RENEWABLE ENERGY FOR SUSTAINABLE TOURISM

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ABSTRACT: Over the past decades, the travel industry has been growing rapidly and is today the single largest business sector in the world economy, employing in excess of 200 million people worldwide. According to most prognoses, tourism is bound to continue expanding at an appreciable rate, thus providing new business opportunites alongside a wide array of environmental and socio-economic challenges, both locally and globally.

The hotel industry is an important part of the travel sector. On a world-wide basis, the energy used in hotels is still predominantly fossil fuel based, despite the fact that many of these facilities are located in areas with ample access to renewable energy resources. The hotel industry is a conglomerate of very diverse subsectors with different energy consumption profiles. Hotels are typically geared towards providing high-level comfort and entertainment, as well as a broad spectrum of services, often without much concern for associated environmental, or socio-economic impacts. Hotels typically compete on a global market by offering more comfortable and spacier accomodation, better and more food, more sophisticated services, entertainment etc., commonly leading to the overexploitation of energy and other resources. A significant amount of the energy used in this sector is waisted, leaving ample room for ambitious measures of energy-efficiency and conservation.

This paper will focus on the possibilities to increase energy-efficiency and conservation in the hotel industry, and will examine the possibilities of enhancing the use of renewable energy. A cross-disciplinary approach to the analysis presented here will be taken with both system (technical), planning and management aspects being addressed. Examples of successful cases in different parts of the world will be used to illustrate the potential for combining economic and environmental success in this important sector.

1. INTRODUCTION

The travel industry is one of the most rapidly expanding industries worldwide, with the hotel industry constituting one of its most significant and dynamic subsectors. A steadily growing repertoire of variations on the accomodation theme are offered today on a highly competitive international market by establishments including resort-type hotels, business hotels and conference facilities. The hotel industry generates a wide range of business and employment opportunities, thus accounting for significant portions of local and/or national income in many parts of the world. In providing the large variety of services, levels of luxury and comfort, attractions, entertainment and products, this industry consumes (and wastes) enormous amounts of energy, [1]. On a global scale, the largest portion of this energy is still fossil fuel based. The resulting emission of pollutants and greenhouse gases contributes to both local and global environmental degradation. This, in turn, jeopardizes the sustained attractivity of the natural environments marketed, and thus also the long-term success and survival of the very businesses by which these impacts are generated.

Considering that hotels are often located in places with an abundance of (solar, wind, hydro, biomass, geothermal and other) renewable energy resources, in naturally attractive coastal, mountain, riverine, or lake environments, it is suprising that these resources remain largely unexploited. The Hawai'ian Islands provide a showcase example of an attractive and well-visited travel destination blessed with abundant supplies of practically every renewable energy resource imaginable. Despite this, more than 95% of the energy use in the State of Hawai'i is still fossil-fuel based. Many similar examples can be found worldwide.

While in some parts of the world an obvious improvement in the levels of environmental consciuosness, education and responsibility has occurred over the past decades, attitudes towards the use of renewable energy are still commonly negative. More often than not, renewable energy is dismissed as prohibitively expensive and unreliable compared to energy derived from non-renewable (=finite) resources (fossil and nuclear fuels).

This attitude is probably as wide-spread as it is narrow-minded, and is typically the result of poorly educated, and/or short-term-profit-oriented thinking. Renewable and non-renewable energy alternatives are typically not compared with each other from the perspective of their entire lifecycle impact and cost, whereby the overall effects of a wide range of externalities associated with the use of finite energy resources are unfairly disregarded. With few exceptions, insufficient or no value is attached to the effects of energy use on the quality of the environment, biodiversity, human health and the overall quality of life, all of which would substantially benefit from an enhanced use of renewable energy resources and technologies.

Giving preference to renewable energy may further:

- reduce the dependence on imported fuels by using domestic resources (resulting in foreign currency savings);
- provide access to specific financing schemes (tax-rebates; emission trading benefits, e.g. within the framework of the Clean Development Mechanism, [2]; soft-loans etc.);
- attract a more environmentally responsible category of guests (generating an overall lower environmental impact at the sites visited);
- offer possibilities of integrating passive space-conditioning concepts with renewable energy systems already in the early stages of planning, designing and constructing new facilities, thus reducing installed power and overall energy requirements;
- generate additional employment opportunities in the renewable energy and associated industries.

The purpose of this paper is to show on the example of two distinctly different cases, [3,4], that environmental concern and healthy profits can be combined very cleverly. Not only can hotels decrease their energy bills by using renewable resources and technologies, they can directly use this for documenting environmental responsibility, and thus enhance their status and competitiveness on an increasingly conscious and demanding travel market.

The two cases presented describe different approaches taken in a resort-type facility, [3], in Australia, and a conference-type hotel, [4], in Sweden. The examples discussed show that very different attempts at sustainable business practice can prove successful, and that environmental responsibility and solid economic returns can be simultaneously achieved under very different conditions (including business profile/concept, climate, location, as well as the availability, type and abundance of renewable energy resources).

2. SUCCESS STORIES

2.1 Case 1: Couran Cove Resort, Queensland, Australia

The Couran Cove Resort is one of the largest ”ecotourism” resorts in Australia, [3, 5]. It is a 5-star, 567-unit facility located on South Stradbroke Island, in southern Queensland, ca. 90 km from Brisbane. The facility offers a typical range of amenities for a resort-type hotel of this category, including a variety of restaurants, heated pools, jacuzzis, a surf club, conference facilities, as well as a variety of sports facilities. Within its 151 hectares, the property contains a variety of landscapes and natural environments, including high-conservation rain-forest, beaches and open woodlands.

The business objective of the Couran Cove Resort is to achieve sustainable operations, while maintaining cost-efficiency.

The average daily electricity consumption at the facility is ca. 4200 kWh, while an additional 20 GJ/day (5560 kWh/day) of liquid petroleum gas (LPG) are used in the kitchens and for meeting the domestic hot water (DHW) demand. The resort’s base energy system consists of seven LPG-powered generators (installed capacity 150 kWe/unit), covering ca. 60 % of the resort’s primary energy demand, [3]. This proportion will be reduced to ca. 48 % after a wind turbine is installed which is expected to generate an additional 225 kWe (ca. 12% of total primary energy). Currently, a 2,5 kWe wind generator provides about 10% of the electricity demand at the surf club. In addition, solar water heaters and heat recovered from the LPG-plants are used for pool heating, acounting for 7,3% and 6,7%, respectively of the resort’s primary energy use. The LPG-boosted active solar system is also used for generating domestic hot water (DHW). LPG-gas used for cooking and heating accounts for another 25,2% of the total. Heat recovered from the LPG-plants amounts to a total of 1,5 GWh primary energy savings per year.

The LPG-based system was chosen after evaluation of three system alternatives, see Table 1, [5]. The choice was made based on the requirement that the system should be as cost-efficient as possible, and that it should emit a minimum of greenhouse gases (CO_2). As Table 1 shows, The LPG-fired plant generates about 10% of the CO_2 that would be generated by a conventional diesel-fired plant.

The energy system was computer-modelled to optimize its size (installed power), as well as to minimize overall operation and maintenance costs. Peak energy needs have been shaved off by both using more efficient equipment, and by scheduling services intermittently, to minimize the duration and amplitude of peak power demands. For example, pumping, treatment, supply and disposal of water and sewage are scheduled to off-peak times, [3]. By combining renewable resources with the use of LPG-gas, ca. 75 000 GJ ($2{,}08 \cdot 10^7$ kWh) of primary energy are reportedly saved compared to providing energy by a conventional natural-gas-fired system.

A number of energy-efficiency measures have been adopted to reduce the overall energy use at the resort. Passive solar measures, ceiling- and wall-insulation, as well as shading are all integrated into building design. Highly energy-efficient lighting is used (including street lighting operated by electronic ballasts, and movement detectors installed in public areas such as toilets and walkways). Energy-efficient, electronically speed-controlled engines are used for larger motor loads including those in the resort’s HVAC-systems, and the water pumping system.

Each room is individually metered such as to provide feedback to both guests and management regarding gas-, electricity- and water usage. The relevant information is displayed on a TV-screen. All power in unoccupied rooms is routinely shut down.

Table 1: Comparison of the three energy-system alternatives considered (gn=guest night), [5]

Energy system alternatives Factors	A LPG-gas/wind option with heat recovery	B Grid electricity (coal-fired plant)	C Diesel based generation with heat recovery
Capital cost, 10^6 AUD Operating cost, 10^6 AUD Maintenance cost, 10^6 AUD	5,28 0,18 0,2	8,69 0,6645 unknown	8,33 0,8 0,6
Noise pollution	Power station 55 dbA at 10 m Wind generator 50 dBA at 70 m	No local noise	Power station 65 dBA at 10m
Type of emissions / pollution	CO2 and H2O Visual "pollution" by wind generator	No local pollution	CO2, particles/soot, etc. Possible diesel fuel spills during transport, unloading and storage
CO_2-emissions, tonnes / yr Fossil fuel use, tonnes / yr (fuel type) Primary (fossil) energy use, kWh / gn Renewable energy use, kWh / gn	517 680 (LPG) 33,06 8,61	7884 3229 (coal) 64,72 0	5 166 2317 (diesel) 62,22 0

As regards resort economy, significant savings have been achieved by choosing the hybrid LPG-fired/renewable energy system rather than grid-supplied electricity, or diesel-based power generation with heat recovery. The total capital cost for the resort's energy system amounted to AUD 5,28 million, which is AUD 2,61 million less then the next-cheapest option considered in the format of a conventional 3,9 MW natural-gas-fired plant. Additional savings of ca. AUD 1 million in annual operating cost have been achieved. The overall amount of greenhouse gases emitted by the system installed amounts to ca. 30% of the emissions that would have been generated had the natural-gas-fired plant been chosen, instead.

However, one should bear in mind that LPG is also a finite resource, and that it is likely that an even larger proportion of the energy consumed at the Couran Cove Resort could be derived from renewable resources (particularly solar and wind energy), amply available at its sunny coastal location.

2.2 Case 2: Sånga-Säby Courses & Conferences, Svartsjö, Sweden

Sånga-Säby Courses & Conferences (SSCC) is a conference facility located on Färingsö Island in Lake Mälaren, about 35 km northwest of the City of Stockholm. The climate at the site is well representative of its Nordic location (ca. 59° 20´ N, 17° 45´ E), with long and cold winters, and short and mild summers. SSCC has 134 rooms (159 beds) and 28 conference-rooms distributed in a total of 9 buildings. The facility has profiled itself by having combined a high level of environmental responsibility (including energy- and resource-efficiency) with good economic returns, [4, 6].

Throughout the facility, operations are certified according to the ISO 9002 quality control and the ISO 14001 environmental management systems. In October 1999, the facility was the first conference-type hotel in Scandinavia to become Nordic-Swan-ecolabelled, [7]. The facility is also EMAS-registered (according to the Eco Management and Audit Scheme developed by the European Union, [8].

The facility has been awarded a number of environmental prizes, most notably the International Hotel & Restaurant Association's 1997 Environmental Award (Green Hotelier of the Year, in the Independent Unit Category). In 2000, the facility achieved a turnover of 37,5 MSEK (34,5 MSEK /1999; 21,7 MSEK /1995), at a profit of 12% (2% / 1999; 0,2%/1995). SSCC's environmental program is focused on reducing and making more efficient the use of energy and other resources, and on continuously replacing products having an adverse environmental impact with more environmentally compatible alternatives. The principle of reducing and replacing is applied to a broad range of activities and operations including those using energy resources, consumables, cleaning and other chemicals, and transportation. Environmental criteria are further given high priority when choosing furnishings, inventories, and – not least – architectural design, construction methods and building materials, when erecting new structures within the facility. Within the framework of its

environmental management program, SSCC aims at conducting all operations as environmentally consciously as possible (with the ambition of being the most environmentally adapted conference facility in Sweden); satisfying all energy requirements with renewable resources within an overall ecocycle that should be as closed as possible; minimizing the use of environmentally hazardous substances; offering high-quality food made to the extent possible from Swedish produce (the facility has a KRAV-certified, [7] restaurant); designing all operations such as to achieve continuous improvement and to create a basis for preventive environmental programs; designing and developing all activities such as to satisfy the four system conditions defined by The-Natural-Step-Concept (Det Naturliga Steget) applied. This concept requires that substances from the Earth 's crust must not systematically increase in nature; substances produced by society must not systematically increase in nature; the physical basis for productivity and diversity of nature must not be systematically diminished; and that energy and other resources must be used justly and efficiently.

As of September 1996, all operations are conducted relying entirely on renewable energy resources. SSCC has expressed its committment to using renewable energy to the extent possible – within certain limits even if this may result in higher overall energy costs. An annual average of 65% of the overall heating demand is satisfied by a heat pump system operated by heat extracted by 7,5 km of PE-tubes submerged in the coastal waters of the adjacent Lake Mälaren. The system consists of three Kylma Compacta 15308 units (installed capacity 67 kW/unit), operated with propane R290 as refrigerant. Since January 1996, rapeseed oil methyl ester (RME) has been used to meet peak heating demands. A number of energy-efficiency and conservation measures have been implemented. Heating is entirely non-fossil-fuel based. Only "green electricity" (hydroelectric- or windpower-based) is used. No electricity is used for direct space-heating. Heat pumps are used to the extent possible for heating, and a solar collector plant is used for heating the pool-water. Low-energy bulbs are used for ca. 50% of all lighting requirements. External lighting is entirely need-driven (lighting of the outdoor fitness track and exterior lighting). Most buildings are equipped with motion/presence detectors and timers. Ventilation is provided by a variable air volume system equipped with a heat recovery unit. 2- and 3-pane windows are installed throughout the complex. The sauna-facility is equipped with a timer, and can also be directly controlled from the reception. It is heated by "green electricity". Guests are encouraged to switch off lighting and TV-sets when leaving their rooms, and to decrease excessive room-temperatures during winter by adjusting radiator valves rather than by opening windows. To reduce the amount of laundry processed, guests have the option to keep their towels for several days if they so wish. None of the rooms have minibars.

Energy consumption throughout the facility is low, compared to similar facilities worldwide, [1]. This is obvious both from the low amount of energy consumed per guest night (76 kWh/gn), as well as from the amount of energy consumed per unit floor area (currently 163 kWh/m^2), see also Table 2 and [9]. This is a particularly good result with regard to the climate zone in which the facility is situated.

The entire company-owned vehicle fleet is fuelled by renewable fuels. To the extent possible, guests are shuttled to and from the facility by an RME-fueled bus. Transports within the facility rely on vehicles powered by "green electricity", or bicycles. The company car is ethanol-fueled. The use of public transport to and from the facility is encouraged, as is car-pooling.

The facility further has an advanced recycling and waste-treatment system. Waste products throughout the facility are separated into 24 fractions. Organic waste (including frying oil) and gardening waste are composted. A fat-separator is installed and emptied according to existing regul-ations. All kitchen-waste is separately weighed. Surplus equipment/inventories are delivered to second-hand or recycling facilities. Containers for disposal of used batteries are available at the reception and throughout the buildings. Conference guests have the possibility to fraction two types of paper wastes, as well as compostable organic wastes. The overall amount of waste is reduced by presorting and by choosing products with more resource-efficient packaging.

Table 2: Evaluation of the energy use for the period 1995-2000

Key Parameter	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Amount Renewable Energy Used / Overall Energy Used, kWh / kWh	0,03	0,94	1,00	1,00	1,00	1,00
Electricity Consumption / Guest Night, kWh	84	83	95	87	76	73
Amount RME Used for Heating / Guest Night, l	2,112	2,389	2,384	0,724	0,749	0,376
Total Amount Energy Used / Turnover (excluding income from forestry), kWh / (10^3 SEK)	-	-	-	48	40	43
Total Amount Energy Used / Guest Night, kWh	-	-	-	83	81	76
Total Amount Energy Used / Overall Indoor Area, kWh / m^2	-	-	-	185	173	163

At least 50% of all electronic office instrumentation is equipped with stand-by-mode options, and the same proportion of all computers, fax- and copy-machines are ecolabelled.

Environmental management and accounting at SSCC entails the use of a total of 64 key ratios in evaluating a wide range of activities and operations, including the use of energy (Table 2) and other resources, as well as a variety of environmental issues, [3, 5]. The requirement to use a minimum of resources as efficiently as possible is applied to energy and material resources, as well as to labour time and financial resources. In a business approach, resource management and value creation are thus given the same level of importance. Such a comparatively large number of parameters is considered necessary by management for evaluating relevant environmental and financial issues with the necessary level of detail. This data is also used to develop the structure of operations, as well as corporate goals and strategies. Despite substantial investments in new structures and environmental programs, profits have been steadily increasing from a level of 3% in 1997 to 12% in 2000. Turnovers reached a level of SEK 37,5 million in 2000, equivalent to SEK 0,75 million per employee (based on an annual average of the number of employees).

The latest addition to the complex is the Mälarblick building consisting of 16 guest-rooms, Fig. 1 and [10]. The intention was to provide first-class accomodation with as little negative environmental impact as possible. The building was designed to fit into the surrounding environment under the requirement that as little vegetation and rock material as possible be removed during its erection.

The roof was designed to accomodate an active solar thermal (and eventually even a PV) collector system. The portion of the roof not occupied by solar equipment is covered with sedum (green roof) which has good heat insulating properties. The active solar system currently consists of 37 m^2 of Solsan Sunergy evacuated-tubes, arranged in 8 units of varying size. The system is used for DHW-generation. There is enough roof-space available to expand the system (if necessary) to almost three times the current collector area. It is also intended that all solar collector systems will be upgraded as more efficient equipment becomes available.

Heating is provided by a water-based floor heating system. The water circulated is heated by a (geothermal) heat pump system extracting heat from a number of bore-holes drilled into the rock below the building. The system consists of two IVT Greenline S16F/H heat pumps (installed capacity 15,5 kW/unit), with R407c as refrigerant.

Sånga-Såby Courses and Conferences is an excellent example of a conference facility where the objective to minimize environmental impact has been successfully integrated with high-quality accomodation, energy-efficiency, appealing architecture and sound economic returns. Obviously, environmental management and responsibility do make good business sense.

Figure 1. Mälarblick building, SSCC, Svartsjö, Sweden (Foto: P. Bohdanowicz, 2001)

3. CONCLUSION

As shown above, very different approaches can be taken in attempting to combine healthy economic returns with environmentally responsible concepts and activities in the hotel industry. It is obvious from the examples described that these two goals are in no way mutually exclusive, as is frequently and wrongly assumed. Wholesomely sustainable businesses are by definition environmentally compatible *and* economically successful. In the case of hotels, the level of success that can be achieved largely depends on the degree of wholesomeness applied in planning, designing, constructing, operating and - eventually - removing a facility.

While the well-known signals of climate change and accelerating environmental degradation undoubtedly call for immediate measures and ambitiously set goals, it is encouraging to know that there are many roads to environmentally responsible practice. There exists a great variety of sensible business alternatives within the interval demarked at its least responsible end by entirely environmentally (and ultimately economically) unsustainable practice, and at its ideal and most ambitious antipode by wholesomely sustainable activities and products. The paths chosen will vary depending on many parameters, including local climatic conditions, local availability and type of renewable resources, existing laws and regulations, services/activities offered by the facility and customer profiles catered to, availability of investment capital and economic incentives, and - not least - the level of economic returns and environmental compatibility aimed to be achieved.

Replacing and/or complementing to the extent possible non-renewable energy resources and technologies with renewable alternatives, is undoubtedly a significant step on any of those roads.

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