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SUSTAINABLE TOURISM CRC

Clean Technology Applications in Tourism Accommodation

A BEST PRACTICE MANUAL FOR PERU

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APEC TOURISM WORKING GROUP

Clean Technology in Tourist Accommodation: A Best Practice Manual for Peru

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Abbreviations

AC	Alternating current
AHA	Australian Hotels Association
AICST	APEC International Centre for Sustainable Tourism
APEC	Asia-Pacific Economic Cooperation
BAS	Building automation System
BMS	Building management system
CCHP	Combined cooling heating and power
CDM	Clean Development Mechanism
CFL	Compact fluorescent light
CHP	Combined heat and power
CREED	China Rural Energy Enterprises Development
CSR	Corporate Social Responsibility
DC	Direct current
DNA	Designated National Authority
DVD	Digital video disk
EE	Energy Efficiency
EMS	Energy management system
FIT	Feed in tariff
FONAFIFO	Fondo Nacional de Financiamiento Forestal
GDP	Gross domestic product
GHG	Greenhouse gas emissions
GSTC	Global sustainable tourism criteria
HMAA	Hotel Motel and Accommodation Association of Australia
HSPF	Heating seasonal performance factor
HVAC	Heating, ventilation and air conditioning
HW	Hot water
IADB	Inter-American Development Bank
ICT	Information and communication technology
IEC	International Electrotechnical Commission
IPCC	Intergovernmental Panel on Climate Change
IREC	Interstate Renewable Energy Council (USA)
ISO	International Organisation for Standardization
KITE	Kumasi Institute for Technology and Environment
kV	Kilovolts
kW	Kilowatts
kWh	Kilowatt hours
LED	Light emitting diode
LEED	Leadership in Energy and Environmental Design
LPG	Liquid petroleum gas
MARTI	Mesoamerican Reef Tourism Initiative
MINCETUR	Peruvian Ministry of Tourism

MJ	Megajoules
MtCO2-e	Million tonnes of carbon dioxide equivalent greenhouse gases
NASA	National Aeronautics and Space Administration (US)
NGO	Non-governmental organisation
NREL	National Renewable Energy Laboratory
PPA	Power purchase agreement
PV	Photovoltaic
RBC	Rural business centre
RE	Renewable energy
REEEP	Renewable Energy and Energy Efficiency Partnership
SEIA	Solar Energy Industries Association
STCRC	Sustainable Tourism Cooperative Research Centre
TBL	Triple bottom line
tCO2-e	Tonnes of carbon dioxide equivalent greenhouse gases
UNEP	United Nations Environment Programme
UNF	United Nations Foundation
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollars
USDA	US Department of Agriculture
USDoE	US Department of Energy
V	Volts
VER	Voluntary emissions reduction

About This Manual

This manual was produced by researchers at the Institute for Sustainable Futures at the, University of Technology, Sydney for the APEC Tourism Working Group. The Project Coordinator was the Peruvian Ministry of Foreign Trade and Tourism (MINCETUR) and the APEC International Centre for Sustainable Tourism (AICST) in conjunction with the Sustainable Tourism Cooperative Research Centre (STCRC) managed the research.

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1 INTRODUCTION

This manual provides information and guidance on clean energy technologies and approaches for tourist accommodation in Peru[1]. The main goal in producing the manual is to promote clean energy in small to medium accommodation establishments and to assist the future development of regional and rural accommodation. The overall aim is to raise awareness about the opportunities for application and use of clean energy.

The manual showcases and draws lessons from good practice in the use of clean energy in tourist accommodation around the world. It is designed to assist those in Peru who make decisions about hotels, small hostelries and other tourist accommodation and about the facilities in tourism destinations to:

- better understand what good practice in clean energy in the accommodation sector means,
- determine what clean energy elements might be locally appropriate, and
- increase uptake of these locally appropriate options.

While the focus is predominantly on what may be suitable for smaller hotels and hostelries in regional and rural areas, the manual also covers larger accommodation and resorts. This is in order to give a more comprehensive coverage and application in the light of the importance of larger hotels to the overall tourism market in Peru (see chapter 2 of this manual).

Although the technical details of clean energy can be complex and require expert consultation, the fundamental concepts central to developing high quality clean energy initiatives are accessible to any local decision maker looking to harness the benefits of clean energy. The manual is designed to assist a range of local decision makers in the transition to a more affordable, reliable, environmentally friendly and locally appropriate energy system. It deals with energy used in accommodation facilities for heating and cooling, lighting, cooking and other “internal needs” but does not cover related accommodation activities, such as transportation.

1.1 How the Manual Has Been Produced

The manual has been produced in three phases:

1.1.1 Phase one

The research team at the Institute for Sustainable Futures (ISF) in consultation with the Sustainable Tourism Cooperative Research Centre (STCRC) and the APEC International Centre for Sustainable Tourism (AICST) developed a framework for understanding the key issues and barriers to the introduction of clean energy in hotels and tourist accommodation facilities throughout the APEC region, based on ISF’s organisational expertise in clean energy systems and the principles of sustainable tourism.

The framework was developed further through reviewing the relevant international literature and then developing a template to obtain information from APEC economies on best practice examples in the use and management of clean energy technologies in hotels and smaller-scale rural and remote accommodation establishments.

The template was then circulated to the APEC economies and used to collect information on best practice case studies, which was combined with parallel research on case studies in a range of economies inside and countries outside of APEC (described in the introduction to chapter 8, Appendix A).

[1] This version of the manual has been prepared to provide specific assistance in Peru. It has been edited from a manual developed for use throughout the economies of APEC.

Both the research framework and the case studies on the direct experience of hotels and small-scale accommodation providers were used to identify what should be included in a best practice manual for application in APEC economies.

1.1.2 Phase two

The framework for the manual, indicating the overall approach, the general contents and how it could be used, plus the coverage of case studies, was presented at an international workshop organised by the Peruvian Ministry of Tourism, MINCETUR, on behalf of the APEC Tourism Working Group, in Cusco, Peru on March 23rd and 24th 2010. The workshop was attended by a number of people involved in tourism in Peru included representatives of MINCETUR, Regional Directorates of Tourism and people from several of the country's main tourism destinations

1.1.3 Phase three

The final phase of the project has been to prepare two manuals to include results of the research and outcomes of the workshop in Peru. One edition of the manual was prepared for use throughout the APEC region. This version is intended to be of use in the specific context of Peru.

1.2 Focus and Contents

The manual is intended for people with an interest in how clean energy can be used in a single hotel, hostel or tourist facility, as well as those who are interested in the potential of broader clean energy uptake across a number of facilities in the same area or destination and nationally.
The manual is structured in the following chapters:

- **Chapter 2: Why use Clean Energy** introduces the approach to clean energy used in the manual, and outlines the significant benefits that can be derived from utilising clean energy in hotels and other tourist accommodation.
- **Chapter 3: Making the Best Use of Clean Energy- How to Use this Manual** is the core component of the manual. This chapter provides guidance in how to plan and deliver clean energy for tourist accommodation facilities that is locally appropriate and sustainable environmentally, financially and socially.
- **Chapter 4: Clean Energy Technologies- Reducing or managing the energy needed.** This chapter and the following chapter explain all of the commonly available clean energy technologies that have been or could feasibly be applied in the tourist accommodation sector in Peru, from small-scale home-stays to medium and large hotels. Chapter 4 covers technologies to reduce energy use. For each technology there is an explanation of what it is and how it works, guidance on how to determine in what situation each technology might be applied, and benefits and challenges relevant to each. This chapter is particularly relevant for those focussing on the needs of a single hotel or facility but also provides an invaluable guide to the types of technologies applicable to promote clean energy programs throughout the broader accommodation sector.
- **Chapter 5: Using Clean Technologies to Supply Energy** is focussed on technologies to clean up and improve energy supply. As in the previous chapter there is an explanation of what each technology, how to determine where the technology might be applied, and the benefits and challenges. It will be of particular use to those focussing on the needs of a single facility but also provides guidance to the types of technologies applicable throughout the accommodation sector.
- **Chapter 6: Developing an Approach to Clean Technology – what one hotel or hostel can do** outlines the relevant approaches that accommodation owners and operators can take to manage their energy use to reduce consumption and optimise benefits to the business that do not involve installing or investing in technology "hardware". For each approach there is an explanation of what it is, guidance on how to determine in what situation each approach might be applied, and benefits and challenges relevant to each. Similarly to Chapters 4 and 5, this chapter

will be of particular relevance to those interested in applying these approaches in one hotel or facility, but also to local decision makers interested in many facilities who want to know what approaches to promote more broadly in the accommodation sector.

- **Chapter 7: Facilitating clean energy in tourism accommodation – what can be done by hotels and stakeholders in tourism working together** contains specific strategies directly targeted at encouraging increased use of clean energy in the accommodation sector, based on approaches applied by a range of local decision makers around the world. This takes a similarly comprehensive approach to Chapters 4, 5 and 6, and will be of primary interest to those interested in promoting uptake in *many facilities* in a towns, region or across the country of Peru. Those interested in a *single facility* will be interested in this chapter if they wish to pursue a collaborative approach with other industry stakeholders, or want ideas when seeking support from local government or industry bodies.
- Chapters 4, 5, 6 and 7 draw on the experience of best practice case studies of accommodation and resorts from around the world. In these chapters, for each technology, approach or facilitation strategy there is reference to at least one best-practice case study. In **Appendix A** at **Chapter 8** there is more detailed information about each of the **18 case studies** referred to.
- Appendix B at **Chapter 9** provides details of **additional information resources** for the various components of the manual, including the technologies and approaches.
- Finally, **Appendix C at Chapter 10** gives specific information on **options for creating and obtaining funding** for clean energy initiatives.

2 WHY USE CLEAN ENERGY IN TOURISM ACCOMMODATION?

2.1 Tourist Development in Peru

The tourism industry in Peru has been growing rapidly since the 1990s achieving average growth rates of 7.85%[2.] The strong growth in the tourism industry is helping to diversify Peru's economy and as many of the most popular tourist attractions are located outside of the coastal region, tourism offers the opportunity to spread economic growth to less developed regions of the country. Peru attracted 1.55 million foreign tourists in 2009 who spent $1.081 billion USD[3.] The average foreign tourist spends 13 days in Peru and there are a particularly large proportion of young tourists with 25-34 year olds making up 53% of the foreign tourists in the years 2003-2005[4.] Chile and the USA are by far the biggest source of foreign tourists, providing 438 560 and 386 769 tourists respectively in 2009. South American countries represent the most important market; with not only Chile but also Argentina, Ecuador and Brazil also providing significant numbers of tourists[5.]

Despite the relative youth of the foreign tourists, four and five star hotels are a significant proportion of the market with almost half of all foreign tourists staying in one of these hotels at some point during their visit[6]. It is difficult to ascertain the exact breakdown of the share of the accommodation market for hostels and home-stays. Due to their small size there is a lack of reliable data on the level of utilisation of these services. However due to the relatively young age of the foreign tourists and Peru's strength in ecotourism and cultural tourism there it is possible that these smaller operators represent a larger percentage of the market than in many countries.

The public and private sectors are promoting the country's tourist industry in two specific categories: ecotourism and historical/cultural tourism. The main drawcard sites in the ecotourism sector are the Amazon rain forest and high Andes, including the Colca Canyon. In the historical/cultural tourism market Machu Picchu is the most important site receiving as many as 2000 tourists per day[7.] Cultural tourism has many flow on benefits, for example, each tourist spent on average $98 USD on Peruvian handicrafts in 2009[8].

2.2 The Energy System in Peru

In 2007 the estimated installed electrical capacity in Peru was 6.24 Gigawatts (GW) with 24.92 Terawatt hours (TWh) generated and 22.37 TWh consumed[9]. Of the total electricity produced, 84% enters the market while 16% is consumed onsite. It is expected that the demand for electricity will grow at a rapid rate of between 6% and 8.5% over the next eight years[10].

At present, Peru primarily depends upon hydropower and gas to generate energy. In 2006 around 72% of electricity generated was from hydroelectricity and approximately 24% of total electricity production was

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[2] Ministerio de Comercio Exerior y Trismo (2010), accessed at www.mincetur.gob.pe
[3] ibid.
[4] http://www.travelagentcentral.com/peru/perus-marketing-efforts-are-paying
[5] Ministerio de Comercio Exerior y Trismo (2010), accessed at www.mincetur.gob.pe
[6] ibid.
[7] Barcelona Field Studies Centre, (2009) "Machu Picchu: Impact of Tourism" accessed at http://geographyfieldwork.com/MachuTourismImpact.htm
[8] Andina (2010), "Every foreign tourist visiting Peru spends about $98 on handicrafts", accessed at http://www.andina.com.pe/ingles/Noticia.aspx?id=00YBAm5B5Sg=
[9] United States Energy Information Administration (2006), 'Peru energy Profile; accessed at http://tonto.eia.doe.gov/country/country_energy_data.cfm?fips=PE
[10] Global Business Reports (2009), "Minister of Energy and Mining anticipates energy projects with Brazil", "accessed at http://www.powermag.com/business/Peru-The-Potential-to-Become-a-Regional-Energy-Hub_2507_p2.html

from gas[11]. The development of the LNG Camisea project in the Amazon basin has lead to a significant rise in gas production and expansion of the gas industry is expected to continue.

Privatisation of the electricity sector began in 1994. While investment in generation, transmission and distribution in urban areas is predominantly private, resources for rural electrification come solely from public sources.

Where there is an electricity supply in the country, it is relatively reliable in a regional context. In 2005 the average number of interruptions per subscriber was 14.5 per annum with an average duration of 18.3 hours, which is only marginally above the average for the Latin American region.[12] Nonetheless, power outages of this magnitude have the potential to cause significant disruption to accommodation providers, and lead to a desire for improved security of supply, particularly at the higher end of the tourism market where more electrical services are provided. One of the main challenges for the country is the current level of access to energy sources, hence the importance of looking for additional sources of and increased access to energy. Peru has one of the lowest rural electrification rates in Latin America with only 79% of the population having access to grid electricity, which compares poorly to the Latin America and Caribbean average of 94.6%. In poorer, rural areas the percentage without access to grid electricity runs as high as 30%. Peru's National Rural Electrification Plan (PNER) aims to address and improve these access issues.

However, in meeting the challenge of access, the vulnerability of Peru to earthquakes, flooding, landslides and mild volcanic activity is important. These natural disasters are serious considerations in planning large-scale energy infrastructure and so the use of smaller scale local energy supply systems, described in Chapter 5 of this manual, also offers potential risk management benefits.

The other major challenge for Peru from its energy system, as with all economies in APEC and globally, is in relation to greenhouse gas emissions. The Peruvian electricity sector produced an estimated 29.93 Million Metric Tons of CO2-equivalent emissions in 2006[13]. With the assistance of the international community, energy sector planning will need to address this issue increasingly in the short- to medium-term and beyond, and thus local clean energy options are likely to align with national environmental objectives.

2.3 What is Clean Energy?

'Energy efficiency behaviours lead to reduced operational costs. This is the crucial first step before investment in more complex clean and renewable energy technologies. By introducing energy efficiency behaviours first they have reduced electricity consumption by 36%. If these savings continue over five years, this would be the equivalent reduction in carbon emissions of 20 000 tree seedlings growing for 10 years.' URBN Hotel, Shanghai, China

'One-third of our [energy] savings are derived from technical innovation and improvements, whereas two-thirds are from operational changes, avoiding wasteful habits and using energy/resources more wisely' Aurum Lodge, Rocky Mountains, Canada

[11] International Energy Agency (2007), "Energy/Heat in Peru in 2007", accessed at http://www.iea.org/stats/electricitydata.asp?COUNTRY_CODE=PE

[12] The World Bank, Benchmarking data of the Electricity Distribution Sector in the Latin America and Caribbean Region 1995-2005, Available from: http://info.worldbank.org/etools/lacelectricity/countryscorecard.asp?country_id=19&gr3=1&gr4=1&gr5=1&selline=#chart, Accessed 20 May 2010.

[13] United States Energy Information Administration (2006), 'Peru energy Profile; accessed at http://tonto.eia.doe.gov/country/country_energy_data.cfm?fips=PE

'Clean energy' is about far more than just the technologies that are used to generate energy. In this manual it refers to an energy system, which is using truly sustainable sources of energy supply to match the real energy needs of users. The key points of focus for the manual are these:

2.3.1 Energy sources

There are two major sources of energy used in tourist accommodation: electricity and fuel. The vast majority of energy use in the accommodation sector is electricity, due to its suitability for a wide range of applications, from lighting, heating and cooling, to cooking, pumping water and operating appliances. Fuel is primarily used for space heating, kerosene lighting, water heating and cooking (fuel used for transport is not covered in this manual). When considering the energy needs of an accommodation facility or the broader energy needs of a tourism region, it is necessary to consider how users currently consume or desire to consume these two kinds of energy.

2.3.2 Energy sources and energy uses

When considering energy system there is both an energy **source** and an energy **use**. In an *electrical* system, the energy source is the electrical generator, for example a solar panel, diesel generator, or coal-fired power station feeding electricity into the electricity grid. The energy use is the equipment that consumes the electricity, such as a light globe or appliance. In the case of *fuel,* the energy source is the fuel itself that is burned on-site, such as wood, gas or kerosene. The energy use is the equipment used to burn the fuel, such as a stove, gas heater or lantern. Accommodation owners, managers, staff and guests are the critical final piece of this equation, as they control the operation of these energy uses.

2.3.3 Matching energy supply and usage

Different sources of energy produce output at different times of the day, season or year (such as a solar panel producing electricity during sunlight hours), and energy users require energy at specific times (such as lighting at night time). Therefore it is important to consider how energy is produced, how energy is used, and potentially how energy is stored when determining the suitability of clean energy options. Well-matched energy supply and demand will result in a robust, stable energy system; while poorly matched supply and use can lead to unsatisfactory performance or failure.

Therefore, one of the primary considerations when designing any energy system is how the system could most benefit the people that use it, and how people are likely to operate it.

Best practice application of clean energy in a single hotel, hostel or facility, or for a tourism destination or region considers both the technical elements of energy supply and use, and the human elements of operation.

A clean energy system, therefore, incorporates **three fundamental components**:

- **efficient appliances:** ensuring that the energy using equipment within a facility uses the least amount of energy necessary to provide the desired services
- **supply:** using renewable and low-impact energy supply technologies in place of traditional technologies **and, importantly**
- **people:** ensuring that the users of energy (operators and managers of hotels, operational staff and guests) operate energy-using equipment in the most effective way to limit unnecessary energy use and to maximise the benefits of whichever technology is being used.

For accommodation facilities which are connected to an electrical grid, this research of best practice case studies in accommodation suggests that the most significant and commonly derived benefits of clean energy are reduced operating costs from installing energy efficient equipment and making users aware of their consumption, and access to new environmentally aware target markets.

For accommodation facilities—or those looking to develop accommodation facilities—in rural and remote areas off the electrical grid, the most significant benefits of clean energy tend to be access to new, more reliable energy services that improve living standards, and enabling new business opportunities in tourism services.

This manual provides the information necessary to understand what benefits specific clean energy technologies and approaches can offer within a given local context, and the steps to take to successfully tap into those benefits.

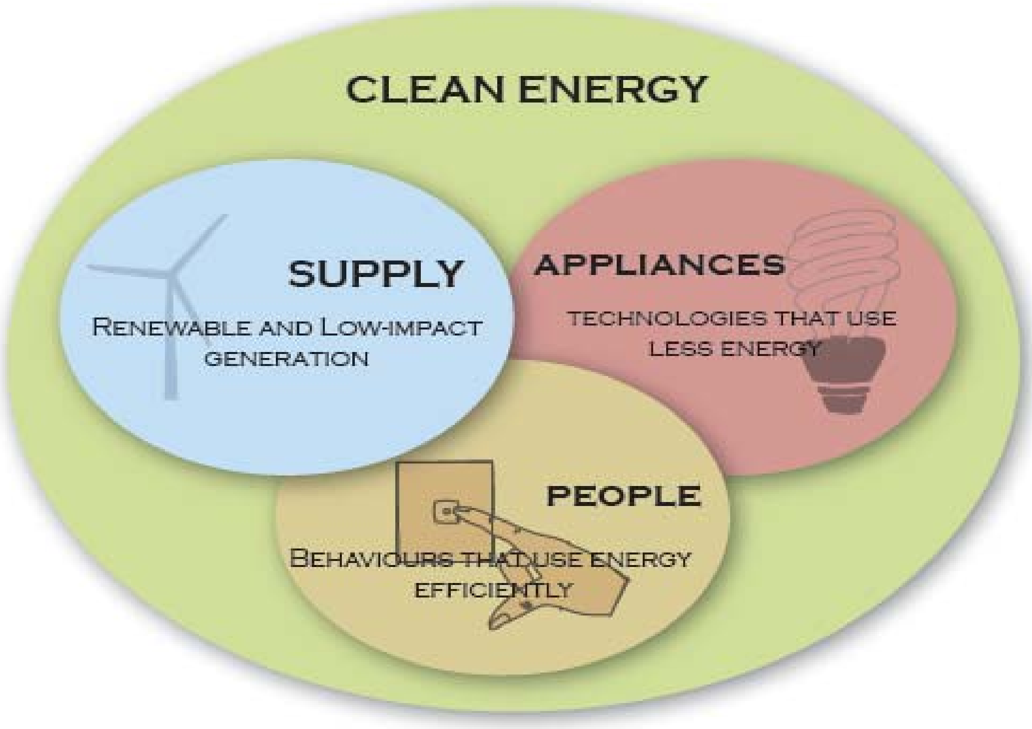

Figure 1 The three fundamental components of clean energy

2.4 The Benefits of Clean Energy

Adopting good practice in the use of clean energy contributes to each of the 'three pillars of sustainability' delivering social, environmental and economic benefits. These three pillars are based on the concept of the triple bottom line for sustainability (often referred to as 'TBL' or '3BL') promoted by many international organisations including APEC and the United Nations. The three pillars of sustainability are represented graphically below, indicating that overall sustainability is best achieved when environmental, economic and social objectives are all being met through the same initiatives. That is, the process of designing and implementing a clean energy system can address social needs, contribute to building a more sustainable environment, and be commercially viable.

Properly designed and managed clean energy will balance social, environmental and economic considerations in a manner that is tailored to the local situations and local needs.

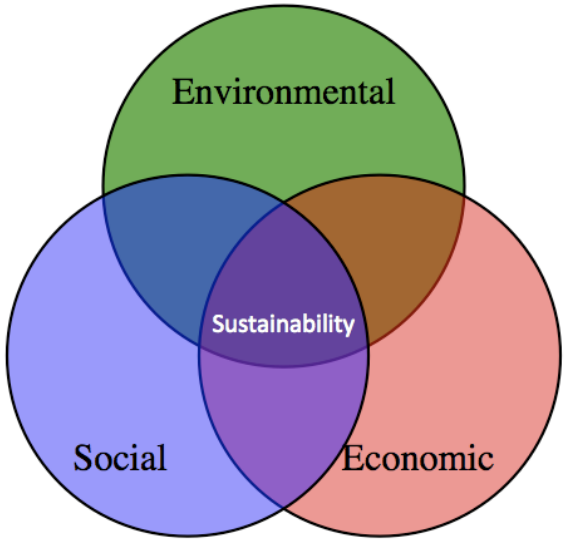

Figure 2 Sustainability is achieved when environmental, social and economic considerations are all in balance

The **environmental** benefits from applying clean energy in tourism accommodation include:

- reducing greenhouse gas emissions
- minimising local air, water, soil, air and noise pollution
- reducing stress on ecosystems (both local and 'upstream in the energy supply chain').

The **social** benefits for clean energy in tourism accommodation include:

- providing modern electrical and other energy services suitable to meet the needs of business and development needs of the local community (particularly in developing countries)
- improving reliability of energy supply to provide better user outcomes
- promoting positive social and cultural outcomes in the local community
- increasing visibility of the clean energy applications in the industry and community.

The **economic** benefits from clean energy in tourism accommodation include:

- increasing income through reduced cost of operation
- making efficient use of available resources and financing
- increasing customer satisfaction
- increased access to new ecotourism markets
- capitalising on external funding opportunities.

2.5 Clean Energy and Tourism

The travel and tourism sector's current contribution to global greenhouse gas emissions (excluding aviation) is estimated to be 3 per cent of global emissions from human activities. Worldwide accommodation emissions make up more than 15 per cent of the overall travel and tourism sector's footprint14. The World Economic Forum estimates that accommodation emissions will increase by 156 per cent by 2035, with the biggest growth in emissions expected to occur in the Asia Pacific region15. In order to reduce greenhouse gas emissions and improve energy security a step change in the way energy is supplied and used is required.

[14] WEF 2009, Towards a Low Carbon Travel and Tourism Sector, p.17
[15] WEF 2009, Towards a Low Carbon Travel and Tourism Sector, p.18

2.6 The Potential for Clean Energy in Peru

There are currently limited examples of renewable energy investment in Peru, with the focus to date predominantly on large-scale gas and hydro projects. Despite this, the government through the PNER and the Energy Efficiency Plan has begun the process of identifying clean energy potential, with partnerships being formed with international development agencies such as United Nations Development Program and the EU4CDM. However there is still little mention of renewable energy within the government's currently prioritized energy infrastructure projects16. The good wind and solar resources in some regions could be leveraged through investment in renewable energy projects at the local, regional or national scale.

Peru, like many developing countries, does not have substantial consumption of energy per capita. However, investment in demand side reduction measures can have a substantial impact on the existing and planned energy infrastructure. Energy efficiency and peak power planning can limit expenditure on unnecessary supply infrastructure to more effectively allow expanded energy access where it is most beneficial.

As access to electricity increases, managing attitudes and behaviours through education on energy and electricity use can increase the effectiveness of energy infrastructure. Education and incentive programs can be used to limit cost and wastage, while still increasing access to electricity.
The three major categories of clean energy (clean supply, demand side management and education) can contribute to the nation's commitments to energy access, GHG reductions, energy efficiency and energy security.

The Peruvian government is interested in clean energy as a way to improve living standards throughout the country17. Critical goals that can help to meet this need include improving the access to electricity for the rural poor and improving the reliability of the electricity system.

The technologies, approaches and case studies presented in this manual can be effectively applied to improve quality of life in Peru. There are opportunities to increase local quality of life by demonstrating successful application of clean energy in tourism accommodation, opportunities to apply policy and approaches that have been used in other regions, opportunities to promote clean energy for tourism at a regional level, as well as opportunities to increase the linkage between improved infrastructure for locals and improved services for tourists.

[16] Global Business Reports (2009), "Minister of Energy and Mining anticipates energy projects with Brazil", accessed at http://www.powermag.com/business/Peru-The-Potential-to-Become-a-Regional-Energy-Hub_2507_p2.html
[17] Sivella, E., Vice-minister, Peruvian MINCETUR (Ministry of Foreign Trade and Tourism), Personal communication (28 April 2010)

3 MAKING BEST USE OF CLEAN ENERGY: HOW TO USE THIS MANUAL

3.1 Technologies, Approaches and Facilitation

> *'This is core to the whole process of Clean Energy—to implement reductions and savings through energy efficient procedures first. Once this is completed, the revised energy audit then reveals which are the remaining key users of electricity. Research from here can then reveal the most suitable energy efficiency or renewable energy application to implement to reduce the remaining consumption areas.' Mesoamarica Reef Tourism Initiative, Mexico*

This chapter identifies the key considerations for making the best use of clean energy in hotels hostelries and other tourist accommodation. It is based on the approach outlined in the previous chapter in that adopting clean energy is about more than looking at introducing technologies, which use clean or renewable sources for generating energy or as a source of fuel.

Evidence from the diverse case studies investigated in preparing this manual (see chapter 8, Appendix A) suggests that while significant amounts of energy can be saved through the installation of more efficient technologies, even greater energy savings can be achieve by changing the way appliances are used. Moreover, where new renewable supply or energy efficient technologies *are* introduced, they will have a more sustainable impact when combined with approaches which address how and where energy is used in an establishment by both staff and guests.

3.1.1 Key messages

There are a number of key messages from the experience of the case studies of good and best practice reviewed for the manual:

- **Undertaking local assessments** is crucial in order to identify:
  - How much energy is currently being used, what it is being used for and at what times of the day and year
  - How the hotel or facility can become "cleaner" and more efficient in its energy use before thinking about investing in new technologies or equipment
  - What are the most locally appropriate and available technologies to make energy use efficient, and, if there is a need for an increase in the supply of clean energy, for generating energy
  - What are the potential barriers or challenges locally in moving to cleaner energy use and generation and how can they be overcome
- **Planning the introduction of cleaner energy** should be undertaken over a period adequate to:
  - undertake the necessary assessments to identify options
  - get the benefits from initial savings and identify the sources of finance for new equipment
  - introduce any new technology and learn how to operate it most effectively
  - train and educate staff and guests
  - engage with local stakeholders

Case study: China—URBN Hotel, Shanghai

URBN Hotel is a renovated factory warehouse in Shanghai developed into a 26 room boutique hotel that incorporates a raft of sustainable design principles and energy efficiency equipment and behaviour. Beginning with basic applications such as energy efficient lighting, the hotel has undertaken a program of no-cost and low-cost behaviour and operational changes in their heating, cooling and water systems including:

- careful management of the HVAC system to minimize simultaneous heating and cooling of the building;
- the chiller coil is manually reset every 10 days to ensure it is not operating too coolly for the hotel's needs;
- HVAC filters are cleaned every month and coils are cleaned every two months;
- guest room temperature thermostats have been adjusted;
- hallway lights are turned off during day time as there is sufficient natural light and only half are on 2am-6am; and
- radiant floor heating only comes on if the room falls below 22 degrees celcius.

Focussing on efficiency behaviours first has reduced electricity consumption by 36% which translates to approximately US$20,000 and 92 MtCO2-e of greenhouse gas emissions savings. This case demonstrates that a number of small operational and behavioural changes can add up to highly significant savings when a range of stakeholders is brought on board.

3.2 Undertaking local assessments

For operators of an individual hotel or tourist accommodation, the available technologies for managing energy needs, for generating energy and for approaches to clean energy provide a range of options. The manual indentifies the conditions and situations where each of them is likely to be most effective. However, in order to decide whether or not the use of a particular technology or approach is going to be beneficial, the operators need to have prior information about a number of aspects of the local conditions, including the availability of support and funding from government and other sources. So, before assessing each of the options for technologies or approaches, operators will need to have undertaken an assessment of the following elements of their local situation:

- existing energy use
- existing energy supply
- locally available renewable energy resources
- local barriers to clean energy uptake.

3.2.1 Existing energy use

Knowing what the current levels of energy use are in the hotel or facility will help identify priorities for introducing clean energy initiatives and also what the effective options are likely to be. This means measuring:

- The total use of energy in the establishment
- The particular appliances or activities that are using the most energy, such as heating, cooling or lighting.
- The times of the day and year when energy is being used in the hotel or facility. This pattern of usage will be linked to the most significant energy using activities and the season of their occurrence.

Energy use can be measured by monitoring or auditing. Auditing current use makes it possible to consider to what extent the hotel or facility can make itself “cleaner” and more efficient in its energy use before looking at the options to generate or buy more energy.

3.2.2 Case studies

Auditing then monitoring energy use is a significant component of the approach taken to clean energy in every best practice case study in this manual. The Black Sheep Inn in Ecuador put a lot of initial time into knowing what their energy use patterns were and on the basis of this introduced incremental improvements in energy use at minimal cost all of which amounted to considerable savings. Collecting information on energy use has been an integral part of the Saving in the City initiative in Melbourne Australia through which 30 City Hotels and serviced apartments have been able to make significant costs savings. The Energy Wise Hotels toolkit prepared for Savings in the City contains information on how to collect energy data.

The evidence from the best practice case studies is that the time spent in undertaking the assessments of what energy is used for and the real ‘need’ is rewarded in the longer term. The Evason Phuket and Six Senses Spa spent the first two years of an initial four-year program of renovation and energy reduction initiatives monitoring and analysing the energy use then the second two years was the testing and implementation of initiatives.

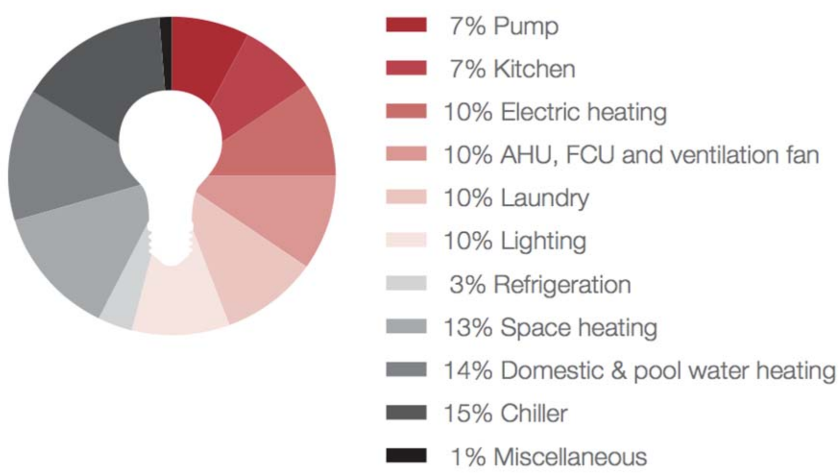

Figure 3 Example of total energy consumed in a hotel

Source: Energy Wise Toolkit, Green Hotels program Melbourne, Australia

3.2.3 Existing energy supply

Consideration of, if or how electricity is currently supplied to a facility or the local area will be a key determinant of the types of options available.

On-grid

The *reliability* of the local electricity supply also influences the types of electrical services or alternative supply options which can be used effectively. In Peru the number of interruptions per subscriber is around 14.5 per annum at 18.3 hours per outage. Despite this figure being only marginally above the average for the Latin American region, it is likely that accommodation operators reliant on the electricity grid have needed to adapt with contingency plans such as backup generators or alternative lighting sources such as candles and kerosene lanterns. This results in additional expense and inconvenience, particularly where services such as electric refrigeration of perishable supplies are interrupted. Therefore the reliability benefits of clean energy are considered likely to be of importance to Peru accommodation providers. The Peru reliability context may mean that a grid-connected solar PV system, for example, may be most appropriately designed with some (limited) battery storage to cover these periods of outage if they are of significant concern to the facility operator and its guests.

The *cost* of the local electricity supply will influence the relative cost-effectiveness of clean energy in terms of avoided electricity purchases, both for energy reducing appliance and behaviour, and supply technologies that offset the need to import electricity. Electricity prices across APEC vary considerably

county by country. The higher the cost of local electricity and other traditional energy fuels supply, the more cost-effective clean energy options to reduce usage will be.
In Peru, where hotels and hostelries are able to connect to the electricity grid, they are likely to be using energy generated from a majority renewable source, since 72% of the country's energy is from hydropower. Therefore in terms of environmental *sustainability,* the overall emissions reduction benefit achievable from converting to a local renewable electricity supply source is reduced considerably.

Off-grid

In many rural and regional areas in Peru, there will not be an option of a small hotel or hostel connecting to an existing electricity grid given that between 20 and 30% of the population in these areas do not have grid access. For a single hotel or facility this is likely to mean making an assessment of the viability of the various options for using clean energy technologies to generate or produce energy, discussed in Chapter 4 of this manual. Considerable use is already made of hydropower in Peru, and the potential from wind power generation and solar energy in the country have already been identified[18].

However, determining what is going to be the most suitable technology in a particular location will be influenced by a number of factors. It will be important to have assessed each of these **before** considering which clean energy technologies are suitable:

- location geographically, climatically and in terms of topography
- availability of energy sources
- the scale of generation required (for which making a prior estimation of the energy requirements as indicated above is a prerequisite)
- the cost, in terms of installation, operating costs, likely maintenance requirements. It is important to make estimations in terms of total historic cost not merely initial costs of installation/purchase
- the potential availability of financial resources and support
- the availability of local resources, particularly skilled people, to install and maintain technologies.

3.2.4 Locally available renewable energy resources

Each of the technologies for using renewable energy resources to generate energy depends on the availability of those resources locally, as described in Chapter 5 of this manual.

- Bio-energy based generation (see section 5.1) depends upon the local and sustainable availability of:
    - o biomass which can include wood, agricultural energy crops or waste
    - o Liquid bio-fuels including vegetable oils, bio-diesel and ethanol
    - o biogas from organic matter such as animal waste.
- Geothermal systems require heat in the ground or a significant temperature difference between the earth and the air. The soil also has to be of an appropriate quality and composition (section 5.3).
- Micro-hydropower is dependent on flowing water in the vicinity of the establishment (section 5.4).
- Solar photovoltaic (PV) systems and solar water heating are powered by sunlight (sections 5.5 and 5.6).
- Wind energy systems require adequate annual average wind speeds and distribution during seasons that match the user's needs (section 5.7).

So, consideration of locally available resources is important to select appropriate approaches and technologies. Having the skills, knowledge, and, in some cases the equipment, to assess what is feasible in terms of technologies may be beyond what is possible for a single hotel or facility. There may be indirect sources of this information through looking at what other facilities in the same area are able to

[18] Global Business Reports (2009), "Minister of Energy and Mining anticipates energy projects with Brazil", accessed at http://www.powermag.com/business/Peru-The-Potential-to-Become-a-Regional-Energy-Hub_2507_p2.html

accomplish successfully. Local or national government departments in some countries are also able to assist with providing, locating or recommending resources to make the assessments.

3.2.5 Identifying the likely challenges and barriers to clean energy uptake

Operators intending to introduce clean energy into a hotel or facility will undoubtedly face challenges. All the successful case studies reviewed in the preparation of this manual have identified barriers and challenges they have had to overcome. Many of them refer to their resilience and adaptability in meeting these challenges as being the key to their successful introduction.

Part of the preparation for successful introduction of clean energies is to identify the potential barriers and incorporate measures to meet them into the plan for moving towards clean energy. This implies undertaking assessments before embarking on implementing plans, particularly about local conditions, and using the technologies and approaches, which are most appropriate for local conditions in the light of these barriers.

For the longer term, successfully removing barriers to clean technology will involve the active involvement of the National government, tourism organisations and other stakeholders, hence the inclusion in this manual of a chapter on facilitating clean energy.

The main challenges identified in the successful case studies, and which are therefore likely to arise are:

- **costs of investing in new technologies:** this emphasises the importance of reviewing what can be done in terms of efficient clean energy **before** embarking on projects to invest in new equipment and also the importance of making any decisions on appropriate technologies in terms of their likely total cost
- For the national government in Peru and for regional organisations interested in promoting or supporting clean energy, this underlines the importance of assisting in identifying funding opportunities (section 7.4 of this manual) and providing information resources on issues such as funding (section 7.3).
- **the absence of local skills or knowledge** and finding suitable and skilled contractors, etc: for an individual hotel or facility, the sh**ort ter**m solutions f**o**r meeting this challenge will be to select the technologies which can be supported by local skills and knowledge. For the longer term, it underlines the importance of the Government and other stakeholders supporting the development of local skills (section 7.5)
- **lack of information** *"In the planning / design phase, the main difficulty was to obtain information on renewable energy / energy efficient building practices, which were not very readily available in North America. As a result, much of the design is based on European reference literature, adapted to North American building practices"*[19]. This manual is designed to provide information and links to resources to assist in meeting this challenge. But it also points to the importance of the Government and its agencies, the regional tourism organisations and other stakeholders assisting in providing the local information which hotels and other facilities will need (section 7.3).
- **local regulations or building codes:** *'In their recent planning of a 6kW wind turbine, council regulations are proving too restrictive with no measure for adapting to or facilitating the process of reducing emissions, despite council's goal of reducing emissions throughout the county."*[20] Understanding the local regulations that will apply is an important part of the preparation for thinking about which clean energy technologies can be adopted in specific local circumstances. It emphasises the importance of engaging early with local stakeholders and particularly the Government.
- **local availability of technology and equipment:** knowing what is available in a particular country or location is as important part of the assessment of the appropriateness of any of the technologies for using energy more efficiently or introducing cleaner technologies for energy

[19] Aurum Lodge, Canada.
[20] The Hytte, UK.

generation. Providing clear information on what is available locally is also an important part of the support and facilitation for the introduction of cleaner technologies.

- **education and keeping engaged with people:** *'Probably one of the most challenging items has been educating the guests and staff in the consumption of energy. [The facility] prohibits the use of hair dryers, irons, and to limit the amount of energy guests use, there is one outlet in the reception where people can charge their mobile phones and cameras.'* One of the most important messages in this manual is that introducing or moving towards cleaner energy use is as much about people as it is about the technologies. Providing information to guests, and training staff therefore need to be integral parts of the plans hotels and resorts make for cleaner energy
- **constraints from designs of existing buildings and facilities:** assessing the capacity and potential of the existing physical structures and locations is a fundamental part of the preparatory work for hotels and facilities thinking about the options really available to them
- **technical challenges and issues**: *'There was also doubt about the solar water pumps because they had never heard of anyone pumping water 54m (in elevation) with solar water pumps'* Local appropriateness is an essential consideration for each of the technologies contained in chapters 4 and 5 of this manual. However, many of the case studies indicate the importance also being innovative and adaptable in working out how a technology can be used, with local support and expertise
- **getting local energy suppliers to support initiatives/agree to projects:** Local energy utilities, suppliers and suppliers of equipment are some of the most important stakeholders in bringing clean energy initiatives for hotels and facilities to fruition. Individual hotels and resorts will need to think about engagement with these stakeholders as parts of their own planning. For the Government and associations promoting or facilitating clean energy uptake communication and information sharing with energy utilities and suppliers is a significant part of building local, regional and national networks.

3.3 Planning the Introduction of Clean Energy

One of the greatest operating costs of our hotel is the cost of energy. Our hotel is committed to sustainable tourism. We are also concerned about the greenhouse gas emissions associated with our energy use. We therefore commit to reducing the energy consumption of our hotel by 2 per cent each year for the next 5 years. We commit to supplying 30 per cent of our energy from renewable energy sources within 5 years. Energy efficiency will be the main consideration when purchasing equipment. It is the responsibility of staff members and guests to use energy wisely and efficiently.

3.3.1 Making an energy policy and plan

Before deciding upon any specific technologies or other courses of action, a hotel or resort can usefully combine the information from the assessments of current energy use, the various aspects of local conditions including likely barriers and challenges and how these can be overcome, in a clean energy policy. This can set the direction for an organisation's objectives, while also providing a high level set of principles and goals for a local accommodation site or a tourist area.

An energy policy can be adopted for both small and large accommodation facilities. It is useful to have a picture of the accommodation facility's energy use, including the cost of energy bills. With this information, and in consultation with staff members, the high level principles of the energy policy can be determined.

Once the clean energy policy is established, a more detailed energy management plan can be developed that maps out the specific actions that need to be implemented to achieve the policy goals. The energy management plan might include timetables for installing clean energy technologies as well as plans for introducing energy awareness training for staff, and a communication plan for staff and guests. The energy management plan would also develop indicators to measure success.

3.3.2 Training and educating staff and guests

Energy awareness training for staff can include some fairly simple messages which are virtually cost free to implement but which can be highly successful and effective in reducing unnecessary energy use, such as:

- turning off lights and other appliances when not required
- turning off office equipment such as computers and printers
- drying laundry outside in the open air instead of with dryers
- turning off or dimming the lights in common areas at night time.

Some of the successful case studies have also used staff recognition and rewards which encourage staff members to identify new innovations and practices that will result in energy savings is as part of a process of keeping staff motivated and creating a culture of energy efficiency and innovation.

One of the benefits of clean energy commitments is the attraction to tourists and guests seeking environmentally responsible accommodation providers, so these can be promoted through new or pre-existing marketing channels.

In Kruger National Park (South Africa) guests at the Mopani Rest Camp were given reductions in the costs of their accommodation but had to pay for their own water and electricity. Guests were provided with feedback information about their water and electricity use and energy and water saving devices such as compact fluorescent light bulbs and low-flow shower heads were installed. The results were very positive as guests reduced their water use by 74% and their electricity use by 52%. Guests were positive about the experiment and perceived the level of inconvenience to be low[21].

3.3.3 Monitoring progress

Energy use must then be continually measured in order to monitor performance. Without monitoring, it will be difficult to evaluate any energy and cost savings. Continual follow up is required so that energy efficient practices are maintained. Monitoring energy use can also be useful for identifying faulty equipment or unusual activities such as equipment being left on at certain times.

Energy monitoring can be carried out by reviewing electricity bills, readings from on-site energy monitoring equipment, checking equipment daily as well as surveying staff and guests about their energy use.

3.3.4 Engaging organisations and stakeholders

A hotel or tourist facility working towards the use of cleaner energy is clearly going to have to work with a range of stakeholders both ‘internal’ (owners, staff, guests) and ‘external’. The wide range of potential indicators is illustrated below. Identifying the important stakeholders in a specific locality and engaging with them are crucial steps to be undertaken, particularly in addressing some of the potential challenges identified previously. The good practice case studies in the Appendix A (chapter 8) to this manual have indentified the stakeholders who were important in the planning and implementation of their facility or initiative.

[21] Preston, G 1994, the effects of a user-pays approach, and resource-saving measures, on water and electricity use by visitors to the Kruger National Park. South African Journal of Science, Vol 90, Nov/Dec, pp 558-561

Figure 4 Tourism stakeholders

For those stakeholders with an interest and commitment to supporting or facilitating the take up of clean energy in specific hotels, tourist destinations or regions, it will be important to consider what particular services or facilities they can provide. Individual hotel owners and operator and tourism organisations can obviously take a role in encouraging or asking local and national governments and other stakeholders to provide these support services and activities. The most important support and facilitation services and activities identified from the case studies are identified in chapter 7 of this manual.

3.4 Being Clear About Goals and Objectives

It will be important for the hotel or facility to be clear about the specific goals of introducing clean energy. While there are undoubtedly many potential benefits in moving to cleaner energy in tourist accommodation (reducing greenhouse gas emissions, investing in more secure sources of energy, reductions in costs, etc.) the priorities for a particular hotel or facility, its owners and operators will influence how it proceeds and what will be the most suitable options. For many of the best practice case studies, the goal has been to move to a greater overall sustainability in their operations, which has meant that using cleaner energy has been part of larger overall programme. For others, the main driver and imperatives have been to reduce costs. For those without access to grid electricity, having a secure and modern energy source in the major priority.

Being clear about the goals in introducing or moving toward cleaner energy in a particular hotel or facility will assist in:

- identifying and assessing options in terms of whether investment in technologies will be helpful
- communicating with staff, guests about how the hotel or facility operates and how they can contribute
- communicating and networking with other stakeholders
- providing the basis for monitoring how well the hotel is proceeding in meeting these goals—ongoing monitoring is an important component of most of the best practice case studies covered in this manual.

3.5 Using a Combination of Initiatives

To be most effective, the approach to clean energy combines:

- **efficient appliances:** ensuring that the energy using equipment within a facility uses the least amount of energy necessary to provide the desired services
- **supply:** using renewable and low-impact energy supply technologies in place of traditional technologies
- **people:** ensuring that the users of energy (operators and managers of hotels, operational staff and guests) operate energy-using equipment in the most effective way to limit unnecessary energy use and to maximise the benefits of whichever technology is being used.

Every one of the best practice case studies included in this manual is using a combination of approaches to use the most efficient and effective appliances, to introduce or use clean energy generation technologies and using education, training and other activities for staff and guests so that unnecessary and costly use of energy is reduced if not removed.

This manual therefore goes through the technologies for efficient use of energy and for energy supply, before tackling the approaches to promote best practice behaviours in accommodation management, staff and guests. Finally, a dedicated section on facilitating broader uptake of clean energy across the accommodation sector is provided.

3.5.1 Clean technologies to reduce or manage energy needs

The manual covers the following applications of clean energy technologies which enable hotels, hostels and resorts to manage their energy needs and for each of them provides a description of what it is and how it works, guidance on how to determine in what situation each technology might be applied, and benefits and challenges relevant to each:

- building design
- efficient heating and cooling
- energy efficient pools and spas
- energy management system
- energy efficient appliances
- energy efficient laundry
- energy efficient lighting
- water efficiency and energy savings.

3.5.2 Clean technologies to supply energy

The manual also includes the relevant information about each of the following technologies which use clean or renewable energy sources to generate and supply energy and indicates the situations in which they are likely to be most useful, including:

- bioenergy
- combined heat and power (CHP) Systems
- geothermal systems
- micro-hydropower
- solar photovoltaic (PV) systems
- solar water heating
- wind energy system.

3.5.3 Developing an approach to clean energy

Apart from, or in addition to, adopting cleaner and more efficient technologies for how energy is used, accommodation facilities can become ‘cleaner’ in their energy use by adopting approaches, which do not require any new or different technological hardware. These are also discussed in the manual:

- certification schemes
- carbon offsetting.

3.5.4 Facilitating clean energy in tourist accommodation

The Government, regional bodies and tourism organisations can provide significant support for and facilitate the take up clean energies through technologies and approaches in several ways. These are beyond the scope or resources of an individual hotel or hostel but can be very important in establishing the framework for taking up clean energy in a tourism location, be it a town, region or across the country.

These mechanisms for sponsoring or supporting clean energy included in this manual are:

- promoting certification schemes
- facilitating communication
- developing information resources
- establishing a vision for clean energy in an area
- creating funding opportunities
- green tourism branding.

4 CLEAN ENERGY TECHNOLOGIES: REDUCING OR MANAGING THE ENERGY NEEDED

This chapter covers applications of clean energy technologies, which enable hotels, hostels and resorts to reduce or manage their energy needs. For each of the following technologies it provides a description of what it is and how it works, guidance on how to determine in what situation each technology might be applied, and benefits and challenges relevant to each:

- building design
- efficient heating and cooling
- energy efficient pools and spas
- energy management system
- energy efficient appliances
- energy efficient laundry
- energy efficient lighting
- water efficiency and energy savings.

4.1 Efficient Heating and Cooling

4.1.1 What makes heating and cooling efficient?

Active heating and cooling the interior of an accommodation facility can be very energy intensive and expensive. Therefore, if heating or cooling devices are operated efficiently it will minimise cost and environmental impact.

In order for a heating and cooling system to be operating efficiently: firstly, it should be operated in a way that minimises energy wastage. Secondly, the system should be suitable for the needs of the accommodation facility. Thirdly, is the heating or cooling technology and/or the fuel source should be appropriate.

4.1.2 Is it right for you?

Do you need a heating or cooling system?

One of the first steps to take when considering the installation of active heating or cooling is to ask whether you really need it. What could you do to avoid installing an expensive and energy intensive technology? In warmer climates, will increasing the use of fans and increasing ventilation be sufficient? In colder climates, will increasing winter sunlight using passive building design be sufficient (refer to section 4.2)? Will improving the thermal performance of the ceilings, walls, floors and windows improve comfort sufficiently?

Can you make your existing heating or cooling system more efficient?

If you already use heating and cooling devices in your accommodation facility, can you improve the efficiency and reduce the energy consumption of your existing technology? If you have not done so already, applying the methods listed above (see ‘Do you need a heating or cooling system?’) must be a priority. Doing so will substantially reduce the amount of time your heaters or coolers are in use, and also reduce the amount of energy they demand when in use.

It is a good idea to use control devices such as thermostats and timers for your heating and cooling system, particularly if guests or employees are in control of the device. In bedrooms, energy activating key-tags will ensure bedroom heaters or coolers are not left on when the room is empty.

If your heater or cooler has a thermostat, ensure it is set as high as comfortably possible in summer and as low as comfortably possible in winter. Each extra degree Celsius you can adjust the thermostat will save 5 to 10% energy. It is a common myth that using a high winter thermostat (low summer thermostat) will heat (cool) the space quicker. In fact, when you use the thermostat you are programming your desired room temperature; the heating or cooling device will operate at its maximum until the desired temperature is reached. It will then reduce its energy consumption to maintain a constant temperature. As a guide, the Australian Government recommends thermostats should be set to between 25°C (77°F) and 27°C (80.6°F) in summer, and between 18°C (64.4°F) and 20°C (68°F) in winter. Check your local energy authority for advice about an energy efficient temperature for your climate. If guests or employees have control of the thermostat, signage, which informs of appropriate temperature settings will minimise energy wastage.

If your heater or cooler has a thermostat, check it for accuracy and location. Use a thermometer to check accuracy of thermostats by comparing the thermostat reading with the actual room temperature. For example, if you are cooling and the thermostat reads 27°C but the actual room temperature is 23° C, the air-conditioner is overworking, either because the location of the thermostat is inappropriate as it does not measure the actual room temperature, or the thermostat itself in inaccurate.

Fans use 40 to 100 times less energy than a single room air conditioner. If an air conditioner is still required, use fans in conjunction with a higher thermostat setting to achieve energy savings.

If your facility has a ducted heating or cooling system, ensure the ducts are well insulated and checked regularly for leaks. Ensure the system has zoning to minimise the space that is being heated or cooled.

4.1.3 Which system suits your needs?

What are the needs of your accommodation facility?

If you have decided that you do require heating or cooling, it is crucial to choose the right type of system for your needs. There are two main types of heating and cooling systems, centralised, or auxiliary.

Centralised systems have a single source of warmth or cooling and work by either pumping air into rooms through a series of ducts and vents (ducted system), or pumping water or steam into radiators in rooms or under floor through a system of pipes (hydronic system). One of the main benefits of a centralised system is that an accommodation manager can have complete control over how the system is used.

Auxiliary heaters and coolers are much smaller than centralised systems and are used to heat a single space. They either sit in the room on the floor or are mounted on the wall, and are often portable. An advantage is that guests can use the device to suit their personal comfort; however, this may also lead to wasteful energy consumption. Another advantage is that the costs of using auxiliary heaters or coolers in bedrooms can be covered by a premium room tariff.

Centralised systems are an efficient choice when:

- the climate demands regular heating or cooling; and
- accommodation facilities are concentrated in only one or a few buildings, and
- rooms are frequently occupied.

Auxiliary systems are an efficient choice when:

- the climate demands heating or cooling for only some months of the year, or
- accommodation facilities are spread through multiple buildings, or
- rooms are less frequently occupied.

A mix of centralised and auxiliary systems may be efficient. For example, take a hotel in a cold climate. Common areas such as foyers, kitchens, halls, offices have regular use and therefore centralised heaters may be suitable. Bedrooms are less frequently occupied and therefore auxiliary heaters may be suitable.

Which heating or cooling technology should you use?

Once you have determined the right type of heating or cooling system, you need to choose an efficient technology to do the heating and cooling. On top of this, you need to ensure the technology is no larger than what is required to heat or cool your space/s. Consult with a heating and cooling specialist to find the correct size for your needs.

Electric heat pump technology (also known as a reverse cycle air conditioner) is the most common form of heating and cooling in temperate to tropical climates. It uses 3 to 4 times less energy for heating than electric boiler technology. It works by compressing a refrigerant to generate heat (the process is reversed when cooling). Air is utilised in the process, and if the air temperature drops below approximately 10°C (50°F) the heat pumps heating effectiveness diminishes. As a result, geothermal heat pump systems are common in colder climates, as they boost the ambient air temperature required for operation. They are effective because they utilise warmer underground temperatures, which are relatively constant throughout the year. Similarly, if you have reliable winter sun, solar thermal energy can be used to boost the effectiveness of a heat pump. Because of the high upfront costs of geothermal and solar heat pump technology, they are typically only used for centralised heating systems.

Hydronic systems can be environmentally friendly, particularly if a renewable resource is utilised. Close to tectonic plate boundaries, underground temperatures may be high enough to heat water via a series of underground pipes, before distributing to rooms. This is known as direct geothermal heating. Similarly, a solar hydronic system, where water is heated by the sun in collectors, is possible in temperate, sunny climates. Again, these energy sources are typically only used for centralised heating systems.

Hydronic, ducted and auxiliary heating systems which use fuels such as natural or liquid petroleum gas, wood, biofuel, biomass or biogas often have lower emissions compared to oil and electric heaters. Wood, if sustainably harvested, can be an excellent fuel because it is a renewable energy source. However, air pollution from wood fires and the transport of firewood to urban areas is environmentally detrimental. Similarly, the environmental costs of using biofuels or biogas will vary depending on how they are produced. Only burn these fuels in high efficiency, low emission heaters with appropriate ventilation.
Recycling heat from cogeneration may be possible if you have a separate heat source emitting waste heat in your accommodation facility. Cogeneration may be used for hydronic or ducted systems, as well as providing a boost for a heat pump air-conditioner.

Auxiliary electric heaters are usually energy inefficient compared to the technology discussed so far. However, some models can still heat small rooms using little energy. For example, low wattage wall mounted panel heaters can heat a bedroom-sized space relatively effectively at little cost.

Evaporative coolers are an effective cooling technique in dry climates. A fan draws air from outside the unit through a moistened pad. As it passes through the pad, the air is cooled by evaporated moisture. Used in the right climate, evaporative coolers can use 70% less energy than a heat pump air conditioner. They do, however, require water to operate.

4.1.4 Benefits

Energy efficient heating and cooling systems provide effective warmth or cooling at a lower running cost. Renewable resources such as direct geothermal and solar hydronic heating have zero running costs (assuming boosting is not required). Resources such as biofuel, biogas and wood may be locally sourced, providing additional local economic benefits.

4.1.5 Challenges

The upfront cost of purchasing and installing energy efficient heaters or coolers is high, particularly with a centralised system or multiple auxiliary systems. Despite being efficient, the energy running costs may still be quite high in many cases. Maintenance costs may also be high in larger accommodation facilities. Renewable resources will not be available in all geographic locations or climates.

4.1.6 Further information

The Australian-focussed Your Home technical manual covering heating and cooling is available at: www.yourhome.gov.au/technical/fs62.html

4.2 Building Design

4.2.1 How can building design reduce energy needs?

Building Design or 'passive solar design' refers to a group of design approaches that aim to harness the sun's heat energy to assist heating, cooling, ventilating and lighting a building. It involves understanding and managing the transfer of heat in and out of your building. By doing this effectively, passive solar design can greatly reduce a building's energy needs.

While new buildings provide the flexibility to incorporate energy efficient design, it is not limited to new construction. Existing accommodation types can also be effectively retrofitted to significantly improve their performance.

4.2.2 Is it right for you?

Will it suit your accommodation type and available space?

Passive solar design can be applied to any accommodation type in any location.

Will it suit your climate?

A building can be designed to make the most effective use of the local climate. That is, the building can maximise the sustainable use of local resources and the amount of available sunlight such that it is easy and inexpensive to cool in hot weather, or heat in winter particularly at altitude. Some of the key principles of solar passive design are explained in greater detail below.

4.2.3 How does it work?

Passive solar design involves a number of design strategies which, when combined properly, assist in heating, cooling, ventilating and lighting your building. Passive solar design is centred upon understanding and managing the transfer of heat in and out of your building—that is, what can we do to prevent heat loss in winter and heat gain in summer?

Concepts of good passive solar design include:

- maximising the use of available daylight for lighting (for example, windows, skylights) whilst using techniques to prevent heat transfer through your windows
- using insulation and thermal mass to reduce indoor temperature variability
- orienting new buildings to maximise the amount of available sunlight for heating
- orienting new buildings to capture prevailing breezes (known as natural ventilation)
- where appropriate, shade your building.

How can I maximise day lighting?

Bigger north-facing windows in combination with using light wall finishes and floor coverings will assist in increasing reflection of natural light and reducing the requirement for artificial light.

How can I reduce heat gain from windows?

Windows are an excellent source of daylight, however conventional glass windows also allow for the transfer of the sun's heat into the building. To reduce the amount of heat gain during summer and heat loss during winter, whilst maximising day lighting, windows can be simply covered using internal window coverings (such as curtains and blinds), tinted (also known as coating) or insulated. Tinting involves coating a window's glass panes with a special film that helps to minimise heat transfer through the window. Tinting is a cheaper albeit less effective option compared to insulated windows. Insulated windows (also known as double or triple glazed windows and insulating glass units) use multiple glass panes to form layers with spaces in between each pane. In these spaces there is no air, otherwise known as a vacuum. Having these empty spaces in between each glass pane reduces potential for heat transfer to and from a building through the window. This type of heat transfer is known as convection. If your current windows do not need replacing, you can simply add a second pane of glass to the existing window frame.

How should I orient my building?

Building orientation is a fundamental element of passive solar design.. Generally, your building should aim to get the most sun exposure between 9am and 3pm. Ensure rooms that are commonly used during daylight hours have adequately sized windows for maximising daylight. In Peru in the southern hemisphere, the general rule is to maximise northern exposure. This will ensure the building receives adequate sunlight for heating and lighting during the winter months when the sun is lower in the sky. During the summer months, the sun is higher in the sky and more intense, so it is important to incorporate other elements of passive solar design such as shading and window glazing to minimise heat gain. In tropical environments close to the equator such as in Peru's northern Amazon, orienting the building to capture prevailing breezes is the best means of providing natural cooling (see How can I cool my building?).

What is insulation?

Natural or synthetic materials can be used to prevent the transfer of heat into the building during summer and out of the building during winter. These materials are collectively referred to as insulation. These can be installed during construction or after the building has been constructed ('retrofitting'). Natural fibres such as animal hide, wool, cork, hemp, cotton, flax and straw; rock minerals such as pyrite; and recycled materials such as clothes are often readily available for insulating buildings. Many synthetic materials are also available; however these may cost slightly more depending. You can install most types of insulation yourself; however there are companies that specialise in installing insulation. Certain types of synthetic insulation may also require an accredited professional.

What is thermal mass?

Thermal mass refers to the ability of building materials to absorb heat, store it and release it at cooler times of the day. Adding thermal mass to a building helps reduce temperature variability, meaning you do not have to use as much energy to heat or cool your building. Heavy materials such as mud brick, stone, rammed earth, concrete and clay fired bricks have a high thermal mass, meaning they can store a lot of heat. Lightweight materials such as timber have a low thermal mass, as they do not readily store heat.

Ideally, thermal mass should be insulated from outside temperatures. That is, the thermal mass should be located inside the building, for example, forming internal walls and floors that receive direct sunlight only through windows or opening during times of the year when heating is desired. This will enable the thermal mass to be used as a heat source during cool times, and as a heat sink during hot times.

How can I cool my building using passive solar design?

Natural ventilation or passive cooling offers the least expensive means of cooling a building. In addition to orienting new buildings to maximise exposure to cool breezes, using insulation to prevent heat gain and using thermal mass to reduce temperature extremes, there are a number of ways to cool your building using principles of passive solar design. For example:

- having operable windows to allow breezes into the building
- reducing barriers through the building to aid air flow (open plan)
- providing paths for warm air to exit the building, usually closer to the ceiling—warm air rises because as air warms it expands and becomes lighter than cooler, denser air
- using light coloured roofs and walls to reflect sunlight and reduce heat gain
- use plantings and fixed shading devices (such as eaves overhangs) to shade external walls and windows during the summer months when the sun is higher in the sky. Effective shading should allow maximum winter solar gain and prevent summer overheating. Consider using adjustable shading (such as native deciduous tree species) to regulate solar access on other elevations. In the tropics, consider shading your roof, as it is a major source of heat gain into the building.

Although a form of active cooling, fans offer an energy efficient means of aiding the movement of air through a building than other alternatives such as air conditioning.

If you intend to use more energy intensive active cooling techniques instead of passive cooling techniques, seal any holes or gaps to prevent warm air from getting into your building. This will improve the efficiency of any active cooling systems (such as evaporative or refrigerant air conditioning).

What else can I do?

- Allow adequate sheltered space for natural (solar) drying of laundry. Constant use of dryers will result in very large energy bills.
- Green roofs are an increasingly popular method of keeping your building insulated. Green roofs range from very simple to structurally complex, but the basic idea is to allow vegetation to grow on the roof of your building. This vegetation and soil layer absorbs heat, helping to regulate the indoor temperature of the building. Green roofs are essentially a type of additional thermal mass. As with any structural addition, ensure your roof can take the added weight of a green roof. Professional engineers can assist you with this matter.
- To prevent heat loss in your building, seal up any holes to prevent the entry of colder air inside.

4.2.4 Advantages

There are significant advantages for hotel owners and operators through passive solar design, including:

- Reducing your energy use
- Improving the comfort of your guests
- Avoiding the ‘sick building syndrome’ effect

A building that employs the principles of solar passive design will cost significantly less to run than a conventional building of similar type in the long term. Designing for improved energy efficiency also reduces greenhouse gas emissions.

One of the great advantages of sustainable building design is the improved comfort and reduced health risks associated with passive solar design. Studies have shown that occupants of buildings that use passive solar design for natural ventilation, heating and cooling reduce the incidence of sick building syndrome. In buildings that use artificial heating and cooling systems, ‘old air’ is cycled continuously throughout the building producing mild irritations and aiding the spread of pathogens (illnesses). By comparison, natural ventilation systems bring in fresh air from outside, whilst maintaining a comfortable indoor temperature and using less energy.

Passive solar design also maximises daylighting, which not only saves on operating costs, but has also been shown to improve the well being of the occupants.

4.2.5 Challenges

In colder climates, if thermal mass does not receive enough sunlight this may actually increase winter energy use for heating. Increasing the area of north-facing glass can help reduce this effect, but be sure to provide adequate summer shading to prevent overheating

The greatest barrier to effective implementation of passive solar design is the lack of adequate skills, information and guidance. Seek guidance on design elements and maintain a close working relationship with consultants/advisors to strengthen understanding of sustainable building design. Look for other places that market themselves as having a green building. What have they done? How can you improve on these elements? Most importantly, read through this manual and follow the directions to technical guidelines and 'how-to' guides that may be available to you.

Some climates may not be favourable for rapid enough outdoor clothes drying. Wasted heat from other processes may be utilised to overcome this barrier (see section 5.2 on combined heat and power (CHP)).

A common misconception is that guests have a preference for air conditioning. Natural ventilation (or passive cooling), when combined with other elements of passive solar design and low-energy active cooling alternatives (such as fans), can generally provide greater comfort levels at minimal cost.

4.2.6 Further information

Sustainable Design—step-by-step approach, available at http://www.d4s-sbs.org/

Case Studies

USA—Proximity Hotel

This purpose built 147-room high quality hotel was built to combine heritage design, local historical acknowledgement and modern green building and sustainable principles. The hotel gained LEED Platinum certification (for more information about certification schemes see Section 6.1), an accolade rarely found in tourism accommodation. The hotel was designed, built and now operates following the LEED certification standards. Through building design and operation the hotel uses approximately 39.2% less energy and 33% less water than a similar quality hotel.

Australia—Rainbow Lodge, Tasmania

This eco-lodge of 3 guest cabins in the remote wilderness of Tasmania employs passive solar design principles. All of the buildings face a north to north easterly direction, which enables direct solar energy to be harnessed for heating and natural lighting in this cool to cold climate southern hemisphere location. The passive design combined with other clean energy technologies as well as behaviour change has allowed the site to run completely off-grid. This has brought cost savings for the lodge and improved profitability.

Canada—Aurum Lodge, Rocky Mountains

Aurum Lodge is a fully designed eco-tourism operation with 6 guestrooms and 3 self-contained units in Canada's Rocky Mountains. The lodge was designed and purpose built to be a sustainable tourism facility. The lodge was built according to passive solar design principles for cold climates.

In the planning and design phase, the main difficulty was to obtain information on energy efficient building practices, which were not very readily available in North America. As a result, much of the design is based on European reference literature, adapted to North American building practices.

While supplies were generally available, finding suitably skilled contractors for construction who could understand and implement the design was a major obstacle, and required constant supervision and intervention.

For more information on any of these case studies see Appendix A (chapter 8).

4.3 Energy Efficient Pools and Spas

Pools and spas, particularly if they are electronically heated, can be very energy intensive to operate. However, with careful design and utilisation of appropriate technologies, a pool or spa can become energy efficient.

Most pool or spa systems have two major energy consuming components. For hygiene purposes, pools and spas require water treatment (by filtering and adding chemicals), where the water is passed through the treatment system by an energy intensive pump. In colder climates where the water temperature may be uncomfortable for guests, the water is usually heated either by an electric boiler (i.e. an element) or a more energy efficient heating system. Factors such as pool or spa size, pump size and regime, water treatment method, heater technology, thermal insulation (with spas in particular) and climate will affect the energy demands of your pool or spa.

4.3.1 What is an energy efficient pool or spa?

The list of considerations below can all be used as part of creating an energy efficient pool or spa.

- Ensure pool size is no larger than necessary. The greater the water, the greater the pumping and heating requirements.
- Ensure pump size is no larger than required and your daily pump regime (hours of pumping) is minimised.
- If the climate requires a pool heater, choose an energy efficient heating technology. These include solar heating, electric heat pump heating, gas heating or utilising the waste heat from another power/heating source (see section 5.2 on combined heat and power (CHP) technology).
- Minimise evaporation and subsequent heat loss by using a well-fitted pool or spa cover and protecting the pool from excessive wind.
- Reduce heat loss from the spa with thermal insulation within the cover and around the shell.
- Ensure the pool heater is only used when needed. If it is required, the lower the temperature, the lower the energy consumption. Lower the spa's temperature when not in use.
- If available in the area, consider water treatments such as copper-silver ionisation if they are locally available. This creates a shortened pumping regime, particularly compared to salt-water chlorinated treatment systems.

4.3.2 What aspects are right for you?

Pools and spas—even when operated efficiently—use a lot of energy. This should be taken into account as well as the initial installation costs. How large should my pool be?

It is important to consider if a pool is necessary in a particular situation. A pool is a large investment that requires a lot of time, money, and energy to operate.

Once you have decided a pool is appropriate, be aware that a larger pool requires more pumping—and more energy. To save energy and reduce the cost of managing the pool, the smallest pool that suits your situation should be selected.

Can I reduce how often I run my pool pump?

The time required to pump will vary with the size of pool, the amount it is used, the pump size, and the climate.

For hygiene reasons, a pool must by 'turned over' or pumped on a regular basis. This turnover usually requires a pump, which requires ongoing energy consumption. Larger pools usually require a larger pump; however the pool's level of use will also help determine the size of the pump required. More frequent use requires a 'turnover rate' (the time recommended to pass all the pool's water through the filtration system) that uses more pumping and more energy than a pool with less use.

If the pool has low-usage, then a smaller pump should be enough to satisfy the turnover rate. If use is highly variable, a dual speed pump might be a more suitable option for energy savings.

How do I reduce the energy required for my pool pump?

Greater evaporation leads to increased rate of chemical loss, and hence increases pumping requirements. Therefore, add chemicals at times when evaporation is lower (i.e. early mornings or evenings) to ensure chemicals remain longer in the system and your pumping is minimised. Also ensure that the length of pumping is sensitive to changes in evaporation rates through the seasons. For example, in temperate climates the daily pumping time in winter is usually half of what is required in summer. Likewise, in equatorial and sub-tropical climates the wet season brings increased humidity, allowing a reduction in pumping times. A pool cover will drastically decrease evaporation rates (see below), and therefore pumping times.

Ensure that a timer is used to regulate the pumping requirements, and giving regular attention to emptying skimmer boxes and net scooping can ensure that leaves and other debris do not increase pumping demands.

A pump suited to the needs of your pool can reduce energy required. A study commissioned by the Californian Public Utilities Commission found that installing more appropriate pumps in spas (such as low-wattage or multi-speed) could reduce the energy demands of pumping by as much as 50% (Pacific Gas and Electric 2004).[22]

The design of treatment system piping can also impact the energy required to pump. Design considerations such as minimising the hydraulic resistance in your piping system by using sweeps instead of elbows, removing bottlenecks or unnecessary valves, and avoiding large filters can reduce the energy needed for your pool. Properly selected pool piping will allow a smaller pump for your pool.

Is there an efficient way to heat a pool?

In a climate where the water temperature may be too uncomfortable for guests, it may be necessary to consider heating the water with an energy efficient heating device.

There are a number of options available:

- Solar heating is the most energy efficient form of heating, as the only electricity it requires is to pump the water through the solar system. It is suitable where overnight temperatures are usually above freezing (however freeze protection is possible) and requires direct sunlight conditions. In warmer climates, the water usually runs through a series of UV-resistant rubber tubes, which are installed on a roof facing the sun. In colder climates a flat-plate or evacuated-tube technology (similar to a household solar water heater) is more suitable. In most climates, a solar-heated spa may require additional boosting from a secondary heat source.
- Electric heat pump heating is up to 65% more efficient than an electric boiler heating system. It is a good option when solar cannot be installed (insufficient space or sunlight). However, when air temperatures are below 10°C (50°F) the heat pump must work much harder, and the energy savings diminish.
- Efficient gas heating has approximately half the energy demand of an electric boiler system but gas may not be readily available.
- If the accommodation facility has a separate heat or power source, there may be potential to utilise waste heat to maintain your pool or spa's temperature. For an example, see the case study on Black Sheep Inn, Ecuador.

[22] Pacific Gas and Electric Company (2004). *Analysis of standard options for portable electric spas*, available at: http://www.energy.ca.gov/appliances/2003rulemaking/documents/case_studies/CASE_Portable_Spa.pdf

How can I reduce the energy required to heat my pool?

In hotter climates, it may be possible to switch off the pool heater for a large part of the year. When a pool or spa is not being used for an extended period switch off the heater. When the heater is in operation, having programmable control settings will allow you to accurately manage the water temperature. Having a programmable control panel has been found to reduce a spa's annual energy consumption by 5%[23]. Bringing the temperature down just 1°C may reduce heating costs by as much as 10%, or more in colder climates. Therefore it is important to find a compromise between swimmer comfort and energy efficiency. As a guide, the American Red Cross advises temperatures of 25.6°C (78°F) for competitive swimming, although warmer or cooler temperatures may be more appropriate in your area.

Spa jets usually blow ambient air into the heated spa, which may increase the heating demands when the air is cold. Utilising the waste heat from the confined space around the pump or heater would be efficient from a thermal performance viewpoint.

How can a pool cover save energy?

Increasing evaporation occurs with higher temperatures, wind and decreasing humidity. Evaporation on the surface of a pool leads to a large loss of heat, chemicals and water. All of these things lead to increased heating and pumping demands. Therefore using a pool cover when the pool is not in use is the single most important energy saving device for a swimming pool. According to the US Department of Energy, a pool cover can reduce heating energy demands by between 50% and 70%, and chemical consumption by between 35% and 60% (and hence reduce pumping requirements) (US Department of Energy 2009). Additional benefits include reduced water loss and cleaning time.

When choosing a pool cover, a transparent cover is best for outdoor pools as it allows approximately 85% of solar radiation in through during the day, contributing to warmth. In colder climates, where more heat is lost via heat transfer from the pool surface, a cover with air bubbles or insulation will reduce this heat loss. The application and removal of a cover can be manual or automated; however with automation comes increasing energy use and upfront costs.

How can a spa cover save energy?

Compared to a pool, a spa has a smaller surface area, higher water temperature, and is often used in colder outside temperatures compared to a pool. Because of this a spa requires a cover, not so much for purposes of evaporation, but rather heat loss prevention. Crucially, a spa cover must be well insulated and sealed. Similarly, the spa's shell must be well insulated. The Californian study found that spas with average to low energy performance would use 30% less energy per year if better insulation was installed in the cover and shell (Pacific Gas and Electricity 2004). This figure would increase in colder climates.

Should I consider ionisation for my pool to save energy?

Water treatment techniques such as chlorination and salt-water chlorination require extensive hours of pump operation. An alternative is ionisation, which uses a small electric current to add copper and silver ions to the water. The technique was first developed by NASA to purify drinking water for Apollo astronauts in the 1960's, and was used in the Athen's Olympic Pool in 2004. Manufacturers claim that chlorine levels, and subsequent pumping times can be reduced by as much as 80%. The energy demands of running the charge through the ioniser is usually low and some models run using a small solar panel.

Ionisation is appropriate in many areas; however the availability of the equipment needs to be considered. Check to see if a supplier can provide both the ionisation unit and the replacement parts.

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[23] Pacific Gas and Electric Company (2004). *Analysis of standard options for portable electric spas*, available at: http://www.energy.ca.gov/appliances/2003rulemaking/documents/case_studies/CASE_Portable_Spa.pdf

How does it work?

There are several ways to make a pool more energy efficient:

- Most pools and spas require a pump, and proper pumped system design can reduce the size of the pump needed, saving money on equipment and energy during operation.
- A pool/spa pump requires a lot of power to run. Reducing pump run time to the lowest safe levels can save large amounts of energy.
- Pool and spa covers reduce heat loss, water loss, and chemical loss. Water and in particular heat require substantial energy to replace.
- Heating a pool or spa requires a lot of energy. If heating is required, using a low impact (or renewable) heat source will reduce the cost of operation and save energy required from other [potentially] less sustainable sources.

4.3.3 Advantages

A pool is a major consumer of energy in a facility. Considering appropriate operation and design can save large amounts of energy and reduce costs.

4.3.4 Disadvantages

Space requirements

Consider if you have the space available for a pool. The UV-rubber type solar heaters require space (approximately 50-100% of the water surface area) which may be difficult to accommodate.

Upfront costs

Pool and spas have very high upfront costs. Particularly expensive is installing more efficient pumping and heating technology. These costs will vary depending on the availability of suppliers in your region, as well as individual circumstances.

Ongoing costs

Ongoing chemical, electricity and maintenance costs can also be very high.

Other issues

A pool cover may be a potential safety hazard if someone was trapped underneath, so it is important to ensure a pool is fenced when a cover is in use.

4.3.5 Further information

NSW Department of Health, (1996). Pool swimming pool and spa guidelines. Available at: http://www.cityofsydney.nsw.gov.au/Business/documents/Health/PoolSpaGuidelines.pdf

Pacific Gas and Electric Company (2004). Analysis of standard options for portable electric spas, available at:
http://www.energy.ca.gov/appliances/2003rulemaking/documents/case_studies/CASE_Portable_Spa.pdf

United States Department of Energy (2009). Information of pool and spa heating available at: http://www.energysavers.gov/your_home/water_heating/index.cfm/mytopic=13290

Swimming Pool Heating,
www.energysavers.gov/your_home/water_heating/index.cfm/mytopic=13130

Case study: Australia—Couran Cove

Couran Cove Island Resort in Queensland, Australia is a large scale 4.5 star eco-tourism resort with 192 marine apartments, 24 villas, 36 lodges and 102 eco-cabins. The resort is not on an electricity grid due to its remote island location, and the owners decided that several low-emission gas fired cogeneration engines were most appropriate to meet the electricity needs of the resort, without compromising on luxury services. As with all combustion engines, a significant amount of waste heat is produced, which is captured and used to heat the resort swimming pools, which is effectively a 'free' source of water heating. This technology avoids the need for installing specific water heating equipment, such as solar collectors.

For more information on case studies see Appendix A (chapter 8).

4.4 Energy Management System

4.4.1 What is an energy management system?

An energy management system (EMS) monitors and controls energy use in a building. It uses the information it collects to turn off lights, adjust heating and cooling systems, control security access, monitor safety systems, and alter the operation of other equipment. An EMS is designed to respond based on expected usage of energy and information from sensors. While it can simply automate many of the energy control processes that are part of a well-designed staff task list it can also improve performance and quality of energy using systems. An EMS can also be used to adjust electrical consumption (demand) based on current electrical generation (supply), in particular when integrated with many renewable and other intermittent electrical supply technologies.

There is a wide scope of systems that an EMS can control. A typical EMS system may adjust how much heating and cooling is necessary based on the time of day and expectations about whether a room will be used. It may also turn off lights if sensors indicate that no one is present in a room.

An EMS can be set up to control an entire facility from a centralised location (such as a control room), or it can be more distributed. There is also a wide range of complexity, from a very sophisticated system with computer control to a much simpler system that will control energy usage in a single guest room.

An EMS is sometimes referred to as a Building Management System (BMS) or a Building Automation System (BAS). The term EMS is also occasionally used to describe behaviour change, but here it describes the set of technological tools that improve a facilities ability to improve energy usage.

4.4.2 Is an energy management system right for you?

When should I consider an EMS?

An EMS can be used to supplement and support behaviour change. If there are particular areas of energy usage that need management on an on-going basis and staff are unable to manage it, an EMS may be appropriate. More sophisticated EMS systems tend to be used only in larger facilities, but there are less complicated types of EMS that can support a strategy for managing energy consumption.

What should my EMS control?

The areas that need to be managed will depend on your particular circumstances. In general, the more systems that an EMS controls, the higher the cost will be for the system. The operational needs of your facility should be considered to determine where an EMS is necessary and where behaviour change strategies may be more appropriate. It is also possible to use an EMS to engage with guests and staff to manage energy consumption.

An EMS may control many things, including:

- lighting
- heating and cooling systems
- security systems
- power points and electrical plugs.

What types of EMS are available?

An EMS can be wired throughout a building and can control all aspects of how energy and electricity are used. This type of EMS is typically very sophisticated and can use multiple computers and data collectors through the facility. Most facilities install EMS in large buildings where the cost can be distributed.

An EMS can also control individual rooms. In this instance, the system can be computer controlled (as above) or it can be a simple switch in a guest’s room. A simple switch near the door and controlled by a room key can be connected to the lighting, heating, ventilation, cooling, and power points in the room. The guest is required to insert a key to use energy, which ensures that the guest is in the room when energy is being used.

Controlling indoor temperatures with an EMS

Some facilities use an EMS to provide climate control, but this will depend on the requirements of your guests or staff. An EMS controlling a centralised heating, ventilation and air conditioning (HVAC) system can provide a consistent indoor temperature, but this can be at the expense of individual preferences in climate, and may require occasional service from a skilled technician to adjust. There may be substantial capital investment to connect the appropriate equipment to measure and control the HVAC system.

Is there a way to reduce energy when guests are not in their rooms?

It has become more common in hotels to prevent guests from turning on lights, air conditioners, heaters, and power plugs in rooms unless the room key is inserted into a master switch just inside the entrance to the room. This key system prevents a guest from using unnecessary energy when they are not in the room, and can help to create substantial operational energy and cost savings.

This is an effective EMS system that assists guests in using less energy with minimal effort.

Can I use an EMS to monitor energy behaviours?

An EMS may be an effective way to understand and track behaviours that use energy. Understanding how energy is used in a facility is important to guide decisions on your energy system. An EMS can provide on-going monitoring that enables appropriate decisions.

A building-wide EMS may be used to get centralised information about your whole facility. Operational information from the EMS can provide useful information for understanding staff and guest behaviour.

Can an EMS track electricity usage?

Tracking electricity usage, particularly in tourism accommodation that uses large amounts of electricity, provide a strong basis to guide decisions. It is possible to track current electrical power use and historical electrical energy use. Many facilities that install electricity-tracking hardware will find unexpected electricity use and will likely be able to reduce this. In many cases, the cost of the electricity saved will be less than the cost of the electricity monitoring system.

An EMS can be used to track electricity. However, other types of systems can provide similar monitoring and tracking and consideration should be given to which is more appropriate in your situation. The Maho Bay resorts in the Virgin Islands use an EMS system that engages with customers to match power use to power generation.

4.4.3 How does it work?

The term EMS covers a broad range of equipment, but in effect it allows automated control of energy usage from sensors placed in the facility. The sensors may be switches (such as master switch mechanisms in guest rooms or motion detectors), or it may be temperature sensors. In both cases a mechanism is designed to prevent the unnecessary usage of energy, and in some cases, such as temperature sensors, may improve quality of services delivered.

A simple EMS may use strategic electromechanical switches, but a more complex EMS may use a computer that calculates system behaviour based on complicated optimisation algorithms.

4.4.4 Advantages

An EMS can support and enhance energy efficient behaviour strategies by assisting guests and staff to reduce energy consumption. EMS automates many of the repetitive processes in a facility, and encourages the reduction of unnecessary energy use.

The concept of an EMS is scalable and can be selected and highly customised to match a particular facility. EMS master switches in guest rooms can substantially reduce operating costs, particularly if guest rooms have air conditioners. A master switch is low-cost, requires minimal maintenance, reduces costs and reduces energy consumption. A building-wide EMS allows for centralised control, provides status information on the building, and can assist with tracking and monitoring energy use.

4.4.5 Challenges

An EMS, depending on the system chosen, can require large initial investment. However, installing an EMS only in portions of a facility or installing an EMS only for the most strategic equipment can reduce this cost.

Some EMS systems are very complicated and require specialists to install, maintain, and operate. Depending on the complexity, staff training may be necessary. This can be reduced or controlled by considering the local resources available for the installation, maintenance, basic operation, and advanced operation of the EMS.

Much (but not all) of the energy savings from an EMS could also feasibly be achieved through lower cost staff behaviour strategies. Examples include turning off lights and setting the heating and cooling thermostats at more efficient levels (refer to Energy Management Plans in section 3.3).

Case Studies

Australia—Couran Cove

Couran Cove resort (see also case study in Section 4.3) operates an Energy Management System. The EMS is used to ensure energy using equipment throughout the property is operated at maximum efficiency. A common energy efficiency application is the activation/deactivation of public area lighting depending on ambient lighting or guest activity. In addition, the system can send a multitude of signals when something happens around the property to alert maintenance staff. For example, if a failure or alarm point is reached such as a fire alarm, power station fault, vacuum sewer system fault, water treatment plant fault, waste water treatment plant fault or cool room temperature loss, this is registered on the control computer in the security office. This then triggers a message to be sent out via the paging system to the respective responsible persons to be rectified. Such responsive maintenance can dramatically reduce energy consumption resulting from equipment not operating optimally.

Thailand—Evason Phuket and Six Senses Spa

The 260-room resort is located on 64 acres of tropical land. An EMS was first purchased to control peak demand to save expenditure on electricity transformers, which resulted in the resort moving from requiring two 1300KW transformers to one 1100kW transformer, reducing costs and increasing efficiency. In addition to reducing peak demand this produced significant savings in total energy consumption, due to timers and settings on lighting, pumps and other systems being altered. The EMS is an important part of the hotel's delivery of energy usage that significantly outperforms EarthCheck benchmarks, demonstrating 65% less energy consumption than the EarthCheck Best Practice level. The EMS produced a 10% saving on consumption, which equated to about $US50 000 per year. This investment cost of the EMS was $US4500—a payback period of just over one month.

4.5 Energy Efficient Appliances

4.5.1 What are energy efficient appliances?

For each type of appliance used in tourist accommodation facilities (washing machines, dryers, dishwashers, ovens, toasters, refrigerators, televisions and computers) there is a wide variation in the level of energy used by each brand and style. The critical decision point regarding energy consumption usually occurs when the appliance is bought. This section discusses appliances and energy efficiency in general, and what things might be considered when purchasing new appliances. Specific discussion on some appliances (heating and cooling, hot water systems) can be found in other sections.

4.5.2 Is it right for you?

Do you really need a new appliance?

The first questions when purchasing a new appliance are whether it is really needed, and if so, whether its function could be performed by a renewable source of energy. For example:

- Is a clothes dryer really necessary, or could drying be done passively using the sun? (see section 4.6)
- Is an additional fridge needed or could some goods be stored in a cellar?
- Could the sun's energy be used for cooking? (see Isla Suasi case study mentioned below)
- Can geothermal energy assist with your heating or cooling? (see section 5.3)

Can you save even more energy with your existing appliance?

Are existing appliances being used as efficiently as possible? For example, some appliances such as televisions, DVD players, stereos and computers use standby power when they are not in use. An appliance that shows a digital clock or a small light when it is off is still using energy. When summed together, the energy saved from switching off standby power can be large. Bedroom appliances can be automatically switched off if the room is unoccupied when a control device like a key-tag is used.

Products are used most efficiently in the way that they are designed to be used. For example, using the maximum recommended load each time using dishwashers, washing machines or dryers are used or using an eco-setting if the appliance has it.

Appliances are also positioned according to manufacturer's recommendations. For example, refrigeration needs to be well ventilated on the back, top and sides and not located in a hot location or in direct sunlight. Refrigerator temperature should also be set to the recommended temperatures.

It is also important that appliances are well maintained. For example, seals on refrigerators and ovens should be checked, and dust refrigerator coils in line with the manufacturer's recommendations.

Is it worth upgrading your existing appliance?

Where inefficient appliances are being used it is useful to consider purchasing energy efficient replacements. The more frequently this inefficient appliance is used, the greater the long run savings will be from upgrading to something more efficient.

4.5.3 How do you find energy efficient appliances?

Using energy-labelling

The Peruvian Government passed a framework law in 2000 enabling mandatory energy efficiency labelling for energy consuming equipment and products[24]. As of May 2010 the first mandatory labelling for clothes washers and refrigerators was still under consideration[25].

Until this labelling scheme develops further, in cases where appliances are being imported from or via countries with energy labelling schemes, often energy labels will still be pre-attached. While this means that all appliances will not have labels, Peru consumers can still benefit from such manufacturer provided information. Alternatively, the energy consumption for an imported appliance may be found in an appliance database from another country's energy labelling scheme (see resources below).

How do you use energy-labelling schemes to decide on a product?

Energy labelling schemes usually provide comparative information through star ratings or bar graphs. Whilst these are helpful, it is always important to look at the gross electricity consumption per year (kWh/year) of that appliance.

If for example you have the choice between a 300 litre 3 star rated refrigerator and a 400 litre 4 star rated refrigerator. While a 4 star rating is more efficient than a 3 star rating, because of its size, the 4 star model may in fact use more electricity than the 3 star model. The energy use of each refrigerator would then be a better indicator. This would usually be measured as kWh per year. So if the additional 100 litres of refrigeration capacity is not really needed the 3-star refrigerator is a better choice because it uses less energy and would be cheaper to operate.

A star rating and annual estimated electricity consumption per year will assume average conditions and usage. This will vary depending on how much the product is used, so the kWh figure should be adjusted to match usage. For example, a washing machine may have an annual rated consumption of 600kWh per year based on being seven warm washes a week. However, it is being used for 4 warm washes a week, then annual consumption will be 14/7x600 = 1200kWh/year.

To convert kWh/year into running cost per year, it is multiplied by the cost of electricity per kWh. For example, if the price of electricity is $0.25/kWh, and the annual consumption is 1200kWh/year, then the annual electricity running cost is 1200 x 0.25 = $300.

4.5.4 Benefits

- Lower energy consumption and running costs

4.5.5 Challenges

- Upfront costs may make it more difficult to purchase a new appliance, or require financing
- Energy labelling generally does not cover all appliances
- Many energy labelling schemes have not taken standby power consumption into account. They are starting to address this issue.

Case studies

There is no one case study that most obviously demonstrates the breadth of energy efficient appliance use in accommodation facilities, as these clean energy technologies are employed by all case studies.

[24] Harrington, L. and Damnise, M. Energy Labelling and Programmes throughout the World, NAEEEC, Australia 2004
[25] http://www.apec-esis.org/index.php

Therefore some examples are listed below:

- a split-type air conditioning was refitted to an efficient mini-chiller system, saving around $US45,000 per year (Thailand—Evason Phuket and Six Senses Spa)
- solar cookers (Peru—Isla Suasi)
- efficient propane fuelled refrigeration (Ecuador—Back Sheep Inn)
- 6-star rated Air Conditioning plant that uses inverter and movement sensor technology (Australia—Alto on Bourke Hotel).
- grey water heat exchanger (Canada—Aurum Hotel).

Further information on all of these case studies can be found in Appendix A (chapter 8).

4.5.6 Further information

Australian Government website provides information about purchasing energy efficient appliances. Available at: www.livinggreener.gov.au

Some energy labelling schemes are listed below. These sites also provide energy consumption databases for specific products.

- Australia http://www.energyrating.gov.au/
- Singapore http://www.nccc.gov.sg/energylabel/
- Canada http://oee.nrcan.gc.ca/energuide/home.cfm
- USA http://www.energystar.gov/

Energy Cost Calculators for Energy-Efficient Products,
http://www1.eere.energy.gov/femp/technologies/eep_eccalculators.html

Energy Efficiency Best Practice Guides,
http://http://www.resourcesmart.vic.gov.au/for_businesses/energy_efficiency.html

APEC provides an Energy Standards Information System which covers all APEC economies including PERU, available at http://www.apec-esis.org/index.php

4.6 Energy Efficient Laundry

4.6.1 What are energy efficient drying options?

In many accommodation facilities the drying of bed linen, towels and clothes with mechanical dryers can be very costly and energy intensive. Alternatives such as hanging laundry outside or utilising a passive design drying room will completely eliminate this energy consumption. In cases where such methods cannot be utilised, using an energy efficient mechanical dryer instead of an inefficient model will save substantial energy and cost.

4.6.2 What is right for you?

Is passive drying suitable in my climate?

Drying speed increases with increasing sunlight, temperature, wind and decreasing humidity. If local weather and climate outside satisfies any number of these conditions, an outside line will be effective for drying laundry.

When conditions are less favourable, a passive design drying room will create a less humid, warmer environment, more beneficial for hanging clothes.

Will passive drying suit my accommodation and available space?

Each accommodation facility has different laundry demands. As quantity of laundry increases, so too does the requirement for space to hang that laundry. Less favourable climates may slow the drying time, creating extra demand for drying space. Some accommodation facilities may not have the room and/or the time to dry clothes passively.

Do I need to use a mechanical dryer?

If climate, space, or any other factors make passive drying unsuitable, using a dryer may be necessary. If a less efficient mechanical dryer is in use (i.e. with a heating element), switching to a more energy efficient dryer will result in considerable energy and cost savings. Many mechanical dryers run on electricity, however if there is a gas connection also it is possible to use a gas mechanical dryer.

4.6.3 How does it work?

Solar passive drying room

A solar passive drying room utilises radiation of the sun which heats a room in which the laundry hangs on a line. Ideally, the room should be well sealed, insulated and consist of a large glass window (double- or triple-paned may be necessary in colder climates). To fully utilise the angle of sun, the main window/s should face north in Peru. Once the sun has set, drawing interior curtains or tight fitting blinds will assist to store the heat.

Energy efficient mechanical dryers

Dryers with a sensor are an improvement on manually timed dryers as they automatically turn off when the clothes are dry. Heat pump dryers compress air to generate heat, as opposed to using an element, often obtaining energy savings of between 40% and 65% over mechanical dryers without a heat pump. Gas dryers can use up to 50% less energy than an inefficient electrical dryer. Spin dryers typically do not use a heater but instead remove the moisture with a very high spin speed. However, spin dryers may not always fully remove the moisture from the laundry. If it is necessary to use a mechanical dryer, a combination of these features will reduce energy consumption and operating cost.

4.6.4 Advantages

Advantages of passive drying over mechanical dryers:

Passive drying is optimal from an energy consumption point of view as zero energy is consumed. Once the line or passive drying room is established, there are no ongoing maintenance or energy costs. Passive drying makes no noise, and eliminates the risk of shrinking or degrading material fibres that can shorten the life of laundered items.

Advantages of energy efficient mechanical dryers over inefficient mechanical dryers:

Energy efficient models save on energy and running costs compared to inefficient dryers. Some may have additional benefits of expelling less heat into the surrounding space.

4.6.5 Challenges

Challenges of passive drying:

Finding sufficient drying space may be challenging in some accommodation facilities. Unfavourable climatic factors (particularly a lack of sunshine hours) may increase the drying time. Passive drying may be more labour intensive than using a dryer. If an outdoor line is not suitable, there may be upfront costs of building or retrofitting a passive design drying room.

Challenges of energy efficient mechanical dryers:

There may be upfront costs of to build or retrofitting a drying machine room, and additional capital may be needed for proper electrical and gas supply. In some places, dryers use a different voltage than other appliances in the household. In general, mechanical dryers have a limited life span and will likely need to be replaced more frequently than passive drying technologies. In addition, mechanical dryers require more technical expertise and may require assistance of a trained specialist for maintenance and repair. Mechanical dryers with a heating element also increase the risk of electrical fires, particularly if used improperly or not maintained properly.

Case study: Costa Rica—Playa Nicuesa Rainforest Lodge

Playa Nicuesa is a 5-cabin and 4-room rainforest lodge and cabin operation (accommodating up to 24) on a 165 acre privately owned and operated reserve in Central America's largest remaining Pacific Coast rainforest, the Piedras Blancas National Park. It has no roads, and is accessible only by boat.

As part of a deep commitment to energy efficiency and conservation, the lodge identified, through the process of an energy audit, that the two largest users of electricity were the clothes dryers and ceiling fans. In response to this finding the owners specially constructed a passive solar drying room to dry laundry, eliminating the need for dryers.

The passive solar drying room has had multiple benefits. In addition to reduced electricity consumption of between 5–8.6kW per day, they do not need to replace clothes dryers, which have short life spans in the rainforest climate and less noise pollution. Furthermore, staff time spent re-hanging laundry to dry has been saved, as the passive solar room has been designed and built to hold all the day's laundry in one hanging in a rainproof enclosure.

4.7 Energy Efficient Lighting

4.7.1 What is energy efficient lighting?

Energy efficient lighting is lighting technology which, compared to other lighting, provides equivalent light with lower electricity consumption. Energy efficient lighting includes compact fluorescent lights (CFLs), light emitting diode (LED) lights, and low power ('low wattage') halogens. Natural light is also considered energy efficient lighting and is the best option for energy savings.

Effective positioning of windows and skylights reduces the daytime lighting requirement significantly but where this is not possible using an energy efficient lighting is the alternative.

Other technology will reduce the amount of time that lights are on. These include sensors, timers, and using multiple switches for large groups of lights that are not required all at once.

4.7.2 Is energy efficient lighting right for you?

Light is required to do almost everything. As such, installing efficient lighting will benefit all accommodation facilities—the environmental and economic benefits are clear.

If the accommodation facility is not yet built, it can be designed with natural light and energy efficiency in mind. If the accommodation facility is already established, potential modifications can be made to allow natural light into high-use areas. If lighting is being used it is possible to switch to a more efficient alternative to reduce energy consumption.

Table 1 Alternatives to inefficient lighting

Existing	Energy Efficient Alternative
Incandescent light	Compact fluorescent light (CFL)
Halogen light	• Compact fluorescent downlight • Light Emitting Diode (LED) • Low wattage halogen
Floodlight	• Compact fluorescent floodlight • LED spotlight
Older style fluorescent tube light (T12)	Low wattage fluorescent tube (T8, T5)

Figure 5 A typical energy efficient compact fluorescent light

Some lights require additional energy-using components to run. Linear fluorescent lights require a ballast (3–20w) to regulate the voltage and current. Low voltage halogens require a transformer (4–10w) when running off mains voltage. As these fittings cannot be cheaply replaced, choosing efficient ballasts or transformers upon installation will save a lot of energy and cost in the long run.

Other ways to reduce lighting energy consumption:

Where there is more than enough light in one area, the wattage of the lights or the number of the lights can be reduced. For example, replacing many downlight fixtures (which have a narrow beam) with a one or a few CFL or fluorescent fixtures (which have a more dispersed light) will dramatically reduce the energy used in lighting a space. Likewise, removing one linear fluorescent light from a two ballast fixture will halve the electricity consumption.

Older fluorescent light ballasts can be retrofitted with reflective fixtures to boost luminosity considerably, allowing a reduction in light fixtures without a reduction in light.

If a high number of lights are connected to one switch but do not always need to be used simultaneously, the lights could be split onto multiple switches.

For in-room lighting, lighting services can be activated by using a control mechanism such as a key-tag. In less frequented areas timers or sensors can be installed to ensure that lights are not left on for longer than what they are required. These may be useful in hallways, bathrooms, or outdoors and as a nightlight.

4.7.3 How they work?

Only 20% of the energy for incandescent and halogen lights is converted to light; the remaining 80% is lost as heat. Efficient lights such as fluorescents, CFLs and LEDs are able to convert energy to light much more efficiently and with less lost as heat.

CFLs use 4 times less energy than an incandescent globe of the same luminosity, as well as lasting 10 to 15 times longer. They fit directly into both screw and bayonet fittings. They utilise the same technology as a linear fluorescent light.

CFL downlights (10–13w) use 4 to 5 times less energy and last up to 10 times longer than an inefficient halogen downlight (45–50w). Furthermore, replacing low voltage halogen downlights with CFL downlights will save an additional 8–10 watts per globe, as a transformer is no longer necessary.

LEDs use 6 to 10 times less energy than an inefficient light, and are available for an increasingly wide range of applications including downlighting, floodlighting and decorative lighting. They are durable, with some manufacturers claiming a lifespan of 50 000 hours.

Energy efficient halogen downlights are available which use 30–50% less electricity than a regular 50w halogen.

4.7.4 Advantages

- Energy efficient lights leads to a large reduction in lighting energy consumption, reducing running costs.
- The upfront cost of switching to energy efficient lighting is often low.
- Energy efficient lights have a much longer lifespan, reducing ongoing and maintenance costs.
- Because energy efficient light do not emit much heat, no extra workload is added to cooling systems and the risk of fire is eliminated.
- CFL varieties have become diverse to match market demand. For example, varieties can now be found which give maximum light at start up, are dimmable, are contained within a globe (like an incandescent), and give many different light tones (e.g. warm, warm white, cool).

4.7.5 Disadvantages

- Upfront costs of installing efficient lights can sometimes be expensive, however costs are coming down. This is particularly the case with LEDs, or when replacing low voltage halogen lights (recessed fixed into the ceiling) with compact fluorescent downlights which run on mains voltage.
- The light particles emitted by CFL lights are more dispersed than halogen and incandescent lights. Because of this, energy efficient lights bear a closer resemblance to natural light and may not always provide the same warm tone as incandescent and halogen lights. Similarly, LED lights are relatively cool in colour tone.
- Most energy efficient lights are not dimmable. Some compact fluorescent lights are dimmable, however dimming a CFL does not increasing the warm tone, unlike incandescent and halogen lights.
- CFL and fluorescent lights contain a small level of mercury vapour. Consult your local authorities regarding appropriate disposal technique of broken CFLs.

Case studies

Energy efficient lighting is one of the simplest and most cost-effective clean energy measures, and is essentially a prerequisite for any best practice accommodation provider using clean energy. This is demonstrated by every case study utilising energy efficient lighting—for more information refer to case studies contained in Appendix A (chapter 8).

4.7.6 Additional information

Energy Efficiency Best Practice Guide: Lighting,
http://www.resourcesmart.vic.gov.au/for_businesses/energy_efficiency_3453.html

Light bulb Cost Analysis Calculator, http://www.ajdesigner.com/fl_light_bulb/light_bulb.php

Energy Cost Calculators for Energy-Efficient Products,
http://www1.eere.energy.gov/femp/technologies/eep_eccalculators.html

4.8 Water Efficiency and Energy Savings

Whenever we use hot water, or use water that has been pumped using energy, there is corresponding amount of energy being used to heat and/or move that water. In many accommodation facilities, the heating of hot water accounts for a large proportion of the total energy consumed. Therefore, wherever hot water is being used, if it can be used more efficiently large energy savings can be achieved.

Here we confine our focus to some of the most common ways to improve the water efficiency and hence achieve energy savings in the accommodation sector. In many circumstances, by installing suitable technologies and promoting behaviour change, large energy savings can be achieved in a simple and cost effective manner.

4.8.1 How can you achieve water efficiency and energy savings?

Showering

If a facility uses hot water showers, a simple way to dramatically reduce the amount of hot water consumed is to install water efficient showerheads or flow restrictors (also known as aerators) to reduce the water flow rate coming out of the shower. A facility that has cold-water showers can still reduce the energy that is needed to pump water, although the energy savings will not be as great.

Washing machine

Washing machines have high water demands, particularly in accommodation facilities where linen and towels must be frequently washed. If a water intensive washing machine is in use, switching to a water efficient washing machine will lead to water savings which will translate into energy savings if hot water or warm water is used for washing.

Other ways you can save energy in the bathroom

- Displaying signage which urges guests to minimise shower times may be appropriate in some accommodation settings. If successful, this can lead to substantial water and energy savings.
- Flow restrictors can also be installed in basin taps to minimise hot water wastage when washing hands.

Other ways you can save energy in the laundry

- Washing with a full load where possible.
- Washing in cold water as opposed to warm or hot water (where hygiene considerations allow) will reduce energy consumption by between 50% and 90%. UV rays when solar drying is almost as effective in killing bacteria as hot water.
- Choosing a washing machine with a higher spin speed means the finished load contains less moisture, and hence less energy is required for drying (if a mechanical dryer is used).

Can you supply your water in a way that minimises energy use?

In many accommodation facilities, water is pumped either at the facility or into the facility from an external water provider. In both cases, energy is used to pump and deliver the water and proper consideration can contribute to overall energy use reduction. For example, if a rainwater tank can utilise gravity to create water pressure, a pump is no longer required to move water from the tank, potentially saving energy.

4.8.2 Is it right for you?

Will you benefit by making your showers more water efficient?

An easy method of testing whether such a showerhead technology will help reduce energy consumption is to measure the flow rates of your existing showerheads, which can be easily done by holding a bucket under the showerhead, and measuring how much water is collected in one minute. If the flow rates exceed the minimal flow to meet requirements, installing flow restrictors or an efficient showerhead can save energy.

Do you need a water efficient washing machine?

Where an accommodation facility already washes in cold water most of the time, or does not use a washing machine, switching to a water-efficient washing machine might not save any energy at all.

However, where a water intensive washing machine is in use with warm or hot wash cycles, energy savings through switching to a water efficient washing machine can be substantial. As a guide, front-loading washing machines (with a horizontal tub and lid on the side) are generally more water efficient than top loading washing machines (with an upright tub and lid on top), the reason being is that a top loader requires the load to be fully immersed in water. Because they use less heated water, front loaders are generally less energy intensive than top loaders when using warm or hot wash settings.

For domestic sized washing machines, a number of countries have implemented independent water and energy efficiency labelling schemes to provide information on the product's energy and water efficiency. In this case, the product's energy rating information will indicate the anticipated scale of energy savings from upgrading to a more efficient washing machine.

4.8.3 Benefits

Water efficient showers

Flow restrictor technology is cheap, simple to install, concealed within the showerhead or neck, and reliably creates instant savings in energy. In many cases the user will be unable to notice the decreased water flow. Low flow showerheads are quite diverse in their appearance, functionality and comfort levels.

The scale of energy savings will vary depending on the existing showerhead flow rate and hot water heating technology. If water is heated using electricity or gas, the ongoing operational cost savings will quickly offset the small cost of installing water efficient technology.

Water efficient washing machine

Switching from a standard top loader to a more efficient front loader will generally reduce water consumption by anywhere between 20% and 70% so if washing is with warm or hot water, the reduced water demand of front loaders transfers into similar proportioned energy savings (regardless of whether the front loader has a heating element or draws hot water through a hot tap connection).

4.8.4 Challenges

Water efficient showers

It may not be possible to install flow restrictors in all existing showerhead in which case it may be beneficial to replace the entire showerhead with a water efficient showerhead.

Some electric or gas instantaneous hot water systems do not allow a regulated flow rate.

Water efficient washing machine

Many front-loading washing machines have longer wash times.

4.8.5 Further information

Australian Government information about water efficiency, available at: www.livinggreener.gov.au

Case study: Virgin Islands—Maho Bay

Maho Bay was the world's first eco-resort in 1976, which now has 114 units implementing significant energy conservation practices. The application of sustainability principles is at the core of all resort operations, with a systematic approach of continuous improvement in employing clean energy. Maho Bay and its two sister facilities have a wide range of clean energy initiatives across the three core components of clean energy: renewable supply, energy efficient equipment, and behaviour change. The latter aspect of influencing guest behaviour is one in which Maho Bay has progressed further than many other accommodation facilities. In the area of water efficiency, the owner has installed water tank gauges in bathrooms for guests to see how much water supply is available (the cabins rely on rainwater) to help to limit shower water use, which in turn reduces energy for water heating. The resort has found guests to be quite responsive to this provision of information to help them manage their own environmental impacts.

For more information on case studies refer to Appendix A (chapter 8).

5 USING CLEAN TECHNOLOGIES TO SUPPLY ENERGY

This chapter contains the relevant information about each of the following technologies which use clean or renewable energy sources to generate and supply energy and indicates the situations in which they are likely to be most useful:

- Bioenergy
- Combined heat and power (CHP) systems
- Geothermal systems
- Green power
- Micro-hydropower
- Solar photovoltaic (PV) systems
- Solar water heating
- Wind energy system

5.1 Bioenergy

5.1.1 What is bioenergy?

Bioenergy refers to energy generated from the combustion of biological material derived from living, or recently living organisms such as plants.[26] There are three main classes of bioenergy that may be directly used for energy supply in the tourist accommodation sector:

- biomass: which can include wood, agricultural energy crops or food, animal or crop waste which is most commonly burned to produce heat for space heating or cooking
- liquid biofuels: includes vegetable oils (e.g. waste cooking oil; coconut, peanut and palm oil), biodiesel and ethanol, and are used to generate electricity in combustion engines or operate vehicles or machinery
- biogas: gas produced from the biological breakdown of organic material such as human or animal waste. Biogas can be burned to create electricity, but is more commonly used as a direct fuel for cooking.

5.1.2 Is bioenergy right for you?

Bioenergy has the potential to be a cost effective option for various application in the accommodation sector, however there are many prior considerations that determine whether a bioenergy option is appropriate for your situation, and will yield positive social and environmental outcomes.

Do I have an appropriate bioenergy source locally available?

It is first necessary to consider whether there is a readily available source of bioenergy. Transporting biomass over large distances for use in a facility reduces the environmental benefits from its usage, as well as its cost-effectiveness.

Is my available bioenergy source environmentally sustainable?

Secondly, it is important to assess whether or not there are positive or negative environmental implications of using locally available biological material. For example, if biomass is sourced by cutting down native trees in the local catchment, this will have highly negative environmental impacts through increased erosion, altering the hydrological cycle of the water catchment, and eliminating the positive ‘carbon sink’ effect of the trees. However, if the wood is selectively harvested locally from an invasive tree species and replanted with a native tree, or if biogas was created from digesting pig waste that otherwise contaminated local waterways, and then the environmental outcomes would be highly positive.

[26] Definition adapted from ‘Biomass’ definition of the Biomass Energy Centre: www.biomassenergycentre.org.uk

Case study: Ecuador—sustainably harvested wood biomass

The Black Sheep Inn is a small 10-acre farm and eco-lodge operation with 7 rooms and a bunkhouse in Chugchilan in the Ecuadorian Andes Mountains. In this (at times) cold environment the Inn chooses to use wood stoves for space heating its facilities, in part due to the readily available supply of sustainable biomass. The region is dominated by eucalyptus trees introduced in the late 1800's from Australia, which displace native tree species and increase soil acidity from the decomposition of their leaves. This makes eucalyptus ideal for felling as a locally appropriate source of biomass for the Black Sheep Inn's space heating needs.

For more information on case studies refer to Appendix A (chapter 8).

Is the available bioenergy source socially sustainable?

Thirdly, it is important to assess whether or not there are positive or negative social implications of using locally available biological material. For example, if the bioenergy source (such as an agricultural energy crop) is harvested by a vulnerable sector of society subject to poor working conditions, then increasing demand for that resource can drive further social inequity. Likewise if fuel wood for heating is harvested by women in the community that shoulder an inequitable burden of hard labour, or by children that might otherwise be enrolled in formal education, then inequitable social outcomes can result.

Does the available bioenergy source negatively affect food supply?

Bioenergy crops, or regular agricultural crops used for energy supply, can have negative impacts on local food supply. However, the issue is less about whether or not that particular food crop itself is actually edible, and more about the potential displacement of arable land otherwise used for food production. This issue comes back to considerations of where locally consumed produce is grown, and whether arable land (that might be suitable for bioenergy crops) is in short supply.

Furthermore, there may be indirect impacts on food supply. For example, if the edible supply of a staple food source is reduced through the diversion of a large volume of that crop to biofuels, this can drive up the local market price, negatively impacting vulnerable sectors of society that may be dependent upon consumption of that staple. Conversely, an increased market price for a local crop could have positive social implications if it results in increased earnings for low-income farming families.

Thus it is evident that this issue is complex and requires careful consideration of the local situation. Broad generalisations about the suitability of bioenergy can be harmful. Just remember—a biofuel that is socially and environmentally sustainable in one location may well not be sustainable in a different setting.

Do energy needs match the type of bioenergy source and its use?

The source of bioenergy needs to match your energy requirements. It is necessary to know whether electricity supply (from burning biofuels in engines), gas supply (from biogas), or direct heat (from directly combusting various biofuels) is most suitable for the desired energy uses. For example, harvesting fuel wood for space or water heating may be highly applicable in cold climates or at high altitude, but less so in tropical locations. Or, in an off-grid location already using a diesel engine for electricity supply, the conversion to using locally made liquid biofuels instead of imported diesel may be an appropriate and cost-effective choice as it may be possible to use an existing generator.

5.1.3 How does it work?

The energy contained in biological matter is released when it is burned or 'combusted'. This energy can be:

- direct heat energy, which is then harnessed for space or water heating, or less commonly, cooking
- converted to electrical energy in a range of types of engines
- mechanical energy, used to drive machinery.

Biomass is combusted to either harness heat energy (1) for domestic or commercial purposes; or can be used to generate electricity through a chemical process known as 'gasification', although the latter is rarely applied on a small scale as applied in the accommodation sector.

Liquid biofuels are combusted in engines to produce electrical (2) or mechanical (3) energy. Depending on the oil source (e.g. cooking waste, coconuts, peanut or oil palm), vegetable oils can often be used to create electricity in diesel-electric or similar engines by a) in pure form, with some engine modification, b) blended with diesel with no or more limited engine modification, or c) first converting to 'biodiesel' through a process called 'esterification'. Biodiesel is generally directly substitutable for regular diesel fuel in diesel engines. Ethanol, another liquid biofuel derived by fermenting fruit or other organic matter,[27] is generally used blended with gasoline as a transport fuel in regular mechanical gasoline engines (3).

Biogas is predominantly methane and carbon dioxide, and is produced from the biological breakdown of organic material such as human or animal waste in a digestor. Biogas can be combusted to create electricity (2) in a gas-electric engine, but is more commonly use as a fuel for cooking (1).

5.1.4 Advantages

From an environmental perspective, bioenergy is generally considered greenhouse gas emission free, or 'carbon neutral', as the carbon that is released at the time of combustion has (relatively recently) been captured from the atmosphere during the plant's growing cycle, creating a net zero effect on atmospheric carbon.

If implemented well and in the appropriate context, bioenergy can have positive and equitable social outcomes through the income generation for rural farming families, or reducing disproportionate workloads of certain sector of the community. Technologies such as biogas, which are often applied in remote households as a replacement for low quality fuel wood (and may be candidates for initiating small scale tourism businesses), can have significant health benefits. Respiratory problems caused by indoor burning of biomass are reduced, and sanitation can be improved if linked to the use of safer human waste disposal.

5.1.5 Challenges

There are many challenges to effectively sourcing bioenergy forms that have positive social and environmental outcomes from their production.

Not all biofuels are compatible with diesel engines.

Using certain types of bioenergy may be new to some geographical regions or specific local areas and thus skills, equipment and good advice may be difficult to find (see Playa Nicuesa lodge case study).

Case study: Costa Rica—Playa Nicuesa Lodge

In 2009, Playa Nicuesa Rainforest Lodge in Costa Rica set about its latest Clean Energy addition. A biofuel generator was identified as the best option to meet the specific additional energy demands of the lodge. It investigated various supply options of different liquid biofuels with their existing generator, but found they were either difficult to obtain or not environmentally sound. The latter issue is of prime concern to the operators due to the ecological sensitivity of the region. It was eventually decided that a recycled vegetable oil generator was the most viable option. However, 'off the shelf' components were unavailable and assistance from a local engineer was required to construct the 'Mean Clean Green Machine' out of recycled components. Various components were sourced through local contacts all recycled from local boats and salvage junkyards. These were all transported to the property by boats (the lodge is boat

[27] Ethanol can also be produced from **'second** generation' techniques. Examples include 'cellulosic' ethanol from woody plant matter. These have not been covered as are not currently applied at small scale such as in the accommodation sector.

access only) and assembled onsite. The vegetable oil to run the generator is sourced from used oil in local restaurants, which is then filtered to be utilised directly in the generator.

For more information on case studies refer to Appendix A (chapter 8).

5.1.6 Further information

For further technical information on coconut oil and its uses from experience in Pacific Island countries see:

The World Bank, *Pacific Islands Coconut Oil Power Generation: A how-to guide for small stationary engines*, December 2009, Available from:
http://siteresources.worldbank.org/EXTEAPASTAE/Resources/Coconut-oil-Power-gen_How-to-guide-for-small-stationary-engines-Feb-10.pdf

Biomass Energy Centre
http://www.biomassenergycentre.org.uk/portal/page?_pageid=73,1&_dad=portal&_schema=PORTAL

Implementing Sustainable Bioenergy Production: A Compilation of Tools and Approaches
http://data.iucn.org/dbtw-wpd/edocs/2008-057.pdf

5.2 Combined Heat and Power (CHP) Systems

5.2.1 What are CHP systems?

Combined heat and power (CHP), also known as *cogeneration* provides a means of recycling energy. When a fuel is burnt to generate electricity, much of the energy in the fuel is lost as 'waste heat' in the conversion process. This heat can be harnessed for other purposes, such as cooking, heating water or heating buildings and even generating more electricity. Combined cooling heating and power (CCHP) or *trigeneration* is an extension of the CHP concept and uses heat passing through an *absorption chiller* to provide cooling. Both cogeneration and trigeneration technology are often collectively referred to as *green transformers*.

5.2.2 Is it right for you?

What sorts of CHP systems are available?

As CHP systems can be applied to a range of scales—from small-scale accommodation to a centralised power plant capable of powering a city—and can use a variety of fuel sources, there are many different types of CHP systems available. For most accommodation types, a small-scale micro CHP (*mircoturbines*) will adequately meet energy needs. Micro CHP systems are typically fuelled using natural gas; however other fuels include biomass, liquid petroleum gas (LPG), vegetable oil, woodgas, landfill gas (methane) and heat from the sun. CHP systems may also use coal, diesel and oil, however the burning of these fuel sources generate air pollution and more greenhouse gas emissions that other fuels.

What is CHP good for?

Micro CHP systems resemble a gas-fired boiler, providing both heat for space and water heating. But unlike a boiler, a micro CHP system also generates electricity to power lights and appliances.

Can I use combined heat and power for cooling my building?

An extension of CHP technology is to pass 'waste heat' (generated from converting a fuel into electricity) through an *absorption chiller* to produce cool air. Waste heat is used to heat water at very low pressure, causing the water to boil at 2˚C. A refrigerant (a substance used for absorbing and transferring heat) absorbs this heat from the water, thereby lowering the temperature of the water. This chilled water can then be used in air conditioning (humid, tropical climates) or evaporative coolers (temperate climates) for cooling a building.

Will it suit my climate?

CHP technology is suited to any climate but is particularly useful for locations that use a lot of energy on heating and cooling.

5.2.3 How does it work?

- Fuel is burned in an internal combustion engine to drive a turbine and produce electricity.
- Not all of the energy contained in the fuel is converted to electricity, but released as heat. This waste heat is captured from the engine or exhaust to heat water or steam for a range of applications.

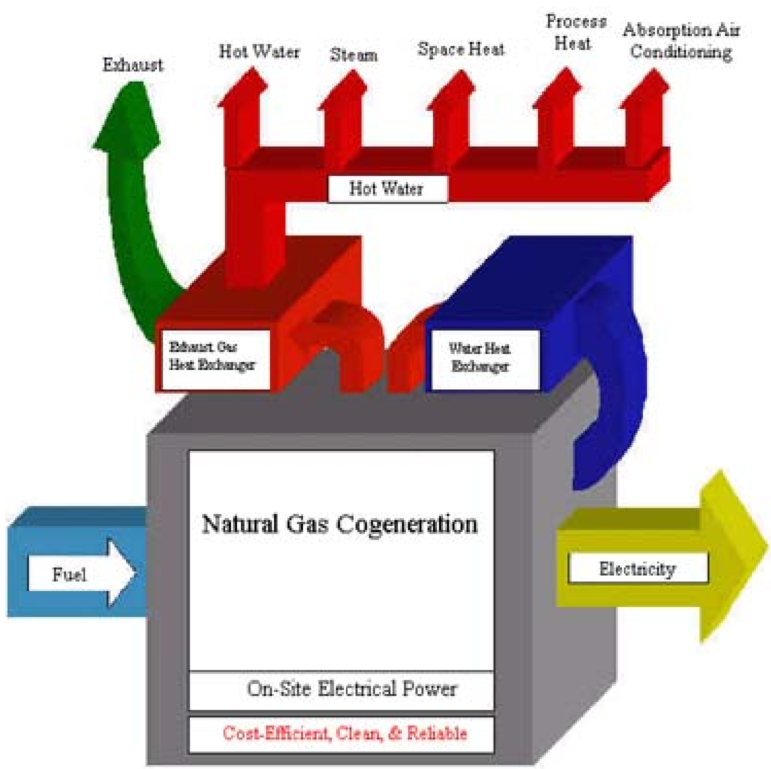

Figure 6 Combined heat and power system

(Image source: Juniata College, n.d., Cogeneration, Fact Sheet)

5.2.4 Advantages

Some advantages of CHP technology include:

- immediate energy savings
- the long-term cost savings
- lower greenhouse gas emissions and other pollutants
- energy security provided by greater ownership of energy generation and use
- CHP requires relatively low maintenance

- CHP technology is a much more efficient means of capturing energy from a fuel source. Not only does it reuse waste heat, but generates usable energy at the point of use. By comparison, big power plants (known as *centralised systems*) are less efficient as energy is needed to transmit electricity over vast distances.

Case studies:

Australia—Couran Cove Island Resort
Couran Cove Island Resort in Queensland, Australia is not on an electricity grid due to its remote island location. As the continuous electricity demands of the facility were high and guest services in the luxury range, the owners decided that several low emission gases fired cogeneration engines were most appropriate to meet the electricity needs of the resort. One larger central generation set combined with a series of small gas fired generators are used to give maximum flexibility and efficiency in power supply to the resort given differing demand levels. For example, when consumption is low only 1 or 2 units are on, however during a hot summer day when air conditioning is in high usage, all units will operate to meet the resorts power needs. As mentioned in the Couran Cove case study in section 4.3, the waste heat produced by the engine is captured and used to heat the resort swimming pools. This dramatically increases the efficiency of the system, as specific water heating equipment such as solar collectors would have otherwise needed to be installed.

Grenada, Caribbean Islands—Paradise Bay Resort
Another innovative approach to waste heat utilisation is at Paradise Bay Resort in Grenada, a Caribbean beach resort and spa of 9 Villas in 8 acres of natural park, bush land and beaches. The air conditioning systems also have heat recovery units installed which turns otherwise lost heat (extracted from the rooms) into guests' hot water supply as a supplement to solar hot water. A similar heat-exchanger approach is used on grey (waste) water at **Aurum Lodge, Canada.**

For more information on either of these case studies refer to Appendix A (chapter 8).

5.2.5 Challenges

At present regulatory barriers exist in some countries that can prevent the uptake of CHP technology. This is largely due to complicated planning processes and knowledge gaps, which create uncertainty about the operation of CHP systems, especially those interacting with existing power grid infrastructure. Fortunately, because CHP technology is becoming increasingly popular these challenges are being addressed.

Another barrier to the uptake of CHP systems is the lack of access to 'cleaner' fuels, particularly natural gas. If fuel options are limited to heavy polluting fuels such as diesel, oil or coal, it may be more effective to explore alternative clean technology solutions and improving energy efficiency.

5.2.6 Further information

London Climate Change Agency, 2007, *CHP Trigeneration*, London Development Agency

Cogeneration Project Development Guide http://www.cogen3.net/pdgform.html

Distributed Energy Resources Guide www.energy.ca.gov/distgen/index.html

http://www.oit.doe.gov/bestpractices/steam/pdfs/guide_chp_boiler.pdf

5.3 Geothermal Systems

5.3.1 What are geothermal systems

Geothermal systems transfer heat between the ground and a facility. Thus, they can heat and cool air and/or heat water. When heating air and water, heat is transferred from the ground to the facility. Transferring heat from the facility back into the ground cools the air.

Geothermal systems consist of a few components; a heat pump, which causes the transfer of heat; piping, which the heat travels through; and a compressor, the core of the heat pump that moves heat to and from the ground. The majority of the components are installed under-ground, generally at depths ranging from 2 to 7 meters. At these depths temperature is relatively constant worldwide, ranging from 5 to 30 Degrees Celsius. If piping is installed vertically however, depths of up to 100 meters can be reached and this may deliver much higher temperatures, depending on geological factors.

Geothermal systems require installation of extensive piping, horizontally or vertically. How the piping is laid depends on factors such as quality of soil and rock, the surrounding climate, the area in which one has available for installation and the intended purpose of the geothermal system. Some systems are designed to operate in one mode only, heating or cooling, or both, depending on climate. Figure 7 shows the flow of energy when a geothermal system is used to provide both heating and cooling.

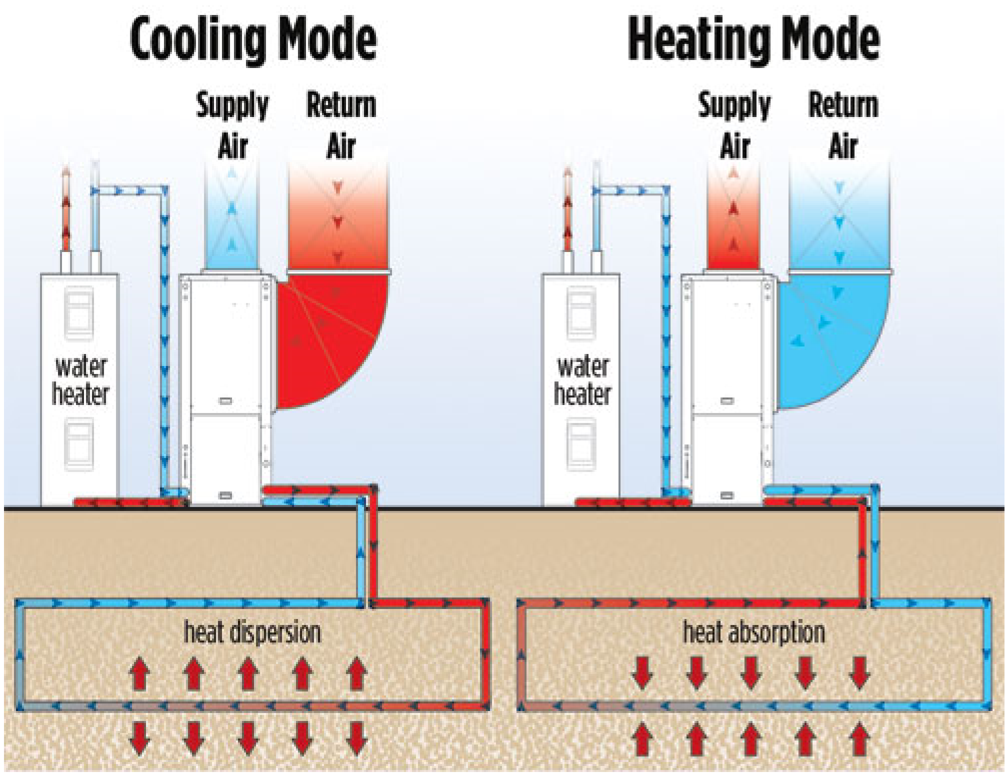

Figure 7 Heating and cooling processes of a geothermal system

5.3.2 Is it right for you?

There are several models of geothermal systems—the intended use of the system and the surrounding environment will determine which model is most suitable. The surrounding environment includes the climate, the geological conditions, and the demand for hot water and/or air-conditioning.

Is a geothermal system suitable?

It is important to consider what you wish the technology to be used for—to deliver heating, cooling or both. There will be slight differences in the components that make up a geothermal system depending on what the geothermal system is going to be used for.

Geothermal systems can be used in any country, city or region, as heat exists in the ground at all locations across the world. Major factors that will affect whether or not geothermal systems will be appropriate to use at a facility will be the size of the facility and the space to install a system. A large area is usually needed for the installation of the piping system. Piping can be laid horizontally or vertically. If piping is laid horizontally a large area is needed—how large will depend on how much heating and/or cooling is required. If space is limited or if the system is intended to reach high temperatures piping can be laid vertically. Vertical piping however is more expensive as drilling costs are greater.

The composition and soil quality surrounding the facility will affect the rate of heat transfer so specialist advice is necessary.

Geothermal systems can be noisy to install and run so the location in a facility is an important consideration. However, since the majority of the geothermal heat pump system will be underground it will free up significant space, will not obstruct views and can be integrated into a facility design.

Is it easy to install a geothermal system?

Installing the system requires considerable civil engineering work. Thus, it is easiest to install these systems in new-build projects, as they can be included in the building design. It may be difficult and expensive to install a geothermal system into an already existing facility. When installed horizontally, piping is laid only a few meters below the ground surface, usually between 2 and 5 meters. When installed vertically, piping can reach depths of 100 meters. Whilst most of a geothermal system is installed underground some of it exists above ground. The parts that exist above ground are generally small and easy to install and maintain.

What will it cost to install a geothermal heat pump?

As various models of geothermal systems exist, costs vary. Models that perform more than one function, for example heating, cooling and providing hot water will consist of more parts and thus be more expensive.

Installation costs will vary both on the chosen model and also the method of installation. Laying pipes vertically will be more expensive but may be necessary if space is limited. The initial costs of installation are high but once the system is installed there are considerable savings on electricity costs.

What will it cost to run and maintain a geothermal heat pump?

The cost of running a geothermal heat system will largely depend on the energy efficiency rating of the system. Energy efficiency ratings for geothermal systems are indicated as a *Heating Seasonal Performance Factor* (HSPF). The HSPF will have a big impact on the electricity needed to run the system and therefore cost. In general, the higher the HSPF rating, the less electricity the unit will use to do its job.

Geothermal systems have very low ongoing costs; they last for up to 50 years without significant maintenance or repair costs. Maintenance costs are low because geothermal systems are made of only a few, simple mechanical parts that are very durable. Most components of a geothermal system are protected from the weather as they are installed underground. The parts of the system that exist inside the facility are easily accessible, making maintenance of them easy.

Will it suit hot water and air conditioning needs?

The size of a facility may require the use of multiple systems. A single unit may be sufficient for a small commercial building; multiple units may be required for larger facilities. The local climate will also determine the extent to which a geothermal system covers all hot water and air-conditioning needs. If a facility is located in a relatively hot climate the system may fully cover your hot water needs, depending on the size of the facility and peak demand of resources.

5.3.3 How does it work?

- Water, or an environmentally safe anti-freeze solution is injected into an underground closed looped piping system (piping is made of durable material that allows heat to pass through efficiently).
- The liquid circulates the piping system—as the liquid circulates it absorbs heat.
- A compressor (run by a small amount of electricity) and a substance called a *refrigerant* carries the heat from one area to another.
- Geothermal systems have an outdoor unit (condenser) and an indoor unit (evaporator coil)—heat is able to travel to and from both units (in the summer hot air from inside the facility is transferred back into the earth or it can be used to heat water; in the winter heat from the earth is transferred into the facility which can be used to heat water and air).

When the system is used to cool air from inside the facility it simply draws the excess heat from inside the facility and transfers it through the piping back into the earth. The heated or warmed air is distributed, often through ductwork in a forced-air-system.

5.3.4 Benefits

Geothermal systems are efficient at providing low cost hot water and air conditioning services. The electricity output from the system significantly exceeds the electricity needed to run the systems (approximately four fold). The system is run on approximately 70% renewable energy from the ground. It is the earth's constant underground temperatures that make geothermal systems one of the most efficient heating and cooling systems on the market.

Geothermal systems are less expensive to operate than many other heating and cooling systems. Exact costs will depend on the local situation. The largest ongoing expense is electricity used to run the pump, which uses much less energy than direct heating systems. In a direct heating system, fuel or electricity is used to create heat, whereas a geothermal heat pump only uses electricity to get energy from the earth. This is much more efficient.

Additionally, the part of the system above the ground is much smaller than conventional heating and cooling systems, providing more space inside your facility.

5.3.5 Challenges

The main challenges will be the high initial costs of purchasing and installing the geothermal system, however the money saved on operation costs will pay for the initial investment in a few years. The length of the pay-back period will depend on several factors including the size of the system that the facility requires, the type of model, how the system is installed, whether it is installed at the time of building the facility or installed into existing infrastructure, the energy rating of the pump and the climate surrounding the facility. It will also depend on what other heating options are available.

Laying the piping system may require a large area and thus may not be appropriate for very small development. Appropriate space to install the piping will be necessary, although after installation the land above the piping can be used for other purposes. Considerable engineering work is required to install the piping, particularly if installing piping vertically. Drilling costs required for installing vertical piping can be very expensive.

Heat pumps can also be noisy to set up and operate. The condensing unit may be particularly noisy and may interfere with the quiet enjoyment of your facility. You should inquire about noise levels and compare the noise levels of different models, or consider installing sound insulation around the heat pump.

It may be necessary to engage with specialists, engineers and local government for a number of reasons. This can become expensive and time consuming. It may be necessary to engage with specialists when deciding on whether or not a geothermal system will be a valuable investment, including carrying out geological assessments; what the system is to be used for; what model purchased; how and where it is installed; and ongoing maintenance and repair services (although maintenance and repair costs will be infrequent and low).

5.3.6 Further information

Geothermal Heat Pump Design Manual
www.mcquay.com/mcquaybiz/literature/lit_systems/AppGuide/AG_31008_Geothermal_021607b.pdf

Case study: UK—The Hytte

The Hytte is a self-contained holiday cottage in Northumberland National Park, a remote area in the North of England, that has 4 rooms sleeping 8 guests and has taken on far-reaching clean energy commitments. After researching many different options on the Internet, no option for heating in the cold Northumberland climate had presented itself. The owner then heard a radio program referring to geothermal heat pumps, which were noted to work best in circumstances of under floor heating and well-insulated buildings. As the Hytte's design fit this description, they were able to find a local company who installed them. A 6kW geothermal (ground source heat pump) was installed to heat all water and also provide under-floor heating. The multi-zoned under-floor heating provides three units of heat for every one unit required to drive the pump. This technology is both high efficiency (thereby limiting energy consumption), and low maintenance. This reduces operating cost substantially relative to comparable technologies for water and space heating.

After commencing building, they found out there were grants for renewable energy and managed to secure 50% funding for the heat pump system through the government's Energy for Enterprise program and the National Parks' Sustainable Development Fund.

5.4 Micro-hydropower

5.4.1 What is micro-hydropower?

The geography and typography of Peru make hydro one of the best renewable energy resources available. Peru generated 9,549 GWh of large-scale (not micro-) hydroelectricity in 2007[28] and has an estimated potential of 60,000 MW. Most Peruvian rivers originate in the Andes and drain into one of three basins. Those that drain toward the Pacific Ocean are steep and short, flowing only intermittently. Tributaries of the Amazon River are longer, have a much larger flow, and are less steep once they exit the sierra. Rivers that drain into Lake Titicaca are generally short and have a large flow.

The Peruvian government is already promoting hydro energy because it allows the country to ensure its power supply while it also helping to solve the problems of global warming and water supply security. The

[28] International Energy Agency (2007), "Energy/Heat in Peru in 2007", accessed at http://www.iea.org/stats/electricitydata.asp?COUNTRY_CODE=PE

government, in collaboration with Brazil, is investigating projects with the potential to supply roughly 6,000MW by 2013[29]. The flagship is project is Inambari, a 2.2-GW venture in the Amazon jungle, already at the final stages of environmental and feasibility studies.

In this section we are dealing with micro-hydropower which is the generation of electricity from the movement of water on a small scale. At very small scales it is sometimes called pico-hydropower. Unlike large-scale hydropower plants, no dam is present; energy is generated from either the natural fall of water down a stream or by diverting some stream flow through a penstock (an installed pipe or canal). Micro-hydropower generators range in size from very small-scale (200-300 watt) generators up to larger generators of 100KW. Once installed, running costs are very low; a World Bank study found that micro-hydropower was by far the cheapest electricity option for small scale off-grid power supply (World Bank, 2007). The major disadvantage of micro-hydropower is that it requires unique geographic and climatic circumstances in the local area and is therefore unavailable to a majority of accommodation facilities.

5.4.2 Will it suit your needs?

Suitable locations

The first requirement is for flowing water with a reliable flow in the direct vicinity of the accommodation facility, for example in a stream. As the stream must flowing downhill to generate the levels of energy required, mountainous or hilly regions with reliable flows for all, or at least most, of the year is a necessity.

There are additional considerations, which will depend on local circumstances:

- Is the accommodation facility directly adjacent to the stream, and if not, will complications emerge from installing wires or cables across land not owned by the facility owner?
- Is installing a generator in the natural stream something that the local authorities will allow?

The higher the water pressure and speed of flow, the higher the energy generating potential. If a natural stream has both water pressure and speed, installing a generator directly in the stream may be suitable for smaller applications up to 4 or 5KW. If not, or if the facility has higher electricity demands, it may be preferable to install a penstock. A penstock is a pipe or canal, which takes water from an uphill source and runs it down to a generator at its base in a way which increases the water pressure and/or water speed.

What size generator is required?

The optimal generator will be dependent on a) the water and flow rate and b) the peak energy use from the hydro system.

How does it work?

Water moves from where the water is captured, along a penstock to the turbine generator. Before entering the penstock, a grill-like structure is required to filter out floating debris, fish or ice. The water falls down the penstock or down the stream (where no penstock is installed) and turns a turbine whose mechanical action is used to create electricity. The energy can be regulated at the generator itself through a load bank (which dissipates the energy not required), or an induction generator (which regulates the frequency), or via electronic means such as an inverter (which converts the output to grid frequency). The electricity is sent to the accommodation facility or village via overhead wires.

[29] Global Business Reports (2009), "Minister of Energy and Mining anticipates energy projects with Brazil", accessed at http://www.powermag.com/business/Peru-The-Potential-to-Become-a-Regional-Energy-Hub_2507_p2.html

5.4.3 Benefits

- a renewable source of energy
- very cost effective as energy use costs are free
- relatively low start-up capital costs, particularly compared to solar PV technology.

5.4.4 Challenges

- not available in areas of flat topography or in dryer climates
- reliant on stream flow, which may be highly variable
- potential visual intrusion on the stream or waterfall
- potential damage to equipment from flooding.

Case Study: Sadie Cove Wilderness Lodge, Alaska

This remote wilderness lodge of 5 eco cabins is on a privately owned beach, on the ocean in Alaska's Kachemak Bay State Park. The owners originally spent 11 years operating the guest facility with no electricity and thus no lighting, refrigeration or other modern energy services. Lanterns were used for light and a small generator was used for rare instances that required use of a power tool. After careful consideration of different local sources to create electricity, it made sense to tap into the year round swift stream 200 feet up above the lodge. Electricity for the entire lodge is provided by a small, non-polluting, hydroelectric system, which is connected to a battery bank to store the electricity created, and an inverter to convert it from 12V to 110V for use in the lodge. The one system provides electricity for the Lodge and 5 cabins. A small wind generator also tops up the same battery bank. The result is 100% off-grid renewable energy supply with no back up generation required. The only maintenance issues that arise are occasional gravel and detritus clogging up the pipes occasionally, or a section of the pipe freezing in extreme weather.

The primary benefit that clean energy provides is access to modern energy services that would have been otherwise unachievable given the constraints of the location. This has dramatically improved the quality of life of the owners and the ease of operating the business, as well as the services that can be offered to guests. So although saving up for the capital cost to build the system initially was very difficult, it is an investment they consider 'definitely worthwhile'.

5.4.5 Further information

Micro-hydropower factsheet. Intermediate Technology Development Group Technical Brief. www.habiter-autrement.org/12.energies/contributions12/Hydroelectricite_Micro_hydro_power_1.pdf

World Bank Group and Energy and Mining Sector Board (2007) Technical and Economic Assessment of Off-Grid, Mini-Grid and Grid Electrification Technologies—Summary Report. Energy Sector Management Assistance Program. www.wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2008/04/18/000333037_20080418011100/Rendered/PDF/430990ESM0REVISED01public1.pdf

Hydro Resource Evaluation Tool www.lancs.ac.uk/fas/engineering/lureg/nwhrm/index.php

HOMER micropower optimisation model www.homerenergy.com

5.5 Solar Photovoltaic (PV) Systems

5.5.1 What is a solar photovoltaic energy system?

Sunlight is the most abundant energy source in the world. Currently there are a number of different technologies available that directly harness the energy from the sun. Solar photovoltaic (PV) systems use panels that convert sunlight directly into electricity.

5.5.2 Is it right for you?

Will solar PV suit the climate?

Peru has massive solar energy potential, with some of the southern areas in particular having amongst the highest solar energy concentrations in the world. The Peruvian Government is working on solar energy projects in some rural areas where it is not possible to access grid electricity[30].

Will it suit your accommodation type and available space?

A solar PV system will work best if the panels can receive full sunshine from 9am in the morning to 3pm in the afternoon when the sun is higher in the sky and at its strongest. It is best to locate panels out of any shaded areas such as below trees or adjacent buildings.

Will it suit my energy needs?

The amount of energy a solar PV system produces depends on the weather. On rainy or overcast days panels will receive less sunlight, meaning they will produce less energy. If there is no connection to a major energy grid (known as *off-grid*), it is useful to have some way of storing excess energy produced on sunny days for use at night or overcast days. Solar PV systems are usually coupled with an energy storage system such as lead-acid batteries.

Solar PV systems provide direct current (DC) electricity. Most appliances such as electric kettles, phones, radios, televisions, fans and electric heaters use alternating current (AC). For this reason, a *converter* may be necessary, to convert DC electricity to AC.

Getting financial assistance?

For remote or non-serviced locations, the cost of solar PV is usually cheaper than connecting to an existing energy grid.

5.5.3 How does it work?

- Solar PV systems consist of flat panels (or *modules*) made up of solar cells. When sunlight hits these cells, light energy is converted to electricity. The greater the amount of sunlight, the greater the amount of electricity produced.
- Solar PV systems produce direct current (DC) electricity. Most electrical appliances require alternating current (AC). An *inverter* converts DC to AC electricity.
- You may wish to store some of the energy your solar PV system produces when the sun is shining brightly. This energy can be stored using one or more *batteries*.
- If you are connected to the grid and generate more electricity than you use, you can export this energy back to the grid. Energy service providers will often pay you for this excess energy.

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[30] Global Business Reports (2009), "Minister of Energy and Mining anticipates energy projects with Brazil", accessed at http://www.powermag.com/business/Peru-The-Potential-to-Become-a-Regional-Energy-Hub_2507_p2.html.

5.5.4 Advantages

- Once installed, solar PV systems are generally very easy to maintain as they require very little maintenance and have practically no operating costs, thus once installed the electricity is essentially free.
- Solar PV panels can last between 25 and 40 years before needing to be replaced. However, older panels will be less efficient at converting sunlight into electricity.
- As solar PV systems are made up of panels, they can be adapted to suit your energy needs. The more energy you use, the more panels you can install.

5.5.5 Challenges

An accredited professional may be required to install a system. This can be a challenge if skilled people are not available. Roof mounted solar panels can be heavy so it is important to ensure a roof is strong enough to support this added weight, particularly for older buildings.

5.5.6 Further information

Grid-connected PV Systems Design Guidelines
http://www.cleanenergycouncil.org.au/cec/accreditation/Solar-PV-accreditation/forms/mainColumnParagraphs/0/text_files/file9/Grid%20Connect%20Design%20Guidelines%20CEC.pdf

HOMER micropower optimisation mode www.homerenergy.com

Distributed Energy Resources Guide www.energy.ca.gov/distgen/index.html

Case Study: Rainbow Retreat, Tasmania, Australia

Rainbow Retreat is a remote wilderness eco lodge with 3 guest cabins that have their own 100% solar PV 12V energy system. The owners live in the main lodge that is 100% solar PV powered. Due to remote (off-grid) location and wilderness value, clean energy was considered essential by the owners. The main lodge has 12 solar panels with a battery bank and sine wave inverter giving it 240V mains electricity. The main house does all the cooking for guests and charges up guest cameras and mobile phone batteries as the cabins are only 12V and cannot run appliances such as hair dryers. There is 1 wind generator that trickle feeds into the main lodge battery bank as a supplementary energy source. The cabins each have their own 2 x 60W panel solar PV system which powers efficient lighting and specialised 12 volt low compression electric fridges.

5.6 Solar Water Heater

5.6.1 What is a solar water heater?

A solar water heater uses energy from the sun to heat water. Solar panels placed on the roof of your facility collect the sun's rays and heat the water, which then flows to a storage tank ready for showers, cooking and space heating.

There are many different types of solar water heaters available. It is important to select the type most suitable for climate, roof characteristics, water quality and available space.

5.6.2 Is it right for you?

There are many different types of solar hot water heaters available. With careful selection, a solar hot water system can be suitable for most settings. There is choice in the selection of solar collector technology, boosting system, tank type and where to position the tank. Sizing the system appropriately for the accommodation facility is a critical consideration to achieve efficient operation.

Will it suit your accommodation type and available space?

A solar water system can be tailored to an accommodation facility by selecting a suitable tank capacity and suitable number of collectors. The tank can be located on the roof, on the ground or in a roof cavity. A solar water heater will work best if the collectors can receive full sunshine during the middle of the day when the sun is high in the sky and at its strongest. It is best to locate collectors out of any shaded areas such as below trees or adjacent buildings.

Will it suit your climate?

Solar water heaters can be used in all climates, including colder climates. There are particular systems available for areas prone to frost or snow and for areas where temperatures reach 30^{o}C below zero. Positioning your collectors on a 40 to 50 degree angle will achieve better winter performance because the sun is lower in the sky in winter.

The two main types of solar collectors are flat plate panels and evacuated tube systems. Flat plate panels are a common type of system and operate best when the sun is directly overhead but less so when the sun's rays hit the panels at different angles. Evacuated tube collectors use glass tubes and can be more efficient than flat plate panels in certain conditions such as cold climates.

Will it suit your water supply?

Storage tanks are made of different materials such as vitreous enamel (also called mild steel), stainless steel or copper. The choice of tank material will be dependent on water quality and whether there is a connection to mains water supply or the supply tank water. In areas with hard water, a corrosion resistant tank is more suitable.

Will it suit your hot water needs?

Depending on location, the direction solar panels face and the amount of water used, a solar water heater can provide between 60% and 90% of hot water needs. On days where hot water usage is higher, or on cloudy or rainy days, water stored in a tank may need an additional boost to keep it at the preferred temperature. Solar water heaters come with electric or gas boosters for these times.

5.6.3 How does it work?

- Solar water heaters use a tank to store water that has been heated by the sun.
- Cold water flows from the tank to the solar collector, usually positioned on the roof. In a split system, cold water is pumped up to the collector. In a thermosiphon system with the tank above the collectors on the roof, cold water flows naturally into the collector because it is heavier than hot water.
- The solar collector is made of materials that absorb the sun's heat very efficiently. The cold water travels through the collector and the heat in the collector heats up the water, which returns to your tank.
- Hot water floats to the top of the tank and colder water is taken from the bottom and returned to the solar collector. When you need hot water, it is taken from the top of the tank where the water is hottest.

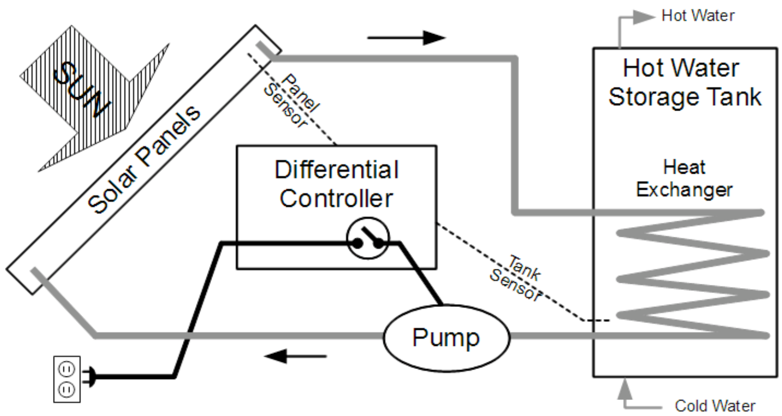

Figure 8 Solar water heating process

5.6.4 Advantages

Solar water heaters are quiet, use renewable energy from the sun and therefore do not emit greenhouse gases. Water heating can account for a large percentage of an accommodation facility's energy use. If a solar water heater is appropriate, it can lower the cost of energy bills and add value to a facility. Of all the small-scale clean energy technologies, a solar water heater is the most efficient and cost effective.

5.6.5 Challenges

The upfront cost of purchasing and installing a solar hot water heater may be prohibitive for some owners and operators of tourist accommodation.

A solar hot water heater can last for 10–12 years before it needs replacing but ongoing maintenance is recommended. This may include replacing parts periodically, fitting insulation around the tank and pipes, cleaning collectors and trimming trees, which may shade the collectors. To avoid legionella and kill any pathogens in the water, the recommended thermostat temperature is usually 60^{o}C.

An accredited professional is required to install systems. This can be a challenge if skilled people are not available. Roof mounted tanks can be heavy so it is important to check that a roof is strong enough to support this added weight, particularly for older buildings.

5.6.6 Further information

Please refer to Appendix A (chapter 8) for links to solar hot water heating online calculators.

Case Study: USA—Proximity Hotel

This purpose built 147-room high quality LEED Platinum certified hotel 100 large solar collectors have been installed on the roof, providing 4000 square feet of solar hot water capacity. The hot water is stored in four 1450-gallon tanks. This provides hot water equivalent to about 100 homes. It provides 60 per cent of the water required for the hotel and restaurant and gives a saving of between US$14 000–US$20 000 per year.

As Dennis Quaintance, CEO of Proximity Hotel comments, 'When we started the design process four years ago, I would have never believed that we could use 39.2% less energy and 33.5% less water without one iota of compromise in comfort or luxury and with minimal additional construction costs. It just goes to show what a determined team can accomplish if they use common sense and get a little bit of help from the sun.'

After energy efficient lighting and appliances, solar water heating is the most widely adopted form of clean energy technology found in our case studies, both on- and off-grid. For numerous examples of case studies at a smaller scale see Appendix A (chapter 8).

5.7 Wind Energy System

5.7.1 What is a wind energy system?

A wind energy system, or wind turbine, uses energy from the wind to create electricity. Wind turbines need to be placed on towers engineered for the wind system. Rooftops, silos and existing towers are typically not appropriate for wind systems. The wind spins the blades, which in turn spins the generator to create electricity.

There are many different types and sizes of wind energy systems available. It is important to select the type of wind system that is most suitable for your facility. When investigating wind energy for your site, the following should be considered: your wind speed, predominant wind direction, topography, ground clutter, proximity to airports, and available open space.

5.7.2 Is it right for you?

Will a wind system suit an accommodation type and available space?

Peru generated 1GWh of wind power in 2007[31], however the country has great potential for expansion in the wind energy sector especially in the northwest coastal region. It is estimated that there is potential to tap into 19 GW of wind energy in Peru[32].

When considering a wind system, there are some basic requirements.

- The site needs to have a good wind resource. Ideally, a wind energy system requires locations with an average annual wind speed of at least 4.4 m/s or greater.
- The surrounding terrain should be relatively free of clutter; wooden and urban areas are considered very cluttered.
- Wind turbines need to be on tall towers to access faster, smoother wind speeds. The friction between the wind and the earth causes wind speed to increase rapidly with increasing distance from the ground, especially in the first 20m. Also, obstructions around the turbine, such as trees or buildings cause turbulence, which not only reduces the efficiency of the turbine; it also shortens its life due to additional wear and tear.
- A general rule for tower height is that the bottom of the turbine rotor, or blades, should be at least 10m above the tallest obstruction within 150m or the nearby prevalent tree height (for trees, this means the mature tree height over the 20 to 30 year life of the turbine, not the tree height current tree height). For residential or small business sized wind systems, towers of 30m or 37m are common.
- The tower needs to be placed within 300 meters from the point of interconnection to be financially feasible. The longer the distance, the higher the cost due to the labour cost of trenching, the cost of the longer wire and because a larger diameter wire will be required.
- Typically wind systems are placed a distance equal to or greater than their total extended height away from inhabited dwellings, roads, above ground infrastructure. The total extended height of a turbine is the height of the tower plus the length of the blade.
- The site for a wind system must be accessible, either for a crane or with space to tilt up a tower.

Will a wind system suit the climate?

Wind energy systems can be used in all climates, including colder climates or salty climates. However a climate may require specific maintenance needs.

Will a wind system suit energy needs?

If a site has wind speeds appropriate for a small wind system, it may be possible to source a turbine to meet energy needs. There are two ways to increase the energy production of a wind system to meet additional needs:

- invest in a turbine with longer blades. Small wind systems range in capacity from 1kW to 100 kW, with blade lengths ranging from 1m to 15m. The energy generated by a wind turbine is directly proportional to the 'swept area', or the area that is encompassed by the blades when they are spinning, therefore increasing the blade length can significantly increase the power output of the wind system
- site the turbine so that it has access to faster wind speeds, by investing in a taller tower and sitting the tower on the highest elevation and with access to the predominant wind direction.

How does it work?

[31] International Energy Agency (2007), "Energy/Heat in Peru in 2007", accessed at http://www.iea.org/stats/electricitydata.asp?COUNTRY_CODE=PE

[32] Global Business Reports (2009), "Minister of Energy and Mining anticipates energy projects with Brazil", accessed at http://www.powermag.com/business/Peru-The-Potential-to-Become-a-Regional-Energy-Hub_2507_p2.html

- The wind turbine is properly installed in a location with appropriate wind speed. The wind pushes the rotor, or blades, of the wind system. The rotor drives the shaft of a generator to produce electricity.
- The electricity flows from the generator, down the wires to the base of the tower.
- An inverter, typically at the base of the tower, changes the electrical output of the turbine to match the electrical requirements at the point of interconnection.
- The electrical wires can then be connected in three ways: 1) directly to your utility's distribution system, 2) directly to your facilities or 3) the electricity can be stored in a battery bank.

5.7.3 Advantages

Wind energy systems use renewable energy from the wind and therefore do not emit greenhouse gases. Wind energy can account for a large percentage of your accommodation facility's energy use. If a wind energy system is right for you, it can lower the cost of energy bills and add value to your facility. Of all the small-scale clean energy technologies, a wind energy system is the most visible.

5.7.4 Challenges

The upfront cost of purchasing and installing a wind energy system may be prohibitive for some accommodation providers.

A wind energy system can last for 20 years and maintenance is recommended two times a year, which will be a reoccurring cost. Maintenance includes checking the blades for cracks, checking any moving parts, tightening bolts and inspecting the tower. An accredited professional is required to install your system. This can be a challenge if skilled people are not available in your location.

5.7.5 Further information

Quick guide to large wind www.rurdev.usda.gov/OR/biz/QuickGuide2LargeWind.pdf

Small wind handbook www.windpoweringamerica.gov/pdfs/small_wind/small_wind_mi.pdf

Wind-turbine power calculator http://windwithmiller.windpower.org/en/tour/wres/pow/index.htm

Wind-works www.wind-works.org

HOMER micropower optimisation model www.homerenergy.com

Distributed energy resources guide www.energy.ca.gov/distgen/index.html

Case studies:

Grenada—Paradise Bay
This Caribbean beach resort and spa of 9 Villas in 8 acres of natural park, bush land, and beaches installed a utility-sized 80kW wind turbine in 2008. There are few, if any, other tourism operations globally with this size wind system installation. The resort is on the electricity grid and consumes 120 000 kWh of electricity per year. The wind turbine provides 180 000 kWh per year, thus providing 150% of their annual electricity needs, meaning that they make money selling excess power to the local electricity supplier. The calculated cost of the wind energy is 0.258c per kWh, which includes product life, maintenance, write-offs, profits from surplus electricity, and all costs and management time required to negotiate with the electricity company, as it was the first to be installed in the region. Compared to the local charge for electricity of 0.331c per kWh this represents a 22% saving.

Many challenges were faced in getting the project initiated and then completed, largely due to being the first installation of its kind in the region. It took six years to get an agreement with the electricity company. Key issues were getting the electricity company to support the initiative, and then ensuing negotiations were very challenging at times, especially as they were a monopoly.

Paradise Bay notes that (in an on-grid situation) establishing a contract with a local electricity supplier is the first step before committing to a project like this, thoroughly researching all the issues that need to be addressed. If they were to do this again, they would have gone for a larger turbine and negotiated different financing with a better interest rate.

Canada—Aurum Lodge, Rocky Mountains

Aurum Lodge, an eco-tourism operation in the Rocky Mountains with 6 guestrooms and 3 self-contained units, provides an example of an accommodation facility that found the local wind regime to be unsuitable for wind power. A small wind generator was installed to monitor the site for wind power, and after three years it was removed, as it was determined that the site had a highly variable wind regime, often reaching extreme wind speeds that create turbulence and reduce the longevity of a wind turbine. As a result, the lodge expanded their PV system in preference to installing a larger, permanent wind turbine.

6 DEVELOPING AN APPROACH TO CLEAN TECHNOLOGY: WHAT ONE HOTEL OR HOSTEL CAN DO

This chapter identifies two approaches through which best practice hotels and tourist accommodation facilities have become 'cleaner' in their energy use by adopting approaches, which do not require any new or different technological hardware such as:

- certification schemes
- carbon offsetting.

6.1 Certification Schemes

6.1.1 What are certification schemes?

Certification schemes offer third party verification of environmental performance. Certification schemes provide the tools and information to help accommodation providers achieve their clean energy goals. Organisations offering certification provides support for the certified organisation with monitoring their performance by way of benchmarking data and rating systems to compare performance within a sector.

6.1.2 Could certification make a contribution in your situation?

Is certification important?

Accommodation providers are increasingly embracing 'green' practices and committing to environmental sustainability. Through the process of gaining certification, organisations and staff members gain a greater understanding of the various areas for improvement in the operation of their facility. Certification provides verification of sustainability achievements.

Is your organisation a leader in environmental performance?

Successful certification will mean that a facility has made significant achievements in environmental performance by way of energy efficiency, water efficiency, greenhouse gas reductions and more. Unless there is real evidence that such reductions are achieved and sustained, the application for certification is less likely to be successful. Therefore it is important to verify that any achievements claimed are real and can be fully substantiated.

Does your organisation have the resources to carry out the certification process?

The certification process can be time consuming and will require staff resourcing. Skilled staff will need to prepare documentation and detailed information during the application process.

Do you have a plan for communicating your certification?

One of the benefits of certification schemes is the attraction to tourist and guests. Certified accommodation provider may wish to promote this aspect of their accommodation offering through pre-existing or new marketing channels.

The LEED (Leadership in Energy and Environmental Design) is a green building certification system offering third party verification of green building performance in the areas of energy savings, water efficiency, greenhouse gas emission reductions, indoor environmental quality and resource stewardship. LEED certification is internationally recognised. LEED certified buildings (can include hotel accommodation) should use resources more efficiently than buildings built to building code standards.

The LEED system was developed by the US Green Building Council and provides a framework for identifying and implementing practical and measurable green building design, construction, operations and maintenance solutions.

6.1.3 How does it work?

Various certification schemes operate throughout the world. Choice of certification scheme will depend on an organisation's goals.

Once a certification scheme is selected, time and resources are required in order to review the accreditation requirements. Organisations will need to register with the scheme operator. Registration will typically allow access to a range of tools and resources from the scheme operator to assist with the application for certification.

Following registration a range of documentation requirements will need to be completed as part of the application process. This process requires assembling a range of information and checking of details.

At some stage of the certification process, either at registration or at the time of submitting an application, fees will be charged. Fees will vary depending on the scheme and type of accreditation applied for.

Once all information is assembled, the application must be submitted for review. Most certification schemes will assign scores to different levels of performance. All documentation will be reviewed for compliance.

Once certification is approved, organisations will receive a formal certificate and listing on the certification scheme's website or directory.

Case studies

USA—Proximity Hotel, USA

The design of this purpose built 147-room high-end hotel was strongly guided by the LEED design criteria, and it has subsequently gained LEED Platinum certification (for more information about certification schemes see above), the highest accreditation obtained from the US Green Building Council's certification program, leading the hotel to be acknowledged as America's 'Greenest Hotel'. Design features of the hotel that gained credit under LEED include:

- energy efficient passive solar building design and materials
- large-scale solar water heating
- automated energy management technologies
- geothermal cooling equipment is used for the restaurant's refrigeration
- North America's first 'regenerative drive' elevators, which use electricity going up but generate electricity as they descend
- a green, vegetated rooftop
- other non-clean energy initiatives such as high levels of fresh air movement, resulting in a healthy internal environment with healthier and more productive occupants (staff and guests).

The hotel now operates following the LEED certification standards, and as reported above, through building design and operation the hotel has dramatically reduced operating costs, using approximately 39.2% less energy and 33% less water than a similar quality hotel.

Case Study: The Hytte—United Kingdom

The Hytte, a self-contained holiday cottage in Northumberland National Park with 4 rooms, has obtained Gold Certification with the UK's Tourism Accreditation Scheme—the Green Tourism Business Scheme. They discovered the scheme shortly after opening, and whilst this did not influence the original design, it has provided a source of accreditation to assist in their marketing as well as provide a framework to continue improving their clean energy and other sustainability initiatives.

For more information about either of these case studies, refer to Appendix A (chapter 8).

6.1.4 What are the benefits of certification schemes?

Certification schemes—particularly the more established schemes—are trusted by government entities, organisations and industry leaders. Certification can have good environmental outcomes and at the same time make good business sense. This is because the energy savings achieved through certification processes deliver cost savings but at the same time, certification can be communicated to guests as a selling point and is attractive to the 'eco-tourist'.

6.1.5 What challenges are associated with certification schemes?

Certification requires a high level of commitment as all claims must be verified and all results made transparent. This is necessary for maintaining the credibility of the certification scheme.
The fees associated with certification schemes may be prohibitive.

6.1.6 What is available in Peru

Many of the Green Rating schemes internationally have been developed with or by national Green Building Councils. Peru has a "prospective Green Building Council" and it is possible to access the worldwide Green Globe scheme through the Latin American "preferred partners" based in Mexico.

6.1.7 Additional resources

http://www.greenglobe.com/index.html

http://www.usgbc.org/DisplayPage.aspx?CategoryID=19

Ernst and Young 2008, Hospitality going green. Global Hospitality Insights: A publication for the hospitality industry.

Green Globe

Green Globe is a worldwide benchmarking, certification and performance improvement program based on the Agenda 21 principles. Green Globe certifications are assessed by third party auditors (in accordance with ISO/IEC 17021). Auditors work onsite together with clients providing advice and guidance during the process.

Green Globe membership provides access to the certification criteria and benchmarking tools. Organisations can work toward certification according to a timeframe that is suitable to them.

Green Globe updates its certification criteria annually to ensure international compliance. In addition to providing customer service in key areas, Green Globe offers a strong marketing component, supporting certified businesses with marketing through worldwide channels.

Green Globe Certification supports the Global Sustainable Tourism Criteria (GSTC). The GSTC is the agreed international standard for the sustainable operation and management of travel and tourism businesses. The Green Globe Standard meets and exceeds all the requirements of the GSTC. It is available in Peru through Green Globe "Preferred partners" in Mexico at http://www.greenglobe.com.mx/

6.2 Carbon Offsetting

6.2.1 What are carbon offsets?

Carbon offsets are *indirectly* related to clean energy in that they do not actually influence energy supply, but are covered in this manual because they may be considered by hotels pursuing a greater clean energy plan. Carbon offsets represent reductions in greenhouse gas emissions from one activity, purchased in order to compensate for the emissions of another activity. Offsets are representative of measures that prevent greenhouse gases from entering the atmosphere in the first place; and measures that remove greenhouse gases from the atmosphere after they have been released.

The process of buying and retiring carbon offset credits is known as carbon offsetting and a voluntary carbon market has emerged to supply carbon credits for this purpose.

Case study: Costa Rica—Playa Nicuesa Rainforest Lodge, carbon neutrality

In Costa Rica, the Playa Nicuesa Rainforest Lodge buys carbon offsets in regional conservation programs in order to achieve carbon neutrality. The carbon credits are administered by Fondo Nacional de Financiamiento Forestal (FONAFIFO), Costa Rica's official carbon credits foundation. Nicuesa Lodge has earned a FONAFIFO certification for offsetting the emissions associated with the lodge's fossil fuel use. The credits represent the carbon emissions reduced through the protection and reforesting of Costa Rican rainforests.

Nicuesa lodge aims to achieve carbon neutrality and has begun the official process of certification. The certification will verify that the lodge minimises its carbon footprint. The lodge also offers guests the option to purchase offsets for the emissions associated with international flights to Costa Rica. FONAFIFO's carbon credits calculator is used to calculate the emissions.

For more information about this case study, refer to Appendix A (chapter 8).

6.2.2 Could carbon offsets make a contribution in your situation?

Is carbon neutrality important?

With increasing public concern about climate change, many organisations are looking for ways to take action to reduce their greenhouse gas emissions to promote good public image and appeal to new customers. 'Carbon neutrality' can be a useful marketing tool in this regard and can be achieved by individuals, organisations and businesses that pay to offset all of the emissions associated with their activities.

Have I already done everything I am willing or able to do to clean up my own energy supply?

Best practice in clean energy first involves reducing the environmental impact of the existing energy supply. Once other options are exhausted, a business may consider offsetting the remaining emissions.

Are there more cost effective methods of reducing your emissions?

Improving the energy efficiency of hotel or accommodation facility and implementing some of the more cost-effective clean energy options on site are usually less costly ways of reducing emissions. However, where these options are exhausted or where further actions are not cost effective, an alternative is to voluntarily pay for emission reductions elsewhere, by way of carbon offsetting.

Can you afford to purchase carbon offsets?

The price of carbon offsets can fluctuate and differ widely depending on the offset type. It is important to take the time to compare market prices when buying offsets. The total cost of carbon offsets will also depend on the accuracy of the carbon calculator used to calculate the carbon emissions of an activity.

Do you have a plan for communicating carbon neutrality?

One of the benefits of purchasing carbon offsets and achieving carbon neutrality is the attraction to tourist and guests. This aspect of an accommodation offering could be promoted through pre-existing or new marketing channels.

6.2.3 How does it work?

Carbon offsetting is carried out by buying voluntary carbon offsets, which are generated by projects elsewhere in the world that have been verified to reduce carbon emissions, such as energy efficiency or renewable energy projects. Purchasing carbon offsets from the market removes (retires) them so they cannot be re-sold.

A widely accepted principle of environmental policy is that emission reductions at source are preferable to cleaning up emissions after they have occurred. It is better to prevent emissions at source, rather than to offset emissions after they have occurred[33].

The steps for carbon offsetting are as follows[34]:

- assess your carbon footprint
- account for your renewable energy use
- implement additional energy efficiency measures
- calculate your remaining greenhouse emissions
- purchase offsets for these remaining emissions
- communicate carbon neutrality.

Once all other measures to reduce emissions have been undertaken, emissions from accommodation operations can be calculated using an emissions calculator. Emissions calculators are typically provided by carbon offset providers. Emissions are then calculated and a choice of offset products is offered for purchase. Many retail offset providers offer online assistance through the use of online carbon calculators for consumers to estimate their carbon footprints.

6.2.4 What are the benefits of purchasing carbon offsets?

Purchasing offsets as an additional measure of a clean energy plan has both a good environmental outcome and at the same time can make good business sense. Carbon neutrality can be communicated to guests as a selling point and is attractive to the 'eco-tourist'.

6.2.5 What challenges are associated with carbon offsets?

The task of understanding and choosing between the diverse carbon offset products available can be difficult. This is because there are different ways in which a carbon credit can be generated, several competing standards of certification and many different voluntary carbon product and service offerings.

[33] www.carbonoffsetwatch.org.au
[34] Adapted from Clean Air Cool Planet 2006. A Consumer's Guide to Retail Carbon Offset Providers

The following tips are provided for buying carbon offsets:[35]

- Before you consider buying offsets, try to reduce your carbon footprint as much as possible.
- Only buy offsets from offset retailers who provide detailed information about their products and services, and the projects they use to generate offsets. Projects may be in your own country or overseas. Ask for more information if you need it.
- Choose retailers that help you estimate your carbon footprint and explain how the footprint is calculated.
- Choose offsets that are independently accredited by a recognised scheme or standard. Many voluntary carbon retailers are flexible and can get different kinds of offsets on request.
- Choose offset projects that change or prevent the underlying activities that create greenhouse gases. These are best for combating climate change in the long-term. Such projects include those that:
  - improve energy efficiency
  - increase renewable energy
  - prevent waste going to landfill
  - protect existing forests.
- Other types of projects, like tree planting projects, can have different benefits (such as restoring ecosystems or rehabilitating land).
- Get documentary evidence of your offset purchase. Ensure that the retailer guarantees to 'retire' the offset from the market on your behalf, or transfers ownership of the offset to you so that you can retire it yourself. This is the best way to be sure that someone else does not claim the emissions you have saved.
- Choose offsets that are listed in a registry that tracks ownership of the offset and records that the offset has been removed from the market. This helps to ensure that the offset you bought is not sold again.

6.2.6 Additional resources

Specific schemes and standards:

The Gold Standard: http://www.cdmgoldstandard.org

Clean Development Mechanism: http://cdm.unfccc.int

Voluntary Carbon Standard: http://www.v-c-s.org

VER+: https://www.netinform.de/KE/Beratung/Service_Ver.aspx

Reports about the voluntary carbon market and offset schemes and standards:

Hamilton, K. Bayon, R. et al, 2007. State of the Voluntary Carbon Markets 2007, Picking Up Steam. Ecosystem Marketplace and New Carbon Finance
http://ecosystemmarketplace.com/documents/acrobat/StateoftheVoluntaryCarbonMarket18July_Final.pdf.

Kollmuss, A., Zink, H., Polycarp, C., 2008, Making Sense of the Voluntary Carbon Offset Market, A Comparison of Carbon Offset Standards, prepared by the Stockholm Environment Institute and Tricorona for WWF Germany, http://assets.panda.org/downloads/vcm_report_final.pdf

Bayon, R. Hawn, A. and Hamilton, K. 2007, Voluntary Carbon Markets, an International Business Guide to What They Are and How They Work, Earthscan, London

Clean Air Cool Planet 2006. A Consumer's Guide to Retail Carbon Offset Providers

[35] www.carbonoffsetwatch.org.au

VCS Secretariat, 2007. Voluntary Carbon Standard Program Guidelines

The Gold Standard, 2006. The Gold Standard Voluntary Emission Reductions (VERs) Manual for Project Developers

7 FACILITATING CLEAN ENERGY IN TOURISM ACCOMMODATION: WHAT CAN BE DONE BY HOTELS AND TOURISM STAKEHOLDERS WORKING TOGETHER

This chapter covers mechanisms through which the Government, tourism organisations and other stakeholders can provide support for and facilitate the take up clean energies through technologies and approaches. These are beyond the scope or resources of an individual hotel or establishment but can be very important in establishing the framework for taking up clean energy in a tourism location, be it a town, region or country. These mechanisms for sponsoring or supporting clean energy included in this manual are:

- promoting certification schemes
- facilitating communication
- developing information resources
- establishing a vision for clean energy in an area
- creating funding opportunities
- green tourism branding.

7.1 Promoting Certification Schemes

Decision makers can assist tourist accommodation providers by promoting broad participation in formal eco-rating schemes, or incorporating this aspect as a prerequisite element of a facilitation program. This can provide the basis for robust comparison of performance across different hotels, which could be used for recognition and awards programs (see section 7.7 on clean energy incentives). Refer to section 6.1 for more information about certification schemes.

7.2 Facilitating Communication

7.2.1 What do we mean by facilitating communication?

One of the most useful functions that a local organisation may be able to play in overcoming the barriers to clean energy is in acting as a facilitator, bringing the right people together in the one room (or even online) with the necessary information and common goals. This might take the form of either bringing together:

- like-minded peers potentially looking to develop clean energy in their accommodation facilities, who can act as a 'community of practice' and share their experiences for mutual benefit; or
- cross-sectoral stakeholders, who may be integral to the development of a greater clean energy plan for the area, but may be unlikely to otherwise meet.

7.2.2 Could facilitating communication make a positive contribution in my situation?

Effectively fostering improved industry or cross-sectoral communication is unlikely to result in negative outcomes in any situation. Nonetheless, the local suitability of creating a community of practice to facilitate discussion, knowledge sharing and learning will depend on a range of factors, including:

- whether local accommodation providers are accustomed to communicating directly
- any social, cultural, political or business reasons why participants may be unwilling to share information or experiences; (see also 'challenges' below)
- whether potential participants are located close enough to make in-person discussion feasible, or have access to suitable internet resources for online communication; or

- whether as a facilitating body you have the venue, time, or human resources (including technical input from service or product providers) available to bring together semi-regular meetings.

In the case of bringing together a broad range of stakeholders to further a clean energy project, the major factor to consider regarding suitability will be any notable social, cultural, political or business reasons why those stakeholders may not work well together. If such reasons are apparent, it does not mean that a project cannot go ahead, but may just mean that one-on-one engagement with different agencies is a more suitable approach.

7.2.3 Who might be involved?

In the case of developing communities of practice, the main target participants could include:

- accommodation owners or management, and
- lead representatives of hotel staff involved in daily energy management or maintenance.

And be combined with specific input from clean energy experts or service/product providers, as the participants begin to better establish areas of required knowledge.

In the case of bringing together cross-sectoral stakeholders, the full suite of participants may be involved, including:

- local accommodation industry participants
- tourism/hotel industry association
- clean energy industry association or service providers
- financing organisations
- community representatives
- all relevant government agencies (e.g. energy, environment, finance, tourism).

For an example of the above facilitation options, see the Fiji Case Study below entitled ‘Bringing clean energy stakeholders together’.

Case study: Fiji—bringing clean energy stakeholders together

Key to the developmental success of a new hotel sector wide clean energy facilitation project in the Republic of Fiji Islands has been the careful selection of a project Steering Committee, initiated through a broad stakeholder engagement workshop. The project has brought together government agencies (energy, environment, finance and tourism), the Hotels Association, the Central Bank, and local hotel owners and operators to coordinate a large-scale clean energy rollout. Reported examples of positive outcomes of broad stakeholder involvement are that the Central Bank has created appropriate loan arrangements for project participants, and project specific marketing efforts are in the process of being scaled up to a national level green branding campaign (see Section 7.6 ‘Green Tourism Branding’).

More information of this case study can be found in Appendix A (chapter 8)

7.2.4 What are the benefits?

In bringing accommodation sector participants together in a collaborative environment it may be possible to break down competitive barriers to information sharing and foster more open learning relationships. From a facilitator’s perspective this will have flow on effects in broadening the learning on clean energy applications in the local area or region, building momentum to enable the buy-in necessary to design and facilitate larger funded project components (see section 7.4 ‘Creating Funding Opportunities’ and section 7.6 ‘Green Tourism Branding’)

Providing stakeholders with the opportunity to share in the development and design of a clean energy program will strengthen the effort in a number of ways:

- greater knowledge of a program's content amongst the industry and community will reduce the likelihood of insurmountable issues due to opposition from parties perceived to be negatively affected or left out of the process
- certain aspects of a program may only be realised if all key parties are present and have been adequately involved in the consultation/design process
- other *unplanned* benefits may develop from having the right people with adequate decision-making power in the one room.

7.2.5 What are the challenges?

In the case where competing accommodation providers in a local area are wishing to develop clean energy to give them competitive advantage in the tourist market, encouraging peer sharing of information may be difficult. If this is the case, a less 'hands on' approach similar to that taken in the Australian case study (see section 7.5, 'Melbourne's Savings in the City Program, Hotel Staff Training Guide') may be appropriate. This approach involved capacity building through a published 'Toolkit' for participants, and face-to-face consultation between hotel energy managers and the facilitation body only.

7.3 Develop Information Resources

Information barriers to clean energy might include:

- lack of information about clean energy technology options for a local area
- lack of information about renewable energy resources such as wind in a local area
- lack of information about financing options and other types of assistance available
- lack of information about how to calculate emissions and environmental footprints.

7.3.1 What information resources will make a positive contribution in my situation?

The type of information resources required will depend on the local context, the style of accommodation offering available in an area and the needs of accommodation providers. Consultation with the target audience is advised to establish the needs and identify the information gaps of tourist accommodation providers in an area.

The following list provides examples of information resources that could be provided to facilitate clean energy in tourism accommodation:

- energy management plan guides
- energy management toolkits
- information resources for staff training
- Information about way to engage and communicate with guests
- benchmarking information for particular areas or accommodation types
- directory of eco-rating schemes
- information to assist with environmental performance assessment
- lifecycle assessment tools and information
- carbon footprint estimation and reduction methods
- energy resource maps e.g. wind maps.

More examples of information resources, including Internet web links and brief descriptions are provided in a table in Appendix A (chapter 8) of this manual.

7.3.2 Who might be involved?

Decision makers and facilitating bodies at the local level are best placed to determine and understand the information gaps that are impeding the uptake of clean energy technologies and behaviours in their area. Obtaining the necessary understanding of these knowledge gaps is best carried out by consultation and communication with a range of stakeholders including accommodation property owners, accommodation managers and local clean energy suppliers.

For a more thorough discussion of the process involved in understanding your local conditions, refer to section 3 of this manual.

Case study: Australia—City of Melbourne Green Hotels Program

The City of Melbourne, in partnership with Sustainability Victoria, EC3 (GreenGlobe) and the Smart Water Fund, has developed toolkits to assist hotels to reduce their waste, water and energy consumption. The Energy Wise Hotels Toolkit provides step-by-step instructions for a hotel to collect energy data and calculate greenhouse gas emissions. The toolkits are provided on the City of Melbourne Enterprise website.
The 'Energy Wise Hotels Toolkit' publication has a section for the following crucial and effective areas:

- educates on how to collect energy data and calculate greenhouse gas emissions
- lists out the different levels of energy efficiency savings from those requiring little or no financing to those that are capital intensive
- gives specific examples of initiatives in each department of the hotel
- has a program on how to train and motivate staff and guests
- it has a technology discussion educating hotel staff on the key areas of energy and technology currently used in hotels and introducing how to shift towards efficiency in these areas, in very clear and simple language.

The publication then moves onto renewable energy and how a hotel can adopt it. This is followed by how a hotel can become carbon neutral.

Clean technologies covered are: energy efficient lighting, heating, office equipment, air conditioning, hot water, room key cards, kitchen equipment and refrigeration.

It also covers **key** investment components of energy efficient equipment such as motors, variable speed drives, chillers, and building and energy management systems.

7.3.3 What are the benefits of developing information resources?

The main benefit of developing information resources is that by addressing informational barriers, the uptake of clean energy is facilitated.

7.3.4 What are the challenges?

Developing information resources requires time commitment and funding. Most types of information resources require human resources, skills and finances to develop, which may be lacking in local organisations.

Case study: E-Commerce and Renewable Energy, Ghana

Though not directly linked to hotel accommodation, this initiative in remote areas of Ghana indicates how access to solar power as a renewable energy source has been able to support a project making information and information technologies available to a wide range of small businesses by powering **rural business centres with solar PV.**

'The project helps in this regard by firstly bridging the "energy divide" and secondly bridging the "digital divide" in a cost effective manner. The project therefore helps government achieve its aim of accelerating the diffusion of Information Technology in the country by circumventing the hurdle of the lack of infrastructure (energy)' World Clean Energy Awards Website.

7.3.5 Further information

Appendix B (chapter 9) of this manual provides a range of examples of information resources.

7.4 Creating Funding Opportunities

7.4.1 What do we mean by creating funding opportunities?

One of the most significant barriers to implementing many clean energy technologies is the high capital cost and associated long payback times. This is an issue for two main reasons:

- the general cost competitiveness of many renewable energy supply technologies in the current market environment in many countries
- the competing demands on available funds and limited access to finance faced by many accommodation providers, particularly at the smaller scale.

These challenges underline the importance of the emphasis given in this manual to carefully examining and understanding the local context, including assessing actual energy requirements (Chapter 3) and assessing other means of managing energy used (Chapter 4) before embarking on potentially costly investment to install new generating capacity.

Where investing in technology or equipment is necessary to improve the efficiency of equipment, or introduce cleaner generating technologies access to funding opportunities can reduce payback times or lower other financial barriers. The role of national or local organisations and/or Government bodies may be to *understand* the funding streams and options which are available, and matching them with appropriate investors or groups of investors under planned accommodation sector programs. Alternatively or in addition in may be beneficial to create more innovative funding opportunities

7.4.2 What sorts of funding would make a positive contribution in my situation?

This manual has identified seven possible funding options which could be made available:

1. **Government Funding**
2. **Promoting Green Finance Products** –financial institutions can be involved in designing favourable finance conditions to clean energy project participants, in return for positive publicity or other benefits.
3. **Bulk Buying Schemes -** If facilitating a large-scale project that utilises a significant number of units of the same clean energy technology, it is possible to act as a broker for the participating businesses to use the bulk purchasing power to obtain reduced prices.
4. **Leasing / third party ownership** - High capital costs for clean energy supply options can be overcome through third party companies leasing renewable energy systems to accommodation providers at guaranteed prices. The capital cost is thereby "spread" across the operating life of a renewable energy supply system.
5. **Carbon trading markets** –If 'bundled' together, clean energy installations in accommodation facilities on a broad scale could attract funding through "carbon credits" under a range of different carbon trading schemes. See the "Fiji - Carbon Market Funding for Clean Energy in Hotels" case study for an example of how this can be applied in the accommodation sector.

6. **Grant/Donor Funding Options**–Grant or loan funding for projects in developing countries may be available through global or regional development banks, United Nations agencies or specific clean energy funding bodies or foreign assistance programs. For an example of a regional bank funding program See the 'Peru – Revolving Fund' case study for an example of microfinance application to clean energy and tourism opportunities. Examples of relevant agencies are provided in Appendix C (chapter 10).
7. **Microfinance -** Microfinance is the provision of very small loans directly to those who would not generally have access to traditional financial lending services. In tourism accommodation, this type of financing would primarily apply to rural, off-grid householders wishing to develop home stay accommodation or small accommodation facilities. See the 'China – GreenVillage Credit' case study for an example of microfinance application to clean energy and tourism opportunities.

More detail on each of these seven funding options and when they may be appropriate is provided in Appendix C (chapter 10).

7.4.3 Who might be involved?

The parties involved in designing and providing funding options is highly specific to the type of funding opportunity pursued. For more detail on who might be involved in each of the seven funding options see Appendix C (chapter 10).

7.4.4 What are the benefits of sourcing funding opportunities?

Access to funding opportunities to subsidise clean energy can be very effective in increasing the willingness of potential clean energy participants to invest upfront capital for efficient equipment or renewable or low impact energy supply systems by reducing payback times or lowering other financial barriers, if all other barriers are overcome.

7.4.5 What are the challenges?

Obtaining funding is often not a simple process, particularly in the case of grant/donor funding for developing countries. While grant or donor funding generally does not have to be repaid (although development bank funding generally has a repayable component), challenges to receiving this type of funding can include the design and justification of the project concept to the donor agency and significant reporting requirements. Additionally, projects utilising donor funding are generally not eligible for CDM carbon credits.

Case study: Fiji—carbon market funding for clean energy in hotels

Throughout 2009 and 2010, the Republic of the Fiji Islands is participating in a hotel clean energy facilitation project funded by the Renewable Energy and Energy Efficiency Partnership (www.reeep.org) and designed and implemented by Australian company Greenlight Technology Group.

This project involves introducing new and existing cost-effective energy efficiency technologies and behavioural change in lighting, refrigeration and Heating, Ventilation and Air Conditioning (HVAC) systems into the hotel sector. It is also intended to use some smaller-scale solar PV as a more visible symbol of clean energy, and in off-grid areas electricity generated from locally produced coconut oil biofuel.

While the primary financing of the project is through loans from the Central Bank and payback times for targeted energy efficiency investments (from energy bill savings) are generally less than 18 months, the project is also looking at funding from carbon markets. The project is currently working towards monitoring and verifying all emissions reductions, and bundling them into a 'programmatic methodology' through the Clean Development Mechanism (CDM) to bring an additional carbon credit revenue scheme to improve financial viability of the scheme. A private firm is being used to write the methodology for approval by the UNFCCC. At the time of writing the project was still in development, and thus its effectiveness remains to be seen and the CDM methodology is yet to be approved. However, if successful, the project could pave the way for harnessing CDM funding for other tourism sector clean energy initiatives around the world.

More information of this case study can be found in Appendix A (chapter 8).

Case study: Peru - Revolving Fund for the Implementation of Small Hydro Schemes

In Peru a group called Practical Action (http://www.solucionespracticas.org.pe/) developed an implementation project for small hydropower schemes in isolated rural areas to improve the living standards of villagers and to promote "business activities capable of generating employment and income".

The project is centred around a "revolving fund" created through agreements with the Inter-American Development Bank totalling USD 600,000, which has a soft loan component combined with technical assistance jointly finance by several institutions. Community members which may include communities, farmers or rural business operators can access a loan up to USD 50,000 at an interest rate of 10% repayable over five years, to construct a small hydro scheme. A more recent Practical Action project has focussed on small wind energy systems for rural areas.

Such a model could be adapted for rural communities in other countries with available hydropower or other renewable resources wishing to develop a tourism industry. This case study is not fully profiled in this manual, however for more information see Wisions of Sustainability: http://www.wisions.net/Download-Dateien/1st_PREP_issue_06.pdf

Case study: China—GreenVillage Credit, small loans for clean energy and livelihoods

GreenVillage Credit is a microfinance operation set up as part of UNEP's China Rural Energy Enterprises Development (CREED) project which entrusts loan capital to 'local rural credit co-operatives' that act as the loan agents to local communities. Two types of credit are provided to participants: household credit, which can be used for purchasing and installing renewable and efficient energy systems; and credit for use in income generation activities stemming from the use of the energy system, including tourism services.

This approach promotes economic empowerment and environmental protection in the remote mountain communities, and distinguishes itself from other grant funding approaches by engaging more heavily with the livelihoods of participants. The project also aims to eventually use existing local financial institutions to offer renewable energy finance products.

Technologies covered by the program include 'solar water heaters, fuel-efficient commercial stoves, biogas digesters integrated with a greenhouse for raising livestock or growing vegetables, micro-hydropower generators, improved cooking stoves, improved fireplaces for room heating, energy-efficient houses or house retrofitting for better fuel efficiency and indoor air quality, and any other sustainable energy systems that reduce environmental impacts and protect biodiversity.'

This case study is not fully profiled in this manual; however for more information see Wisions of Sustainability: http://www.wisions.net/Download-Dateien/1st_PREP_issue_06.pdf

Case Study: Peru—Revolving Fund for the Implementation of Small Hydro Schemes

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7.5 Developing Local Skills

7.5.1 What is skill development?

For any rollout of clean energy to be effective, all parties involved need to have the appropriate skills and/or knowledge to be able to effectively perform their role. This could include:

- local retailers, that may sell clean energy products but not fully understand in what situations they should be used
- clean energy technology and service providers, who need to know the technical aspects of how to design, install and use their products according to safety and other regulatory standards and to optimise benefits for the customer
- service companies or local organisations responsible for auditing energy use of existing facilities and providing and costing recommendations for improvements, who are often new to the area
- accommodation owners or managers, who are determining what clean energy options meet their needs, and how best to apply and fund those options
- accommodation staff members who are responsible for day-to-day energy management and need to be aware of how to control the operation of their energy supply or usage to meet their needs while minimising energy consumption
- hotel service engineers/maintenance staff and other supervising staff who may take on responsibility for the coordination of energy management
- other local government, industry or community organisations involved in the delivery of a clean energy program, such as through information provision, marketing or the provision of secondary training to participants
- finance providers, who may need a better understanding of the use of clean energy initiatives to design suitable financial support services.

Essentially the *development* of skills and knowledge refers to offering, coordinating (or directing towards) training for those involved in clean energy delivery and use, such as those listed above. As part of understanding your local situation, in terms of the technical, financial and human resources you have to work with (see section 3), it should become apparent whether a lack of skills and knowledge in either the accommodation industry, or in providers of clean energy services is a barrier to clean energy development.

7.5.2 What positive contribution could skill development make in my situation?

The international evidence is that most owners and operators of hotels and other accommodation and their staff and the other organisations directly involved in tourism lack to necessary skills and knowledge to undertake most of the assessments proposed in this manual and to develop clean energy - understanding and delivering energy services is not their primary focus. Therefore training and information provision is likely to be a key ingredient in getting them to engage with clean energy issues. The lack of specific technical knowledge and skills about technologies is also a challenge in their implementation and application.

Mapping and assessing the training requirements in a particular locality (destination, town, region or country) then developing strategies to meet the requirements is therefore an important contribution to the development of clean energy.

In order to determine the skills development (training) needs, the basic questions are:

- Is training necessary?
- Who requires training?
- What specific skills and knowledge do they require?
- What equipment, resources, and other facilities are available?

To answer these questions, consultation with various industry and potential project partners will be necessary.

7.5.3 Who might be involved?

There are two main stages to consider in determining who might need to be involved in clean energy training project:

Stage 1 – determining skills and training needs: this will entail consultation with various industry and potential project partners

Stage 2 – designing and delivering training: often the necessary technical or training skills will not exist within the organisation driving or initiating the uptake of lean energy and external private service providers or established government training centres will need to be engaged.. Particularly in the case of technical and safety training associated with the clean energy designers and installers, it is likely that this type of training will need to be performed according to formal accreditation standards through recognised training institutions.

Depending on the nature of the training needs and the resources available to the facilitating body, there may in fact be no formal delivery of training resources. As the Melbourne Savings in the City case study below demonstrates, it may be appropriate to design training courses for hotel owners and operators.

7.5.4 What are the benefits of local skill development?

Many clean energy projects internationally have failed or been subject to public criticism as a result of inadequate consideration of training needs.

Is should also be noted that one of the most powerful roles and local organisations may be able to play as training providers or facilitators is in fostering communication and ‘communities of practice’ between industry participants.

7.5.5 What challenges might I face in taking this approach?

Adequate training for many of the more technical aspects of introducing clean energy depends on the prior development of national quality or safety standards which is itself a time consuming process that is generally conducted at a national or regional level. In some cases, locally appropriate installation guidelines may be sufficient, and can be developed or borrowed and adapted from other countries. Alternatively or additionally, targeting technologies that can effectively and safely be applied with limited industry skills and knowledge may be an important method of overcoming this barrier.

Good practice in clean energy does not stop at installing efficient equipment – every hotel owners and operators and their staff will need to know how to efficiently manage their energy requirements to reduce consumption, and use their equipment in a way that suits their needs.

Depending on the content and detail, designing, and particularly delivering, training courses is not a trivial task, requiring both time and resourcing. Therefore a realistic assessment of the capacity of each participating organisation is necessary prior to embarking upon such an approach.

As noted under ‘benefits’ above, significant challenges can be faced if there is a mismatch between the scale of what you want to achieve, and the training that can be feasibly provided. However, if the broader program is restricted to clean energy for accommodation providers, there is lower risk that project scale will cause issues at the training level.

Case studies

Australia—Melbourne’s Savings in the City Program, hotel staff training guide

The ‘Savings in the City Program’ run by the City of Melbourne local council, involved the preparation and publication of an ‘Energy Wise Hotels Toolkit’, which amongst other components, contains a program on how to train and motivate staff and guests to better manage energy use to reduce consumption. Further, it contains a technology discussion (not dissimilar to this manual) educating hotel staff on the key areas of energy and technology currently used in hotels and introducing how to shift towards efficiency in these areas. The Toolkit employs clear and simple language that is easily understandable to the broad range of staff members involved in day-to-day energy management in hotels.

Another component of skills and capacity building in this project was the need for initial face-to-face consultations with hotel engineers and facilities managers. The council notes that sustainability had not entered their thinking about the way the hotel energy was used and supplied, and getting these key figures to commit to the program required time and resourcing. Ongoing education and follow-up with engineers and service providers was also required to obtain the level of participation necessary to sustain the project.

To a certain extent this case study overlaps with the ‘develop information resources’ approach, however there is a distinct training element involved. The Energywise Hotels Toolkit can be found at:
http://www.melbourne.vic.gov.au/enterprisemelbourne/environment/Documents/WasteWiseHotelToolkit.pdf

Mexico—MARTI, building capacity of hotels for clean energy and sustainability

The Mesoamerican Reef Tourism Initiative (MARTI) project in Mexico is a joint working initiative to ensure that tourism to the Mesoamerican Reef is managed sustainably. The program involves the education and training of tourism operators in environmental best practices for the hotel sector, the marine recreation tour sector and the cruise ship tour sector. MARTI works with leaders from both government and private sectors, and seeks to engage and educate all operators in the region by 2016, and adopt international best practice standards for the region’s key tourism sectors.

Within the hotel sector there are two components. Firstly, to work with existing hotels, which supply 76 000 rooms (or approximately 150 000 beds), and secondly, to work with developers and government on future development.

MARTI partners with each hotel through a yearlong program to truly ensure the hotel’s team of staff understand the process, are able to implement it successfully and conclude with an operational Environmental Management System in place. They meet with the hotel's team five times throughout the process. It begins with an energy/waste/water audit and then works with the hotel staff to implement key actions indentified and documented in an action plan. This is followed by education workshops and ultimately the hotels implement an Environmental Management System for ongoing operation. This usually takes 9–12 months.

Funding for the program is combined from a contribution by the hotel and funding received from key sources (donor foundations and other organisations).

MARTI's planning; design and construction component for new buildings will focus on energy efficiency, bioclimatic architecture, and renewable energy applications.

For more information on either of these case studies see Appendix A (chapter 8).

7.5.6 Additional resources

Additional resources for technical training can be found at the website of the US-based Interstate Renewable Energy Council (IREC):
http://irecusa.org/wp-content/uploads/2009/10/BestPracticesFormatted2010Final2410.pdf

7.6 Green Tourism Branding

7.6.1 What is green tourism branding?

Green tourism branding is a type of 'destination branding' that refers to an approach to tourism marketing that is based around the positive environmental credentials of the local tourism industry, and/or the geographical region more generally. The focus of such a marketing campaign aims to attract a specific 'ecotourism' market, encompassing guests who wish to experience nature while simultaneously having minimal impact on that environment. Many existing marketing campaigns in this area (such as New Zealand's '100% pure' campaign) focus on the appeal of travelling to pristine environments. However, the approach suggested here provides greater impetus for improvement of the environmental performance of owners and operators of hotels and other accommodation in those tourist locations.[36]

7.6.2 What positive contribution could green branding make in my situation?

Different destinations attract different types of tourists. Therefore when determining whether a green branding approach is appropriate or will be effective requires an understanding of the reasons tourists are drawn to the area, and their likely responsiveness to a push towards better environmental performance. The types of tourist attractions likely to attract "natural tourists" are natural, archaeological or cultural features.[37] These types of tourists may be more responsive to hotels and facilities demonstrating commitment to clean energy; however market research may be useful necessary to confirm whether this is likely to be case.[38]

Some critical questions to ask in determining whether green branding will be beneficial include:

- Is the natural environment a significant asset of this destination?
- Is good environmental performance likely to be valued by the current or target tourism market?
- If destination branding can occur at the local, regional or national level, what scale makes sense in my situation? Are there existing tourism marketing approaches for my region or country that need to be considered?

[36] Green Brand New Zealand (2009) 'Clean & Green?' Available from: http://www.greenbranz.org/?p=446, Accessed 21 April 2010.
[37] Kotler, P. and Gertner, D. (2002) Country as Brand, Product and Beyond": A Place Marketing and Brand Management Perspective, *Brand Management* 9 (4-5) 249-261, at 255.
[38] Ibid.

- Is a green branding strategy likely to distinguish my area from competing tourism destinations? (Noting that 'competing destinations' are determined by the issue of scale in the above bullet point.)
- Are local accommodation providers interested in becoming involved in a green tourism strategy through adopting clean energy?
- As part of this strategy do we have the resources to connect the green branding message to our target market through appropriate channels (e.g. advertising, Internet)?

While stepping through each of these questions is beyond the scope of this manual, it should be noted that it is vital that those considering the suitability of tourism branding do their local research adequately. For an example of the approach taken in Fiji see 'Fiji—Clean me, Green me, Fiji me' case study below.

Case study: green marketing in Fiji—'Clean me, Green me, Fiji me'

Throughout the development process of a hotel sector energy efficiency and renewable energy project in Fiji, it became apparent that the marketing benefits obtainable through this broad sectoral program could be maximised by taking a national approach to green marketing.

Fiji is a relatively small Pacific Island nation, well renowned for its natural island and marine beauty. The program had already secured good participation from different government agencies (finance, tourism, environment) as well as the main hotel industry group. It was decided that with a relatively limited amount of additional effort, the marketing of the environmental efforts under the program could be scaled up to a national green branding campaign, entitled 'Clean me, Green me, Fiji me'.

While in 2010 the process is still in development and has not yet reached implementation, the planned approach involves broadening the application of clean energy to include visible energy improvements at the airport, to greet all international guests and reinforce the environmental improvements targeted by the program. Technological applications through the mobile phone network are currently being considered to engage guests in the sustainability aspects from the beginning to the end of their stay.

It is hoped that the campaign will result in a shift of the tourist market from predominantly package holiday clients, to a more discerning market willing to pay higher prices in return for a more sustainable tourism experience. As the project is still in the development phase, the success of this effort will not be known for some time.

More information on this case study can be found in Appendix A (chapter 8).

7.6.3 Who might be involved?

A green branding campaign can be at least as much about getting different areas of government and the community and tourism industry working together towards sustainability outcomes as it is about directing investment (new or existing) towards creating a novel marketing pitch. New Zealand's '100% Pure' campaign is one example where key to the campaign has been improving coordination of *existing* efforts in a range of sectors towards a single goal. The marketing money was already in place, but the core of the effort involved some policy and public relations commitments towards environmental goals to ensure that marketing and practice are aligned. Reciprocal agreements might include Tourism assisting Forestry by promoting the national leadership in tree planting to international visitors. Forestry in turn could assist Tourism by packaging carbon-offset products to be made available to tourists.[39]

[39] Green Brand New Zealand, above n36.

Stakeholders that might be involved in the design of such a campaign might be:

- government agencies at the appropriate level:
  - trade and Foreign Affairs
  - tourism
  - economic development
  - environment
- tourism associations
- local accommodation providers
- existing tourists (market research)
- finance providers.

7.6.4 What are the benefits?

Developing a recognisable green tourism brand with participation from the local industry can be a useful method of providing the accommodation sector with incentive to uptake clean energy, by assisting in strengthening the link between improved environmental performance and attracting a new customer base. With heightened public awareness of climate change and the need to act to reduce greenhouse gas emissions, there is an increasing market for environmentally friendly tourism facilities and destinations.

7.6.5 What challenges might I face in taking this approach?

It is important to remember that to use an environmentally friendly branding carries with it the responsibility to ensure the implementation of good environmental practice in your region, with a process of continual improvement. Failing to ensure that an environmental branding campaign has true substance is not only poor and misleading practice, but is likely to draw criticism and negative publicity. It may be a challenge to ensure that the local tourism industry is fully on board with this concept before developing the branding concept further.

If your country or region does not currently invest resources into tourism marketing and development, it may be more difficult to access finances and other resourcing to implement such a strategy (as it is easier to redirect existing funds that create new funding).

7.6.6 Additional resources

Additional resources on developing a country branding strategy include the following publications:

- Ottman, Jacquelyn A. (1993) *Green marketing*, Lincolnwood, Ill., USA.
- European Travel Commission (2009) *Handbook on Tourism Destination Branding*.
- Morgan, Nigel (2010) *Destination branding: creating the unique destination proposition*, Butterworth-Heinemann, Amsterdam.

7.7 Providing Incentives for Clean Energy

7.7.1 What are clean energy incentives?

Broadly speaking, local decision makers that exercise authority over tourism accommodation—generally local governments, but this could also be industry bodies or other organisations that exercise authority in other ways such as compliance with industry standards—can direct businesses towards particular goals through mandatory means, via regulation, or voluntary means, by providing incentives for businesses to participate. Thus clean energy incentives refer to any factor in the local business environment that is adjusted to motivate accommodation providers to voluntarily increase their uptake of clean energy. There are numerous types of incentives that may be relevant in different circumstances.

7.7.2 What sorts of incentives would make a positive contribution in my situation?

Incentives to assist the uptake of clean energy in tourist accommodation can either be driven from the local level, or on a broader scale by national or regional governments. It is important to note that it will not necessarily make sense to promote incentives that solely target the accommodation sector—incentives for clean energy uptake in your area might be best served by approaching the issue from a broader viewpoint. Indeed, most of the clean energy incentives around the world are applied across an entire residential or commercial sector, as opposed to a small subset. This should be kept in mind when considering your approach to incentives.

Some critical questions to ask are:

- Is there a need for clean energy incentives at the local level? (Due to the absence of incentives offered at other levels of government or by other government agencies.)
- Does my organisation have direct responsibility over any of the elements that shape the political, social and economic environment to support clean energy?
- Does my organisation have the skills and resources available to develop and implement its own clean energy incentives? (See below for more information.)

Advocate for change

If the answers to the above questions are 'no', it may be most appropriate to advocate to other levels of government or other government agencies for supportive change. This change could be in a range of areas covered below under 'Developing Local Incentives' such as financial, regulatory or even national promotion/marketing of green tourism (for more information see section 7.6, Green Branding). A good example of tourism industry participants engaging in advocacy is provided in the Ecuadorian case study below.

Case study: Ecuador—industry advocacy for national government eco-tourism support

A group of tourism industry experts and business owners voluntarily formed a 'virtual group' called the 'Grupo Internet en Favor de Ecoturismo Ecuatoriano' (GIFEE). The GIFEE worked together via Internet-based communications over a period of four months to develop recommendations to the Ecuadorian Government to develop the country as a world leader in ecotourism. Key recommendations included widespread consultation processes to develop broad stakeholder consensus, economic incentives for private- or community-owned ecotourism operations, supportive educational resources across schools and broader society, and innovative uses of promotional funds and nationally consistent marketing of the eco-tourism industry.

While no significant policy responses have yet been forthcoming from the Ecuadorian Government, the approach remains a valid and innovative method of pooling knowledge and expertise and passion for promoting environmentally friendly tourism practices for the benefits of the industry as whole.

Develop local incentives

If your answers to all of the critical questions above were 'yes', designing and implementing your own local incentives for clean energy uptake may be appropriate. A range of types of incentives may be at your disposal, some or all of which may be appropriate to your situation. For example: if investing in high cost clean energy hardware is a significant barrier in your area, financial incentives may be suitable; if there are limited financial resources at your disposal, regulatory incentives may be more locally appropriate; or if accommodation businesses are responsive to public perception, then establishing a system of public recognition and awards may be useful. Each of these options will now be discussed briefly.

Financial Incentives
While many local organisations may not have significant financial resources at their disposal, this is not always the case. Even if available funds are not immediately apparent, it may be appropriate to consider creating new or redirecting existing local government revenue streams from related activities towards financial clean energy incentives in businesses. For example, the revenue raised by a parking levy at public tourism sites could be targeted at providing finance for clean energy incentives.

When considering *financial* incentives specifically, it is important to consider whether the most appropriate means of supporting clean energy in your area is within tourism accommodation, or at a broader scale (building on the suggestion of advocating for change raised above). This might be a necessity due to lack of local funding, or simply more appropriate for your country's situation, as there may be complementary whole-of-electricity-sector developments already underway nationally or regionally. For example, over 40 countries[40] around the world have created 'feed-in tariff' (FIT) laws at the national or sub-national level as the primary means of financial incentive for renewable energy generation technologies.[41] Most commonly FITs are targeted directly at solar PV, however in countries such as Germany they also support for wind, biomass, biogas and geothermal.[42] Such policies would provide invaluable support to clean energy technologies in the accommodation sector, while having much farther-reaching impacts nationally.

Other forms of local financial incentives might include cash rebate schemes for clean energy equipment such as solar hot water, or other mechanisms discussed under 'Creating Funding Opportunities'. Comprehensive treatment of the range of financial incentives for clean energy is beyond the scope of this manual, however further ideas and information on the range of options implemented around the world can be found on the International Energy Agency's Policies and Measures Database (http://www.iea.org/textbase/pm/index_clim.html) which covers both energy efficiency and renewable energy policies and incentives. A similar resource also exists for state-level financial incentives and other initiatives in the USA, found at: http://www.dsireusa.org/.

Recognition and Awards
As positive publicity is generally considered an asset for many accommodation businesses, simple initiatives such as creating a scheme whereby businesses are publicly recognised and/or rewarded with prizes for their efforts in clean energy development can yield positive results. If accommodation providers are seen to be leaders in the field of promoting environmentally friendly energy supply, not only can this result in improved public profile and marketing benefits for those recognised, but may drive competition in the industry and increase the number of participants in clean energy uptake. Additionally, if prizes offered are can assist winners in further improving their clean energy outcomes, such as the installation of a solar PV system, this will again increase their attractiveness as a local showcase for tourism purposes. There are real opportunities to attract free or discounted clean energy products and services as prizes, as local suppliers of these products wish to capitalise on marketing and public awareness benefits.

Regulatory Incentives
While local governments do not necessarily have power over many of the legal, policy and financial factors that contribute to the favourability of the business environment for clean energy, the most local level of government often exercises a large degree of control over land use and planning decisions that affect existing and prospective accommodation operators. It may be possible to restructure planning controls to create regulatory incentives to implement clean energy options, for example, planning controls often involve restrictions on various aspects of a new developments or renovations. If a hotel owner agrees to incorporate one or a range of desired clean energy initiatives in their development, such as

[40] Mendonca, M. Feed-in tariffs: Accelerating Deployment of Renewable Energy (2007), p.8
[41] Feed-in tariffs, or FITs, function by passing laws that require that power companies purchase 100% of any electricity generated by approved renewable energy technologies, and pay the generator a regulated tariff for that power, which is generally significantly higher than the going wholesale rate for regular non-renewable grid electricity. The increased cost is spread across all electricity consumers in the form of a small increase in the unit cost of electricity. In effect this is a subsidisation that is drip-fed to the renewable generator for every unit of electricity produced. For more information on determining whether feed-in tariffs are right for your jurisdiction, see the World Future Council operated website: http://onlinepact.org/renewableenergy.html
[42] *Renewable Energy Sources Act* 2000 (Germany, Federal)

highly energy efficient design, solar water heating or renewable electricity sources, this can be linked to increased flexibility in other areas of their development approval process. An example of this approach is Gold Coast City Council in Australia, which offered planning permission for additional floor space in multi-level apartment developments—which has significant financial value to the investor—in return for commitment to a range of environmental initiatives above and beyond minimum national environmental standards. From the local government's perspective this can be an attractive and effective no cost option.

Note that the above is just one example of a regulatory incentive. It is important for local decision makers to critically evaluate the factors over which they have control, and consider innovative methods of creating an environment conducive to clean energy uptake.

7.7.3 Who might be involved?

Decision makers and facilitating bodies at the local level are best placed to determine and understand the factors that are impeding the uptake of clean energy technologies and behaviours in their area, and determine what suitable incentives to assist accommodation providers in overcoming those hurdles would look like. Good practice always implies obtaining the necessary knowledge about local issues and constraints, before designing and committing to an incentive scheme.

This is likely to involve communication with a wide range of stakeholders including:

- local accommodation industry, including property owners *and* accommodation management organisations (see note on split incentives under 'challenges')
- local clean energy providers
- finance providers
- government (various levels and agencies).

For a more thorough discussion of the process involved in understanding your local conditions, refer to section 3.

7.7.4 What are the benefits of using incentives?

The primary benefit of using incentives is to use positive communication with industry to encourage participation in the uptake of clean energy. In most jurisdictions businesses view incentives far more favourably than 'forceful' mandatory regulation. Furthermore, mandatory regulation options may be limited by the nature of the control your organisation has over the local business environment.

Local decision makers and facilitating bodies are best placed to determine and understand the factors that are impeding the uptake of clean energy technologies and behaviours in their local area. Thus locally developed incentives may be better targeted to the needs of your area than incentives developed at higher levels of government.

7.7.5 What are the challenges?

In the case of advocating for change to other levels of government or government agencies, broader change agendas at higher levels require more time, political will and financial backing. Furthermore, the level of influence that local decision makers have in this arena may be limited.

Where the local hotel industry is structured with property owners that contract the hotel management to dedicated companies, which is particularly applicable at the larger end of the market, it is often necessary to take special account of the often-misaligned interests of the two groups. This phenomenon is referred to as the 'split incentive', a common example being when a highly cost effective energy efficiency lighting retrofit with fast payback time requires capital investment on the part of the property owner, while the benefits of reduced electricity bills accrue to the management company. This is a context specific challenge that may need to be worked through in the design of incentives or other contractual arrangements as part of your clean energy scheme.

Many forms of incentives require human resources, skills or finances to administer, which may be lacking in local organisations. The capacity to design and implement incentive schemes should be critically evaluated before embarking upon a program of incentives (see section 3 for more detail on assessing local capacity).

7.8 Providing Incentives for Clean Energy

7.8.1 What are Clean Energy Incentives?

We use the term "clean energy incentives" to refer to any factor in the local business environment that is adjusted to motivate owners and operators of hotels to voluntarily increase their uptake of clean energy. There are numerous types of incentives that may be relevant.

7.8.2 What sorts of incentives would make a positive contribution in my situation?

Incentives to assist the uptake of clean energy in tourist accommodation can either be driven from the local level, or on a broader scale by the government. It will not necessarily make sense to promote incentives that solely target the accommodation sector – incentives for clean energy uptake in an area might be best served by approaching the issue from a broader viewpoint. Indeed, most of the clean energy incentives around the world are applied across an entire residential or commercial sector, as opposed to a small subset.

Some critical questions to ask:

- Is there a need for clean energy incentives at the local level? (due to the absence of incentives offered at other levels of government or by other government agencies)
- Does my organisation have direct responsibility over any of the elements that shape the political, social and economic environment to support clean energy?
- Does my organisation have the skills and resources available to develop and implement its own clean energy incentives? (see below for more information)

Advocate for change

If the answers to the above questions are "no", it may be most appropriate for stakeholders to advocate to the government and government agencies for incentives that will support a greater take up of clean energy. A good example of tourism industry participants engaging in advocacy is provided in the Ecuadorian case study below.

Case Study: Ecuador – Industry Advocacy for National Government Ecotourism Support

A group of tourism industry experts and business owners voluntarily formed a 'virtual group' called the "Grupo Internet en Favor de Ecoturismo Ecuatoriano" (GIFEE). The GIFEE worked together via internet-based communications over a period of 4 months to develop recommendations to the Ecuadorian Government to develop the country as a world leader in ecotourism. Key recommendations included widespread consultation processes to develop broad stakeholder consensus, economic incentives for private- or community-owned ecotourism operations, supportive educational resources across schools and broader society, and innovative uses of promotional funds and nationally consistent marketing of the ecotourism industry.

While no significant policy responses have yet been forthcoming from the Ecuadorian Government, the approach remains a valid and innovative method of pooling knowledge and expertise and passion for promoting environmentally friendly tourism practices for the benefits of the industry as whole.

Develop Local Incentives
If your answers to all of the critical questions above were "yes", designing and implementing your own local financial, regulatory or awards incentives for clean energy uptake may be appropriate.

Financial Incentives
Even if available funds are not immediately apparent, it may be appropriate to consider creating new or redirecting existing government revenue streams locally from related activities towards financial clean energy incentives in businesses. The scale of the issues may mean that local incentives are unlikely to be effective and that development for the whole of the energy sector are likely to have more impact. For example, over 40 countries[43] around the world have created "feed-in tariff" (FIT) laws at the national or sub-national level as the primary means of financial incentive for renewable energy generation technologies.[44] Most commonly FITs are targeted directly at solar PV, however in countries such as Germany they also support for wind, biomass, biogas and geothermal.[45] Such policies can provide invaluable support to clean energy technologies in the tourism accommodation sector, while having much farther reaching impacts nationally.

Other forms of local financial incentives might include cash rebate schemes for clean energy equipment such as solar hot water, or other mechanisms discussed under "Creating Funding Opportunities". Comprehensive treatment of the range of financial incentives for clean energy is beyond the scope of this manual, however refer to further ideas and information on the range of options implemented around the world can be found on the International Energy Agency's Policies and Measures Database (http://www.iea.org/textbase/pm/index_clim.html) which covers both energy efficiency and renewable energy policies and incentives. A similar resource also exists for State-level financial incentives and other initiatives in the USA, found at: http://www.dsireusa.org/.

Recognition & Awards
As positive publicity is generally considered an asset for many accommodation businesses, simple initiatives such as creating a scheme whereby businesses are publicly recognised and/or rewarded with prizes for their efforts in clean energy development can yield positive results. If hotel and accommodation facility owners and operators are seen to be leaders in the field of promoting environmentally friendly energy supply, this can result in improved public profile and marketing benefits for them, but also drive competition in the industry increasing the number of participants in clean energy uptake. Additionally, if prizes offered are can assist winners in further improving their clean energy outcomes, such as the installation of a solar PV system, this will again increase their attractiveness as a local showcase for tourism purposes. There are real opportunities to attract free or discounted clean energy products and services as prizes, as local suppliers of these products wish to capitalise on marketing and public awareness benefits.

Regulatory Incentives
The government exercises a degree of control over land use and planning decisions that affect existing and prospective hotels and hostels. It may be possible to restructure planning controls to create regulatory incentives to implement clean energy options, for example, planning controls often involve restrictions on various aspects of a new developments or renovations. If a hotel owner agrees to incorporate one or a range of desired clean energy initiatives in their development, such as highly energy efficient design, solar water heating or renewable electricity sources, this can be linked to increased flexibility in other areas of their development approval process. An example of this approach is Gold Coast City Council in Australia, which offered planning permission for additional floor space in multi-level

[43] Mendonca, M. Feed-in tariffs: Accelerating Deployment of Renewable Energy (2007), p.8
[44] Feed-in tariffs, or FITs, function by passing laws that require that power companies purchase 100% of any electricity generated by approved renewable energy technologies, and pay the generator a regulated tariff for that power, which is generally significantly higher than the going wholesale rate for regular non-renewable grid electricity. The increased cost is spread across all electricity consumers in the form of a small increase in the unit cost of electricity. In effect this is a subsidisation that is drip-fed to the renewable generator for every unit of electricity produced. For more information on determining whether feed-in tariffs are right for your jurisdiction, see the World Future Council operated website: http://onlinepact.org/renewableenergy.html
[45] *Renewable Energy Sources Act* 2000 (Germany, Federal)

apartment developments – which has significant financial value to the investor – in return for commitment to a range of environmental initiatives above and beyond minimum national environmental standards. From the local government's perspective this can be an attractive and effective no cost option.

Who might be involved?

Local decision makers and facilitating bodies are best placed to determine and understand the factors that are impeding the uptake of clean energy technologies and behaviours in their area, and determine what suitable incentives to assist accommodation providers in overcoming those hurdles would look like. Good practice always implies obtaining the necessary knowledge about local issues and constraints, before designing and committing to an incentive scheme. This is likely to involve communication with a wide range of stakeholders including:

- Local accommodation industry, including property owners *and* accommodation management organisations (see note on split incentives under 'challenges')
- Local clean energy providers
- Finance providers
- Government (various levels and agencies)

For a more thorough discussion of the process involved in understanding your local conditions, refer to section 3.

What are the benefits of using incentives?

The primary benefit of using incentives is to use positive communication with industry to encourage participation in the uptake of clean energy. In most jurisdictions businesses view incentives far more favourably than 'forceful' mandatory regulation. Furthermore, mandatory regulation options may be limited by the nature of the control your organisation has over the local business environment.

Local decision makers and facilitating bodies are best placed to determine and understand the factors that are impeding the uptake of clean energy technologies and behaviours in their local area. Thus locally developed incentives may be better targeted to the needs of your area than incentives developed at higher levels of government.

What are the challenges?

In the case of advocating for change to other levels of government or government agencies, broader change agendas at higher levels require more time, political will and financial backing. Furthermore, the level of influence that local decision makers have in this arena may be limited.

Where the local hotel industry is structured with property owners that contract the hotel management to dedicated companies, which is particularly applicable at the larger end of the market, it is often necessary to take special account of the often misaligned interests of the two groups. This phenomenon is referred to as the "split incentive", a common example being when a highly cost effective energy efficiency lighting retrofit with fast payback time requires capital investment on the part of the property owner, while the benefits of reduced electricity bills accrue to the management company. This is a context specific challenge that may need to be worked through in the design of incentives or other contractual arrangements as part of your clean energy scheme.

Many forms of incentives require human resources, skills or finances to administer, which may be lacking in local organisations. The capacity to design and implement incentive schemes should be critically evaluated before embarking upon a program of incentives (see section 3 for more detail on assessing local capacity).

8 APPENDIX A: CASE STUDIES

Selecting Case Studies

The best practice case studies included here were identified from the following sources:

- direct approaches to members of the APEC Tourism Working Group (including the international workshop held in Cusco, Peru, 23rd and 24th March 2010)
- tourism websites: for example, Green Globe/EarthCheck
- University of Technology, Sydney tourism and energy networks
- targeted Internet searches
- sustainable tourism literature tourism books.

The Case Studies

- Alto Hotel on Bourke—Melbourne, Australia
- Aurum Lodge—Rocky Mountains, Canada
- Black Sheep Inn—Ecuador
- Savings in the City—Melbourne, Australia
- Couran Cove Island Resort—Queensland, Australia
- Evason Phuket & Six Senses Spa—Thailand
- Tourism sector energy efficiency and renewable energy—FIJI
- Casa Andina Isla Suasi—Lake Titicaca, Peru
- Maho Bay Camps Inc., Harmony Studios and Concordia Campground—Virgin Islands
- Mesoamerican Reef Tourism Initiative (MARTI)—Mexico
- Paradise Bay Resort—Grenada
- Playa Nicuesa Rainforest Lodge—Costa Rica
- Proximity Hotel—North Carolina, USA
- Rainbow Retreat Wilderness Eco Cabins—Tasmania, Australia
- Sadie Cove Wilderness Lodge—Kachemak Bay State Park, Alaska, USA
- Solar Initiatives Project—Sibay, Peru
- The Hytte—Northumberland National Park, UK
- URBN Hotel—Shanghai, China

8.1 Case Study: Alto Hotel on Bourke—Melbourne, Australia

Type of Accommodation	A 50 room 4-star boutique hotel in the central business district of Melbourne, Australia
Clean Energy Technologies	Energy Management EE lighting EE key tags EE HVAC EE Building Design (windows double glazed)
Clean Energy Approaches	EE behaviours Guest education and incentives Staff education and communication Formal Accreditation (EarthCheck/Green Table) Networks

8.1.1 Location and brief description

Alto Hotel on Bourke is a 50-room 4-star boutique hotel in the Central business district of Melbourne, Australia. It is a 6-storey building in between major high-rise buildings of 30+ storeys.

It has no capacity to install renewable energy supply onsite but has still taken the necessary steps to reduce consumption and be a leader in sustainability for its location and type of tourism accommodation.

8.1.2 Why this is an informative case study

The hotel has taken on the full commitment to be an eco-hotel. It has aligned with the highest standards of accreditation and has a program of continuous improvement. All electricity purchased from the local grid is from 100% renewable sources, and they continue to seek to reduce their consumption and have a result well exceeding best practice standards of their chosen accreditation framework.

8.1.3 Setting up the clean energy initiative

The commitment of the director and management to demonstrate leadership in environmental performance was the primary driver of clean energy uptake, given expectations of the social, environmental and business implications of doing so.

8.1.4 Clean energy technologies and approaches being used

- Energy Management System forming functions such as automatically turning air conditioning units off when there is no one in the room
- environment and sustainability management framework through EarthCheck accreditation system
- an external body audits their greenhouse gas emissions, including all inventory, flights, cars, food and beverages
- EE lighting is installed throughout 95% of hotel
- windows and balcony doors are double glazed (to limit heat loss and gain), heat reflecting and are able to be opened. These features result in reduced demand for air conditioning
- EE Air Conditioning plant with a 6-star rating that uses inverter and movement sensor technology
- gas on-demand hot water with limited storage, resulting in reduced heat losses and less gas usage
- consistent monthly monitoring of all energy consumption is communicated to staff throughout the hotel through the following metrics:
    - kW of electricity per guest per night
    - MJ of gas per guest per night
    - litres of water per guest per night
    - litres of waste per guest per night.
- purchase 100% green electricity through their energy supplier at a premium cost approximately 40% higher than standard coal-fired grid electricity. Originally it was a combination of wind and hydro. Then with a drought in Victoria, they were unable to be supplied 100% electricity as there was not enough hydro electricity generated. This resulted in more wind electricity infrastructure, and now they are back to 100% wind green electricity
- purchase offsets for all remaining energy consumption at the hotel (gas and diesel) from an agricultural waste bioenergy power generation project in India
- provide free parking for hybrid and electric cars, including free recharging of electric cars
- the restaurant is accredited with ‘Green Table’, a program advocating use of seasonal foods grown on farms less than 100 miles from the restaurant. Ensuring minimum greenhouse gas by not using energy to power hothouses and fuel on transport.

8.1.5 Benefits from clean energy

- Credibility through formal accreditation (EarthCheck and Green Table) demonstrating they are implementing truly best practice initiatives through meeting and exceeding the accreditation standards.
- A carbon audit conducted by the Carbon Reduction Institute shows a one night stay at Alto Hotel produces an average 13.5 kilograms of carbon, compared to the estimate for hotels as set by Sustainable Tourism CRC of 24–26 kilograms, a reduction of approximately 58%.
- Lower electricity and water utility bills resulting from reduced consumption.
- Occupancy is 12% above other hotels of as similar classification despite a room rate 5% higher than the competition, which management partially attributes to their environmental performance and eco-hotel branding.
- The staff retention rate is very high, with 100% for full-time staff in 2008/09 and 86% for part-time and casual staff. This has resulted in significant financial savings through reduced advertising for and training of new staff.
- Communication to staff of monthly consumption figures and explanations for variances, results in keeping staff interested and motivated, further ideas for reductions from staff, and generates a broader conservation culture throughout.
- Investment in green electricity and carbon offsets are commitments part funded through operational budget and part through marketing budget, as the message is used to promote the hotel to companies and government organisation with a green procurement policy for their accommodation services.

8.1.6 Challenges faced

Skills: The environmental aspects of the operation are so multifaceted that managers have often found they do not have the skills in house and have to learn first how to implement or use the technology.

Clean energy product quality: They have experienced some expensive mistakes through being an early adopter, such as purchase of large quantity of LED light globes that had a design failure and lasted only 1% of marketed lifespan. They have trialled some water aeration technology that did not work,

Suitability of (non energy) products to hotel needs: They have trialled three different technologies for composting kitchen green waste, and still some adaptation was required before it suited their needs.

8.1.7 Success factors and lessons learned

Stakeholder involvement is key: It is vital to ‘take your team for the ride’. Unless staff, management and even clients know what you are trying to achieve with your environmental objectives, the effort may still fail.

Value of formal accreditation: Using an established methodology for your monitoring and reporting is important to compare your performance to others. Reporting in succinct quantitative terms increases credibility and clarity of actions and outcomes. Credibility by using an external accreditation body is also extremely important—they use EarthCheck for accreditation and management framework and Carbon Reduction Institute to audit greenhouse gas emissions.

Staff training is vital: The operational management of energy use requires high levels of staff knowledge and involvement. Constant communication of their monthly environmental performance results helps to keep the program top of the staff’s minds, maintains interest and generates new ideas for further reductions—makes it a whole of team program.

Research and experimentation have value: Good research helps to ensure that your initiatives meet your needs, while a willingness to try things to find through trial and error carries its own value.

8.1.8 Key stakeholders

The hotels' director and management have been the key drivers of the project, and the key stakeholders include:

- operational staff
- broader management
- clients.

8.1.9 More information

Alto Hotel on Bourke
636 Bourke Street
Melbourne VIC 3000

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www.altohotel.com.au

8.2 Case Study: Aurum Lodge—Rocky Mountains, Canada

Best practice from inception, design, building, operations and continual maintenance and diligence in energy monitoring.

Type of Accommodation	A fully designed eco-tourism operation, with 6 guestrooms and 3 self-contained units
Clean Energy Technologies	EE building design EE and sustainable building materials and insulation Solar PV Wind (100% off-grid with battery storage) Solar Hot Water EE lighting and appliances EE plant equipment, e.g. boiler Maintenance plans Biomass wood stove Passive solar design for cold climate Grey water heat exchanger
Clean Energy Approaches	Values/CSR—applying the 4 R's (refuse, reduce, re-use, re-cycle) EE behaviour Accreditation Networks Guest education

8.2.1 Location and brief description

A fully designed eco-tourism operation, with 6 guestrooms and 3 self-contained units. It is a wilderness experience in the Rocky Mountains in Alberta, Canada targeted at nature-lovers.

8.2.2 Why this is an informative case study

From inception the facility has been planned and maintained to high sustainable tourism standards.

The diligence with which this project has been executed is best practice. This begins with the continual monitoring and awareness of patterns of energy usage and extends to responsive measures to reduce consumption. There is a commitment to the necessary maintenance of each part of their clean energy system, both in terms of physical maintenance and monitoring, review and continual improvement.

The facility's environmental performance is backed up by external verification and achievement of the highest level in the Aubudon Green Leaf Certification Program. They have gained and maintained this rating since their first year of operation.

8.2.3 Setting up the clean energy initiative

Aurum Lodge was designed and purpose built to be a sustainable tourism facility of the highest quality. *'The extra investment for these features represents about 30% of the overall building cost, with payback in dollar terms estimated at around 15 years. However, many benefits are intangible—reduced pollution, no noise, raw material and resources conserved, intact eco-system.'* Alan Ernst, Owner/Manager, Aurum Lodge.

Also received funding from Renewable Energy Development Initiative and the Commercial Buildings Incentive Program (a Canadian Government Initiative).

8.2.4 Clean energy technologies and approaches being used

- Energy monitoring—constant monitoring of appliances and resource use (power, water, waste produced). This helps to identify areas of wastage and potential savings and ensures that systems are working optimally
- solar PV produces over 80% of electricity (with the balance obtained from a propane generator), solar collectors for heating (including in-floor heating and hot water)
- wind—small wind generator installed to monitor site for wind power. After three years this was removed since the site is very windy at times but not ideal for wind power (turbulence!). As a result, PV system was expanded, rather than installing a larger/permanent wind turbine
- biomass—wood is primary fuel for heating and cooking in winter
- EE lighting and appliances
- heat recovery and reuse of air and water exhausts
- grey water heat exchanger—takes heat from grey water and uses it to help heat other water.
- maintenance plans which help reduce waste and repairs—time intensive, but cuts down on unexpected repair costs, (e.g. *'a past energy audit of all our appliances showed that the freezer we were using was not operating to specification. The difference in power used compared to what it was supposed to use, amounted to almost 10% of our power consumption! The cost and time invested in this review—which resulted in other improvements—was well worth it!)'* Aurum Lodge Website.

8.2.5 Benefits from clean energy

Since commencing operations in 2000 utility bills are still the same (less than 1.5 % of operating costs), despite increasing occupancy of the facility and rising energy costs. This includes all power, heating, hot water, laundry, cooking and refrigeration etcetera.

'Monitoring our energy/resource use and savings over the years has shown an interesting pattern, in that only 1/3 of our savings are derived from technical innovation and improvements, whereas 2/3 stems from operational changes, avoiding wasteful habits and using energy/resources more wisely.' Alan Ernst, Aurum Lodge Owner/Manager

Energy conservation features make up 30% of the lodge's capital investment but save
$25 000/yr in propane costs. The initial payback period was estimated at 12–15 years without subsidies, as they were unaware of these at the planning stage. The owner suggested that after taking into account available subsidies, and given the annual energy usage of a comparable business in the area, the payback could be closer to 6–7 years.

8.2.6 Challenges faced

Lack of information and design skills: In the planning/design phase, the main difficulty was to obtain information on renewable energy/energy efficient building practices, which were not very readily available in North America. As a result, much of the design is based on European reference literature, adapted to North American building practices.

Lack of construction skills: While supplies were generally available, finding suitable/skilled contractors for construction who could understand and implement the design was (and still is to this date) a major obstacle, and required constant supervision/intervention. Some time was required to assist in education of building inspectors not used to the design features of the facility.

8.2.7 Success factors and lessons learned

Comprehensive planning is the key: Systems installed have to be designed to work together, rather than to be installed as individual stand-alone solutions that may not work efficiently, or worse, counteract each other. For example, ground source geothermal heating might be beneficial and save energy in an on-grid situation, however, in this off-grid application it would not work as it is too power intense.

8.2.8 Key stakeholders

Owner/operators of the facility oversaw design and construction of the project although other contributors included government agents (funding) and service providers.

8.2.9 More information

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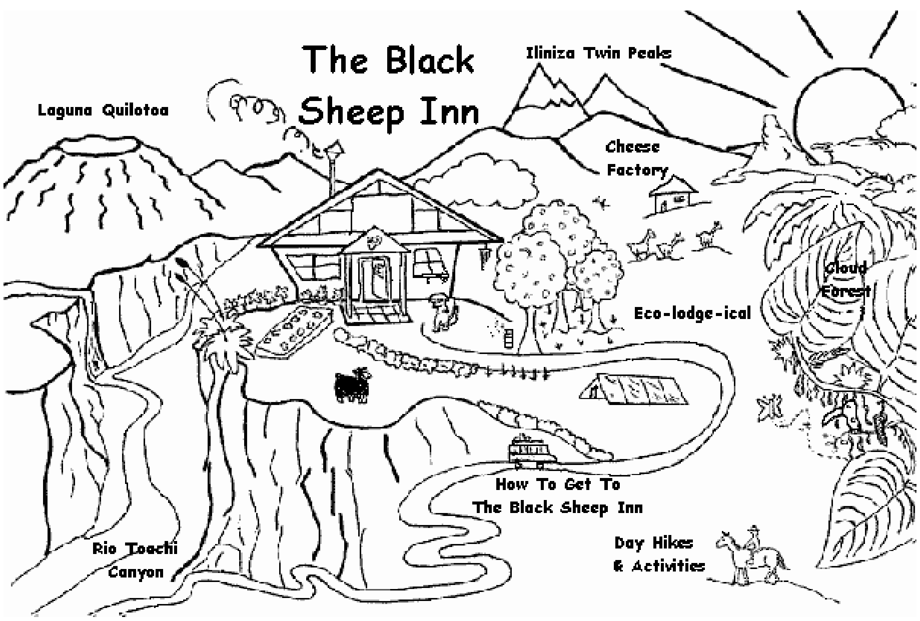
8.3 Case Study: Black Sheep Inn—Ecuador

Type of Accommodation	A small 10-acre farm and eco-lodge operation with 7 rooms and a bunkhouse.
Clean Energy Technologies	Solar water pump for ground source water supply EE lighting—natural & CFLs Biomass—wood stoves for heating (biomass mainly sourced from felling invasive species). EE building design—natural cold room for perishables storage. Planned technologies—Solar HW, Solar/Wind hybrid system, biogas digesters.
Clean Energy Approaches	EE behaviour Energy Monitoring



8.3.1 Location and brief description

A small 10-acre farm and eco-lodge operation in Chugchilan with 7 rooms and a bunkhouse.

8.3.2 Why this is an informative case study

Energy monitoring and consumption management is very good. They have put the time into knowing their energy usage patterns, and have adopted a process of implementing a range of improvements, each with minimal cost and incremental improvements but overall add up to significant decreases in consumption.

Pricing incentives to impact guest behaviour are also innovative.

The owners have also engaged in advocacy activities to attempt to facilitate broader uptake of ecotourism initiatives through enhanced government support.

8.3.3 Setting up the clean energy initiative

The Black Sheep Inn's goal is to become self-sufficient in energy, water and food production. It has a very resourceful and sustainable approach to analysing its inputs and outputs and makes changes that have a positive cost-benefit ratio progressively.

8.3.4 Clean energy technologies and approaches being used

- EE lighting and appliances such as laptop computers (switched from more energy intensive desktop computers) and hand coffee grinder. Also have gravity fed showers to eliminate the need for mechanical pumping
- biomass—heating is done by a biomass stove using felled invasive tree species
- EE building design—built a natural underground cold room for storage of perishables
- solar PV water pump is used for irrigation, animal watering troughs and waterslide
- guest education—pricing incentives to impact guest behaviour, for example, offering a 10% discount for guests travelling by bicycle (not directly energy system related but similar concepts can be applied to clean energy systems to promote behavioural change)
- the spa is solar heated then kept hot by a biomass stove that is used to heat the sauna using a thermal siphon. No electricity or pumps are used
- the next step they are looking to invest in is solar HW, using a strong do-it-yourself approach to make it cost effective with a reasonable payback period.

8.3.5 Benefits from clean energy

Financial: minimisation of consumption and inputs results in lower operating costs.

Energy security: 60% of the local grid electricity supply is from hydropower, and when water reserves are low, rolling blackouts are implemented. If they were to install solar/wind power and be 50–100% off grid, then security of supply in times of blackout would be a significant benefit.

8.3.6 Challenges faced

Capital cost of clean energy supply: The cost of solar and wind is quite prohibitive and is the item that requires the most significant capital investment. Any available funds over the past several years have been put toward lots of small clean energy steps rather than one big investment item such as solar power. As the owner explained: *'…Further, have been hesitant to spend $30 000 to $40 000 on such a system when we know how far that money can go on simpler behaviours and technologies'.*

Environmentally friendly electricity supply: A key driver for clean energy is the a commitment to reduce greenhouse gas emissions, another factor in preventing the installation of their own clean energy supply is that electricity supply through the local grid has a large proportion (60%) of hydropower. This means that the environmental benefits of going off-grid are not as significant.

Availability of clean energy products: Ecuador has limited availability of clean energy technology products, such as small wind and solar systems. Availability of efficient propane power refrigerators would (through fuel switching from electricity to propane) dramatically decrease number of solar panels required and would make solar more favourable.

Fossil fuel subsidisation: The owners suggest that heavily subsidised propane, diesel and gasoline fuels inhibit their use of renewable energy supply options as this makes payback periods too long and deters investment.

8.3.7 Success factors and lessons learned

Know and monitor your resources: Tap into clean energy resources available locally, such as consistent wind or abundant sunshine. It is important to know your resource through monitoring before making large investments in the technology.

Self-reliance has been important: The owners suggest that a certain self-reliance has been key to their efforts due to their remote location. This has included utilising guests with clean energy expertise to assist in developing plans, and having the ability to do self-maintenance.

8.3.8 Key stakeholders

The owners were the key drivers. The owner has a strong DIY (do-it-yourself) attitude and thus likes to design and build himself. Furthermore, the owner likes to maximise use of any resources and investments. Enablers were inspired guests with some expertise that offered their design services (e.g. solar pump) for free or at cost.

8.3.9 More information

Black Sheep Inn Website, 8 March 2010, www.blacksheepinn.com

8.4 Case Study: Savings in the City—Melbourne, Australia

Type of Accommodation	All
Clean Energy Technologies	Training and stakeholder engagement in clean energy program
Clean Energy Approaches	Advocacy Information resources Network facilitation

8.4.1 Location and brief description

This case study originated as a 4-year pilot program running from 2005 to 2008. The City of Melbourne and Sustainability Victoria administered it with six other partner organisations. Thirty city hotels and serviced apartments participated and achieved significant savings in energy, waste and water. Over 24 000 tCO_2e were saved.

The program was designed to demonstrate a 'proof of concept' that hotels represented a significant target market for achieving energy, water and waste efficiencies within an urban environment.

The program produced three education and implementation handbooks, one each for Energy, Waste and Water. This is the aspect of the program that was reviewed for this case study as well as an interview with a member of the City of Melbourne Sustainability team.

Whilst not designed to be an ongoing program from the outset, efforts were made to encourage various agencies to take on the administration of the scheme following the conclusion of the pilot period. Unfortunately these efforts proved unsuccessful and the program now exists as a series of Education Publications that enable hotels to instruct their own clean energy efforts.

8.4.2 Why this is an informative case study

The handbook is a clearly and simply written toolkit that sets up accommodation operators to take on the challenge of clean energy.

It covers the crucial steps for success from management commitment and energy data collection to understanding energy and how to convert that to greenhouse gas emissions. It then provides many very specific examples of initiatives to take for each section of the hotel's key energy usage areas.

It documents best practice approaches to clean energy in a user-friendly, practical and accessible way.

8.4.3 Setting up the clean energy initiative

The City of Melbourne has a business focused enterprise centre that has a range of initiatives, one of them being the 'Savings in the City' program. One of these initiatives stemming from this centre was the Green Hotels Program, where the City of Melbourne encourages Melbourne's hotels to get energy, water and waste wise.

The program was initiated through a partnership of eight organisations from local, state and national levels. It was set up as a pilot program and has evolved into an education publication.

8.4.4 Clean energy technologies and approaches being used

The **'Energy Wise Hotels Toolkit'** publication has a section for the following crucial and effective areas:

- gives a clear, step-by-step process for the hotel to be educated by and then implement
- educates on how to collect energy data and calculate greenhouse gas emissions
- lists the different levels of energy efficiency measures from those requiring little or no financing to those that are capital intensive
- gives specific examples of initiatives in each department of the hotel
- has a program on how to train and motivate staff and guests
- it has a technology discussion educating hotel staff on the key areas of energy and technology currently used in hotels and introducing how to shift towards efficiency in these areas; in clear and simple language
- the publication then moves onto clean energy supply and how hotels can adopt this technology. This is followed by how a hotel can become carbon neutral
- clean technologies covered are: EE lighting, heating, office equipment, air conditioning, hot water, room key cards, kitchen equipment and refrigeration
- it also covers key investment components of EE equipment such as motors, variable speed drives, chillers, and building and energy management systems.

8.4.5 During the pilot program

The process followed by the hotels during the program was:

- conduct energy audit and establish baselines (utility bills and limited metering used)
- develop targets and identify key areas for improvement
- measure & report on progress towards targets.

An external auditor/assessor was used to provide an objective assessment of the program's effectiveness.

8.4.6 Benefits from clean energy

The hotels that participated in the pilot program demonstrate the benefits of using the education publications. The 30 hotels that participated in the facilitated program saved 24,769 tCO^2e. That is an average of 825 tCO^2e per hotel.

One specific example given was the Holiday Inn on Flinders. It dedicated $27 000 to energy conservation measures and had saved $48 000 in that same year—that is a payback period of about 7 months. This is not highly unusual—first year savings are enormous and then average annual savings settle down. However, it is still a reduction in operating costs year in year out. Savings can be maximised with proper consistent energy data monitoring and management and can be done by staff already employed by the hotel.

In addition to changing behaviours to more energy efficient procedures, also identifying old plant and replacing it with more energy efficient equipment was a key saving area as well for a number of hotels.

Staff motivation is also a key benefit reported by participating hotels.

Once operational costs and GHG emissions savings from behavioural change are established, benefits expand into corporate responsibility and enhanced branding and reputation benefits.

8.4.7 Challenges faced

Unfortunately comments from individual hotels that participated were not possible to obtain, however these challenges relate to the facilitation of the program by the City of Melbourne.

Time and Effort in Hotel Engagement: During the program a challenge was keeping engaged with hotel participants. It was a very intensive program, involving a lot of education of engineers and service providers to get buy-in regarding data monitoring and management. A considerable amount of cajoling, reminding, encouraging was required.

Long-term Operation: It was established as a pilot project that ran over a 4-year period. However, the program had no 'home' to go to. It is no longer coordinated by one particular body. An attempt was made to get a hotel association to run with it however at the time they were not resourced to manage such a program. It is now simply available on the City of Melbourne ‘Enterprise Melbourne’ website as a series of handbooks that hotels can run with. Immediately after the program, interested Hotels were referred to the Green Globe program—now called EarthCheck (EC3) in Australia.

8.4.8 Success factors and lessons learned

For each hotel:

Understanding Energy Usage: Gaining an understanding of the hotels' unique patterns of energy usage.

Clean Energy Requires an Holistic Approach: Understanding that success is a mix of energy monitoring, data management, change in behaviours as well as implementing more complex clean energy technologies was a key lesson stemming from the program.

Management Commitment: Management commitment is absolutely crucial to the success of a hotel’s clean energy endeavours.

Benefits of Energy Management Frameworks: Formal adoption of an energy management framework, steered by a multi disciplinary team across the hotel is also crucial incorporating Management, Finance, Engineering, Housekeeping, F&B and Front Office.

Training Staff is Key: This is especially the case in early stages, and in time it just becomes part of business-as-usual training and operations at the hotel.

For a program facilitator:

Education of Hotel Operators: The program facilitators had not originally anticipated the time and resourcing required to sit down with engineers/ facilities managers one-on-one to discuss clean energy and sustainability issues. These concepts had not entered their thinking before and how they approached their roles required a new way of thinking.

Value of Participant Meetings: Frequent meetings of the group of hotels participating helped to keep the momentum of the program going. Also, getting the larger hotels sharing their stories helped inspire smaller operators into action.

Building Momentum is Difficult: Getting participants on board at the beginning took quite some time.

Value of Friendly Competition: League tables during the program helped to spur action, inspiring participants to pursue further measures.

8.4.9 Key stakeholders

The City of Melbourne (local government) with its partners:

- Sustainability Victoria
- Smart Water Fund
- EC3 Global
- Australia Hotels Association (AHA)
- Hotel Motel and Accommodation Association of Australia (HMAA)
- City West Water
- Tourism Victoria

8.4.10 More information

City of Melbourne, Melbourne, Australia.
http://www.melbourne.vic.gov.au/enterprisemelbourne/environment/Pages/GreenHotels.aspx

8.5 Case Study: Couran Cove Island Resort—Queensland, Australia

Type of Accommodation	A large-scale eco-tourism resort with 192 marine apartments, 24 villas, 36 lodges and 102 eco cabins; situated on an island just off the South Queensland Coast.
Clean Energy Technologies	Sustainable Planning, Design and Construction Passive Solar and Cooling Design Gas fired cogeneration Solar HW Energy Management System EE Lighting
Clean Energy Approaches	EE Behaviour Information resources Network facilitation

8.5.1 Location and brief description

A large-scale 4 1/2 star eco-tourism resort with 192 marine apartments, 24 villas, 36 lodges and 102 eco cabins.

It is situated on an island just off the South Queensland Coast, without access to a local grid supply of electricity.

It was built in the mid 1990s and was a pioneer in sustainable tourism development at this luxury level.

8.5.2 Why this is an informative case study

This resort was developed in the mid 1990s and was groundbreaking in its approach and achievements. All initiatives and technologies discussed here were implemented at the site's construction in the 1990s and still deliver efficiency to comparable newly constructed resorts.

The depth to which conservation and sustainability permeate its approach is best practice. Thorough research into the site's history has ensured that aboriginal heritage, flora and fauna conservation and environmental sustainability was core to all planning and development from inception.

8.5.3 Setting up the clean energy initiative

One of the main objectives of the original development was to offer the luxuries of a resort without compromising the integrity of the natural environment and to be ecologically sustainable.

Whilst it is a luxury resort, it keeps sustainability and environmental awareness at its core and throughout all aspects of its marketing and operations.

8.5.4 Clean energy technologies and approaches being used

EE Building Design: Passive solar design and insulation eliminated need for air conditioners in cabins, which is highly uncommon in a resort of this calibre. The passive solar design also maximises the use of natural light and solar heat, reducing heating and lighting requirements.

Gas-fired Cogeneration: One larger set combined with a series of small gas fired generators are used to give maximum efficiency to power supplied throughout the resort at differing demand levels, for instance when demand is slow only 1 or 2 units are on, not all units. Waste heat from the generators is captured and used to heat the resort swimming pools.

Solar HW: (with gas back up) is installed on 162 cabins, lodges and villas.

Energy Management System: An EMS is used to ensure supply throughout the property is operated at maximum efficiency. In addition, this is a system that can send a multitude of signals when something happens around the property, for instance if a failure or alarm point is reached such as a fire alarm, power station fault, vacuum sewer system fault, water treatment plant fault, waste water treatment plant fault, cool rooms/freezer temperature loss, (including mainland receiving depot) along with many others this is registered on the control PC in the security office, power station control room and operations department office with a message sent out via the paging system to the respective responsible persons and also activates/deactivates the public area lighting system dependant on ambient lighting.

EE lighting: Energy efficient lighting and appliances are installed throughout the resort.

EE behaviours: Staff education is incorporated into the induction process explaining the various sustainability measures in place and also how staff can limit their consumption whilst on the island. Guest education is done through signs strategically to encourage EE Behaviours—such as lights and air conditioning not left on when they go out.

8.5.5 Benefits from clean energy

A reduction in greenhouse gas emissions is a clear benefit and also furthers the hotel’s green marketing brand.

Prior research and modelling showed that a series of small generators would better match the site's load requirements, which in turn also produce more efficient operation and savings in costs and emissions.

The following reduced energy expenditure resulted:

- Due to the approach taken by installing a series of small gas generators, an initial capital cost saving of 35% was made relative to diesel generation units.
- A 20% saving in operational costs was also achieved as the gas generators are more universally used and are more efficient than the comparative diesel units that were considered.

8.5.6 Challenges faced

Integration of Technologies: One of the largest challenges was integrating various technologies to allow them to 'talk' to each other to form a total package.

8.5.7 Success factors and lessons learned

Value of Independent Accreditation: Accreditation from an independent body is important to their branding and operational efficiency improvement—Couran Cove has Advanced Eco-tourism Certification through Ecotourism Association of Australia.

Importance of Leadership of Owners/Management: A genuine desire by the organisation as well as the financial ability to design, implement and maintain the technologies and practices was important.

Triple Bottom Line Approach: It is important to ensure that the organisation is focussed on costing and counting the costs and benefits in a holistic sense not just a financial one.

8.5.8 Key stakeholders

Resort Developers in conjunction with a wide range of professional contractors and the Australian Conservation Foundation (non-governmental organisation).

8.5.9 More information

Couran Cove Island Resort, Australia
www.couran.com

8.6 Case Study: Evason Phuket and Six Senses Spa, Thailand

Type of Accommodation	260 room island resort in Thailand
Clean Energy Technologies	Solar thermal water heating with gas backup Gravity fed water pumping EE design, building, natural ventilation EE HVAC Plant EE lighting
Clean Energy Approaches	EMS - Energy Monitoring System EE Behaviour Corporate Social Responsibility

8.6.1 Location and brief description

A 260-room resort that employs some 400 staff. Originally built in 1972, purchased and redeveloped in 2001 using sustainable principles.

The resort is located on the eastern side of the island of Phuket facing the Andaman Sea and is located on 64 acres of tropical land.

The resort has at its core, sustainability, and uses the marketing tagline 'redefining experiences' to communicate this intention. They seek to provide luxurious experiences without degrading the environment.

8.6.2 Why this is an informative case study

Achievements in reduced energy consumption are very impressive.

This comes from the depth of commitment, from the Hotel Group, the management, and the commitment to aligning with an international accreditation program. This is reinforced by the employment of an Environment Coordinator to be the driver behind the constant monitoring, reporting and improvement.

8.6.3 Setting up the clean energy initiative

The resort was purchased and redeveloped in 2001 by Six Senses, a sustainability-focused resort and spa Management Company as well as a development company.

The company's aim is to provide luxurious holidays for guests, whilst taking measures to limit impacts and to not degrade the natural environment that the guests come to enjoy, while also ensuring minimal negative impacts on surrounding communities.

They have a Group-wide 'Holistic Environmental Management Programme' as well as a 'Social and Environmental Responsibility Fund'. The fund receives 0.5% of each resort's revenue, which the fund uses to implement projects in local communities and to raise awareness of environmental concerns.

The process began with a peak demand monitoring system to analyse and control peak periods of energy use. This was followed up by evaluating each new technology on a case-by-case basis, which led to a number of initiatives.

8.6.4 Clean energy technologies and approaches being used

- An energy monitoring system (EMS) was first purchased to control peak demand. This resulted in timers and settings on lighting, pumps and other systems being changed. In addition to reducing peak demand this produced a 10% ($US50 000/yr) saving on total energy consumption
- split-type air conditioning was refitted to an efficient mini-chiller system in one wing of the resort. This saved around $US45 000 per year
- the hotel uses a solar thermal plant for hot water. Back up for this plant was changed to gas, far more efficient than diesel powered boiler back up
- central water pumping—water is pumped up to the highest point and stored there. Distribution is then gravity fed, reducing the number of water pumps required and pumping energy consumption.
- EE lighting
- use of water ponds and waterfalls to create cooling for parts of the resort—minimising use of air conditioners. Also use of natural ventilation to lobby, fitness centre, kitchens and restaurants. Kitchen renovations also included maximising natural light and fridges built into outer walls to transfer waste heat directly out of the building
- medium voltage (6.6kV) underground electrical cables were installed to reduce power loss due to length of running power cables
- the resort has a wide range of waste, water, noise and air quality controls in place as well as a number of social and community driven initiatives. Refer to further information available on their website.

The resort also has strong education policies. All staff members are put through an environmental module in their training on all aspects of energy consumption and separating waste to social and community programs. There is also a strong culture amongst staff to encourage and remind guests about appropriate behaviours. For guests, there is a 'Little Green Book' in each room outlining the resort's initiatives, and reminders and signage in relevant places.

8.6.5 Benefits from clean energy

The resort has moved from requiring two 1300kW transformers to one 1100kW transformer as a result of reducing peak demand, reducing costs and increasing efficiency. It is EarthCheck certified and exceeds EarthCheck's standards in some areas, with energy consumption being 65% better than the EarthCheck Best Practice level.

The EMS produced a 10% saving on consumption, which equated to about $US50 000 per year. This investment cost of this was $US4500—a payback period of just over one month.

The mini-chiller system investment was $US130 000 producing a saving of $US45 000 per year—thus a payback period of just under three years.

8.6.6 Challenges faced

Time Intensiveness: Taking the time to monitor and analyse the resort's particular patterns of energy usage, and come up with improvement options was a challenge. This was very detailed and demanding, but produced significant results. Out of the initial four-year program of renovation and energy reduction initiatives, the first two years was devoted to energy monitoring and analysis, the second two years was the testing and implementation of initiatives.

Availability of Clean Energy Expertise and Technologies: This proved to be a challenge in Thailand, exacerbated by the fact that many of the technologies used were not yet proven, meaning that preparedness for trial and error was necessary.

Retrofitting Difficulties: Limitations in dealing with an existing building, which put constraints as the original designs were not very efficient.

8.6.7 Lessons learned and success factors

Research: Taking the time to truly evaluate each technology and then to weigh up which will bring the most benefit for this resort's particular patterns of usage proved to be invaluable.

Financing: Financial support from investors was crucial in allowing changes to happen.

Value of Formal Accreditation: Having a best- practice program to provide the guiding principles, categories and actions to implement made the improvement process simpler.

Management Policy: Having an executive management committed to best practice in this area with a very strong group policy and management plan.

Staff Training: Training of staff with a specific module is important. Being able to develop a culture throughout the staff of being ambassadors for the green initiatives helps immensely. Having a broader commitment to the wider community also facilitates this culture.

Guest Engagement: Communication to and education of guests.

8.6.8 Key stakeholders

The group's management and investors.

8.6.9 More information

Evason Phuket & Six Senses Spa
Rawai, Phuket, Thailand
http://www.sixsenses.com/Evason-Phuket/

+66 76 381 010

8.7 Case Study: Tourism Sector Energy Efficiency and Renewable Energy—Fiji

Type of Accommodation	All
Clean Energy Technologies	Encouraging EE through stakeholder engagement
Clean Energy Approaches	Advocacy Branding Funding Network facilitation Vision Education

8.7.1 Location and Brief Description

This case study is a multi-stakeholder approach to creating a sustainable framework for the tourism sector in Fiji. The program seeks to foster private/public cooperation in the broad uptake of clean energy that can be replicated in other developing island countries.

It seeks to integrate sustainable tourism (specifically low carbon tourism) as a key brand for Fijian tourism and mobilise/support EE & RE initiatives across the sector.

8.7.2 Why this is an informative case study

A broad sectoral approach to EE & RE encompassing bringing together a broad range of diverse stakeholders including government, finance, industry and clean energy expertise sectors. While still in development, the program seeks to bring technical knowledge and financing to businesses for EE and RE initiatives. It further seeks to aggregate the emission reductions achieved into a bundled carbon credit funding model under the Clean Development Mechanism (CDM), which is highly unusual in the tourism industry.

The program has gone beyond technological implementation and intends to incorporate ‘green marketing’ benefits of this into overall Fiji brand marketing.

Other innovations include plans to establish an online marketplace bringing hotels together with technology and service providing firms.

8.7.3 Setting up the clean energy initiative

Greenlight Technology Group developed the program concept, and takes on the role of formation and co-ordination of a national steering committee of key stakeholders. Significant national buy-in has been achieved as tourism is a large component of GDP (approximately 25%), and thus the program is seen to potentially deliver prominent national benefits. Funding for the concept came from the Renewable Energy & Energy Efficiency Partnership (REEEP), a non-profit organisation that seeks to be a catalyst for private sector market activation in energy efficiency and renewable energy. REEEP see energy efficiency as a vital first step to remove inefficiencies, before investing in and implementing clean energy supply options. Operational funding has been boosted through contributions from program funding of the Fiji Department of Energy.

They see Fiji has an opportunity to tap into a significant amount of energy efficiency in the resort and hotel sectors in the first instance. Additional benefit is that this could be linked to CDM markets due to a mature tourism industry and a number of easily implemented energy efficiency opportunities.

They also believe that once a national approach like this is developed it could be made into a model that can be adopted by other South Pacific countries and even island countries—with REEEP South Pacific already liaising with colleagues in the Caribbean.

8.7.4 Clean energy technologies and approaches being used

The project has a number of stages to proceed through. To date they have done a strategic plan showing current costs of fuel and energy to the Fijian hotel sector and economy. This plan shows a range of EE and RE solutions that can be implemented and the savings these can produce as well as the more secure and efficient energy supply for this sector which is 25% of Fiji’s GDP. This document is being presented to the Fijian Government Cabinet early 2010.

A steering committee is already comprised of key stakeholders (see list in stakeholders question) and is meeting every six weeks. This plays a vital role in continually refining the project and improving it to keep things moving forward.

The program has established a technology trial for air conditioning & refrigeration technology at three selected sites (hotel, government office, food processor). Allied to the initiative, a coconut biofuel facility has been recently commissioned near a remote tourist resort to highlight potential for off-grid clean energy applications.

The program is currently engaging the hotel sector with the government subsidised Solar System offer and energy audits.

The program will also look at guest education and hopes that staff will take what they learn back to their villages.

On the basis of successful technology trials, a programmatic CDM project has been identified for a Project Idea Note (PIN). Whilst this is arduous and demanding, the possible financial benefits will be worthwhile.

They have no plans for governance or accreditation at this stage. The CDM may well provide some guidelines for that. They see that as a development down the track once the program is established and has taken shape.

If successful, the carbon market funding being pursued through the CDM could increase the possibilities for broader clean energy uptake. The Department of Environment is having a national CDM policy written and a private operator with proven record of attracting CDM funding for energy efficiency in Mexico is assisting to write the CDM methodology.

8.7.5 Benefits from clean energy

- reduced electricity bills for participating hotels
- estimated annual greenhouse gas reduction of 500 to 1500 tCO_2e per hotel
- coordinated approach to government funding to support this national initiative
- rebranding of tourism sector to hopefully attract more mid range and upper range tourists
- significant potential for further rollout to other countries.

8.7.6 Challenges faced

Steering Committee Formation: Getting an influential and engaged steering committee.

Locally Inappropriate Technology: Perception of clean energy ineffectiveness had to be overcome due to problems faced by a number of hotels with the type of Solar HW systems locally installed that has gas backup. Gas has to be delivered by road and is very expensive and the sizing and design of systems did not match hotel needs, leading to overuse of gas backup.

Cultural Barriers: Some cultural resistance to changing the status quo to adopt more market oriented behaviours and processes has proven challenging.

8.7.7 Success factors and lessons learned

Influential Steering Committee: Getting a coordinated approach between the Central Bank, Hotels Association, Tourism Fiji, Department of Environment and Department of Energy, to ensure the program's success.

Government Ownership and Funding: Getting the Department of Energy to focus funding on activities for the program. The next vital step is that Cabinet passes the paper being presented which will give a mandate to all government departments to align with and support the program.

Local Skills: Ensuring adequate auditing and installation skills are available in the private sector has been critical to success.
Access to New Clean Energy Technology: Getting new technologies to the Pacific region that is appropriate for it is perceived as a vital advantage, although note that this new technology is still being piloted before broader rollout.

8.7.8 Key stakeholders

The steering committee has been formed and consists of:

- Tourism Fiji
- Department of Energy
- Department of Environment
- Reserve Bank of Fiji
- Ministry of Finance
- Ministry of National Planning
- Fijian Islands Hotel & Tourism Association
- Green-light Technology Group, and

- REEEP have access to the committee and may participate at any time.

This in itself is a key milestone achieved, to secure the participation of the broad sectoral stakeholders.

8.7.9 More information

REEP, Eva Oberender,
Regional Director,
South East Asia and Pacific,
eva.oberender@reeep.org
(03) 9929-4112,

Chris Andrew, CEO,
Green Light Technology Group – GLTG
chris.andrew@gltg.com.au

8.8 Case Study: Casa Andina Isla Suasi—Lake Titicaca, Peru

Type of Accommodation	An eco-lodge built on a privately owned 43-hectare island
Clean Energy Technologies	Solar PV Solar Thermal Hot Water
Clean Energy Approaches	Accreditation Network


8.8.1 Location and brief description

An eco-lodge built on a privately owned 43-hectare island. The island is on the banks of Lake Titicaca, the world's highest navigable body of water.

A professional hotel management company, Casa-Andina, runs the eco-lodge. The island's owner and the hotel staff manage the island as a project for the conservation and preservation of the island's environment.

The island's only structures are the eco-lodge and the owner's home. They are both run completely by independent solar systems. The eco-lodge can accommodate 30 people.

8.8.2 Why this is an informative case study

The operators claim that it is the only hotel in Latin America that is purely solar powered. Others in Peru have one or two solar components, but are not completely solar powered.

The owner is maintaining the integrity of the island's unique unspoilt location and is serious about running a hotel that is not damaging to the island and its flora and fauna and natural beauty.

8.8.3 Setting up the clean energy initiative

The staff on the island run the island like a protected private area, and therefore to be consistent with the project for the conservation and preservation of areas of wild flora and fauna, and Andean crops, they felt that they had to have solar energy to compliment the project. They wanted to develop an experience that respects the natural environment. Having the pollution and noise from traditional motors would go against what they are trying to convey through their project.

The company Inti Luz realised the initial solar project with engineers from the renewable energy program at the National University of Engineering in Lima, Peru.

8.8.4 Clean energy technologies and approaches being used

Solar Electricity: Consists of solar panels and a large amount of batteries. The solar electricity powers the entire hostel, including the energy-saving fluorescent lights, televisions, computers, a refrigerator (24V) and a freezer. Electricity is turned off from 11pm to 6am to reduce wastage and ensure that the solar PV system can meet the needs of the lodge. Many guests are fine with this, although some are not.

Solar Hot Water: The solar hot water system is from an Australian company and works very well for the lodge. It provides hot water for both guests and the kitchen.

Solar Water Pump System: Most interesting because it pumps the water up a very long hill. The three-phase pump motor, with variable frequency inverter, is located in a well 5.4m deep (below the level of the lake) and 1.5m in diameter. The submersible pump pumps water to a 24m^3 tank at the top of the hotel (54m above the lake at a distance of 198m from the well). From this tank, the water is carried by gravity to the hotel and gardens when needed, so that sporadic pumping is not required.

Solar Cookers: Provides primary cooking energy needs.

Biomass: Guest rooms have chimoneas (small fires), lit by staff each evening and hot water bottles are provided for guests.

8.8.5 Benefits from clean energy

Using renewable energy means the ambience of the hotel is relaxing and in keeping with the natural setting, uninterrupted by generator noise.

A local natural energy source saves on costs of fuel and its transportation.

Accommodation costs are also kept to a minimum, keeping access to such a location affordable to a wider audience.

8.8.6 Challenges faced

Availability of Products and Skills: Sourcing materials for the solar system and the knowledge of maintenance were original challenges. However, the assistance from the University Engineering Department overcame the maintenance challenges (see success factors below). Regarding product availability, importing the equipment was a big challenge due to taxes and all of the paper work required by customs. The energy efficient refrigerator and freezer came from the US and solar hot water system from Australia. Since the installation, there have not been many challenges, and any have that occurred, have easily been overcome. Everyone's enthusiasm has played a role here.

There was also doubt about the solar water pumps because they had never heard of anyone pumping water 54m (in elevation) with solar water pumps.

Guest Education: Probably one of the most challenging items has been educating the guests and staff in the consumption of energy. They prohibit the use of hair dryers, irons, and to limit the amount of energy guest's use, there is one outlet in the reception where people can charge their mobile phones and cameras.

Financing: Financing is a big challenge—the owner is financing the entire project, which has had a large start up cost.

8.8.7 Success factors and lessons learned

Attitude: A self-reliant attitude and approach is important.

Maintenance: Being organised to ensure that any parts are obtained and kept on hand for any maintenance work is crucial, as is having a staff member trained in maintenance. Being diligent with maintenance work to keep the solar working in optimal condition.

Pricing: There is a $US12 charge per guest built into the cost of staying at the hotel, which contributes to conservation projects on the island.

Local Skills & Advice: Within Puno there is a large amount of experience in installing and providing solar energy to rural areas. Many islands have solar energy, so there are lots of people in Puno that are able to maintain the equipment. There is also the National University of Engineering in Lima that has a renewable energy program that the personnel from Isla Suasi are able to consult when they have difficulties.

8.8.8 Key stakeholders

The owner, renewable energy company, and engineers from the Renewable Energy Program at the National University of Engineering in Lima, Peru.

8.8.9 More information

Casa Andina Private Collection
Ugarte 403,
Lima tel. 01/213-9700,
www.casa-andina.com

8.9 Case Study: Maho Bay, Harmony Studios and Concordia Campground—Virgin Islands

Type of Accommodation	Three eco-resorts together providing 160 units/eco-tents—30 almost energy self-sufficient
Clean Energy Technologies	Solar PV—grid connected and off-grid Awaiting permit for grid connected wind Solar HW EE building materials EE lighting and appliances EE behaviours Energy monitoring—in room for guests to see CHP from glass furnace Gravity fed water supply to eco-tents
Clean Energy Approaches	EE Behaviour—feedback on renewable energy is given to guests Guest education Organisational values

8.9.1 Location and brief description

The three resorts are all owned by one owner who began the world's first eco-resort in 1976 with Maho Bay and since then has added Concordia Campground and Harmony Studios.

The original Maho Bay has 114 units with minimal clean energy initiatives but significant sustainable and conservation practices.

The second, Concordia, has 25 eco-tents, which have numerous outstanding clean energy and sustainable principles. The Concordia also has the newest 4-eco studios coming online February 2010. The third, Harmony, is the latest development and continually adds more clean energy and sustainable principles.

In all there are about 160 units/tents, with 30 of these being almost energy self-sufficient.

8.9.2 Why this is an informative case study

This was the world's first eco-resort, since 1976, as reported by American Way Magazine. Consistent application of keeping sustainability at the core of everything they do and every aspect of the resorts where possible, and also being in the mid price range.

The approach towards continuous improvement in employing clean energy is best practice. They have a wide range of clean energy initiatives in place in varying degrees throughout the resorts and are always adding new options. Latest additions are a 'super insulation' in new eco-cabins and have application in for wind turbines. In addition they are always looking for creative solutions that offer more sustainability which often include more clean energy benefits.

8.9.3 Setting up the clean energy initiative

The local community appealed to the owner for sensitive development.

8.9.4 Clean energy technologies and approaches being used

- twenty-five eco tents are self-sufficient with their own solar PV systems providing energy for fridge, fans, water pump and electric lights. These eco tents also have solar HW, gravity fed showers run off a hand pumped water tank and composting toilets. The tents are also made of space-age fabrics that help with temperature control
- water tank gauges in bathroom for guests to see help to limit shower water use, reducing water-heating needs
- the main buildings have solar PV panels that provide energy for lights, appliances and other equipment.
- where inverters are used to convert solar energy to 120V electricity, the inverters are put inside the guest rooms and visible so that guests can see the meters and match their current use to available supply
- application for permits to run four wind generators are being processed but some locals object to the visual impact. If/when these are installed, they will be connected to the big electricity users in the main part of the resort—the kitchens and chilled storerooms
- passive solar design and climatic conditions eliminate the need to heat the units
- four brand new eco studios are super insulated with a very high R rating. They currently have no cooling. With their first summer approaching the resort is doing a 'test run' to see how they fare without any cooling provided
- barometers are provided in some rooms, which indicate if there will be less sunny weather soon, which means there will be less energy available. Guests have been responsive to limiting their energy consumption in these times
- waste heat from the craft glass furnace is captured and sent back to the bottom of the glass furnace, saving energy and maximising efficiency.

8.9.5 Benefits from clean energy

- Reduced environmental impact
- Lower energy costs
- Green marketing benefits
- High repeat customer rate
- Creative ideas throughout the resorts keep sustainability at their core, resulting in high levels of staff satisfaction
- Employment generation for local community

8.9.6 Challenges faced

Availability of Products: Key barriers originally were to get materials and supplies.

Community Concerns: Local objections to visual impacts of wind turbines have proved an impediment to wind power development. The owners note that it is necessary to take the time to work through the stakeholder consultation process.

Keeping Costs Down: The latest four eco studios have cost more than budget so the job now is to refine these for the next lot to be built. It's always a challenge to keep it simple and affordable for the mid-price range. This has required creativity and resourcefulness.

8.9.7 Success factors and lessons learned

Alignment with Local Community: On the whole it has been a very successful 30-year journey of keeping things sustainable, in line with the local community's wishes and concerns. For example, the local community had concerns about the property being on/near protected lands, and the camps were developed with this in mind. It was successful and a community internal to Maho Bay grew and in turn are supported and integrated with the local community.

The owner, Stanley Selengut offered: 'Local networks and local businesses are key to this whole approach. The result is community education, employment for local people, and economic benefits for our own resorts as well as local businesses and communities.'

Continued Commitment to Sustainability: A commitment to keeping sustainability as the core focus and not getting distracted. For example, the resort has had many opportunities to turn the craft centre into a very big and profitable gallery business—however, they keep bringing the focus back to the resort and it is a resort business and the craft centre's purpose is to recycle waste from the resort.

8.9.8 Key stakeholders

Resort owner, local community authorities, the local community, and resort management.

Key enablers are the resort owner and the management and then in time the community that arose out of the development.

8.9.9 More information

Maho Bay Camps, Inc.
PO Box 310, Cruz Bay
Saint John, VI 00830 Tel. 1-800-392-9004
Tel. 340-715-0501
MahoBay@Maho.org

8.10 Case Study: Mesoamerican Reef Tourism Initiative, MARTI—Mexico

Type of Accommodation	All
Clean Energy Technologies	Hotel operator's sustainability best practice program EE procedures through training are primary focus EE lighting and water flow restrictors An emerging Solar HW market
Clean Energy Approaches	Information resources Vision Network facilitation Funding

8.10.1 Location and brief description

A joint working initiative to ensure that tourism to the Mesoamerican Reef is managed in a sustainable way.

Originated by 3 conservation organisations, and in 3 years has made significant progress with a coordinated approach, secured funding and implemented key actions.

The program is education and training of operators in environmental best practices for the hotel sector, the marine recreation tour sector and the cruise ship tour sector.

Within the hotel sector there are two components. The first is working with existing hotels to become more sustainable. The second is working with government and developers for the planning and design of more sustainable hotels.

8.10.2 Why this is an informative case study

The significant depth and breadth of knowledge within the three conservation groups initiating and running the program that draws from best practice in similar tourism destinations around the globe, was brought into the initiative of the second largest Hotel Association in Mexico.

Their vision is far-reaching yet articulated in a definitive target with a timeline. Their implementation is strategic, organised, well structured and methodical.

They partner with each hotel through a year long program to truly ensure the hotel’s team of staff understand the process are able to implement it successfully and conclude with an operational Environmental Management System in place. They would meet with the hotel's team 5 times throughout the process.

It is a broad sectoral approach for the 3 key sectors of the region’s tourism industry.

8.10.3 Setting up the clean energy initiative

The initiative was established *‘To demonstrate that large-scale tourism, if properly planned and managed, can contribute to long-term conservation, development of vibrant communities, and a better future for the region.’*

MARTI works with leaders from both government and private sectors. They seek to engage all operators in the region by 2016 to be educated in, and adopt international best practice standards for the region’s key tourism sectors.

8.10.4 Clean energy technologies and approaches being used

The Hotel Sector Program has two components:

- to work with *existing* hotels, which supply 76 000 rooms (or approximately 150 000 beds), and
- to work with developers and government on *future* development.

To date they have engaged with hotels covering 29 000 rooms (58 000 beds). MARTI is objective and does not recommend any particular product or equipment.

The primary activity is dissemination of information, training workshops and education in best practice for sustainable operations in the hotel sector.

It begins with an energy/waste/water audit and then works with the hotel staff to implement key actions indentified and documented in an action plan. This is followed by education workshops and ultimately MARTI hotels are assisted to implement an Environmental Management System. This usually takes 9–12 months. It ends with another audit to identify savings realised.

Funding for the program is combined from a contribution by the hotel and funding received from key sources (donor foundations and other organisations) for the program.

Key EE procedures and changes in operational behaviours for energy focus on:

- EE air conditioning—adjustment of air conditioning thermostat temperatures and to implement education and behaviour change programs for air conditioning to be turned off when guests go out
- sustainable towel and linen change programs which results in a significant reduction in energy for hot water
- use of water restrictors, again to save on hot water
- EE swimming pool operation, another key saving area

- energy efficient operation of kitchen, coolers, freezers as well as insulation is the key recommendation; and
- EE lighting.

Solar HW is fairly new to the region and is going through early teething stages as an immature industry in the region—see notes in challenges.

MARTI's planning, design and construction component for new buildings will focus on energy efficiency, bioclimatic architecture, and renewable energy applications.

8.10.5 Benefits from clean energy

Hotels reduce operational costs by using less energy and water. However, as the program is only three years since inception there are no documented savings results from hotels available as yet due to many hotels not having fully completed the program and reported data.

Staff motivation is another key benefit reported from hotels' participation in the program.

MARTI's services to a tourism market, helps to spread the environmental standards and this helps to transform operators and guests.

As a destination—overall there is improved waste management, reduced water demand on local water resources and reduced energy demand. Promoting a culture of sustainability in the tourism sectors not only for hoteliers and tourists, but also local employees and communities.

Finally, there is a lot of information transfer throughout the entire region. This disseminates best practices, but also helps to educate about new technologies.

8.10.6 Challenges faced

Willingness to Invest: The majority of hotels are only a few years old and thus are still looking for key returns on investment before further investment. This is why, at this early stage, the program focuses on education on operational changes that can be made by staff that are already on the payroll.

Natural Disasters: Solar HW is fairly new to the region and key challenges to date have been the prevalence of hurricanes that damage equipment, reducing the willingness to invest. This issue is being looked at.

Retaining Local Skills: Solar HW only recently became possible due to availability of technology in the region and better supply chains. Still needs improved maintenance and service, as there is a lack of sufficient depth and breadth of preventative maintenance and engineering know how. What happens is that when the unit gets installed, the information is given to the current maintenance manager/engineer. Job movement is fairly frequent due to rapid growth of number of hotels, and they take the information with them, leaving nothing behind for the new maintenance crew.

Broader Coordination: On a broader scale for the whole MARTI initiative—challenges have also been coordination with other organisations and projects that have similar objectives.

Political Support: MARTI needs more support from the political side, particularly in relation to new developments.

Getting Hotel Developer Commitment: A bit more understanding from the tourism developers. Whilst hoteliers are embracing the program favourably, to get the hotel developer involved from the beginning is more of a challenge.

8.10.7 Success factors and lessons learned

Training and Education: The whole approach of MARTI as a facilitation program demonstrates the immense value in training and education and the impact this can have on a whole region.

Local Skills: Available expertise is crucial, as demonstrated with the challenges faced in the Solar HW industry. Using a mix of local expertise and outside professionals who have been involved in clean energy for long periods has helped the program.

Stakeholder Support: Support through the key stakeholders has been very strong which has been a key success factor. The whole program was begun by the joint initiative of Amigos de Sian Ka'an, The Coral Reef Alliance and Conservation International. Local industry has embraced the project and the inclusion of the Rivera Maya Hotel Association in the MARTI initiative has been facilitating this greatly.

Financing: Having a very generous donor has allowed them to have sufficient resources from the beginning (for the facilitation component), to allow them to tailor their work towards the needs of the hotelier.

8.10.8 Key stakeholders

The cooperation between the private sector and NGOs has been the key enablers.

8.10.9 More information

Thomas Meller, - Hotel Component.
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Cancún, Q. Roo, México. C.P. 77511,
tmeller@amigosdesiankaan.org

8.11 Case Study: Paradise Bay Resort—Grenada

Type of Accommodation	A tropical beach resort and spa of 9 Villas in 8 acres of natural park, bush land, and beaches.
Clean Energy Technologies	Wind Power EE appliances EE lighting
Clean Energy Approaches	EE behaviours Carbon neutral program for guests Purchase of carbon offsets Networks

8.11.1 Location and brief description

A tropical beach resort and spa of 9 Villas in 8 acres of natural park, bush land, and beaches.

8.11.2 Why this is an informative case study

The resort has demonstrated a far-reaching vision and commitment to being sustainable and responsible.

The owner has invested beyond the limits of his own needs as a resort and has the intention and commitment to prove wind and solar as viable energy sources in the Caribbean. There are few if any tourism operations globally with this size wind system.

8.11.3 Setting up the clean energy initiative

The resort was opened in 2007 by an international owner with corporate experience.

The Caribbean has one of the world's most expensive electricity rates at between $US0.25–$US0.38 per kW. Given the Caribbean’s trade wind and sunshine, implementing clean energy initiatives was seen as a potential cost-saving opportunity as this reduces relative payback times. This broadened into the creation of a sustainable and responsible resort and to demonstrate leadership in applying these principles in the region.

In addition to implementing clean energy initiatives at the resort, the owner has also established a carbon offsets program that is fully externally audited and runs a program to educate and motivate the local community to adopt energy efficiency initiatives.

8.11.4 Clean energy technologies and approaches being used

Wind Power—a utility sized 80kW wind turbine was installed in 2008. The resort consumes 120,000 kWh of electricity per year. The wind turbine provides 180 000 kWh per year—thus providing 150% of their electricity needs. The wind turbine will be connected to the mains electricity grid and the excess supply sold back to the utility company.

Energy Efficiency activities include:

- EE lighting
- EE appliances
- Cogeneration—the air conditioning have heat recovery units which turn heat loss into hot water. This is supplementary to solar hot water as well
- EE lighting throughout the resort as well as some solar lights outside
- towel reuse program to reduce water use and drying requirements
- the resort is preparing a project to make bio-diesel out of kitchen waste oils.

The resort has run a couple of programs for educating and encouraging locals to uptake energy efficient products. For example, they sold EE lights at the resort with an offer that a free lunch will be provided to the same value as the lights they bought, over a two-month period. The resort also offers to assist other resorts with the sustainability planning and showing them how it can be done.

The resort has also taken on buying carbon offsets for every guest to make the guests whole trip carbon neutral. They calculate guests' carbon through using flight calculators and other calculations. The carbon offsets are linked to a tree-planting program in Ethiopia that provides other benefits to the community there. This is simply paid by the resort for all guests. External auditors audit the program.

8.11.5 Benefits from clean energy

The calculated cost of the electricity using the windmill is 0.258c per kWh. This includes all costs and management time required to negotiate with the electricity company, as it was the first to be installed in the region. It also includes product life, maintenance, write-offs and profits from surplus electricity.

Compared to the local charge for electricity of 0.331c per kWh—this is a 22% saving.

The owner believes that wind power is a very viable source of energy for that area due to the trade winds. He now provides consultancy to other resorts, helping them with the feasibility and financing calculations of what is best for a resort—a wind or solar application.

There are also marketing benefits and the knowledge that as a tourism business you are meeting the challenge and responsibility to not damage the environment.

8.11.6 Challenges faced

Many challenges were faced in getting the project initiated and then completed. It involved many firsts for the utility company and local construction companies and thus met many hurdles along the way.

Negotiating With the Utility: The key barrier was convincing the local energy supplier to agree to the project. It took 6 years to get an agreement with the electricity company. Key issues were getting the electricity company to support the initiative, and then ensuing negotiations were very challenging at times, especially as they were a monopoly.

Technical Problems With New Technology: Further, technical issues during installation can quickly grow from small problems to large ones and this adds to time and money—especially being a first. Other key barriers were the impacts of this being a first project and the amount of education and management and finding solutions was required. This should hopefully be easier for future installations in the region.

8.11.7 Success factors and lessons learned

Value of Research: To establish a contract with a local electricity supplier is the first step before committing to a project like this—to find out all the issues that need to be addressed. If Paradise Bay were to do this again, they would have gone for a much larger turbine and negotiated different financing with a better interest rate. To do the research and analyse what initiatives will work, are available locally (relatively) and give you the best results throughout your business.

Stakeholder Relations: Good relations were also crucial to the successful outcome. Support from local authorities would help, but if you are in the position of educating them then this takes time, but is worth the investment.

Staff and Guest Education: Educating guests and staff has a flow on effect and is an important step.

8.11.8 Key stakeholders

A key enabler was the owner's commitment and belief that wind is a good energy source for their region.

A local electricity supplier was critical.

8.11.9 More information

La Tante
St David
Grenada
West Indies
Caribbean Islands

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8.12 Case Study: Playa Nicuesa Rainforest Lodge—Costa Rica

Type of Accommodation	5 Cabins and 4 room lodge in national park
Clean Energy Technologies	100% off grid Solar PV—off grid Recycled vegetable oil backup generator Passive solar drying room and EE building design EE hot water, lighting and appliances
Clean Energy Approaches	Carbon offsets Registered to become accredited carbon neutral operation Guest and staff education Full time sustainability coordinator employed

8.12.1 *Location and brief description*

Playa Nicuesa Rainforest Lodge is a 5-cabin and 4-room rainforest lodge and cabin operation (accommodating up to 24) on a 165 acre privately owned and operated reserve in Central America's largest remaining Pacific Coast rainforest, the Piedras Blancas National Park. It has no roads, and is accessible only by boat. Piedras Blancas National Park in the Golfo Dulce/Osa Peninsula region has been called one of the most biologically diverse places on the earth.

No TV, Internet, phone or other electronic entertainment is provided.

8.12.2 *Why this is an informative case study*

The lodge has excellent credentials with regard to clean energy. Further, the way in which carbon offsetting is approached through regional conservation programs is best practice in the tourism industry.

Many broader sustainability and conservation practices, employment of a full-time sustainability co-ordinator, commitment to education of guests as well as staff throughout the whole venue and broader outreach to the community show a depth and breadth of commitment and excellence.

8.12.3 Setting up the clean energy initiative

The owners both had backgrounds useful to starting an eco-lodge. Additionally, they had a lot of assistance from locals who knew the property well in terms of creating trails and locating buildings. From inception, this establishment was designed to make as little impact on the environment as possible. The owners have adopted the practice of progressively implementing renewable energy, as they are able to. This is a process of taking the time to learn what the best source of energy is, balanced with time and investment costs. Energy efficiency practices are constantly employed as well.

They also have a Sustainability Centre next to reception, which outlines and demonstrates all their activities relating to sustainability. Also provide their continually updated 'Sustainability Goals and Sustainability Policies' document for guest perusal.

For the latest clean energy addition in 2009, the 'Mean Clean Green Machine'—a recycled vegetable oil generator—it took some time to decide on the best option. Before deciding on this technology they explored various other options:

- a mini hydro system had great potential but was not selected as the fairly flat terrain made getting to the water source impractical
- adding more solar panels would result in the same limitation that already existed due to low sun productivity days
- also considered various biofuels through existing generator but found they were difficult to obtain and not always ecological.

8.12.4 Clean energy technologies and approaches being used

- Electricity is provided by solar power. Twenty panels of 100 watts each are centrally located on main lodge structure, with battery bank storage and state-of-the-art inverter.
- in 2009, with help of local engineer, a recycled vegetable-oil generator was designed and made out of recycled components due to unavailability of 'off the shelf' components. Various components were sourced through local contacts all recycled from local boats and salvage junkyards—all transported to the property by boats and 'strongmen' and assembled onsite. Now vegetable oil to run the generator is sourced from used oil in local restaurants, which is then filtered to be utilised directly in the generator
- EE Building Design—cabins and lodges are designed for cross ventilation, natural airflow, and natural illumination and have a ceiling fan for cooling only (no air conditioning)
- passive solar drying room used to dry all laundry. Specially constructed after an energy audit identified two largest users of electricity were dryers and ceiling fans. There are now no dryers in use
- hot water is provided by on-demand propane, which means that the propane is used only when the hot water is turned on
- energy efficient light bulbs, refrigerators and freezers
- use of solar lanterns for pathway lighting
- also, candles supplement the low lighting used at night to prevent any alterations in natural animal behaviours and conserve energy
- while not strictly related to clean energy, where use of fossil fuels is unavoidable, purchasing carbon offsets to help the reforestation and protection of other local areas is done through the national foundation FONAFIFO. This contributes to regional sustainability efforts.

8.12.5 Benefits from clean energy

Apart from 'on-demand' efficient propane used for water heating, all other energy sources are either solar power or recycled vegetable oil backup generator. As the generator use is minimal, the remote and quiet feel of the premises is maintained as naturally as possible, without interruptions of noise and unsightly infrastructure from continuous operation of generators.

Clothes dryers do not last very long in the rainforest climate. The passive solar drying room, in addition to reduced electricity consumption also means less noise pollution and less waste. Further, the staff were spending a lot of time rehanging laundry to dry, and the passive solar room has been designed and built to hold all the day's laundry in one hanging. This has resulted in a saving of between 5–8.6kW per day as well as saving staff time.

Taking the next step to encourage guests to buy offsets for their travel and facilitate the process on the website and to match guest contributions to conservation organisations extends the impact of conservation, education and sustainability.

8.12.6 Challenges faced

Availability of Clean Energy Technology: For the recycled vegetable oil generator, nothing was available in Costa Rica to buy off the shelf, so they had to design and build themselves with help of local engineer who runs his van on recycled oil from fried chicken outlets. Thus a resourceful approach and the use of local skills were required to overcome this barrier.

Remote Location (access): Operating from a location only accessible by boat has complicated efforts to participate in the community and transport certain things to the lodge, such as materials for new projects.

8.12.7 Success factors and lessons learned

Resourcefulness: A resourceful attitude and commitment to always looking for the way things can be done sustainably have been key to success. This involves just making a start, doing what you can and allowing time for things to be realised.

Dedicated staff responsibility: They have employed a full-time Sustainability Co-ordinator whose role is to keep sustainability goals as a priority. This was achieved after using interns for 3 years.

Using locally available resources: Looking for the solution that is available locally, be it natural renewable energy resources, locally grown food or activities, or skills and knowledge.

Maintenance: Diligent maintenance of all electrical equipment with own staff and occasional visits by experts is necessary in the tropical climate.

8.12.8 Key stakeholders

The Owners drove the process, while constant consultation of local and regional communities as well as the Ministry of the Environment to help with solutions to the challenges faced.

8.12.9 More information

www.nicuesalodge.com

8.13 Case Study: Proximity Hotel—North Carolina, USA

Type of Accommodation	A purpose built 147 room high quality hotel
Clean Energy Technologies	Green building design and materials Solar HW—extensive Geothermal EE plant equipment
Clean Energy Approaches	Accreditation—LEED


8.13.1 Location and brief description

A purpose built 147-room high quality hotel and restaurant that opened late 2007.

The owners have sought to combine heritage design, local historical acknowledgement and modern green building and sustainable principles.

8.13.2 Why this is an informative case study

Energy usage results are best practice and the hotel has gained LEED Platinum Certification. This is the highest accreditation obtained from the US Green Building Council's certification program, thus making the hotel acknowledged as America's Greenest Hotel.

8.13.3 Setting up the clean energy initiative

The owners of Proximity Hotel have a very clearly stated Mission Statement on their website outlining the sustainable principles and practices that drive their business model. The intention is to be part of a new class of sustainable buildings and business that use significantly less energy and water, without compromise to the standard of guest comfort, service, amenities or experience.

The Proximity Hotel was designed, built and now operated using the US Green Building Councils certification program as their reference and guidance point.

8.13.4 Clean energy technologies and approaches being used

- Formal Accreditation—extensive use of green building design principles were incorporated.
- EE Building Design—the design utilises abundant natural lighting, including large energy-efficient, and windows which can be opened.
- Solar hot water—100 large solar thermal collector panels have been installed on the roof of the hotel, providing 4000 sq feet of solar hot water capacity, the hot water is stored in four, 1450 gallon tanks. This provides hot water equivalent to about 100 homes. It provides 60% of the water required for the hotel and restaurant and results in energy bill savings of between US$14 000–US$20 000 per year.
- Newly engineered variable speed hoods in the restaurant use a series of sensors to set the power according to the kitchen's needs and adjust to a lower level of operation (typically 20% of their full capacity). The sensors also detect heat, smoke or other effluents and increase the fan speed to keep the air fresh.
- Geothermal cooling equipment is used for the restaurant's refrigeration, instead of a standard water-cooled system, saving significant amounts of water.
- Efficient lifts—North America's first Regenerative Drive model of the Otis' Gen2 elevator reduces net energy usage by capturing the system's energy and feeds it back into the building's internal electrical grid—put more simply the elevators generate electricity as they descend, contributing to the energy they use when they ascend.
- A green, vegetated rooftop will be planted on the restaurant to both insulate the underlying hotel space and to reduce the 'urban heat island effect', helping to keeping ambient temperatures down to reduce cooling energy required in this and neighbouring facilities.
- Air quality is improved by circulating large amounts of outside air into guestrooms—60 cubic feet (1.69 cubic meters) per minute—and doing so in an energy efficient manner by employing 'energy recovery' technology where the outside air is tempered by the air being exhausted.

8.13.5 Benefits from clean energy

Reduced operating costs, and relatively short or reasonable payback periods. The water saving technology, for example, had a payback period of 7 months.

> *'When we started the design process four years ago, I would have never believed that we could use 39.2% less energy and 33.5% less water without one iota of compromise in comfort or luxury and with minimal additional construction costs. It just goes to show what a determined team can accomplish if they use common sense and get a little bit of help from the sun.' Dennis Quaintance, CEO, Proximity Hotel.*
>
> *Healthy internal environment with healthier and more productive occupants (staff and guests).*

Reduced environmental impacts with associated marketing benefits as a business and an educational showpiece.

8.13.6 Challenges faced

None stated.

8.13.7 Success factors and lessons learned

The guidance from involvement in the LEED program has assisted greatly in produced a world-class development.

8.13.8 Key stakeholders

Owners/developers and US Green Building Council's LEED Certification Program.

8.13.9 More information

Proximity Hotel
704 Green Valley Road
Greensboro, NC 27408
336.279.8200

http://www.proximityhotel.com/green.htm

8.14 Case Study: Rainbow Retreat Wilderness Eco Cabins—Tasmania, Australia

Type of Accommodation	Eco lodge with 3 guest cabins that have their own 100% solar PV 12V energy system
Clean Energy Technologies	Solar PV Wind generator Biomass for heating Passive solar design EE lighting EE appliances

8.14.1 Location and brief description

Rainbow Retreat is a remote wilderness eco lodge with 3 guest cabins that have their own 100% solar PV 12V energy system. The whole site is a private nature reserve.

The owners live in the main lodge that is 100% solar PV powered at 240V with additional wind generator.

8.14.2 Why this is an informative case study

This case study demonstrates a holistic approach to clean energy at the small scale (3 rooms), through both energy reduction strategies and a range of different clean energy supply options suited to different needs of each part of the lodge. The business is carbon neutral and takes a broad approach to sustainability and conservation.

8.14.3 Setting up the clean energy initiative

Clean energy was considered essential by the owners due to the remote (off-grid) location and wilderness value. The site was purchased when partially built, then they completed the main lodge and then decided to live in it and not use if for guest accommodation. The owners later built the accommodation cabins themselves, ensuring they had personal control over limiting environmental disturbance.

8.14.4 Clean energy technologies and approaches being used

All buildings are oriented north/northeast to achieve effective passive solar design.

The main lodge has 12 solar panels with a battery bank and sine wave inverter giving it 240V mains electricity. The main house does all the cooking for guests and charges up guest cameras and mobile phone batteries as the cabins are only 12V and cannot run appliances such as hair dryers. There is 1 wind generator that trickle feeds into the main lodge battery bank as a supplementary energy source.

The cabins each have their own 2 x 60W panel solar PV system which powers efficient lighting and specialised 12 volt low compression electric fridges.

No electrical dryers are used—EE washing machines are used and a passive solar drying room.

They harvest a small amount of timber to run the slow combustion stove which provides hot water, heating and cooking. To ensure that stocks of biomass are replenished they are continually planting new indigenous trees and shrubs on the property.

8.14.5 Benefits from clean energy

Cost efficiency (no ongoing bills) and thus profitability is significantly enhanced. The payback period for implementation of solar systems was 1 year. Would have been 2 years, however, the owners received a government grant for 50% of the cost of the system. The research team expect that this payback period is so short due to the very high relative cost of alternative options such as grid extension or diesel generation in a remote location.

Educating guests and the local community as to how it is possible to live in a carbon neutral fashion.

The owners suggest that their quality of life is enhanced through operating a carbon neutral business and the associated way of life that is offers.

8.14.6 Challenges faced

Very few challenges were faced. The project took two years to plan and implement, however they received a lot of support from local and other government agencies.

8.14.7 Success factors and lessons learned

Government support: Support from local authorities and industry helped to facilitate the whole process.

Grant Funding: 50% government grant was of significant assistance. Each cabin system cost $2500 AUD before the grant.

Resourcefulness: Their approach of taking energy conservation very seriously and so planning everything around self-reliance and resourcefulness has been a significant success factor.

Maintenance: Regular maintenance (monthly check of batteries and cleaning of solar panels) ensures long life and maximum efficiency.

8.14.8 Key stakeholders

The clean energy initiatives were driven by the owners with support from local authorities.

8.14.9 More information

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Rainbow Retreat Wilderness Eco Cabins
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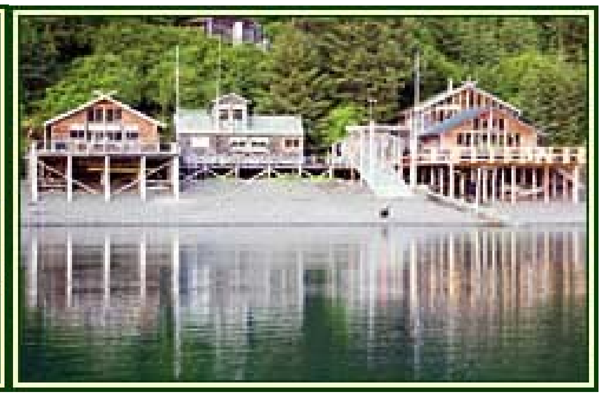
St Mary’s 7215 TAS
http://www.rainbowretreat.com.au

8.15 Case Study: Sadie Cove Wilderness Lodge—Kachemak Bay State Park, Alaska, USA

Type of Accommodation	5 eco-cabins on a privately owned beach
Clean Energy Technologies	Micro-hydroelectric system Wind power backup—100% off grid EE lighting EE appliances
Clean Energy Approaches	EE behaviour Accreditation



8.15.1 *Location and brief description*

A very remote wilderness lodge of 5 eco-cabins on a privately owned beach, on the ocean in Alaska's Kachemak Bay State Park. Access is only by boat.

8.15.2 *Why this is an informative case study*

This case study exemplifies the philosophy of tapping into what is available locally as an energy source. In this case it is a year round mountain stream. A micro hydroelectric system has been developed and installed. A wind generator has also been installed as an additional energy source.

This case study also highlights how, whilst the initial investment has a large cost component, the benefits are real, tangible and worthwhile.

This is backed up by their participation in two accreditation schemes—Green Star of Alaska and GreenGlobe of Australia, now called EarthCheck (EC3).

8.15.3 Setting up the clean energy initiative

The owners originally spent eleven years operating the guest facility with no electricity and thus no lighting, refrigeration or washing machine. Lanterns were used for light and a small generator was used for rare instances that required use of a power tool. After careful consideration of different local sources to create electricity, it made sense to tap into the year round swift stream 200 feet up above the lodge and utilise available wind energy.

When asked about data relating to payback periods, savings or investment costs, this response shows the result of taking on the significant investment:

> *"We really don't have this data. For us it was a no-brainer to put in the hydro/wind system, as it is the only reasonable solution to having electricity at our lodge. We do not wish to pollute by using noisy, smelly, gas generators and our guests wanted to have lights and power to charge their cell phones and laptops in their cabins. It is very handy for the crew to have refrigeration in the kitchen and a washing machine has made our lives much easier, so in terms of cost we have not made any comparisons. In terms of improvement to our lives and our business, it has been tremendous and we are now considering adding a second, back-up system, to the one we have for times when there is heavy usage. It is a big investment for us, but one that is definitely worthwhile." Randi Iverson, Owner/Manager*

8.15.4 Clean energy technologies and approaches being used

- Hydro and Wind—electricity for the entire lodge is provided by an in-house, non-polluting, hydroelectric system operating from a swift mountain stream 200 feet up the mountain behind the lodge. A small wind generator also reinforces this.
- The Hydro system uses a battery bank to store the electricity created, and an inverter to convert it from 12V to 110V. The one system provides electricity for the lodge and 5 cabins. A wind generator also feeds into the same battery bank. The result is 100% off-grid renewable energy supply with no back up generation required.
- EE lighting—all light fixtures use compact fluorescent bulbs.
- EE appliances—with the advent of energy efficient appliances they now have a washing machine and run an entire professional kitchen, with refrigeration.
- EE motors—used on boats, which is the only form of transport.

8.15.5 Benefits from clean energy

The primary benefit is that clean energy provides access to modern energy services that would have been otherwise unachievable given the constraints of the location. This has dramatically improved the quality of life of the owners and the ease of operating the business, as well as the services that can be offered to guests.

8.15.6 Challenges faced

High capital cost: Saving up for the capital cost to build the system initially was very difficult, as was adding other components as became viable. This represented a big investment for the owners, but one they consider ‘definitely worthwhile’.

Maintenance: The only maintenance issues that arise are occasional gravel and detritus clogging up the pipes, or a section of the pipe freezing.

8.15.7 Success factors and lessons learned

Self-reliance and resourcefulness have been key factors for success.

Knowing the local resources: Doing the research to stimulate thinking to find a solution that links with what is available naturally, as well as what can be achieved in your specific location.

Now that they see the benefits of investing in such a system, they are looking at adding a second for further supplementation in heavy demand times.

8.15.8 Key stakeholders

The owners drove the process, with limited additional involvement.

8.15.9 More information

Randi Iverson
Sadie Cove Wilderness Lodge, Alaska
www.sadiecove.com

8.16 Case Study: Solar Initiatives Project—Sibayo, Peru

Type of Accommodation	14 local houses in community based programme
Clean Energy Technologies	Solar PV Solar thermal hot water Solar cooking ovens
Clean Energy Approaches	EE behaviour


8.16.1 Location and brief description

A rural community-based tourism program where 14 local houses were made suitable to be home-stay accommodation for 24 guests.

Due to remote and rural location of the village, initiatives centred on use of solar to improve supply of basic amenities for both guests and townspeople.

8.16.2 Why this is an informative case study

The project is designed to have considerable ‘flow-on’ benefits to the town. As a primary goal, the project creates home stay accommodation at a standard acceptable to tourists. The project has additional benefits by creating access to modern electricity and heating services.

The project was undertaken in a strategic area. The community is currently developing community-based tourism, and this development initiative supports and aligns with other initiatives.

8.16.3 Setting up the clean energy initiative

The project was initiated by the Village of Sibayo—the people involved in experiential tourism. They aligned with the Rural Community Tourism Program run by the National Ministry of Tourism (MINCETUR).

The implementation of the project was based from the community in conjunction with the municipality, and other organisations such as the national government, the public, and NGOs. All of them co-financed the project.

There are a number of similar initiatives happening throughout Peru with a new tourist route opening up in Peru, as a circuit between rural villages. Central to this is the refurbishment of a number of houses in the towns, to be able to cater as home-stay accommodation. It is possible Sibayo may be part of this.

8.16.4 Clean energy technologies and approaches being used

- the first initiative was 22 solar cookers built and installed in 2007
- the next initiative was 13 solar panel modules installed in 2009
- in 2010 a solar shower program is happening, where solar showers will be installed to provide hot water to the home-stays and homes of townspeople. Sixteen tanks will be installed, with solar panels and will be able to provide hot water to showers to four people from four houses at a time.

8.16.5 Benefits from clean energy

- assists with creating income for the village
- the initiative serves a dual purpose, pairing quality of life improvements with strategic business interests to support tourism in the area. The technologies provide hot water and electricity to the households both as homes and as home-stays
- the essence of sustainability is also captured here—the provision of accommodation to a standard more acceptable to today's tourists, results in being able to attract more tourists. Tourists coming to the town also results in expenditure at local markets, on local craft works as well as stimulus for local eateries.

8.16.6 Challenges faced

Lack of knowledge: Each of the systems were novel technology in Colca. Solar showers had to be studied and learnt about by the townspeople. The families who received the solar systems had to learn about the setup, maintenance, and management of the technologies. This in turn required them to change their lifestyle.

8.16.7 Success factors and lessons learned

Stakeholder Cooperation: The project spanned across many levels of governance and built upon the strengths from each. The project used resources and expertise from private non-governmental organisations, the local government (Colca), the national government (MINCETUR), and the Spanish overseas development organisation Spanish Agency for International Cooperation.

Local Government Facilitation: The local government played a critical role by facilitating the local families' involvement with local tourism businesses, national government agencies, and international development agencies.

Local Appropriateness: A critical feature of the program was that it worked with the households to install the system in a manner appropriate to their situation. In addition to assisting the local families with the logistics of sourcing, delivering, and managing the solar systems, the project also engaged with the recipient families to ensure a clear understanding of the technologies. The local government's involvement will ensure ongoing support for the operation and maintenance of the solar systems.

Funding: Funding and support provided from the Peruvian government agency MINCETUR in collaboration with international donors.

8.16.8 Key stakeholders

Colca Local Government
Public/Private Institutions
NGOs
Local townspeople
National Tourism Ministry, Peru (MINCETUR)
Government of Spain, Spanish Agency for International Cooperation (SAIC)

8.16.9 More information

N/A

8.17 Case Study: The Hytte—Northumberland National Park, UK

Type of Accommodation	Single 4 room holiday cottage in Northumberland National Park in north of England in UK
Clean Energy technologies	Geothermal (ground source heat pump) for HW and under floor heating EE Appliances EE lighting Insulation Energy Monitoring
Clean Energy Approaches	Green Tourism accreditation

8.17.1 Location and brief description

A self-contained holiday cottage in Northumberland National Park that has 4 rooms sleeping 8 guests.

It is built in the style of a Norwegian Mountain Timber Hut, and is complete with a grass roof and Norwegian fireplace.

8.17.2 Why this is an informative case study

This cottage has taken on the responsibility to be truly sustainable.

It has recognised that electricity is a key cost component of its business and has taken the time to do the energy monitoring to determine average use. It has implemented demand management energy efficiency measures first, and communicated this to its guests in a way that ensures its commitment.

The Hytte's sustainability measures include energy, waste and water management to planting of 1000 trees including specific types to improve the flora and fauna in the area.

8.17.3 Setting up the clean energy initiative

The Hytte seeks to be a sustainable self-catering holiday cottage that integrates with the local environment.

8.17.4 Clean energy technologies and approaches being used

- formal Accreditation—The Hytte has obtained Gold Certification with the UK's Tourism Accreditation Scheme, the Green Tourism Business Scheme
- EE Appliances—All appliances 'A' rated. All laundry is line dried, no driers are used
- EE lighting throughout
- EE Building Design—The Hytte exceeds standards for insulation including double-glazing on all windows using energy efficient 'E' rated glass. The grass roof also provides insulation. Extra insulation has been put around the hot tub (spa) to reduce heat loss and heavy lined curtains are used to reduce heat loss from windows in the evenings
- a 6kW geothermal (ground source heat pump) is used to heat all water and also provide floor heating. The multi-zoned under floor heating provides three units of heat for every one unit required to drive the pump. This technology is both high efficiency (thereby limiting energy consumption), and low maintenance. This reduces operating cost substantially relative to comparable technologies for water and space heating
- they have elected for their electricity to be supplied by their grid electricity supplier renewable ‘Green Energy’
- they have attempted to install a 6kW wind turbine—however, are currently working through local planning issues (see challenges)
- the Hytte monitored electricity use weekly for two years to determine the 'average' use of electricity. From this they have determined an average daily use figure. Guests, who use above this 'average', are charged an additional 10p per kW, which they call 'Payback'—this is donated to local charities
- an internal electricity meter is provided for guests to see their use. Guests can ‘monitor, control (or reflect) on their electricity use’ as the website says: *‘We feel this is the best aid to careful consumption and fairest to all our guests. This “Pay Back” will be donated to Northumberland National Park Environment Association and The Great North Air Ambulance.’* The Hytte Website.

8.17.5 Benefits from clean energy

Cost Management: Since installing the ‘payback’ mechanism and their guest education efforts they have noticed a reduction in the number of people who mindlessly waste electricity and have noticed a reduction overall in the average use. Due to their energy monitoring and setting a weekly average, the Hytte is taking control of its electricity costs. This not only reduces costs and emissions, it also provides more concise business management, as electricity can often be the second biggest cost item for tourism accommodation.

Public Image: Such initiatives also align with their location of a national park setting and being a nature destination and responsible tourism accommodation provider.

8.17.6 Challenges faced

Local Planning Regulations: In their recent planning of a 6kW wind turbine, council regulations are proving too restrictive with no measure for adapting to or facilitating the process of reducing emissions, despite council’s goal of reducing emissions throughout the county. They are still seeking ways to implement the wind turbine.

8.17.7 Success factors and lessons learned

Value of Research: The owners believe many challenges were overcome due to their research and planning. They suggest that it is necessary to keep researching options until you figure out what suits your circumstances the best.

Funding grant: After commencing building, they found out there were grants for renewable energy and managed to secure 50% apiece funding for the heat pump system through the government's Energy for Enterprise program and the National Parks' Sustainable Development Fund.

8.17.8 Key stakeholders

The owners did all the planning, research and commencement of building themselves. Government agencies were useful for financing assistance and the Green Business Tourism Scheme (GBTS) provided a source of accreditation to assist in their marketing as well as to provide a framework to continue improving their sustainable initiatives.

8.17.9 More information

The Hytte
Bingfield, Hexham
Northumberland NE46 4HR

http://www.thehytte.com/

8.18 Case Study: URBN Hotel—Shanghai, China

Type of Accommodation	26-room boutique hotel
Clean Energy technologies	EE lighting EE appliances ESM
Clean Energy Approaches	EE Behaviour Network

8.18.1 Location and brief description

A renovated factory warehouse in Shanghai developed into a 26-room boutique hotel incorporating sustainable building design principles. From there, the hotel aligned with key networks to implement a review of their operations and implemented some key energy efficiency behaviours.

8.18.2 Why this is an informative case study

This is a good example of how operational and behavioural change can lead to significant electricity reductions, cost savings, and carbon emissions reductions. In addition to continually seeking reductions, they purchase offsets for electricity used at the hotel to be carbon neutral. The hotel still has further plans for expanding their clean energy initiatives.

8.18.3 Setting up the clean energy initiative

URBN is owned by a property development company committed to blending sustainability and unique design in buildings. One of the cornerstones of delivering on sustainable practices is tracking operations.

Since June 2009, URBN Hotel Shanghai has implemented a range of no-cost and low-cost behavioural changes. This was the result of the crucial first step—analysing energy usage patterns and looking for steps to take to gain energy efficiency.

The next steps for this hotel now are to look at clean energy technology investments, and they have already identified roof solar, grey-water recycling and guest education as potential next steps to improve sustainability and track success. *'The more we focus on operations the more we'll be able to reduce consumption'* is what the hotel's head engineer said.

8.18.4 Clean energy technologies and approaches being used

URBN has aligned with support networks to gain expert advice in implementing sustainable practices. In the design stage, architects incorporated:

- passive solar shading
- double-paned windows, and
- EE low wattage lighting.

In the last six months of 2009 they implemented a range of no-cost and low-cost behaviour and operational changes in their heating, cooling and water systems. This was the result of the crucial first step—detailed analysis of all components of electricity usage throughout the hotel and looking for steps to take to gain energy efficiency.

The energy efficient behaviours and operational changes that have been implemented include:

- careful management of the HVAC system to minimise simultaneous heating and cooling of the building
- the chillers coil is manually reset every 10 days to ensure it is not operating too coolly for the hotel's needs
- HVAC filters are cleaned every month and coils are cleaned every two months
- guest room temperature thermostats have been adjusted
- hallway lights are turned off during day time as there is sufficient natural light and only half are on 2am–6am
- radiant floor heating only comes on if the room falls below 22 degrees Celsius.

8.18.5 Benefits from clean energy

By doing energy efficiency behaviours first they have reduced electricity consumption by 36% and saved about US$20 000 and 92 Mt$CO_2$-e. If they continue these savings over five years, this would be the equivalent reduction in carbon emissions of 20 000 tree seedlings growing for ten years.

8.18.6 Challenges faced

Establishing monitoring systems: It is quite a challenge to adjust the mental thinking for current business-as–usual-behaviour of operations. To take the time to learn how to monitor energy usage in different parts of the hotel, to develop data monitoring systems, and to analyse these systems can be time consuming at first. However, once done, the savings are immediate and then a system is developed to monitor, review and refine these operational behaviours.

8.18.7 Success factors and lessons learned

The combination of:

- expert partnerships
- executive commitment
- empowering hotel staff to make changes.

The time and effort put into gathering specific hotel electricity usage data, and analysis of this to identify patterns and areas where changes can be made. It is often a number of small changes that add up to significant savings.

8.18.8 Key stakeholders

A clear mandate by the executive of the hotel gave the go-ahead and cooperation throughout the hotel.

Partnering with facilitation expert bodies was key to this process—URBN partnered with the US Agency for International Development’s US-China Sustainable Building Partnership, implemented by ICF International (www.icfi.com).

Finally, strong involvement of the engineering staff at the hotel to implement a variety of behavioural changes of the hotel's heating, cooling, lighting and water systems.

8.18.9 More information

Review Document, US-China Sustainable Buildings Partnership July 2009, US Agency for International Development, 5 April 2010.

Review Document, URBN Hotel Couples Green Design with Green Operations to Reduce Electricity Use by Over 30%, ICF, 5 April 2010.

URBHN Hotel Website, http://www.urbnhotels.com/urbn-shanghai/welcome, 5 April 2010.

9 APPENDIX B: ADDITIONAL RESOURCES AND LINKS

9.1 Resources for Whole Manual

Resource	Link	Organisation	Comments/Description
Development Technical How-To Guides	www.fastonline.org/CD3WD_40/CD3WD/INDEX.HTM		This collection of how-to guides provides short and accessible guides to developing appropriate technology programs and systems. From building construction to combined heat and power systems, to every conceivable renewable technology, this collection has information and case studies relevant to the clean energy project you are considering. The titles starting with 'Appropriate Technology' are most useful for clean energy projects.
Renewable Energy Resources for Australian Tourism	www.crctourism.com.au/WMS/Upload/Resources/bookshop/Baldock_RenewEnergySources.pdf	Sustainable Tourism CRC	This report presents data on renewable energy resources in Australia, with implications for how they could be used within the tourism sector. Although Australia specific, it is an example of the type of base information that may be useful for hostelries considering clean energy projects.
Australian Renewable Energy Atlas	www.environment.gov.au/apps/boobook/mapservlet?app=rea	Australian Department of Environment, Water, Heritage and the Arts	This is an interactive map that provides energy resource data at a relatively fine scale for Australia. In particular data is available for key solar, wind, wave, land-use and geothermal parameters. Although Australia specific, it is an example of the type of base information that may be useful for hostelries considering clean energy projects.
Carbon Trust Practical Guides	www.carbontrust.co.uk/Publications	Carbon Trust	From biomass heating to swimming pool energy efficiency, the Carbon Trust has a downloadable practical guide to help develop your project. Typically they include an introduction and overview of the technologies, a technical manual and an implementation guide from initial assessment to operation and maintenance. Although targeted at a UK audience, the information contained in the guides will be useful worldwide. Use the search function to narrow down which guide is most appropriate to you.
The Encyclopaedia of Alternative Energy and Sustainable Living	http://www.daviddarling.info/encyclopedia/AEalphindex/AE_categories.html	David Darling	This website has a large collection of articles related to all clean energy technologies and energy sources. It includes technical overviews and guides to selecting and installing different technologies.
Guidebook for Managing Energy Use in your Hotel		ICF International for British High Commission New Delhi, 2008	A useful general guide to managing energy use produced for the context of developing countries

9.2 Resources for Particular Technologies or Approaches

CHP	**Cogeneration Project Development Guide**	http://www.cogen3.net/pdgform.html	Cogen 3	This guide takes you through the steps that are required to undertake a pre-feasibility assessment of cogeneration including what technologies are available. It also describes what to do to secure investment and what is required in the operation phase of a CHP plant. COGEN 3 also provides a downloadable technical-financial analysis model. The guide is written for a European audience, however will be useful worldwide.
Wind	**Quick Guide to Large Wind**	www.rurdev.usda.gov/OR/biz/QuickGuide2LargeWind.pdf	USDA	The Quick Guide to Large Wind provides an overview of the necessary considerations for planning the installation of large (>500kW) wind turbines, including explaining the key terms and the governing equations for calculating annual energy output and environmental and economic assessment.
Wind	**Small Wind Handbook**	www.windpoweringamerica.gov/pdfs/small_wind/small_wind_mi.pdf	NREL	The Small Wind Handbook provides comprehensive explanations for the things to consider when installing a household scale wind turbine. It includes discussion of the different types of small-wind turbines available, how to calculate energy output, economic assessment and environmental considerations. It is designed for a US audience; however the majority of the information provided is applicable anywhere in the world.
Wind	**Wind-turbine Power calculator**	www.windwithmiller.windpower.org/en/tour/wres/pow/index.htm	Danish Wind Energy Association	This wind power calculator is most appropriate for large wind turbines or bigger projects. It enables you to calculate the likely energy output of a technology. It is best used after a preliminary resource assessment has been undertaken.
Wind	**Wind-works**	www.**wind-works**.org	Paul Gipe	This website provides a large number of technical and information resources for small, medium and large-scale wind projects.
Solar PV	**Grid-connected PV Systems Design Guidelines**	http://www.cleanenergycouncil.org.au/cec/accreditation/Solar-PV-accreditation/forms/mainColumnParagraphs/0/text_files/file9/Grid%20Connect%20Design%20Guidelines%20CEC	SEIA	These design guidelines take you step-by-step through how to calculate the most appropriate sized Solar PV system for your needs. It can be used with minimal additional information, although access to a local solar insulation data would be useful.

		.pdf		
EE lighting	**Energy Efficiency Best Practice Guide: Lighting**	http://www.resourcesmart.vic.gov.au/for_businesses/energy_efficiency_3453.html	Sustainability Victoria	This guide provides a comprehensive overview of different lighting technologies available, their advantages and disadvantages. It identifies a series of technical issues to consider when designing an environmentally sustainable lighting system to meet your needs. Most appropriate for large hotel facilities that have complex lighting systems.
EE lighting	**Light bulb Cost Analysis Calculator**	http://www.ajdesigner.com/fl_light_bulb/light_bulb.php	AJ Design	This calculator allows you to calculate the cost savings associated with using different lighting technologies.
EE lighting EE appliances Water Efficiency Energy Savings	**Energy Cost Calculators for Energy-Efficient Products**	http://www1.eere.energy.gov/femp/technologies/eep_eccalculators.html	US DoE	This website provides a series of Excel based spreadsheets to calculate and compare the energy and cost of different energy-efficient appliances including lighting, dishwashers, heating and cooling equipment, showerheads, food service equipment, office equipment and more.
EE appliances	**Energy Efficiency Best Practice Guides**	www.resourcesmart.vic.gov.au/for_businesses/energy_efficiency.html	Sustainability Victoria	This website provides a series of step-by-step guides to improving the energy efficiency of different commercial systems including pumping, heating, air quality, hot water and more. Although written for an Australian business audience they are useful worldwide.
Solar Hot Water	**Online Calculators**			Many online calculators exist to help you determine: • the amount of water your business uses and associated tank size (e.g. www.consumerreports.org/cro/appliances/heating-cooling-and-air/water-heaters/how-to-size-a-water-heater/overview/sizing-hot-water-heaters-ov.htm) • the size of solar collector you need (e.g. Sunflower Solar - http://www.sunflower-solar.com/en/Solar_Basics/solar_collector_size.html) • the energy and cost savings associated with a solar hot water system (e.g. Sunrain - http://en.sunrain.com/solar_energy_Toolbox.html). These calculators are typically associated with one specific commercial product and should only be used as a rough guide. To get the right sized system for your needs particularly tank size, it is important to consult experienced professionals.

Efficient Pool and spa	**Swimming Pool Heating**	www.energysavers.gov/your_home/water_heating/index.cfm/mytopic=13130	US DoE	This web resource provides information regarding different ways of increasing the energy efficiency of swimming pool heating. It includes an overview of different technology approaches and guides to sizing, efficiency and cost comparisons of different systems.
Geothermal Hot Water	**Geothermal Heat Pump Design Manual**	www.mcquay.com/mcquaybiz/literature/lit_systems/AppGuide/AG_31-008_Geothermal_021607b.pdf	McQuay International	This manual goes through all of the factors that need to be considered when designing a ground source heat pump system. It includes a background to the technical theory and design properties of key components. Written for a US audience, it is nonetheless useful worldwide.
Hydro	**Hydro Resource Evaluation Tool**	www.lancs.ac.uk/fas/engineering/lureg/nwhrm/index.php	Lancaster University	The Hydro Resource Evaluation Tool is an extremely useful tool for identifying what information you need and then calculating the economic, energy, environmental and technical potential of a micro-hydro system. Designed for a UK audience, most of the information is nonetheless applicable worldwide.
Alternative Fuels	**Biomass Energy Centre**	http://www.biomassenergycentre.org.uk/portal/page?_pageid=73,1&_dad=portal&_schema=PORTAL	UK Forestry Commission	This website provides an overview of the different bioenergy technologies and fuels. It identifies issues that must be considered in each stage of the development process and of the fuel chain. Designed for a UK audience, the regulations and some of the agricultural practices may not be applicable in many countries; however it still provides a wealth of useful technical information.
Alternative Fuels	**Implementing Sustainable Bioenergy Production: A Compilation of Tools and Approaches**	http://data.iucn.org/dbtw-wpd/edocs/2008-057.pdf	International Union for Conservation of Nature	This report identifies a series of tools and approaches for assessing the potential of a bioenergy project from environmental, economic, and social perspectives. Particularly, it helps to identify all the issues that must be considered when pursing bioenergy. It is tailored to developing country contexts, but is useful worldwide.
PV, Wind, Hydro, Hydrogen	**HOMER**	www.homerenergy.com/	HOMER Energy	HOMER is a micropower optimisation model. It enables you to model different on- and off-grid micro-power systems based on different technologies (PV, wind, hydropower, hydrogen fuel cells) of different sizes, to identify the most technically efficient and cost effective solution to meet your energy needs. HOMER is a powerful and useful tool, with comprehensive instructions, however it requires quite a lot of local technical information to use.

CHP, PV, Wind, Energy storage	**Distributed Energy Resources Guide**	www.energy.ca.gov/distgen/index.html	The California Energy Commission	This website provides a series of resources on different distributed energy resources including CHP technologies, PV, wind and energy storage. This site is particularly useful for technology assessment and economic analysis. It is designed for a Californian audience, thus the permitting and regulatory information is California and US specific.
Wind, Solar Hot Water, Solar PV	**NASA Surface Meteorology and Solar Energy Tables**		NASA	Provides data for a wide range of solar and wind parameters. This data is available for the whole Earth, however is averaged over large areas. As such the data is useful for a preliminary analysis of which technologies might be appropriate, but not for a detailed site assessment.

10 APPENDIX C: OPTIONS FOR CREATING FUNDING OPPORTUNITIES

This section gives detail on the seven possible funding opportunities for local facilitating bodies identified for use throughout APEC. Not all will be immediately applicable or feasible in Peru but this provides and indication of the types of funding opportunities made available in other APEC economies (see also section 7.4)

10.1 Pre-existing Government Funding

While government funding is most applicable in developed countries as those governments have larger funding pools at their disposal to allocate to clean energy and a greater global responsibility for climate change mitigation more generally, every country may have government initiatives in place or under development, and the policy environment in this area is changing rapidly. To find out more about government funds available, see the contact options listed in the box entitled 'Pre-Existing Funding Options for Accommodation Providers', but with a view to funding broader implementation programs rather than individual clean energy installations.

If government or other funding options similar to those below relevant to clean energy are already available, the simplest and most useful function that a facilitator may be able to perform is simply disseminating the information on existing funding options to relevant industry and community participants. Ecuador provides an example of when information on financing options is called for by industry. An advocacy group comprised of academics and tourism industry operators recommended to government that the provision of information on financing would be invaluable to the development of ecotourism, particularly for small enterprises and communities. For more detail of the recommendations the group provided see:
http://www.ecoclub.com/gifee.html.

10.2 Promoting Green Finance Products

Financial institutions have the ability to positively influence the uptake of clean energy through allowing favourable finance conditions specifically for the purchase and installation of environmentally friendly technologies. Incentives might include lower fees or interest rates, increased borrowing limits or repayment pauses.

As a local facilitation agency, opportunities exist to engage financial institutions in offering such products either exclusively to clean energy project participants, or to accommodation businesses that are already looking to make new investments or upgrades, to encourage them to add or substitute with clean energy features. For the financial institution, incentives to become involved may include advertising prominence at clean energy installation sites, inclusion in broader public or sectoral promotions of the scheme, and good public image through environmental consciousness.

10.3 Bulk Buying Schemes

If facilitating a large-scale project that utilises a significant number of units of the same clean energy technology, it is possible to act as a broker for the participating businesses (individual accommodation owners) to use the bulk purchasing power of the group. Examples of such an approach can be found in Australia, where 50% and 55% discounts on the market prices of household solar PV systems were reported through bulk purchasing schemes[46]. Key reported successes have been the establishment of direct partnerships with solar PV wholesalers prepared to offer substantial discounts for volumes purchases in the order of 100 systems.

'50% and 55% discounts on the market prices of household solar PV systems were reported through bulk purchasing schemes'.

In the case of solar hot water, the Bendigo Sustainability Group initiated a bulk-buying scheme, which achieved a 20% saving on installed systems through a bulk buy of 50 unit batches.[47]

10.4 Leasing/Third Party Ownership

Another option available to address the issue of high capital cost for clean energy supply options is to facilitate the leasing of renewable energy systems at accommodation sites by a third party. This approach, as demonstrated in a residential precinct through the Mosier Creek development in Oregon, USA, involved the creation of a separate company that owns, operates and maintains the generation infrastructure and sells to the site owner under a Power Purchase Agreement (PPA).[48] In the case of Mosier Creek these were solar PV systems, however for cogeneration or trigeneration systems this is a common operating arrangement for large commercial buildings and could feasibly be utilised for a range of other clean energy technologies.

While this removes the barrier of upfront capital costs to businesses, thereby providing greater access to generating systems, the customer does not necessarily reap the benefit of reduced operating costs (lower electricity bills). The cost-effectiveness of this approach for accommodation providers depends on the local context in terms of competing regular electricity prices and the uses of waste heat in the case of cogeneration/trigeneration. In off-grid rural areas looking to promote the provision of new accommodation services, this model could be used to provide electricity supply such as solar PV as the competing costs of electricity supply (such as diesel generation) may be significant and logistically difficult. More detail on the considerations in rural areas if provided in section 3.

10.5 Carbon Trading Markets

10.5.1 What are they?

In the process of the global community responding to the challenge of climate change through reducing emissions of carbon dioxide, many developed countries have taken on fixed carbon emission reduction commitments or 'caps'. The primary legal instrument through which these emissions reduction targets are set is the *1997 Kyoto Protocol*, which operates under the *1992 United Nations Framework Convention on Climate Change* (UNFCCC). In designing the instruments through which countries can legitimately achieve their targets, 'flexible mechanisms' were created to allow countries to trade carbon emission reduction credits. This means that countries are able to fund carbon emissions reduction efforts in other countries, where it may be cheaper for them to do so instead of implementing those emission reductions in their own countries. The primary mechanisms created for this purpose are 'Joint Implementation (JI)', which allows developed country parties to invest in emissions reductions within other developed countries that are party to the Kyoto Protocol, and the 'Clean Development Mechanism (CDM)', which allows developed country parties to invest in emissions reductions within developing countries that are party to

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[46] Rutovitz, J. (2009) *Low Energy Housing: Legal And Administrative Opportunities And Constraints.* Report to Investa; see also Robinson, J. (2008), *Sydney Energy Cooperative Profile*, http://www.communitybuilders.nsw.gov.au/download/sydneyenergycoopcasestudy.doc

[47] Refer to http://www.bendigosustainability.org.au/index.php?option=com_content&task=view&id=24&Itemid=44

[48] Daly, J. & Rutovitz, J. (2009). Review of Best Practice in Australian and International Housing Development. Report to Investa, Institute for Sustainable Futures.

the Kyoto Protocol.[49] Additionally, many developed countries are now planning or implementing carbon emissions trading schemes that operate within their own borders, and may link with the international UNFCCC carbon trading mechanisms. Furthermore, there are also 'voluntary carbon markets' which exist outside formal national commitment schemes, which are funded by organisations and individuals that wish to *voluntarily* reduce their carbon emissions for ethical or business reasons, by purchasing 'offsets' that fund projects in other sectors or countries.

10.5.2 What does this mean for clean energy providers?

Carbon trading creates a market that places a monetary value on carbon emission reductions (commonly referred to as a 'carbon price'). Even in developed countries that have adopted emissions caps under the Kyoto Protocol, the tourism accommodation sector will generally not be given a direct responsibility to reduce carbon emissions associated with its activities (such as emissions from its energy usage).[50] However, while there is unlikely to be an *obligation* on sectors such as tourism accommodation to reduce carbon emissions, carbon trading allows the *opportunity* for accommodation providers to receive 'carbon credits'[51] to assist in funding their clean energy activities.[52]

Implementing clean energy technologies and practices within *individual* accommodation facilities will generally be at too small a scale to warrant harnessing funding through carbon trading markets. This is because there are significant administration fees associated with having emissions credits verified as being genuine and 'additional' to what would have occurred under regular business as usual practices. Historically, under the Clean Development Mechanism (CDM) for example, very few small projects have gained funding through the scheme. However, a facilitating body such as a local government or tourism association can implement a specific clean energy program across a large number of accommodation providers and thereby achieve the necessary economy of scale to enable access to carbon credits to subsidise the initiative. While even at this aggregated scale obtaining credits through the CDM has been difficult, however there have been efforts in recent years directed towards allowing 'bundling' of many initiatives into a single larger project, to reduce administrative overheads and allow access to such funding for activities such as a broad rollout of clean energy in the tourism sector. See the 'Fiji—Carbon Market Funding for Clean Energy in Hotels' case study (under section 7.4) for an example of how carbon credits can be harnessed by the accommodation sector.

10.5.3 Who do I contact about accessing carbon market funding?

In the case of CDM, most developing countries that are party to the Kyoto Protocol have a government agency that has been granted the authority to assess CDM applications. This is commonly either the national environment or energy office and is known as the 'Designated National Authority' or DNA. The DNA is the first body to contact in relation CDM enquiries—a list of registered DNAs is available at: http://cdm.unfccc.int/DNA/index.html

For information about other carbon trading funding opportunities such as JI, national or voluntary schemes, contact your national government energy or environment office. Particularly in developed countries, some of the most knowledgeable entities may be private businesses that provide project development and/or credit certification services that can assist in developing your project concept. More information on CDM can be found at: www.mdgcarbonfacility.org/

[49] Parties to the Kyoto Protocol that carry emissions reduction commitments can also trade emissions allowances directly if they have an over- or under-supply.
[50] This responsibility is generally applied to very large carbon emitters, and would be applied to energy generators and suppliers 'upstream' of where the consumer uses that energy.
[51] The market value associated with the emissions reductions that can be verified as resulting from its voluntary implementation of clean energy initiatives.
[52] This is because the implementation of clean energy technologies and behaviours generally results in lower carbon emissions from reduced energy usage or switching to low or no emissions energy supply.

10.5.4 How much funding is available through carbon markets?

It should also be noted that the amount of funding available through carbon credits depends on your local energy supply situation. For example, in Peru, 82% of the national grid electricity supply comes from emission-free hydroelectricity, and the remaining 20% from higher-emission imported diesel fuel, then the amount of carbon funding available to your project from reducing electricity consumption would be 80% lower than if Peru's national electricity grid was entirely supplied by diesel fuel. Australia, at the opposite end of the spectrum derives the majority of its electricity supply from emission intensive coal-fired generators, and thus the number of carbon credits resulting from clean energy projects would be far higher. Remember that projects attract funding for how many *emissions* are reduced, not how much *energy* is saved.

10.6 Grant/Donor Funding Options for Developing Countries

In developing countries there may be several additional funding avenues available to facilitating bodies to increase uptake of clean energy. While grant or donor funding generally does not have to be repaid (although development bank funding generally has a repayable component), challenges to receiving this type of funding can include having to design and justify the project concept to meet the requirements of the donor agency and significant reporting obligations. Note that projects utilising donor funding are generally *not* eligible for CDM funding. Examples of funding bodies include:

Global and Regional Development Banks:

- Asian Development Bank: www.adb.org
- Inter-American Development Bank (IADB):[53] www.iadb.org (See below for case study example).
- The World Bank: www.worldbank.org

United Nations Agencies and Funding Bodies:

- United Nations Development Program: www.undp.org
- United Nations Environment Program: www.unep.org
- United Nations Industrial Development Organization: www.unido.org
- World Tourism Organisation: www.unwto.org
- Global Environment Facility: www.thegef.org
- Wisions of Sustainability (SEPS Funding Rounds): http://www.wisions.net/pages/SEPS.htm
- Renewable Energy and Energy Efficiency Partnership: www.reeep.org/

Developing countries also commonly have access to foreign assistance funding programs offered by certain developed countries, which will consider programmatic support for renewable energy, energy efficiency and other climate change mitigation and adaptation projects. Some aid agency examples include:

- United States Agency for International Development: www.usaid.gov
- EuropeAid: http://ec.europa.eu/europeaid/where/index_en.htm
- Australian Agency for International Development: www.ausaid.gov.au

10.7 Microfinance for Developing Countries

Microfinance refers to the provision of very small loans directly to poor households or individuals who would not generally have access to traditional financial lending services, for the purpose of enabling them to start new or develop their existing income generation activities. In relation to the tourism accommodation sector, this type of financing would primarily apply to rural, off-grid householders wishing to develop home stay accommodation or small accommodation facilities. In such cases microfinance

[53] Note that the IADB has recently announced increased financing for renewable energy and climate-related projects in Latin America and the Caribbean to $3 billion a year by 2012. See http://www.iadb.org/news-releases/2010-04/english/idb-to-expand-lending-for-renewable-energy-and-climaterelated-projects-in-latin-6982.html

could allow access to small solar lighting or cooking facilities, and could progress to more substantial 24-hour renewable electricity supply enabling refrigeration services, opening tourism business options further. See the ‘China—GreenVillage Credit’ case study (under section 7.4) for an example of microfinance application to clean energy and tourism opportunities.

Microfinance operators are increasing in number and geographical coverage and while they may not be active in all countries, this situation is likely to change rapidly.

Asia-Pacific Economic Cooperation

APEC Members

Australia
Brunei Darussalam
Canada
Chile
People's Republic of China
Hong Kong China
Indonesia
Japan
Republic of Korea
Malaysia
Mexico
New Zealand
Papua New Guinea
Peru
Philippines
Russia
Singapore
Chinese Taipei
Thailand
United States of America
Viet Nam

AICST APEC INTERNATIONAL CENTRE FOR SUSTAINABLE TOURISM
COOPERATIVE TOURISM RESEARCH CENTRE FOR THE ASIA PACIFIC REGION

AICST was established by the Tourism Minister of the 21 APEC Economies and the APEC Tourism Working Group to provide information and assistance to APEC Economies and tourism destinations to improve tourism sustainability throughout the region.

AICST aims to:

- Contribute to improved planning and management of tourism
- Assist better policy development by governments
- Increase capabilities and capacities
- Foster improved tourism education and training

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