the same time being gases with a very high GWP, up to 23.000 times greater than CO_2.

The supply of fluorinated gases to the EU, measured in CO_2eq, has been decreasing since 2010, with the exception of 2014, which saw extraordinarily high levels of hydrofluorocarbon imports prior to the EU-wide hydrofluorocarbon phase-down, coming into effect in 2015 under the relevant F-gas Regulation ((EU) No 517/2014). The supply of unsaturated hydrofluorocarbons and hydrochlorofluorocarbons that have low GWP approximately doubled each year from 2014 to 2017, replacing hydrofluorocarbons that have high GWP.

Figure 15: Supply, production, import, export and destruction of F-gases (tonnes)[29]



However, trends in the use of non-halogenated refrigerants, which can also substitute hydrofluorocarbons, are not covered by statistics. The EU is on track to phase down the use of hydrofluorocarbons, in terms of both complying with its internal targets under the said Regulation since 2015, and reaching the hydrofluorocarbon consumption limit, in effect since 2019, under the Montreal Protocol.

Appliances using refrigerants covered by the ((EU) No 517/2014) Regulation of the European Parliament and of the Council shall be inspected and maintained as follow:

a. For equipment that contains fluorinated greenhouse gases in quantities of 5 tonnes of CO_2 equivalent or more, but of less than 50 tonnes of CO_2eq: at least every 12 months or, where a leakage detection system is installed, at least every 24 months.
b. For equipment that contains fluorinated greenhouse gases in quantities of 50 tonnes of CO_2 equivalent or more, but of less than 500 tonnes of CO_2eq: at least every 6 months or, where a leakage detection system is installed, at least every 12 months.

[29] Source: https://www.eea.europa.eu/publications/fluorinated-greenhouse-gases-2019

c. For equipment that contains fluorinated greenhouse gases in quantities of 500 tonnes of CO_2eq or more: at least every 3 months or, where a leakage detection system is installed, at least every 6 months.

Therefore, hotels are responsible for monitoring and reporting the usage of the refrigerants used.

Table 3: GWP of most commonly used refrigerants[30]

Refrigerant type	GWP (CO_2eq)
R134a	1.430
R32	675
R404A	3.922
R407A	2.107
R407C	1.774
R407F	1.825
R410A	2.088
R413A	2.053
R417A	2.346
R422A	3.143
R422D	2.729
R427A	2.138
R434A	3.246
R507	3.985
R508	13.214

[30] Source: https://ec.europa.eu/clima/policies/f-gas/legislation_en

1.2.4 Self Study/Exercises

Box 3: Understanding the signifigance of impacts of the GHGs

To understand the magnitude of the impact these GHGs have on the warming of the planet we should consider that a home air conditioning unit, of 9.000 btu cooling capacity, contains approximately 0,7 kg of the R410A refrigerant. In case this quantity escapes into the atmosphere, it will have the same GWP of 1.461 kgCO_2 released to the environment, because 0,7 x 2.088 = 1.461 kgCO_2eq. This number corresponds to the emissions of an average medium size car[31] running for approximately 11.600 km, since 1.461 / 0,126 = 11.595 km. Imagine now an accommodation with 100 or more of such units not performing regular monitoring and servicing.

Exercise 1: Calculate the accommodation carbon footprint by using the Green Key methodology[32] https://www.greenkey.global/online-hcmi

Exercise 2: Calculate the overall emissions from your Hotel by using the Business4Climate methodology available on http://business4climate.oeb.org.cy/. Please use the following input data:

Sector Of Activity: Hotels and other accommodation establishments (SERVICES)

Contact person: Your name

Building name: GoGreen

Building address: Limassol

Contact details: 25000000

No. of rooms: 202

Energy	AIR CONDITIONING	REFRIGERATION	SOLID WASTE
Buildings Electricity 2.339 MWh Fuel Oil 83,26 tn **Machinery** LPG 15 tn Fuel Oil 46,25 tn **Transport** Diesel 0,23 tn	**Stationary** Split R-407C, 2,7 kg, 11 units VRV R-407C, 10 kg, 7 unit Water Chillers HFC-134a 150kg 1 unit **Mobile** Mobile HFC-134a 0,5kg 1 unit	**Stationary** Fridge HFC-134a 0,4kg 53 units	10% recycling

[31] The calculation is based on the emissions of the VW Golf, 2020 model, 1.0 TSI, 115 PS, 5-doors, 6-speed manual, at 126 g/km under the Worldwide Harmonized Light Vehicles Test Procedure (WLTP), source: https://www.volkswagen.co.uk/files/live/sites/vwuk/files/pdf/Brochures/golf-p11d.pdf.

[32] Source: HCMI tool and benchmarking system is developed by the International Tourism Partnership http://tourismpartnership.org

Exercise 3: In which of the following topics your organisation should focus and why regarding GHG emissions?

- Climate Change
- Emissions
- Biodiversity & forestry
- Electricity
- Materials and raw materials
- Waste
- Product & Operational Efficiency
- Packaging
- Transportation
- Water management
- Supply Chain emissions
- Local identity/context
- Disaster recovery

2 GHG Emissions reduction and energy savings

2.1 The need for an internal energy strategy in hotels

According to UNEP and UNWTO's joint background report on Tourism in the Green Economy (2012, p.3), **"tourism is a significant contributor of greenhouse gas (GHG) emissions at the global scale", estimated to be responsible for 5% of global CO_2 emissions.** Considering the radiative forcing of all greenhouse gases[33], this figure could be as high as 12,5%. Moreover, a recent thorough study on tourism's global footprint has found that, between 2009 and 2013, the figure has increased four times more than previously estimated, from 3,9 to 4,5 $GtCO_2eq$[34], thus accounting for about 8% of global GHG emissions (Lenzen et al., 2018). The largest part of these emissions, almost 75%, occur during the transportation of tourists to/from destinations, with aviation accounting for 40% and vehicles for 32%, while the hotel sector is responsible for about 21%. The remaining 7% can be attributed to other means of transportation (cruise ships or trains) and tourism activities. However, it must be clarified that these figures do not represent indirect emissions from the consumption of energy during the construction phase of tourism-related infrastructures or the energy used in other sectors, which form part of the tourism supply chain. Under a lifecycle perspective, the inclusion of such indirect and even induced emissions would definitely lead to higher amounts of emissions and ultimately to a more comprehensive assessment of tourism's carbon footprint (UNWTO, UNEP and WMO, 2008).

The accommodation sector relies heavily on building infrastructures. As per the International Energy Agency (2020), the buildings sector, including construction, is responsible for over one-third of global final energy consumption and nearly 40% of total direct and indirect CO_2 emissions. Energy demand from buildings and buildings construction continues to rise, driven by improved access to energy in developing countries, greater ownership and use of energy-consuming devices, and rapid growth in global buildings floor area. The speed of energy intensity reductions in the buildings sector has fallen in recent years. According to an analysis on energy use by European hotels in the context of the Hotel Energy Solutions project (2011), accommodation facilities rank among the top five in terms of energy consumption in the tertiary building sector (minor only to food services and sales, health care and certain types of offices).

Although no collective data is available on global energy consumption in the hotel sector, it is estimated that 97,5 TWh of energy was used in hotel facilities worldwide in 2001. Furthermore, the CHOSE project[35], Energy Savings by Combined Heating, Cooling and Power (CHCP) systems Plants in the Hotel Sector estimated that European hotels – which are reported to provide nearly half of the world total hotel rooms – used a total of 39 TWh[36] (terawatt hours) in 2000, half of which is in the form of electricity. Most of this energy is derived from fossil sources, and the hotel sector's contribution to global warming and climate change is estimated to include annual releases between 160 and 200 kg of CO_2 per m^2 of room floor area, depending on the fuel mix used to provide energy. Global hotel-based CO_2 emissions were assumed to be at the level of 55,7 Mt[37] (megatons) in 2001, while the estimated annual energy consumption for European hotels of 39 TWh would result in emissions of more than 10 Mt of CO_2 each year[38].

The hotel accommodation sector in Europe is dominated by small businesses, which provide around 90% of the total number of rooms, and studies show that small independent hotels are less proactive

[33] Radiative forcing is a measure of the influence a factor has in altering the balance of incoming and outgoing energy in the Earth-atmosphere system and is an index of the importance of the factor as a potential climate change mechanism (IPCC, AR4 report).

[34] Gigatonne or metric gigaton (unit of mass) is equal to 1.000.000.000 metric tons. Since a metric ton is exactly 1.000 kilograms (SI base unit), 1 Gt = 1 trillion kilograms.

[35] Source: http://www.inescc.pt/urepe/chose/chose-project.htm

[36] 1 Terawatt hour is the electrical energy consumption rate equivalent to 1.000.000.000 kilowatts consumed in one hour. Since one kilowatt hour is exactly 1.000 watthours, 1 TWh = 1 trillion watthours.

[37] 1 Megaton or metric megaton (unit of mass) is equal to 1.000.000 metric tons. Since a metric ton is exactly 1.000 kilograms (SI base unit), 1 Mt = 1 billion kilograms.

[38] Source: Hotel Energy Solutions (2011), Analysis on Energy Use by European Hotels: Online Survey and Desk Research, Hotel Energy Solutions project publications

about the environment than large hotel chains. Only 10% of rooms are provided by large hotel chains, and it is these chains which have made most of the energy efficiency improvements in the hotel sector. As part of the same project, data from relevant research studies about energy use in hotels in Europe have been analysed to reach the following findings[34]:

- Annual energy consumption for **most hotels** falls in the range of **200-400 kWh/m^2;** a "meta-analysis" (combining data from all the various studies) suggests that average energy use by hotels varies between **305-330 kWh/m^2 per year.**
- Variation in energy use levels between hotels within each study sample is far greater than the differences between the averages for different study samples. There is no evidence for any statistically significant differences in levels of energy use intensity (kWh/m^2/year) between hotels or other accommodation with different star ratings.

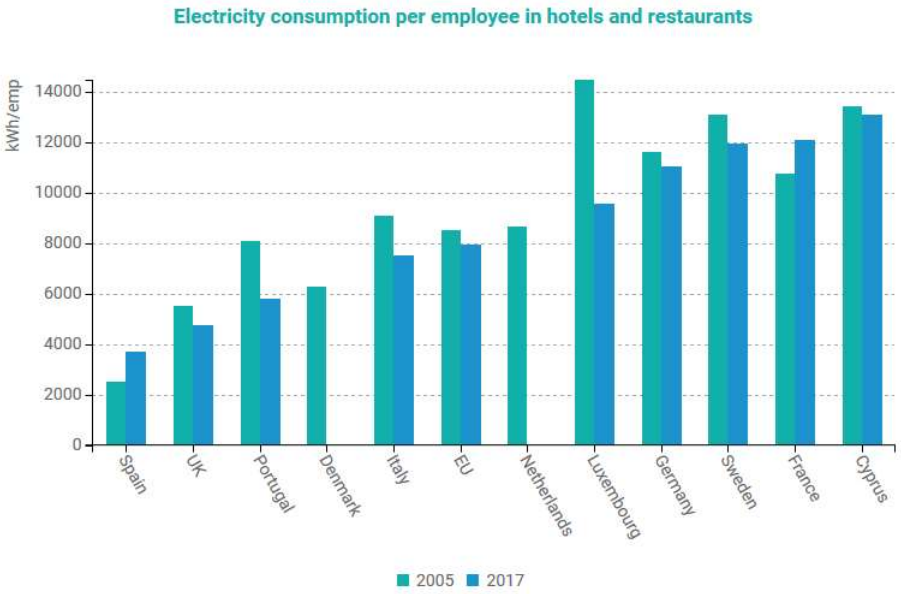
Regarding **Cyprus**, based on the results of a recent Study (2019)[39] the energy intensity of Hotels are given in the table below:

Table 4: Energy intensity of Hotels in Cyprus

	Average
Energy intensity per hotel: kWh/guest	**44**
Energy intensity per square meter: kWh/m^2	**212**
Primary energy intensity kWh/guest	**89**
Primary energy intensity kWh/m^2	**407**
Energy cost intensity: €energy/guest	**6**
CO_2 intensity: emitted kgCO_2/guest	**60**

According to the ODYSSEE-MURE database, in the EU, there is a decreasing trend in electricity consumption per employee in **hotels and restaurants in most of countries except Spain and France.**

Figure 16: Electricity consumption per employee in hotels and restaurants[40]



[39] Ricerca sul Sistema Energetico – RSE S.p.A, Determination of the actual energy demand of different types of buildings and processes (European Commission)

[40] Source: https://www.odyssee-mure.eu/publications/efficiency-by-sector/services/hotel-restaurant-specific-energy-electricity-consumption.html

2.2 Energy Management – Definition and basic concepts

According to Carbon Trust, “energy management is the systematic use of management and technology to improve an organisation’s energy performance” (2011, p.5). In the hotel sector, particularly with regards to building infrastructures, energy management can be defined as the process of identifying, monitoring, analysing, and controlling energy use with the purpose to minimise it. Energy management is the tool to controlling a building's energy consumption, which leads to lower:

- Costs, since energy represents between 5% to 10% of all operating costs in a hotel.
- Emissions of GHGs, to meet internal sustainability goals and regulatory requirements.
- Risk against energy price increases or supply shortages that could affect profitability and smooth operation.

Often, the term "energy management" is used to describe energy-saving efforts focusing mainly on behavioural changes (e.g. encouraging people to use less energy by raising their awareness), and the use of simple control equipment such as timer switches and motion or light sensors. However, the installation of more sophisticated energy management systems and efficient equipment can reduce the demand for energy significantly and make it more predictable.

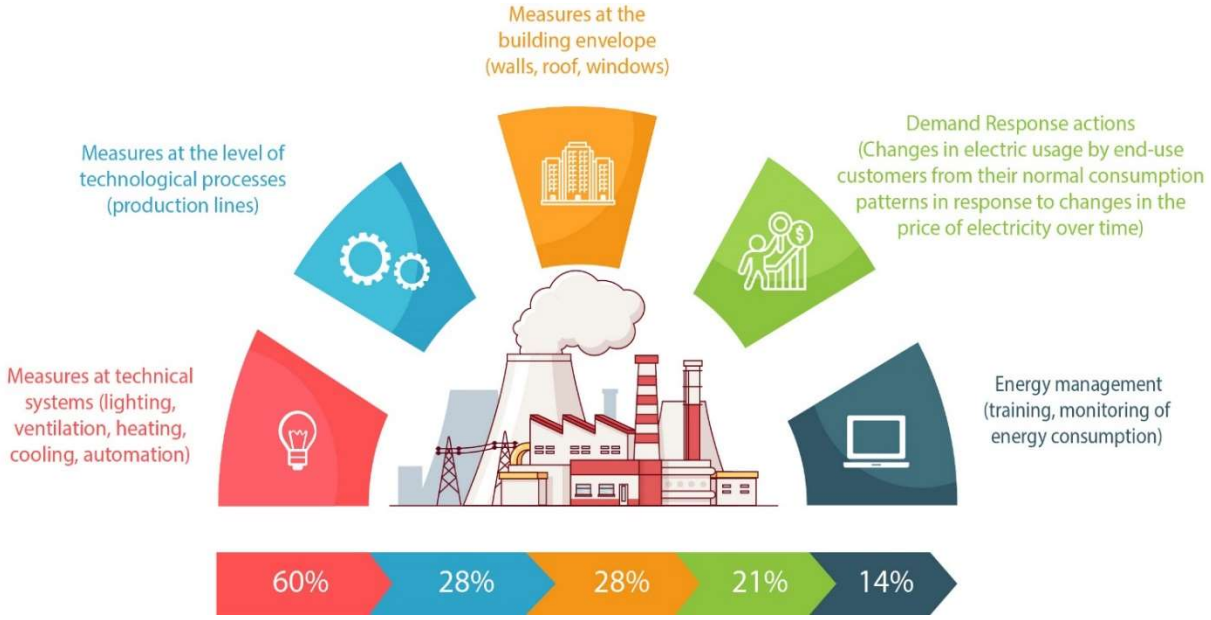
2.2.1 Energy Efficiency and Intensity

As stated by the US Department of Energy (n.d.), the difference between energy efficiency and intensity in day-to-day tasks is trivial; one is simply the inverse of the other. While energy efficiency refers to the work that can be produced with a given amount of energy, intensity is measured by the quantity of energy required per unit output or activity. Lighting offers an "obvious" example for understanding these notions. A light emitting diode (LED) bulb is using less than 20% of the energy required by an incandescent lamp or about half of its fluorescent counterpart for the same level of brightness, thus it has lower energy intensity. Equally, LED technology can deliver many more lumens per watt than the other two, therefore it is far more energy efficient compared to them. In other words, a more energy efficient device will generate more output for any given input of energy or consume less energy to perform the same task.

As suggested by the Environment and Energy Study Institute (EESI, n.d.), energy efficiency can generate a variety of benefits, from lowering energy demand and costs to reducing GHGs emissions, at both business and economy-wide level. While renewable energy technologies also help accomplish these objectives, energy efficiency improvements in existing processes and infrastructures offer the cheapest –and often the faster– way to reduce the use of fossil fuels.

There are enormous opportunities for efficiency improvements in the accommodation sector, whether it concerns Heating, Ventilation and Air Conditioning (HVAC) or Domestic Hot Water (DHW) systems, washing, cooking or refrigeration equipment, lighting, etc.

According to the results of recent Study (SMEmpower efficiency, 2020)[41], the SMEs prefer to implement measures related with the increase of energy efficiency in technical systems (60%) (e.g. lighting, ventilation, heating, cooling and ventilation), 28% of measures related with improvements in technological processes, 28% of measures are related with improvement of energy efficiency in building envelope, 21% are demand response measures and lastly, 14% are energy management measures.



The current energy efficiency framework in the EU consists of a number of directives, the revision of which is either ongoing or planned. The Energy Efficiency Directive (2012/27/EU), which entered into force in December 2012, requires Member States to set indicative national energy efficiency targets in order to ensure that the EU reaches its headline target of reducing energy consumption by 20% by 2020. Member States are free to make these minimum requirements more stringent as they strive to save energy. The directive also introduces a binding set of measures to help Member States achieve this target and sets legally binding rules for end-users and energy suppliers. Further energy efficiency standards for products and buildings were set with the Ecodesign Directive (2009/125/EC), the Energy Efficiency Labelling Directive (2010/30/EU), which was updated in 2017 (2017/1369/EU), and the Energy Performance of Buildings Directive (2010/31/EU)[42].

2.2.2 Energy class of air conditioners

According to the EU regulation (EU) No 626/2011, from 1st January 2013, the criterion to classify air conditioners into energy categories are based on the SEER (Seasonal energy effusion ratio) and SCOP (Seasonal coefficient of performance) coefficients. The SEER factor is the overall efficiency of the device, which is defined as the ratio of the annual need for cooling to the total annual energy consumed for cooling. Respectively, the SCOP factor is the overall rate of return of the appliance to the heater, which is defined as the ratio of the total annual need for heating to the total annual energy consumed in heating. This change was necessary because until that date, the criterion for classifying an air conditioner into an energy category has been the EER (Energy Efficiency Ratio) rate for cooling and COP (Coefficient of Performance) for heating.

The way to calculate these two factors is very simple. The EER factor is obtained by dividing the cooling efficiency of the machine into KW by consuming electricity again in KW. This results in a net number that, if greater than 3,20, ranks the device in energy class A for cooling consumption. Similarly, if we divide the heating efficiency of the machine into kW by consuming in kW, a net number (COP) is obtained which, if it is greater than 3,60, classifies the device into energy class A for heating. Both coefficients indicate the conversion ratio of the absorbed electric power to thermal or cooling power,

[41] SMEmpower efficiency, Identification of the current Energy Efficiency level in SMEs, 2020, https://smempower.com/

[42] Source: https://www.europarl.europa.eu/factsheets/en/sheet/69/energy-efficiency

respectively. For each air conditioner there are these coefficients, which characterize the quality of the machine. The higher these indicators, the better. This way of classifying energy categories is quite simple, but it is unfair to Inverter devices because the calculation is done in their nominal performance, not in the real one. But energy savings are achieved when Inverter devices operate at a lower efficiency. The energy class of each air conditioning system is depending on the SEER and SCOP values according to the following table:

Table 5: Energy labeling for heating/cooling systems[43]

A +++	8,50 ≤ SEER	5,10 ≤ SCOP
A ++	6,10 ≤ SEER <8,50	4,60 ≤ SCOP <5,10
A +	5,60 ≤ SEER <6,10	4,00 ≤ SCOP <4,60
A	5,10 ≤ SEER <5,60	3,40 ≤ SCOP <4,00
B	4,60 ≤ SEER <5,10	3,10 ≤ SCOP <3,40
C	4,10 ≤ SEER <4,60	2,80 ≤ SCOP <3,10
D	3,60 ≤ SEER <4,10	2,50 ≤ SCOP <2,80
E	3,10 ≤ SEER <3,60	2,20 ≤ SCOP <2,50
F	2,60 ≤ SEER <3,10	1,90 ≤ SCOP <2,20
G	SERR ≤ 2,60	SCOP ≤ 1,90

Only air conditioner with a SEER factor greater than 3,60 and a SCOP factor greater than 3,40 are allowed to be imported in the European Union.

From 1 January 2013 onwards, electric air conditioners should come with an energy label indicating their energy efficiency.

The energy label for single and double duct air conditioners shall indicate an energy efficiency scale from A+++ (most efficient) to D (least efficient). Therefore, only air conditioner with a SEER factor greater than 3,60 and a SCOP factor greater than 3,40 are allowed to be imported in the European Union.

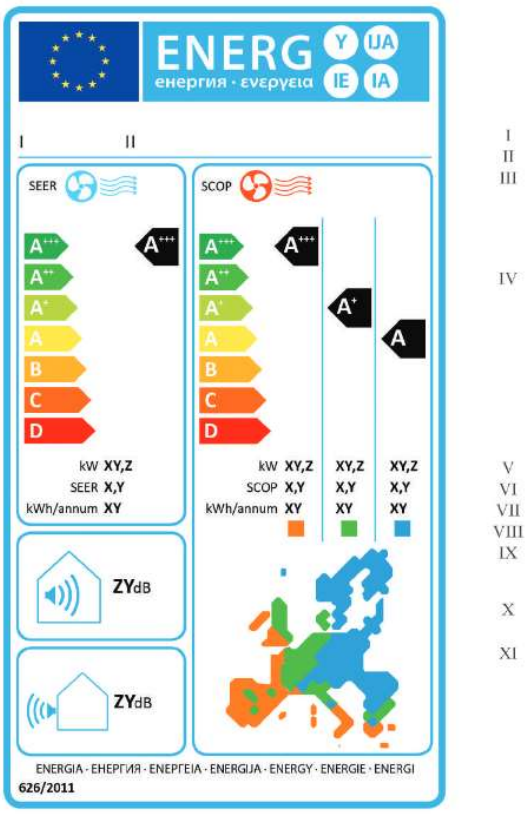
The energy label for the other types of air conditioners, stipulates the following rules:

- from 1 January 2013, an energy efficiency scale from A (most efficient) to G (least efficient);
- from 1 January 2015, a scale from A+ to F;
- from 1 January 2017, a scale from A++ to E;
- from 1 January 2019, a scale from A+++ to D;

There are nine different labels, each providing information on the company that placed the product on the market, the product model, how energy efficient the product is, the average annual energy consumption, the SCOP and/or SEER value(s), the noise level, etc.

[43] Source: https://ec.europa.eu/energy/topics/energy-efficiency/energy-label-and-ecodesign/energy-label-generator/air-conditioners_en

Figure 17: Example of the energy label of reversible air conditioners classified in energy efficiency classes A+++ to D[44]



2.2.3 Cooling and Heating degree days

Cooling and Heating Degree Days (CDDs and HDDs) are defined in relation to a base temperature — the outside temperature — below or above which a building is assumed to require heating or cooling. They express the number of days in a data series (examined period) by which the daily average minimum and maximum temperatures are higher than 22°C (CDDs) or lower than 15,5 °C (HDDs) respectively. Degree days are very useful in order to estimate the energy demand for heating or cooling a building (EEA, 2020). For Cyprus as there are no widely available data (expected revision from Cyprus Meteorological Department), you may use for HDD and CDD calculations the link below: https://www.degreedays.net/#

2.2.4 Life Cycle Costing

Life Cycle Costing is used to determine **how much any given equipment will cost over its whole active life.** The energy cost of running most equipment is many times higher than the original purchase price. This can justify a higher purchase cost for more efficient equipment. For example, the capital cost of an electric motor may be as little as 1% of its lifetime cost. To calculate a life cycle cost, the following factors must be determined:

A. The total power demand of the equipment (in kilowatts). This information can be easily obtained by technical manual or the supplier.

B. The number of hours the equipment will operate each year. This information can be based on an estimate.

[44] Source: https://www.applia-europe.eu/images/Library/Energy_Labelling_for_Air_Conditioners_and_Comfort_Fans_-_626_2011-compress.pdf

C. The cost of energy (in € per kWh). Check energy prices from your current energy bill and consider if future price changes are likely.

D. The annual maintenance cost of the equipment (in €).

E. The number of years for which the equipment will be used.

F. The equipment capital cost (in €).

The annual running cost of the equipment is then (A x B x C) + D. Multiply this by the number of years the equipment will be used (E) to provide the total lifetime running cost. Add this to the capital cost (F) to get the total life cycle cost of the equipment.

The life cycle costs of different options can be compared to determine the most attractive solution. Most accountants would use a method based on discounted cash flow to also take account for the value of money over time. It becomes apparent that the greater B, C and E factors are, the more important it is to choose equipment with lower A, despite a higher D or F factor.

Box 4: Understanding LCC

For example, a water pump of 5kW operating for 8 hours a day throughout the year would have an annual consumption of 14.600 kWh (5 x 8 x 365). For a price of €0,15/kWh the annual operation cost -without maintenance- would be €2.190. If there was a more energy efficient pump that could achieve the same work at a 10% lower energy demand and assuming all other factors remain unchanged, the savings over a period of 5 years could reach €1.095.

Many business associations and companies in industry already use the life-cycle assessment approach (LCA) in the framework of sustainability. LCAs have been used increasingly by industry to help reduce the overall environmental burdens across the whole life cycle of goods and services. LCA is also used to improve the competitiveness of the company's products and in communication with governmental bodies. LCA is used in decision making as a tool to improve product design, for example the choice of materials, the selection of technologies, specific design criteria and when considering recycling.

Taking an LCA approach allows benchmarking of product system options, as well as in decision making of purchasing and technology investments, innovation systems, etc. The benefit of the LCA is that it provides a single tool for gaining insights into upstream and downstream trade-offs associated with environmental pressures, human health, and the consumption of resources. These macro-scale insights compliment other social, economic, and environmental assessments (Carbon Trust, 2011).

2.3 Energy Management in the Hotel Sector

Energy management requires a top to bottom approach to be implemented successfully in any type of organisation. First, the top management must be convinced about the importance of managing energy within the organisation and commit to this by allocating the necessary resources. This commitment must be expressed in a formal energy policy where the main aspects and goals of its energy strategy will be deployed. Second, an initial energy assessment should take place to determine the most appropriate action plan and establish the baseline from which progress will be measured. A dedicated team of people with expertise should be formed next. These people will take responsibility for monitoring energy consumption, implementing energy reduction measures and assessing energy performance. The whole process takes time to deliver results and requires continuous effort.

2.3.1 Drafting an internal energy policy for a Hotel

A suitable internal energy policy provides the foundation for best practice in energy management. An effective policy needs to be directly relevant to the organisation and appropriate to its nature and size. It should provide a clear focus on the organisation's objectives and be the formal expression of the

senior management's commitment to the organisation's energy strategy. The policy should include the following elements:

- The context with respect to corporate vision and mission. It should avoid being overweening and pompous. For example, having statements such as "…our main goal is to stop climate change". Quite often, the energy policy forms part of the environmental or even sustainability policy of an organisation.
- A clear expression of the organisation's energy/carbon vision and aspirations, with specific objectives and quantitative targets, as well as the adoption of qualitative public commitments or external recognition/accreditation schemes such as the Carbon Trust Standard or ISO 50001.
- A commitment to develop and maintain an up-to-date energy strategy ensuring the integration of energy management across all relevant decision-making.
- A commitment to ensure that sufficient resources are in place to meet the policy objectives.
- A commitment to meeting the training and development needs of energy management staff and raising the energy awareness of all staff.
- A commitment to review the policy regularly and in a formal way.

An energy policy should be short and concise, signed by the General Manager (or equivalent), and be available to all stakeholders, i.e. to be a public document.

2.3.2 The Energy Management Process

As mentioned above, the main role of energy management is focused on satisfying fully the energy requirements of an organization by making the best possible usage of its energy resources. As explained in detail by Business Energy Efficiency Software (BizEE, 2020) company, this is a perpetual process that involves the following steps:

Step 1 – Measuring energy consumption and identifying areas of major use

If something is not measured, it cannot be managed and thereafter reduced. Moreover, the more data we collect, and the more detailed they are, the better. Energy-data collection can be done manually from the energy bills or by reading the respective meters every day, week or month. However, the usefulness of this information is quite limited since it lacks the necessary detail and is prone to human recording error. Measuring energy consumption even daily will not easily reveal sudden increases in the power demand, which occur randomly throughout the day, but at least it will provide a base figure (baseline) against which energy efficiency improvements can be measured.

In addition, this baseline allows the comparison of your energy performance with that of other similar accommodations. While manual recording can be quite easy when just a few energy meters are in place, this procedure will become very time consuming as their number increases, particularly in large hotels. This issue also highlights the importance of installing a sufficient number of energy sub-meters at various locations in order to identify the most energy consuming users, such as HVAC systems, DHW production, laundry, refrigeration, etc.

The best approach to energy-data collection is to fit automatic metering systems that measure and record energy consumption at short, regular intervals, e.g. every few seconds or minutes. Such detailed energy consumption data allows us to see patterns of energy wastage that would be impossible to detect otherwise.

Step 2 - Finding opportunities to save energy and estimating savings

The data collected in the previous step are useful in identifying and quantifying energy-saving opportunities. Many times, the most effective energy-saving opportunities are quite easy to implement and require little or no capital investment. For example, a great number of hotels have advanced control systems for handling HVAC properly, however quite often these systems are misconfigured, and as a result they may be heating or cooling an empty conference hall or unoccupied guest rooms.

By using interval data, it is usually easy to make reasonable estimates and calculate how much energy (in kWh) is being wasted at different times or areas. Walking around the building at different times of day (including after hours) and complete a list of the equipment that are in operation is another helpful technique in order to identify what other energy savings are possible.

The life cycle costing approach previously discussed (Section 2.2.4) could also be used to assess the cost efficiency of existing equipment against new equipment. While many of these opportunities can be

easily identified internally by the hotel's technical or maintenance team, it is always a good practice to seek external specialist help. Such experts could bring out of the box ideas and knowledge on the latest energy efficient technologies.

Step 3 - Prioritising actions and focusing on the opportunities that save energy

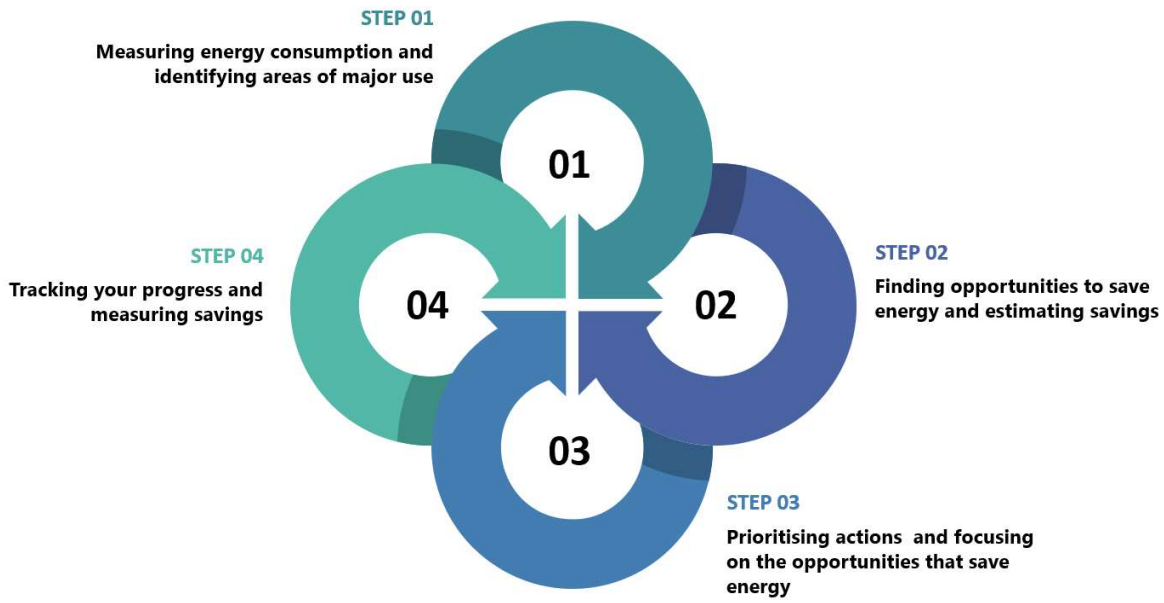
Identifying the energy savings opportunities is a good start but setting the right targets and taking appropriate action is necessary to achieve further energy savings. Firstly, you will need to define the time frame of your energy strategy and set specific, measurable, achievable, realistic, and timely (SMART) goals, in relation to the size of your accommodation and the financial capacity of your business. Then, you will have to elaborate an action plan for each of your goals and define the measures that are required for their attainment. Adding progressive and scalable targets to each of these measures is essential in order to be able to assess your progress in step 4. For the energy saving measures that require the participation of staff and guests, more guidance is offered in sections 3.4 and 5.2, respectively. If motivated effectively, these stakeholders can help you achieve considerable energy savings without any major capital spending.

Nevertheless, an investment for raising awareness among guests and organising relevant staff trainings will be required. As for those energy-saving opportunities that necessitate upgrades in equipment or building infrastructure, although it might be possible to implement some of them in-house, most will require a specialist assistance. It is highly recommended to discuss the more complex or expensive options with a qualified person or company.

Furthermore, as these options usually entail higher investment costs and good planning, the life cycle costing methodology used in the previous step will help you calculate the payback period and return on investment (ROI) ratio and choose the option that best fits your business.

At this point, is important to highlight some non-economic factors when deciding on which equipment to choose. The manufacturer's warranty, the availability in spare parts, the response time for servicing in case of failure and in general the reputation of the supplier should be carefully weighed in relation to the initial cost of the equipment. Inevitably, you will develop a long-term relation with these suppliers, from which it will not be easy to disengage, but most important their reliability is crucial for the continuity of your operations and the satisfaction of your guests.

Figure 18: Four steps of the Energy Management Process



Step 4 - Tracking your progress and measuring savings

After implementing energy saving actions, it is important to measure their effectiveness and see how they perform in relation to your targets and goals. You might have to reconsider some of them or make certain adjustments. Generally, energy savings that are based on behavioural changes (e.g. switch off equipment or manually adjusting the thermostat) need constant reminders to ensure they remain effective and achieve their maximum potential. Even automatic control devices, such as timers or thermostats, must be checked regularly to ensure that everything is working properly. Simple things like a power failure can easily cause these devices to revert to factory settings or lose their configuration. It is quite common for unsupervised buildings to become less efficient with time.

Analysing your energy data on a regular basis -once a week or once per month as a minimum- is the only way to ensure that you are on track with your energy strategy, targets, and goals. It is such a pity when easy-to-fix mistakes such as misconfigured timers or restrooms' lights and ventilation are left on 24/7 and remain unnoticed for months. Ideally your energy-management drive will be an ongoing effort to find new opportunities (step 2), to prioritise actions (step 3), and to track your progress (step 4). Managing your energy consumption does not have to be a full-time job, but you will achieve much better results if you make it part of your regular routine.

2.4 Sustainable Energy Sourcing

It can be argued that electricity is not exactly a source of energy, but rather a form of energy, resulting from the conversion of other -conventional or renewable- energy sources, such as fossil fuels or the sun. Nevertheless, is often referred to as such, particularly in energy reports and logbooks. In any case, the use of electricity is generally considered as "cleaner" and more environmentally friendly compared to conventional energy fuels, e.g. heating oil, LPG, coal. In most cases, the use of electricity reduces GHG emissions locally[45].

However, this generalisation can be deceiving, therefore, to determine the source of energy with the lowest carbon footprint, more factors must be considered. For example, in remote locations -particularly islands- where the production of electricity is solely based on diesel fuelled power plants, the selection of a heat pump unit for the production of hot water might have a similar net emissions result with a conventional burner-boiler system using any type of fossil fuels. Therefore, when assessing the overall impact of GHG emissions at a local level, is important to know the true origin of energy.

2.4.1 Renewable sources of energy (RES) in the hotel context

As per the Natural Resources Defense Council[46] (NRDC), renewable energy is defined as the energy coming from natural sources or processes, such as the sun, the running water or the wind that are constantly replenished. It is also referred to as clean energy, because it is not associated -at least in principal- with any direct GHG emissions. Almost, every natural phenomenon, such as waves, sea currents, even lightings, has a promising energy potential, however most of the technologies capable of harvesting this potential are still at very early development stage. On the other hand, there are several technologies today, most of which have already been adopted by hotels in Cyprus and Greece (see section 2.6), taking advantage of the following RES.

2.4.1.1 Solar energy

The term solar energy is used to describe the various forms of energy prompting from the sun, and for this reason, it is considered practically inexhaustible. Such energy forms are the sunlight, the heat and other radiations. There are three main technologies for solar energy exploitation: **passive solar systems, active solar systems, and photovoltaic systems.** The first technology is being used in

[45] GHG emissions from electricity are considered indirect emissions, i.e. scope 2 - not emitted on-site

[46] The Natural Resources Defense Council works to safeguard the earth - its people, its plants and animals, and the natural systems on which all life depends.

hotels for many years while the latter is at an early adoption stage. More information about these technologies is provided in chapter 3.

2.4.1.2 Wind energy

Wind energy is the energy produced by the exploitation of the wind. However, wind energy is created indirectly by solar radiation, as the uneven heating of the earth's surface causes large masses of air to move from one area to another, thus creating winds. Wind's kinetic energy is transformed to electricity via a wind turbine. Although it is considered an environmentally friendly form of energy and practically inexhaustible, there are many environmental concerns associated with mega wind farms. However, a small-scale installation can be part of the energy mix of a hotel, if certain environmental and aesthetic conditions are met.

2.4.1.3 Shallow geothermal energy and thermal energy from the sea

In a strictly scientific perspective, geothermal energy refers to the thermal energy stored below the earth's surface (in the subsoil, in groundwater, etc.) with temperatures ranging between 25°C to 350°C. It has many industrial applications including the production of electricity. However, in a wider use of the term, geothermal energy can include the thermal energy of the earth's interior with temperatures lower than 25°C. In these cases, the exploitation depth is usually less than 50 meters and for this reason, it is characterized as shallow geothermal energy. This energy is mostly used for supplementing cooling/heating and DHW systems. Such systems can also take advantage of the fairly steady seawater temperatures below a certain depth (between 20-50 meters). Both energy sources, although not so widely used so far, have a great potential in Cyprus and Greece since most hotels are located near the sea or have adequate land to dig in.

2.4.1.4 Biomass and biofuels

The term biomass refers to the biodegradable fraction of products, waste, and residues of biological origin from agriculture, forestry, and related industries, such as fisheries and aquaculture, of industrial and household waste as well as of wastewater treatment processes. In simple words, biomass is the material that has direct or indirect biological (organic) origin. Biomass can take the form of solid, liquid or gaseous biofuels, e.g. pellets, briquettes, bioethanol, biodiesel or methane. It is no surprise that the energy stored in biomass also stems from the sun, as plants convert solar energy into biomass, through the process of photosynthesis. In this sense, it is a renewable energy source and can reduce GHG emissions by replacing fossil fuels in the energy mix of a hotel. However, its use creates air pollution locally that should not exceed certain limits. Many touristic establishments in Cyprus and Greece are located in areas where agricultural activities are also broadly developed and as a result, several biodegradable waste or residues can be in high supply.

2.4.1.5 Cogeneration of heat and power

Cogeneration is the simultaneous production of electricity and useful heat. In a regular power plant, the heat produced in the generation of electricity is lost, often through the chimneys. But in a cogeneration plant, it is recovered for use in homes, businesses, and industry. Cogeneration plants can achieve energy efficiency levels of around 90%. Small cogeneration facilities can also be an effective way to supply energy to remote areas without the need for expensive grid infrastructure.

The Cyprus Ministry of Energy Commerce and Industry announced in 2017, the operation of a support scheme for the installation of cogeneration systems fuelled by biomass/biogas to produce electricity for self-consumption. The combined heat and power (CHP) units are included in the category of net-billing support scheme, which can be located on any commercial or industrial premises (e.g. commercial or industrial units, public buildings, camps, hotels, schools, agricultural and livestock units). The installed power of each CHP system cannot exceed 5MW per installation and the total power for all units allocated to this scheme is 20MW. Until now, there is no interest in this scheme as the tariff regime is a bit.

It should be noted, that the implementation of CHP units is one of the measures included in the Cyprus NECP that are planned to be implemented during the period 2021 - 2030, in order to contribute to achieving the energy efficiency target for 2030.

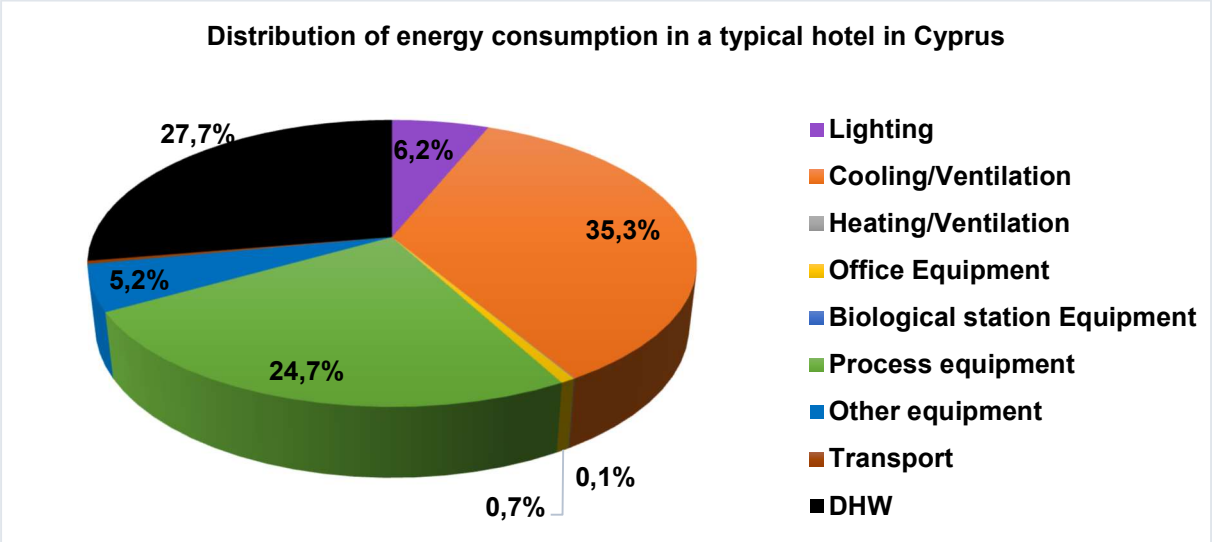
2.5 Main energy users in hotels' facilities

The main energy users in most accommodations are listed below:

Table 6: Main energy users in most accommodations

• **HVAC is considered the largest consumer of energy in hotels, accounting for approximately half of their total energy demand. Weather conditions, indoor temperature levels, floor area and several technical parameters (e.g. insulation) are among the main factors affecting energy requirements for HVAC.**
• **DHW is commonly the second largest consumer, accounting for up to 25% of the total energy demand.**
• **Kitchen (Meals' preparation, refrigeration and deep freezing) could also claim a significant share of the total energy consumption, ranging between 15-25% depending on the size and star category of the establishment.**
• **Lighting can vary between 8-10% of the total energy consumption.**
• **Laundries (if applicable)**
• **Swimming pool (if applicable)**
• **Water pumps and wastewater processing (If applicable)**
• **Other users (e.g. Spa, Gym, IT infrastructure, transportation) Sports and health facilities are typically high energy consumers.**

Figure 19: Energy consumption in a typical Hotel in Cyprus, (OEB, 2019)



**The process equipment includes kitchen, room, laundry, gym, saloon, spa and pool equipment.*

2.6 Hotels4Climate best practices

The European project "**Hotels4Climate**" aims to reduce the greenhouse gas emissions produced by the hotel industry in Greece and Cyprus. Project activities include, among others:

- Assessment of the current situation of the hotel sector in Cyprus and Greece in terms of energy use, energy and greenhouse gas emissions savings, and selection of good practices.
- Capacity building workshops and training for hotel staff on possible GHG reduction measures and energy saving practices.
- Development of an online information hub, to promote information exchange between the concerned hoteliers, to share knowledge products and to assess GHG emission reduction potential through a virtual tool.
- Study visits of 10 Cyprus hotel representatives to hotels that apply good practices in Greece and Germany.
- Networking events with hotels representatives and financial institutions to showcase business models and best practices and enhance their collaboration opportunities.
- Identification of green opportunities of the hotel industry after the post COVID-19 phase and provide recommendation to policymakers to support hoteliers in their shift towards sustainable tourism and GHG reduction.
- Promotion of the Circular Economy in the Hotel Industry via workshop and business coaching delivery, identifying current and potential circular practices and opportunities to adopt circular business models.

Examples of best practices were identified in hotels in Cyprus, Greece and Germany, which are listed in the tables below. All the best practices identified during the project can be found at the following link http://www.oeb.org.cy/hotels4climate/

Box 5: Best practice from Cyprus

napa mermaid HOTEL&SUITES	**Hotel's name: NAPA MERMAID HOTEL & SUITES**
	Address: Kryou Nerou 45, Ayia Napa 5343, Cyprus, P.O. Box 30505 Telephone number: +357 23721606 Website: https://www.napamermaidhotel.com/contact-us Email: reservations@napamermaidhotel.com
	Classification: 4 stars Area in m^2:11.000 Number of rooms: 150 Number of beds: 360 Year of construction: 1985 Certification: ISO140001, Travelife Facilities:1 Outdoor Swimming pools, 1 Indoor Swimming pool (heated), 1 restaurant, 1 kitchen, 1 bar, 1 laundry, 1 Gym, 1 spa, 1 sauna, 1 steam bath, 1 jacuzzi, tennis court.

Annual energy consumption in kWh:

The total annual energy consumption of the hotel was 1.795.916 kWh in 2018 corresponding to 1.046.411 kg of CO_2eq.
Breakdown of total energy consumption:

Electricity: 1.202.212 kWh

LPG: 117.225 kWh

Heating Diesel: 470.158 kWh

Petrol (Transport): 6.321 kWh

Climate protection measure(s) implemented

Lighting:

Description: Replacement of approximately 90% of the hotel's conventional bulbs & spotlights with LED

Date of implementation: Gradually from 2014 until 2018

Investment cost: appr. € 30.000

Annual energy savings: appr. 70% reduction of the electricity consumption for lighting replaced by LED corresponding to 164.700 kWh

Estimated annual GHG emissions savings: 116.000 kgCO_2eq

Annual cost savings: appr. € 26.300

Simple Payback period: 1 year

Autonomous PV:

Description: The autonomous PV system was installed in 2012 and has a capacity of 14kW. It is intended for the operation of 3 x swimming pool pumps

Date of implementation: 2012

Investment cost: appr. € 30.000

Annual energy savings: appr. 22.500 kWh per year

Estimated annual GHG emissions savings: 16.695 kg CO2eq

Annual cost savings: appr. € 3.600

Simple Payback period: 8,5 years

Solar thermal panels for hot water:

Description: In 2018, 80 solar thermal panels on the hotel roof were replaced by new ones. The hot water produced from these panels covers a significant proportion of the hotel needs. The solar thermal panels have a lifespan of around 25 years

Date of implementation: 2019

Investment cost: appr. € 20.000

Annual energy savings: appr. 35% reduction in heating diesel needs corresponding to 10.000 Lt

Estimated annual GHG emissions savings: 26.380 kg CO2eq

Annual cost savings: appr. € 8.000

Simple Payback period: 2,5 years

	Heating: Description: Replacement of the diesel fired boiler with a wood pellet boiler of 90% energy efficiency and 180 kW heating capacity. The contribution of this measure will be measurable during the following year Date of implementation: end of 2019 Environmental Measures: Recycling: The hotel collects and recycles paper, PMD, glass, batteries, ink cartridges, cooking oil, lamps, electric and electronic appliances, plastic, wood, metals, gardening waste. Since July 2018 organic waste is also recycled Significant reduction of plastic straws use: The use of plastic straws has been reduced from 77.750 in 2017 (8 months of operation) to 67.250 in 2018 (11 months of operation) Participation in Recycling campaigns/programs: All departments participate at the REduse, REuse and REcycle program. Clients participate at recycling through "Let's Recycle Together" Replacement of Christmas and new year's printed cards with electronic cards

Box 6: Best practice from Greece

DORYSSA SEASIDE RESORT 	**Hotel's name: DORYSSA SEASIDE RESORT**
	Address: 83103 Pythagorion, Samos (island), North Aegean Prefecture Telephone number: +30 22730 88300 Website: https://www.doryssa.gr/en/home-page Email: info@doryssa.gr
	Classification: 5-star Area in m^2: 53.000 Number of rooms: 308 Number of beds: 636 Year of construction: In two stages: Main building in 1975 and the village addition in 1992 Annual energy consumption in kWh: 1.860.262 Certification: Travelife, Blue Flag Facilities: Its 300 rooms and suites are attractively arranged in bungalows (the "village") and in the main building. In addition, the hotel offers a wide range of choices and activities to its guests and visitors. Spa with a variety of treatments, Jacuzzi and Sauna, Gym, Tennis Courts, Beach Volley, Soccer 5×5, Various water sports, Children outdoor playground, Outdoor pool, Piano bar, Lounge bar, Pool snack bar, "Unan" Sushi bar (a la carte), "Asterias" seaside restaurant (a la carte) and two Buffet restaurants (open daily for breakfast, lunch and dinner). There is also a traditional coffee house (Kafenio), a mini market, a conference centre (with a capacity of 500 people) and a museum of Folk Art.

 	**Solar thermal panels for hot water:** Description: Installation of 1.000m^2 of solar panels for the production of DHW. The installation also combines a heat recovery unit from the return of the Heating/Cooling system and is supported by two LPG burners in case of cloudy weather. Almost half of the solar panels were placed over the parking lot of the hotel providing shade for the parked cars. Although this technology is characterised by a low degree of innovation, it is considered extremely efficient and cost effective, especially in regions with high solar potential. Thus, it is already used on a large scale in hotels with adequate suitable space. In some destinations, the installation of solar panels is not permitted due to reasons of preserving the aesthetic of the scenery (traditional settlements, cultural heritage sites, etc.). No particular involvement of staff and guests, nevertheless the said measure is quite visible to everyone working and staying at the hotel. Date of implementation: 2006 Investment cost: appx. € 1.300.000 Annual energy savings: 270.000 L of LPG (appx. 90% reduction) Estimated annual GHG emissions savings: 400.000 kgCO_2eq Annual cost savings: appx. € 186.000 Simple Payback period: 7 years
	Lighting: Description: 70% of all lighting have been replaced with LED lamps. This measure is implemented gradually because it requires a quite extensive restoration work of the hotel's interior spaces. No particular involvement of guests, but the project is carried out by the hotel's maintenance/technical staff. Date of implementation: 2015 (ongoing) Investment cost: Appx. €55.000 Annual energy savings: 75.000 kWh (appx. 45% reduction on average) Estimated annual GHG emissions savings: 76.000 kgCO_2eq Annual cost savings: appx. €9.000 Simple Payback period: 6 years

Cooling/Heating:

Description: The Heating/Cooling system is taking advantage of the sea water temperature to cool down the return of the circulation water before going through the chillers again (SWAC). The measure exemplifies a high degree of innovation and has achieved significant reduction in the amount of energy required by the four chillers. Theoretically, any hotel in close proximity to the sea could easily implement this technology, however it requires a considerable capital investment and is necessary to make sure that no special environmental restrictions are applicable in each specific destination. No particular involvement of staff and guests so far.

Date of implementation: 2006

Investment cost: appx. € 1.750.000

Annual energy savings: 985.000 kWh (appx. 75% reduction)

Estimated annual GHG emissions savings: 1.060.000 $kgCO_2eq$

Annual cost savings: appx. € 118.500

Simple Payback period: 15 years

Box 7: Best practice from Germany

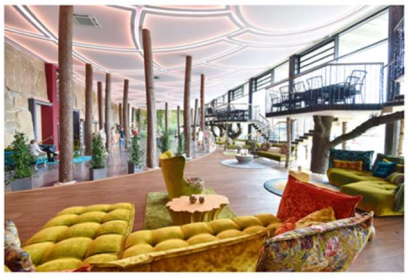
Hotel's name: MAWELL RESORT

Address: Roseneck 5, 74595 Langenburg (Hohenlohe), Baden-Württemberg

Telephone number: +49 (0) 7905 9414-0

Website: https://mawell-resort.de

Email: info@mawell-resort.de



Classification: 4 stars

Area in m^2: 120.000

Number of rooms: 76

Number of beds: N/A

Year of construction: 2013

Annual energy consumption in kWh: N/A

Certification:N/A

Facilities: The resort with 60 rooms and 16 suites is perfectly integrated into the natural surroundings of Baden-Württemberg's smallest town, far away from everyday life and yet within easy reach from Stuttgart, Heilbronn, Wurzburg, Nuremberg and Munich. It features a panorama restaurant boasting regional cuisine, a tower bar at 200 meters above the valley and a gin bar with over 100 gin varieties and different tonics. Mawell Resort has a 5.500 m^2 wellness landscape, including both indoor and natural outdoor pools, saunas, steam baths, a gym, and wellness & beauty centres. It puts sustainability at the centre of a relaxing getaway without compromising all of the necessary luxuries.

Climate protection measure(s) implemented:

OWN POWER SUPPLY: In 2013, a satellite cogeneration plant (biogas) with 400kW/el (electrical) and 480k/th (thermal) has been installed directly on site. The waste heat is used in the Mawell Resort; surplus heat is transferred to the open-air pool Langenburg, school, town hall, kindergarten and Innopark. Peak loads are covered with a 450 kW wood chip heating system during the heating period. Moreover, a 150 kW photovoltaic system was built on the roof of the reception building in 2017.

GREEN ROOF: The flat roof features a full substrate covering and sedum planting. This measure reduces heating and climate costs through natural insulation. Additionally, rainwater is collected and used for the natural pool and washing machines.

BUILDING SERVICES MANAGEMENT SYSTEM: Since 2013, the resort continuously expands the building services management system. It involves regulated/performance-based heating pumps, regulated local heating network and transfer stations, motion-controlled lighting regulation, demand-driven ventilation technology, EC fans and heat recovery via a rotary heat exchanger.

RESOURCE MANAGEMENT: The concept of sustainability and wellness in harmony with nature can be recognised throughout the resort: regional building materials such as oak & birch wood, natural rock (approx. 250 million years old), shell limestone, Jurassic rock and clay have been utilised. Rain and well water is treated on site through ultrafiltration. Furthermore, the resort cooperates with regional farmers and suppliers in addition to having an own herb garden.

OBJECTIVES FOR THE FUTURE: Future plans of the Mawell Resort include a no-waste concept, elimination of packaging and utilisation of compostable products instead of plastic where possible. The resort also plans to expand the photovoltaic system, install a pellet heating system and further extend the building services management system.

Date of implementation of each measure:

Satellite cogeneration plant – 2013

Wood chip plant – 2013

Photovoltaic system – 2017

Green roof – 2013

LED lighting – 2013

Building services management system – since 2013

	Investment cost: Satellite cogeneration plant – approx. 1 M € Wood chip plant – approx. 200.000 € Photovoltaic system – approx. 150.000 € Green roof – approx. 40.000 € LED lighting – approx. 60.000 € Building services management system – approx. 2 M € Total investment - approx. 3.450.000 € Annual energy savings: Satellite cogeneration plant, wood chip plant and photovoltaic system – approx. 800.000 litres of heating oil/year LED lighting – approx. 72.000 kW/year Estimated annual GHG emissions savings: Satellite cogeneration plant, wood chip plant and photovoltaic system - approx. 2.160 tonnes of CO_2/year Estimated annual cost savings: Satellite cogeneration plant, wood chip plant and photovoltaic system - approx. 300.000 €/year. LED lighting – approx. 20.000 € Simple Payback period:For renewable energy systems = approx. 4,5 years For LED lighting = approx. 3 years

2.7 Self Study/Exercises

Exercise 1: A hotel has decided to replace the conventional bulbs in the lobby with LEDs. Calculate the annual energy savings, the annual GHG emissions savings and the simple payback period by using the following input data:

- Number of conventional bulbs: 188
- Power of each conventional bulb: 60 W
- Power of each LED: 15 W
- Working hours: 3.630 hours/year
- Cost of each LED: 15€
- 0,7409 kg CO_2/kWh

Exercise 2: An AC Split unit is used to cover the cooling needs of a conference room in a hotel. The cooling needs are estimated to be 1.000 kWh per year. The hotel owner decided to replace the existing system with a more energy efficient unit. Calculate the annual energy savings, the annual GHG emissions savings and the simple payback period by using the following input data:

Existing AC split unit

- Energy Class: C
- SEER: 4,2
- Price of electricity: 0.16 €/kWh
- 0,7409 kg CO_2/kWh

New AC split unit:

- Energy Class: A++
- SEER: 7
- Cost of the split unit: 700€

3 Opportunities for GHG reduction and energy savings

3.1 GHG reduction and energy saving potential in the hotel industry

Energy savings and GHG reduction go hand in hand. The same applies to energy bills. As already discussed in previous chapters, savings in the hotel industry can be achieved through two different ways. On the one hand, we should educate staff -and guests- to make simple every day choices that could save hundreds, if not thousands, of kWh every year, and on the other we should gradually invest in more energy efficient technologies in the most significant areas, based on the findings of the energy audit and analysis conducted.

To reach better results faster, the use of both tactics is required, as well as a systematic monitoring and reviewing of our progress in order to make the necessary adjustments. The potential for savings is considerable and is hidden in every hotel department, therefore, to make any proposed measures more relevant and applicable, both tactics will be seen through this perspective. This chapter intends to provide the necessary knowledge, simple guidelines, and practical ideas to take full advantage of any opportunities to reduce energy consumption and expenses and mitigate GHG emissions in your accommodation. Guests participation and awareness will be covered in chapter 6.

3.2 Energy saving opportunities in various hotel facilities

This section aims to identify **opportunities to save energy and reduce GHG emissions in the various hotel's facilities.** These opportunities appear in the form of technological solutions capable of achieving significant energy savings with minimal or no human intervention. This absence of human effort is the principal element of differentiation with the staff recommendations in section 3.5 further below. This element is noteworthy because, once these systems are in place, employees are relieved from various repetitive and sometimes dull procedures to concentrate on more important tasks. In combination with the following section 3.3, we propose an extensive, but not exhaustive, list of such technologies and systems that are readily available and tested for their effectiveness in reducing energy consumption. Their key elements and features, as well as any substantial advantages or disadvantages, are highlighted.

3.2.1 Kitchen and restaurant facilities

Kitchen and restaurant facilities are areas of high energy use, usually combining different energy sources in the process of preparing and conserving food. Since food safety and hygiene are a top priority in these hotel areas, the installation of energy efficient systems and automation that require minimum staff involvement is highly recommended.

- Install a data logger system for monitoring and recording temperature (and humidity) levels on a 24/7 basis. A temperature logger is an electronic device capable of storing a large number of measurements from one or more sensor inputs at predetermined frequencies. Some systems can even transmit the measurements wirelessly to a central device, eliminating the need for costly wiring installations. Measurement data can be analysed later or in real-time. Such systems can work autonomously or be part of an integrated Building Management System (BMS).
- Install an opening alarm on every freezer / fridge door. A door alarm device is basically a sensor, generating an audible signal every time the door of freezer or fridge stays open for more than a predefined period. It can be an autonomous system or be part of a BMS. Some systems are capable to send an alarm message to a mobile device, such as a phone. This is extremely important, from both hygienic and energy wastage perspective, in case of a door being left accidentally open at the end of a working day.
- Install PVC strip curtains on every freezer / fridge door or other openings to highly air-conditioned areas, such as chemical or dry food stores. They reduce energy consumption by minimising thermal losses. They are low cost and easy to install.
- Prefer high-energy efficiency electric devices (B or higher) when replacing or upgrading kitchen or restaurant equipment; a higher initial price is often quickly offset by lower running costs. The

equipment specifications should be relevant to the size and average guest capacity of the accommodation.
- Install CO and smoke detectors where applicable.

Figure 20: An example of a kitchen design

Photo: https://www.forketers.com/things-know-restaurant-kitchen-design/

3.2.2 Domestic Hot Water Systems

As seen, the production of DHW can represent up to 25% of the total energy consumption in an accommodation. Moreover, it usually involves the use of diesel or LPG, which both are responsible for high direct emissions of GHGs. Luckily, there are plenty solutions available to produce DHW without emitting GHG and paying for fuels or electricity.

- Install low flow showerheads; excessive water flow in the shower is related to increased consumption of hot water, thus it should not exceed 10L per minute.
- Install solar water heaters for the production of DHW (see also section 3.3.1.1).
- Install heat-pumps for the production of DHW (see also section 3.3.2.1).
- Install heat recovery systems (see also section 3.3.2.2).
- Install thermometers on the boilers.
- Install thermal insulation on pipes and buffer tanks to reduce thermal losses.
- Replace the oil/gas boiler with a pellet (biomass) boiler, particularly in case you have access to such energy resources that are produced locally (see also section 2.4.1.4).

3.2.3 Heating, Ventilation and Air Conditioning Systems

This is by far the heaviest energy user in any type of accommodation, particularly in destinations with a warm climate, like Cyprus and Greece. For this reason, they constitute a great opportunity for energy savings and GHG emissions' reduction.

- Install heat recovery systems (see also sections 2.4.1.3 and 3.3.2.2).
- Install occupancy sensors in every room or touch sensors on the balcony doors to reduce the wastage of energy.
- Install a BMS system to control temperature, operation hours, etc. (see also section 3.5).
- Installation of or replacement with high efficiency air conditioning systems (see also section 3.3.2.1).
- Install ceiling fans in guest rooms, restaurants, bars and other common areas since they have considerably lower energy requirements than other cooling systems. Fans can make guests feel

comfortable at higher temperatures, as they create an evaporative cooling effect by blowing air over the skin.
- Install CO_2 sensors in large functions rooms and other common areas to automatically control outdoor air supply in the most energy effective way while avoiding under-ventilation that may compromise the comfort and health of guests and staff.

3.2.4 Lighting across the hotel

Lighting is of great importance to hotels because it is directly linked with their design and style. Before the widespread use of LED technology (about 10 years ago) energy consumption for lighting accounted for more than 25% of a hotel's total electricity consumption and up to 10% of the total expenditure for energy. This is because, at that time, most of the energy intensive uses, such as DHW and heating, were mostly based on other energy sources, such as fossil fuels. Today, lighting accounts for less than 10% of a hotel's total electricity consumption, although the use of electricity has increased its share in the total energy mix. The following measures can reduce the energy consumption for lighting between 10% to 80% depending the percentage of LED lights already installed in your accommodation.

- Replace incandescent or halogen bulbs and T12 fluorescent tubes with newer type LED lamps and T5 tubes; savings in electricity consumption from lighting could reach 70%. (see also section 3.3.2.3).
- Install lighting controls connected to high end centralised systems, such as BMS or KNX[47].
- Install light, motion sensors and timers in appropriate locations.
- Install occupancy sensors or a master light switch in every guest room.
- Install a magnetic or key-card power switch in every room.

3.2.5 Building infrastructure

These interventions are usually more difficult and expensive to implement but have a quite high and long-lasting effect in improving energy efficiency and cutting total costs for energy between 5% to 80%.

- Install shades (see also section 3.3.3.5)
- Install energy efficient frames (see also section 3.3.3.6)
- Install double-glaze windows (see also section 3.3.3.3)
- Install heat rejection films (see also section 3.3.3.4)
- Install a thermal facade (see also section 3.3.3.1)
- Install additional insulation on the roof or a "green roof" (see also section 3.3.3.2)
- Install PV systems under the net-metering or net-billing schemes (see also section 3.3.1.2)

3.2.6 Office and information technology (IT) facilities

- Look for high energy efficiency ratings when purchasing new IT equipment, such as printers, monitors, photocopiers, etc.
- Install occupancy sensors to avoid energy wastage from leaving lights, air conditioning and other equipment on after working hours.

3.2.7 Pumping and drainage facilities

- Install inverter type pumps wherever the flow of water has to be aligned to the demand for water. Besides lower energy consumption, these pumps are ideal to normalise the water flow an entire hotel facility.
- Install autonomous PV systems connected to the swimming pool pumps. These pumps need to operate more intensively during daytime.
- Replace the sand inside the swimming pool filters as per the manufacturer's guidelines to avoid increased energy demand during the filtration process.

[47] KNX is an open standard for commercial and domestic building automation. KNX devices can manage lighting, blinds, HVAC and DHW systems, security systems, energy management, audio and video equipment, white appliances, etc. For more information: https://www.knx.org/knx-en/for-professionals/What-is-KNX/A-brief-introduction/index.php

3.2.8 Gym and Spa facilities

- Use facilities with appointment in order to reduce energy load when not in use. This also increases guest satisfaction.
- Install buttons and controls on the various gym equipment, as well as on the jacuzzi, in order to allow guests turning them on and off as they please instead of having them on all-day long.
- Install occupancy sensors to avoid energy wastage from having lights, air conditioning and other equipment on when nobody is using these facilities.

3.2.9 Transportation

These suggestions, although not linked to the reduction of energy expenditure, can have a significant impact on the Scope 3 GHG emissions and contribute to the sustainability image of the hotel.

- Install a charging station for electric cars, scooters and bicycles preferable from solar PV.
- Offer to your guests the option to rent an electric car, scooter or bicycle.
- Offer to your guests the option to use regular bicycles free of charge.

3.3 Overview of various technologies towards the minimization of GHG emissions

3.3.1 Renewable energy technologies

Humans have been harnessing nature's power in various ways since the ancient times, e.g. windmills and sailing boats, but over the past few centuries, they have increasingly turned to cheaper and more convenient energy sources, such as coal, oil and gas. As the effects from global warming are becoming more apparent by the day across the globe, the need to turn again to these abundant energy sources is more urgent than ever. At the same time, increasingly innovative and efficient technologies to capture and store renewable sources are getting more reliable and affordable. In the following paragraphs, we are going to present the basic characteristics of these technologies through the lens of their applicability to the hospitality sector in Cyprus and Greece.

3.3.1.1 Solar thermal energy

Solar Thermal is the utilisation of solar energy (basically, sunlight) as a source of heat. Most commonly known for water heating, it has more applications, e.g. cooking, space heating and cooling or generating electricity. However, water heating is considered the most applicable option, because of its proven efficiency[48], reliability and relatively short payback period[49]. It is widely used in accommodations of all sizes worldwide, due to the adaptability and variety of available apparatuses, often referred to as solar water heaters (SWH). Different technologies of SWH include glazed flat plate collectors, evacuated tube collectors, and lower-temperature swimming-pool heaters made from plastic tubes. SWH systems have low maintenance requirements, but they can be sensitive to low atmospheric temperatures (usually below 0°C). However, there are technical solutions that minimise the risk of ice formation inside the collectors. Although, they are less effective during winter months, this is of little concern for the seasonal hotels in Cyprus and Greece. It is also important to stress that SWH, not only make use of a free and renewable source of energy, but in most cases, they replace conventional fuels, such as heating oil, natural gas (LNG) or liquid petroleum gases (LPG), used in burners for the same purpose. Therefore, SWH should be on top of the list of any energy action plan aiming to reduce GHG emissions.

[48] A collector of 1-1,5 m^2 is required to cover the overall, daily needs of hot water for 1 guest.

[49] Payback period is ranging between 2-6 years for seasonal hotels in Cyprus and Greece, depending on the solar dynamic at each location, the orientation of the installation and the collector's technology.

Figure 21: Photo taken from Amavi Hotel in Cyprus

Photo: Amavi Hotel Cyprus

3.3.1.2 Solar photovoltaic (PV) technology

Firstly, it is important to understand that solar PV technology is different to any form of solar thermal energy, even when the latter one is used to produce electricity. As the name suggests, PV panels capture solar energy and directly convert sunlight into electricity. There are three types of solar PV systems, i.e. grid-tied, grid/hybrid and off-grid. However, for the time being only the first one is considered as an affordable PV technology for both domestic and commercial installations that are already connected to the grid. In this type of solar PV system, all of the produced electricity has to be directed to the national grid and cannot be stored locally for a later use.

In Cyprus[50] and Greece[51], this technology is promoted through a scheme called Net-Metering or Net Energy Metering (NEM). It is essentially an energy-offset mechanism that allows consumers who generate some or all of their own electricity to use that electricity anytime, instead of when it is generated. Simply put, the amount of energy produced is deducted from the total energy consumed from the grid. In Greece, if at the end of a calendar year the total energy consumed from the grid is higher than the amount of energy contributed to the grid, we have to pay for that difference.

If on the other hand, the produced energy exceeds the total energy consumed, this energy is transferred to an energy "credit account" that can be used to offset the consumed energy over a period of three consecutive years. In Cyprus case, the billing arrangement is done in every billing period. In case that the consumption exceeds the production, then the consumer will be billed the difference, while in the opposite case, the production surplus is transferred to be used in the following (forthcoming) two-month billing period. The final clearing will be stated on the last bill of the financial year (February-March). Any surplus may not be transferred to the next billing year. For this reason, the installed capacity of a PV system is preferred to be slightly lower than the annual energy needs. Net Metering is a great tool for any accommodation interested in reducing energy costs and GHG emissions. It is a simple process, fairly easy to implement at a relatively low cost and a satisfactory depreciation period. In addition, lower GHG emissions create a positive environmental footprint for the hotel that can be appealing to like-minded guests.

[50] Certain restrictions may apply in relation to the total installed capacity of the installation.

[51] Ministerial decision no. ΑΠΕΗ/Α/Φ1/οικ.24461 (ΦΕΚ Β' 3583/31.12.2014).

Figure 22: Photo taken from Crown Plaza hotel in Cyprus

Photo: Crown Plaza Hotel, Limassol, Cyprus

Since 2018, the net-billing scheme was launched in Cyprus. It concerns RES installations that are implemented in premises of commercial or industrial pricing (in commercial, industrial buildings, public buildings, camps, schools, agricultural and animal husbandry units, fishing enterprises etc) for the purpose of generating electricity for own use. The maximum power of each RES system can not exceed the 80% of the installed capacity except the occasions where a storage system would be installed. In case of net-billing, if the cost of exported electricity does not exceed the cost of imported electricity then the consumer will pay the difference resulting from the offsetting the cost of exported and imported electricity for each time of billing period. Respectively, in case where the cost of the exported electricity exceeds the cost of imported electricity the surplus amount will be credited for the next billing period. The size of the PV system under the net-metering and net-billing scheme should not exceed 10 kW and 10 MW, respectively.

Table 7: Comparison of SWH and PV systems

SWH systems	**PV systems**
Solar thermal installations are more space efficient than solar PV.	PV installations require more space per kWp. (depending on the type of solar panel, an area between 7-12m^2 per kWp is required).
It can be up to 70% more efficient in collecting heat from sun rays than solar PV (only for heating up water).	They produce electricity that can be used for any purpose. They directly reduce energy bills.

The technology is less complex than PVs, thus it has lower maintenance costs.	More complex technology, thus more expensive to maintain.
They are less expensive; thus, they have a shorter depreciation period (2-5 years).	They are more expensive; thus, they have a longer depreciation period (6-10 years).
Shorter lifespan (12 -15 years).	Longer lifespan (20-25 years).

3.3.2 Energy efficient technologies

As already discussed in section 2.2, energy efficient technologies manage to deliver a higher output for the same amount of energy input. Systems and devices are ranked for their energy efficiency, based on their annual consumption, to different energy categories (ratings) from G being the lowest to A being the highest (EC, n.d.-4).

3.3.2.1 Heat-pumps for space heating/cooling and hot water production

Cooling systems based on this technology draw about 3/4 of the required thermal energy from the environment, and only use electricity to produce the remaining 1/4. That is why, heat-pumps have very high efficiency rating (COP[52]>4,5). In other words, for each kWh consumed they deliver approximately 4,5 kWh of thermal energy. Through the use of an alternator, they can transform this thermal energy to either heat or cold. They are ideal for areas with temperate climates, such as the climate of Cyprus and Greece, where they operate at their maximum efficiency. Nowadays, almost all heat-pump systems are equipped with inverter technology to effectively control the rotational speed of the compressor's electric motor and reduce energy consumption by up to 30%. There are two main types of heat pumps:

Air-to-Water systems

These systems transfer the energy absorbed from the external environment to water, which in turn is circulated in the heating/cooling system of the building through fan coils or Air Handling Units (AHU). This type of heat pumps is also used for the production of DHW.

Air-to-Air systems

This type of heat pump also receives energy from the external environment to transfer it directly to the air circulating in a building. The form factor and capacity of these systems vary considerably, from mini split air conditioners to semi-central air conditioning systems, such as air ducts, cassettes, closets or central VRF systems.

3.3.2.2 Heat recovery systems

Heat recovery is the process by which part of the heat discharged into the environment by a heat generator is captured and reused. Using the appropriate heat recovery method, up to 70% of the lost heat can be retrieved, thus significantly reducing energy requirements. Heat recovery can be applied to both liquid and air circuits. The recovery from hot currents, such as condensers or DHW returns, is achieved with a device, called heat exchanger, capable to transfer thermal energy between two fluids of different temperatures. Correspondingly, in building ventilation systems, tile air-to-air heat exchangers or thermal wheels are commonly used. The recovered thermal can be used in hot water systems (for DHW, spas, swimming pools), air conditioning, etc.

3.3.2.3 LED lighting

LED lamps offers very high energy efficiency gains compared to all other lighting technologies. This is because LED technology uses more than 80% of consumed electricity to produce light and only 20% is lost as heat. In contrast, conventional incandescent bulbs consume more than 75% of electricity in heat and only 25% in light production. Therefore, an LED lamp requires between 50%-90% less electric

[52] Coefficient of performance (COP), is an expression of the efficiency of a heat pump. When calculating the COP for a heat pump, the heat output from the condenser (Q) is compared to the power supplied to the compressor (W).

energy than other technologies to generate the same light (level of brightness). LED technology has improved a lot in the past few years, offering a very wide range of fixtures, sizes, luminance and lighting colours, while at the same time became very affordable. Other advantages include, a very long lifespan (10+ years), being 100% recyclable and not containing zinc, like CFL bulbs. Zink is known to be harmful to both humans and the environment. However, is good to know that although LED lamps produce minimal heat themselves, they are quite sensitive to heat and if exposed to high temperatures, both their efficiency and lifespan are reduced.

3.3.3 Building insulation

In building constructions, the term insulation refers to the isolation of a space from various external elements, such as heat or cold, sound, liquids and even radioactivity. Building insulation includes any technique or material used in a building for insulation purposes. In the context of energy savings and GHG mitigation, we mainly focus on available solutions to enhance the thermal insulation of a building whether it is an existing or new construction. The contribution of insulation in the energy performance of a building is significant and in cases where the right mixture of techniques is applied, it can lead to almost zero energy requirements (Nearly Zero Energy Building - NZEB[53]) or even generate more energy than needed (carbon positive building). The energy performance of buildings across Europe should be in line with the Directive (EU) 2018/844 of the European Parliament and of the Council of 30 May 2018 amending Directive 2010/31/EU on the Energy Performance of Buildings and Directive 2012/27/EU on Energy Efficiency.

In Cyprus, specific requirements have been implemented towards improving the energy efficiency of buildings. As of late 2007, mandatory measures were implemented for energy saving through the insulation of the building envelope, for all new buildings and all existing buildings over 1.000 square meters which underwent major renovations. As of 1 January 2010, an additional minimum energy performance requirement was added to the effect that all new buildings should be classified as a minimum under energy class B in the Energy Performance Certificate (EPC). This has led to the implementation of better thermal insulation. Moreover, the installation of a solar thermal systems for the production of hot water was made mandatory for all new dwellings, and the fitting of a standby installation for the use of renewable power systems was made mandatory for all new buildings. By the Decree of 2013, the maximum U-values of the building envelope were reduced by approximately 15%, while a maximum shade coefficient for windows was adopted for the first time. The Decree states that, in respect of buildings that are not used as residences, at least 3 % of total energy consumption must originate from renewable energy sources. As of 1 January 2017, the U-values for the building envelope were further reduced aiming to have the cost-benefit ratio over the lifecycle of the building reach its cost-optimal level, i.e. close to the NZEB requirements, as laid down in K.D.P. 366/2014. The minimum percentage of total energy consumption that must originate from renewable sources was also increased significantly both for residential and non-residential buildings. Recently new minimum energy efficiency requirements were announced by the Ministry of Energy that came into force from 1 July 2020. These require all residential buildings undergoing major renovation to be energy class A, while all non-residential buildings energy class B+. Specific requirements for hotels are also in place[54].

3.3.3.1 Envelope insulation or building thermal facade

The external thermal insulation or thermal facade refers to the application of a thermal insulating material on the outside surface of all vertical external walls of a building. Successive layers of other specialized materials are also used as protection, providing resistance to weather conditions, mechanical stress, wind pressure or any other cause that may affect its energy performance. For the selection of the most efficient envelope insulation, a number of factors must be considered, such as the existing thermal insulation of the building, the climatic zone of its location and its use. It is even more important to check the thermal insulation on the roof of a building. This insulation is usually combined with roof sealing and apart from using a variety of specialized materials, it is recommended to assess the option of using a “green roof”.

[53] Source: https://ec.europa.eu/energy/topics/energy-efficiency/energy-efficient-buildings/nearly-zero-energy-buildings_en

[54] Source: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32018L0844&from=EN

3.3.3.2 Roof insulation (green roofs)

Instead of using typical insulating materials -artificial or natural- for increasing the protection of the roof(s) against heat and water, the creation of a green roof and terraces is one of the most environmentally friendly solutions for achieving significant energy savings and an aesthetic upgrade of the accommodation. The term “green roof” or “living roof” is used to describe a roof, terrace or veranda of a building that is entirely or partially covered with vegetation. This vegetation is planted in a layer of soil, which can be placed over a waterproof membrane or on top of additional layers, such as a root barrier and a drainage/irrigation system.

"Green roofs" or planted roofs are categorized internationally into two main types, i.e. The extensive type, where the total surface of the roof is covered and the semi- intensive type, where other build elements might be included. The creation of a "green roof" increases the Energy Efficiency of the building, but has many benefits for its inhabitants and the environment, too:

- Extends the life of the building's waterproofing up to 40 years, because it protects it from exposure to extreme temperature differences.
- Enhances thermal insulation, (saves up to 2 litters of heating oil/m^2, thus reducing GHG emissions by 5,5 $kgCO_2eq/m^2$).
- Reduces the abrupt flow of rainwater. The result is that 10-50% of the water, instead of ending up in the sewers, returns to its natural cycle.
- Filters and improves the city air. It retains suspended particles and dust and makes the microclimate in cities healthier.
- Absorbs, instead of reflecting, noise, and solar radiation, mitigating the phenomenon of "urban heat island".
- Offers recreation area for the residents of the building.
- Recyclable and recycled materials can be used for its construction.

When considering installing a “green roof”, you should consult with your building engineers, before you go ahead with the instalment.

Figure 23: Photo of a green roofed resort

Photo: https://inhabitat.com/6-green-roofed-resorts-to-relax-in-and-on-top-of/

3.3.3.3 Double glazed windows

A double-glazed windows or insulated glass consists of two or more panes of glass sealed together and separated by a thin cavity filled with air or other gas. This void creates an insulating barrier between the external weather conditions and the interior of your building. By limiting the transfer of hot or cold air through glass surfaces, double-glazed glass provides superior insulation, compared to single panes of glass, and keeps your space cooler in summer and warmer in winter. In addition, double-glazing offers increased protection against damaging UV radiation from the sun, enhanced security and significantly lower outside noise levels. Taking things to another level, insulated glass products that combine photovoltaic properties are already available in the market today, and manufacturers promise annual cost savings up to €600/m^2 of installed area.

3.3.3.4 Glass membranes

In cases, where upgrading to double glazed glass might be deemed expensive or not feasible, a fairly good alternative is to install a heat rejection film on your glass surfaces. This solution allows high transmission of natural light into your building while drastically reduces the amount of harmful UV rays that cause fading to fabrics and furnishings. Insulation films are available in various qualities and darkness tones, offering different levels of heat and glare reflection. Glass membranes are generally easy to install and maintain, and usually come at a lower cost compared to blinds, screens or other shading options. They can even be used in combination with double-glazed glass for superior results in extreme cases, e.g. large glass surfaces on southern orientation with limited options for external shading. Most glass films are sophisticated products encompassing nanotechnology and in the near future might even combine photovoltaic properties to further increase their contribution to energy savings. A point of attention, certain types of glass films with metallized coating might affect wireless transmissions.

3.3.3.5 Screens and shading systems

Less exposure to sun can greatly decrease glare and temperature in both interior and exterior spaces. Interior shading systems (single/double/triple rollers, vertical and horizontal blinds, sliding panels, pleated blinds) can limit the solar radiation entering a building while, at the same time, improve its style and aesthetic. Similarly, the use of a pergola or gazebo increases the comfort feeling in the exterior areas of a building -in terms of temperature and light- and softens the impact from heavy rains and strong winds; thus, creating a protected outdoor environment that can be enjoyed almost all year round regardless of weather conditions. In addition, such constructions can lower sun exposure to any adjoining building and in that sense contribute further to its overall energy savings. As a result, these systems are considered to be fully aligned with the requirements of bioclimatic architecture.

3.3.3.6 Energy efficient frames

A window or door frame with improved thermal resistance contributes to its overall energy efficiency. There are many types of frame materials, such as wood, fiberglass, and aluminium or metal, that provide different thermal resistance (U-factor[55]).

Aluminium or metal frames

Although very strong, light, and almost maintenance free, conventional metal or aluminium frames exhibit very poor insulating properties because they conduct heat very rapidly. In order to reduce heat flow and the U-factor, a thermal break -an insulating plastic strip- is placed between the inside and outside surface of the frame. These frames are more expensive than the conventional aluminium frames but provide a very good thermal resistance.

Fiberglass and vinyl (PVC) frames

These frames are made of synthetic materials and have good resistance to moisture. They have air cavities that can be filled with insulation, giving them superior thermal performance compared to wood or aluminium/metal frames. They are generally less expensive than aluminium, metal or wooden frames,

[55] The rate of heat loss from a window is indicated in terms of the U-factor (U-value). The lower the U-factor, the higher a window's resistance to heat flow and the better its insulating properties

but they are considered more sensitive to sun exposure (UV radiation) and extreme high temperatures, in terms of their average lifespan.

Wood Frames

Wood window frames insulate relatively well, but they require regular maintenance and are more expensive than all other materials. However, the feeling and aesthetic of this type of frames is considered by many as superior and in some cases their selection is mandatory due to specific building regulations concerning traditional settlements.

3.4 Energy saving guidelines and practical tips for staff

As presented in previous chapters, altering everyday behaviours and habits, even slightly, can lead to significant cuts in energy demand and spending. This tactic is relatively easier and certainly less expensive to implement compared to other measures involving equipment and building upgrades. However, easier does not mean effortless and a considerable amount of time for staff training will be required. The purpose of this is to give our staff the information that justifies the necessity of all proposed guidelines, not just for the benefit of the business, but the environment as well. Nevertheless, always keep in mind that these are generalised suggestions and you should consult with the heads of departments and your technical team before passing them on to your staff.

3.4.1 Food and beverage department (Kitchen, Service and Storehouse staff)

The F&B staff have very diverse responsibilities and some of the most energy intensive tasks, such as cooking and food storage, take part in this department. Energy consumption can be reduced in the following ways:

- In restaurant areas, turn off lights between meal services and make sure no exterior lights are on during the day.
- If not centrally controlled, adjust the A/C thermostats at a temperature of 20-22°C for the winter season and 24-26°C for the summer season.
- Between meal services, set the A/C thermostats at a slightly lower / higher temperature for the season concerned, i.e. minus or plus 2°C of the temperatures, respectively. Energy consumption can be reduced up to 10% during that time.
- When air conditioning is on, make sure no windows and doors remain open.
- Turn off or turn down kitchen and restaurant equipment when not in use (e.g. stoves, fryers, plate warmers, coffee makers, toasters). Usually, ovens can be turned off 10-15 minutes before cooking is finished to take advantage of the residual heat. Also, timer plugs can be installed to ensure that certain appliances are not consuming energy out of serving-hours.
- Use pans and pots of appropriate size in relation to the cooktop and keep them covered to minimise heat losses.
- Fill up casseroles with hot water from the mains to reduce the time and energy required to reach boiling point.
- Make sure dishwashers are operating at full loads in order to minimise their daily use.
- Check dishwashers for any lime deposits on the heater coils and the spray nozzles and remove them.
- Unless you have a dedicated blast chiller, you should avoid storing hot food in regular cooling chambers.
- Try to open fridge and freezer doors as less as possible. You can count the openings per hour / day and try to minimise this number by changing your workflow. Hanging a list of what is inside every chamber can help you avoid unnecessary door openings and save time too.
- Organise the storage of food supplies in a way that fewer fridge and freezer chambers are used.
- Inspect fridges and freezers at least monthly for any faulty operation or signs of wear and inform technical department accordingly; condensers and evaporators should be clean, door seals must retain their elasticity, etc.
- Keep daily records of chamber temperatures at regular intervals; this is considered a best practice for hygienic purposes, but can also provide an early signal of a possible malfunction; consider the possibility of installing a data logger system for monitoring and recording temperature (and humidity) levels on a 24/7 basis (see also sections 3.2.1 and 8.1.2).

- Have all gas equipment checked regularly (as outlined by legislation) by a competent technician, in order to avoid gas leakage and CO emissions to the environment, due to incomplete combustion.
- The last person leaving the area, should make sure all appliances and lights are turned off and fridge / freezer doors are firmly closed; consider the possibility to install an alarm system in case a chamber's door is left open.
- When considering equipment replacements or upgrades, always investigate energy efficient alternatives, preferably above B class of the new European energy efficiency labelling system; try to make such a commitment part of the hotel's energy policy.

3.4.2 Housekeeping department (Cleaning and Laundry staff)

Housekeeping staff can bring essential energy savings when servicing rooms in the following ways:

- Upon entering the room, check if a cardkey is left in place by the guests and remember to uplift it slightly before leaving the room.
- If not centrally controlled, adjust the A/C's fun speed and thermostat settings according to the technical department's guidelines; a temperature of 20-22°C for the winter season and 24-26°C for the summer season is considered reasonable; if the A/C is in operation, turn it off[56].
- While cleaning the room, turn off any non-essential lighting and take advantage of the natural daylight by opening the curtains.
- Turn off any appliances, e.g.TV, and check the temperature setting of the mini-bar refrigerator (if applicable).
- Inform maintenance department of any damage, e.g. water leaks, bad light bulbs.
- Strictly follow the towels/bed sheets change program or guest's wish when a linen change policy applies, e.g. the "change my linen card" is placed on the bed.
- Strictly follow the recycling program (if applicable).
- Before leaving, switch off any remaining lights and make sure balcony doors, windows and curtains are firmly closed in order to block sun rays from unnecessarily warming the room.

Laundry staff can also contribute to energy savings in the following ways:

- Strictly follow any guidelines or pre-set washing programs, concerning temperature setting, detergent dosage, etc., for each type of unwashed load. These guidelines or programs are usually the result of synergies, between the manufacturers of washing machines and detergents, which consider numerous factors in order to deliver the cleanest results at the lowest possible consumption of energy, water and chemicals.
- Make sure washing machines are operating at full loads in order to minimise their daily use.
- If space permits, make use of air-drying to achieve a triple-zero in energy consumption, emissions and cost.
- Turn off or turn down appliances when not in use (e.g. dryers, iron presses)
- The last person leaving the area, should make sure all lights, appliances and ventilation/air conditioning systems are turned off.

3.4.3 Front and back office departments (Reservations, Reception/Guest Relations, Administrative/Accounting staff)

Although, the direct energy saving potential (in kWh) from these departments is lower compared to other departments, they play a significant role in communicating the hotel's energy saving efforts to guests and can make a big difference if opting for the most energy-efficient choices when it comes to the procurement of relevant equipment. Still, they can contribute to energy savings in the following ways:

- Enable all energy saving features on all computers and electronic equipment (e.g. photocopiers, monitors, printers, scanners) during work hours and shut down (not on stand-by or sleep mode) any devices not in use overnight.
- If not centrally controlled, adjust the A/C thermostats at a temperature of 20-22°C for the winter season and 24-26°C for the summer season.
- Keep entrance doors and other openings closed to minimise loss of heat or cooling.

[56] In rare cases, when for example a room has a southern or northern (in case of winter) orientation and no appropriate insulation measures are in place, the A/C could remain in operation for the whole time, but at slightly higher or lower temperature setting, respectively.

- Take advantage of natural light as much as possible and avoid having all interior lighting powered on during the day. In collaboration with the technical department a zoning system can be applied to all lights, thus it can be easily determined which lights should be kept on or off under any given conditions.
- Limit lighting to an acceptable (safety) minimum during the night shift.
- Promote the hotel's environmental program to guests and make suggestions on how they can take part in its efforts to reducing energy consumption and GHG emissions. You can appoint a member of staff as a "green" ambassador to communicate such issues to guests (you can also create a "green" team to further increase employee engagement).
- Set the temperature of the AC units in the server and telecommunication room at 26°C.
- When purchasing new IT equipment, investigate low energy alternatives (A higher cost price is often quickly offset by lower running costs).

3.4.4 Technical/Maintenance department

The technical/maintenance staff is probably the most important actor in implementing a successful energy reduction plan. The ways this department is contributing to energy savings are as follows:

- Monitor, record and analyse energy consumption data; if possible install additional meters (for electricity, liquid or solid fuels and water) in appropriate locations in order to obtain information about the consumption patterns of specific equipment, a hotel area or use (e.g. a freezer, a pumping station or the air conditioning system). This is a valuable tool for assessing the efficiency of a piece of equipment and the payback period of an upgrade before making relevant recommendations to the hotel management.
- Check for high peaks in your instant demand for electric power that might affect your billing; try to reduce such peaks by not operating high intensity systems simultaneously, if possible.
- At least once every two years, perform an energy audit to map energy usage patterns and identify any significant changes in major users (more information is available in Chapter 8).
- Monitor and regulate the operation of critical equipment, such as the HVAC system, the domestic hot water (DHW) boilers, the fire protection system, the swimming pool filtering system or the wastewater treatment facility, as per the manufacturer/installer's guidelines. Such installations are very energy consuming too.
- If you have additional boilers only turn them on when the capacity of operating boiler(s) is insufficient. Turn these boilers back off when not in use and overnight.
- Give priority to solar thermal and heat recovery from the chiller.
- Respond to all reports of faulty or damaged equipment at the earliest possible.
- Perform all necessary preventive maintenance according to the level of technical expertise of the department's staff members (from just cleaning the filters of the HVAC system or repairing a pump, to adjusting the λ factor of a gas burner in order to improve combustion quality). A well-maintained system operates more smoothly and can save up to 10% of its annual operating costs. Its life expectancy is also increased.
- When more specialised skills are required, seek external support and request evidence that all manufacturer/installer's requirements have been fulfilled.
- Keep detailed and updated service logs for all equipment; this will provide the necessary information to better assess the overall running cost of each piece of equipment.
- Label control and power switches.
- Provide clear guidelines to staff from other departments on how to use certain equipment.
- Divide lighting into zones (where applicable); It will be easier to switch on only the lights needed at any given moment.
- Clean lighting covers regularly in order to maintain their luminosity.
- Install motion sensors to control lighting in areas with a low frequency of visitors (such as public restrooms or staff changing room)
- Install daylight sensors to control lighting in exterior areas.
- Install automatic timers to control lighting or other electrical equipment in areas with specific requirements (e.g. underwater swimming pool lights, ventilation fan in a storage).
- Check if all external doors and window frames close properly and make any necessary adjustments (at least twice per year in year-round hotels and before the opening in seasonal hotels).
- If centrally controlled, adjust the A/C's thermostats at a temperature of 20-22°C for the winter season and 24-26°C for the summer season.

- Check periodically for any deterioration of pipes or air ducts insulation and make the necessary repairs.
- Regularly check for hot water leakages.

3.5 Efficiency technical recommendations in accordance to EU guidelines

A building energy management system (BEMS), often part of a BMS, provides occupants and facilities managers with real-time information on the building's energy use by using networked sensors and a minimum of half-hourly utility metering. The user interface allows for information on the buildings energy use to be analysed and shared with occupants and facilities managers without requiring significant training. The performance of key aspects of the building that can be controlled by the system shall be easy to adjust i.e. lighting, heating, cooling.

In 2017, the European Commission has established the EU Ecolabel for Tourist Accommodation Services which comprises with a set of criteria for hotels and other hotel related businesses to lower their environmental impact while offering enough flexibility to allow proper guest satisfaction.

Criterion 6: Energy efficient space heating and water heating appliances[57]

a. Water-based space heating appliances installed within the duration of the EU Ecolabel licence shall:
   I. be a high efficiency cogeneration unit as defined by Directive 2012/27/EU of the European Parliament and of the Council, or
   II. have seasonal space heating energy efficiency and/or GHG emission limits in accordance with the values calculated as stated in Commission Decision 2014/314/EU.
b. Local space heating appliances installed within the duration of the EU Ecolabel licence shall comply with the minimum seasonal space heating energy efficiency set out in Commission Regulation (EU) 2015/1185 or in Commission Regulation (EU) 2015/1188.
c. Water heating appliances installed within the duration of the EU Ecolabel licence shall have at least the following relevant energy efficiency indicators:

Table 8: Criterion 6 - Energy efficiency indicators of EU Ecolable

Water heater type	Energy efficiency indicator
All water heaters with a declared load profile ≤ S	Energy Class A
All water heaters except heat pump water heaters, with a declared load profile > S and ≤ XXL	Energy Class A
Heat pump water heaters with a declared load profile > S and ≤ XXL	Energy Class A+
All water heaters with a declared load profile > XXL (3XL and 4XL)	Water heating energy efficiency ≥ 131 %

d. Existing cogeneration units shall comply with the definition of high efficiency in Annex III to Directive 2004/8/EC of the European Parliament and of the Council or Annex II to the Directive 2012/27/EU if installed after 4th December 2012.
e. Existing hot-water boilers fired with liquid or gaseous fuels as defined in Council Directive 92/42/EEC shall comply with efficiency standards at least equivalent to three stars as stated in that Directive. The efficiency of boilers excluded from Directive 92/42/EEC shall comply with the manufacturer's instructions and with national and local legislation on efficiency, but for such existing boilers (with the exception of biomass boilers) efficiency lower than 88% shall not be accepted.

[57] Source: https://eur-lex.europa.eu/eli/dec/2017/175/2017-02-02

Criterion 7: Energy efficient air conditioning and air-based heat pumps appliances

Energy efficient air conditioning and air-based heat pumps appliances should be installed.

Household air conditioning and air-based heat pumps appliances installed within the duration of the EU Ecolabel licence shall have at least the following relevant energy classes as defined in Commission Delegated Regulation (EU) No 626/2011:

Table 9: Criterion 7 – minimum energy classes of air conditioniong and air-based heat pumps appliances

Type	Energy efficiency class (cooling/heating)
Monosplit < 3kW	A+++/A+++
Monosplit 3-4 kW	A+++/A+++
Monosplit 4-5 kW	A+++/A++
Monosplit 5-6 kW	A+++/A+++
Monosplit 6-7 kW	A++/A+
Monosplit 7-8 kW	A++/A+
Monosplit > 8kW	A++/A++
Multi-split	A++/A+

3.6 Motivation and awareness of staff

The motivation and engagement of all staff are fundamental elements for the successful implementation of any action plan to reduce energy consumption and GHG emissions. In turn, for attaining high engagement rates is necessary to improve staff awareness on issues related to energy efficiency and sustainability. Without a strong support from staff, any efforts to reduce energy consumption and GHG emissions will not achieve their full potential. There are three tools that can be used to increase staff's participation and contribution to any sustainability program: provide training, regular updates and incentives on relevant issues.

3.6.1 Staff training

Training has always been the cornerstone in every employee's development. It provides staff with the necessary skills -relevant to each organisation and job description- to perform at their best and meet management's expectations. Thus, it is necessary to include a simple, concise narrative about the hotel's energy strategy and goals in the basic staff training. Thereafter, additional training sessions, focused on the specific role and position of each employee, can be offered.

3.6.2 Keeping staff informed and updated

Staff have to be aware of the progress the organisation is making in relation to its energy reduction targets and sustainability efforts in general. Have these targets been attained or not, and by how much? How do these results benefit the environment and the local community? What was the contribution of each department? Knowing the answer to such questions, gives an assurance that their efforts paid off and increases their participation in the program. Largely, the same promotional material produced to inform guests, such as an annual sustainability report or relevant graphs and tables, can be used for staff too.

3.6.3 Incentivizing staff

Recognising the contribution of staff to the success of any action plan is important and usually creates extra motivation to their engagement. Recognition can take many forms, but especially in this context, it should be used as an additional way to motivate staff, both at individual and collective level, in order to enhance team spirit and maximise benefits for all stakeholders. Various incentives, such as a monthly “green champion” contest or a “green rewards” scheme for all staff can simultaneously function as a reward tool for their commitment and effort, and as a boost mechanism for their improvement in both aspects.

4 Reducing GHG emissions through proper waste management

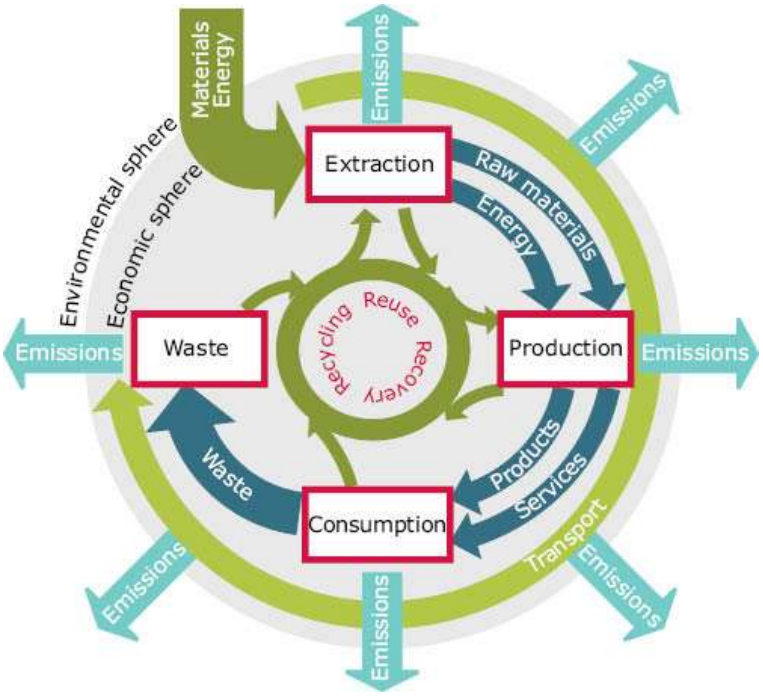
4.1 Waste management definition and strategies

EU waste policy has evolved over the last 30 years through a series of environmental action plans and a framework of legislation that aims to reduce negative environmental and health impacts and create an energy and resource efficient economy.

The EU's Sixth Environment Action Programme (2002-2012) identified waste prevention and management as one of four top priorities. Its primary objective is to ensure that economic growth does not lead to more and more waste. This led to the development of a long-term strategy on waste. The 2005 Thematic Strategy on Waste Prevention and Recycling resulted in the revision of the Waste Framework Directive (Directive 2008/98/EC), the cornerstone of EU waste policy[58]. It sets the basic concepts and definitions related to waste management and lays down waste management principles such as the "polluter pays principle" and the "waste hierarchy".

In addition, in 2015, the European Commission adopted an ambitious 'Circular Economy Package' which established a concrete programme of actions outlining measures that cover the entire product life cycle: from production and consumption to waste management and the market for secondary raw materials. The 2015 Circular Economy package led to the revision of six waste directives with new waste management targets regarding landfilling, recycling, and preparing for reuse.

Figure 24: Emissions in life-cycle chains (extraction, production, consumption, waste)[59]



As mentioned in Section 1.1.7, in 2020, the European Commission has adopted a new and more comprehensive Circular Economy Action Plan – one of the main building blocks of the European Green Deal, Europe's new agenda for sustainable growth. The new Action Plan announces initiatives along the entire life cycle of products, targeting for example their design, promoting circular economy

[58] Source: https://ec.europa.eu/environment/waste/framework/

[59] Source: https://www.eea.europa.eu/soer/2010/synthesis/synthesis/chapter4.xhtml

processes, fostering sustainable consumption, and aiming to ensure that the resources used are kept in the EU economy for as long as possible.

A key principle of the circular economy is preventing waste from being generated in the first place. The European Union's approach to waste management and prevention is based on the "**waste hierarchy**" which sets the following priority order when shaping waste policy and managing waste at the operational level: prevention, (preparing for) reuse, recycling, recovery and, as the least preferred option, disposal (which includes landfilling and incineration without energy recovery).

Minimization of waste, or waste prevention, is the top management principle of the waste management hierarchy. The EU legislation introduces a five-step waste hierarchy where prevention is the best option, followed by re-use, recycling and other forms of recovery, with disposal such as landfill as the last resort. EU waste legislation aims to move waste management up the **waste hierarchy**[60]:

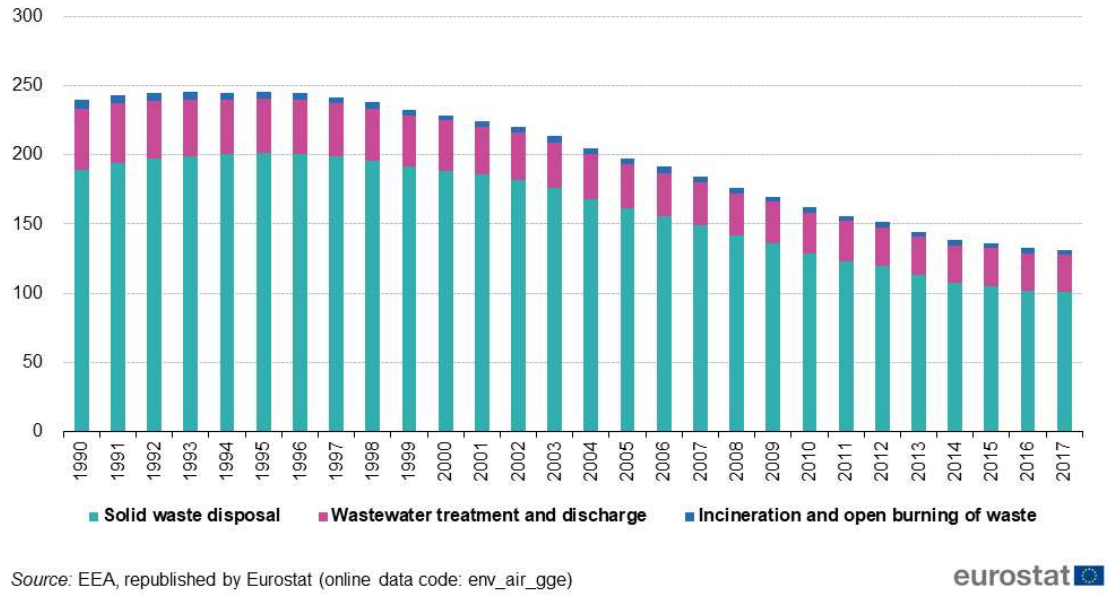
- Prevention
- Preparing for reuse
- Recycling (including composting)
- Other recovery (including energy recovery)
- Disposal

Figure 25: Moving up the waste hierarchy[60]

The EU waste management framework had a great impact on the GHG emissions reduction. Between 1995 and 2017, GHG emissions from waste in the EU have fallen by 42%, according to estimates by the European Environmental Agency. The amount of emissions from waste depends on how the waste is treated. A strong example is when waste is sent to landfill, the organic material included in the waste decomposes and produces gas particularly CO_2 and CH_4. The reduction in GHG emissions from solid waste disposal follows from an increase in the recovery of landfill gas and a reduction in the amount of landfilling. With more waste being recycled, less of it needs to be landfilled or incinerated, which contributes to protecting the climate (EC, n.d.-5).

[60] Source: https://ec.europa.eu/environment/waste/framework/

Figure 26: Greenhouse gas emissions of waste management, EU-28, 1990-2017 (million tonnes of CO_2eq)



Source: EEA, republished by Eurostat (online data code: env_air_gge)

eurostat

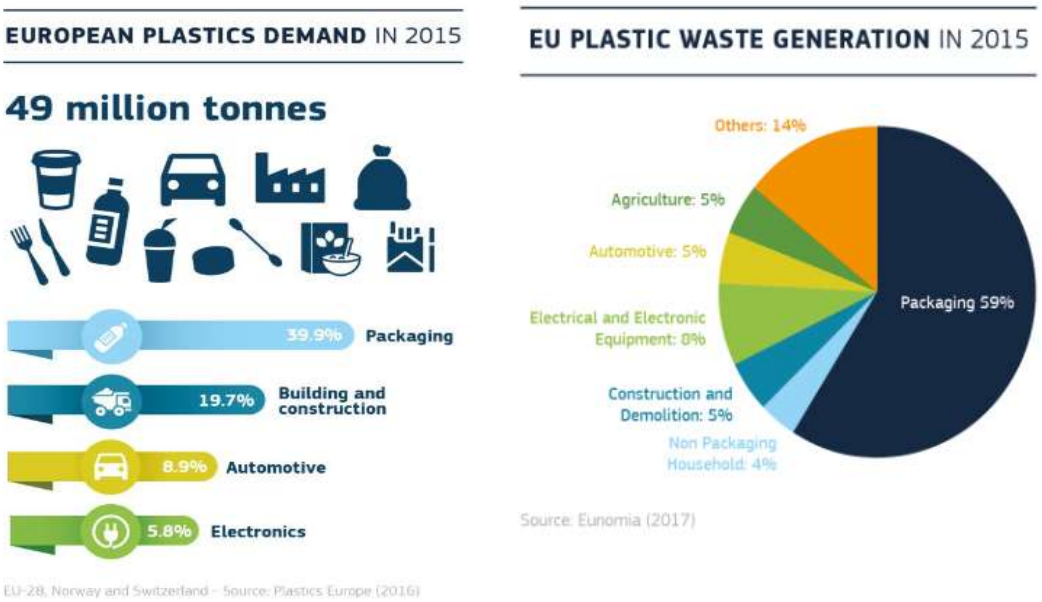
According to a report developed by the EU Platform on Food Losses and Food Waste (2019), the food service sector accounted for 12% of the total EU food waste (11 million tonnes). The EU and its Member States are committed to meeting the food loss and waste reduction targets adopted by the United Nations General Assembly as part of the 2030 Sustainable Development Agenda. In order to support achievement of the Sustainable Development Goals (SDG) Target 12.3 on food loss and waste and maximise the contribution of all actors, the European Commission established, in 2016, a multi-stakeholder platform dedicated to food loss and waste prevention.

Figure 27: Total food waste produced (kgs) per person in EU countries (2010)

Figure 28: Food waste throughout the entire supply chain[61]

Another example is when plastic waste is sent to landfill, or escape in the water systems (oceans, rivers, ground water), it does not only break down to microplastics causing pollution, its material value as secondary material is lost. Therefore, changing the treatment of waste is just one example of how creating a more circular economy helps to reduce emissions and fight climate change.[62]

Figure 29: EU Plastic waste generation and EU plastic demand (2015)



4.1.1 Types and classification of waste

The classification of waste is based on the

[61] Source: https://www.europarl.europa.eu/news/en/headlines/society/20170505STO73528/food-waste-the-problem-in-the-eu-in-numbers-infographic

[62] Source: https://ec.europa.eu/eurostat/web/products-eurostat-news/-/DDN-20200123-1?inheritRedirect=true&redirect=%2Feurostat%2Fweb%2Fwaste%2Fpublications

- the European List of Waste (Commission Decision 2000/532/EC), and
- Annex III to Directive 2008/98/EC (consolidated version).

In 2018, the Commission released the technical guidance on the classification of waste (2018/C 124/01), which provides guidance to national and local authorities and businesses on the correct interpretation and application of EU legal framework on the classification of waste. Waste is classified in 20 categories, codes as below.

Table 10: Classification of waste as per the European List of Waste[63]

Waste classification	General description
1	Wastes resulting from exploration, mining, quarrying, physical and chemical treatment of minerals
2	Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing, food preparation and processing
3	Wastes from wood processing and the production of panels and furniture, pulp, paper and cardboard
4	Wastes from the leather, fur and textile industries
5	Wastes from petroleum refining, natural gas purification and pyrolytic treatment of coal
6	Wastes from inorganic chemical processes
7	Wastes from organic chemical processes
8	Wastes from the manufacture, formulation, supply and use (MFSU) of coatings (paints, varnishes and vitreous enamels), adhesives, sealants and printing inks
9	Wastes from the photographic industry
10	Wastes from thermal processes
11	Wastes from chemical surface treatment and coating of metals and other materials; non-ferrous hydrometallurgy
12	Wastes from shaping and physical and mechanical surface treatment of metals and plastics
13	Oil wastes and wastes of liquid fuels (except edible oils, 05 and 12)
14	Waste organic solvents, refrigerants and propellants (except 07 and 08)
15	Waste packaging: absorbents, wiping cloths, filter materials and protective clothing not otherwise specified
16	Wastes not otherwise specified in the list
17	Construction and demolition wastes (including excavated soil from contaminated sites)
18	Wastes from human or animal health care and/or related research (except kitchen and restaurant wastes not arising from immediate health care)
19	Wastes from waste management facilities, off-site waste water treatment plants and the preparation of water intended for human consumption and water for industrial use
20	Municipal wastes (household waste and similar commercial, industrial and institutional wastes) including separately collected fractions

[63] Source: https://ec.europa.eu/environment/waste/framework/list.htm

4.2 Hotel Waste generation

Tourism is responsible for a small share of waste generation within Europe, contributing towards the 6,7% of total waste generation that arises from the wider services sector in the EU-27(EEA, 2010). Nonetheless, the quantities of solid waste generated by tourism enterprises are large in absolute terms–35 million tonnes of solid waste per year globally (Conservation International, 2003)–and the types of waste generated are associated with greater environmental impacts than bulky and often inert wastes from the construction and mining sectors that dominate waste generation statistics. Tourists may generate up to twice as much solid waste per capita as local residents (IFC, 2007). Waste from accommodation has similar characteristics to mixed household waste (waste classification 20, Table 6 above), being composed of a diverse mix of materials, including organic and hazardous materials, that can give rise to significant environmental impacts upon disposal (especially through GHG emissions and leaching of toxic materials)[64].

Accommodation and restaurants are major contributors to packaging waste (Eurostat, 2010), including plastics and metals with high embodied energy that are responsible for significant resource depletion upon disposal. Furthermore, tourism waste often varies seasonally, and is generated in areas sensitive to littering, potentially putting pressure on waste management facilities during peak season and damaging high nature value resources. Plastic waste in the oceans poses a threat to whales, dolphins, sea turtles and birds.

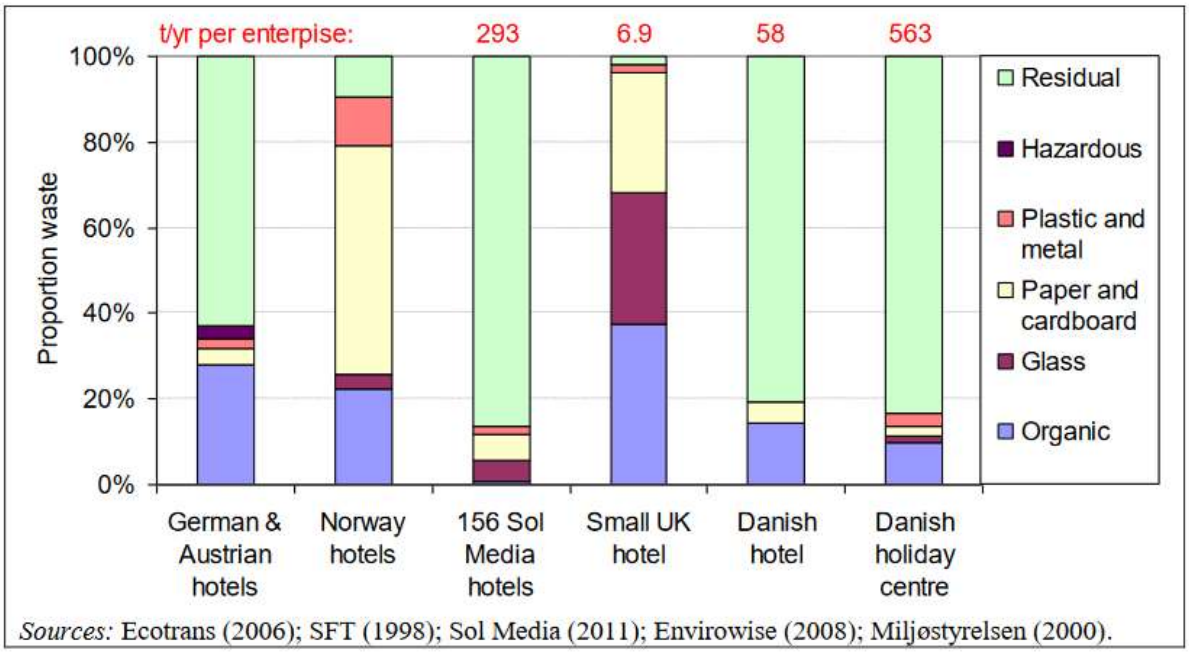
The composition of waste from accommodation establishments is similar to household waste but varies somewhat depending on the services offered. Hotels with restaurants have a higher share of organic waste. Classification of waste varies according to sorting, but organic, glass, paper and cardboard and plastic and metal are the main fractions (Figure 20). For many hotels with poor sorting, residual waste is the dominant fraction. The composition of waste in Hotels is consisted mainly by the following:

- Bathroom toiletries
- Food waste
- Drink waste
- Packaging
- Bedding and towels that are deemed unusable for guests
- Waste Electrical and Electronic Equipment (WEEE)
- Garden waste
- Glass
- Cardboard
- Paper
- Hazardous waste (e.g. chemicals packaging, engine oils, paints, etc)
- Other (e.g. textiles, demolition waste, etc)

Photo: https://www.hotelmanagement.net/food-beverage/american-hotel-lodging-association-shares-food-waste-project-results-hotel-toolkit

[64] Source: https://ec.europa.eu/environment/emas/takeagreenstep/pdf/BEMP-6-FINAL.pdf

Figure 30: Composition of waste for accommodation enterprises reported by different sources



4.3 Waste management in the hotel industry

In 2003, the tourism industry contributes to **the production of 35 million tons of waste per year globally and within Europe, tourism is responsible for generating approximately 7% of the total waste production of the services sector**[65]. Even though these figures are relatively small share of the overall waste generation, the types of waste generated are associated with greater environmental impacts than bulky and often inert wastes, e.g. generated from construction sector.

In 2007, the European Commission published an "Agenda for a sustainable and competitive European tourism", including identified major challenges including waste management, and the key principles that can help the industry address these challenges. Limiting negative impacts at tourist destinations, including the use of natural resources and waste production was identified as one of the major challenges.

Hotels, catering and tourism sector are one of the important producers of waste packaging (paper, plastic, glass and metal) and food waste creating problems especially in areas where their effective management capabilities are limited and costly (e.g. island areas, mountainous areas, isolated places etc.). Important is also the problem of pollution that is created mainly through the disposal of plastic and other disposable packaging.

Hotels perform a number of functions that can be broadly grouped into three areas: **food and beverage, accommodation, functions and events.** These three areas can generate a significant amount of waste – solid and effluent. All waste producers, such as the hotels, are required to have waste management in their facilities to collect all waste generated. Due to the nature of their service, hotels present particular waste management challenges due to the:

- wide variety of functions and staff roles,
- 24-hour nature of operations,
- requirement for immediate good service,
- Hotel and accommodation uses may not generate any waste on site or the waste the guests generate may be handled by staff. Or in some cases, guests are responsible for disposing of waste that they have generated.

[65] Source: https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/best-environmental-management-practice-tourism-sector

In Greece, the average waste production per person per night is estimated at 1,7-2,5 kg/person per night. Thus, the hotel sector together with the cruise sector (27m arrivals and an additional 2m of cruise ships) produces about 400.000-550.000 tons of municipal waste during their operation while together with the restaurant sector, the number amounts to approximately 600.000-650.000 tons of municipal waste per year. For these quantities, the recycling is estimated at about 250.000-350.000 tons while the organic waste amounts to 200.000-250.000 tons annually. It is worth noting that the above quantities come from the seven-month average operation of most tourism businesses.

It is therefore understandable that the benefits of implementing sustainable waste management and recycling practices in the tourism industry is environmentally, socially and economically valuable. Sustainable waste management can substantially help upgrade customer experience, protect nature and natural resources, reduce pollution and GHG emissions, while on the other hand save significant amounts of money and reduce business risks through effective compliance with legislation. The increase in recycling to the desired levels set by European legislation could lead to recycling above 250.000 tn per year in the tourism sector and save money from 10,0-12,5 million euros for municipalities depending on the cost of waste management today. At the same time, significant opportunities are provided from the utilization of materials and the reduction of operating costs of tourism businesses.

A detailed study (in Greek) about recycling in the tourism sector can be found in the following link. As regards Cyprus (in Greek), the solid waste management strategy can be found at the link.

Table 11: EU waste legislation

Waste Framework Directive[66] 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives	It provides for a general framework of waste management requirements and sets the basic waste management definitions for the EU. The revised Directive 2008/98/EC sets the basic concepts and definitions related to waste management and lays down waste management principles such as the "polluter pays principle" or the "waste hierarchy".
Urban Waste Water Directive[67] 91/271/EEC on Urban Waste Water Treatment and as amended by Directive 98/15/EEC	Council Directive 91/271/EEC concerning urban waste water treatment was adopted on 21 May 1991 to protect the water environment from the adverse effects of discharges of urban waste water and from certain industrial discharges.

4.3.1 Waste generation, prevention & treatment in hotels

According to Directive 2018/851, waste management should be improved and transformed into sustainable material management, with a view to protecting, preserving and improving the quality of the environment, protecting human health, ensuring prudent, efficient and rational utilisation of natural resources, promoting the principles of the circular economy, In order to contribute and ensure to be on track towards the attainment of the UN Sustainable Development Goal, all EU countries should achieve an indicative Union-wide food waste reduction target of 30 % by 2025 and 50 % by 2030.

Sustainable procurement practices can be a powerful tool for hotels in waste prevention, not only inhouse, but across the supply chain. In contracts where waste will be generated, clauses should be included for the efficient use of materials and the potential for reuse and recycling. There should be forecasts for waste, details of how waste will be reduced, and the plans for waste recovery, such as segregation. It is also important to establish how suppliers of waste services will report back on the benchmarks. Coordination between contractors and all stakeholders should extend across the site so that procurement decisions — such as the type of materials to be used — are aligned with the best choice in terms of waste management.

[66] Source: https://ec.europa.eu/environment/waste/framework/framework_directive.htm

[67] Source: https://ec.europa.eu/environment/water/water-urbanwaste/legislation/directive_en.htm

Food waste

Generally, food generated from accommodation businesses is disposed of in the general waste stream. Reducing food waste is a key challenge in fighting climate change and cutting down GHG emissions. Action needs to be taken focus on preventing food surplus and food waste being generated in the first place, redistributing surplus food that does arise, and diverting surplus (that cannot be used to feed people) into animal feed and high value biomaterial processing.

a. Prevention of food waste

The best way to find out how much food is being wasted, is to conduct, as part of the waste audit, a food waste review to identify how much food waste is produced; map out where it occurs; measure and monitor food waste; and use the results to identify savings. It is also important to engage with staff, to help them to recognise where food waste arises, what the impact is and what they can do to reduce it.

Table 12: Food waste prevention opportunities

Is the stock over-ordered?
Are deliveries frequent enough?
Can less ingredients be used across the menu?
Is food over-produced and/or spoilt?
Are the portion sizes right for different customer types?
Do waiting staff feedback any issues with certain types of meals?

Box 8: A case study reported by WRAP: Buffet savings at Crieff Hydro[68]

During an 8-week trial in one of its restaurants Crieff Hydro Hotel reduced food waste costs by around 43%. This equates to 11,5 tonnes of food and £51.750 per year. Crieff Hydro achieved these savings by:

- **smart production planning and greater use of small batch preparation.**
- **using reduced buffet container sizes,**
- **greater staff engagement and setting of weekly food waste reduction targets.**

Cardboard

Cardboard can be a major component of waste generated in hotels. A compactor may be used if quantities are large enough, otherwise cardboard may be placed in, and collected from, bulk bins. Cardboard boxes should be flattened as much as possible to save space in bins. Front-lift bins with wire panels allow contamination to be checked and are widely used for this material. Balers are also commonly used for cardboard. Cardboard is generally very bulky but comparatively light weight — it compacts well, and compactors and balers are ideal for containing and transporting cardboard.

Plastic film

Plastic film is not normally a major component of hotel and accommodation waste streams – any that is generated is often contaminated with food or liquid. Plastic film is very bulky but comparatively light weight and compacts well. However, large quantities are not as common and it is generally compacted

[68] Source: https://www.wrap.org.uk/food-drink/business-food-waste/case-study/crieff-hydro

in a baler, rather than collected in bins and sent for recycling. Contaminated plastic film is not suitable for recycling and must be disposed of in the garbage stream.

Recyclables

Hotels, with or without large restaurants, can generate large quantities of recyclable containers, metal such as cans, plastic bottles, and glass bottles. Metal and plastic waste are widely recycled, easy to store as they are lightweight, however, glass waste can be more difficult to store and move efficiently due to its heavy weight. There is often limited space available to store glass containers, therefore, more frequent collection might be needed to ease glass recycling. Glass bottles should be reused where possible, e.g. water refillable glass bottles can be reused, and collected at the end of their life for recycling.

Newspapers and magazines

Hotels often provide a range of daily newspapers to customers as well as magazines in rooms and common areas. Newspapers and magazines are recyclable, although the quality of the paper does not normally make them suitable for separate collection. Hotels can consult their waste management contractor to be advised of the best way they can be handled for recycling.

Office paper

Hotels have office areas and often business centres – both are usually relatively small. Although the amount of office paper produced is also likely to be small, it may be worth separating and for collection as an office paper stream.

General waste

If the hotel is large enough and produces significant amount of waste, a compactor may be used for garbage. For smaller hotels, garbage may be collected in bulk bins. Many of the components of the waste generated from hotels are recoverable in some way. However, often these materials can only be recycled if separated and this is where problems can occur. Waste materials are often either so mixed or physically contaminated that separation is either not possible or not cost effective.

Other waste types

There are cases where hotels also generate quantities of less common waste types including polystyrene boxes, and cooking oil. Polystyrene boxes, in which fresh or chilled food is delivered, can often be returned to the supplier. As it is not widely recyclable, hotels should consult their suppliers and identify opportunities to switch to reusable and recyclable packaging for product transport. Cooking oil is widely recycled through specialist oil recyclers, to produced biofuels. Typically, oil recyclers will provide a large container for storing oil on site before collection by recyclers. Pallets should be reused where possible and returned to suppliers or processors for recycling. Mattresses should be recycled through mattress recyclers. Other types of waste are generated in small amounts and/or occasionally. Sustainable procurement practices can be implemented to help the hotels tackled some of the difficult waste streams in their sites.

4.3.2 Waste separation

Before embarking on a waste-separation programme, find out which material can be collected by local waste and recycling contractors. Try to implement recycling actions wherever practically possible. Local conditions may limit what can be done. Review how the use can be eliminated or reduced. It is better to minimise the use of items so separation into waste streams and paying to dispose of them will be avoided. For example:[69]

- Avoid the use of plastic straws.
- Use containers with lids in preference to plastic wrap, cling film or foil.

[69] Source: http://www.greenhotelier.org/wp-content/uploads/2014/09/4-Waste-for-web-1-1.pdf

- Use refillable containers for soap, cleaners and foodstuffs.
- Use cloth or canvas bags or baskets for laundry, shoe polish, etc. instead of plastic bags.
- Use mugs in preference to paper cups, and paper cups rather than polystyrene.
- Maximise the use of computers/electronic mail to reduce paper use. Ask yourself if you really need to print out the document.
- Make and use your own compost, where feasible.

Implement recycling at source to make the sorting process more efficient – for example put divided waste bins with compartments for paper, cans and glass in guest rooms. Housekeeping trolleys should have similar compartments so that sorting can be carried out in situ. Look at what can be reused in the hotel or by external organisations:

- Worn towels, sheets and tablecloths can be re-used as cleaning cloths and dusters or turned into aprons.
- Reuse printed and other paper as notepaper.
- Donate used and surplus items to schools or charitable organisations instead of throwing them away, such as donating partially used guest shampoo, conditioner and bath gel to homeless shelters and charities.
- Reuse leftover pads and pencils from meeting rooms.
- Use straw and shredded paper or other degradable material for packaging to replace polystyrene.
- Use cloth napkins in preference to paper ones. If you do use paper ones, they can be composted after use unless they are badly soiled.
- For Christmas, Easter and other festival decorations use live, rooted trees that can be replanted afterwards. If you cannot obtain a tree with roots, chip it for composting.
- Avoid using waste disposal units that grind kitchen waste before putting it down the drain. They require a lot of water to work effectively and increase the burden on wastewater treatment. They can also cause odours and attract rodents.

Box 9: Tips of success of a recycling programme[70]

Recycling programmes require attention to detail to run successfully. As a rule, the nearer to the origin of waste that recovery occurs, the less sorting and processing will be needed before the material can be recycled.

Ensure that your staff understand the reasons for the programme and are motivated. Introduce a 'no waste' campaign and provide training for staff throughout the hotel.

Regular and clear communication is essential to maintaining interest.

Incentivise staff by allocating the money you save through recycling to a special staff fund. Introduce a prize each month or quarter for the best suggestion on how to reduce waste.

Do not be afraid to seek advice. Consultants can help you carry out a waste audit and some only charge a percentage of the money they help you save. Expertise may also be available through your hotel association or local government initiative.

Work with your suppliers to review and reduce to a safe minimum the amount of packaging used. Consider, at all stages, using returnable and/or reusable (as opposed to disposable) packaging.

Join forces with other hotels, restaurants and companies if your waste volume is too small to interest recycling agents or brokers to gain the benefits of scale. Find out if there is a waste minimisation club in your area by contacting your local government authority or hotel association. The internet will help you to track down waste reduction and recycling organisations.

Do not start sorting and storing until you have identified and appointed a company to recover the sorted material. i Reduce waste volume (e.g. cardboard by using a compactor and glass bottles with a crusher).

[70] Source: http://www.greenhotelier.org/wp-content/uploads/2014/09/4-Waste-for-web-1-1.pdf

Make sure your recycling bins are clearly labelled with what can and cannot go in to avoid confusion among staff.

Cleaner waste products usually obtain higher prices. Paper rapidly loses its value when mixed with other waste or refuse, and newspapers must be free of other waste products (particularly food or organic waste) in order to be effectively recycled.

Compost all your tea bags, coffee grounds, eggshells, raw fruit and vegetable peelings. The process requires and moisture and a variety of material. You can also include (in small quantities at a time) paper serviette, scrunched up newspaper, grass clippings and leaves. Do not put disease-infected plants, weeds that have gone to seed or grass treated with weed killer into the composter.

Box 10: Photos taken from Napa Mermaid Hotel in Cyprus

Photos: Napa Mermaid Hotel, Agia Napa, Cyprus, (© OEB, 2020)

4.3.3 Hotel waste treatment

The Hotel waste management and treatment might include the following available options:

a) Waste collection

b) Waste transportation

c) Landfill

d) Recycling

e) Thermal treatment methods

- incineration – combustion
- gasification
- pyrolysis

f) Biological processing methods

- aerobic treatment (composting)
- anaerobic treatment (fermentation)
- mechanical & biological treatment.

The Table 9 below shows the GHG emissions from the several waste management & treatment activities.

Table 13: GHG emissions from several solid waste management & treatment activities[71]

Activity	Direct Emissions Sources	Indirect Emissions Sources	Avoided Emissions Sources	Biogenic CO_2 Emissions Sources
Collection & Transportation	-> CO_2 from fuel consumption -> HFC from A/C leakages	-> CO_2 from electric vehicles -> CO_2 from outsourced transport	N.A.	-> CO_2 from consumption of biomass energy (biofuels, bioliquids, solid biomass, biogases)
Transfer	-> CO_2 from fuel consumption	-> CO_2 from purchased electricity consumption	N.A.	-> CO_2 from consumption of biomass energy (biofuels, bioliquids, solid biomass, biogases)
Mechanical Pre-treatment (dismantling)	-> CO_2 from fuel consumption	-> CO_2 from purchased electricity consumption	N.A.	-> CO_2 from consumption of biomass energy (biofuels, bioliquids, solid biomass, biogases)
Sorting, Recycling & Recovering	-> CO_2 from fuel consumption -> HFC emissions from WEEE dismantling	-> CO_2 from purchased electricity consumption	-> Potential avoided GHG emissions corresponding to the difference between virgin raw material production emissions and material recovery emissions -> Potential avoided GHG emissions corresponding to the difference between burning fossil fuel and solid recovered fuels (SRF)	-> CO_2 from consumption of biomass energy (biofuels, bioliquids, solid biomass, biogases)
Physico-chemical waste treatment	-> CO_2 from fuel consumption	-> CO_2 from purchased electricity consumption	-> Potential avoided GHG emissions corresponding to the difference between burning fossil fuel and alternative fuels	-> CO_2 from consumption of biomass energy (biofuels, bioliquids, solid biomass, biogases)
Biological Treatment (composting)	-> CO_2 from fuel consumption -> Process emissions (CH_4 and N_2O)	-> CO_2 from purchased electricity consumption	-> Potential avoided GHG emissions corresponding to the difference between use of chemical fertilizer and compost spreading	-> CO_2 from consumption of biomass energy (biofuels, bioliquids, solid biomass, biogases) -> CO_2 process emissions

[71] Source: EpE - emission calculator - Protocol for the Quantification of GHG Emissions from MSW activities.pdf

Activity	Direct Emissions Sources	Indirect Emissions Sources	Avoided Emissions Sources	Biogenic CO_2 Emissions Sources
Biological Treatment (Anaerobic Digestion)	-> CO_2 from fuel consumption -> Process emissions (CH_4 and N_2O)	-> CO_2 from purchased electricity consumption	-> Potential avoided GHG emissions corresponding to the difference between biogas recovery emissions (as power, heat and/or fuel) and substituted energy production emissions	-> CO_2 from consumption of biomass energy (biofuels, bioliquids, solid biomass, biogases) -> CO_2 process emissions -> CO_2 from biogas combustion
Landfill	-> CO_2 from fuel consumption -> Diffuse CH_4 emissions -> CH_4 from incomplete landfill gas combustion	-> CO_2 from purchased electricity consumption	-> Potential avoided GHG emissions corresponding to the difference between landfill gas recovery emissions (as power, heat and/or fuel) and substituted energy production emissions	-> CO_2 from consumption of biomass energy (biofuels, bioliquids, solid biomass, biogases) -> Diffuse CO_2 & oxidised CH_4 emissions -> CO_2 from landfill gas combustion process
Thermal treatment	-> CO_2 from fuel consumption -> N_2O process emissions -> CO_2 process emissions (only the fossil carbon share of the waste)	-> CO_2 from purchased electricity consumption	-> Potential avoided GHG emissions corresponding to the difference between energy from thermal treatment processes recovery (as power and/or heat) emissions and substituted energy production emissions. -> Potential avoided GHG emissions corresponding to the difference between virgin raw material production emissions and material recovery emissions (e.g. slag, scrap, metals and bottom ashes)	-> CO_2 from consumption of biomass energy (biofuels, bioliquids, solid biomass, biogases) -> CO_2 process emissions (the biogenic carbone share of the waste)
Mechanical Biological Treatment (MBT)	-> CO_2 from fuel consumption -> Process emissions (CH_4, N_2O)	-> CO_2 from purchased electricity consumption	-> Potential avoided GHG emissions corresponding to the difference between biogas recovery emissions (as power, heat and/or fuel) and substituted energy production emissions -> Potential avoided GHG emissions corresponding to the difference between virgin raw material production emissions and material recovery emissions (compost production, alternative fuels, material recovery...)	-> CO_2 from consumption of biomass energy (biofuels, bioliquids, solid biomass, biogases) -> CO_2 process emissions

In the paragraphs below will be presented some selected biological treatment methods, that can be applied in situ in Hotels.

Composting

A composting system could be established either inhouse, if a building has gardens or grounds, or via external contractor. Composting can be done in the open or in-vessel and requires surprisingly little effort. Compost is organic material that can be added to soil to help plants grow. Around the world biodegradable waste in landfills is the main factor for the generation of the GHG methane. Making compost keeps these materials out of landfills where they take up space and release methane, a potent greenhouse gas. Compost and digestate are used as organic fertilizers. The bio-waste recycling may also directly contribute to climate protection if the methane produced during the fermentation is used for energy production.

All composting requires two basic ingredients:

- Greens - This includes materials such as dead leaves, grass,
- Organic from kitchens - Vegetable waste, fruit scraps, coffee grounds.

The main advantages and disadvantages of composting are summarised below:

Table 14: Advantages and disadvantages of composting

Pros	Cons
Easy to compost, easy methodology	Requires very good waste separation
Very cheap	Space is required for large quantities
Enriches soil, helping retain moisture and suppress plant diseases and pests.	Possible smells

Reduces the need for chemical fertilizers.	Not suitable for indoors
Encourages the production of beneficial bacteria and fungi that break down organic matter to create humus, a rich nutrient-filled material.	
Reduces methane emissions from landfills and lowers your carbon footprint.	

Aerobic bio-digesters

Aerobic Bio-digesters are the newest treatment methodology for high-strength organic waste. They are extremely efficient because microbes are exponentially more effective at digesting organics, fats/oils/greases, and hydrocarbons if they have a fixed film media surface on which to live. Aerobic Bio-digester technology has been limited in the past by the type of aeration used. New developments in bubble size have expanded the use of bio-digesters for high strength waste. Their main advantages and disadvantages are summarised below:

Table 15: Advantages and disadvantages of aerobic bio-digesters

Pros	Cons
Very easy to operate	Expensive Technology
Small mistakes allowed	Requires energy and water to operate
Suitable for city hotels	

Anaerobic digestion

Organic waste matter is treated either bio-chemically (AD for biogas and bio-ethanol fermentation) or thermo-chemically (combustion, gasification and pyrolysis for heat and power) for energy generation purposes (Bundhoo, et al., 2016). AD is a complex biochemical breakdown of organic matter by micro-organisms in an oxygen deprived environment which produces biogas consisting mainly methane (CH_4) (50-75%) and carbon-dioxide (CO_2) (25-50%), and nutrient rich digestate or biofertilizer as by-product. The AD biogas yield potential and degradability rate depends upon the type of the feed and digester conditions. Inadequate waste separation may cause problems in the operation of the AD.

4.4 Waste management plan in hotels

In order to establish a robust waste management system, the hotels should form a waste management strategy and plan in place. In the first phase, the Design phase, the hotels should begin planning their waste management system, taking into account their waste streams, their facilities, and the locations where waste are produced, stored, transported, recovered, minimised and disposed of. All this information should be captured in their waste management plan.

Waste management plans should also cover other issues such as the amount and types of waste generated, staff and stakeholder roles and responsibilities, time frames, targets and performance indicators. During this process, it is important to request feedback from stakeholders to see from an operational point of view, any obstacles or good practices that might already be in place. Potential supplier activities that might generate waste on site should also be considered, e.g. renovation or construction waste.

Additional obstacle to consider is the current local waste infrastructure available to hotels and any upcoming changes. They are to some extent limited by the waste management infrastructure in their locality, often owned and operated by the local authority, especially if they are not able to find other takers for waste fractions that the local system does not accept. In addition, waste separation in the hotel requires available ground floor space for the instalment of multiple bins for separated waste fractions. However, several case studies illustrated that there are innovative and smarter means of preventing, reusing, sorting, and recycling waste in hotel accommodations. Monitoring waste is also essential to understand the GHG mitigated. In Cyprus a **Waste Mapping Guidance for Hotels in Cyprus** has been developed and it is available online, which can provide a useful guidance for Hotel Waste management plan and mapping[72].

Table 16: Waste management plan – Checklist example[73,74]

Step	Actions
Initial Planning	☐ Consider the current available local waste infrastructure. ☐ Ensure compliance with national and EU regulations and policies. ☐ Engage with waste contractors to find out about available waste and recycling services and identify future service requirements. ☐ Assign waste and recycling manager or co-ordinator to be responsible for the waste management plan's execution and monitoring. ☐ Conduct a waste audit to identify quantities and types of all waste streams. Then, determine the type of containers or system to be used to collect these waste streams, the containers' capacities, how often they should be collected and how full they are normally when collected. For food waste, it is a good practice to measure the quantities of food spoiled, food waste from preparation activities and food waste generated by guests. ☐ Decide the key stakeholders that will be included in the waste management plan.
Waste systems	☐ Select easy and convenient waste management systems, for both employees and guests. ☐ Ensure waste bins and containers conform to national/EU design and safety standards. ☐ Decide what materials will be recycled and what new services might be required. ☐ Decide the roles and responsibilities of the key stakeholders involved. ☐ Discuss with employees and contractors and decide how existing practices might be changed. ☐ Develop a plan for communicating with employees. ☐ Define targets and performance indicators that will assist in the monitoring.
Storage facilities	☐ Estimate waste quantities based on the hotel's waste generation. ☐ Estimate if there is sufficient space to accommodate interim storage of at least two days' worth of segregated garbage and recycling. ☐ Estimate if there is sufficient space onsite to store, in separate bins or containers, the volume of garbage and recycling (and organics where appropriate) likely to be generated onsite during the period between waste collections. ☐ Examine if there is storage space available for bulky waste. ☐ Examine if allocated storage facilities allow easy access to employees for handling waste and cleaning bins and the storage areas.

[72] Source: http://www.tourism.gov.cy/tourism/tourism.nsf/All/A9F84CCB90BC8BEFC225849D003A4B90/$file/Waste_Mapping_Guidance_Hotels.pdf?OpenElement

[73] Source: https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/managewaste/120960-comm-ind.pdf

[74] Source: https://www.wrap.org.uk/content/supporting-resources-hospitality-and-food-service-sector-4

	☐ Identify locations for display signs and educational material. ☐ Consider future service flexibility.
Waste collection points	☐ Estimate the number of waste collection points depending on the hotels' facilities. ☐ Ensure easy access for collection vehicles.
Implementation	☐ Develop a timeframe for implementation of the waste management plan.
Signage and education	☐ Examine and identify the hotels' needs for signs in relevant areas of the building to designate waste bins, recycling bins and storage facilities. ☐ Specify the requirements for signs to provide sufficient instructions on how to use the waste and recycling facilities, including identifying recyclables. ☐ Develop a communications and education program that addresses how new staff and contractors will learn how to use the waste management system.
Ongoing management and continuous improvement	☐ Schedule an annual monitoring and audit program of the system. ☐ Note any occurring nonconformities in the system. ☐ Identify opportunities to continually improve performance.

Table 17: Waste audit – Report example

Date of the audit	Area of audit	Last audited date	Auditor
Waste stream 1:			
Material	Waste Material description	Observations (e.g. contaminations)	Weight (kg) or Volume (lt)
Waste stream 2:			
Material	Waste Material description	Observations (e.g. contaminations)	Weight (kg) or Volume (lt)
Waste stream 3:			
Material	Waste Material description	Observations (e.g. contaminations)	Weight (kg) or Volume (lt)

Table 18: Annual waste monitoring – Report example

Year:					
Month	Waste stream (e.g. general, recycling, organic, garden)	Material type (e.g. general waste, organic, plastics, glass, etc)	Weight (kg) or Volume (lt)	Emission factor	GHG emissions (kg or tonnes CO_2eq)
January	Stream 1 Stream 2 Stream 3	Material a Material b Material c			
February					
March					
April					
May					
June					
July					
August					
September					
October					
November					
December					
Total					

5 Sustainability awareness, eco-certification, and CSR

5.1 Creating an awareness campaign towards external stakeholders and how to communicate the green strategy in marketing plans

Over the past several decades, hoteliers have turned their focus to the importance of sustainability in the hospitality industry as it relates to hotel development and operations, including the environmental, economic, and social impact. Sustainability is one of the most important issues currently facing our world[75].

If you have some great environmental or social initiatives at your hotel, you may well want to communicate it. But how to do that? Many sustainability messages fail because they are just put out as a list of facts without thought to how they might be received[76].

Why do you want to communicate?

It's worth taking a step back to consider why you want to communicate your sustainability efforts in the first place. Do you want to get more bookings by differentiating your property? Enter new markets? Do you want to get your customers to support your efforts, e.g. choosing certain products, supporting your charities or engaging in the linen-change option, or just impress your customer? Whatever your reasons, these options will all require different approaches.

Who do you want to communicate to, and how?

Corporate customers are increasingly asking questions of their hotel suppliers, such as the carbon footprint, water consumption and waste per occupied room. Using the Hotel Carbon Measurement Initiative (HCMI) methodology will help you respond to questions about carbon footprint. The Global Business Travel Association (GBTA) and other RFP templates are useful reference to the type of question asked. Even if your customers are not yet asking, it's wise to be prepared for when they do. You don't want to be the hotel that can't communicate! Remember though that the corporate customer is the company booking and not the person travelling, so whilst the company may out demand on their hotel suppliers, this may have little or no relevance to the business traveller themselves.

Independent customers are not all the same and you need to know what kind of customer you have, or what kind of customer you want to attract, and which messages resonate with them. Responsible tourism communications consultancy Respondeco divides customers into three brackets:

1. The **"What's in it for me?"** type who are not too interested in sustainability but are prepared to be persuaded.

This group won't respond to sustainability for the sake of it - they also may be suspicious that sustainable choices make them lose out on something. For this group, it's best to communicate sustainability as a quality issue;

- **Quality of service:** Hotels that care about people and the environment are likely to also care about all aspects of the hotel service.
- **Quality of experience:** Positioning your hotel as one that offers well-sourced products, including fixtures and fittings, amenities, food; well-looked after staff, an interest in the local environment and engagement with the local community, makes it a much more interesting

[75] Source: https://www.danacommunications.com/importance-of-sustainability-in-the-hospitality-industry/

[76] Source: Know How Guide, https://www.greenhotelier.org/know-how-guides/communicating-sustainability-to-guests/

proposition for potential guests than a hotel that just talks about how it reduces its environmental impact.

Soneva Resorts and Nikoi Island are really good examples of how sustainability is completely embedded in the guest experience. Guests don't have to be eco warriors to appreciate the use of natural materials, surrounded by nature, good service through staff wellbeing, and so forth. Don't miss the opportunity to tell guests how your sustainability initiatives enhance their experience. Start telling the story of what difference it is going to make to the guest.

2. The **"not bothered"** who want to switch off and relax.

Being too heavy on sustainability messages could turn this group off. Research from DEFRA and the University of Surrey in the UK in 2007 indicates how guests have come to your property to relax and they want to feel happy and comfortable, however long their stay or their reason for staying. They have paid their money so they may be inclined to be a little more selfish than at home, taking longer showers, leaving the lights on, and getting their linens changed daily. They certainly don't want to be preached at or to be made to make choices that make them feel they are having to give something up or make an extra effort. The best message to communicate to this group is more that 'we've done this so you don't have to' and to do the work behind the scenes.

3. The **"I care about the planet and society"** who genuinely want to see what difference you make.

With this audience you have to be prepared to be put under scrutiny and possibly answer questions about your initiatives and any claims around them. This is a minority at the moment and it is important to be realistic; most of the time guests choose hotels on the basis of price, location, availability and quality – but the number of people who look to buy products and services from companies that share their values is growing and the trend is only going to continue in that direction.

Before deciding how to communicate your sustainability efforts have a think about which group of customers you need or want to appeal to. If you target group 3 specifically, you have to be aware that you might put off group 2 and vice versa. If you want to appeal to all three then you need to make sure there is a balance of messages and information so that all types of guests are satisfied with their stay. However, be wary that this may dilute your positioning and you'll need to be very clear in your communications strategy to what extent you are satisfying each type of customer.

Tell your story

You do not have to be operating a lodge in the rainforest to have stories to tell. It may appear to be more challenging if you are in an urban area but just look at the great case studies we have on Green Hotelier, from airport hotels such as the Hotel Verde in Cape Town and the Heathrow Marriott, Wyndham's Super 8 brand - budget hotels frequently located on highways which excel in their environmental initiatives, and the Ramada Ajman UAE which is noted for its green initiatives and charitable support in a region where sustainability is often less visible.

Everyone can find a story. Questions to ask are what is the history of the area you are operating in? Do your suppliers have interesting backgrounds? What about the food sourcing, the staff? Make that link to the world around you and you can create a sense of pride and belonging for your guests and staff. It is increasingly 'on trend' to source locally, promote wellbeing, preserve nature and be in touch with the local community. People and places are interesting; all the more so when guests were not particularly expecting any stories.

The language you use in communication is important. Cornell University's report How To Tell Your Hotel's Green Story gives excellent guidance on how to identify the correct tone for each audience, depending on what you want to communicate and the outcome you are looking for.

What to communicate?

Do not just list what you do. So, you do stuff, so what? What difference does it make? Why should anyone care? Answering the 'so what' is key, in particular for the guests who care about these issues.

Environmental initiatives are often just a list of details, but if you want to engage your guest, tell them what you are doing to reduce your impact and then invite them to help support that effort. Don't make the guest feel guilty or that all responsibility lies with them. This example from Marriott shows an honest, pragmatic and positive response to the issue of climate change and sustainability.

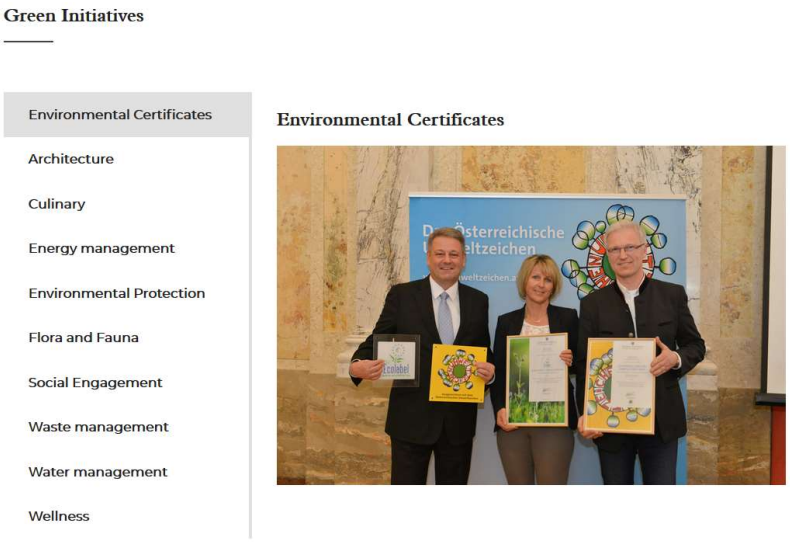
Figure 31: Marriott website on Source Responsibility[77]

Source Responsibly

We are committed to integrating leading environmental and social practices into our supply chain and partnering with like-minded suppliers. We aim to reduce the negative environmental and social impact of our business activities by focusing on sustainable, responsible and local sourcing.

When communicating about your carbon footprint, or citing other figures, bear in mind who your audience is - 31kg CO_2e means nothing to most people. One good communication example is the Green Pearls Hotels in Germany where guests can really appreciate the difference they and the hotel are making. It also shows you have done your homework and know what you are talking about.

Figure 32: Green Pearls' Green initiatives[78]



Green Initiatives

- Environmental Certificates
- Architecture
- Culinary
- Energy management
- Environmental Protection
- Flora and Fauna
- Social Engagement
- Waste management
- Water management
- Wellness

Environmental Certificates

[77] Source: https://serve360.marriott.com/sustain/

[78] Source: https://www.greenpearls.com/hotels/hotel-outside1/

Make it visual or relate facts and figures to something tangible, e.g. the equivalent number of trees planted, the number of cars taken off the road, 5 Olympic-sized swimming pools, etc.

Figure 33: visualisation of Carbon dioxide saved per day

Source: Carbon Visuals http://www.carbonvisuals.com/

And always remember that if you want to be credible, **no numbers without stories, no stories without numbers…**

Social initiatives are often of great interest to guests. Where possible try to relate these to your business. How do you look after your staff and suppliers? How could you better support the local community? It feels good to be part of something that does good and gives back. Charitable support is an easy way for willing guests to get involved or relate to what you are doing, so don't miss the opportunity to let them know about your staff volunteering and fundraising.

Where is the best place to communicate?

You need to place your messages where the people you are wanting to engage are most likely to read them. You also need to think about which communication platform is best suited to each message and how best to present that message. When will guests realistically have time to read lots of info, when would an image be more powerful and where are infographics most hard hitting?

Corporate customers will most likely request the information directly, but it may be worth writing directly to your regular and potential customers to tell them about your activities. It may give you the edge over other properties in the area. Before writing, look at the issues corporates are prioritising. If a company has a focus on water reduction or the living wage, for example, it is good to be able to state how you may be able to help them achieve these objectives.

With **guests** in general, there are many opportunities. Here are some options to consider;

Your website

It is certainly worth creating a separate page detailing all your social and environmental activities in one place but make the most of other opportunities to highlight how these contribute to a better stay, such as your local sourcing of food, your use of natural materials and environmentally-friendly cleaning products, which create better indoor air quality and beautiful décor. Keep the pages fresh with blogs and news stories to generate interest.

Figure 34: Aphrodite Hills website on sustainability awards[79]

Certification and awards are great to highlight prominently on your home page as these can often act as a quality label. You can also look into getting listed on sites such as bookdifferent.com and responsibletravel.com or TripAdvisor's GreenLeaders.

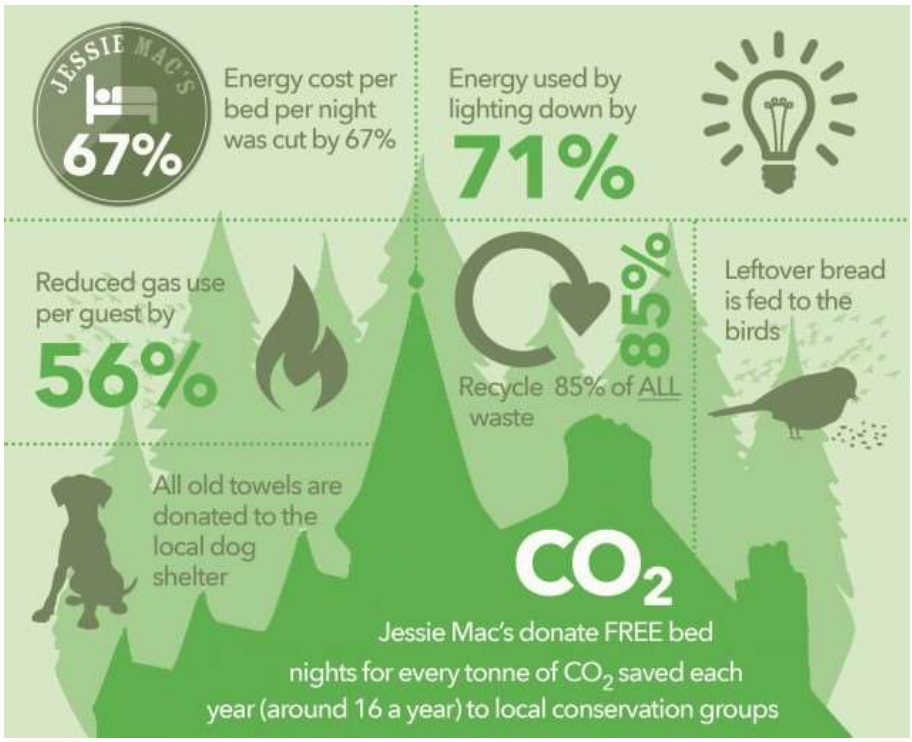
Social media

Never underestimate the power of social media – Facebook and Twitter. This is one of the easiest places to tell your story and highlight news and little details about your initiatives on a much more regular basis than elsewhere. Think about fun facts, engaging with new suppliers or partners and using images and video to get the message across e.g. staff fundraising successes, photos of volunteering days, beach clean ups, raising the profile of community issues or praising a local supplier.

Everyone loves to feel part of something and social media is a great way to get guests engaged before and after their stay. IHG's Planet CR is a great example of this and Cape Town's Hotel Verde creates a great feeling about the hotel through its quirky Tweets and You Tube videos of what looks like a very happy workforce!

[79] Source: https://www.aphroditehills.com/resort-news/aphrodite-hills-golf-resort-wins-iagto-sustainability-award-for-outstanding-contribution/

Figure 35: Jessie Mac's environmental and business savings[80]

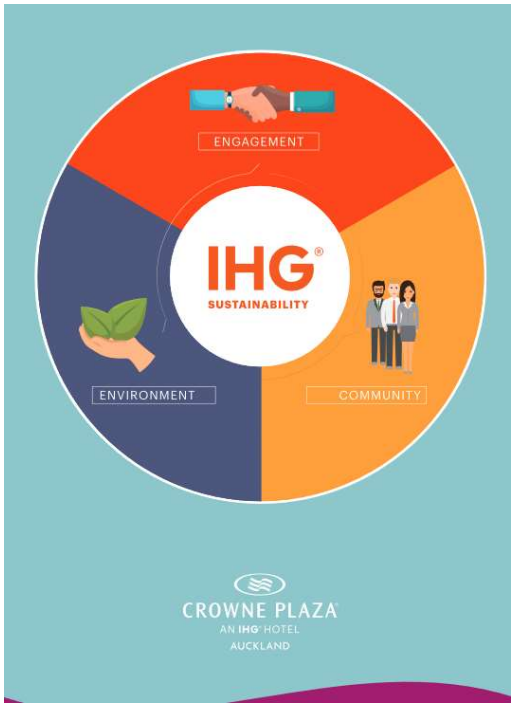


Booking confirmations

You can easily add in information to your booking confirmation to interest and engage guests, such as advising them the carbon footprint of an overnight stay and a link for them to offset that, or points that will get guests looking forward to their stay, such as “did you know that we offer bicycle hire to explore the local area / our breakfast menu is all locally sourced / we think you’ll like our fresh water pool”.

[80] Source: https://www.greenhotelier.org/our-themes/policy-certification-business/scottish-hostels-green-business-benefits/

Figure 36: Sustainability factsheets from Crowne Plaza hotel[81]



Room signs

Linen change options are the one thing guests usually see, and often the one thing everyone talks about when thinking of sustainability and hotels.

Other options can be to encourage guests to turn lights and appliances off when they leave the room. We love this sign on the keycard fob in the Regal i-club Hong Kong, right by the door as guests leave the room. No nagging or preaching, the message raises a smile and is spot on.

Figure 37: Example of a hotel's room sign

Room signs need not just be about environmental stuff. The Statler Hotel at Cornell has cards with pictures and stories about hotel staff, many of whom are students at the university. This is a wonderful way to show how you value your people. A hotel that shows it values its people is likely to value quality, service and guest satisfaction. All very good messages to engage the guest.

[81] Source: https://auckland.crowneplaza.com/wp-content/uploads/2019/12/CP_sustainability-chart_AKLNZ-1.pdf

And what pictures do you have in your rooms and public areas? Generic stuff or something from a local artist or pictures of the local area – current and historic? Part of sustainability communication is about creating a sense of place and this can be achieved in many ways.

Remember that even the most engaged guest could get overloaded with messages so don't overdo it. Choose the messages that you think are most important and relevant to your guests.

Guest information books

You should always use the in-room guest information book to get messages across. Create a specific page to demonstrate that sustainability is important to you but also use other pages to highlight specific initiatives, for example tell guests about your sustainable and local food sourcing policy in the food and beverage section, indicating any meals that use these products, e.g. sustainable fish or locally sourced fruit. If you have a section on excursions, highlight any that specifically benefit local people or the environment. Also highlight any staff initiatives that show you have a valued and dedicated workforce. All this helps create a very personal experience in your property and a rich experience for the guest.

Rather than printing out an A4 list, make this information as engaging as possible. Give the guest something to think or talk about. If you are near the Indian Ocean, what sea life is most at risk and why? If you are an airport hotel, what are the latest initiatives in clean fuel and how are they making a difference? Use designers or photography where possible and think outside the box.

If some of your initiatives are back of house, this is a good place to tell the guest about them.

TV channel

Similar to the information book, use your hotel's home and information pages to highlight the good stuff you are doing.

Restaurant & F&B

If you source from local suppliers or have policies for purchasing sustainable products, e.g. if your coffee and tea are fair trade, your eggs free-range, tell guests! Put it in the menu or on tent cards in serving areas. The way to a guest's heart can be through their stomach as, whether or not guests are particularly interested in social and environmental initiatives, most people like food and care about what they eat. Create more of an experience around the food and guests generally feel good. Wherever your hotel is in the world, this is something you can do. You can also encourage guests to waste less food by using messages in the menu, buffet signs and on tent cards. See great examples from WRAP in the Love Food Hate Waste Resource Pack.

Figure 38: Example of food saving efforts on hotel's website (WRAP)

Talk to your guests

We don't want you to sit guests down to a lecture or briefing but do mention things that might interest them when you get the chance. Lure them into the restaurant by telling them about your local dishes (and excellent chef!), tell them about any awards you've won, point out any features in the room that help them reduce their environmental impact without them having to try too hard, such as motion sensors and key cards. If you're staff are on board with all your sustainability practices this will make spreading the word even easier.

Communicating in the press

Your sustainability initiatives can get you good PR coverage, but you need to be a bit different to generate interest. Sustainability targets are unlikely to get you noticed unless they are ambitious or have an interesting angle, such as to go 100% renewable or using a new technology. People stories or those about your community outreach are likely to resonate more with what can be a cynical press. Local press can be a better option than national press. If you can demonstrate how you contribute and offer great service to the local community and visitors your local tourist board may also be interested in promoting your story. Of course Green Hotelier is always keen to share interesting case studies so take a look at our Guidelines for Contributing. Often events, such as World Travel Market World Responsible Tourism Day, have a blog which highlights best practice from hotels so look out for these opportunities. Entering awards are another good way to get the media's attention – take a look at Green Hotelier's, Tourism for Tomorrow, Considerate Hotelier's and Responsible Travel.

Involve your guests

Some hotels get guests actively involved in more than just linen change options. For example, many hotels participate in Earth Hour each year and turn their lights off or down for an hour and host romantic candle-lit evenings or discos in the dark to create a unique event and share an important message. Other events like World Ocean Day and Make Holidays Greener give hotels the opportunity to organise educational and fun events.

Others give guests the opportunity to join in an event, such as Rezidor's Walk for Water day where hotels will invite guests to walk for roughly 35 feet/10 metres carrying 'jerry cans' full of water to illustrate the daily struggle millions of people around the globe face in their efforts to access safe drinking water. For every 330 feet/100 metres walked, Radisson Blu will donate the funds to provide one child with safe drinking water for life through the charity Just a Drop. Beach clean ups, 3-minute shower challenges, sponsoring staff fund raising activities, World Environment Day…there are so many opportunities to create fun activities which may also be great selling points to stay in your property.

How will you monitor your success?

Monitoring the success of a sustainability communications plan is not easy but it can be done. First of all, make sure you are measuring and reporting on your initiatives and have set a baseline so you can say what has been achieved within a certain timescale. If you don't do this, you will not have the right information to communicate in the first place. Sustainability has to be part of your business model; it can't just be used for marketing. If you try to use it as such, your messages will be hollow and people will see through them.

Ask your guests for feedback after their stay, either by questionnaires in the room, at check-out or by email. What initiatives were they made aware of? What did they like? What suggestions do they have?

Also talk to your staff. Engage them in supporting initiatives and get them to feed back.

Figure 39: Announcement on a hotel's achievements[82]

Radisson Blu Marseille wins annual Think Planet award

June 8, 2017 | Filed under: Energy & Carbon,Europe,Industry News | Posted by: Siobhan O'Neill

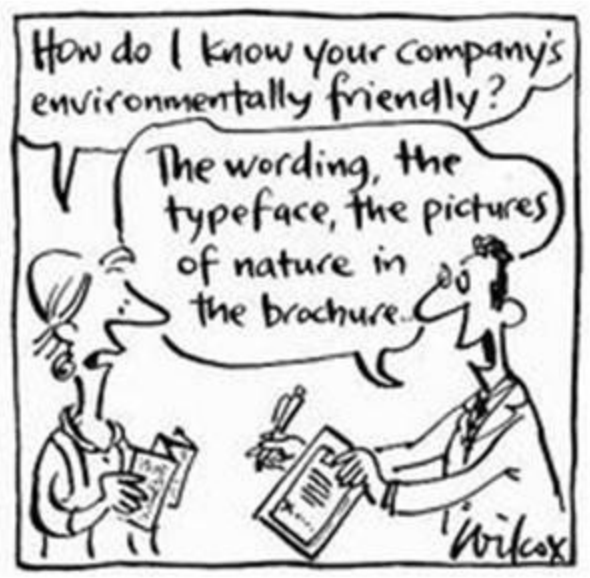
Radisson Blu Marseille test their Think Planet bikes

The Radisson Blu Hotel Marseille is this year's winner of Carlson Rezidor's Think Planet Award. The hotel was recognised for its exemplary commitment to energy and water savings.

A note on 'greenwash'

Greenwash is making misleading environmental claims which are not backed up by fact. Avoid generalisations like 'we are a green / eco hotel'. What does green or eco mean? What evidence do you have to back up such a claim? Communicating in such a vague way can lead to accusations of 'greenwash'. Equally, if saying you are reducing your water / energy / waste by 20%... compared to what? Make sure you share enough facts to be credible.

[82] Source: https://www.greenhotelier.org/our-themes/energy/radisson-blu-marseille-wins-annual-think-planet-award/



Use realistic & simple language. Remember, you are not saving the environment / planet / Mother Earth. You are just doing a little less bad. This kind of language can appear overly emotive and unrealistic to many.

Box 11: Tips on how to create a sustainability awareness campaign

- **Create a newsletter for guests and the local community**
- **Develop a project study and submit it to a magazine**
- **Make a story and publish it to social media**
- **Appoint a member of staff as a "green" ambassador to communicate to guests all relevant issues (you can also create a "green" team)**
- **Develop a relevant video**
- **Speak to a conference about your efforts**
- **Provide site tours to guests**
- **Develop relevant leaflets for guest**
- **Develop a relevant section at the website**
- **Publish a sustainability report to summarise all your efforts regarding environmental protection, local community engagement and staff support.**

Box 12: Tips on how to demonstrate your commitment towards environmental protection

To demonstrate your commitment, you should:

- **Make the hotels' environmental policy easily available to your guests, describing the actions taken to reduce energy consumption and GHG emissions. This document can be available at the reception, the guest relation office, on the information board or inside every guest room.**
- **Inform your guests about simple actions they can take every day to avoid wasting energy and minimise the environmental or carbon footprint of their stay. This can be done through relevant suggestions available in the room (in a printed leaflet or on TV). Similar suggestions can also be placed to specific hotel facilities. These suggestions could be about:**
    - **Reducing the use of (hot) water that affects energy consumption, e.g. "Please consider taking a shower instead of a bath"**

  - **Making better use of the heating/cooling system, e.g. "Please turn off the air-conditioning when you leave your room" or "Please switch off all lights when you leave your room", "Please have windows and doors closed while the A/C is in operation" or "Please keep the A/C temperature setting between 24°C and 26°C".**
  - **Supporting the bed linen and towel change policy of the hotel, e.g. "Your bed linen and towels are changed every x number of days. If you would like them changed sooner, please inform the reception" or "Your bed linen and towels are changed at your request, please place the relevant card on the bed".**
  - **Extending the use of pool towels over one day, e.g. "Get a 10% discount at the pool bar for keeping your pool towel for an extra day".**
  - **The recycling options available in the hotel.**
- **Inform your guests about your efforts, the measures you have taken already to reduce energy consumption and GHG emissions and what your next steps are.**
- **Tell them about your performance during the last year and what your targets are for this year. Avoid jargon language, complex calculations and excessive information. For example, there is no point to share with guests, analytical tables with your monthly energy consumption per energy source; the average annual consumption per guest night is a simple, comprehensible number for the average reader. If possible, make comparisons that will help your guests to better appreciate your performance. For example, "Our annual savings in energy could cover the energy needs of a 4-person household for 5 years". This can be done through:**
  - **The annual sustainability report.**
  - **Relevant graphs and tables.**
  - **Short messages on the TV inside every guest room, e.g. "Did you know that last year…"**
- **Ask your guests to evaluate your efforts and give them the chance to make suggestions for improvement.**
- **Try also to spot your "green champions", i.e. Guests who helped you the most to achieve your energy targets during their stay by abiding to your suggestions and policies. If possible, reward them in an appropriate manner. This way you can increase their engagement and transform them to "green ambassadors", i.e. Guests who will speak about your hotel to their family and friends.**
- **Provide appropriate incentives to motivate guests supporting your sustainability measures, e.g. you can offer a discount in the spa or at the bar for skipping housekeeping for a day or two.**

5.2 Energy, environmental and sustainability certification

5.2.1 The concept of eco-labels

Essentially, a label is the consumer's informer about a product or service, thus an eco-label is the one that provides environment related information for the said product or service to the potential buyer (Buckley 2001). The American Environmental Protection Agency (EPA, n.d.) has defined environmental labelling as "…the practice of labelling products based on a wide range of environmental considerations (e.g. hazard warnings, certified marketing claims, and information disclosure labels). In other words, an eco-label is communicating information about the environmental performance of a product or service – in this case the hospitality sector– to travellers, aiming to influence their buying behaviour. Often, the terms eco-labelling and eco-certification are used interchangeably to declare the compliance of an accommodation to a predefined set of environmental standards stipulated by the attesting organisation. But at the same time, the role of eco-labels as meaningful, trustworthy and decisive factors in choosing an accommodation is also important (Buckley 2001). In this market-centred perspective of eco-labels, Font (2001) has also recognised their significant potential to function as strong drivers for improving the environmental performance of the entire tourism industry. The rationale supporting this approach

considers travellers' preferences and intentions as an additional motivation towards hotels to adopt "greener" practices. Eco-labels can be based on environmental awards, eco-certification and accreditation schemes or just on voluntary commitment to a set of environment friendly principles. They may be operated by private companies, sector-specific or governmental organisations, NGOs, etc. and may refer to regional, national, and even international geographical areas.

5.2.2 Eco-management and audit schemes

Sustainability standards and certifications are voluntary, usually third party-assessed, norms and standards relating to environmental, social, ethical and food safety issues, adopted by companies to demonstrate the performance of their organizations or products in specific areas. According to the "Ecolabel Index[83]" there are over 450 eco-labels across the world, including 17 that are specialised to tourism and the hospitality sector, but there are more local certification schemes. The European Union has two main schemes that tourism sector can adopt, i.e. EMAS and EU-Fleur.

5.2.2.1 EU Eco-Label (EU-Fleur)

EU Ecolabel is a label of environmental excellence that is awarded to products and services meeting high environmental standards throughout their life-cycle: from raw material extraction, to production, distribution and disposal. The EU Ecolabel promotes the circular economy by encouraging producers to generate less waste and CO_2 during the manufacturing process. The EU Ecolabel criteria also encourages companies to develop products that are durable, easy to repair and recycle. Criteria for awarding the EU Ecolabel to Tourist Accommodation are divided into mandatory criteria, common for all the accommodations, and optional criteria (with a maximum score of 124 points). At the same time, the product group criteria are included in different sections: General Management, Energy, Water, Waste and wastewater, and other criteria (EC, n.d.-6). All the awarded hotels are listed in EU Ecolabel Tourist Accommodation Catalogue available at the following link: http://ec.europa.eu/ecat/hotels/en/list

5.2.2.2 EMAS

The EU Eco-Management and Audit Scheme (EMAS) is a premium management instrument developed by the European Commission (n.d.-7) for companies and other organisations to evaluate, report, and improve their environmental performance. EMAS is open to every type of organisation eager to improve its environmental performance. It spans all economic and service sectors and is applicable worldwide. The Commission has published the Decision (EU) 2016/611 of 15 April 2016 on the reference document on best environmental management practice, sector environmental performance indicators and benchmarks of excellence for the tourism sector under Regulation (EC) No 1221/2009 on the voluntary participation by organisations in a Community eco-management and audit scheme (EMAS) (notified under document C (2016) 2137) (Text with EEA relevance).

5.2.3 GCTC Standards

Another initiative related to tourism sustainability is the (GCTC, 2020) that is managing the GSTC Criteria, global standards for sustainable travel and tourism; as well as providing international accreditation for sustainable tourism Certification Bodies. The GSTC establishes and manages global sustainable standards, known as the GSTC Criteria. There are two sets: Destination Criteria for public policy-makers and destination managers, and Industry Criteria for hotels and tour operators. These are the guiding principles and minimum requirements that any tourism business or destination should aspire to reach in order to protect and sustain the world's natural and cultural resources, while ensuring tourism meets its potential as a tool for conservation and poverty alleviation. The GSTC Criteria form the foundation Accreditation for Certification Bodies that certify hotels/accommodations, tour operators/transport providers, and destinations as having sustainable policies and practices in place. GSTC does not directly certify any products or services; but provides an accreditation program through its partner ASI/Assurance Services International to accredit Certification Bodies.

[83] Source: The "Eco-label Index" (Big Room, Inc) is the largest global directory of eco-labels (http://www.ecolabelindex.com/ecolabels/).

5.2.4 ISO 14001

ISO 14001:2015 is issued by the International Organisation for Standardisation (ISO, n.d.) and specifies the requirements for an environmental management system that an organization can use to enhance its environmental performance. ISO 14001:2015 is intended for use by an organization seeking to manage its environmental responsibilities in a systematic manner that contributes to the environmental pillar of sustainability.

- It can help tourism organizations to achieve the intended outcomes of its environmental management system, which provide value for the environment, the organization itself and interested parties. Consistent with the organization's environmental policy, the intended outcomes of an environmental management system include:
  - enhancement of environmental performance;
  - fulfilment of compliance obligations;
  - achievement of environmental objectives.
- It is applicable to any organization, regardless of size, type and nature, and applies to the environmental aspects of its activities, products and services that the organization determines. It can either control or influence considering a life cycle perspective as it has a holistic approach of all life cycle of the product or service. ISO 14001:2015 does not state specific environmental performance criteria.
- It can be used in whole or in part to systematically improve environmental management. Claims of conformity to ISO 14001:2015, however, are not acceptable unless all its requirements are incorporated into an organization's environmental management system and fulfilled without exclusion.

5.2.5 ISO 50001:2018

ISO 50001 is based on the management system model of continual improvement also used for other well-known standards such as ISO 9001 or ISO 14001 available from the International Organisation for Standardisation (ISO, n.d.-2). This makes it easier for organizations to integrate energy management into their overall efforts to improve quality and environmental management.

ISO 50001 provides a framework of requirements for organizations to:

- Develop a policy for more efficient use of energy
- Fix targets and objectives to meet the policy
- Use data to better understand and make decisions about energy use in all departments of the organization
- Measure the results with KPIs
- Review how well the policy works, and
- Continually improve energy management

ISO 50001:2018 is an excellent tool for energy management and energy efficiency improvements.

5.3 A selection of tourism related eco-labels

The following table outlines a selection of certification schemes and eco-labels relevant to the accommodation sector available at the Eco-label Index and the GSTC-Recognized Standards for Hotels. While they do not directly provide (financial) incentives, they can be easily bundled with such instruments. For example, in some regions, tax incentives, soft loans, grants, bonuses or expedited permits are available to developers or building owners implementing green certifications.

Box 13: List of certificates different types of hotels can obtain[84]

Large Independent Chains:

- **Greenkey**
- **Green Globe**
- **Travelife**
- **Green Seal**
- **Audubon**
- **ENERGY STAR**
- **LEED**
- **TripAdvisor GreenLeaders**
- **Green Tourism (United Kingdom and Canada)**

Bed & Breakfasts:

- **Greenkey**
- **Travelife**
- **ENERGY STAR**
- **Audubon**
- **TripAdvisor Green Leaders**
- **LEED**
- **Green Tourism (United Kingdom and Canada)**

Independent Properties or Hostels:

- **Audubon**
- **ENERGY STAR**
- **Travelife**
- **LEED**
- **Green Tourism (United Kingdom and Canada)**
- **TripAdvisor GreenLeaders**

[84] Source: https://www.clock-software.com/blog/hotel-sustainability.html

Table 19: Certification descriptions

Organizasion/Company, Logo	
Green Globe Certification	The Green Globe Standard facilitates responsible and sustainable environmental and social activity; and improved environmental and social outcomes for travel and tourism operations. The Green Globe Standard is a structured assessment of the sustainability performance of travel and tourism businesses and their supply chain partners. Businesses can monitor improvements and document achievements leading to certification of their enterprises' sustainable operation and management. The Green Globe Standards is a collection of 339 compliance indicators applied to 41 individual sustainability criteria. The applicable indicators vary by type of certification, geographical area as well as local factors. The Green Globe Standard is reviewed and updated twice per calendar year
The Green Key	The Green Key award is a standard of excellence in the field of environmental responsibility and sustainable operation within the tourism industry. This eco-label represents a commitment by businesses that their tourism establishments adhere to the criteria as stipulated by the Foundation for Environmental Education (FEE). A Green Key stands for an establishment's promise to its guests that by opting to stay with such an establishment, they are helping to make a difference on an environmental and sustainability level. The environmental standards expected of these establishments are maintained through documentation and audits.
EarthCheck	EarthCheck is a benchmarking certification and advisory group for travel and tourism. Since 1987, EarthCheck have helped businesses, communities and governments to deliver clean, safe, prosperous and healthy destinations for travellers to visit, live, work and play. EarthCheck's approach has been to help operators break resource challenges into manageable actions that can be taken forward by management
Green Tourism Business Scheme (GTBS)	The GTBS is the national sustainable tourism certification scheme for the UK & Ireland with over 2400 members. It is the only national certification programme endorsed by the National tourism agencies. Businesses opting to join Green Tourism are assessed by a qualified grading advisor against a rigorous set of 145 criteria, covering a range of areas, including energy and water efficiency, waste management, purchasing, travel, biodiversity and more. Those businesses that meet the required standard, receive a Bronze, Silver, or Gold award based on their level of achievement. They are regraded once every two years.
Travelife	Travelife is an internationally recognised accommodation sustainability programme. In over 50 countries we have around 1,500 members who use our practical tools and resources to improve their business's environmental, financial and social impact.
Viabono (Germany)	Certifies accommodation businesses, destinations and other tourism businesses in Germany. Viabono's prerequisite for "natural enjoyment" is an intact environment and natural world, plus a high-quality tourist product.
ECO certification (Malta)	EarthCheck is a benchmarking certification and advisory group for travel and tourism. Since 1987, EarthCheck have helped businesses, communities and governments to deliver clean, safe, prosperous and healthy destinations for travellers to visit, live, work and play. EarthCheck's approach has been to help operators break resource challenges into manageable actions that can be taken forward by management
Legambiente Turismo (Italy)	Eco-tourism label for Italy for any type of tourist accommodation business. Since 1997 Legambiente Turismo has worked to help tourist businesses to reduce tourist impacts in the destination and raise awareness in holiday makers, while enhancing quality and comfort and involving local businesses and tourists in more sustainable choices. The ecolabel aims to improve environmental management in tourist services by minimising waste, recycling, using less water and energy, promoting soft mobility practices, healthy food and typical local produce and products, promoting local nature and culture heritage.
EcoLabel (Luxembourg)	The EcoLabel is an initiative by the Ministry of Tourism and the Ministry for sustainable development and infrastructure, running since 1999. Ever since, the non-profit organization OekoZenter Lëtzebuerg has been in charge of the environmental counseling of both the businesses aiming to join the EcoLabel initiative and the businesses already part of the network. Up to now, the certificate has been awarded to 37 accommodations, ranging from country lodgings, guest rooms and youth hostels to first class campsites and luxury hotels.

6 Tools for performance monitoring

6.1 Actions checklist – self-monitoring

To achieve energy efficiency, energy reductions and GHG reductions there are four main steps the hotel management can take

- Energy monitoring
- Energy auditing
- Setting up KPIs

Setting up targets and continual improvement

6.1.1 Monitoring process - Metering and sub-metering

Energy metering can be done using the monthly bills. Reading the energy bill is an important task. Most energy providers have examples online on how to read the energy bill. Another way to measure energy is with the use of meters and submeters. Sub-metering is an important part of the energy management in order to achieve energy efficiency and energy reductions. Sub-meters can be placed in various areas such as chiller pumps, cooling fan, hot water pumps or various department like kitchens, spa, or guest rooms. The advanced energy metering must have the following characteristics:

- Meters must be permanently installed, record at intervals of one hour or less, and transmit data to a remote location.
- Electricity meters must record both consumption and demand. Whole-building electricity meters should record the power factor, if appropriate.
- The data collection system must use a local area network, building automation system, wireless network, or comparable communication infrastructure.
- The system must be capable of storing all meter data for at least 36 months.
- The data must be remotely accessible.
- All meters in the system must be capable of reporting hourly, daily, monthly, and annual energy use.

6.1.2 Energy audit

An energy audit is the systematic review of each fuel-consuming system in the hotel. The legislation requires all large enterprises based in the European Union - with at least 250 employees, or annual revenues over €50 million and an annual balance sheet of over €43 million - to comply with the national energy audit obligation, including calculating their total energy consumption and identifying saving opportunities across their estate, every four years. Businesses that apply an energy or environmental management system certified by an independent body, according to the relevant European or international standards, are exempted from the above requirement, provided that these management systems include an energy audit as per the minimum criteria set by the said legislation.

All other businesses, including Small and Medium Enterprises (SMEs), are highly encouraged to perform an energy audit, however it is not mandatory at this stage. These audits fall into three categories as follows:

- Category A: Residential buildings, office and commercial buildings up to 2.000 m^2 and workshops with installed capacity not exceeding 22 kW for motors or 50 kW for thermal.
- Category B: Office and commercial buildings over 2.000 m^2 (including other buildings that house uses of the tertiary sector (such as school buildings, hotels, hospitals, etc.) and industrial facilities with a total installed capacity not exceeding 1.000 kW.
- Category C: industrial installations with a total installed capacity of more than 1.000 kW.

Simplified energy auditing can be conducted to hotels with the use of the HOTELS 4 CLIMATE tools.

6.1.3 Key Performance Indicators and metrics for energy use

Energy KPIs generally have the role of monitoring, analysing, and benchmarking the energy performance. Energy intensity and specific energy use are two commonly used energy efficiency indicators. The tourist accommodation shall have procedures for collecting and monitoring data monthly or, at least, yearly, on the following aspects as a minimum:

- Specific energy use (kWh/guest night and/or kWh/m^2 (of indoor area) year);
- Percentage of final energy use met by renewable energy generated on site (%);
- Total energy consumption per guest night
- Total energy consumption per number of rooms or per square meter
- Energy consumption per source
- Energy consumption per activity
- Renewable energy contribution
- GHG emissions per guest night
- GHG emissions per m^2

Also, the tourist accommodation should monitor the following indicators for sustainability purposes:

- Water consumption per guest-night (litters/guest-night) including the water used for irrigation (if applicable) and any other activities related to water consumption;
- Waste generation per guest-night (kg/guest-night). Food waste shall be monitored separately;
- Consumption of chemical products for cleaning, dishwashing, laundry, sanitizing and other special cleaners (e.g. swimming pool backwashing) (kg or litters/guest night).

The below matrix shows how a tourist accommodation should monitor the energy consumption for all energy sources (Electricity, LPG, Diesel, etc.) – see monitoring tool.xls. This simple energy monitoring tool can be very helpful for hotel managers to start monitoring energy and GHG emissions during operation months.

Table 20: Screenshot of energy monitoring tool

	Occupancy	Energy Consumption and GHG emissions										KPIs			
Month	2019	Electricity (kWh)	GHG emissions from Electricity (kgCO2e) Scope 1	LPG (kg)	LPG (kWh)	GHG emissions from LPG (kgCO2e)	Diesel (L)	Diesel (kWh)	GHG emissions from diesel (kgCO2e)	Total energy (kWh)	Total GHG emissions (kgCO2e)	Energy consumption/Guest night (kWh)	Energy consumption/room or m2 (kWh)	GHG emissions/ Guest night (kgCO2e)	GHG emissions/ room or m2 (kgCO2e)
January															
February															
March															
April															
May															
June															
July															
August															
September															
October															
November															
December															
Totals	0	0	0	0	0	0		0		0	0				
Please ensure that you provide reports for ALL energy sources, including electricity, gas, petrol, diesel or LPG. All energy sources must be converted into kilowatt hours and please give the conversion rates you used below.															

6.1.4 Targeting and continual improvement

With the previous steps that hotel management now should fully understand the energy use in total and per department. The information that energy monitoring and energy auditing will provide can be used to set clear, measurable targets for reducing energy use. The objectives and the targets should be able to target to the following criteria:

- Reducing energy consumption - either overall or by a particular department or process i.e. kitchen
- Reducing emissions of carbon dioxide equivalents (CO2e) as the result of the above actions
- Increasing the percentage of the energy budget invested in energy-saving measures
- Improving the return on investment from energy efficiency activities
- Increased staff awareness with capacity trainings
- Increasing the number of employees who receive an energy efficiency training
- Measuring an increase in energy-saving actions by staff

The above process should be conducted on an annual basis in order to achieve results and continual improvement. The targets, objectives and results should be analysed to top management in order to gain support and budget. The level of continual improvement demonstrated by a hotel organization will likely vary each year. Usually, energy savings and performance improvements are relatively more pronounced in the first years of a hotel starts with an energy management program, and the level of 'continual improvement' that the energy team looks for each year will be adjusted accordingly.

7 Bibliography

Aphrodite Hills Resort (2020), News. Available at https://www.aphroditehills.com/resort-news/aphrodite-hills-golf-resort-wins-iagto-sustainability-award-for-outstanding-contribution/ (Accessed on 24/08/2020)

BizEE (2020). Energy Lens: Energy management software [online]. energy/lens.com. Available at: https://www.energylens.com/articles/energy-management (Accessed on 10/4/2020)

Buckley, R. (2001), Tourism ecolabels. Annals of Tourism Research, Vol. 29, No. 1, pp. 183–208, 2002

Burroughs W. (2007). Climate Change: A multidisciplinary Approach (2nd edition). Cambridge University Press.

Clock Software (2019), The Importance of Environmental Sustainability in the Hospitality Industry. Available at https://www.clock-software.com/blog/hotel-sustainability.html (Accessed on 24/08/2020)

Council on Foreign Relations (2020). Timeline: UN Climate Talks [online]. cfr.org. Available at: https://www.cfr.org/timeline/un-climate-talks (Accessed on 10/6/2020)

Crowne Plaza Auckland (n.d.), IHG Sustainability report. Available at https://auckland.crowneplaza.com/wp-content/uploads/2019/12/CP_sustainability-chart_AKLNZ-1.pdf (Accessed on 24/08/2020)

Cyprus Department of Meteorology. Available at http://www.moa.gov.cy/moa/ms/ms.nsf/DMLindex_en/DMLindex_en?opendocument (Accessed at 24/08/2020)

Cyprus Institute - Cyprus Weather Forecast. Available at http://weather.cyi.ac.cy/en/climate/climate-change/ (Accessed on 24/08/2020)

DANA Communications (2018), The Importance of Sustainability in the Hospitality Industry. Available at https://www.danacommunications.com/importance-of-sustainability-in-the-hospitality-industry/ (Accessed on 24/08/2020)

Department for Business, Energy & Industrial Strategy (2020) on Government conversion factors for company reporting of greenhouse gas emissions. Available at https://www.gov.uk/government/collections/government-conversion-factors-for-company-reporting (Accessed on 24/08/2020)

Greenhouse Gas Protocol (GHG Protocol). Available at https://ghgprotocol.org (Accessed on 24/08/2020)

Green Hotelier (2015), Communicating Sustainability to Guests. Available at https://www.greenhotelier.org/know-how-guides/communicating-sustainability-to-guests/ (Accessed on 24/08/2020)

Green Hotelier (2017), Scottish hostel's green business benefits. Available at https://www.greenhotelier.org/our-themes/policy-certification-business/scottish-hostels-green-business-benefits/ (Accessed on 24/08/2020)

Green Hotelier (2017), Radisson Blu Marseille wins annual Think Planet award. Available at https://www.greenhotelier.org/our-themes/energy/radisson-blu-marseille-wins-annual-think-planet-award/ (Accessed on 24/08/2020)

EESI (n.d.) Energy Efficiency [online] eesi.org. Available at: https://www.eesi.org/topics/energy-efficiency/description (Accessed on 10/6/2020)

Electricity Authority of Cyprus (EAC – 2018) Data on elect ricity consumption. Available at www.eac.org.cy (Accessed on 24/08/2020)

EU Platform on Food Losses and Food Waste (2019). Recommendations for Action in Food Waste Prevention. Available at: https://ec.europa.eu/food/sites/food/files/safety/docs/fs_eu-actions_action_implementation_platform_key_recommendations.pdf (Accessed on 10/6/2020)

Environmental Protection Agency (n.d.). Greenhouse Gas Emissions, Understanding Global Warming Potentials [online]. epa.gov. Available at: https://www.epa.gov/ghgemissions/understanding-global-warming-potentials (Accessed on 10/6/2020)

Environmental Protection Agency (1998), Environmental Label Issues, Policies, and Practices Worldwide. Available at: http://www.epa.gov/oppt/epp/pubs/wwlabel3.pdf (Accessed on 05/04/20)

Environmental Protection Agency (2019), EEA Report No 20/2019. Available at https://www.eea.europa.eu/publications/fluorinated-greenhouse-gases-2019 (Accessed on

European Commission (n.d.). EU Action: 2050 long-term strategy [online] ec.europa.eu. Available at: https://ec.europa.eu/clima/policies/strategies/2050_en (Accessed on 14/5/2020)

European Commission (n.d.-2). Climate change consequences [online] ec.europa.eu. Available at: https://ec.europa.eu/clima/change/consequences_en (Accessed on 10/6/2020)

European Commission (n.d.-3). EU Action, Emissions monitoring & reporting [online] ec.europa.eu. Available at: https://ec.europa.eu/clima/policies/strategies/progress/monitoring_en (Accessed on 10/6/2020)

European Commission (n.d.-4). New energy efficiency labels explained [online] ec.europa.eu. Available at: https://ec.europa.eu/commission/presscorner/detail/en/MEMO_19_1596 (Accessed on 20/6/2020)

European Commission (n.d.-5). Greenhouse gas emissions from waste [online] ec.europa.eu. Available at: https://ec.europa.eu/eurostat/web/products-eurostat-news/-/DDN-20200123-1 (Accessed on 20/6/2020)

European Commission (n.d.-6). Environment, EU eco-label [online] ec.europa.eu. Available at: https://ec.europa.eu/environment/ecolabel/index_en.htm (Accessed on 10/6/2020)

European Commission (n.d.-7). Environment, Eco-Management and Audit Scheme [online] ec.europa.eu. Available at: https://ec.europa.eu/environment/emas/index_en.htm (Accessed on 10/6/2020)

European Commission (2010). Being wise with waste: the EU's approach to waste management. Available at: https://ec.europa.eu/environment/waste/pdf/WASTE%20BROCHURE.pdf (Accessed on 10/6/2020)

European Commission (2020). Clean energy for all Europeans package. Available at https://ec.europa.eu/energy/topics/energy-strategy/clean-energy-all-europeans_en (Accessed on 10/6/2020)

European Commission (2020). A European Green Deal. Available at https://ec.europa.eu/info/node/123797 (Accessed on 10/6/2020)

European Commission, EU Action, Emissions monitoring & reporting. Available at https://ec.europa.eu/clima/policies/strategies/progress/monitoring_en (Accessed on 24/08/2020)

European Commission (n.d.), EU Action, EU legislation to control F-gases. Available at https://ec.europa.eu/clima/policies/f-gas/legislation_en (Accessed on 24/08/2020)

European Commission, Energy, Energy Label Generator, Air conditioners. Available at https://ec.europa.eu/energy/topics/energy-efficiency/energy-label-and-ecodesign/energy-label-generator/air-conditioners_en (Accessed on 24/08/2020)

European Commission (n.d.), Energy, Nearly zero-energy buildings. Available at https://ec.europa.eu/energy/topics/energy-efficiency/energy-efficient-buildings/nearly-zero-energy-buildings_en (Accessed on 24/08/2020)

European Commission (2019), Directive 2008/98/EC on waste (Waste Framework Directive). Available information at https://ec.europa.eu/environment/waste/framework/ (Accessed on 24/08/2020)

European Commission (2019), Waste Framework Directive/ Waste classification and the European List of Waste. Available at https://ec.europa.eu/environment/waste/framework/list.htm (Accessed on 24/08/2020)

European Commission (n.d.), Best Environmental Management Practice in the tourism sector. Available at https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/best-environmental-management-practice-tourism-sector (Accessed on 24/08/2020)

European Commission (2019), Urban Waste Water Directive. Available at https://ec.europa.eu/environment/water/water-urbanwaste/legislation/directive_en.htm (Accessed on 24/08/2020)

European Council, A new strategic Agenda 2019-2024. Available at https://www.consilium.europa.eu/media/39914/a-new-strategic-agenda-2019-2024-en.pdf (Accessed on 24/08/2020)

European Environment Agency (2020). Heating and cooling degree days [online]. eea.europa.eu. Available at: https://www.eea.europa.eu/data-and-maps/indicators/heating-degree-days-2/assessment (Accessed on 10/6/2020)

European Environment Agency (2019), Atmospheric greenhouse gas concentrations [online]. eea.europa.eu. Available at: https://www.eea.europa.eu/data-and-maps/indicators/atmospheric-greenhouse-gas-concentrations-6/assessment-1 (Accessed on 10/6/2020)

European Environment Agency (2020), Chapter 4: natural resources and waste, image ETC Sustainable Consumption and Production. Available at https://www.eea.europa.eu/soer/2010/synthesis/synthesis/chapter4.xhtml (Accessed on 24/08/2020)

European Parliament (n.d.), Energy efficiency. Available at https://www.europarl.europa.eu/factsheets/en/sheet/69/energy-efficiency (Accessed on 24/08/2020)

European Parliament (2017), Food waste: the problem in the EU in numbers [infographic]. Available at https://www.europarl.europa.eu/news/en/headlines/society/20170505STO73528/food-waste-the-problem-in-the-eu-in-numbers-infographic (Accessed on 24/08/2020)

European Travel Commission (2018), Tourism and Climate Change Mitigation. Embracing the Paris Agreement: Pathways to Decarbonisation. Compiled by: Daniel Scott and Stefan Gössling, Brussels. Available at: https://etc-corporate.org/uploads/2018/03/ETC-Climate-Change-Report_FINAL.pdf (Accessed on 10/6/2020)

European Union (2019), Going Climate-Neutral by 2050: A strategic long-term vision for a prosperous, modern, competitive and climate-neutral EU economy. ISBN 978-92-76-02037-0. Available at: https://op.europa.eu/en/publication-detail/-/publication/92f6d5bc-76bc-11e9-9f05-01aa75ed71a1 (Accessed on 8/5/2020)

Eurostat (2020), Greenhouse gas emissions from waste. Available at https://ec.europa.eu/eurostat/web/products-eurostat-news/-/DDN-20200123-1?inheritRedirect=true&redirect=%2Feurostat%2Fweb%2Fwaste%2Fpublications (Accessed on 24/08/2020)

Font, X. (2001), Regulating the Green Message: The Players in Ecolabelling. In: Font, X. and Buckley, R. (eds.), Tourism ecolabelling: Certification and promotion of sustainable management, pp.1-17. Wallingford, Oxon; New York: CABI Pub.

Global Sustainable Tourism Council (2020). What is the GSTC? [online] gstcouncil.org. Available at: https://www.gstcouncil.org/about/about-us/ (Accessed on 10/6/2020)

Green Pearls ® (n.d.). Available at https://www.greenpearls.com/hotels/hotel-outside1/ (Accessed on 24/08/2020)

Hotel Energy Solutions (2011), Analysis on Energy Use by European Hotels: Online Survey and Desk Research, Hotel Energy Solutions project publications. First edition: 2010. Revised version, July 2011

International Energy Agency (2020). Buildings: A source of enormous untapped efficiency potential [online] iea.org. Available at: https://www.iea.org/topics/buildings (Accessed on 8/5/2020)

International Organisation for Standardisation (ISO, n.d.). ISO 14001:2015, Environmental management systems - Requirements with guidance for use [online] iso.org. Available at: https://www.iso.org/standard/60857.html (Accessed on 06/06/2020)

International Organisation for Standardisation (ISO, n.d.-2). ISO 50001, Energy Management [online] iso.org. Available at: https://www.iso.org/iso-50001-energy-management.html (Accessed on 06/06/2020)

International Tourism Partnership. Available at https://www.tourismpartnership.org/ (Accessed on 24/08/2020)

International Tourism Partnership (2014), Environmental management for hotels, the Industry guide to sustainable operation. Available at http://www.greenhotelier.org/wp-content/uploads/2014/09/4-Waste-for-web-1-1.pdf (Accessed on 24/08/2020)

INESC Coimbra - Instituto de Engenharia de Sistemas e Computadores de Coimbra (n.d.), Energy Savings by CHCP Plants in the Hotel Sector. Available at http://www.inescc.pt/urepe/chose/chose-project.htm (Accessed on 24/08/2020)

IPCC (2018). Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. In Press.

IPCC (2014). Climate Change 2014, Synthesis Report, Summary for Policymakers Chapter. Available at: https://www.ipcc.ch/site/assets/uploads/2018/02/AR5_SYR_FINAL_SPM.pdf (Accessed on 25/4/2020)

Lenzen, M., Sun, Y., Faturay, F. et al. (2018). The carbon footprint of global tourism. Nature Clim Change 8, 522–528. Available at: https://doi.org/10.1038/s41558-018-0141-x (Accessed on 25/4/2020)

Marriott International, Inc (2019), Sustain responsible operations. Available at https://serve360.marriott.com/sustain/ (Accessed on 24/08/2020)

Monroe, R. (2020). What does it take for the coronavirus (or other major economic events) to affect global carbon dioxide readings? In Climate in the News, Measurement Notes, Scripps Institution of Oceanography at UC San Diego [online] scripps.ucsd.edu. Available at: https://scripps.ucsd.edu/programs/keelingcurve/2020/03/11/what-does-it-take-for-the-coronavirus-or-other-major-economic-events-to-affect-global-carbon-dioxide-readings/ (Accessed on 25/4/2020)

NASA (n.d.). Arctic Sea Ice Minimum ? [online] climate.nasa.gov. Available at: https://climate.nasa.gov/vital-signs/arctic-sea-ice/ (Accessed on 25/4/2020)

NCEI (n.d.). What's the Difference Between Weather and Climate? [online] ncei.noaa.gov. Available at: https://www.ncei.noaa.gov/news/weather-vs-climate (Accessed on 25/4/2020)

New South Wales EPA (2012), Better Practice Guidelines for Waste Management and Recycling in Commercial and Industrial Facilities. Available at https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/managewaste/120960-comm-ind.pdf (Accessed on 24/08/2020)

NOOA (n.d.). Climate Change: Global Temperature Level [online] oceabservice.noaa.gov. Available at: https://www.climate.gov/news-features/understanding-climate/climate-change-global-temperature (Accessed on 28/4/2020)

NOOA (n.d.-2). Climate Change: Global Sea Level [online] oceabservice.noaa.gov. Available at: https://oceanservice.noaa.gov/facts/sealevel.html (Accessed on 30/4/2020)

NRDC (2020). Greenhouse Effect 101 [online] nrdc.org. Available at: https://www.nrdc.org/stories/greenhouse-effect-101#whatis (Accessed on 25/4/2020)

ODYSSEE-MURE (n.d.), Electricity Consumption in Hotels And Restaurants. Available at https://www.odyssee-mure.eu/publications/efficiency-by-sector/services/hotel-restaurant-specific-energy-electricity-consumption.html (Accessed on 24/08/2020)

OJEU, Commission Delegated Regulation (EU) No 626/2011 of 4 May 2011 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of air conditioners. Available at https://www.applia-europe.eu/images/Library/Energy_Labelling_for_Air_Conditioners_and_Comfort_Fans_-_626_2011-compress.pdf (Accessed on 24/08/2020)

OJEU, Directive (EU) 2018/844 of the European Parliament and of the council of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency. Available at https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32018L0844&from=EN (Accessed on 24/08/2020)

OJEU, Commission Decision (EU) 2017/175 of 25 January 2017 on establishing EU Ecolabel criteria for tourist accommodation (notified under document C(2017) 299). Available at https://eur-lex.europa.eu/eli/dec/2017/175/2017-02-02 (Accessed on 24/08/2020)

SMEmpower efficiency, Identification of the current Energy Efficiency level in SMEs, 2020, https://smempower.com/

Ricerca sul Sistema Energetico – RSE S.p.A, Determination of the actual energy demand of different types of buildings and processes (European Commission)

Service for Water Indicators in Climate Change Adaptation SWICCA.eu. Available at https://swicca.eu/ (Accessed on 24/08/2020)

The Travel Foundation (2013), Waste Mapping Guidance for Hotels in Cyprus: Saving money and improving the environment. Available at http://www.tourism.gov.cy/tourism/tourism.nsf/All/A9F84CCB90BC8BEFC225849D003A4B90/$file/Waste_Mapping_Guidance_Hotels.pdf?OpenElement (Accessed on 24/08/2020)

The "Eco-label Index" (Big Room, Inc) is the largest global directory of eco-labels (http://www.ecolabelindex.com/ecolabels/).

Tourism for SDGDs, a platform developed by UNWTO. Available at: http://tourism4sdgs.org/tourism-for-sdgs/tourism-and-sdgs/ (Accessed on 24/08/2020)

UCDAVIS (n.d.). Climate Change Terms and Definitions [online] climatechange.ucdavis.edu. Available in: https://climatechange.ucdavis.edu/science/climate-change-definitions/ (Accessed on: 25/4/2020)

UN (n.d.) Climate Change [online] un.org. Available at: https://www.un.org/en/sections/issues-depth/climate-change/ (Accessed on 06/06/2020)

UNEP and UNWTO (2012), Tourism in the Green Economy – Background Report, UNWTO, Madrid.

UNFCCC (2020-a). What is the United Nations Framework Convention on Climate Change? [online] unfccc.int. Available at: https://unfccc.int/process-and-meetings/the-convention/what-is-the-united-nations-framework-convention-on-climate-change (Accessed on 06/06/2020)

UNFCCC (2020-b). What is the Kyoto Protocol? [online] unfccc.int. Available at: https://unfccc.int/kyoto_protocol (Accessed on 06/06/2020)

UNFCCC (2020-c). The Paris Agreement [online] unfccc.int. Available at: https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement (Accessed on 06/06/2020)

Simpson, M.C., Gössling, S., Scott, D., Hall, C.M. and Gladin, E. (2008) Climate Change Adaptation and Mitigation in the Tourism Sector: Frameworks, Tools and Practices. UNEP, University of Oxford, UNWTO, WMO: Paris, France.

UNWTO (2020). Tourism & SDGs. [online] tourism4sdgs.org. Available at: http://tourism4sdgs.org/tourism-for-sdgs/tourism-and-sdgs/ (Accessed on 06/06/2020)

UNWTO, UNEP and WMO (2008), Climate Change and Tourism: Responding to Global Challenges, (prepared by Scott, D., Amelung, B., Becken, S., Ceron, JP., Dubois, G., Gössling, S., Peeters, P. and Simpson, M.C.), UNWTO, Madrid, and UNEP, Paris.

US Department of Energy (n.d.). Energy Intensity and Efficiency [online] energy.gov. Available at: https://www.energy.gov/eere/analysis/energy-intensity-indicators-efficiency-vs-intensity (Accessed on 06/06/2020)

USGS (n.d.). Why is climate change happening and what are the causes? [online] usgs.gov. Available at: https://www.usgs.gov/faqs/why-climate-change-happening-and-what-are-causes-1?qt-news_science_products=0#qt-news_science_products (Accessed on 05/06/2020)

Volkswagen (2020), The Golf-price and specification guide. Available at https://www.volkswagen.co.uk/files/live/sites/vwuk/files/pdf/Brochures/golf-p11d.pdf (Accessed on 24/08/2020)

WRAP (2014), Crieff Hydro case study. Available at https://www.wrap.org.uk/food-drink/business-food-waste/case-study/crieff-hydro (Accessed on 24/08/2020)

WRAP (n.d.), Supporting resources for the Hospitality and Food Service sector. Available at https://www.wrap.org.uk/content/supporting-resources-hospitality-and-food-service-sector-4 (Accessed on 24/08/2020)

8 Appendix

The knowledge, skills and competences PER LEARNING OUTCOME AND LEARNING UNIT

Module		Learning outcome	hr	Description	Knowledge	Skills	Competencies
1. Introduction to climate change	1	The human induced climate change phenomenon and how it is linked with GHG emissions. Which are these gases and what are their consequences at a global level. Relevant international conventions, EU and national policies.	1,5	This session aims at providing a basic understanding of the greenhouse effect and its linkage to human induced climate change. How GHG emissions contribute to the greenhouse effect, which are the main sources of emissions, particularly in the hospitality sector. A quick review of international conventions, EU and national policies relevant to climate is also included.	Knowledge of human induced climate change phenomenon, its linkage to GHG emissions and relevant European/ National legislation and 2030 targets.	Ability to participate consciously, and thus more diligently, to all GHG mitigation efforts of the hotel.	Competency in contributing to the mitigation of GHG emissions.
	2	Principles of carbon accounting. Energy units and conversion factors for the quantification of GHG emissions.	0,5	The session aims at providing a basic understanding of carbon accounting principles and carbon footprinting methodology (GHG Protocol), information concerning energy units and GHG conversion factors. Energy conversion is a main element in carbon footprint.	Knowledge of emission sources and scopes; energy units and GHG conversion factors; Basic methodology of calculating the carbon footprint in an organisation	Ability to manage perfectly the physical quantities and conversion factors in order to verify and validate the measurements, make comparisons and calculations.	Competency in understanding and identifying emissions sources, applying energy units and GHG conversion factors, and calculating the organizational carbon footprint.

Module		Learning outcome	hr	Description	Knowledge	Skills	Competencies
2. Introduction to GHG emission reduction and energy savings	1	An understanding of the main energy sources (incl. renewables) and energy consumption patterns in the hospitality sector. Basics of the supply and cost aspects of the energy market (Charges and tariff structuring)	1,0	The session aims to provide information about reading and interpreting the energy invoices, considering the electricity, gas and other energy sources tariff structures. Includes a review of contracts for the supply of energy, switch the energy supplier.	Knowledge of metering equipment, tariffs and tariff structures.	Ability to read the utility tariff, bearing in mind the time of use rates, the peak charges, the usage profile, the demand charges, green power offerings and contractual obligations in order to propose suitable solutions to reduce the energy	Competency in understanding of the various energy tariffs and making a metering plan for the data collection and analysis and to reduce energy supply costs
	2	The basics of data analysis	1,0	The session aims to provide information on methodology of the data collection, analysis of energy consumptions and costs. How to collect and analyze all data concerning energy, including energy carriers, adjustment factors affecting energy consumption.	Knowledge of data collection methods useful for the energy audit and method of analysis.	Ability to collect information through effective interviewing, listening, observing, measuring, reviewing documents, records and data.	Competency in verifying and validating any collected data and competent in assessing factors that may affect the reliability of the energy management.
	3	Energy-mix and energy-use patterns found in accommodations and share some relevant consumption data from the hospitality industry based on different property types; energy performance indicators	1,0	The session aims to provide information on energy performance indicators in accordance with National Standards. Identifying and calculating the key energy performance indicators is vital for the planning process, as it provides a clear overview of energy uses.	Knowledge of reference indicators (benchmarks and standards) and current energy performance indicators.	Ability to identify and review one or more energy performance indicators and any factors that may affect them. Ability to use correctly readily available energy performance indicators.	Competency in understanding and calculating energy performance indicators. Competent in measuring the effectiveness of the energy management efforts and identifying inefficient areas with low energy performances.

Module		Learning outcome	hr	Description	Knowledge	Skills	Competencies
	4	Understand the key elements of an energy strategy and the importance of higher management support and approval.	1,0	The session aims to provide information on how to draft an effective energy strategy and explain its role in implementing a successful energy management.	Knowledge on drafting an energy strategy.	Ability to prepare an energy strategy.	Competency in drafting and evaluating the effectiveness of an energy strategy.
3. Opportunities for GHG reduction and energy savings	1	Simple and specific procedures/measures, tailored for each department and job position, that can mitigate GHG emissions.	10	The session aims to provide detailed guidelines, tailored for each department and job position, on implementing simple and specific procedures/measures that can reduce GHG emissions effectively.	Knowledge on specific, per department and job position, procedures/measures that can reduce GHG emissions.	Ability to execute an energy savings program.	Competency in contributing to the mitigation of GHG emissions.
	2	Acquire a basic understanding on the various measures and technologies that can significantly mitigate GHG emissions.	2,0	The session aims to provide information on the current measures and technologies that can reduce GHG emissions more effectively.	Knowledge on the availability of several measures and technologies and their effectiveness in the reduction of GHG emissions.	Ability to evaluate the applicability and efficiency -in the hospitality context- of certain measures and technologies that can reduce GHG emissions. Value for Money	Competency in recognizing and evaluating any GHG reduction opportunities through various available technologies.

Module		Learning outcome	hr	Description	Knowledge	Skills	Competencies
4. Waste management	1	Understand the concept of waste management and identify any limitations associated with the type, size and location of an accommodation for choosing to the most appropriate waste management strategy.	2,5	The session aims to provide information on waste management strategies.	Knowledge on the various waste management strategies.	Ability to prepare an energy strategy.	Competency in assessing the applicability of the various waste management strategies in the hospitality sector.
	2	The various types and classification of waste	2,5	The session aims to provide information on the various types of waste.	Knowledge on the various types of waste.	Ability to identify the various types of waste.	Competency in selecting the most appropriate (applicable/available) waste management strategy.
	3	Choosing the right waste management strategy and technology (Composting, Biodigesters, Dryers, etc.) for reducing GHG emissions.	0,5	The session aims to provide information on the various and often complex processes for (solid and liquid) waste treatment.	Knowledge of the pros and cons of each waste treatment process and technology.	Ability to plan, implement and monitor a waste management policy in the context of an accommodation.	Competency in selecting and assessing the respective waste management program.
5. F-Gases	1	Understand the function of F-Gases and their contribution to greenhouse effect.	1,5	The session aims to provide information on the various types of F-Gases used in the hospitality industry and their impact on GHG emissions.	Knowledge on the significant impact of F-Gases to climate change and the legal requirements associated with their usage.	Ability to recognize the major F-gases and where they are used.	Competency in applying proper management to F-gases.

Module		Learning outcome	hr	Description	Knowledge	Skills	Competencies
6. Creating an awareness campaign towards stakeholders and how to communicate the green strategy in marketing plans	1	Understand the main elements, purpose and different target groups of an awareness campaign for -and about- mitigating GHG emissions.	2,0	The session aims to provide information on how to plan, implement and assess an effective awareness campaign in relation to the various stakeholders (Staff, guests, suppliers, local community) is intending to influence.	Knowledge on the constituent elements, application stages and the assessment criteria of an awareness campaign.	Ability to plan and implement an awareness campaign.	Competency in evaluating an awareness campaign.
7. Energy & Environmental certification	1	Acquire a basic understanding on the different energy, environmental or sustainability certification schemes and standards. Which are their differences and how they can contribute to the mitigation of GHG emissions.	2,0	The session aims to provide information on the various energy, environmental or sustainability certification schemes and standards available to hospitality organisations. Clarify any differences regarding their application and relevance to GHG mitigation.	Knowledge on the various energy, environmental or sustainability certification schemes and standards available to hospitality organisations.	Ability to implement and monitor an energy, environmental or sustainability certification scheme or standard.	Competency in assessing the suitability and efficiency of the various energy, environmental or sustainability certification schemes and standards available to hospitality organisations.
8. Tools for performance monitoring	1	Understand the methodology in applying and using appropriate tools and key performance indicators (KPIs) for monitoring energy usage and GHG emissions mitigation.	2,0	The session aims to provide information on applying and using appropriate tools and key performance indicators (KPIs) for monitoring energy usage and GHG emissions mitigation. The SDG and CSR will be mentioned.	Knowledge on applying and using relevant monitoring tools and key performance indicators (KPIs).	Ability to implement and use relevant monitoring tools and key performance indicators (KPIs).	Competency in evaluating relevant monitoring tools and key performance indicators (KPIs).