

Energy aspects in traditional buildings at touristic places

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Abstract

Touristic sector is a most sensitive one in Mediterranean countries like Greece or Spain. Buildings with traditional architecture in touristic places represent an attraction for tourists but to these buildings the integration of renewable energy sources is a difficult aspect. Energy saving in buildings is significant for the energy targets of EC for 2020 and the implementation of Renewable Energy Sources (R.E.S.) in traditional buildings always poses new challenges for designers. In this paper we include analysis for the implementation of R.E.S. respecting traditional building design and atmosphere, which signifies a new constriction, by also an opportunity, seeing the sustainability paradigm in a more general way. Solar thermal collectors, photovoltaic and wind turbines, are visible and need a special care to be also adapted with the architecture of the touristic sites. Currently developed innovative solar energy systems and integration aspects are presented and strategies for a further expansion are discussed.

Keywords: RES to Buildings, Building Integration, Energy to touristic sector, Sustainable Tourism Eco-tourism

Introduction

Energy saving in buildings is significant for the energy targets of EC for 2020. Buildings with traditional architecture in touristic places represent an attraction for tourists but for these buildings the integration of renewable energy sources is a difficult aspect. The implementation of Renewable Energy Sources (R.E.S.) in traditional buildings always poses new challenges for designers. Touristic sector is a most sensitive one in Mediterranean countries like Greece and Spain where it arrives to about a 15% of GNP and 20% of employment. The strategic importance of tourism grows in present times where tourism is, the most, near the only, valuable industry of Greece and Spain for attaining economic inputs from abroad. Towards energy production by renewable technologies, the installation of solar thermal collectors and photovoltaics on buildings and of wind turbines close to touristic places forms a new environment figure, which sometimes affects seriously the “touristic product”. This concept concerns the main characteristics of sustainable tourism, which includes economic, social and environmental items aiming to improvement of tourists’ experiences. The sustainability of tourism’s development relies on the creation of particular characteristics of a tourism product in line with present and future tourists’ needs. This kind of development is an additional opportunity for the local communities to benefit from the products of their own local identity and local natural resources.

It is also of particular interest to take into consideration the regional historic, economic and political conditions of Mediterranean countries, as sustainable tourism is affected by such factors. This seems feasible that the application of RES in the Mediterranean basin includes

features of a political and strategic character. Therefore, the challenge is to maintain a holistic approach in the understanding of renewable energy technologies integration which includes governance and political aspects. This is contrary to past approaches, which were mainly based on technical or economic criteria and we can observe the potential for the development of new type tourism, through the implementation of RES, the eco-tourism. The criteria for this qualitative type of tourism led to specific models of sustainable economic and tourism development. The need for a further tourism development has led to the development of an energy infrastructure based on RES and mainly on photovoltaics, to cover electricity and desalination needs [Michalena et al., 2005].

The relation between RES and tourism development is essential, as it constitutes a motivation for the development of specific tourism activities and the application of solar energy systems could be of importance for the “qualitative” energy feeding of the touristic places along Mediterranean coast line for the further development of the local economy. In this paper we give a figure of implementation aspects of R.E.S. in respect with the traditional building and atmosphere. It signifies a new constriction by also an opportunity for seeing the sustainability paradigm in a more general way, considering also that the application of RES to the touristic sector contribute to a high cultural class tourism.

Economic and cultural aspects regarding sustainable tourism

The Mediterranean area has a significant economic growth regarding tourism during last decade, with also population increase, touching now about 150 million residents. This region is of a strategic importance for Europe and thus the European Union is trying to support Mediterranean countries, so as to be gradually transformed into a zone of stability and well being. Considering tourism activity in global scale, annual increase rate of 3%-4%, raises significant incoming and is considered the first “industry” at a global level, in terms of expenses, employees and part of modern life. These features find a particular application in the Mediterranean area, where there are thousands of touristic places on coast line and also small and big islands, attracting more than 30% of worldwide tourism. Mediterranean coast line cities, other places and islands are rich in natural resources, cultural heritage and political interest. Benefiting from these features they attract the interest of tourism activity and thematic forms of tourism. Hence, these places become destinations of “luxury holidays”, resort, cultural information, sport activities, etc. Mass tourism, dominant in the majority of cases, often leads to severe degradation of natural landscapes, a lack of water provisions, pollution of coastal zones, and the construction of massive transport and building infrastructure [Michalena and Tripanagnostopoulos, 2010].

Renewable energies technologies in general have several benefits such as sustainability and security of energy supply, increased employment, long lifetime of energy systems etc. The cost of wind energy and solar energy systems is dropping every year and considering the cost increase of conventional energy sources (mainly of oil), these technologies become gradually cost effective. Especially for Mediterranean islands, the different particularities in their economic and social development and their restricted communication with the main-land, create closed economies with an intense need of energy sufficiency and autonomy. The carrying energy capacity in islands concerns the influences of energy equipments on many factors of the islander environment, where the arrival of more tourists as means more energy load on the island. Therefore, the increased tourist traffic during the summer months results to increase highly the demand for energy in Mediterranean places.

The most wide-spread form of tourism is the “Mass Tourism”, which concerns the construction of hotel, transport and other infrastructures, a need which in combination with the challenge of competitiveness and the environmental worries offer a marvellous opportunity for the promotion of effective energy policies, the exploitation of RES and the reasonable usage of energy in the hotel sector. The direct application of Solar Energy Systems

into buildings, make them identical for use in tourist accommodations. More than 60% of electricity in EC is consumed for heating and air-conditioning, the 25% for various services and the 15% for water heating. In Greece, the annual energy demand in the hotels represents the 28% of total energy demand in the sector of not domestic buildings, while in Spain is 35%. Many successful attempts and examples by such a usage of RES and RUE technologies are reported in an international level by the Council of local environmental initiatives.

“Mass Tourism” is usually considered a successful market mode in order to make tourism cost effective. On the other hand, the novel eco-architecture design of the new Hotels and other Residences, influenced by the green targets of EC countries, can promote another type of tourism, the high cultural class tourism. This tourism is based on the “people with a lot of culture”, with sensitivity to sustainability, which is not necessary in contrary with the “people with a lot of money” and sometimes less sensitivity to sustainability. These people give priority to sustainable conditions and touristic places with consumption of energy provided by “green” sources are preferable to others based on “CO₂” conventional energy sources. Thus, the use of RES in tourism can wide the categories of visitors by eco-sensitive criteria.

Solar Energy Systems, as thermal collectors and photovoltaics are integrated to the external surfaces of buildings and aesthetics is an additional important aspect. These systems should harmoniously implemented into the existing, local, natural particularities of the environment through good planning and wise environmental studies. Most of Mediterranean islands are characterized by particular morphological and territorial features, transformed human environment, rich cultural heritage and rich visible resources. This kind of features, transform these regions into poles of an international ecological and cultural heritage. For sensible ecosystems of this kind, the danger of visible disturbing, as of the large wind turbines on hills or on mountains, is very important and needs a balanced handling. In order to avoid annoying results and formulate a multidimensional image of the landscape, we have to consider that the new technology image of RES should be adapted with the local environment. It should be pointed out that such situation happened also in the old times with windmills.

Some other aspects are system extension and energy storage. Solar energy systems offer the potential of extension, a critical point since the energy needs are changing all the time. They also offer the potential of storing the produced energy, especially if combined with wind generators forming hybrid complexes. Thus their use is convenient to cover energetically dispersed energy applications (agricultural, hothouses, hotels, units of desalination, etc), which are useful applications in periods of tourist loads. In addition, in a social level the use of solar energy systems results in the cultivation of a feeling of environmental responsibility and, the most important, in the assurance of labour posts. A further reason of the social positive effects of RES systems is the enriching of the local community funds, mainly in case of electricity production by the special retributive end on the price of sale of energy.

RES implementation strategies to tourism development

Tourism development differentiates by private interests or national strategies. Motivation for the RES development includes centrally designed strategy, existence of local skills and innovations spirit. All these, practically mean that RES applications can follow different routes, depending on the existing tourism needs and the choice of tourism policy, involving action, methodology, effectiveness and collaboration of all policy makers and local actors. Strategies should aim at preserving nature and heritage, developing society in a sustainable way, building energy capacity and energy autonomy and achieving economical growth. Local societies should be well informed before the implementation of RES, which should be applied by priority in areas where people are familiarized with these technologies.

Solar thermal collectors and photovoltaics, also wind turbines, are visible and need a special care to be also adapted with the architecture of the touristic sites. Small wind turbines can

have vertical axis, more adapted to buildings but more expensive or horizontal axis, less expensive, but they need to follow wind direction. Geothermal heat pumps give good space heating and space cooling, but they need electricity (probably covered by photovoltaic). Biomass boilers can fulfil building heating needs, but they need a bigger space for the material. A better knowledge of RES has to be included, not only scientific and technical aspects but, aesthetic requirements. Respecting building and image traditions is a crucial issue. According this condition a smooth and balanced economic and social development should be adapted in touristic places, which respects the particular local conditions, doesn't destroy the natural and cultural environment neither does it reverses their basic traditional features, to combine the socioeconomic and energy needs of inhabitants and the maintenance of a high level of life quality of visitors and residents.

Suggested solar energy systems

Aiming to a wider application of solar energy systems to Mediterranean touristic places, the main investigated systems at the University of Patras can adapt accepted performance, cost and aesthetic requirements. Water heating through integrated collector storage (ICS) is a more economic and aesthetic choice in relation to the flat type collectors. These solar water heaters are simpler and they have the advantage that they can be more aesthetically attractive when they are integrated in the buildings structure [Tripanagnostopoulos et al, 2002].

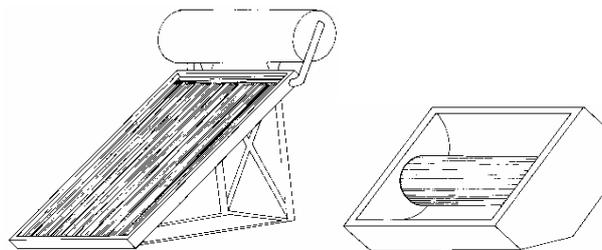


Fig. 1 Comparison of FPTU (left) and ICS (right) solar water heaters

Fig. 1 shows the advantage of ICS system compared to the Flat Plate Thermosiphonic Unit (FPTU) and Fig. 2 the array of suggested ICS systems, where a separate hot water storage tank can be the system temperature buffer. Moreover, in order to avoid the dull black color of solar collectors, colored absorbers have been proposed [Tripanagnostopoulos et al, 2000]. These collectors even if they absorb lower quantities of solar radiation (roughly 20% less) can be used on the external surfaces of buildings. Another system category is the hybrid Photovoltaic/Thermal (PV/T) collectors [Tripanagnostopoulos et al, 2002], which convert simultaneously solar radiation in electricity and heat, which can be effectively combined with typical thermal collectors. In addition, the booster reflectors are suggested, so as to increase the energy input to collectors.

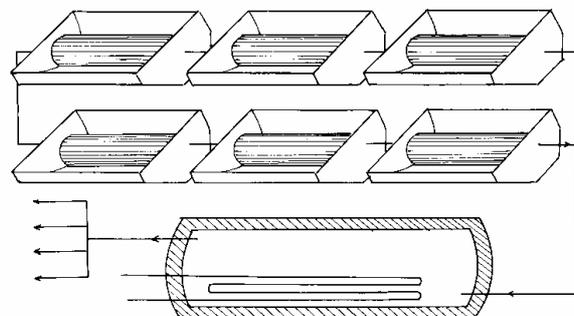


Fig. 2 Integrated Collector Storage (ICS) system array with separate hot water storage

For coastal places and mainly for island complexes with special characteristics (like Cycladic islands for example), the use of blue collectors is much more aesthetically adapted, might helping in the wide distribution of solar energy systems. The design of Fig. 3 gives an idea on the aesthetic interest, based on the blue color of the collectors on Cycladic building roof.

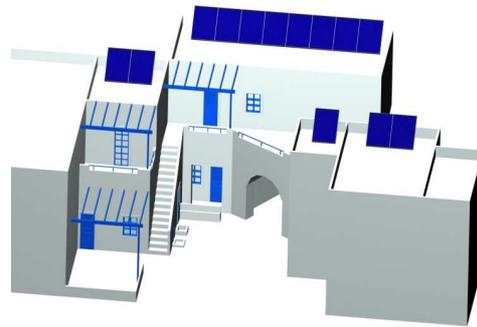


Fig. 3 Blue flat plate collectors on the roof of a house at a Cycladic island (architectural design)

Moreover, in the majority of Mediterranean hotels, roofs are horizontal and the placement of flat type mirrors between the rows of collectors is proposed, for the exploitation of solar radiation in the gaps between the rows of collectors [Tripanagnostopoulos et al, 2000]. These devices can provide a double amount of energy during summertime and provide the possibility of a cheaper solar heating of liquids and hence a more effective operation of solar air conditioning systems. An interesting issue is also the use of uncovered solar thermal collectors, possibly combined with booster reflectors, for low temperature applications (swimming pools, water preheating, etc). As far as photovoltaics are concerned, apart from the installation of the usual PV modules on the horizontal or inclining building roofs (domestic, hotels, etc.), hybrid photovoltaic/thermal collectors are proposed, which achieve the conversion of solar energy into both electricity and heat (Fig. 4). Experiments at the University of Patras show that their thermal efficiency can exceed 50% [Tripanagnostopoulos et al, 2002]. These collectors can be incorporated on external surfaces of Mediterranean buildings. Fig. 3 demonstrates the installation of the blue color pc-Si PV or PV/T modules on a Cycladic building roof, being in accordance with the blue solar thermal collectors.

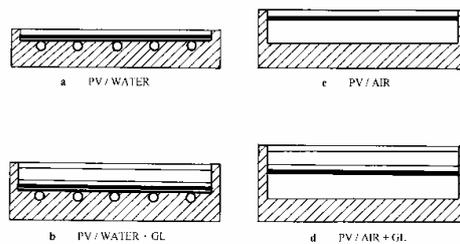


Fig. 4 Hybrid PV/T systems with water (a, b) and air (c, d), with (b, d) or without (a, c) top glazing

To improve performance of PV and PV/T systems, the use of diffuse reflectors has been proposed, which increase the energy output. A more effective use of PV/T collectors is to preheat the heat removal fluid, with the main heating to be performed by efficient thermal collectors. In this case we have a higher electrical output of PV panels, due to the relatively low temperature of their operation. Fig. 5 shows the small size combination of the hybrid PV/T collectors with the FPTU system (Fig. 5, left) and with the ICS system (Fig. 5, right).

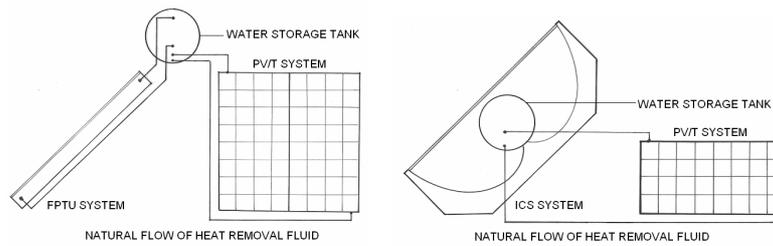


Fig. 5 The PV/T-FPTU (left) and PV/T-ICS (right) systems with natural flow operation mode

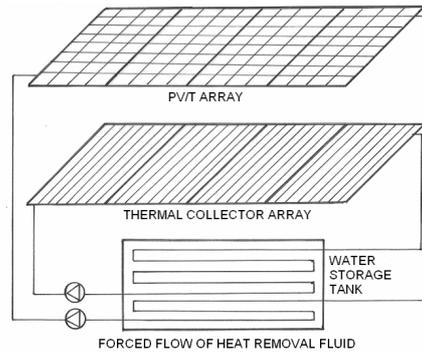


Fig. 6 The PV/T-TC combined system with separate hot water storage tank

In case of a larger installation of PV/T and thermal collectors on buildings (Fig. 6), the PV/T collectors can operate effectively if they are connected with the lower and cooler part of the hot water storage tank. The flat plate solar thermal collectors are connected with the higher part of the water storage tank, to operate at higher temperature level of the system. Moreover, the use of small wind turbines in combination with solar energy systems on a building of Cycladic islands [Tripanagnostopoulos and Souliotis, 2008] has also been suggested (Fig. 7). This system is considered effective regarding the complimentary operation of sun and wind.



Fig. 7 Solar wind combined system on buildings of Cycladic islands

Conclusions

Furnishing energy in a sustainable way to touristic places is a main goal of our times. Solar energy systems constitute the main devices to meet energy demand in tourist sector and social, economic, and other aspects should be considered. Rigorous study of devices is absolutely crucial for development of new and more efficient systems. Aiming to increase the penetration of solar thermal collectors and photovoltaics some designs of improved systems have been investigated at the University of Patras, in Greece. These studies have proved in laboratory that such new systems are cost effective devices and can be harmonized to the local architecture in many Mediterranean places. Monitored but in real conditions service installations “in situ” at touristic places have to be deployed. As a final idea, complementary operation systems must be installed.

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