

Malta Green Hotels Guide

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Introduction to Green Hotels

What is a Green Hotel?

A green hotel is one that is environmentally friendly. It does not harm local, regional, or global ecosystems. Instead, it works continuously to improve its environmental relations, reducing its “ecological footprint” and giving back to the environment in beneficial ways. When located in degraded areas, the green hotel often seeks to improve the health and vitality of those areas upon which the health of both economy and environment depend.

The Importance of Green Hotels

Though few hotels can claim to be truly green, many of the world’s hotels are making efforts to become greener, or more environmentally friendly. Although hotels can take advantage of greening the most when designing a new facility, there are many actions they can undertake to green existing facilities.

Creating greener hotels is important for several reasons. First, it demonstrates the hotel’s commitment to environmental responsibility. This helps to establish trust as guests recognize that the hotel is concerned with more than merely making profits. Second, it helps to protect or enhance the natural beauty that draws guests to many hotels. Third, certain greening activities, such as reducing energy and water waste, can reduce the hotel’s expenses. Fourth, greening hotels is important for environmental health. Particularly on Malta, where large numbers of tourists tax a small nation’s resources, any greening activities can have a positive impact.

What the *Malta Green Hotels Guide* Contains

This guide contains several sections that explore green hotels. The next, or second, section, “Malta’s Eco-Certification Program,” discusses the country’s new scheme to certify hotels as green. This section is organized according to the program’s 10 areas of focus for greening.

The third section, “Room by Room Greening,” offers lists of different activities that hotels can implement in order green their restaurants and kitchens, guest rooms, laundry rooms, lobbies, and hotel offices.

The fourth section, “Additional Information,” explains two technologies in detail. These are the development of a grey water system and the implementation of living roofs. These technologies are both growing in popularity as their environmental and economic benefits are increasingly realized.

***Malta's Eco-
Certification
Program***

Introduction

Recognizing the importance of hotel greening, Malta's Tourism Authority has developed an eco-certification program for tourism accommodation establishments. Based on a variety of criteria, this accreditation program recognizes hotels for their excellence in certain areas.

In total, there are 130 criteria that fall within the following 10 assessment areas:

- Environmental management systems
- Waste management
- Products and materials
- Energy use
- Water use
- Air quality
- Noise protection
- Buildings and green areas
- Local culture
- Guest information

In order to receive eco-certification, a hotel must successfully undertake 65% of the 130 criteria. Forty-four of these criteria are required for certification. The rest is achieved from the remaining pool of 86 elective criteria from which hotels can choose.

Malta's Eco-Certification program, begun in 2002, aims to help hotels reduce their waste by up to 50% while lowering energy costs by 15-35% and water use by 15-45%. Those who wish to apply for eco-certification can do so twice annually – in both May and October.

The process of Eco-Certification is fairly straightforward. First, a coordinator is identified for the hotel's greening project. Next, the hotel assesses itself to ensure that it meets the criteria for certification. If it qualifies, it applies for certification. Then, an independent audit is conducted followed by the creation of a plan for greening the hotel. Eco-certification, which lasts for one year, is awarded, and the hotel continues to improve its environmental relations. In order to retain certification, the hotel must continuously work toward becoming greener, annually undergoing independent audits and reapplying for certification.

For more information, contact the Malta Tourism Authority's Product Planning & Development Directorate as shown below:

Telephone: 22915801

Fax: 22915899

Internet: www.maltatourismauthority.com

Email: eco-certification@maltatourismauthority.com

Environmental Management Systems

The Issue

It seems as though nearly everything that a hotel does can harm the environment. However, environmental problems are so broad that it can be difficult to know which are more important than others, how to prioritize them, or how to incorporate them into the hotel's daily operations.

What You Can Do

An environmental management system (EMS) is a formalized, systematic approach to incorporating both environmental and social issues into every facet of the hotel's activities. By using an EMS, the hotel has an established way to identify problem areas, set goals and develop strategies for improvement, implement those strategies, and monitor progress. An EMS can help the hotel to set environmental benchmarks and quantitatively measure its progress. The success of any EMS depends on the ongoing commitment and collaboration of every staff member, including those in senior management.

Commitment

- Ensure that all hotel management and staff are committed to the concept and long-term practice of greening.
- Establish a formal sustainability policy and goals.

Organization

- Create a green task force for the hotel. Be sure to include representatives from each department that can both inform the task force and take information back to their departments.
- Review all aspects of the hotel, including its waste, purchasing, energy, water, air quality, noise, buildings and green areas, local culture, and guest information.
- Identify areas for improvement in each of these areas.
- Establish priority areas in which waste is the greatest.
- Work with employees from relevant departments to establish particular goals, timelines, and strategies for improvement.
- Ensure that at least one person takes responsibility for each area of improvement.
- Be sure that all staff members understand their particular roles in greening and that they understand how to achieve established greening goals.
- Train management and staff through workshops and other means on the connections between their jobs and environmental health.
- Offer staff feedback through performance reviews and other methods.
- Be sure to encourage staff and managers, who might be intimidated by their new responsibilities.
- Let guests know what they can do to help the hotel's commitment to becoming a green hotel.
- Encourage guests to protect local ecosystems.

- Monitor progress toward goals and identify areas for improvement. Devise strategies accordingly.
- Give feedback to staff, guests, and others to let them know what improvements the hotel has made along its greening journey.

Waste Management

The Issue

Waste production is an ever-growing problem that affects all aspects of Maltese society. It threatens the health and quality of life of Malta's residents, visitors, and native plant and animal communities on the land and in the Sea. It is also an eyesore. In 1995, Malta produced an estimated 1,496,000 tonnes of solid waste, all of which went to the Maghtab Landfill. Sixty-five percent of this waste consisted of construction materials. The rest included a wide variety of things, from batteries and oil drums to paint cans and paper. Many of the items that end up in landfills can leach harmful chemicals into the air, water, and soil, contaminating farmland, coastal areas, and the air that we breathe.

What You Can Do

Hotels can significantly lower their contribution to the country's waste problem by using three principles – reduce, reuse, and recycle. Reducing refers to waste prevention. By preventing waste in the first place – be it from working with suppliers to decrease product packaging or other measures – the overall amount of waste can be reduced. Reusing suggests that products can be reused or repaired in order to extend their useful lives. Recycling refers to the conversion of one product into another, such as organic food scraps that are recycled naturally into compost. Similarly, products that do not decompose, such as glass or aluminum, can be recycled when used as “raw” materials in the manufacture of new products.

Assess

- Conduct a waste audit, assessing waste by type and quantity.
- Determine how much the hotel is paying for its waste disposal.
- Identify ways in which to reduce each type of waste.

Reduce

- Help to prevent waste by purchasing products with less packaging.
- Buy products that are biodegradable and can be composted.
- Alternately, purchase items that are recyclable and can be incorporated into current, effective recycling programs.

Reuse

- Purchase products that can be reused, particularly disposables, helping to eliminate both packaging and product waste. Such products include rechargeable batteries, using soap and shampoo dispensers rather than individually wrapped soaps and other toiletries, and laundry bags made of cloth.
- Buy used products, such as furnishings, when possible.
- Whenever possible, encourage vendors to take wooden crates and pallets.

Recycle

- Keep different types of waste separate in order to make recycling easier.

- Be sure to take advantage of organic kitchen waste by composting it. It can help to rebuild and replenish local soils.
- Compost leaves and other types of organic waste from hotel grounds.
- Recycle other items, such as paper, glass, and aluminum, whenever possible.
- Locate recycling bins near trash cans and along nature trails in order to facilitate recycling by guests.
- Encourage the development of an effective recycling system as well as markets to support it.

Wastewater

- Lower water use in order to reduce the amount of wastewater that is generated.
- Keep waste oil and grease out of the water by collecting them and disposing of them separately. Edible Oil collects the waste oil from Malta's restaurants and turns it into clean biodiesel for vehicles.
- Use non-toxic, biodegradable detergents that are safe for local flora and fauna.
- Develop the capacity to treat wastewater on site by using any of a variety of grey water treatment systems. These systems use plants and bacteria, not chemicals, to clean the water.
- Reuse grey water to water gardens, flush toilets, irrigate golf courses, and wash floors.
- Encourage local treatment facilities to discharge only environmentally safe water into the environment.

Products and materials

The Issue

Malta's hotels purchase a vast supply of products and materials every year. These include furniture, cleaning products, toilet paper, bottled water, food, electricity, batteries, paints, carpets, napkins, utensils, bedding, toiletry products, and so on. Though many hotels might not realize it, these products and materials can harm people and the environment throughout their life cycles – from the extraction of raw materials to their manufacture, use, and disposal. This means that even the simplest decisions about what to buy can have far-reaching consequences.

What You Can Do

Hotels can purchase products that are environmentally preferable, meaning that they have one or more green features. For example, a particular cleaning product might be non-toxic or less-toxic than the competitors' products. Similarly, one vendor's toilet paper might be made of recycled fibers that were not bleached with chlorine, which can cause a host of environmental problems. Social justice issues, such as fair pay and child labor laws, also fall into this category as hotels want to ensure that their purchases do not support unfair labor practices, such as sweatshops. Thus, buying products and materials that are ecologically and socially benign throughout their life stages and replacing harmful materials with safe ones are important aspects of this category.

Awareness

- Ensure that all employees understand how to work with and dispose of chemicals in a way that does not harm them or the environment.
- Share information with guests regarding opportunities for them to buy more eco-friendly products and services during their stays.
- Let guests know what to avoid, such as local products or services made from endangered species.

Equipment

- Monitor equipment, such as heat pumps, air conditioners, refrigerators, and freezers, to ensure that all gaskets and hoses are in proper working order. This will help to prevent the leakage of CFCs, HFCs, and other substances that deplete Earth's ozone layer.
- Be sure that new equipment does not use chemicals that deplete the ozone layer.

Purchasing

- Buy non-toxic, biodegradable products, such as solvents, cleaning products, toiletries, laundry detergent, and herbicides and pesticides.
- Look for products that are environmentally certified, which indicates that they have met certain criterion of environmental preferability.
- Buy locally whenever possible to reduce the resources required for international transport.
- Purchase products in bulk.

- Buy items with reduced packaging. This helps to reduce packaging waste and the energy required for transport.
- Be sure to buy paper products that are made from recycled fibers that have not been bleached with chlorine.
- Purchase products made by workers who are paid fairly and have decent working conditions.
- Buy items that are made of recycled materials.
- Buy products that can be recycled or composted safely (e.g., without leaching heavy metals).

Vendors

- Ensure that suppliers understand the hotel's commitment to greening and that they can supply greener products and services.
- Ask suppliers if they have environmental policies and purchase their products or materials using both environmental and fair trade criteria.
- Be sure that vendors who work on the hotel's property use environmentally friendly materials and practices.

Toxins

- Work to eliminate all toxic chemicals and items from hotel property.
- If you must use hazardous substances, be sure to comply with local environmental regulations.
- Use only the amount of chemicals needed to treat swimming pools.

Energy use

The Issue

Energy is an important topic because hotels use so much of it. This use occurs every time a guest turns on a light or the air conditioning, a housekeeping employee runs the vacuum, or a chef turns on a piece of equipment. Energy typically is created by burning fossil fuels such as coal, oil, and natural gas. It is in the burning of these materials that environmental harm occurs. Burning fossil fuels releases into the air certain substances, such as carbon dioxide, nitrous oxide, and particulates, which are tiny particles created by the combustion of these fuels. Airborne particulates are a primary cause of respiratory problems, such as asthma. Carbon dioxide and nitrous oxide are known as “greenhouse gases” because they travel into the atmosphere where they contribute to global warming. In 1998, alone, Malta emitted 1,803,000 metric tons of carbon dioxide into the atmosphere, averaging 4,700 metric tons per person. The key sources of these emissions are energy used to power lighting, air conditioning, heating, and equipment in buildings, such as hotels; vehicle travel; and the reverse osmosis plant.

What You Can Do

Hotels can improve the environmental and health impacts of their energy use in two ways – by reducing their use and by shifting their energy dependence from fossil fuel sources to renewable energy sources. Renewable energy is clean and relies on “free” resources that are abundant on Malta, such as the sun and wind.

Awareness

- Work with hotel staff to ensure that everyone understands how they can lower their energy use.

Conservation

- Encourage staff to turn the heat or air conditioning on or off to match comfort needs in public areas rather than leaving them running at all times.
- Have housekeeping lower the air conditioning and heating settings in guests’ rooms.
- Ensure that dryers and dishwashers operate with full loads.
- Raise the energy awareness of guests so that they, too, understand their role in reducing energy use.
- Encourage guests to turn off their air conditioners and open their windows for ventilation.
- Suggest that guests turn off their room lights, televisions, and other electronic equipment when they are not being used.
- Let guests know that they can save energy and increase their summertime comfort by closing their window shades before leaving their rooms during the daytime.
- Give guests the opportunity to request new towels and linens rather than changing them automatically on a daily basis.

- Install timers or sensors to turn off lights and equipment when they are not being used.
- During periods of low occupancy, reduce the number of elevators or escalators in use.

Maintenance

- Be sure that equipment is serviced regularly and that seals and gaskets are replaced as needed.

Monitoring

- Do an energy audit, determining how much energy the hotel uses, where the most energy is spent, and the areas that can benefit the most from improved efficiency.
- Track energy use regularly as a way to ensure that all equipment is working properly and to see actual energy savings and following increases in efficiency from better equipment and behavior modification.

Purchasing

- Replace older, inefficient equipment with equipment that is newer and more efficient.
- Buy towels, linens, and other products that can be maintained using less energy. For example, colored towels and linens can be washed at cooler temperatures, saving energy.
- Use renewable energy sources, such as solar and wind power, when available.

Swimming Pool

- Turn off the swimming pool pump in the evenings.

Water Use

The Issue

Water use is a particularly important issue for Malta. Though the nation's freshwater supply is limited, its demand is enormous (*statistics?*). The Mediterranean is one of the world's largest tourism destinations and one of the most strained to meet the demands of its guests. Hotel guests typically use far more water than local residents, and this places considerable strain on the country's water infrastructure – and on its natural hydrology. This causes greater demand for desalinization, which uses the majority of the country's energy from non-renewable sources. Unfortunately, little of the water that is used is reclaimed and recycled, and much of the rainwater that falls on the island is allowed to run off the landscape and into Sea. However, the overuse of water and failure to reclaim and recycle is not the only water-related problem. The pollution of water supplies by toxic chemicals used in detergents, cleaning supplies, and other sources also threatens the country's drinking water.

What You Can Do

Hotels can significantly help to protect Malta's water supply in two ways – by ensuring its conservation and cleanliness. Simply by conserving water, hotels will create several environmental benefits. They will reduce the need to further drain the country's aquifers. They also will decrease their reliance on water produced using the energy-intensive reverse osmosis process. This, in turn, will lower the need for energy used to power desalinization. As a result, the country's air pollution will drop, which is likely to decrease the incidences of associated respiratory problems. Additionally, by ensuring that they do not pollute water with toxins, hotels will help to enhance the country's ecological and human health.

Awareness

- Let guests know that they can save water by simply turning off the water while shaving or brushing their teeth.
- Raise staff awareness about conserving water.
- Encourage housekeeping to launder only full loads of towels, linens, and other items when possible.
- Promote washing only full loads of dishes to kitchen staff.

Conservation

- Recycle water whenever possible by using grey water and other systems.
- Use low-flow showerheads and low-flush toilets.
- Landscape only with native plants that are well adapted to the local climate.
- Give guests the opportunity to notify housekeeping when they want their linens and towels washed.
- Install drip irrigation rather than using sprinklers to reduce evaporation.
- Water gardens only when necessary and at night when evaporation is reduced.

Maintenance

- Maintain all equipment to prevent leaks and ensure efficient water use.
- Be sure to repair leaks as soon as they are detected.

Monitoring

- Monitor water use in the kitchen, guest rooms, and other areas around the hotel.
- Conduct a water audit, identifying the areas around the hotel that use the most water. If possible, determine how much water is being used.
- Work to reduce water consumption and waste in those areas.
- Ask the housekeeping to watch for leaks in guest rooms, laundry rooms, and other areas.
- Encourage kitchen and restaurant staff to notice leaks in the kitchen.
- Work with all hotel staff to identify leaks in lobby restrooms and other areas of the hotel.

Air Quality

The Issue

Air quality refers to the purity of the air both outdoors and indoors. Many of the ordinary activities that occur in and around hotels contribute to poor outdoor air quality. These include the use of non-renewable energy to power lighting, equipment, and vehicles, which places demand on the power plant to keep producing energy, resulting in pollution. They also include erosion and dust related to construction and poor land use practices as well as airborne toxins and odors related to industry and landfills. Landscaping practices – such as the use of gas-powered mowers, leaf blowers, and harmful pesticides and herbicides – are another source of air pollution.

Indoor air quality can be affected not only by activities that occur outside – such as fumes from vehicle traffic and dust from nearby construction – but also by irritants and toxins that are emitted indoors. Dust, pollen, and other particulates can cause respiratory problems, such as allergies and asthma. Toxins are found in ordinary products that many people assume to be safe, such as toilet bowl cleaners, air fresheners, laundry detergents, paints, glues, solvents, wallcoverings, carpets, upholstered furniture, and certain building materials. Everyday office supplies, such as correction fluid and permanent makers, often contain toxic chemicals as well. Additionally, toxic molds can grow in hotel duct work or in moist areas.

What You Can Do

Hotels can help to ensure good outdoor air quality by lowering their energy and water use. They also can reduce or eliminate the toxins that they bring indoors or onto the surrounding landscape by choosing environmentally preferable products in all that they do.

Emissions

- Encourage guests and staff to walk, bicycle, and use public transportation in order to prevent or reduce pollution.
- Eliminate emissions from hotel equipment, such as boilers.
- Eliminate the use of toxic chemicals in all landscaping.
- Similarly, switch to non-toxic cleaning products that will not degrade indoor air quality.
- Ensure that all interior furnishings – building materials, floorings, paints, wallcoverings, upholsteries, bedding, and towels – neither contain nor are treated with harmful chemicals that can offgas and create poor indoor air quality.

Smoking

- Create non-smoking rooms for guests who do not smoke.
- Ensure that the smoke from smoking rooms is kept out of non-smoking areas.

- Establish smoking areas that are well-ventilated and away from the other guests.
- Offer non-smoking sections in hotel restaurants or ban smoking from restaurants entirely.

Noise protection

The Issue

Noise can be a problem for hotels. Like air quality, the quality of the “sound environment” depends on both outdoor and indoor factors. For example, noise can be emitted by outdoor sources, such as traffic or nearby construction. It also can come from indoor sources, such as loud music or sounds in the corridors or other rooms.

Regardless of the source, noise can detract from guests’ overall experiences, preventing them from returning in the future. Additionally, loud or chronic noise can stress employees and cause permanent hearing loss. It also can stress wildlife, affecting their health, reproduction, and long-term prospects of survival.

What You Can Do

Hotels can work to eliminate or reduce both outdoor and indoor noise. If the noise comes from non-hotel sources, they can work with individuals and other businesses to try to come to some agreement on acceptable times during which noise will occur as well as agreeable decibel levels. Though eliminating outdoor noise completely might be difficult in heavily populated areas or near hunting sites, hotels might be able to make significant improvements, enhancing the experiences of guests, employees, and wildlife. Similarly, indoor noise can be controlled by reducing volume, limiting it to certain hours, and ensuring that loud areas are sound-proofed adequately.

Design

- Ensure that the hotel is designed to buffer interior spaces from outdoor noise.
- Protect the outdoors from interior noise.
- Ensure that the generator room is well-insulated to keep noise inside.
- Use carpet or other means to reduce the noise in hotel corridors.

Music

- Limit loud outdoor music to certain hours and days.
- Limit music to a certain decibel level, as noise can stress wildlife and degrade some guests’ enjoyment of their visit.

Protection

- Provide staff, such as those working around generators and large air conditioning units, with protective equipment when they are exposed to loud noise.

Training

- Educate staff about the harmful effects of too much or too frequent noise.

Buildings and Green Areas

The Issue

Buildings and hotel green areas can have significant impacts on the ecosystems in which they are embedded. These impacts can occur during construction, renovation, building use, maintenance, and deconstruction or demolition. These impacts can include soil compaction and erosion, loss of native plants and animals, and the interference or destruction of local hydrological cycles. Additionally, toxic chemicals that are used in buildings and on landscaped grounds can enter the air and water, harming employees, guests, and terrestrial and marine wildlife.

What You Can Do

There are a number of things that hotels can do to reduce their environmental harm throughout their lives. When they wish to build a new hotel, they can reuse existing building shells and building materials to reduce the amount of materials that they send to the landfill. They also can ensure that all products used in hotel construction, furnishings, maintenance, and landscaping are non-toxic. Plants that are both native to Malta and native to the particular site should be used extensively in hotel green areas. Walking trails should be specified to ensure that native plant and animal communities are not trampled. Any landscape or hotel development should be site-sensitive and work to renew the health of local plant and animal communities, rebuild soils, and restore degenerated hydrological cycles.

Facilities

- Avoid building unless there is no other choice – the greenest hotels are none at all. Instead, consider renovating an existing building.
- If new construction is necessary, consider using a brownfield or already degraded site.
- Use pervious paving to allow water to soak into the ground, feeding the soils underneath and recharging the groundwater.
- Design and build facilities to work with the local landscape, taking advantage of natural windbreaks and solar orientation.
- Use non-toxic, natural materials in constructing and renovating facilities.
- Consider environmental impacts throughout the life cycles of both facilities and sites.
- Ensure that all building products are non-toxic.
- Design and build facilities so that they can be deconstructed more easily when their useful lives are over.

Landscaping

- Support the ecological systems in which the company's facilities are embedded.
- Minimize environmentally harmful development and maximize any landscaping that will help to renew ecological health.

- Plant native plants and provide healthy habitat for native species of insects, animals, and other organisms. Native plants typically require less water, fertilizers, herbicides, and pesticides.
- Support the natural flows of water and remove unnecessary blockages that have been added.
- Ensure that no toxic pesticides or plant-related products are used inside or outside.
- When necessary, use drip irrigation to reduce water loss associated with sprinklers and other watering methods.
- Use automatic irrigation to avoid watering more than needed.
- Fertilize the hotel grounds with composted kitchen and other organic waste rather than chemical fertilizers.
- Use compost and other organic, non-toxic, hotel-based waste to fertilize plants.
- Consider using live, native species of fish and lizard to help control the local insect pest populations.
- Use local trees for natural shading to keep the area cool.
- Plant an organic garden to grow local fruits and vegetables to be used in the kitchen or for guests' pleasure.
- Use the garden on the ground as part of a living roof (see the section Living Roofs later in this guide).
- Collect rainwater in a cistern to be used for watering the plants.
- Develop a grey water system to clean water from sinks and showers, and use this purified water on the plants (see the section on grey water systems later in this guide).

Parking Lots

- Consider using porous paving blocks in parking lots and on roads instead of conventional pavement. Porous pavement allows water to flow through to increase the groundwater supply, which reduces run-off water.
- Keep parking lots cooler by planting native trees and vegetation.

Swimming Pool

- Treat swimming pools with salt water rather than chlorine. This reduces the amount of chemicals used in the system. A
- Use lounge chairs and other pool furniture that contains recycled plastics and other materials.
- If possible, purchase these products locally to reduce the energy and other resources associated with transport.
- Use pebbles and small rocks on pathways around the hotel instead of concrete to make the area more natural.

Local Culture

The Issue

Travel and tourism can have profoundly negative effects on local culture if poorly managed. The intensive resource use often associated with this industry can harm local communities in several ways. For example, the overuse of water, energy, and other resources can cause pollution, which will be experienced by the resident population as the degradation of health and quality of life. If resources are used non-sustainably by Malta's visitors, fewer will be available for the country's residents both now and in the future. Additionally, travel and tourism within Malta can lead to "wear and tear" on the environment when visitors leave the roads and trails in vehicles or on foot. Aside from the environmental effects, travel and tourism can have profound social implications when guests are uneducated about or fail to respect local customs or if staff feels disempowered by guests or by hotel management.

What You Can Do

Fortunately, hotels can do a number of things to help protect their country's culture and well-being. They can focus on protecting natural resources by minimizing the amount of resources that guests use. They also can work to renew the country's ecological health in order to rebuild natural resources available now and in the future. Furthermore, hotels can work with staff to ensure that they feel supported and are given opportunities for advancement and growth. Finally, hotels can educate guests regarding their potential environmental and social impacts, letting them know what they can do to leave the country as healthy as or better than they found it.

Awareness

- Educate guests with regard to the unique aspects of Malta's cultures.
- Teach guests about local customs about which they should be aware.
- Work with local tourism and other schools to discuss the importance of greening and share methods of achieving it.

Human Rights

- Ensure that all of the hotel's activities support human rights at work, in the community, and around the world.
- Pay a fair living wage to all employees.
- Provide equal opportunities for work and promotions and equal pay to individuals regardless of gender, race, age, religion, and/or other qualities.
- Establish effective ways to inform staff members of their rights.
- Protect the health and safety of all employees in the workplace.
- Develop contracts that assure the rights of all employees.
- Establish a formal policy on human rights, including fair trade.
- Be sure that working hours, breaks, and pay are agreed to between the hotel and its individual staff members and that these are in compliance with local laws.

- Ensure that there are safe means for workers to air grievances without fearing retribution of any kind.
- Establish a fair child labor policy that is in line with the country's laws on child labor.
- Become a signatory of the ECPAT Code of Conduct for the Protection of Children from Commercial Sexual Exploitation in Travel and Tourism (www.thecode.org).
- Be sure that all suppliers comply with national human rights, health and safety, and occupational health standards.

Partnering

- Identify other hotels and businesses that are interested in developing informal or formal partnerships to regenerate the health of local ecosystems.

Purchasing

- Buy goods and services made by local artisans, farmers, and tradespeople.
- Support small green companies that are willing to work with you to achieve your greening goals.
- Hire local residents.
- Encourage all employees to use green practices at home as well.
- Consider internship programs by which employees are paid to work for a local environmental organization for a period of time.
- Encourage all employees to volunteer for local organizations.

Training

- Provide ongoing training to improve employee skills continuously so that staff feels challenged and fulfilled at work.
- Offer language classes to employees who do not speak the dominant language(s) spoken by the guests.

Guest Information

The Issue

Guests who are new to Malta and its cultures might have little knowledge of the country's local customs and environment. Without even intending to, they can behave in ways that might be distasteful in a social setting. Similarly, they can do environmental harm through such simple activities as straying from a walking path, driving a vehicle off road, leaving their room lights or air conditioners running when they leave for the day, breaking off a piece of "souvenir" coral on a diving trip, or littering. All of these activities can harm Malta's sometimes fragile environment, leaving it more vulnerable to degradation and less beautiful for future visitors.

What You Can Do

Hotels have the perfect opportunity to educate their guests about the country's customs and local ecology. They can tell guests about walking trails and the importance of staying on them. They also can explain why off-roading is harmful to both soils and local plant and animal communities. Furthermore, hotels can proudly let their guests know about their greening goals and progress and what they can do to ensure the hotel's greening success. They can explain that using less energy and water means a better Malta for residents and guests and that littering and harming plants or animals for souvenirs is unacceptable.

- Inform the guests about the hotel's commitment to greening.
- Provide guests with ideas on ways in which they can contribute to the hotel's greening success.
- Encourage guests to separate their waste and reduce their energy and water use.
- Let guests know about local products or services that help the environment.
- Tell guests about local products or services that harm the environment, such as those that harm endangered species, picking plants, collecting or hunting wildlife, cause erosion, reduce the country's biological diversity, compact soils, or otherwise do harm.
- Set up a guest suggestion box, and encourage guests to provide suggestions on how to become even greener.
- Be sure that guests are aware of local environmental laws that might affect them.

***Room by Room
Greening***

Introduction

This section discusses many ideas that hotels can apply to make their rooms greener. First, it explores some basic concepts that can be applied to any part of the hotel. Then, it lists several things that hotels can do to make their guest rooms, restaurants and kitchens, laundry and housekeeping, lobbies, and offices greener.

Greening Basics for Every Room

The main issues related to the restaurant and kitchen areas are the use of energy, water, waste, and toxic or environmentally harmful furnishings and other products.

What You Can Do

Air Quality

- Ensure that all rooms are properly ventilated. This helps to clear the air of dust, particulates, and other substances that can harm guests' health or cause them discomfort.
- Establish no-smoking rooms in order to protect the hotel air quality.

Energy Conservation

- Design rooms with daylighting whenever possible. This can include using sunlights to illuminate the rooms by having windows placed high on the walls and skylights. In order to keep the sunlight from heating the room but still light the room, shades can be used that will not completely block out the sun, but will block out the direct rays.
- Use compact fluorescent bulbs in all lighting fixtures instead of incandescent bulbs, which are much less efficient. Compact fluorescent bulbs last longer and reduce energy use significantly.
- Encourage guests to keep their doors closed at all times when their rooms are air conditioned. This will help to keep their rooms cooler and reduce energy waste.
- Meanwhile, ensure that rooms without air conditioning have windows that can open to promote the flow of cool air throughout the room.
- Use heavy curtains in air conditioned rooms to keep the sun from heating up the room. Similarly, this helps to keep the warm air in heated rooms.
- Ensure that energy-efficient air conditioning units are used. All guests might not require or desire air conditioning, so consider conditioning only certain units.

Furnishings

- Furnish rooms only with non-toxic, environmentally sound products that will not cause air quality problems.

Energy Conservation

- Design the rooms to maximize daylighting.

- Ensure that air conditioned or heated air are maintained by using well-insulated curtains. Consider using a small overhang over windows to keep out the hot midday sun.
- Use water-saving fixtures in bathrooms, kitchens, and other areas.

Guest Rooms

What You Can Do

Awareness

- Provide each guest room with a card or plaque explaining the hotel's environmental commitment.
- Because water usage is an important issue in Malta, hotels can inform guests about how they can easily conserve water on a daily basis without decreasing their satisfaction with their stay at the hotel.
- Place a card on the door or pillow suggesting that guests who want their sheets changed should leave the card on the bed or another specified place. This card should explain that this measure is intended to reduce energy and water use associated with in washing linens.
- Similarly, suggest that guests who want their towels changed should leave dirty towels on the bathroom floor.

Energy

- Use compact fluorescent light bulbs instead of incandescent lamps.
- Install motion sensors or other creative means to control lighting or air conditioning in order to conserve energy.
- Keep appliances in the room to a minimum, and ensure that they are energy-efficient. Appliances such as coffee makers, refrigerators, and microwaves should be optional rather than placed in every room.
- Furnish guest rooms with energy-efficient televisions and hair dryers.
- Consider laminating any brochures in the rooms so that they can be reused. If they are intended for guests to keep, ensure that they are printed on recycled paper with soy-based inks.
- Consider using organic cotton towels and shower curtains.

Furnishings

- When buying furniture, ensure that it is non-toxic. Many upholsteries, paints, and finishes cause poor indoor environmental quality. Additionally, ensure that wooden furniture is made of sustainably certified wood.
- Consider purchasing used furniture.
- Alternately, purchase furniture that is made locally when possible. Importing furniture reduces the energy required for shipping and helps to support the local economy.

Toiletries

- Provide shampoos, soaps, and other toiletry products that are organic and cruelty-free (not tested on animals).
- Place the shampoo and soap in refillable dispensers to reduce packaging waste.
- Provide other amenities, such as shoe polish and shower caps, upon request.
- Donate partially used soaps to a homeless shelter.

- Leave partially used toilet paper rolls for the next guest, use in employee restrooms, or donate them to a local shelter.

Towels & Linens

- Purchase towels, linens, and other products in bulk when possible in order to reduce the cost and energy needed to acquire them.
- If using cotton linens, let your suppliers know that you are interested in organically grown cotton. Conventionally (non-organic) grown cotton is pesticide intensive.
- Consider using coloured linens that can be washed in cooler water. Hotels can either purchase cotton coloured with non-toxic dyes. Otherwise, naturally coloured cotton is also available – the fibres grow with colours that become darker the more they are washed.
- Buy bathroom and flooring tiles made from recycled automobile windshields or other products.

Waste

- Eliminate the plastic lining in ice buckets because it is unnecessary and wasteful.

Water

- Use low-flow toilets to reduce water usage.
- Use water-efficient showerheads.
- Equip toilets with a toilet tank fill diverter to decrease water usage.
- Consider buying used toilets, sinks, and bathtubs.

Restaurant and Kitchen

What You Can Do

Air Quality

- Ensure that ventilation is good in order to reduce the harmful effects of fumes from cooking. Windows offer a free, more natural means of ventilation than forced ventilation systems.

Energy

- Buy energy-efficient appliances, including the refrigerator, toaster, microwave, oven, stove, and blender.
- Check the refrigerator and freezer seals frequently to save energy. This can decrease the number of times the freezer has to be defrosted and save on energy costs.
- Turn on the stove, oven, and other appliances only when they are needed in order to reduce energy costs.

Linens

- Use cloth rather than paper napkins and linens to reduce waste.

Meals

- Include vegetarian and vegan alternatives on the menu. They tend to require far less land, energy, and water inputs to produce than meat.

Packaging

- Encourage food suppliers to sell food in reusable or recyclable containers, such as aluminium.
- Use recyclable or reusable packaging for guests' leftovers.

Purchasing

- Buy in bulk and use dispensers for sugar, salt, pepper, cream instead of purchasing individually wrapped items.
- Purchase organically grown fruits and vegetables from local farmers. Alternately, grow some in the hotel's garden.
- Buy organically grown flowers for tabletops or silk flowers in order to reduce waste.

Waste

- Serve meals on fewer larger plates rather than on multiple smaller ones to reduce the amount of clean up.
- Distribute leftover food to local homeless shelters.
- Separate trash, such as aluminum, organic waste, and glass.
- Use stained or old tablecloths and napkins as rags in the kitchen or to make aprons for the kitchen workers.
- Donate old utensils and plates to a local charity.
- Compost table scraps with the exception of meat and citrus products. The compost is placed in a container and allowed to decay and then can be used in mulch for plants.

- Whenever possible, purchase used kitchen equipment. This reduces costs and prolongs the life of the equipment.

Laundry Room

What You Can Do

Energy

- When washing, use the lowest possible temperature for hot water. This reduces the amount of energy consumed in heating the water.

Toxicity

- Use non-toxic detergents.
- Ensure that detergents do not contain phosphates or harmful bleaches.

Water

- Wash in full loads.

Waste

- Buy detergent in bulk to save money and reduce waste.
- Purchase concentrated detergent because it requires less packaging for the number of washes it produces.
- Use old sheets to make laundry bags and rags.

Housekeeping

What You Can Do

Awareness

- Ensure that housekeeping staff is training in the proper use of cleaning products and are aware of the dangers of hazardous products.

Toxicity

- When cleaning, ensure that the cleaning products are biodegradable, non-toxic, and cruelty-free. This helps to protect the health of the people who manufacture them and use them as well as the environment product use.

Waste

- Use old towels as cleaning rags.

Lobby

What You Can Do

Air Quality

- Ensure proper ventilation.
- Prohibit smoking from the lobby.
- Provide either well-ventilated smoking areas or suggest that smokers smoke outdoors.
- Use non-toxic furnishings.
- Ensure that the lobby is kept clean by clearing it of dust and dirt that might cause allergies or illness.

Energy

- Use skylights or high windows.
- Use blinds to keep the harsh sun out.
- Light public restrooms using skylights or windows.
- Buy compact fluorescent bulbs instead of incandescent bulbs to save money and energy.
- Turn lights on only when needed.
- Open windows and doors to provide good airflow and cool the area as air conditioners may not be necessary all the time, particularly when the lobby is not crowded.

Furnishings

- Consider using floor tiles from recycled automobile windshields or previously used floors.
- Whenever possible, purchase used or locally made furniture to reduce the energy required for shipping and to help support the local economy.
- Ensure that wood furnishings are certified sustainably harvested, which means that they are not made of endangered or threatened species (e.g., some tropical hardwoods) and that they are from sustainably managed forests.
- Decorate the lobby with local vegetation for improved air quality and regional aesthetics. These plants could be plants that are endangered so that their growth adds to the species' population.

Toxins

- Be sure to use non-toxic building materials made of recycled/recyclable materials in new construction or building renovations.
- Eliminate or reduce the use of harsh chemicals to ensure good air quality.

Waste

- Place recycling bins near trash cans to give guests an alternative to throwing everything away.

Hotel Office

What You Can Do

Energy

- Use energy-efficient lighting, such as compact fluorescent bulbs.
- Use energy-efficient copiers, fax machines, printers, and computers.
- Ensure that copiers, fax machines, printers, and computers are turned on only when they are needed.
- Consider installing motion sensors, which trigger the lights to turn on only when someone is in the room. Additionally, if someone leaves the room and forgets to turn off the lights, they shut off automatically after a short period.

Purchasing

- The hotel should use recycled paper, envelopes, notepads, and any other type of paper.

Recycling

- Encourage recycling by placing bins near the trash cans.

Waste

- Donate used computers to local charities.
- Reduce paper use by storing data on electronic media. However, be sure to back up important documents.
- Use both sides of the paper when printing longer documents.
- Consider using waste paper that is printed on only one side for notes and messages.
- Instead of using staples, use paper clips, which can be reused.
- Use refillable pens and pencils instead of disposable ones to prevent unnecessary waste.
- Whenever feasible, buy reused office equipment to save money and prolong the equipment's life.

Additional Information

Introduction

This section focuses on grey water systems and living roofs starting from the point of construction. Grey water systems recycle water that comes from every water source except for toilet water. This water can then be used for other applications such as toilet water and irrigation. Living roofs are rooftop gardens of varying size that help to keep buildings cool and offer habitat for insects and birds.

Grey Water Systems

Approximately 97% of the earth's water is saline which leaves about 3% making up freshwater. However, of this 3% only 0.014% can be used directly as drinking water. Malta's rainfall averages about 530 mm per year with only 16-25% of that being collected by underground aquifers. About 47% of Malta's freshwater from aquifers is collected for use while the rest of the freshwater comes from desalination plants. Desalination uses a large amount of energy and is costly to produce.

With freshwater being scarce and rapid population and tourist growth drawing on Malta's limited water resources, it becomes essential to practice water conservation methods. Within Malta's infrastructure, hotels attribute to a large portion of this water usage. One of the ways in which hotels can be sure to save freshwater and reduce overall operations costs is through the use of a grey water system.

What is Grey Water?

Grey water is any wastewater, except for toilet (black) water, that is produced within a human system. Grey water consists of dish, shower, sink, and laundry water. This type of water is typically filtered by various methods, purified by the soil, and pumped to other areas for reuse. Grey water maybe reused for toilet water or for irrigation purposes.

How a Typical Grey Water System Works

Though there are many different types of grey water systems, no one approach can be applied generically. Instead, grey water systems must be tailored to the particularities of the local environment.

Aerobic Pre-treatment

One type of grey water treatment is aerobic pre-treatment (shown below), which is suitable for showers, hand washing, and laundry water use. Grey water is collected for pre-treatment to be filtered then allowed to move downward through soil to increase water purification. The water is then distributed for reuse and irrigation.

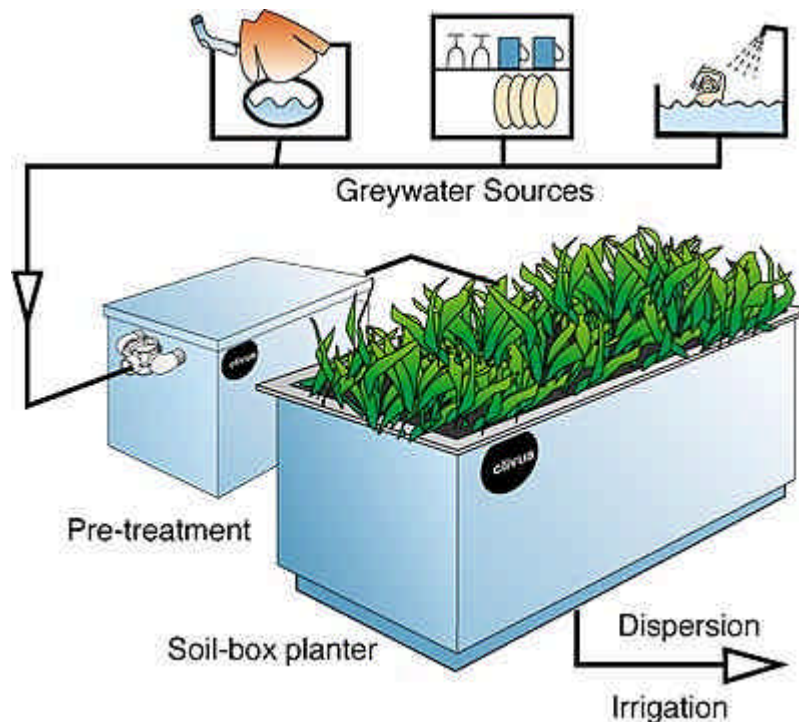


Figure 1. Aerobic Pre-Treatment

In aerobic pre-treatment, a stretch filter is used. This filter is designed to remove large particles and fibers that, otherwise, could clog infiltration pipes. Then, organic material moves to the next processing stage where it is transferred to an aerobic soil layer environment. It is in the soil layer environment that the organic matter is decomposed by both micro-organisms and macro-organisms. Following pre-treatment, the water is sent to a soil-planter box where it is purified further.

The soil planter bed consists of four layers. The bottom layer is made of polyethylene “actfill,” which provides an effective drainage base for the grey water. This drainage helps to prevent the formation of a waterlogged layer of soil that could result in anaerobic conditions. On top of this “actfill” layer lies plastic mosquito netting, which screens out the upper layer of coarse sand. This coarse sand layer is made up of ordinary concrete-mix sand on the bottom and humus-rich topsoil on the upper two feet. Once the water has percolated through the different layers, it is collected and distributed.

This type of filter is used primarily for public facilities in which hand washing and showers are the principal sources of grey water. Stretch filters should not be used with grey water that contains food wastes. If this type of filter were to be used to remove food wastes, the waste would accumulate in the filter. This would reduce the water flow and cause an environment in which anaerobic bacteria would flourish, leading to malodorous decay. Thus, using a stretch filter for a food waste application would require the continual replacement of the filter, creating a costly, high-maintenance situation.

Anaerobic to Aerobic Pre-treatment

If the wastewater contains a significant quantity of food waste from dishwashers and kitchen sinks that might contain cooking grease and food residue, then anaerobic pre-treatment is recommended. This system usually consists of a three-stage septic tank that is used to separate sludge from grease.

When grey water is stored in a tank, it uses the ambient oxygen supply quickly and creates an anaerobic (oxygen-free) condition. Once grey water reaches the septic state, it turns into sludge that either sinks or floats depending on its density and gas content. Septic grey water produces a rancid odour and contains anaerobic bacteria that can include human pathogens.

The outflow of the septic system is anaerobic. In order to restore aerobic conditions, a sand filter is used following the septic tank. The final treatment stage of this process is the planter bed, which produces purified water of near-potable quality. This type of treatment is considered one of the most effective on-site treatment techniques available on the market today.

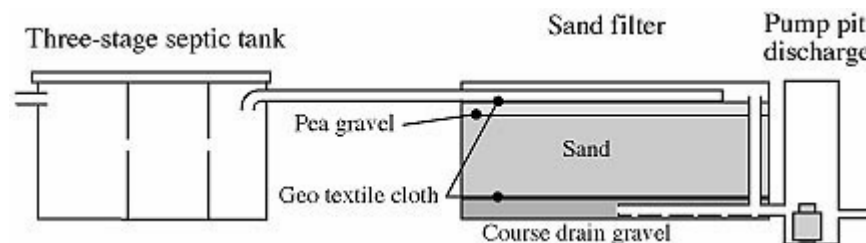


Figure 2. Grease-trap/septic tank + sand filter + sample/pump pit

Advantages of a Grey Water System

There are many benefits associated with grey water systems. Grey water systems can help to protect the nation's water supplies, save money, and help the environment. It reduces the demand for aquifer water and desalinated water as the need for freshwater for sinks, toilets, and irrigation becomes minimal. The decreased need for freshwater also saves money by bypassing the use of reverse osmosis to convert saline water to fresh water. Reverse osmosis accounts for nearly 40% of Malta's energy consumption. Additionally, grey water often can be recycled and filtered further to replace fresh water.

A grey water system places less strain on septic tanks and treatment plants. The reduction of inflows and the outflows decreases wear and tear on the septic system. Therefore, grey water use greatly extends the storage and useful life of septic systems.

Grey water systems have a highly effective degree of purification. Grey water is purified in the upper, most biologically active region of the soil. This purification process helps to protect the quality of both surface and ground waters.

Less energy and fewer chemicals are used in grey water systems because there is less freshwater and wastewater that needs to be pumped. For hotels that provide their own water or electricity, the advantage of this reduced energy consumption

is felt directly. Additionally, grey water systems serves as a deterrent for using toxins that will end up in the water, such as detergents containing phosphates. Using phosphates, nitrates (in fertilizers), and other nutrients in water is dangerous because they can enter the Sea where the process of eutrophication occurs. Eutrophication promotes excessive algae and aquatic plant growth. Such growth consumes large amounts of dissolved, which is essential for the survival of aquatic and marine life. If enough oxygen is absorbed by the algae, marine life can suffocate. Protecting marine life is important to maintain Malta's seafood market.

Groundwater recharge is another advantage of grey water systems. Groundwater recharge occurs when the amount of grey water is greater than what local plants can use. It soaks into the ground and recharges the aquifer. Groundwater becomes essential for maintaining the water table level that is relied on by wells. The use of well water reduces the burden of using other water sources and reducing the energy associated with reverse osmosis.

Grey water can be used to irrigate arid regions, which might help to renew the health of degraded areas. Plants are better adapted to feeding on water containing small amounts of compost rather than freshwater without nutrients.

Using grey water helps to reclaim nutrients and maintain fertility of the land. When grey water systems are not used, nutrients that would typically fertilize plants are lost to the Sea.

Finally, grey water systems can have significant economic benefits. Hotels that uses several thousand gallons of grey water per day and have a similar irrigation demand might find that a grey water system, including irrigation hardware, could pay for itself in a few months to a few years.

Grey Water Precautions

Although grey water systems provide the user with several advantages, there are some precautions that must be taken in order to ensure safety for the user and the surrounding environment.

The safety of grey water systems relies heavily on natural purification through topsoil and the avoidance of direct contact with grey water prior to the purification process. Thus, grey water must be allowed to effectively percolate through the soil so that it does not contaminate surrounding water sources. In order to avoid possible contamination, grey water must be discharged underground or into a mulch-filled basin. Grey water should not be applied to saturated soils and should be applied in intervals to allow soil aeration to prevent saturation.

Chemical contamination can occur because biological purification does not usually remove industrial toxins that might have entered through polluted groundwater or be absorbed by plants. For example, several everyday cleaners contain harmful chemicals. Thus, care should be taken when selecting cleaning

products that might enter the water system. Hotels can substitute harmful cleaning and other products with non-toxic ones that are safe for water.

Storage tanks containing grey water must be carefully monitored to prevent the formation of black water. Grey water becomes black water if it is stored in excess of 24 hours. A 24-hour time period is generally considered the maximum storage time used in grey water applications. Exceptions to this time limit can include other water treatment systems, such as constructed wetland or septic tanks. In these cases, depending on the BOD levels and temperature, grey water can be stored for up to a month. Storage tanks must also be completely drained before the next batch is stored to prevent possible black water contamination.

There are several ways in which direct contact or consumption can be prevented. There must be care taken in correctly labelling all grey water pipes and hoses. Gloves are recommended when maintaining grey water systems, especially when cleaning or changing water filters.

Grey water systems also pose the risk of the inhalation of micro-organisms. This usually occurs when droplets that are introduced into the air by sprinklers evaporate and leave harmful micro-organisms suspended in the air. Therefore, it is strongly recommended that grey water not be used in sprinkler systems.

In addition to inhalation, care must be taken to prevent the consumption of micro-organisms in grey water. This consumption usually takes place if grey water is used to water vegetables directly. Therefore, grey water should not be applied to fruits or vegetables that are consumed raw. One possible way to avoid this contamination is to apply grey water directly to plants' roots via drip irrigation.

Irrigating with Grey Water

The most reliable and safest method of irrigating lawns using grey water is by means of an underground drip tubing system in junction with a sand filter. This method allows water to be applied to root systems where airborne micro-organism contamination is not an issue. Although grey water is effective for lawn irrigation, it is not recommended when growing vegetables due to the possibility of disease transmission. In spite of this fact, vegetable irrigation can be practised with great caution.

It is highly recommended that several layers of protection be worn when working with irrigation systems. Care must be taken to avoid contact between grey water and fruits and vegetables that will be consumed raw and might not be washed sufficiently beforehand. If such contact occurs, fruits and vegetables should be washed well and cooked.

The Differences between Grey Water and Black Water

The most significant difference between grey water and black water is that grey water decomposes at a faster rate than black water. This rapid decomposition means that grey water will have an immediate impact on the point of discharge. If combined with wastewater, however, it might not have a significant impact

further downstream. Grey water also decomposes quickly in soil, reducing the chance for it to pollute surrounding groundwater supplies.

Approximately 90% of the nitrogen contained in combined wastewater (mixed grey water and black water) originates from toilet wastes (black water). Nitrogen is one of the most serious and difficult-to-remove pollutants affecting the freshwater supply. Nitrogen also causes eutrophication in water bodies and the subsequent death of marine life and creation of “dead zones.”

Black water is a far greater source of human pathogens, mainly from feces, than grey water. Therefore, it is essential to separate toilet wastes from grey water stream in order to reduce the possibility of spreading these pathogens via water.

Unlike black water, grey water is not malodorous immediately after discharge. Only after a 24-hour period will grey water turn into black water.

As stated previously, grey water systems must be tailored to different applications based on some ecological parameters. The success of any grey water system lies with the proper installation and understanding of the system. Many of Malta's hotels that are able to incorporate such a system will in turn save water and money and protect the environment.

Additional Information

For more information on grey water systems, visit the following web sites:

www.greywater.com

www.ecotoilets.co.nz/grey.htm

www.oasisdesign.net/greywater/index.htm

Living Roofs

This section discusses the implementation of living roofs either from the initial construction of the building or as an addition to an already existing building. It explores the benefits of creating rooftop gardens, the economics of implementation, and cost savings. It also identifies manufacturers of the different layers that make up a living roof.

What is a Living Roof?

A living roof refers to a rooftop area covered by an artificial structure embedded with plants. A living roof consists of a waterproof barrier, soil, and plant material (as well as other materials that will be addressed later). It can cover the entire roof surface or a smaller area. Living roofs (also known as green roofs) can be cultivated to produce vegetables, citrus, or grasses. They also can provide habitat for insects and birds that have lost their natural habitats due to land development and fragmentation.

Green roofs can be divided into two different categories – extensive and intensive. An extensive green roof has one to five inches of soil, which can support plants with shallow roots. Typically, they will add anywhere from fifteen to fifty pounds per square foot on to the rooftop and generally do not require special construction in order to support this additional weight. Most extensive green roofs do not require much human maintenance.

An intensive green roof has a minimum of one foot of soil, which can support trees and shrubs. A typical intensive green roof will add anywhere from eighty to one hundred and fifty pounds per square foot to the building's roof. Due to the weight of the intensive green roof, the building might need more load bearing capacity than already exists. Intensive living roofs often require significant maintenance as well.

Areas with dense populations and rapid population growth can benefit from the implementation of living roofs. These benefits will be explored as well as common questions and concerns regarding the implementation of such roofs.

The Benefits of a Living Roof

A living roof has several positive environmental benefits. First, it decreases the temperature that large buildings can radiate. This temperature increase around buildings, which often averages five to seven degrees Fahrenheit, is known as the "Urban Heat Island Effect." The Urban Heat Island Effect usually occurs in city areas or other densely populated areas. The decrease in air temperature resulting from a living roof occurs from plant respiration. The plants release enough retained water to cool the surrounding air.

A living roof also can act as a natural air filter. Pollution particles can be trapped and absorbed by the plants growing on the roof. These particles are washed into the soil where some of them are broken down into nutrients that the plant can use

to develop. Thus, some pollution particles can actually act as a natural fertilizer for green roof plants.

Not only does a green roof act as an air filter, but it also can act as an environmental filter for nearby plants, animals, and Sea. Rooftop plants can filter rainwater before it runs off the building and back onto the ground.

A living roof provides economic advantages as well. In many cases, the actual life span of a roof can be doubled by the implementation of a living roof. This is also because the living roof blocks strong winds that might erode the roof over time.

An area that is hot in the summer and cold in the winter would also benefit from the implementation of a living roof. A living roof, due to the layering of materials, materials can act as an insulator. For example, living roofs can decrease the rooftop temperature by forty degrees Fahrenheit on a hot sunny day, keeping the interior of the building cooler as a result. It also can keep a building warmer in the winter. This can save money on heating and air conditioning bills.

A green roof can also increase a hotel's appeal. The living roof can provide a peaceful, park-like setting enjoyed by guests and hotel staff, alike. They can act as a buffer to reduce noise pollution from airplanes, vehicles, and busy city streets.

The Components of a Living Roof

Living roofs comprise several layers of materials. The first layer is a waterproofing material that is placed directly on the actual roof. This layer, usually made of bitumen sheets (a derivative of petroleum) or a synthetic material, is laid down in about three layers in order to prevent leaks into the building. Typically, the top layer of the three is laminated to prevent the plants' roots from digging through the bitumen into the building's roof. To ensure that proper drainage occurs, it is recommended that the layers are sloped at least 1.5% so that water will not pool. Liquid waterproofing agents can be used.

If bitumen was used for the waterproofing, another layer of a root barrier should be set in place. A concrete block often is poured over the bitumen sheets to ensure that the plant roots do not try to dig into the bitumen in search of water and nutrients.

The second layer to be constructed is an insulating layer, such Foamglas®. This layer stops the water absorbed by the living roof from pulling heat from the building in the winter or cool air in the summer.

The third layer is a drainage layer. Although some insulating layers have drainage boards incorporated into them, this layer is still recommended. The drainage layer facilitates the removal of excess water from the roof. In some cases a drainage layer may be incorporated into the filtration layer. In slanted roofs, some may argue that a drainage layer is not needed due to the natural flow of water resulting from gravity.

The drainage capacity varies in different parts of the living roof system. Designers will need to allow for extra room around drainage ducts to accommodate the increase in water flow towards the emptying duct. These ducts must also be accessible for occasional seasonal cleaning. Some systems can be built to hold a small amount of water so that the plants growing on the green roof will have a constant supply of water.

The living roof's fourth layer is its filtration layer. The filtration layer is usually made of a fabric that keeps the soil in place so that the water does not carry small particles into the drainage system. A bitumen adhesive is used to hold the filtration fabric together. Two types of non-biodegradable fabrics can be used – polyester fibrous mats or polypropylene-polyethylene mats.

The fifth layer is the growth media. Several living roof companies have patented their own "green roof soil" that can be used for the growth media. This soil is specifically designed to ensure optimum growing for the environment that the plant is in. If a high-tech soil is not what the builder is looking for, then a simple combination of 20-25 percent organic soil and 75-80 percent of an inorganic mixture (for example: slate or clay) can be used as growth material. This option can save money.

Soil depth largely dictates the plants to be grown. Shallow soil results in smaller plants and less weight on the building (extensive green roof). Deeper soil protects roots from the sun's heat and from occasional frost; however, it also adds weight to the building (intensive green roof).

The sixth layer that is required for a living roof is the water storage and irrigation layer. The plants that grow on a living roof are exposed to large amounts of sunlight and high temperatures. These factors increase the amount of water needed for the plants growing in this environment. This layer is necessary to keep the plants from drying out.

The implementation of a water storage and irrigation layer also increases the rooftop biodiversity. The existence of water can allow different types of plants to grow on a roof and depending on the purpose of the roof, different vegetables can be produced or different flora and fauna may be produced for the new insect habitat or human enjoyment.

The water storage and irrigation system is usually made of two thin layers. The first layer (lower layer) is made of fired clay. The top layer is a granular layer to which water is introduced to encourage root growth. A geotextile is used to separate the two layers. The roots that are propagated in the top granular layer stretch through the geotextile into the fired clay layer where they find optimum growing conditions for temperature and moisture.

The best storage and irrigation systems are natural. Though it is possible to create a water collection pond that continuously irrigates the living roof, this option might not be optimal for dry climates because the pond could dry out easily, and the plants might die as a result.

The seventh and final layer is the plant layer. The compatibility of plants to the roof types must be assessed because some plants will not thrive in high wind or heat areas while others are able to survive with ample amounts of ultraviolet radiation.

Many plants can be bought on a pre-seeded planting sheet. The use of this type of sheet would result in a lower cost as compared to planting each plant separately. The benefit of planting each plant separately is that the gardener picks and chooses the specific plants the he or she wishes to thrive in the rooftop climate.

In many cases, an existing roof will not be able to support a living roof over its entirety even if that green roof is an extensive lightweight one. In such instances, partial living roofs can be built that cover only part of a building's roof. The smaller the living roof, the less extra weight the building will be required to hold.

Living systems like the GreenGrid system, developed by Weston Solutions, Inc., use movable containers that are pre-filled with growth matter and are delivered to the building to be greened. Each container is about two inches deep. These containers can be placed anywhere on a roof as long as the roof can bear their weight. When the module is totally saturated, it can weigh almost fifteen pounds per square foot. Four-inch modules as well as eight-inch deep modules are also available. The eight-inch modules are approximately twenty-eight pounds per square foot when totally saturated. Irrigation is possible for these modules. This is strongly advised for areas in which water is not always readily available.

The mobility of this system means that the roof beneath the module can always be accessed if necessary. Though systems like the GreenGrid system are not as useful as a "real" living roof, they offer many of the same benefits but to a lesser degree.

The Costs of a Living Roof

The cost of a living roof varies depending on the type of roof that will be built and the technology behind it. The depth of the growth matter, the types of plants to be used in the living roof, the area to be greened, irrigation techniques, and the purpose of the roof all affect the green roof's cost. Keep in mind that the membranes used on the roof increase the life span of the hotel's roof. A living roof also reduces heating and cooling costs as well as noise pollution, so the benefits of the living roof can outweigh the initial costs.

Germany, for instance, has the lowest prices for living roof installation. Living roofs range from \$8-\$15 per square foot. Germany has an entire industry that has evolved around the construction of green roofs, and this idea has been practiced since the start of the eighteenth century. It is the advanced knowledge of living roofs that is the reason for the lower costs associated with this country's products. Meanwhile, in the United States, an extensive living roof, including the plants and installation, can range from \$12-20 per square foot.

Canadian Case Studies

The first release of information from a joint effort between the IRC (National Research Council Institute for Research in Construction), Environment Canada, the City of Toronto, and Green Roofs for Healthy Cities occurred during the fall of 2002. Toronto used approximately 65 million square feet of rooftop space (6%) for the implementation of green roofs that were 15cm thick with a simple layer of thick grass growth. The cost for this implementation was \$45.5 million (CDN) annually.

There were many benefits that resulted from this implementation. The green roofs lowered the heat island effect by 1-2 degrees Celsius, and greenhouse gas emissions were reduced annually by 1.56 megatonnes from buildings and 0.62 megatonnes from the urban heat island effect. Meanwhile, the rooftop plants collected 30 tonnes of particulate matter per year. In addition, the production of urban food was estimated at \$4-5.5 million a year while the job creation for the urban agricultural production was found to be 1,300 people per year. There was an annual energy savings of \$1 million dollars per year, and the implementation created public and private space for recreation that was calculated to cover 650,000 square meters. The report was not able to quantify the increase in biodiversity that resulted from the green roofs, storm water quality improvements, or the economic value of the green space that was planted.

A second study in Canada, from the National Research Council of Canada, focused on the potential for saving heating and cooling energy at the Field Roof Facility (FRF). The FRF had half of its rooftop planted as an extensive green roof and the other half setup as a bitumen roof that acted as a simple reference roof. This study showed that a green roof is extremely beneficial in the warm months for reducing the daily temperature of the building. It also indicated that a living roof can save approximately 75% of the energy that is wasted in relation to air conditioning. However, the living roof was more effective in reducing heat gain than heat loss. Similar reports have been published for tropical climates, such as that found in Singapore.

Companies That Sell Living Roof Materials

Germany

- Xero Flor - This company sells a multi-layered growing medium for green roofs. This growth medium was used with Ford's building.

International

Sarnafil Division – Sells membrane systems for both extensive and intensive living roofs. www.sarnafilus.com/GreenRoofs.htm

UK

- Erisco Bauder Green Roof Systems - Developed waterproofing and insulation technology that can be used for a green roof. It also sells a separate Green Roof System that includes waterproofing, insulation, roof barriers, drainage and filtration. www.erisco-bauder.co.uk

- Walter Segal Self Build Trust - A website that provides the “How To's” for building your own living roof.
www.segalsselfbuild.co.uk/articles/creatingagreenro.html

USA

- American Hydrotech, Inc. - Provides waterproofing and roofing technology for green roof systems. Its products were used for the Gap Headquarters in San Francisco, CA. www.hydrotechusa.com
- ZinCo GmbH - Handles all aspects of the living roof, including landscaping, and has several international projects in production that can be referenced on its website
www.zinco.de/ausland/englisch/eimpresum.htm
- American Wick Drain Corporation (AWD) - Produces prefabricated soil sheets and drainage material. The company's AMERGREEN system has a root barrier included that stops solids from entering the drains keeps roots from penetrating the drainage level. www.americanwick.com
- Barrett Company - Produces roofing and waterproofing materials. It has developed different materials for extensive and intensive green roofs.
www.barrettroofs.com
- The Garland Company - Produces waterproofing material made of multiply modified bitumen for over twenty-five years. www.garlandco.com
- The Pittsburg Corning Corp. - Produces Foamglass® used as an insulating material.
- Weston Solutions, Inc. - Developed the green grid system for the implementation of a partial living roof. www.greengridroofs.com