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Use of Sustainable Energies in European Hotels: The DETOCS Project

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ABSTRACT: Hotel buildings consume large amounts of energy compared to other commercial buildings. However, in the coming years they should try to minimize the use of conventional fuels increasing the use of sustainable energies in order to zero their net-carbon emissions. During the implementation of DETOCS project a survey in several EU regions has been conducted, investigating the use of several sustainable energy technologies in nineteen tourism entities. The results indicated that many sustainable, low- and zero-carbon emission energy technologies have been used in hotels and other tourism entities in European regions. They included, energy saving technologies, renewable energy technologies and low-carbon energy technologies which are mature, reliable and cost-efficient. Among renewable energies solar energy, biomass and geothermal energy are the most popular in tourism entities. The use of these sustainable energy technologies can be transferred in hotels located not only in the regions participating in DETOCS project but also in other EU regions. During the survey tourism entities that were using carbon offsetting schemes to reduce their carbon emissions were not identified. The findings indicate that several, technically feasible and economically attractive, sustainable energy technologies can be used in European tourism industry assisting its decarbonization in accordance with the target of net-zero carbon emissions by 2050. The results could be useful to all stakeholders of the tourism industry in all European regions.

KEYWORDS: carbon neutrality, DETOCS, Europe, energy saving, hotels, renewable energies, sustainability

1. INTRODUCTION

Tourism is an important and growing global industry. The improvement of its energy sustainability is of paramount importance for achieving the global target for net-zero carbon emissions by 2050. The energy use in hotels has been analyzed in several studies [1], [2], [3], [4]. The increase of energy efficiency and the use of energy saving techniques in hotels have been also studied [5], [6], [7]. Several authors have examined the use of renewable energies (REs) in them [8], [9], [10], [11], [12], [13]. The reduction of carbon emissions in hotels has been analyzed [14], [15]. Several EU funded projects promoting the use of sustainable energy technologies in hotels have been implemented [16], [17].

The aim of the current work is the investigation of the sustainable energy technologies which are used in hotels and tourism entities in Europe.

The text is structured as follows. After the literature survey the use of energy saving techniques and RE technologies in hotels is analyzed. Next, the EU funded project DETOCS is presented followed by an overview of sustainable energy technologies used in EU tourism entities identified during the implementation of DETOCS project. The text ends with discussion of the findings, the conclusions drawn and the citation of the references used.

The work is innovative since there are no many studies relates with the current use of sustainable energy technologies in European tourism entities while it covers the gap regarding the use of several benign energy technologies in them. The results could be useful to all stakeholders of the hotel industry including policy makers, hoteliers, local authorities, sustainable energy companies et cetera.

2. LITERATURE SURVEY

A systematic literature review on energy use in hotel buildings has been conducted trying to identify the variables affecting the energy consumption in hotels. The authors examined eighteen parameters related to energy use in hotels. They stated that three of them – floor area, number of guest rooms and occupancy rate – had an important relation with energy use [1]. The energy consumption and the carbon emissions in three small-size hotels in Crete, Greece have been estimated. The author stated that these hotels were using benign energy technologies such as solar-PV systems, solar thermal systems, biomass burning and heat pumps. He mentioned that achievement of net-zero carbon emission hotels due to energy use in Crete is technically feasible and economically viable [2]. An analysis on energy use by European hotels has been conducted. It is stated that for most hotels the

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annual energy use falls in the range of 200-400 kWh/m^2 while the average energy use by hotels is in the range of 305-330 kWh/m^2. It is also mentioned that the annual CO_2 emissions due to energy use in European hotels are in the range of 160-200 kgCO_2/m^2 [3]. The factors and initiatives affecting the use of REs in the hotel sector have been studied. It is stated that the factors affecting the use of REs in hotels include: a) The cost, b) the lack of qualified installers, c) the existing administrative obstacles, d) the lack of information about the prospects and benefits of REs, and e) the technical barriers [4]. The enhancement of energy efficiency in hotels has been studied. The authors stated that the main energy saving techniques used in hotels include: a) the use of smart HVAC systems, b) the use of energy management systems, and c) the use of RE systems [5]. The key energy efficient solutions for small and medium-size hotels have been reported. It is stated that there is an urgent need to reduce energy consumption in the hotel sector promoting practical and cost-effective solutions. It is also mentioned that hotels should reduce their energy consumption in order to be competitive, to protect the environment and to reduce their costs [6]. An assessment of practices and technologies related with energy saving and use of REs in hotels has been performed. The authors analyzed 32 hotels located in Crete, Greece. They stated that the mean annual electricity cost per bed was 112.17 € while the mean annual electricity cost per stay was 4.33 €. They mentioned that 93.7% of hotel managers were willing to accept new proposals regarding improvements in energy management in their hotels [7]. An analysis of a solar-PV system and LED lighting in a hotel has been conducted. The authors stated that the net present value in both cases was positive dependent on the percentage of self-consumed energy and the purchase price of electricity. They mentioned that both technologies offer environmental and social benefits [8]. A review on RE use in hotels has been performed. The authors stated that many hotels have adopted REs and green practices. They mentioned that customers have positive perceptions toward hotels using REs tending to refer to their friends and relatives [9]. The use of solar energy and biomass in a Brazilian hotel has been examined. The hotel was located in northeast Brazil with capacity 29 apartments. The authors stated that the hotel had installed 70 solar-PV panels while sugarcane bagasse was used for hot water production instead of solar thermal systems [10]. A report on RE opportunities for island tourism has been published. The report analyzed four RE technologies which can be used in island hotels. It is stated that there are key barriers that limit RE deployment in island hotels such as: a) competitiveness of RE options, b) access to capital and cost of financing, and c) institutional and technical capacity [11]. A technical manual regarding the use of solar-PV and solar thermal systems in the hotel sector in Middle East North Africa (MENA) region has been published. It is stated that electricity security poses a serious challenge to tourism industry in the region. It is also mentioned that solar energy technologies have many benefits for tourism sector taken into account the high solar energy potential in MENA region [12]. A review of tourism and climate change mitigation has been conducted. The authors stated that tourism industry should half its emissions by 2030 and reach net-zero by 2050. They mentioned that the most powerful decarbonization measures face major corporate, political and technical barriers [13]. The reduction of carbon emissions from a medium-size hotel in Rhodes Island, Greece has been studied. The authors stated that by introducing a solar-PV net-metering system the carbon emissions in the hotel could be reduced by 31% [14]. The technical and economic feasibility for achieving net-zero carbon emission hotels has been examined. The author stated that there are many sustainable energy technologies which are mature, reliable and cost-effective that could be used in hotels eliminating their carbon emissions [15]. The use of REs in hotels has been studied. The authors stated that many hoteliers are willing to invest in buildings' renovation while they welcome the concept of introducing REs in their properties. They mentioned that currently there is an extremely low degree of RE penetration in the hotel sector [16]. The use of REs in hotels has been examined. The authors stated that studies on Marriot, Hilton and Verde hotels indicated the use of energy saving practices including LED lighting, smart use of heat ventilation and air conditioning (HVAC) systems as well as RE integration which can reduce the energy consumption by 10-20% [18]. The green innovations in small and medium-size tourism enterprises in the hotel sector have been explored. The sustainability innovations included: a) energy efficiency and RE use initiatives, b) promotion of circular economy, c) zero waste strategy, and d) promotion of green procurement. The authors stated that implementing sustainable innovations in small and medium-size hotels can lead to significant improvements in economic, environmental and operational areas [19]. The potential use of small wind turbines generating electricity in small-size hotels in developing countries, focusing on Indonesia, has been studied. The authors stated that a 30-kW wind turbine could supply 8.8-35.3 % of a small hotel's electricity consumption depending upon the occupancy rate [20]. The elimination of carbon emissions due to energy use in hotels in the island of Crete, Greece conducting a strengths, weaknesses, opportunities and threats (SWOT) analysis has been studied. The author stated that the combined use of solar energy and high efficiency heat pumps can meet all the power needs in Cretan hotels. The SWOT analysis indicated the strengths, weaknesses, opportunities and threats of using REs in hotels in Crete [21]. The green financing and

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the use of REs in promoting sustainable tourism in China have been explored. The authors stated that green financing significantly enhances tourism development while the use of REs has favorable impacts on tourism [22]. The selection of RE technologies in hotel buildings has been examined. The authors assessed eight RE technologies in hotel buildings including: a) solar-PV panels, b) solar thermal collectors, c) solar-powered absorption chillers, d) heat pumps, e) micro-hydropower systems, f) small-scale wind turbines, g) biomass boilers, and h) integrated systems (photovoltaic and heat pumps). These technologies were assessed with eighteen criteria and the results indicated that the three most suitable technologies were the solar-PV systems, the heat pumps and the solar thermal systems [23]. The opportunities for energy saving in hotels has been explored. The authors investigated 250 German hotels stating that electricity accounts for the one third of energy consumption. They mentioned that energy saving up to 20% can be achieved in rooms' heating while BEMS are profitable in hotels with capacity higher than 70 beds [24]. The energy consumption and the use of REs in hotels in Crete, Greece have been calculated. The author stated that the annual energy consumption in five summer-operating hotels in Crete, Greece was estimated at 149 kWh/m^2 or 19.4 kWh per night spent while the average annual CO_2 emissions at 12.1 kgCO_2 per night spent [25]. The integration of solar, wind and wave energy combined with hydrogen (H_2) storage in coastal hotels with reference the Kish Island, Iran has been studied. The authors stated that the combination of diverse REs with H_2 storage in hotels enhance their reliability and autonomy while low-carbon nearly-zero energy hotel buildings can be developed [26]. The energy use and the retrofitting potential of heat pumps in cold climate hotels analyzing 140 hotels in Norway and Sweden has been investigated. The authors stated that the mean energy consumption of 70% of the hotels was in the range of 150-250 kWh/m^2. They mentioned that a shift towards REs during 2015-2019 was observed and the use of district heating and cooling systems had been increased while the electricity consumption had been decreased [27]. The managers' views on REs and ecological sustainability in tourism have been studied. The author stated that small and medium-size hotels promote energy efficiency but rarely adopt REs due to lack of financing and information. Larger hotels express willingness to invest in REs but investments are postponed due to preference in other priorities [28]. A literature survey regarding the use of REs in tourism industry increasing its competitiveness has been conducted. The authors stated that REs should be considered as a core component of sustainable tourism. They mentioned that the literature indicated that REs can support product diversification, strength the destination image, improve operational efficiency, reduce long-term costs and enhance customer satisfaction [29]. The role of carbon offsets in achieving carbon neutrality in hotels has been explored. The authors analyzed four market performing factors such as: project quality, carbon calculations, quality information and price per ton of carbon offset. They mentioned that the claim "carbon neutral" is often used to attract green consumers while the claims of carbon neutrality in hotels can be exaggerated [30]. A comparative evaluation of solar-PV and solar thermal technology in hotel sector has been conducted. The authors stated that solar-PV systems have many benefits such as positive return of investments from the fourth year of operation. They mentioned that solar thermal systems were also profitable while they are efficient for direct water heating having lower initial costs than solar-PV systems [31]. The users' perceptions of green roofs and green walls in Youth hostels in Portugal have been examined. The authors stated that around 90% of the visitors are not willing to pay more for an accommodation having green infrastructure. They also mentioned that the most preferred green infrastructures were indoor living wall and the accessible green roof [32]. The energy optimization in hotels has been studied. The authors stated that the integration of heat recovery into centralized HVAC systems proves to be an effective strategy to enhance energy performance in hotels. They mentioned that heat recovery can reduce the fuel consumption in the auxiliary heating by 75% [33]. The adoption of RE innovations among hoteliers in Portugal has been examined. The authors stated that despite the positive perceptions of hoteliers about REs their adoption in Portuguese hotels is low. They mentioned that the reasons for the low adoption of REs are related with unfavorable market factors [34]. The effect of RE uptake by the hotel sector has been studied. The authors stated that studies about the effect of REs in the hotel sector are absent. They mentioned that hotels can use REs to reduce their energy consumption and to add value to their image [35].

3. THE USE OF ENERGY SAVING FOR DECARBONIZATION IN HOTELS IN EUROPE

The hospitality sector is one of the most energy-intensive industries within the service economy, consuming significant amounts of electricity and thermal energy for heating, cooling, lighting, ventilation, laundry, and food preparation. As the European Union intensifies its efforts to achieve climate neutrality by 2050 under the European Green Deal [36] hotels are increasingly adopting energy-saving measures as a key strategy for decarbonization. Reducing energy consumption not only lowers greenhouse gas emissions but also improves operational efficiency, reduces costs, and enhances the environmental reputation of hospitality

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businesses. Hotels contribute to carbon emissions through both direct and indirect energy use. Heating, ventilation, and air conditioning systems typically account for the largest share of energy consumption, followed by water heating, lighting, and kitchen operations. Since many hotels operate continuously throughout the year, their energy demand remains consistently high. Consequently, improving energy efficiency has become one of the most effective and economically viable methods for reducing the sector's carbon footprint. Energy-saving technologies play a crucial role in achieving decarbonization. The replacement of conventional lighting with LED systems significantly reduces electricity consumption while maintaining high lighting quality. Smart building energy management systems enable hotels to monitor and optimize energy use in real time by automatically adjusting heating, cooling, and lighting according to occupancy levels. Motion sensors, programmable thermostats and occupancy-based room controls further minimize unnecessary energy consumption without compromising guest comfort. Another important strategy is improving the energy performance of hotel buildings. Better insulation, high-performance windows and energy-efficient building materials reduce heat losses during winter and heat gains during summer, thereby decreasing the need for heating and air conditioning. Renovating older hotel buildings according to modern energy efficiency standards can produce substantial reductions in energy use and carbon emissions while extending the lifespan of the facilities. The European Union actively supports these efforts through legislation, financial incentives, and sustainability frameworks. The Energy Efficiency Directive and the Energy Performance of Buildings Directive [37], [38] encourage investments in energy-efficient technologies and building renovations. Furthermore, funding opportunities under EU programs facilitate the adoption of innovative solutions, particularly for small and medium-size hotel enterprises. Voluntary environmental certification schemes, such as the EU Ecolabel and Green Key, also motivate hotels to implement sustainable energy management practices while demonstrating their environmental commitment to customers. Beyond environmental benefits, energy-saving measures provide important economic and social advantages. Lower energy consumption leads to reduced operating costs, protecting hotels from fluctuations in energy prices. Sustainable hotels are increasingly preferred by environmentally conscious travelers, enhancing customer satisfaction and strengthening market competitiveness. In addition, energy-efficient hotels contribute to improved indoor environmental quality, creating more comfortable conditions for both guests and employees. Despite these benefits, several challenges remain. High initial investment costs, limited financial resources, and technical barriers may discourage some hotel owners from implementing comprehensive energy-saving projects. Smaller hotels, in particular, often lack the expertise and capital required for extensive renovations. Nevertheless, technological advances and increased governmental support continue to make energy-efficient investments more accessible. Therefore, energy saving is a fundamental component of the decarbonization strategy for hotels across the European Union. Through the adoption of energy-efficient technologies, building renovations and smart energy management systems, hotels can substantially reduce greenhouse gas emissions while improving economic performance and customer satisfaction. As the EU moves toward its climate neutrality objectives, continued investment in energy efficiency within the hospitality sector will be essential for creating a more sustainable, competitive, and environmentally responsible tourism industry. The perspectives of decarbonization in hotels are presented in Table 1. The sustainable energy technologies that can be used in hotel buildings are presented in Table 2 while the steps for improving the energy efficiency in hotels are indicated in Table 3.

Table 1. Perspectives of decarbonization in hotels

Source	Proposed measures
Sustainable Hospitality Alliance	Increasing energy efficiency
	Use of REs
	Electrification of various operations
	Restructuring and innovations
WTTC-UNEP-UNFCCC	Increasing energy efficiency
	Operational improvements
	Sustainable procurement
	Transition to low-carbon energy
	Reducing wastes

Source: [34]

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Table 2. Sustainable energy technologies that can be used in hotel buildings

1	Solar thermal energy
2	Solar photovoltaic energy
3	Heat pumps
4	Solar-powered absorption chillers
5	Small-scale wind turbines
6	Small-hydropower systems
7	Biomass boilers
8	Hybrid systems (photovoltaics + heat pumps)

Source: [23]

Table 3. Steps for improving the energy efficiency in hotels

1	Conduct a first energy assessment
2	Involve the staff
3	Involve the guests
4	Protect the building from the hot and cold weather
5	Improve the efficiency of the equipment

Source: [6]

4. THE USE OF RENEWABLE ENERGIES FOR DECARBONIZATION IN HOTELS IN EUROPE

Hotels are major consumers of energy due to their continuous operation and the high demand for heating, cooling, lighting, hot water, and other guest services. Adoption of renewable energies has become a key strategy for decarbonizing the hotel sector. By replacing fossil fuel-based energy sources with renewable alternatives, hotels can significantly reduce greenhouse gas emissions while improving energy security, operational efficiency, and environmental sustainability. Renewable energy refers to energy generated from naturally replenished resources such as solar, wind, geothermal, biomass, and hydropower. Unlike fossil fuels, renewable energy sources produce little or no carbon dioxide emissions during operation. Their increasing affordability and technological advancement have made them practical solutions for hotels seeking to reduce their environmental impact and comply with evolving European sustainability policies. Among the various renewable energy technologies, solar energy is the most widely adopted in the hotel industry. Solar photovoltaic panels installed on hotel rooftops generate electricity for lighting, air conditioning, elevators, and other electrical equipment. Solar thermal systems are also commonly used to provide hot water for guest rooms, kitchens, spas, and swimming pools. Since hot water production accounts for a considerable proportion of hotel energy consumption, solar thermal technology can substantially reduce reliance on natural gas or oil-fired boilers while lowering operating costs. Heat pumps have also become an essential renewable energy technology for hotel decarbonization. Air-source and ground-source heat pumps efficiently provide heating, cooling, and domestic hot water by transferring heat from the surrounding environment rather than generating it through fuel combustion. Powered increasingly by renewable electricity, heat pumps can reduce carbon emissions significantly compared with conventional fossil fuel heating systems. Their high efficiency and reliability make them particularly suitable for both newly constructed hotels and renovated buildings. In some regions of the EU, hotels also utilize biomass energy systems that burn wood pellets or agricultural residues for heating purposes. Biomass can serve as a renewable alternative to fossil fuels, particularly in rural or mountainous areas where biomass resources are readily available. Additionally, geothermal energy offers another low-carbon solution by exploiting underground heat for space heating and cooling. Although geothermal installations often require higher initial investment, they provide long-term energy savings and stable performance. The European Union strongly encourages renewable energy deployment through several policy initiatives. The Renewable Energy Directive [39] establishes binding targets for increasing the share of renewable energy across Member States, while the European Green Deal [36] promotes investments in clean energy technologies to reduce greenhouse gas emissions. Financial support through EU funding mechanisms, national subsidy programs, and green financing initiatives enables hotels, particularly small and medium-size enterprises, to invest in renewable energy systems and improve their sustainability performance. Beyond reducing carbon emissions, renewable energy offers numerous economic and competitive advantages for hotels. Generating electricity on-site decreases dependence on volatile

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energy markets and helps stabilize operating costs. Hotels that demonstrate a strong commitment to sustainability are increasingly attractive to environmentally conscious travelers, who often consider environmental performance when choosing accommodation. Furthermore, renewable energy adoption supports environmental certification schemes such as the EU Ecolabel and Green Key, enhancing brand reputation and market competitiveness. Despite these benefits, several challenges remain. High upfront investment costs, limited rooftop space, regulatory barriers, and the intermittent nature of some renewable energy sources can slow implementation. However, continuous technological innovation, declining equipment costs, improved energy storage solutions, and supportive government policies are making renewable energy increasingly accessible and economically viable for hotels across Europe. Therefore, renewable energies play a central role in the decarbonization of the European hotel sector. Technologies such as solar photovoltaic systems, solar thermal collectors, heat pumps, biomass, and geothermal energy enable hotels to significantly reduce greenhouse gas emissions while improving energy efficiency and lowering operational costs. Supported by ambitious EU climate policies and financial incentives, the transition to renewable energies is transforming the hospitality industry into a more sustainable and resilient sector. As Europe progresses toward its climate neutrality goals, the widespread adoption of renewable energies in hotels will be essential for balancing economic growth with environmental responsibility and ensuring the long-term sustainability of tourism. The renewable energies that were promoted in European hotels in HOTRES project are presented in Table 4 while Table 5 indicates the renewable energy technologies that can be used in island hotels.

Table 4. Renewable energies promoted in European hotels in HOTRES project

1	Passive solar energy
2	Solar thermal energy
3	Solar photovoltaic energy
4	Biomass heating
5	Geothermal heat pumps

Source: [16]

Table 5. Renewable energy technologies that can be used in island hotels

1	Solar water heating
2	Solar air conditioning
3	Sea water air conditioning
4	Solar photovoltaic power

Source: [11]

5. THE INTERREG EUROPE DETOCS PROJECT: ADVANCING THE DECARBONIZATION OF TOURISM IN EUROPE

The DETOCS (*DEcarbonizing the TOurism industry post Covid-19 Support)* project, co-funded by the Interreg Europe Program, addresses the challenges of tourism industry by supporting the transition towards a greener, more sustainable tourism industry across European regions. The project reflects the European Union's commitment to achieving climate neutrality while strengthening the resilience and competitiveness of tourism following the COVID-19 pandemic and the energy crisis. DETOCS brings together partners from nine European countries—Slovenia, Greece, Malta, Finland, Italy, Bulgaria, Hungary, Germany and the Netherlands—to exchange knowledge, identify successful practices, and improve regional policies related to sustainable tourism. Its implementation period is from 1st of March 2023 to 28th February 2027. Rather than funding infrastructure directly, the project focuses on interregional cooperation and policy learning, enabling participating regions to learn from one another and adapt proven solutions to their own local contexts. This collaborative approach ensures that innovative ideas and effective policies can be transferred across Europe, creating long-term benefits beyond the project's duration. A key objective of DETOCS project is to reduce carbon emissions associated with tourism by promoting energy efficiency, renewable energy, sustainable mobility, and environmentally responsible destination management. Through stakeholder engagement, peer reviews, thematic workshops, and study visits, the project encourages public authorities, tourism organizations, businesses, and local communities to work together in developing practical strategies for decarbonization. These collaborative activities help strengthen institutional capacity and support

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evidence-based policymaking that aligns with the European Green Deal and the EU Cohesion Policy objective of creating a greener, low-carbon Europe. One of the project's greatest strengths lies in its emphasis on sharing good practices. These examples demonstrate that reducing emissions does not only protect the environment but can also improves the quality, efficiency, and competitiveness of tourism services. By documenting and disseminating these successful initiatives, DETOCS provides a valuable resource for policymakers and tourism stakeholders seeking practical solutions that can be replicated in different regions. Furthermore, DETOCS recognizes that sustainable tourism is not solely an environmental objective but also an economic and social opportunity. Decarbonization can reduce operating costs through improved energy efficiency, increase the attractiveness of destinations to environmentally conscious travelers, and contribute to the long-term resilience of local economies. The project therefore supports a balanced approach that combines environmental responsibility with economic growth and social well-being, ensuring that tourism continues to benefit communities while respecting natural resources. Therefore, DETOCS project represents an excellent example of how European cooperation can drive meaningful change in the tourism sector. By fostering knowledge exchange, promoting innovative policies, and encouraging the adoption of sustainable practices, DETOCS project contributes to a cleaner, more resilient, and climate-friendly future for European tourism. As destinations continue adapting to climate change and evolving visitor expectations, projects such as DETOCS demonstrate that international collaboration is essential for building a sustainable tourism industry that benefits both present and future generations. During the implementation of DETOCS project a survey in 19 tourism entities in the participating EU countries was conducted investigating the sustainable energy technologies that were used in them. Table 6 indicates the types of tourism entities that were studied in DETOCS project while Table 7 the sustainable energy systems that were used in them.

Table 6. Types of tourism entities in several EU countries that have been studied in DETOCS project

	Country	Type of tourism entity	Size of tourism entity
1	Slovenia	Hotel	Small
2	Slovenia	Culture centre – old historical building	Small to medium
3	Greece	Hotel	Small
4	Greece	Hotel	Small
5	Greece	Hotel	Small
6	Malta	Hotel	Large
7	Malta	Hotel	Large
8	Malta	Hotel	Large
9	Malta	Hotel	Small
10	Finland	Leisure centre-Olympic training centre	Large
11	Finland	Hotel	Small
12	Italy	Cultural hub-cinema	Small
13	Holland	Theatre and restaurant	Medium
14	Holland	Wellness centre	Small
15	Hungary	Eco-tourism visitor centre	Small
16	Hungary	Hotel and restaurant	Small
17	Hungary	Thermal Spa and medical complex	Large
18	Bulgaria	Summer resort	Large
19	Bulgaria	Tourist boat	Medium

Source: [17]

Table 7. Sustainable energy systems used in European tourism entities studied in DETOCS project

1	Energy Saving Achieved with Insulation of Buildings' Envelope
2	Solar Photovoltaic systems
3	Solar Thermal Systems for Hot Water Production

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4	High-Efficiency air Heat Pumps
5	Geothermal Heat Pumps
6	Solid Biomass Burning Systems for hot water production
7	Energy Management Systems
8	LED Lighting systems
9	Modern energy efficient HVAC Systems
10	Seawater Chillers
11	Electric Batteries
12	Heat and power cogeneration systems using biogas
13	Wood Gasification Boiler Systems for Heat generation
14	Green roofs
15	Waste heat recovery and reuse

Source: [17]

6. AN OVERVIEW OF THE SUSTAINABLE ENERGY TECHNOLOGIES USED IN THE ABOVEMENTIONED TOURISM ENTITIES

Several sustainable energy technologies were identified in 19 tourism entities during the implementation of DETOCS project which are presented below.

6.1 Energy Saving with Insulation of Building's Envelope

Energy efficiency has become a central concern in modern building design, with insulation of the building envelope playing a crucial role in reducing energy consumption. The building envelope—comprising walls, roofs, floors, windows, and doors—acts as the barrier between indoor and outdoor environments. Proper insulation minimises unwanted heat transfer through these elements, significantly reducing the need for mechanical heating and cooling. In cold climates, insulation helps retain indoor heat during winter, preventing energy losses through conduction and air leakage. Conversely, in hot climates, insulation restricts external heat from entering the building, reducing the load on air conditioning systems.

6.2 Use of Solar Photovoltaics

The hospitality industry is a major consumer of energy, with hotels requiring large amounts of electricity for lighting, air conditioning, heating, water pumping, and other services that ensure guest comfort. As sustainability becomes a growing priority, many hotels are turning to solar photovoltaic systems as a clean and cost-effective energy solution. Solar-PV technology converts sunlight directly into electricity using semiconductor materials. By installing solar-PV panels on rooftops, façades, or nearby open spaces, hotels can generate a significant portion of their electricity demand on-site. This reduces dependence on grid electricity, lowers energy bills, and protects hotels from fluctuating utility prices. In regions with abundant sunlight, such as the Mediterranean, solar energy can cover up to 30–60% of a hotel's total electricity consumption.

6.3 Use of Solar Thermal Systems for Hot Water Production

Hotels are among the most energy-intensive buildings due to their continuous demand for hot water in guest rooms, kitchens, laundries and swimming pools. To meet this demand sustainably, many hotels are adopting solar thermal systems as an efficient and environmentally friendly solution for hot water production. Solar thermal systems capture the sun's energy through solar collectors—typically flat-plate or evacuated tube types—which heat a working fluid that transfers heat to water stored in insulated tanks. This technology is highly suitable for hotels, as they have both large roof areas for collector installation and consistent daily hot water consumption.

6.4 Use of High-Efficiency air-source Heat Pumps

Energy efficiency and sustainability are becoming key priorities in the hospitality sector, as hotels strive to reduce operational costs and minimise their environmental impact. One of the most effective technologies for achieving these goals is the use of high-efficiency air-source heat pumps for heating, cooling, and hot water production. Heat pumps operate by transferring heat from one place to another rather than generating it directly through combustion or electrical resistance. This process makes them significantly

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more efficient than conventional systems. For every unit of electricity consumed, a high-efficiency heat pump can deliver three to five units of heating or cooling energy. In hotels, where the demand for space conditioning and hot water is continuous, this efficiency translates into substantial energy savings and lower utility costs.

6.5 Use of Geothermal Heat Pumps

Among the most efficient technologies available today are geothermal heat pumps (GHPs), which utilise the stable temperature of the ground to provide heating, cooling, and hot water for hotels. Unlike conventional air-source systems that rely on fluctuating outdoor air temperatures, geothermal heat pumps exchange heat with the earth through underground loops filled with water or a refrigerant. Because ground temperatures remain relatively constant throughout the year, typically between 10°C and 16°C, these systems operate with very high efficiency. For every unit of electricity consumed, a geothermal heat pump can deliver three to six units of heating or cooling energy, resulting in significant reductions in energy bills and carbon emissions. In hotels, geothermal heat pump systems can provide space heating and cooling, domestic hot water, and even pool heating.

6.6 Use of Solid Biomass Burning Systems

One effective and environmentally responsible solution is the use of solid biomass burning systems, which utilise organic materials such as wood pellets, chips, or briquettes to produce heat for space heating and hot water. Solid biomass systems operate by burning sustainably sourced biomass in high-efficiency boilers or furnaces. The generated heat is transferred to water or air, which is then distributed throughout the hotel for heating or meeting the domestic hot water needs. This technology is particularly suitable for hotels located in rural or forested areas, where biomass fuel is locally available and cost-effective. The key advantage of biomass systems lies in their ability to provide a carbon-neutral energy source.

6.7 Use of Energy Management Systems

Energy Management Systems (EMS) have become essential tools for improving energy efficiency and sustainability in the hospitality sector. Hotels, which operate around the clock, consume large amounts of energy for lighting, heating, cooling, ventilation, and other guest services. Implementing an EMS allows hotel operators to monitor, control, and optimise energy use across all facilities, leading to significant cost savings and environmental benefits. An EMS integrates various building systems—such as HVAC, lighting, and water heating—into a centralized platform that collects real-time data on energy consumption. Through sensors, smart meters, and automation software, the system identifies inefficiencies, detects faults, and adjusts operations according to occupancy patterns and environmental conditions.

6.8 Use of LED Lighting

Lighting plays a crucial role in the hospitality industry, influencing not only the aesthetics and comfort of hotel spaces but also overall energy consumption. In recent years, the adoption of Light Emitting Diode (LED) lighting has become a key strategy for hotels aiming to reduce energy use, operational costs, and environmental impact. LED lighting is highly energy-efficient, consuming up to 80% less electricity than traditional incandescent or halogen lamps while providing the same or better quality of illumination. Given that lighting can account for 20–40% of a hotel's total electricity consumption, switching to LEDs offers substantial savings.

6.9 Use of Modern HVAC Systems

Heating, Ventilation, and Air Conditioning systems are vital components in hotels, directly influencing guest comfort, indoor air quality, and energy efficiency. As sustainability and cost-effectiveness become top priorities in the hospitality industry, many hotels are adopting modern HVAC systems that combine advanced technology, automation, and energy-efficient design. Modern HVAC systems are engineered to deliver optimal thermal comfort while minimising energy consumption.

6.10 Use of Seawater Chillers

In coastal regions, hotels often face high energy demands for cooling due to warm climates and year-round occupancy. To enhance energy efficiency and sustainability, many seaside hotels are adopting seawater chiller systems as an innovative solution for air conditioning and cooling needs. These systems utilise the natural cooling capacity of seawater to improve the performance of conventional refrigeration processes while reducing environmental impact. Seawater chillers operate by using seawater as a heat sink in the chiller's condenser stage. Instead of rejecting heat to the atmosphere through cooling towers, the system transfers it to seawater, which is continuously available and maintains a stable temperature throughout the year.

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6.11 Use of Electric Batteries

As the hospitality industry moves toward sustainability and energy efficiency, electric battery systems are emerging as a transformative technology for hotels. These batteries, often paired with renewable energy technologies such as solar-PV panels, allow hotels to store electricity and use it strategically, reducing both costs and environmental impact. Hotels are significant energy consumers, operating 24 hours a day with constant demands for lighting, heating, cooling, and electronic devices. Traditionally, this energy comes from the grid, which can be expensive and carbon-intensive during peak hours. By installing electric battery storage systems, hotels can store cheap or renewable electricity during off-peak periods and use it when grid prices or demand are high, optimising energy costs and reducing strain on the power network.

6.12 Use of CHP Systems Consuming Biogas

Combined Heat and Power (CHP) systems, also known as cogeneration systems, are an increasingly popular solution for improving energy efficiency in the hospitality sector, particularly in large-scale hotels. When fuelled by biogas, these systems offer hotels a sustainable and cost-effective way to produce both electricity and heat on-site, significantly reducing dependence on conventional energy sources and lowering greenhouse gas emissions.

6.13 Use of Wood Gasification Boiler Systems for Heating

Wood gasification boiler systems have emerged as an efficient and renewable solution for hotel heating. These systems utilise biomass, primarily wood logs or chips, to produce heat through a two-stage combustion process that maximises energy output while minimising emissions. In a wood gasification boiler, wood is first heated in a low-oxygen environment, releasing combustible gases such as carbon monoxide and hydrogen. These gases are then burned at high temperatures in a secondary chamber, achieving clean and complete combustion. The result is a highly efficient system that can reach thermal efficiencies of over 85%, significantly outperforming traditional wood-burning boilers.

6.14 Use of Green Roofs

Green roofs are increasingly being adopted by tourism entities—such as hotels, resorts, and eco-lodges—as part of broader efforts to enhance sustainability, reduce environmental impacts, and improve guest experience. Their primary advantage lies in improving building energy performance. By providing natural insulation, green roofs reduce heat gains in summer and heat losses in winter, thereby lowering the energy demand for cooling and heating. This contributes to both operational cost savings and reduced carbon emissions.

6.15 Heat Recovery and Reuse

Heat recovery and reuse have become increasingly important strategies for improving energy efficiency in tourism enterprises. Hotels, resorts, and wellness centres generate substantial waste heat from HVAC systems, laundries, kitchens, refrigeration units, and spa facilities. Instead of allowing this thermal energy to dissipate into the environment, heat recovery technologies capture it and redirect it to productive uses, significantly reducing overall energy demand. One of the most common applications is recovering heat from refrigeration and air-conditioning systems to preheat domestic hot water. This is particularly valuable in hotels, where hot water consumption is high and continuous.

7. DISCUSSION

The use of energy saving techniques and renewable energy technologies in 19 tourism entities in EU regions has been studied. The findings indicate that hotel entities use several sustainable energy technologies covering part of their energy needs. These technologies are mature, reliable and cost-effective while they can be replicated in other EU regions. However, their use does not imply that tourism entities eliminate all their carbon emissions due to energy use which should be pursued in the coming years according to the European target for achieving net-zero emissions by 2050. Apart from using sustainable energies, tourism entities can use the existing carbon offsetting mechanisms to reduce their energy-related carbon footprint. Several barriers hindering the use of sustainable energies in the tourism sector should be removed while their financing particularly in small and medium-size tourism enterprises should be increased. The use of benign energy technologies in tourism entities has many economic, environmental and social benefits improving their competitiveness and their attractiveness to environmentally-conscious tourists. Our results are qualitative without indications regarding the percentage of energy needs covered by sustainable energies in tourism entities. They

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do not either categorize the identified sustainable energy technologies according to their profitability. Future research should by focused on realizing annual energy balances in tourism entities finding the share of REs in their energy mix as well as calculating the CO_2 emission saving due to sustainable energy use. Additionally, it should examine the profitability of several REs used in tourism industry.

8. CONCLUSIONS

The sustainable energy technologies used in hotels and tourism entities in Europe have been studied during the implementation of DETOCS project using data from nineteen facilities. The main findings during the project implementation [17] can be summarised as follows:

1. Several sustainable energy technologies can be used in tourism-related enterprises in European regions reducing their carbon footprint and their environmental impacts.
2. Solar photovoltaic systems, solar thermal systems and high efficiency heat pumps are the most popular sustainable energy systems used in tourism-related enterprises in European regions.
3. Sustainable energy investments in tourism-related enterprises are financially supported and subsidized by national and EU funds.
4. The sustainable energy investments in the tourism entities studied are mainly financed by own capital, bank loans and public subsidies.
5. In most cases the payback period of the energy investments was attractive.
6. Involvement of energy saving companies or energy cooperatives in the realisation of the energy investments in tourism entities was not noticed. The tourism entities studied did not use district heating or cooling systems.
7. The tourism entities did not offset their carbon emissions using the existing carbon offsetting schemes.
8. The aim of the tourism entities studied in the current survey is the reduction of the fossil fuels used and their carbon emissions. The majority of them did not try to eliminate all their carbon emissions achieving carbon neutrality.
9. The most of the identified sustainable energy technologies in tourism-related enterprises can be replicated in other European regions. These energy technologies include a) energy saving technologies, b) technologies using locally available renewable energy sources, and c) low-carbon high efficiency energy technologies.

The main takeaway from the current work is the fact that the use of many sustainable energy technologies in tourism entities in Europe has many economic, environmental and social benefits and it should be promoted with several policies. The majority of the identified sustainable energy technologies can be transferred in tourism entities located in other European regions.

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REFERENCES

1. Arenhart, R.S., Martins, T., Ueda, R.M., Souza, A.M. & Zanini, R.R. Energy use and its contributors in hotel buildings: A systematic review and meta-analysis. PLoS ONE, 19(10), 2024, e0309745. https://doi.org/10.1371/journal.pone.03097452
2. Vourdoubas, J. Energy consumption and carbon emissions in three small-size hotels in the island of Crete, Greece. Achieving net-zero carbon emissions. Engineering and Technology Journal, 10(6), 2025, pp. 5472-5482. https://doi.org/10.47191/etj/v10i06.20
3. Analysis on energy use by European hotels: online survey and desk research, 2011, Hotel Energy Solutions. Available from: https://www.e-unwto.org/doi/pdf/10.18111/9789284414970

International Journal of Current Science Research and Review
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DOI: 10.47191/ijcsrr/V9-i8-31, Impact Factor: 8.048
IJCSRR @ 2026
www.ijcsrr.org

4. Factors and initiatives affecting renewable energy use in the hotel industry, 2011, Hotel Energy Solutions. Available from: https://www.uncclearn.org/wp-content/uploads/library/3.pdf
5. Karvounidi, M.D., Alexandropoulou, A.P. & Fousteris, A.E. Towards sustainable hospitality: Enhancing energy efficiency in hotels. International Research Journal of Economics and Management Studies, 3(6), 2024, pp. 410-420. Doi: 10.56472/25835238/IRJEMS-V3I6P145
6. Key energy efficiency solutions for SME hotels, Hotel Energy Solutions, 2011. Available from: https://www.uncclearn.org/wp-content/uploads/library/key1.pdf
7. Zografakis, N., Gillas, K., Pollaki, A., Profylienou, M., Bounialetou, F. & Tsagarakis, K.P. Assessment of practices and technologies of energy saving and renewable energy sources in hotels in Crete. Renewable Energy, 36, 2011, pp. 1323-1328. http://dx.doi.org/10.1016/j.renene.2010.10.015
8. Barbara, C.E., D Adamo, I., Gastaldi, M. & Nizami, A.S. Clean energy for a sustainable future: analysis of a PV system and LED bulbs in a hotel. Energy, 299, 2024, 131547. https://doi.org/10.1016/j.energy.2024.131547
9. Ghimire, B., Muneenam, U. & Techato, K. Renewable energy use in green hotels for sustainability: A systematic review. International Journal of Energy Economics and Policy, 13(6), 2023, pp. 618-627. https://doi.org/10.32479/ijeep.14521
10. de Lima, K.M., de Mello Delgado, D.B., Martins, D.D. & Carvalho, M. Solar Energy and Biomass within Distributed Generation for a Northeast Brazil Hotel. Energies, 15, 2022, 9170. https://doi.org/10.3390/en15239170
11. Renewable energy opportunities for island tourism, IRENA, 2014. Available from: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2014/IRENA_RE_Island_Tourism_report_2014.pdf
12. Solar PV & Thermal Applications for Hotel Sector, Technical Manual for the MENA Region. Available from: https://energypedia.info/images/8/82/Solar_PV_%26_Thermal_Applications_for_Hotel_Sector-Technical_Manual_for_the_MENA_Region.pdf
13. Silva, L. Adoption of renewable energy innovations among hoteliers in Portugal. Tourism and Management Studies, 18(4), 2022, pp. 17-26. https://doi.org/10.18089/tms.2022.1804
14. Spiller, M., Müller, C., Mulholland, Z., Louizidou, P., Küpper, F.C., Knosala, K. & Stenzel, P. Reducing Carbon Emissions from the Tourist Accommodation Sector on Non-Interconnected Islands: A Case Study of a Medium-Sized Hotel in Rhodes, Greece. Energies, 15, 2022, 3801. https://doi.org/10.3390/en15103801
15. Vourdoubas, J. Net-zero carbon emission hotels: Are they technically and economically feasible? International Journal of Advanced Multidisciplinary Research and Studies, 4(3), 2024, pp. 1258-1266. https://doi.org/10.62225/2583049X.2024.4.3.2933
16. Karagiorgas, M., Tsoutsos, Th., Drosou, V., Pouffary, S., Pagano, T., German Lopez Lara & Melim Mandes, J.M. HOTRESS: renewable energies in the hotels. An extensive technical tool for the hotel industry. Renewable and Sustainable Energy Reviews, 10(3), 2024, pp. 1-27. doi:10.1016/j.rser.2004.09.012 www.interregeurope.eu/detocs
17. Menegaki, A.N. Powering Down Hospitality Through a Policy-Driven, Case-Based and Scenario Approach. Energies, 18, 2025, 328. https://doi.org/10.3390/en18020328
18. Chatzifoti, N., Alexandropoulou, A., Fousteris, A.E., Karvounidi, M.D. & Chountalas, P.T. Techno-Economic Evaluation of Sustainability Innovations in a Tourism SME: A Process-Tracing Study. Tourism and Hospitality, 6(4), 2025, 209. https://doi.org/10.3390/tourhosp6040209
19. Tanoto, Y., Jasman, B.S. & Ananda, S.A. Assessing the potential of small wind turbine electricity generation for small-sized hotels towards sustainable tourism in developing countries. International Journal of Renewable Energy Development, 14(3), 2025, pp. 429-440. https://doi.org/10.61435/ijred.2025.61019
20. Vourdoubas, J. Eliminating the carbon emissions in hotels due to energy use in the island of Crete, Greece: A SWOT analysis. International Journal of Advanced Multidisciplinary Research and Studies, 5(4), 2025, pp. 965-972. https://doi.org/10.62225/2583049X.2025.5.4.4702
21. Chen, S., Paramaiah, Ch., Kumar, P., Khan, S. & Haomu, Q. Towards sustainable tourism: Insights from green financing and renewable energy. Energy Strategy Reviews, 57, 2025, 101618. https://doi.org/10.1016/j.esr.2024.101618
22. Arıkan Kargı, V.S. & Cesur, F. Renewable Energy Technology Selection for Hotel Buildings: A Systematic Approach Based on AHP and VIKOR Methods. Buildings, 14, 2024, 2662. https://doi.org/10.3390/buildings14092662

International Journal of Current Science Research and Review
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Volume 09 Issue 08 August 2026
DOI: 10.47191/ijcsrr/V9-i8-31, Impact Factor: 8.048
IJCSRR @ 2026
www.ijcsrr.org

23. Paulusch, K., Sander, K. & Weber, Ch. Opportunities for energy saving in hotels through bus-technology based building energy management systems, in Commercial Buildings: Technologies, Design and Performance Analysis, 3.275-3.286. In 2000 ACEEE Summer Study on Energy Efficiency in Buildings. Available from: https://www.aceee.org/files/proceedings/2000/data/papers/SS00_Panel3_Paper23.pdf
24. Vourdoubas, J. Energy consumption and use of renewable energy sources in hotels: A case study in Crete, Greece. Journal of Tourism and Hospitality Management, 4(2), 2016, pp.75-87. https://doi.org/10.15640/jthm.v4n2a5
25. Fathi, M., Mohammadi, Z., Allahyari, S., Rahimi, S., Ahmadi, A. & Zahedi, A. Integration of solar, wind and wave energy for sustainable hotel operation in coastal regions: optimization of a building with hydrogen-supported hybrid renewable energy system. Energy Strategy Reviews, 62, 2026, 102134. https://doi.org/10.1016/j.esr.2026.102134
26. Smitt, S., Tolstorebrov, I., Gullo, P., Pardinas, A. & Hafner, A. Energy use and retrofitting potential of heat pumps in cold climate hotels. Journal of Cleaner Production, 298, 2021, 126799. https://doi.org/10.1016/j.jclepro.2021.126799
27. Nizic, M.K. (2025). Manager's views on renewable energy and ecological sustainability in tourism, in the 2nd International Scientific Conference on Economics, Management and Information Technologies. https://doi.org/10.71159/icemit2514K
28. Demir, E. & Bahar, O. Why renewable energy matters for sustainable tourism: A conceptual and literature-based review from a tourism competitiveness perspective. Journal of Academic Tourism Analysis, 7, 2026, 1888698. https://dergipark.org.tr/en/pub/journalata/article/1888698
29. Dhanda, K.K. The role of carbon offsets in achieving carbon neutrality: An exploratory study of hotels and resorts. International Journal of Contemporary Hospitality Management, 26(8), 2014, pp. 1179–1199. doi: https://doi.org/10.1108/IJCHM-03-2013-0115
30. Cruz Davila, J., Parada, M. & Arriaga-Gutierrez, A. Comparative evaluation of photovoltaic and solar thermal installations for water heating at hotel Casa Del Arbol Galerias in San Pedro Sula. E3S Web of Conferences, 629, 2025, 05004. https://doi.org/10.1051/e3sconf/202562905004
31. Liberalesso, T., Mutevuie Junior, R., Cruz, C.O., Silva, C.M. & Manso, M. Users' perceptions of green roofs and green walls: An analysis of youth hostels in Lisbon, Portugal. Sustainability, 12, 2000, 10136. http://dx.doi.org/10.3390/su122310136
32. Valdivia Nodal, Y., Iturralde Carrera, L.A., Zapatero-Gutierrez, A., Guerra Plasencia, M.A.A., Reyes Calvo, R., Alvarez-Alvarado, J.M. & Rodriguez-Resendiz, J. Energy Optimization in Hotels: Strategies for Efficiency in Hot Water Systems. Algorithms, 18, 2025, 301. https://doi.org/10.3390/a18060301
33. Gossling, S., Balas, M., Mayer, M. & Sun, Y-Y. A review of tourism and climate change mitigation: The scales, scopes, stakeholders and strategies of carbon management. Tourism Management, 95, 2023, 104681. https://doi.org/10.1016/j.tourman.2022.104681
34. Dhirasasna, N., Sahin, O. & Becken, S. The effect of renewable energy technology uptake by the hotel sector, in the 22nd International Congress of Modelling and Simulation, Hobart, Tasmania, Australia, 3-8/12/2017. Available from: https://mssanz.org.au/modsim2017/K4/dhirasasna.pdf
35. The European Green Deal. Striving to be the first climate-neutral continent. Available from: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en
36. Directive (EU) 2023/1791 of the European Parliament and of the Council of 13 September 2023 on energy efficiency and amending Regulation (EU) 2023/955 (recast) (Text with EEA relevance)
37. Directive (EU) 2024/1275 of the European Parliament and of the Council of 24 April 2024 on the energy performance of buildings (recast) (Text with EEA relevance)
38. Directive (EU) 2023/2413 of the European Parliament and of the Council of 18 October 2023 amending Directive (EU) 2018/2001, Regulation (EU) 2018/1999 and Directive 98/70/EC as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652

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