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A Review of Green Impact in Canary Tourism Economy

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Abstract

The economic importance of tourism worldwide has increased considerably in recent years and future estimates to fifteen years are to double the current values of overnight stays. The tourism emissions are a major factor in global CO_2 emissions therefore have to act on them by implementing improvements in energy efficiency of existing facilities and reduce water consumption associated with tourism. The importance of emissions and energy consumption due to heating of water for human consumption (DHW) and the production of water in areas without water resources are checked. Hotels in the Canary Islands (Spain) as an example for the changes that must give even the reduction of emissions and consumption by implementing production systems of autonomous water and not centralized and implement systems renewable energies in the DHW to decrease between 20% shall be used and 30% of the energy requirements of buildings for to try to get nearly zero energy buildings (nZEB).

Keywords: ***Carbon footprint; Desalination plants; DHW; SWROP; Tourism emissions; NZEB***

Introduction

The tourism has been increasing its global significance and being the star of the biggest gains in economic sectors worldwide, mainly in the last two decades where tourism has been increasing. This dynamic has turned tourism into a key driver of socioeconomic progress of recipient countries of tourism, which based much of their employment and GDP in the tourism industry. Tourism as a global export category, is in third place, behind only fuels and chemicals, and ahead of sectors such as food and the automotive industry. International tourism (both in terms of revenue generated at the destination and passenger transport) accounts for 30% of exports, and tourism's share in total exports of goods and services is the 7% in 2015 [1]. Tourism economy become one of the major players in international trade, and represents both a major source of income for many developing countries. This makes it clear that tourism, by itself, is a major economic source oil markets or car, which a priori is thought to be very high. General grow of tourism in industrialized and developed countries has been beneficial in

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economic and employment terms, for many related sectors, from agriculture or construction. The tourism is an important pillar job creation and improves the local economy as significant destinations in sectors such as construction or agriculture [2].

In the Canary Islands, which form a region of Spain, located in the Atlantic Ocean to the northwest of the African continent, we have not yet managed to combine the cycle tourism to generate sufficient employment, we need feedback from this and other productive sectors, such as agriculture and local industry, which have declined in importance in recent years due to incessant tourist progress. This increase in tourism has to be consistent with the sustainability of destinations, mainly in those with high ecological value, as the Canary Islands, with 63% [3] of the surface of the archipelago has been declared a Biosphere Reserve, and make responsible and efficient energy and water use. It has to take into account the future prospects of climate change waiting, rising temperatures and reduced rainfall, thus, energy and water needs of the tourism industry, will increase significantly [4]. The only possible way to achieve sustainability of destinations, through the rotation of the tourism business policies for a firm commitment to green or renewable energy, giving an energy and water independence to the different establishments of the most vulnerable tourist destinations.

In short, through the various reports of the World Tourism Organization (UNWTO) [5], the international labour organization (ILO) [6], the international energy agency (IEA) [7] and the European Commission [8], where you can check global projections for the coming decades tourism, employment and energy, we reaffirm the theory that our tourism model, is no longer adequate, and is no longer competitive, because it remains stuck in 80, with uncontrolled expansion or rehabilitation. Times have changed, and our competitors, every day more, when they regain political stability, if we have not acted properly, especially at the public level, in terms of legislation, innovation and sustainability of infrastructure, we will have serious problems of sustainability economic model based on tourism. Globally, the tourism economy accounts for 9% of world GDP in 2014, with income above 1,400 million, corresponding to 6% of world trade and 30% of exports of services [9].

In the last 20 years tourism revenues have increased an average of 6.04% annually, and an increase of 195% of income over 1995 [10], with slight declines in 2001 and 2009 as seen in FIG. 1. As stated by the secretary General of the Talef Rifai, addressing the 60th meeting of the Regional Commission for the Americas in Havana (Cuba), "tourism is now an important category of international trade in services' [11]. At the level of global employment, the service sector accounts for 51% of the global workforce, and within it, tourism generates 17.6% of jobs directly and indirectly due to tourism [12].

Along with rising incomes also increased international tourist arrivals worldwide, with a more moderate increase in these 20 years of 4.16% on average [13] as shown in FIG. 2, which implies that tourists have increased their average expenditure on the destinations. This sustained in the years of income and tourists, growth is generating that tourism has a greater importance in the GDP of the countries receiving tourists, such as the case of Spain, which in 2015 represented 11.7% of the country's total GDP and 12% of employment, corresponding to over 18% of employment in the service sector [14].

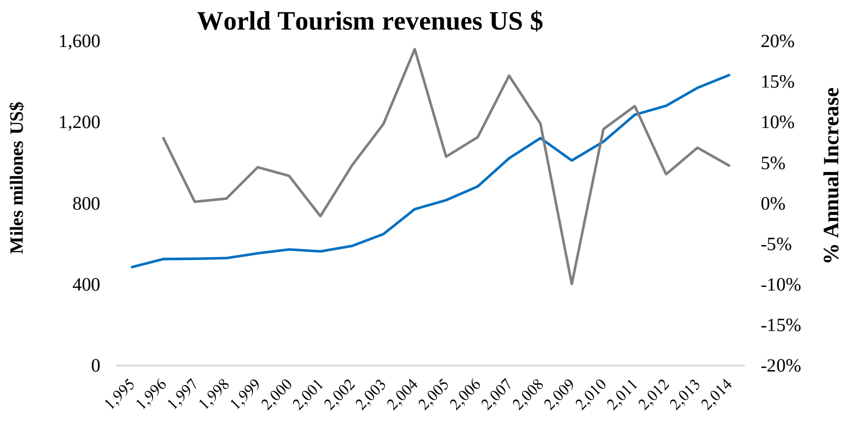

FIG. 1. **International tourist's revenues. Source: World Bank.**

FIG. 2. **International tourist's arrivals. Source: World Bank.**

Projections UNWTO presented at the general meeting of 11 October 2011, tourism estimates presented until 2030, with 1.8 billion tourists [5], almost doubling the values of 2010, with a constant rate annual growth of 3.3%, which will not be equal in all areas, with the highest growth emerging countries with 4.4% annual growth doubling in advanced economies, with 2.2% a year. Europe will remain the preferred destination of visitors, but spend from 51% to 41% of current global tourists in 2030. Traditional tourist areas (Europe and America) account for the largest number of hotel rooms with three quarters of the total, however, their growth rates are lower than those for other emerging tourist areas such as East Asia and the Pacific, which it shows a shift of tourist flows towards less traditional regions. The global hotel capacity is estimated at 16 million beds in 2000, which is estimated on the updates has increased 65% globally. In absolute terms Europe is offering the highest proportion of beds (40%), followed by the Americas (32%) [15].

Methodology

Emissions account and total energy of the different hotels, we have collected data from 12 hotels provided by the management there of, in an average period of six years, with data between 2007 and 2015. Once filtered and reviewed, energy data are converted to a value comparable to each other and the same unit, in this case kWh, using the conversion factors for each fuel energy. Finally, their emissions are compared according to the type of fuel used and emission characteristic values. Estimates of emissions and energy expenditure DHW and emissions from the production of water through a desalination plant has been made taking into account the values of average expenditure per customer provided by each hotel. FIG. 3 shows the flow diagram of the research carried out to obtain the data of this studio.

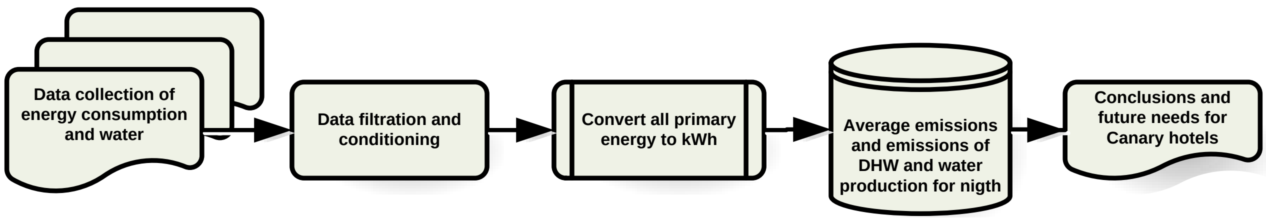

FIG. 3. **Research flow diagram**.

In order to reduce GHG emissions, the exact current process should be identified. First, the process of collecting the necessary data, second the process of developing GHG inventories, and last the process of calculating the carbon footprint is required. If the current carbon emissions status is analysed, the process of selection alternatives is necessary, which set reduction targets and select alternatives in accordance with the technical and economical optimization. Finally, execute the selected alternative carbon reduction, monitoring and reporting process is required. In FIG. 4 shows an overview of the framework and the methodology. Phases:

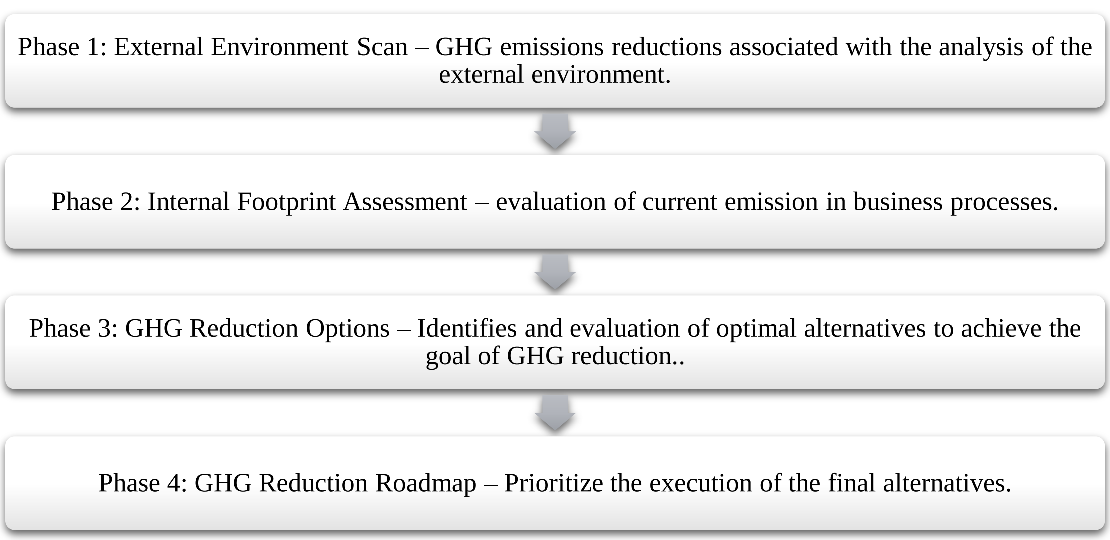

FIG. 4. **Method of reducing GHG emissions**

Footprint Calculations

To calculate GHG footprint in business processes, the GHG Protocol (Corporate Accounting and Reporting Standard) 2008 published by the world resources institute (WRI) and world business council for sustainable development (WBCSD). Coverage is defined as the range suggested by world resource institute (WRI):

- **Scope 1:** direct GHG emissions, which are controlled or owned by hotels: boilers, ovens, vehicles, etc.
- **Scope 2:** indirect GHG emissions associated with electricity.
- **Scope 3:** other indirect emissions, which are those due to the activities of the company.

In addition, the calculation of GHG frame is used the WRI GHG Protocol [16] that one of the methodology of the most widely used in worldwide, and GHG emission factor in the form of database provided that target companies and public agencies. After that, defining the boundaries of consideration and appropriate data are collected to calculate the carbon footprint. Emissions of biomass are also calculated. In order to quantify the emission factors, the conversion coefficients of the different fuels converted to kWh were used based on the tables provided by the IDAE [17]. The electricity emission factors are very different from year to year, due to which it was decided to take into account the last 9 years of emissions [18] as shown in the following TABLE 1.

TABLE 1. **Factors of emission of different fuels. Source: IDAE and REE.**

combustible type	CO_2 emission factor
Diesel Oil	0.311 kg/kWh
LPG Propane	0.254 kg/kWh
Pellet generally	0.018 kg/kWh
Electricity Canary	0.838 kg/kWh

Global Tourism Greenhouse

In several studies conducted by the United Nations, together with the UNWTO and the Intergovernmental Panel on Climate Change (IPCC) [4], an estimate of the global emissions of the tourism industry for the year was calculated 2007, which are reflected in TABLE 2, where you can check the contribution of tourism by 5% of global CO_2 emissions, being the sector housing accounts for 21% of emissions and the transport sector 75%.

TABLE 2. **Distribution CO_2 emissions estimate tourism industry 2007. Source: UNWTO and IPCC**

Type	Milons Tq CO_2	%	Uncertainty
Air transport	515	40%	+- 10%
Road transport	420	32%	+- 25%
Others transports	45	3%	+- 25%

Accommodation	274	21%	+- 25%
Other Activities	48	4%	+- 100%
Total Tourisms	1.302		+- 25%
Global Trade	26.400		
% Tourisms		5%	

The tourist accommodation industry, responsible for 1% of direct global emissions of CO_2 to the atmosphere, has in its hands the possibility to reduce them by improving the efficiency of their energy systems and decreasing water consumption and thus proportionally reduce carbon footprint.

The knowledge of the distribution of energy consumption in hotels, it is essential to know where you can and should make improvements to the lowering them. According to the geographical location of tourism house and its category and type, varies greatly distribution of energy consumption, which is apparent in the many studies conducted to date in several countries and geographical areas, such as hotels Caribbean [19], where 48% of electricity consumed in the air conditioning, in Hong Kong [20] where air conditioning accounts for 45% of electricity consumption in the Balearic islands [21] energy consumption Total is between 22% for DHW, 14% for air conditioning and 21% for heating, the overall mean of hotels in the United States [22] of total energy consumption corresponds to 31% for air conditioning, 15 % to air conditioning and 17% to DHW, or the most recent studies by the Universidad San Jorge (USJ) and the University CEU San Pablo in the Canary islands, where the DHW represents about 31% of total energy consumption, air conditioning over 20% of consumption and desalination plants over 9% in hotels that do not have external water supply. With the generic data world can be checked as air conditioning and conditioning of hot water, in all cases, represent 50% and 70% of total energy consumption of establishments, with priority action on the efficiency of these systems, to reduce emissions of this industry.

It is also important to consider water consumption of tourists in various destinations, which is also highly variable depending on countries and categories of establishments, which several studies conclude variability by this consumption. As examples, most of the Mediterranean [23] is between 250 l/overnight (l/o), Morocco [24] between 300 l/o to 600 l/o by category, in Australia [25] 750 l/o stay in France [26] about 175 l/o stays and worldwide [27] has estimated about 284 l/o. Also has also been studied the characteristic function of water consumption in relation to occupancy in hotels of 4 and 5 stars, that correspond to a polynomial function, being also valid a potential function [28] and the function for total energy for occupancy of 4-star hotels, corresponding to a potential function [29].

Emissions of the hotel industry are motivated primarily by electricity, accounting for between 60 and 85% of primary energy there from, depending on their emissions of the technologies used by suppliers, which have variability very high as destinations. For example, in Spain differences are very high on the Peninsula with 0.266 kg CO_2/kWh, Baleares with 0.645 kg CO_2/kWh or Canary 0.776 kg CO_2/kWh [30] which increase for losses generically statutorily estimated between 6% and 13.81% [31] according to the supply voltage at the point of consumption. Emissions to water also have a direct dependence on the type of supply made and its origin, citing the values of Aragon of 0.788 kg CO_2/m^3 [32] or the Canary Islands which are directly dependent on desalination plants and can have values 4.86 kg CO_2/m^3 for plants without recovery.

Considering the Canary Islands as an example of a tourist destination, which generates 31% of the archipelago's GDP and 36% of employment in the islands [33], the main engine of the economy? At this location, there are 626 hotels that offer more than 244,000 hotel beds and are visited by about 13 million tourists who produce more than 100,000,000 overnight stays [34] in the hotel establishments of the islands. This destination also has the peculiarity that in the last 20 years the source of drinking-water desalination plant has increased from 22% to 90% [35] as shown in TABLE 3. Representing some islands for 100% human consumption such as Fuerteventura and Lanzarote.

TABLE 3. **Total water uptake in the Canary Islands Hm^3. Source: ISTAC.**

Water	**2014**		**2010**		**2005**		**2000**		**1996**	
Surface Water	5.404	4%	47.386	53%	17.881	25%	18.961	25%	3.716	9%
Underground water	7.803	6%	8.652	6%	40.415	31%	11.657	11%	33.984	43%
Desalination	125.386	90%	89.535	62%	71.941	55%	76.835	72%	41.125	52%
TOTAL	138.593		145.573		130.237		107.453		78.825	

Canary hotels have the peculiarity of not using heating facilities in almost all cases, so their energy consumption winter is not as high as in other destinations. The distribution of primary energy of hotels that has been proven in studies of University San Jorge and the Open University of Madrid UDIMA in 12 hotels in the province of Las Palmas, TABLE 4, has resulted in that the distribution of primary energy for two years is divided into 58% for electricity and only 11% for renewable energies, as reflected in TABLE 5. These consumption data are without taking into account the own consumption of the desalination plant of reverse osmosis (SWROP) for the generation of drinking water.

TABLE 4. **Hotels DHW data consumption study.**

Code	**EPG**	**ESH**	**HPE**	**HT**	**ESA**	**ECA**	**HTI**	**MSL**	**EVA**	**HRP**	**ECE**	**ESJ**
Official category	5	5	4	4	4	4	4	4	4	4	3	3
Capacity	122	532	678	710	532	692	658	718	336	1.198	507	1.170
Total overnight stays	24.092	148.655	216.583	240.175	207.579	235.739	226.543	257.878	47.718	478.795	75.463	232.279
% Occupation pax	54%	77%	88%	93%	107%	93%	94%	98%	39%	109%	41%	54%
Litters water sanitarian consumption / pax	136	92	67	63	68	74	76	74	61	84	72	59
m3 Totals	3.277	13.676	14.511	15.131	14.115	17.445	17.217	19.083	2.911	40.219	5.433	13.704

TABLE 5. **Distribution of energy for 2 years by category without taking into account private desalination plants for study hotels.**

Energy	**Total**
Electricity without SWROP	57.8%
LPG Propane	15.3%

Diesel Oil	15.8%
Biomass	8.1%
Thermal Solar	3.0%

TABLE 6. **Distribution of energy emissions in percentage de kgCO_2/n without SWROP in the Canaries for study hotels.**

GHG	Energy whitout SWROP	Average %
Scope 1	LPG Propane	8.7%
	Diesel Oil	7.6%
Scope 2	Electricity Canary	83.6%
Other	Biomass	0.1%
kg CO_2/night Canary		13.1

Taking into account the CO_2 emission factors of the electricity in the Canaries, it is verified that the emissions of electricity represent 83.6% of the total emissions of the hotels, as can be seen in TABLE 6, with an average of 13.1 kg CO_2/night. These emissions are not very high when compared to the emissions from 58 luxury hotels in Taiwan [36] with average values of 29 kg CO_2/n, or that performed for stays in hotels [37] which calculated on average kg CO_2/n. With this data of total CO_2 emissions, it is very important to take into account any reduction in emissions that can be realized. Among the energy consumptions of the hotels and taking into account the consumption due to the heating of water consumption of average DHW per customer and day, whose consumption is 73.9 l/customer and the energy required for heating by conventional boiler technology of LPG propane would be 4.2 kWh/customer and average emissions of 1.1 kg CO_2/n. These values in the hotels of 5* on average are 33% higher than the values of the establishments of 4*, and can reach an emissions of 60% higher. In TABLE 7, the average data of the emissions and energy required per customer and day for the DHW in the study hotels according to their category can be observed.

TABLE 7. **Energy consumption and average emissions by category of study hotels.**

DHW emissions/energy	5	4	3	Average
DHW L/customer	98.1	73.6	62.2	73.9
Energy DHW Boiler LPG Propane kWh/pax	5.6	4.2	3.7	4.2
Emissions kgCO_2/pax	1.4	1.1	0.9	1.1

Take into account the importance of using water consumption are areas, which is performed by desalting seawater or brackish water, with the possibility of providing centralized network general supply or by desalination plants installed in the own establishments. Given the energy consumption of desalination, including water collection and treatment product plants hotels are average values of 4.70 kWh/m^3, and centralized plants have average values of 3.99 kWh/m^3 [38], implying that centralized plants generate less impact, which is not correct, because they do not take into account losses in distribution networks, which are very important especially in large networks and insignificant in the plants themselves, as is found in TABLE 8 that centralized and local desalination plants are compared with Canary average lost for 20.2% [39] Lanzarote 42% [40] and footprint carbon generated by consumption of desalinated water in the hotels studied, with an average consumption of 366 l/o, which implies an average between 1.41 kg CO_2/o for own facilities, to values of 1.71 kg CO_2/o stays in centralized distribution with large losses on the island of Lanzarote facilities.

TABLE 8. **Electric consumption and emissions of desalination SWROP plants according to their centralized or local installation at the point of supply.**

production type	Specific consumption kWh/m^3	Network distribution losses	Equivalent emissions kg CO_2/m^3	Emissions overnight Kg CO_2/o
EDAM own	4.70		3.868	1.41
EDAM Canarias	3.99	20.30%	3.950	1.44
EDAM Lanzarote	3.99	42.00%	4.663	1.71
EDAM Fuerteventura	3.99	35.80%	4.459	1.63

With the current desalination data from the Canary Islands, they serve as an example for the future needs of desalination of water in many areas that, due to the projected climate change, their water sources will be reduced and will have to use these systems in order to obtain the water for human consumption. The water/energy binomial needs to be adapted to the future needs and that in order not to increase the emissions and energy expenses, it must be done by means of technologies of generation with renewable energies so that it does not entail an inasumable expense due to the current water consumption by the cost in electric energy that would be produced and the increase of emissions by the industrial generation of water.

Conclusion

The relentless increase in demand for hosting services related to tourism must raise the real issue guidelines and fees related to this industry that generates about 10% of the world economy. Given future projections, doubling the number of overnight stays in fifteen years, you need to act now to reduce emissions of CO_2, with increasing energy efficiency and reducing consumption of water in the different establishments.

Reductions raised have to focus on the use of renewable energy, by changing current facilities for other green technologies, mainly in the production of hot water, as well as decentralization of water purification and desalination of water, which leaks distribution networks, impede sustainability of current distribution systems to tourist accommodation. The future lies in water reuse and distributed generation systems in small networks, or establishments for their own consumption.

The Canary Islands as sensitive and vulnerable target due to its foreign energy dependence, their high ecological value with several biosphere reserves and their needs for water desalination, lacking sufficient water resources, is a good laboratory to implement measures and improvements in water generation systems and energy consumption of buildings, to see the possibility of energy conversion of existing facilities to nearly zero energy buildings nZEB. The expected effects of hotel's systems energy production processes, which reduce GHG emissions can be summarized by the following three potential points.

- The amount of GHG emission reduction of a systematic analysis tourism market analysis, stakeholder analysis, including competitor analysis, based on a systematic review as a guide to reduce the amount of potential alternatives and emissions reductions can be formally identified.
- GHG emissions reduction projecting and investment guide for the offer: investment reduction potential and execute the ease of evaluation, based on a roadmap by providing economical and efficient emission reduction projects selected at the same time in the long term to reduce GHG emissions can be undertaken consistently and continuously.
- Hotel's operating processes have been developed. The large flow of non-public institution or a company, such as local governments to reduce GHG emissions without major modifications to the project would be possible to apply.
- The current working group, formed by the University of San Jorge and UDIMA University, sees the need to continue research in this field of the reduction of greenhouse gas emissions of hotel establishments, focusing future research on following points:
- Reduction of water consumption in establishments, and search for desalination models based on the water/energy binomial, through generation with more efficient renewable energies.
- Reduce the carbon footprint of hotels in Scope 1 and 2. Alternatives to emissions as high by electricity in the islands.
- Create models of nZEB buildings using self-generating systems and more efficient equipment, reducing average energy per stay.
- Replacement of current DHW heating systems with more efficient and less polluting ones.
- To study the current state of knowledge of the establishments through surveys on the measures to reduce their emissions and the carbon footprint generated by hotels, to establish a point of departure to the current needs of the establishments.

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