

# The Bioeconomy in Sicily: new green marketing strategies applied to the sustainable tourism sector

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## Abstract:

The bioeconomy is a new economic strategy that underlines environmental opportunities, through the concepts of the circular economy or thanks to some tools such as LCA.

The aim of this paper is to analyze the environmental impact of the tourism industry through the LCA analysis. Lately, the tourism sector has grown and offers different services such as transport, hospitality and entertainment. The LCA (Life Cycle Assessment), internationally standardized by the ISO 14040 and 14044 standards, is a technique that studies the environmental effects of all the stages of a service considering changes in the ecosystem, consumption of natural resources and the damage to human health. The functional unit of this study is a “Trip and overnight stay in a hotel during mid- season with the arrival and departure of the tourist at Fontanarossa Airport in Catania, Sicily”.

The tourist arrives at Fontanarossa Airport and must take transport to get to the Hotel Primavera dell’Etna, Zafferana; the transport used involves the emission of CO<sub>2</sub> and other substances which cause air pollution. The overnight stay in a hotel implies multiple environmental consequences caused by the consumption of specific items such as light bulbs, television, disposable products, air conditioning and electricity in general. The tourist’s hotel stay is half board including dinner and breakfast. After breakfast, the tourist will return to Fontanarossa Airport taking private or public transport. The tourism sector is important for the development of a country’s economy. There is a strong relationship between the two elements of tourism and the environment because, on the one hand, for tourism, the environment is a fundamental resource but, on the other hand, it must be deeply analyzed because an uncontrolled spread of tourism could cause serious environmental damage.

The LCA makes it possible to split the entire tourism industry into different steps focusing, not only on the evaluation of the total impact, but especially on the analysis of all the effects created in each phase.

**Key words:** Ecotourism, lca, environmental impacts, green marketing, bioeconomy.

## Introduction

A circular economy is a continuous positive development cycle that preserves and enhances natural capital, optimizes resource yields, and minimizes system risks by managing finite stocks and renewable flows. It works effectively at every scale. (<https://www.ellenmacarthurfoundation.org>)

Tourism represents one of the driving sectors of the economy on a global scale and it's necessary for its importance to observe and analyze its environmental impact. Negative impacts occur because tourism, both international and domestic, causes an intermingling of people from diverse social and cultural backgrounds, and also a considerable spatial redistribution of spending power, which has a significant impact on the economy of the destination. Tourism consequences cannot be prevented, but need to be planned and managed to minimize the negative impacts and accentuate the positive impacts of tourism.

The definition of ecotourism was coined in 2002 at the World summit of ecotourism in Quebec (Canada), and delegates of 132 countries approved the Quebec declaration of ecotourism. (<http://www.ecoage.it>)

Ecotourism is now defined as the following: "responsible travel to natural areas that conserves the environment, sustains the well-being of the local people, and involves interpretation and education" (TIES, 2015). Definitions focus on 'environmentally responsible' tourism that provides 'direct benefits' to the nature conservation area and to 'the economic welfare of local residents', or a nature tourism that promotes conservation and sustainable development' (Wunder, 1999)

A community-based approach to ecotourism recognizes the need to promote both the quality of life of people and the conservation of resources. Even where ecotourism results in economic benefits for a local community, it may result in damage to social and cultural systems thus undermining people overall quality of life. (Scheyvens, 1999).

At the same time, the respect towards tourism refers to both citizens and tourists because ecotourism is based on respect for values by tourists themselves, without which there is no reason to exist. But it is also a rational behavior of the same local populations that sustainably manage their natural and cultural heritage, which ensures long-term economic activity in the long run.

The evaluation of the activities performed using both methods could provide more extensive and comprehensive results and could lead to a more reliable evaluation of the system providing better support for decision making (Castellani, Sala, 2012).

Sustainable tourism has a direct connection with the Life Cycle Assessment method. The LCA is the evaluation of the environmental impact related to the entire vacation. This can include but not limit the following aspects: trip, transport, overnight stay, etc.

Tourist services can be interpreted as a series of consequential processes which, when viewed together, trace the life cycle of the tourist service (Sharpley, 2002).

Since tourism is a composite product, when the tourists begin their trip, the life cycle of the "tourism product" starts; and when tourists finish their trip, the life cycle of the "tourism product" ends. Accordingly, every sector of the whole trip including transportation, accommodation, and recreation is all considered and the environmental impacts of the whole trip can be inventoried under such approach. (Kuo, Chen, 2009)

The general process can be schematized through a stream of activities that characterize the distinct phases which are common to the different forms of tourism. This process, from a life cycle perspective for its implementation, requires that inputs are taken from environment and territory.

Taking into account the wide panorama of the companies in the tourist sector, the LCA method applied to this sector can be used as a lever of green marketing. This, in turn, allows the company to distinguish itself from its competitors thanks to the possibility of obtaining an eco-label. The Eco label represents an element of prestige in the eyes of tourists increasingly sensitive to these issues.

The aim of this paper is to analyze how back up instruments for tourism, in this case the LCA, can become strategies of the application of the circular economy.

The firm that has been studied is a hotel facility in the territory of Catania with a lifelong experience in the sector.

The main advantage of this research in the field of international literature about the sector is to underline the social benefits exploitable from an economic perspective. Through the LCA tool, it is possible to highlight the inefficiencies of the various phases and to improve them from the environmental point of view by reducing consumption and emissions besides other positive economic consequences.

## **Sustainable Tourism**

Tourism impacts on the environment is a delicate and important topic. Nowadays awareness towards respect of what surrounds us, the places in which we live and the environment in general, brought up the need for sustainability; concept that led to the research for sustainable tourism.

The term “sustainable tourism” has come to represent and encompass a set of principles, policy prescription, and management methods which charts a path for tourism development such that a destination area’s environmental resource base (Hunter 1997) .

Tourism, as environmentally responsible, leads to a direct benefit of the natural area and to the economic welfare of local populations.

A community-based approach to ecotourism combines the quality of life of people and the conservation of resources. It is common that economic benefits related to the development of tourism for a local community, may result in damages to social and cultural systems.

At the same time, the respect towards tourism refers to both citizens and tourists because ecotourism is based on the respect for values by tourists themselves, without which tourism, has no reason to exist; but it is also a rational behavior of the same local populations that sustainably manage their natural and cultural heritage, which ensures long-term economic activity in the long run.

Sustainable tourism can be defined as: “Tourism that takes full account of its current and future economic, social and environmental impacts, addressing the needs of visitors, the industry, the environment and host communities” (Lozano-Oyola, 2012).

According to the World Tourism Organization (WTO) “The development of sustainable tourism responds to the needs of tourists and regions that welcome them, protecting and improving opportunities for the future. It must translate into an integrated management of all the resources that can satisfy economic, aesthetic and social needs, while at the same time preserving cultural integrity, ecosystems, biodiversity and the basic conditions for life” (Unep, 2005) . In 2004 the definition is clarified through the identification of three indispensable prerogatives of sustainable tourism: the optimal use of natural resources, which must be preserved; respect for the socio-cultural identity of the host communities and the contribution to inter-cultural understanding and tolerance; the equitable distribution of socio-economic benefits both in terms of employment and social services (Matarazzo 2010). Furthermore, sustainable tourism must be a participated and constantly monitored process and finally must guarantee an elevated level of satisfaction for tourists (www.sinanet.it).

Thus, sustainable tourism should:

- 1) Make optimal use of environmental resources that constitute a key element in tourism development, maintaining essential ecological processes and helping to conserve natural heritage and biodiversity.
- 2) Respect the socio-cultural authenticity of host communities, conserve their built and living cultural heritage and traditional values, and contribute to inter-cultural understanding and tolerance.
- 3) Ensure viable, long-term economic operations, providing socio-economic benefits to all stakeholders that are fairly distributed, including stable employment and income-earning opportunities and social services to host communities, and contributing to poverty alleviation.

Sustainable tourism development requires the informed participation of all relevant stakeholders, as well as strong political leadership to ensure wide participation and consensus building. Achieving sustainable tourism is a continuous process and it requires constant monitoring of impacts,

introducing the necessary preventive and/or corrective measures whenever necessary. Sustainable tourism should also maintain an elevated level of tourist satisfaction and ensure a meaningful experience to the tourists, raising their awareness about sustainability issues and promoting sustainable tourism practices amongst them (UNEP 2005).

The sustainability of tourism in each area depends on the balance of multiple factors, ranging from the ecosystem to infrastructures, from socio-demographic aspects to economic ones. Achieving sustainable tourism planning should be the result of a process agreed between the various stakeholders and will be specific to the location considered.

Eco tourism management has raised a variety of concerns related to the education of the tourist. It is highly expensive to educate tourists on a topic that is still developing and that has not a unique definition. For this reason, cannot be found a single method of tourist's education but the only way of reducing tourism negative impacts is to be aware of the consequences; for example, tourists have the possibility to choose public transport over private transport, understanding which action should be done from an ethical point of view and behave in a responsible way. On the other hand, local population must assume an active role on maintaining safe their environment.

Factors, such as ecosystem, infrastructures, socio-demographic aspects and economic elements are an essential part of the management of sustainable tourism. Achieving sustainable tourism planning should be the result of a process agreed between the various stakeholders and will be specific to the location considered. To respond to the need to build a model of development adaptable to all environmental realities, UNEP in 1997 developed, through the Program of Priority Actions, a Tourism Carrying Capacity Assessment (TCCA).

The tourist load capacity is defined by the WTO as “the maximum number of people who visit, in the same period, a tourist resort without compromising the physical, economic and socio-cultural environment, and without reducing tourists' satisfaction”. This evaluation process takes into consideration three main groups of parameters: physical and environmental, socio-demographic and political-economic, closely linked to a specific territory and to local political management; moreover, it is based on a careful study of the state of the environment and of all possible development scenarios. Quality objectives of the services offered, and promotion of the local economy must be pursued, also based on the introduction of new eco-compatible technologies. Social equity and economic growth must be guaranteed, accompanied by the total well-being of the local population, through the involvement of all subjects in decision-making processes. In the planning and tourism management of the locality the component of durability of development over time must always be considered<sup>1</sup>. An excess of tourist presence can cause environmental damage in ecologically sensitive areas, high consumption of natural resources, increased pollution, deterioration of the artistic heritage, compared to the historical-cultural aspects of the communities involved, can contribute to the cultural flattening, to the loss of local traditions and serious socio-economic imbalances. The consequences of these events negatively affect the tourist attractiveness of a locality. Most of the time “Sustainable” is synonymous with responsible tourism, two concepts that for some they coincide, but for others they show appreciable differences. The meaning of “Responsible” refers to a meeting tourism, in that devotes more attention to the social and cultural aspects of tourism, while “Sustainable” can be referred to a tourism aimed at the conservation of ecosystems. The contribution of Sustainable Tourism can be essential for the development of the social cooperation, not only for the protection of the environment: the fundamental characteristic of this form of tourism is the local management of services and the active participation of indigenous communities, with consequent beneficial effects on the related socio-economic aspects.

## **Environmental Impact of the Tourism Sector**

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The impact of tourism on the environment can be defined in terms of “environmental and social pressure”: greater turnout of vehicles, greater presence of people, increase in waste production and increase in the construction of new accommodation facilities. Surely it is not easy to understand, study and evaluate the effects, so much so that although several studies have been done there is not a real “method” to be followed as there are no models of environmental impact assessment (EIA) generally accepted. The EIA is a process by which we try to verify that a given project can develop by limiting and controlling its negative effects. It is an evaluation aimed at highlighting the consequences of a given intervention so that, in this case, the project can be modified before it is put in place without having to go to the point of trying to correct the errors after the project has been started. It is therefore important to apply this procedure also to developments in tourism projects (Miller 2000).

Some environmental effects, both positive and negative, can be generated by tourism. Speaking of positive effects, the main consequences can be:

Protection of natural areas, beaches and coastal;

Creation of national parks;

Restoration and preservation of historical structures, sites and monuments;

Conservations of forests;

Environmental awareness of both citizens and tourists;

On the other hand, negative impacts can be:

Increased hunting and fishing with effects on fauna and flora;

Destruction destroyed or damaged;

Excessive production of waste and unpolished forms of disposal and therefore soil, water, atmospheric and acoustic pollution;

Disfigurement, erosion, damage to ancient monuments by tourists;

Disfigurement of the landscape (<http://www.puretourism.it>).

The sensibility of public opinion towards a sustainable lifestyle increases with the spread of environmental pollution. The use of mandatory and volunteer tools to respect the environment is the correct action to develop. It is noticeable how tourists appreciate the interventions, for the protection of the environment, promoted by accommodation facilities such as Hotel, B&B and Residences; how they increase their appreciation towards a better environmental quality and how the certification systems of environmental quality are valued.

The main advantages related to the use of the tools previously described can be:

Economic development of the hotel structure;

Environmental conservation and the artistic heritage of the destination;

Waste reduction;

Optimization of waste management;

Economic saving;

Decrease in pollution and environmental impact;

Use of organic products and consequent contribution to a healthy diet benefits for revenue management (<http://www.hotelnerds.it>).

In tourists' facilities such as Hotels, Hostel, B&B and residences, the manager should, through an adequate communication plan, inform the potential guests that the structure adopts environmental sustainability measures and, at the same time, instruct the staff on what are the services offered and the ways in which the hotel is committed to saving resources.

There are several approaches usable to develop a sustainable management such as:

Adopt measures to save energy and water: recover rainwater for irrigation of green areas and use the magnetic card instead of traditional keys. Today many hotels are equipped with a switch placed next to the door of the room where you can insert this type of magnetic key, inserting it activates the electricity; in this way, if the guest is not present, there will be no energy waste;

Separate waste collection;

Use electric cars;  
Take advantage of the short supply chain by establishing partnerships with local companies;  
Install solar panels;  
Use recyclable or recycled materials;  
Use rechargeable packs and ecological products for the courtesy kit;  
Offer organic and local foods.  
These and many more approaches can be developed to implement an efficient sustainable tourism system.

## **Materials and Methods**

LCA is a technique to assess the environmental aspects and potential impacts associated with a product, process, or service, by:

- compiling an inventory of relevant energy and material inputs and environmental releases;
- evaluating the potential environmental impacts associated with identified inputs and emissions;
- interpreting the results to help make a more informed decision about the human health and environmental impacts of products, processes, and activities.

For a typical product, LCA takes into account the supply of raw materials needed to produce the product, the manufacturing of intermediates and finally the product itself, including packaging, transportation and the disposal of the product after it has been used. This sequence, as depicted below, is called “Cradle to Grave” assessment (Grant 2009).

There are four main phases of the LCA process:

### **1. Goals and Scoping**

The scoping step determines which processes will be included, which environmental concerns will be taken into account, what economic or social good is provided by the goods or services in question, it resolves any technical issues and defines the audience for the LCA.

### **2. Life Cycle Inventory (LCI)**

The inventory provides information about all environmental inputs and outputs from all parts of the product system involved in the life cycle assessment. This involves modeling of the product system, data collection and verification of data for inputs and outputs for all parts of the product system.

Inputs include: materials, energy, chemicals and ‘other’.

Outputs include: air emissions, water emissions and solid waste.

### **3. Life Cycle Impact Assessment**

The assessment takes inventory data and converts it to indicators for each impact category. A typical list of impact indicators includes:

- Global Climate Change
- Stratospheric Ozone Depletion
- Smog
- Acidification
- Eutrophication
- Natural Resources (habitat, water, fossil fuels, minerals, biological resources)
- Human Toxicity
- Ecotoxicity

### **4. Interpretation**

The last step is an analysis of the impact data, which leads to the conclusion whether the ambitions from the goal and scope can be met. (B Corporation.net, 2008)

The LCA methodology has continued to develop and has become to some extent mature during recent decades. From the first conceptualizations, LCA is now an internationally standardized methodology (ISO 14040:2006; ISO 14044:2006) recognized by the European Commission (2003) as the best tool for assessing the life cycle environmental impacts of products. While general

guidelines for LCA have been issued by the European Commission (2010), many initiatives have been developing *ad hoc* sector- and product-specific methodologies.

According to a preliminary survey on the use of LCA in the tourism industry, LCA is still uncommon within the tourism industry and for researchers in the field of Sustainable Tourism (Filomanu V.,2016).

According to Judd (2006), the actual product of tourism is the tourist's experience which is generated by several social and economic actors. Middleton (1989) observes that the term "tourist product" is used at two different levels: the "specific" level (i.e. a discrete product offered by a single business, such as a sightseeing tour or an airline seat) and the "total" level (i.e. the complete experience of a tourist from the time one leaves home to the time one returns). From these considerations, it can be deduced that a tourist's experience is the outcome of a tourist product at a "total" level. Such a product can be seen as a system whose components (products and services) are the tourist products at a "specific" level, which are provided by different actors and may be incidental to "non-economic" activities.

Tourism is a complicated system due to the large number of goods and supporting services involved in it. Furthermore, describing the sector is complicated as, scientifically, there is an on-going debate about the definition of tourism. Therefore, applying LCA to calculate the environmental performance of tourist products is often problematic. In particular, these drawbacks have major implications in the "goal and scope definition" step (De Camillis et al.)

## **Experimental**

The study of the LCA of a service or product analyzes each phases from "cradle to grave", in order to establish which are the steps and moments in which the environmental concerns develop. In this paper, the LCA analysis is applied to the Hotel Primavera dell 'Etna.

This Hotel is in Zafferana Etnea,Catania, Sicily in a tourist road Mareneve Sud located between the Mediterranean sea and Mount Etna.

The facility was renovated in 2002 with the aim to improve the costumer comfort and satisfaction and to reduce the energy consumption and its environmental impacts.

The LCA analysis is based on four distinct phases:

1. Identification of the functional unit;
2. Life Cycle Inventory - LCI;
3. Life Cycle Impact Assessment;
4. Lyfe Cycle Interpretation

The functional unit taken into consideration is a "Trip and overnight stay in a hotel during mid-season with the arrival and departure of the tourist at Fontanarossa Airport in Catania, Sicily".

The ambit of the study goes from the transfer of the client from the airport to the check out in the hotel, which means: transfer from the Fontanarossa airport to the Hotel Primavera dell 'Etna, overnight stay, dinner, breakfast, check out (Figure 1).

The consumption analyzed in this study are:

- Consumption of fuel (gasoline) needed for the transfer by car from the airport to the Hotel;
- Consumption of the overnight stay: water, sheets, towel, courtesy kit, breakfast and the energy's consumption associated to the services used by the client such as television, bar service, hairdryer and toilette.
- Consumption related to the check out: Dishwashing utensils, bedroom cleaning and laundry service.

The inventory analysis of the life cycle is the main phase of the study and it is represented by quantitative data of all the material and energy flow at the beginning and at the end of the entire process.

The output of the inventory analysis results in the filling out of a table which shows the use of the resources, the emission associated with the functional unit such as energy flow, air, water and waste. The input and output data was provided directly by the Hotel.

Phases 3 and 4 allow the principal data to be elaborated and analysed in order to reach the final conclusion.

## Results and discussions

The first phase considered is the transfer to the hotel which is located 38.6km from the airport. The main input of this phase are gasoline, oil and tire. The average of the gasoline used is 2.72 liters which generate an emission of 7295g of CO<sub>2</sub>, oil and tires are used for 0.13% generating respectively emission of NH<sub>3</sub> and the attrition of the tire.

The second phase analyzed, concerns the overnight stay of the costumer in the Hotel; the relevant data are:

1. Consumption of 0.528 m<sup>2</sup> of methane gas which generate emission of CO<sub>2</sub>;
2. Consumption of energy of the bedroom for a overnight stay of 14 hours per a total of 1.42 KW divided into:
  - Hairdryer 0.08 kW
  - Television 0.51 kW
  - Minibar 0.40 kW
  - Lighting 0.40 KW
  - CPU 0.028 kW
3. Consumption related to the toilet
  - Water:150 l
  - Shampoo: 20 g
  - Bubble bath: 50g
  - Soap: 13 g
4. Consumption related to breakfast:
  - Water bottle: 0.5l
  - Coffee: 7 g
  - Cracked slice: 17g
  - jam :25 g
  - Butter: 8g
  - sugar: 5g
  - napkin: 2 pieces

The energy consumption of this Hotel is considerably lower than other hotel facilities, which do not operate in a green economy, thanks to the investment made by the company. In 2002 the heating system VRV-CLIMATIZZATOR MULTIZONA was installed. The system is equipped with centralized control so every room and floor of the whole hotel has heating, cooling and ventilation necessary without the need to waste energy to air-conditioning non-temporarily inhabited areas. In addition, these systems operate with intelligent energy management by optimizing seasonal performance. In addition, in 2014, a 63 kwp photovoltaic plant was installed on the roof of the building, meeting the needs of 21 private rooms, exploiting for solar power generation, clean and renewable energy as well as reducing energy costs. Connected with the photovoltaic system and



with the concept of energy saving, a process of energetic qualification of the structure has started, beginning with energy efficiency, thanks to the replacement of energy-saving lamps with LED technology lamps. In the last phase, check out, all the waste generated during the check-in and stay phase is analyzed. Waste generated for the sanitary facilities include: pvc bottles for the use of shampoo and bubble bath and paper packaging for the use of soap.

The waste generated for breakfast is: glass bottle, pvc pack for cookies, jam jar, butter wrapping, sugar paper bag and paper napkins. Speaking of waste management, with a view to carrying out its activities with the least environmental impact and also following the initiatives of the municipality of Zafferana Etnea, the management is committed to reducing waste incineration as much as possible, reducing the amount of undifferentiated donation, and carrying out a very accurate differentiated collection. In this way, at present, the hotel can differentiate between 80% and 85% of its waste.

## Conclusions

The application of the LCA in the Hotel Primavera dell'Etna showed that the main emissions caused by Italian tourism, tourism in southern Italy, is the CO<sub>2</sub> emissions caused mainly by the use of private means of transport. The paper showed, however, that the amount of energy used by the structure (1.42 KW) for one night, is relatively low compared to other tourist facilities. As a matter of fact, that amount is less than that consumed by other hotels in different nations; for example, the average of energy consumption in a hotel room in Hong Kong is: 32% of total energy were consumed for air conditioning, 12% for lighting, 5% for lifts and escalators, 23% for other systems/appliances, and 28% for cooking and water heating (the latter based on gas and diesel) (Deng and Burnett, 2000). A study (electricity only) of hotels in Hong Kong indicated a very high average electricity consumption of 10.9 MJ per bed night (Burnett, 1994, quoted in Jim, 2000). However, this may underestimate total energy consumption by one-quarter, and such low values will generally only be the case in city hotels. Hotels investigated in the Seychelles indicated an energy use of 36–108 MJ per bed night, excluding the use of fossil fuels for cooking etc. (UK CEED, 1994). Hotels with self-supporting power generation may even use more energy per bed night (Gossling, 2002). Finally, the amount of energy consumed is low compared to other hotels in southern Italy thanks to the investments made by the hotel, or through the installation of the VRV-CLIMATIZZATOR MULTIZONA system.

LCA highlights strengths and weaknesses, from a point of view of the effects on the environment, of the chains, identifying the phases that have a greater environmental impact. The advantage of this analysis is that it allows for each of the environmental impact factors (emissions, waste, discharges, etc.) to specify its origin by attributing it percentage to the distinct stages of the life cycle. The inventory analysis makes it possible to highlight the energy resources and products needed for the training process of the offered service, quantifying the resources needed during the consecutive lifecycle impact assessment phase. LCI is a very detailed, simple compilation tool but it is quite difficult to find individual data, very schematic and capable of quantifying the data sought. In the case of the tourist service examined, the choice of functional unit was crucial in identifying the environmental impacts attributed to a single tourist because it made it possible to locate exactly where it is possible to intervene to make tourism more sustainable. Improvement proposals based on inventory results or impact assessment can help decision-makers identify and evaluate ways to reduce impacts on the environment of products or services. Since LCA studies are long, expensive and complex (as it is necessary to acquire a large amount of environmental data during each stage of the production process), more and more "simplified LCA" tools are being developed. They enable a quick review of the life cycle and environmental performance of products, even to those

which do not have all the skills and resources needed to carry out a detailed study. Given the importance of reliable data availability for the success of an LCA study on an international and European level, it is important to promote accessibility, availability and free exchange and Small and Medium Businesses Free LCA data through The development of Public Data Banks, protected, compatible, transparent and accredited.

The main advantages can be summarized as follows:

- Significant economic savings characterized by an initial investment but savings in the medium term.
- Competitive advantage as they show a reduced environmental impact
- Identification of environmental issues during the life cycle of products or processes.
- Information and training for consumers and stakeholders.
- As a tool for certification of corporate environmental management systems (SGAs) for both ISO 14000 and EMAS Community Regulations. The LCA methodology allows the integration of the environmental variable with the core business functions in order to develop environmental management policies. This also helps to improve relations with institutions.
- Definition of eco-compatible strategies for urban solid waste management (RSU). The LCA methodology makes it possible to compare environmental loads with different alternatives by facilitating the choice of the disposal method that minimizes cost and environmental impact.

Therefore, despite the criticalities that can be found in the application of the LDA both from a technical (data acquisition) and economic (initial investment) point of view, the implementation of LCA is a useful tool and competitive for companies that apply it.

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Figure 1. The basic steps of a vacation

