TUI HOTELS & RESORTS

Green Building Guidelines

Content

1.1. Mission Statement

”We are working to reduce TUI’s environmental footprint on the ’Planet‘ and drive-up environmental standards in our industry“

Dear Hotel Partners.

Tourism is a force for good. It is one of the world’s largest industries and the main force for development and prosperity in many parts of the world. Together with our partners we strive to continue to positively contribute to local communities, reduce our environmental footprint and create experiences that are authentic and sustainable. Our hotels play a key role in raising the bar in sustainability performance at our destinations. By carefully managing their impacts on local people, economies and habitats, each hotel is uniquely positioned to make a positive difference for the whole community. Our most sustainably-managed hotels also consistently deliver higher quality and customer satisfaction.

TUI’s ambition is to continue to lead the industry and actively shape a more sustainable future for tourism through the three building blocks of the Sustainability Agenda – People, Planet and Progress. We are working to reduce TUI’s environmental footprint on the ‘Planet’ and drive-up environmental standards in our industry, with commitments to achieve net-zero emissions and become a circular business. Our ambitious goals can only be achieved in cooperation with our partners who share our vision and join our efforts for a more sustainable tourism.

For hotels, we have set a science-based target to reduce absolute CO_2e from TUI Hotels & Resorts by 46.2% by 2030. Our hotel business is among the first leisure hotel companies that has worked with the independent Science Based Targets initiative to get its 2030 emission reduction targets validated and approved confirming that they are in line with the latest climate science. But we are striving for an even more ambitious target internally – to reduce emissions from our hotels to zero by 2030.

These Green Building Guidelines are a helpful tool and provide guidance in order to support our Sustainability Agenda. The catalogue of criteria covers all areas relevant to green building policies and procedures. The Guide highlights the most important aspects to reduce environmental impacts, enhance quality through targeted measures and how to realise savings in water and energy use.

We are delighted to be working with you on sustainable hotel experiences for our guests.

Yours,
Peter Krüger

Chief Strategy Officer &
Chief Executive Officer Holiday Experiences
and member of the Executive Board

Yours,
Thomas Ellerbeck

Chief Sustainability Officer of TUI Group and
member of the Group Executive Committee

1.2. Looking beyond

Long-term thinking is crucial in the construction industry, as the work we do has a significant impact on the environment and the communities in which we build. When planning a construction project, it is important to consider not only the immediate needs and goals but also the long-term goals and implications of the project.

Long-term goals may include considerations such as the durability and lifespan of the building, energy efficiency and sustainability, and the potential impact on the local community and environment. By thinking about these factors from the outset, construction professionals can make more informed decisions that result in buildings that are more resilient, sustainable, and adaptable to future needs.

Additionally, thinking long-term can help construction professionals anticipate and address potential challenges and risks that may arise over the lifespan of the building. This can include considerations such as maintenance and repair costs, changing building codes and regulations, and the potential impact of natural disasters or other unforeseen events.

Ultimately, taking a long-term perspective can help ensure that construction projects are not only successful in the short-term but also contribute to a more sustainable and resilient future for the communities they serve.

As such, the measures mentioned in these Green Building Guidelines should become self-evident for all of our new developments and renovations of existing hotels. In addition to energy efficiency requirements, it also contains other quality specifications for sustainable buildings. This involves reducing environmental impacts, optimizing the lifecycle costs of buildings and urban integration.

While for a hotel operator, Green Building Guidelines may focus on reducing the environmental impact of daily operations, these Green Building Guidelines are focused on designing and constructing buildings that are energy-efficient, water-efficient, and uses sustainable materials. Developers may also consider the lifecycle impact of building materials, choosing materials that are environmentally sustainable, have a minimal impact on the environment and contribute to a circular economy.

Above all, it is also important to ensure that a project complies with legal requirements and regulations - also with regard to the environment. These are not explained in detail below.

The Green Building Guidelines from TUI Hotels & Resorts will help significantly to reduce carbon emissions, even to zero. For Net Zero, a life cycle approach taking into account Scope 3 emissions (upstream and downstream of the value chain) is crucial among other aspects. This includes carbon created for construction materials and products, e.g. embodied carbon, transportation, recycling and disposal, however, these emissions are not discussed further in these guidelines as they are very comprehensive and highly hotel and destination dependent.

The guidelines will be regularly updated and revised with a view to practical considerations.
TUI Hotels & Resorts want their partners, architects, engineers and contractors to commit to applying these guidelines when developing hotels. The goal is to ensure that new construction and renovations optimize sustainability performance while helping to preserve the precious environment where our customers enjoy a unique holiday experience.

TUI Hotels & Resorts

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2. Architectural Design

2. Architectural Design

Architectural design has a huge impact on energy efficiency and carbon reduction, starting with the planning of a building. Therefore, the planning and the specification process shall be carried out with a target-oriented and climate-friendly goal according to operational aspects taking the following into consideration.

Robinson Club Daidalos

2.1. Property & Building design

During the planning and preliminary design stages, all hotel developments are expected to meet a number of requirements – some of which might be regulatory requirements. Planning codes serve several functions, including ensuring safe construction and minimizing environmental impact.

It is important that all new build hotels and major refurbishment hotels obtain the necessary planning permissions from the relevant authorities. In most jurisdictions, an Environmental Impact Assessment (EIA) is a mandatory requirement for granting planning permission for new hotel developments. It may also be required for large-scale Furniture, Fixtures & Equipment (FF&E) renovations and renovations involving major civil works. If an Environmental Impact Assessment is required, it must be carried out by a qualified environmental expert. It should assess any applicable environmental, social and economic issues associated with the proposed redevelopment and, where necessary, propose appropriate mitigation strategies.

The EIA process should be initiated at the concept development stage and then considered throughout the design process so that any mitigation measures or environmental recommendations identified during the EIA can be properly planned. An EIA should not be carried out as an 'add-on' after the design is finalized as there may be limited opportunities for changes based on the EIA results.

In addition, the planning phase of a hotel should also include a proper infrastructure setting and mobility concept for the construction companies including access and departure routes. But also for hotel guests and staff an adequate mobility concept should be available after finalizing of the construction work, for instance, availability of e-charging stations of bus stops close by.

Where possible, sealed surfaces should be avoided in general. Instead, natural appearances should be promoted, e.g. through increased greening, which can lead to shading and thus energy savings and at the same time create a greater sense of well-being for employees and guests.

If a hotel is located near a nature reserve, the design of the hotel can also actively contribute to nature conservation, for example through increased green spaces or animal bridges for migratory species.

2.1.1. Optimal orientation of hotel layout

New hotel developments, or new buildings combined with existing hotels, should adapt as much as possible to the local climate and weather conditions including wind currents as well as topography in order to reduce energy consumption. In hot countries, new buildings should be oriented to minimize the potential for solar heat gain (to reduce the need for air conditioning), while in cooler countries solar gain should be maximized to take advantage of the sun's natural heating potential. For hotels that are open year-round and subject to different conditions, the considerations are more complex. However, careful assessment of a destination's climate and weather patterns as part of building design will prove a valuable exercise, with benefits including improved hotel experience for customers and reduced energy costs.

When planning the building, not only must the optimal arrangement of the individual areas in terms of viewing directions and solar radiation be taken into account, but also the operating hours of special facilities. As an example: a restaurant with a terrace used in the morning can be planned in a different compass direction compared to a restaurant open in the evening.
Advantages of optimal orientation are:

- Maximized natural light: Optimal orientation of the hotel layout can ensure maximum natural light, reducing the need for artificial lighting and energy costs.
- Improved views: A well-oriented hotel layout can offer guests better views of the surrounding landscape and surroundings, enhancing their overall experience.
- Better heating and cooling: An optimized orientation can minimize the need for heating and cooling systems, reducing energy consumption and costs.
- Increased privacy: A well-planned orientation can offer guests more privacy, separating public and private spaces effectively.
- Enhanced guest comfort: Optimal orientation can provide a comfortable living environment for guests, improving their overall experience and satisfaction.
- Better circulation: An effective orientation can improve the flow of circulation in the hotel, reducing congestion and promoting ease of movement for guests and staff.

Furthermore, energy planning should be considered already at the concept stage. In energy planning, jointly developed measures and energy standards are precisely planned and prepared for implementation.
Energy planning involves integrating energy-efficient strategies and technologies into the design to reduce the energy consumption and carbon footprint of the hotel.

The following are some of the key elements to consider when planning energy-efficient architectural design for hotels:

- Building Envelope: A well-designed building envelope helps to reduce energy consumption by minimizing heat transfer between the interior and exterior environments. This can be achieved through the use of proper insulation, air-tightness, and the use of high-performance windows and doors.
- HVAC Systems: Heating, ventilation, and air conditioning systems consume a large amount of energy in hotels. To reduce energy consumption, the HVAC system should be designed to maximize energy efficiency, such as through the use of variable speed drives, energy-efficient air handlers, and programmable thermostats.
- Lighting Design: Lighting is another major energy consumer in hotels. Energy-efficient lighting design should incorporate natural light sources and use of energy-saving light fixtures, such as LED or CFL bulbs. Occupancy sensors and daylight sensors can also be used to automatically turn lights on and off as needed.
- The reduction of light pollution should also be considered to protect the animal and plant species of the local ecosystem.
- Renewable Energy Sources: Integrating renewable energy sources, such as solar panels, into the hotel design can significantly reduce energy consumption and lower operating costs.
- Water Conservation: Water conservation is an important aspect of energy-efficient hotel design. Features such as low-flow showerheads, toilets, and faucets can reduce water consumption and help conserve energy by reducing the energy required to heat water.
- The orientation and placement of the new building should minimize its impact on the existing landscape. Efforts should also be made to preserve the natural drainage patterns, landscaping and vegetation of the site.

- Finally, well-trained staff is crucial to ensure sustainable construction / reconstruction with all its aspects. This can also have a positive impact on the local population, as education and training opportunities can be created.

By incorporating these energy-efficient strategies into the design process, hotels can reduce their energy consumption, lower operating costs, and contribute to a more sustainable built environment.

2.1.2. Protection of windows, skylights & glass doors from direct solar radiation

Whether in the planning, refurbishment or operational phase - there are many sun shading options that can be integrated into hotels. This helps limit solar heat gain in the building, reduces air conditioning energy consumption and improves the customer experience. Windows, skylights, and glass doors can be treated to reduce the direct solar radiation they allow into a building in order to:

- Improve energy efficiency: Solar radiation can transmit up to 1 kWh of energy per square metre per hour. Most of the energy can be “diverted” to air-conditioned spaces through exposed windows, skylights and glass doors. By reducing the amount of heat from the sun entering the building, the need for air conditioning is reduced, which can lower energy bills.

- Provide comfort: Direct sunlight can create glare and cause discomfort to occupants, by treating the windows, skylights and glass doors, the amount of direct sunlight entering the building is reduced, providing a more comfortable environment. Proper shading can reduce the heat load transmitted through glass surfaces by over 80%, but care must be taken to ensure that the shading options used are well suited for the elements they wish to protect. For example, awnings and canopies are only partially effective on east and west surfaces because they cannot shield direct sunlight when the sun is low in the sky.
- Protect furnishings: Direct sunlight can fade or damage furnishings, window treatments can help to reduce this risk.
- Enhance privacy: Window treatments can also provide privacy by reducing the amount of visibility into the building.

A system that combines glass and window frames in an efficient manner is recommended. Modern windows are highly insulated in combination with the window frame. However, this is not always the only advantage: the sun’s rays that heat the structure can be weakened. Using special glass can help prevent this. The thermal insulation effect of components such as window frames is determined by a coefficient.

The so-called heat transfer coefficient (or U-value) indicates the heat transfer of a component, so it should be as small as possible. Double-glazed windows have been the standard for many years, but improvements are still possible:

- The cavity between two glass plates can be filled with a gas that transfers less heat than air.
- Triple glazed windows are now very common. Thanks to their two air gaps, their insulating effect is significantly increased.
- Solar control film applied to glass areas is another highly effective option for protecting bare glass surfaces as it reflects up to 70% of the heat normally transmitted through glass panels, greatly reduces glare and blocks up to 99% of UV radiation.

2.1.3. Vegetation selection

Whether landscaping as part of a new hotel development or replanting as part of ongoing garden maintenance, choosing endemic, non-invasive plants can improve biodiversity, reduce water use and improve the overall guest experience. Established habitats are often impacted by hotel development, so opportunities should be taken to protect or, where possible, restore native habitat within hotel grounds or gardens.

The selection of vegetation for hotel gardens can depend on a number of factors, including:

- Climate: The local climate will determine which plants are best suited to the area, as some plants may not be able to withstand extreme heat or cold. Due to climate change, a regular review of adapted flora may be useful.
- Soil: The soil type and pH will affect which plants can be grown successfully in the garden. Fertiliser should be reduced as much as possible and only used when absolutely necessary.
- Water availability: Some plants are more drought-tolerant than others and may be better suited to areas with limited water resources.
- Maintenance: The level of maintenance required for different types of vegetation must also be taken into consideration.
- Aesthetics: The desired appearance of the garden will also influence the selection of vegetation, as certain plants may provide more colour or texture than others.
- Local flora: Incorporating local flora into the garden can help to create a unique and cohesive look that reflects the local area.
- Enhance biodiversity: When choosing vegetation, choosing native plants will enhance biodiversity by encouraging native fauna such as insects and birds. Planting native grasses, especially turf, that require less irrigation will have biodiversity and water conservation benefits. Creating a herb and vegetable "garden" has positive benefits in terms of cost and perceived menu quality, while providing customers with a truly authentic local flavour when dining. It's also an effective yet subtle way of communicating the hotel's broader sustainability values.

An important factor in selecting vegetation for a hotel garden is to choose plants that will thrive in the specific conditions of the site and that might also contribute to natural shading. In this respect, the vegetation can also create an attractive and inviting environment for guests contributing to a better well-being of the guests and promote local wildlife.

2.1.4. Protection of the natural environment

Protecting the natural environment refers to efforts to conserve and preserve ecosystems, habitats, and biodiversity, as well as reducing pollution and waste, managing natural resources sustainably, and mitigating the impacts of climate change. Apart from compliance with environmental legislation and regulations, measures to protect the natural environment can also be implemented, such as promoting conservation and restoration projects, increasing public awareness, and supporting the transition to green energy.

New hotels or major renovations should be designed to ensure that the impact on the hotel property and the natural environment of the surrounding area is minimized and natural values are preserved.

Every effort should be made to minimize the amount of vegetation that needs to be removed, especially when native vegetation is beneficial to the habitat or appears to contain rare plants. If vegetation is removed, it is recommended to replant it in other areas around the property, or to retain strips of vegetation as "habitat corridors". The promotion of local animal species and their migratory behaviour is also an important point to consider.

An important part of the construction process is the development and implementation of an Environmental Management Plan (EMP) identifying all potential environmental impacts associated with construction and major renovations. The EMP should clearly specify what measures need to be taken to mitigate environmental impacts and how these measures should be communicated to construction personnel. It includes (examples):

- Measures to protect local landscape or cultural heritage features on the site
- Measures to minimize vegetation clearance and relocate trees and other flora as necessary, especially if they are valuable species

- Measures to protect local animal species and their migratory and feeding behaviour
- Measures to minimize noise and dust emissions as well as light pollution
- Measures to manage traffic-related environmental impacts, such as the location, frequency and movement of vehicles on site during construction
- Efforts should be made to reduce the amount of waste generated during the construction time.
- To reduce the damage to nearby waterways, soil and groundwater systems, there should be spill kits present around the work area where there is the greatest risk of a spillage event.

2.1.5. Landscape design for low water consumption

Landscape design in hotels can be optimized for low water consumption for several reasons, including:

- Environmental sustainability: Using less water helps to conserve this precious resource and reduce the impact on the environment.
- Drought resilience: In areas prone to drought, designing landscapes for low water consumption can ensure that the hotel remains attractive and functional even during dry periods.
- Aesthetic appeal: Landscapes designed for low water consumption often incorporate drought-tolerant plants and other water-saving techniques, creating a unique and attractive environment.
- Brand image: Hotels that have a proper landscape design can enhance their brand image and appeal to environmentally conscious guests.

By considering these factors, hotels can create landscape designs that are not only beautiful and functional, but also environmentally responsible in the long-term.

Irrigation of lawns and gardens can account for a significant portion of a hotel's total water use. The following design suggestions reduce the need for irrigation in landscaped areas:

- Choose drought-tolerant plants: Select plants that are native to your region and are adapted to the local climate, as they will require less water to thrive.
- Group plants with similar water needs: Grouping plants with similar water needs together helps to conserve water, as you can water them as a single unit, rather than each plant individually.
- Use mulch: Spread a layer of mulch around your plants to retain moisture and reduce evaporation.
- Implement efficient irrigation: Install a drip irrigation system or a soaker hose to deliver water directly to the roots of your plants, minimizing water waste.
- Capture rainwater: Install rain barrels or a cistern to capture rainwater and use it to water your plants.
- Use native rocks and gravel or other local soil surfaces: Incorporate native rocks and gravel into your landscape design to a reasonable extent to reduce the amount of lawn area, which requires regular watering. Heating of these surfaces must be taken into account (heat island effect).
- Consider the location of your plants: Place plants in areas where they will receive the right amount of sun and shade, as this can affect their water needs.

2.1.6. Involvement of the community during the development stage

When planning a hotel project, it is highly recommended to seek community involvement. It is inevitable that residents and business owners will be curious (and sometimes apprehensive) about the size and nature of the new development. By involving the community early on, you can help build a relationship of trust and mutual respect. Being open and transparent will benefit the hotel business and ensure to understand the positive impact of new developments, such as jobs and benefits for local businesses supporting hotel operations.

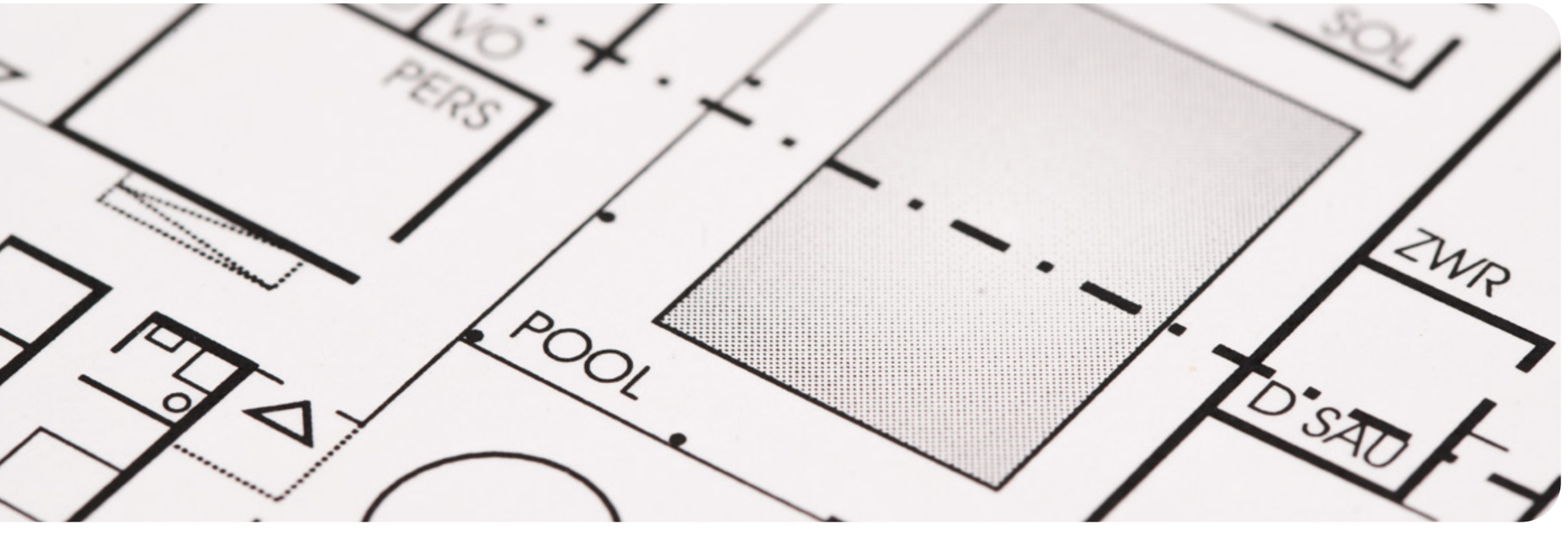
Community engagement also provides an opportunity to allay the concerns of local residents about environmental impact. Therefore, the following steps are recommended:

- Encourage local media to publish articles about the proposed hotel with the aim of outlining the positive impact of hotel operations on the community
- Invite the local community to a forum-style event where you can reiterate your plan. Make sure there is an opportunity to ask questions and to get involved in the progress of the project.
- Ensure that all local employment opportunities are well promoted
- Investigate procurement opportunities for local businesses

2.1.7. Consult with TUI sustainability managers and TUI architects

When planning the development of a hotel, the TUI Sustainability Manager and TUI In-house architects shall also be involved. Guidance is provided on how to ensure compliance with the supplied product specifications and how to ensure that key sustainability issues are addressed from the outset of the project.

Both experts have specialized knowledge and experience in implementing environmentally friendly and energy-efficient practices in hotel development and can help to comply with local, national, and international sustainability regulations and standards, reducing the risk of penalties and non-compliance issues.



Additionally, these experts can help to identify and implement cost-effective measures to reduce energy and water consumption, saving on operating costs and improving profitability.

By consulting TUI sustainability experts and TUI architects in hotel development, hotels can ensure that their projects are designed and built in a sustainable manner, promoting a positive impact on the environment and improving their bottom line.

2.1.8. Selection of suppliers with "green solutions" and expertise

Supplier selection for construction works, technical equipment, furniture and fixtures is a process by which the employer identifies, evaluates, and selects the suppliers of their required materials. Besides conventional criteria such as price and quality, sustainability criteria should also be taken into consideration.

Evaluating the suppliers of the required project materials and selecting the best suppliers is of great importance. Accordingly, some of the criteria for sustainable supplier evaluation and selection which best fit the stakeholders' expectations can be categorized into the following groups:

- Business criteria: Quality of the products and services, time of delivery, commitment to continuous improvement, information sharing, product development, flexibility in changing product volume, launching new products, using new technologies, warranty and insurance, and geographical location.
- Economic criteria: Initial price, financial stability and credit strength.
- Social criteria: No discrimination in employment (age, religion, gender, and other similar factors), child labour, flexible working arrangements, satisfactory working environment, health and safety of the staff and customers and customer privacy, promotion of social entrepreneurs.
- Environmental criteria: Environmental management systems for preventing and controlling pollution (such as emissions, effluents, and waste), resource consumption (energy, water, minerals), animal rights and recycling. Especially with regard to a circular business, material and products that have a high ration of recycled components contribute to a higher energy efficiency in the processing or production process of these materials.
- Innovation criteria: To be a role model and achieve even better performance, it takes courage to test and implement new innovations. This may be in contradiction to a purely economic approach, but it not only increases efficiency and the hotel's reputation but also contribute to a better sustainability performance.

2.2. Materials

In order to have the lowest possible impact on the environment and to reduce carbon emissions, materials should be selected in terms of the local availability and the transport route, the energy input in the production, the physical characteristics of the construction, the life cycle duration and reusability, and disposal or recycling compatibility.

With this regard, natural or bio-based materials can be a good alternative as well as composite materials taking also the challenge of appropriate recycling of composites into account.

2.2.1. Use of high thermal mass construction materials

Solid building components with a high density (e.g. stone, concrete) have a high thermal mass. It allows the material to absorb energy slowly and store it for a much longer period than the surrounding air or less dense materials. This has the advantage of delaying and reducing heat transfer through the material. Concrete and masonry are two common building materials with a high thermal mass.

The use of such materials in hotel construction has the following energy-saving advantages:

- Maintenance of cooler indoor temperatures during periods of high outdoor temperatures.
- Fewer spikes in the building's heating and cooling demand, as high thermal mass slows response time and moderates indoor temperature fluctuations. Smoothing energy demand also reduces the overall demand on the hotel's energy systems or the local electricity grid.
- Lower electricity tariffs by shifting energy demand to off-peak times, which are normally cheaper.
- Overall lower energy consumption and costs than a building with lower thermal mass due to reduced heat transfer.


Atlantica Imperial Resort

2.2.2. Roofs optimized for photovoltaic (PV) installation

Roofs are important areas for generating electricity production through solar energy. The yield of the so-called PV systems is directly dependent on the proportion of solar radiation, which depends on the orientation and latitude. In other words, the more the modules are aligned with the radiation and the closer the modules are to the equator, the higher the yield. Roof surfaces offer the possibility to install the modules free of shading without significantly influencing the operation of the hotel's processes.

The flatter the roof, the easier it is to align the modules with the direction of the radiation. Safe and permanent access to the roof surfaces enables the installation as well as regular maintenance and cleaning of PV modules.

By designing roofs optimized for photovoltaic installation, hotels can take advantage of the many benefits of solar energy, including reduced energy costs, increased energy independence, and a reduced carbon footprint.

If a roof is not suitable for a PV system, it should be checked whether greening the roof surface might be possible.

2.2.3. Sustainable building materials

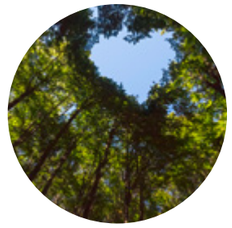
Sustainable building materials are materials that are produced, processed and used in a way that does not harm the environment and can be used with the same or a different purpose in a sustainable way for future generations. This includes factors such as the use of renewable resources, energy and resource use during production, waste generation, recyclability, the use of toxic chemicals and the release of emissions.

The aim is to use building materials that are ecologically compatible and resource-efficient, and to minimise the environmental impact. This can help reduce energy consumption and contribute to promoting a greener and more sustainable society.

Some examples of sustainable building materials are:

- Wood: It is a natural, renewable material that can be sustainably sourced if forests are properly managed. FSC and similar certificates – as international standards are an important way to now if things are properly managed.
- Clay: Clay is a locally available and sustainable building material that is derived from natural raw materials and has low emissions during production.
- Recycled materials: These include, for example, recycled concrete, steel and aluminium, which can be obtained from waste products and used for construction as well as contribute to a Circular Economy.
- Building biology materials: These materials, such as clay plasters, natural paints and ecological insulation materials, take sustainability into account as they are mainly natural, environmentally friendly and non-toxic.

It is important to note that the choice of sustainable building materials also depends on the local circumstances, the area of use and the life cycle of the materials.




2.2.4. Materials with short supply routes

The transport route of building materials can have a significant impact on the sustainability of a building, as it can contribute to increased CO_2 emissions and reduced environmental efficiency. The following are some of the impacts of the transport route of building materials on the sustainability of a building:

- CO_2 emissions: Transporting building materials over long distances requires the use of heavy-duty vehicles, resulting in increased CO_2 emissions.
- Wear and tear on roads: Transporting heavy construction materials can lead to increased wear and tear on roads, contributing to increased deterioration of the road network.
- Energy consumption: the transport of construction materials requires energy, which may be fossil fuels, leading to increased energy consumption.
- Environmental impacts: The transport of construction materials can lead to increased pollutant emissions and other negative environmental impacts, such as noise, particulate matter and pollution.

Overall, it is important to minimise the transport of building materials and use local materials to improve the
sustainability of a building. For that reason, the transport of materials and the related CO2 emissions should be taken into consideration when selecting materials and products. It is also important to use more environmentally friendly transport options to minimise the negative impacts of the transport route and contribute to a Net Zero approach in the long term.

2.2.5. Materials with long service lives

The lifespan of building materials has a direct impact on the energy-efficient operation of a building, as materials that wear out early may need to be replaced, which can incur additional costs and impacts on the environment. Some of the impacts are:

- Energy loss: building materials that age quickly can lead to deterioration of insulation and therefore higher energy loss.
- Repair and maintenance costs: Materials with a short lifespan may require more frequent repairs or maintenance, resulting in additional costs.
- Waste management: Materials with a short lifespan need to be disposed of early, which can lead to a higher amount of waste that needs to be disposed of.
- Sustainability: Building materials with a longer lifespan contribute to a more sustainable building operation as they can be used for longer and therefore produce less waste.

By choosing building materials with a longer lifespan, you can reduce a building's energy consumption, lower the cost of repairs and maintenance, and contribute to a more sustainable building operation.

2.2.6. Thermal material properties appropriate to the climate and weather

The choice of building materials should be based on the climatic region and weather conditions, as both have a major impact on the energy efficiency of a building. The following are some reasons why the choice of building materials should be based on the climatic region:

- Heat and cold losses: the type and amount of heat and cold losses a building experiences depends on the climatic region. In hot climates, it is important to block direct sunlight and reduce heat loss, while in cold climates, insulation of the exterior walls and roof is important for reducing heat and cold loss.
- Humidity: Humidity in different climatic regions can influence the choice of building materials, as certain building materials are better suited to prevent dampness and mould growth.
- Environmental conditions: Environmental conditions, such as rain, humidity and UV radiation, can affect the ageing behaviour and durability of building materials. In some climatic regions, certain building materials may age faster and need to be replaced than in others.
- Cost: The cost of building materials and energy can vary by climatic region, as some regions may require special measures to reduce energy demand.

By taking into account the specific requirements and conditions of the climatic region, one can select building materials that are best suited to optimise the energy efficiency of a building while meeting the needs of the environment and the specific requirements of the building.

2.2.7. Low energy consumption in material production

The production of building materials has an important influence on their energy balance. The energy balance refers to the amount of energy used to produce a building material compared to the energy it can save or generate later when used. The higher the energy cost of producing a building material, the lower its energy balance. Therefore, when choosing building materials, it is important to consider both their energy efficiency in production and in use.

When assessing the energy consumption in the production of building materials, several factors must be taken into account:

- Raw material extraction: The energy required to extract and prepare the raw materials plays an important role.
- Manufacturing process: The energy needed to process the raw materials into building materials can vary depending on the material.
- Transport: The energy consumption for transporting the raw materials and the finished building material should also be considered. See also section ‘Transport routes’.
- Recycling: Another important factor is the energy needed to recycle the building material when it is disposed of at the end of its life. See also chapter ‘Recycling’.

It is important to consider the whole lifespan of the building material, not just the production, to get a comprehensive assessment of energy consumption.

Building materials that have low energy costs in their production and use have a good energy balance. These include, for example:

- Wood: Wood is a renewable raw material whose production causes low energy costs. In addition, it stores CO_2 when used as a building material and thus contributes to the reduction of greenhouse gas emissions.
- Clay: Clay is a locally available and energy-efficient building material, as its production and processing require low energy costs. On the other hand, building materials whose production and use cause high energy costs have a poor energy balance, such as:
- Steel: The production of steel requires high energy costs due to the energy needed to melt and shape the raw material.
- Cement: The production of cement requires high energy costs because the raw materials have to be heated to high temperatures.
- Aluminium: The production of aluminium also requires high energy costs, as it also has to be melted at high temperatures.

However, it should be noted that each building material can have a different energy balance depending on the context and use, and it is important to take a holistic view.

2.2.8. Use of recycled materials

The use of recycled building materials can improve the energy efficiency of a building in several ways and also contribute to a Circular Economy.

- Energy savings during production: The production of recycled building materials often requires less energy than the production of virgin materials, resulting in a saving of CO_2 emissions.
- Higher insulation performance: Some recycled building materials, such as cellulose insulation, have higher insulation performance than their new counterparts. This can help reduce the energy needed for heating and cooling.
- Conservation of resources: The use of recycled building materials means that fewer raw materials need to be mined and processed, which helps to conserve natural resources and reduce the carbon footprint.
- Longer life: Recycled building materials can often be used for a longer period of time than new materials, which helps to reduce the need for energy and resources.

In summary, the use of recycled building materials can help improve the energy efficiency of a building by saving energy and resources and reducing CO_2 emissions.

Building materials that are typically easy to recycle include:

- Concrete
- Steel
- Aluminium
- Wood
- Brick

These materials are relatively straightforward to collect, sort and process for recycling. They can be melted down or broken down into their constituent parts, which can then be used to create new products. However, it is important to note that the ease of recycling can also depend on factors such as the level of contamination, the availability of recycling facilities, and the demand for recycled materials. Experts for proper recycling should be involved in this.

2.2.9. Circular Economy

Circular economy is an economic system that aims to keep resources in use for as long as possible by reducing waste and minimizing the use of raw materials and energy. It involves designing products, processes, and systems that minimize waste and pollution, and maximize the use of resources. The building and construction of hotels can benefit greatly from circular economy principles but also contribute to it.

Incorporating circular economy principles in the building and construction of hotels starts already in the design phase. This involves designing buildings with a focus on reducing waste and maximizing the use of resources. This can include using materials that are renewable, recycled, or biodegradable. Designers can also focus on designing buildings that are energy-efficient, with features such as solar panels, green roofs, and natural ventilation. The creation of an inventory of the materials used can be helpful here; when buildings are deconstructed after a few years, valuable materials can be reused or recycled in this way.

During the construction phase using materials that are locally sourced and that can be recycled or reused contribute to a circular economy. This can include using recycled concrete or reclaimed wood, and using modular construction techniques to minimize waste.

Circular economy principles can also be integrated into the operations and maintenance of hotels. This can include implementing energy-efficient practices, reducing water consumption, and using sustainable cleaning products. Hotel operators can also focus on reducing waste by implementing recycling programs, single-use

plastics items and hazardous waste in particular, composting, and reducing food waste as good as possible.

Overall, incorporating circular economy principles in the building and construction of hotels can result in more sustainable, efficient, and resilient buildings that benefit both the environment and the economy.

Here are some examples of circular economy principles in action:

- Design for durability and repair: Products are designed to last longer, with components that can be easily repaired or replaced. This reduces waste and extends the life of products.
- Renewable energy and resource use: Companies and communities rely on renewable energy sources, such as wind and solar power, and use resources more efficiently to reduce waste and pollution.
- Collaborative networks: Companies and communities collaborate to share resources and reduce waste. By working together, they can create new business opportunities and reduce their environmental impact.
- Closed-loop manufacturing: Closed-loop manufacturing is a process that aims to reduce waste by using recycled materials and designing products that can be easily disassembled and reused.
- Upcycling: Upcycling is the process of taking waste materials and turning them into something of higher value.
- Biodegradable materials: By using materials that can break down naturally, waste can be reduced and the impact on the environment is limited.
- Sharing and access: Rather than owning products outright, consumers share them through peer-to-peer networks or rental systems. This reduces the need for new products and reduces waste.
- Product-as-a-Service: Instead of selling products, some companies are shifting to a model where they offer products as a service. This means that customers pay for the use of a product, rather than owning it outright.
- Digitalisation: Digitalisation can help providing accurate information on the availability, location and condition of products to secure delivery on demand. This can also be an important aspect for hotel construction when several suppliers are involved. Digitalisation also enables more efficient processes, helps reducing waste, promotes longer life for products and minimises the transaction costs.
- Waste reduction and recycling: Waste is reduced by optimizing processes and materials. Waste is recycled and turned into new products or raw materials for other products. (see also 2.2.8.)
- Waste-to-energy: Waste-to-energy technologies convert waste materials into energy, reducing the need for fossil fuels. For example, some landfills are now equipped with technology that captures methane gas from decomposing waste and turns it into electricity.

These examples show how circular economy principles can be applied across industries and communities to create a more sustainable future.

2.2.10. Digitalisation and Internet of Things (IoT)

The Internet of Things (IoT) is the term used to describe the network of physical objects ("things") that are equipped with sensors, software and other smart technology to connect them to other devices and systems via the internet so that data can be exchanged between these objects. These devices range from ordinary household objects to sophisticated industrial tools, e.g. for construction.
IoT provides a solution where equipment, material, and staff are synchronised to a central server that regulates and monitors their activities in real-time.

The Internet of Things can have multiple approaches in construction to simplify or improve processes through the use of digitalization and technology.

- Planning process: The early use of 3D planning tools in the planning process can be used, for example, to simulate lighting and illumination scenarios that allow conclusions to be drawn for optimised room layouts.
- Building Information Modelling (BIM): The use of Building Information Modelling (BIM) can be an effective tool for early simulations and optimisations, especially for new buildings.
- Site monitoring: Site managers receive real-time information about the use of machines and the progress of processes and actions.
- Machine control: IoT sensors control machines with greater precision without human involvement.
- Site safety: IoT can accelerate actions that lead to greater worker safety, e.g. through digital safety checklists or in time training.
- Fleet management: IoT can be used to optimise fleet management, e.g. transport routes and vehicle maintenance, and ensure delivery in time.
- Project management: IoT devices can help reduce costs by reducing site monitoring.
- Wearables for construction workers: Some wearables can warn when workers are near a danger zone. They can provide real-time instructions on how to complete tasks safely and efficiently.

3.

Engineering and Energy management

3. Engineering and energy management

3.1. Energy efficiency & electrification

Electrification of hotels refers to the process of converting a hotel's energy systems to rely on electricity instead of fossil fuels. This usually goes hand in hand with a higher efficiency of the electrical installations and the reduction of CO2 emissions, especially if one is supplied with green electricity by the energy supplier or produces electricity from renewable energy sources oneself.

Electrification can be achieved and supported through a variety of means, including:

1. Replacing fossil fuel appliances with ones that run on electricity, e.g. a heat pump instead of oil heating or electric kitchen appliances instead of gas cookers.
2. Solar panels: Installing solar panels on the hotel's roof or on nearby land can provide a renewable source of electricity, reducing the hotel's reliance on appliances burning fossil fuel, e.g. a power generator.
3. Energy storage systems: Installing energy storage systems, such as batteries, can help to store excess energy generated by solar panels for use during periods of low solar generation.
4. Electric vehicles: Encouraging guests to use electric vehicles and providing charging stations on the hotel property can reduce emissions from transportation and promote sustainable mobility.

By electrifying their operations, hotels can reduce their carbon footprint, improve energy efficiency, and promote sustainable practices that are better for the environment. The process of electrification can also be accompanied by energy management and monitoring systems to help hotels optimize their energy use and minimize waste.

Electrification is one basic prerequisite for CO_2-free energy consumption, always supported by energy-saving measures and the purchase of electricity at a green tariff. Many hotels operate equipment and appliances unnecessarily. Measures to save energy should be integrated into standard hotel operating practices. To avoid high energy consumption all guest rooms as well as all F&B appliances should be as energy efficient as possible.

Using energy efficient appliances can have several benefits:

- Cost savings: Energy efficient appliances consume less energy, reducing the hotel's energy bills.
- Environmental sustainability: By reducing energy consumption, hotels can reduce their carbon footprint and contribute to environmental sustainability.
- Competitive advantage: Energy efficient hotels can differentiate themselves from competitors and attract environmentally conscious guests.
- Improved operations: Energy efficient appliances are often more reliable, require less maintenance and have longer lifespan, making them a good investment for the hotel.

TUI BLUE Atlantica Aeneas Resort

3.1.1. Use of energy efficiently guest room appliances

Some of the measures that hotels should implement in their guest rooms are as follows:

- Use of energy-efficient minibar, preferably one with the most efficient class, (e.g. "A" of the EU classification).
- Minibars shall be placed only in well-ventilated cupboards that comply fully with the appliance manufacturer's recommendations. Temperatures in poorly ventilated cabinets can reach up to 50°C, which can seriously affect the performance of a minibar and increase its energy consumption.
- TVs shall be energy efficient as defined by ENERGY STAR for hotels in American, Central American or South American destinations or the EU energy labelling scheme for all European destinations. For equipment in Asian hotel destinations one of both can be chosen.
- LED lighting is more energy-efficient than traditional incandescent lighting, using less energy and lasting longer. LED lighting can be used in lamps, overhead lighting, and other fixtures in hotel guest rooms.
- Smart thermostats for heating and air conditioning can be programmed to automatically adjust the temperature in the guest room based on the guest's preferences and schedule, reducing energy waste.
- If using an in-room kettle, the type with the right capacity for the number of people in the room (e.g. 0.5 litre jug for double room) shall be chosen. Large kettles waste energy as they tend to be overfilled by customers and end up boiling much more water than needed.

By using these and other energy-efficient appliances, hotels can reduce energy consumption, save on costs, and promote sustainability for the environment.

3.1.2. Use of energy efficiently appliances in all F & B facilities and Back-of-House facilities

The use of energy-efficient electrical appliances in all facilities of a hotel can help to reduce energy consumption and improve sustainability.

Some examples of energy-efficient appliances that can be used in various hotel facilities include:

- Energy-efficient lighting fixtures, such as LED lights, can be used in hotel lobbies, meeting rooms, and other public spaces to reduce energy consumption and improve lighting efficiency.
- Certified kitchen equipment, such as refrigerators, freezers, and ovens, can be used in hotel kitchens to reduce energy consumption and improve efficiency.
- Certified laundry equipment, such as washing machines and dryers, can be used in hotel laundry facilities to reduce energy consumption and improve efficiency.
- Certified HVAC systems, such as air conditioners and boilers, can be used in hotel facilities to reduce energy consumption and improve efficiency.

It is recommended to use a recognized label, like Energy Star or EU Label for equipment. By using these and other energy-efficient appliances in all hotel facilities, the hotel can reduce its energy consumption, save on costs, and promote sustainability for the environment. Additionally, implementing an energy management system can help the hotel monitor and optimize its energy use, further reducing waste and improving efficiency. When replacing equipment, it is recommended to compare the energy efficiency of the old and the new equipment to ensure that the new one is significantly more efficient.

TUI BLUE Sarigerme Park

TUI BLUE Bahari Zanzibar

3.2. Energy production & purchase

Beyond minimizing energy consumption, hotels should also incorporate renewable energy generation sources wherever possible, e.g. PV, geothermal, wind. This will reduce the overall environmental impacts and can provide attractive financial savings. Throughout all TUI Hotels & Resorts a consumption of up to 20 kWh of electricity consumption per person per day is recommended, local circumstances to be taken into account.

3.2.1. Green energy

Green energy providers are an important pillar in achieving carbon reduction. Where possible, TUI Hotels & Resorts should consider incorporating renewable energy into their operations, either through on-site initiatives or by purchasing through utility companies. Many now offer the option of purchasing electricity from 'green' or renewable sources for part, or all, of their power supply.

Power plants using renewable energy from sources such as wind, tidal and solar power are becoming more common and compliment the established technology of hydropower. Certification systems for Energy Attribute Certificates (EAC) have been developed in many countries worldwide to guarantee that the energy purchased comes from renewable sources.

When choosing to produce green energy onsite, some examples of renewable energy sources are:

- Solar energy - harnessing energy from the sun through solar panels and converting it into electricity.
- Wind energy - capturing the energy generated by wind through wind turbines and turning it into electrical power.
- Hydro energy - using the movement of water in rivers, streams, and oceans to generate electricity through hydropower dams.
- Geothermal energy - harnessing heat from the Earth's core to produce electricity through geothermal power plants.
- Bioenergy - using organic matter such as plant material, agricultural waste, and animal manure to generate energy through processes like anaerobic digestion or combustion.
- Tidal energy - capturing the energy generated by the tides to generate electricity through tidal turbines.
- Wave energy - harnessing the energy from ocean waves to produce electricity through wave energy converters.

3.2.2. Solar water heating systems

Solar water heating is a proven and readily available technology. It uses solar energy to replace or supplement the energy that would otherwise be provided by conventional water heating systems. Solar water heating systems can reduce the amount of energy needed to heat a hotel's domestic water throughout the year by more than 60% on average. However, they might need to be equipped with a backup heating system to meet hot water needs during bad weather or periods of particularly high-water consumption.

Ideally, this back-up system should be powered by a renewable energy source (e.g. renewable electricity or biogas) rather than traditional fossil fuels. Solar heating systems have minimal maintenance requirements, and the technical lifetime is around 15 to 20 years. As an alternative to solar water heating systems, PV systems can also be used to produce hot water with electricity generated by solar energy. This must be weighed up regarding an investment plan. See "PV systems".

3.2.3. PV systems

Photovoltaic systems are solar power generators that convert solar radiation into electrical energy. This is done in solar cells which are made of silicon. To increase the voltage of a cell from 0.5 volts to 20 to 50 volts, the cells are connected in series to form a PV module, which protects the cells mechanically and seals them against environmental influences. In the PV system, the modules are connected in series to form strings and connected to an inverter, which converts the DC voltage supplied by the cells into AC voltage. The electricity generated in this way can be fed into a public grid or consumed in the hotel itself (self-consumption). The service life of such PV systems is assumed to be 20 years.

In most cases, the modules are mounted on substructures that fix the cells to the sun. Alternatively, the modules can also be mounted on movable constructions in order to follow the sun during the course of the day. The power of the solar modules is measured in kWpeak (kWp). As of 2022, it takes about 5sqm of module area for 1 kWp. The yield of PV systems is directly dependent on the orientation and distance from the equator. Thus, 1kWp produces on average 1139 kWh per year in Paris, 1659 kWh per year in Seville and 1758 kWh per year in the Maldives with an optimal but fixed orientation.

3.2.4. Geothermal energy

Geothermal energy is a form of renewable energy derived from the heat inside the earth. Geothermal energy uses the earth's natural heat storage potential to generate electricity or for heating and cooling purposes. This is achieved by absorbing heat from the ground at deep hot rock layers and then transporting it to the surface. Geothermal energy can be obtained from conventional deep boreholes as well as from near-surface systems, such as geothermal power plants or heat pumps. Depending on the rock layer and subsoil, the possibilities for use must first be examined and confirmed.

Geothermal energy can be integrated into building services in a number of ways:

- Geothermal heat pumps: these use the underground heat storage potential to generate heat and conduct it into the house.
- Geothermal underfloor heating: Here, geothermal heat is distributed through a series of pipes in the floor to ensure even heat delivery.
- Geothermal cooling: Geothermal systems can also be used to cool buildings by absorbing cold energy from the ground and transferring it into the house.
- Combining heating and cooling: Some geothermal systems can be used for both heating and cooling purposes, resulting in more efficient and cost-effective use of energy.

Integrating geothermal into building systems can lead to a reduction in energy consumption and therefore lower energy costs. In addition, geothermal energy is a CO_2-neutral and reliable energy source that contributes to reducing climate change.

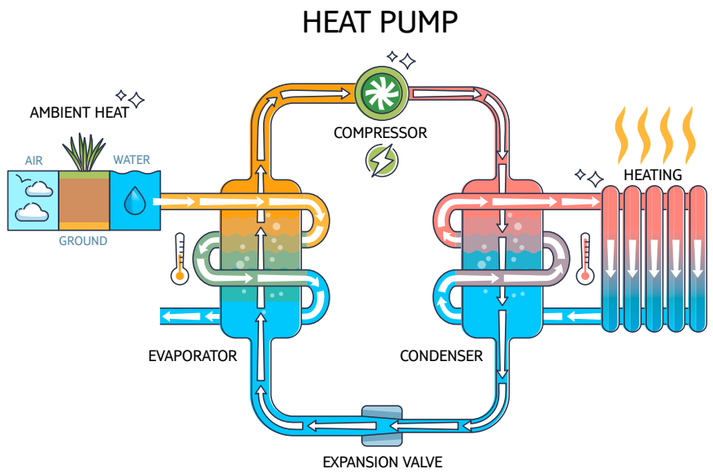
3.2.5. Wind power

Wind is a CO_2 -free energy source that can be used on site depending on the hotel's location and should be considered when climatic conditions are favourable. Although a large hotel may not be able to generate all its energy needs from wind power alone, this is an option that offers a significant return on investment.

An attractive, unobtrusive wind turbine could provide some of the energy while making a positive visual statement to customers and the community. The latest generations of the silent vertical wind turbines also allow the installation of swarm systems, which can be well integrated into a hotel complex. When selecting a site, shadow flicker and noise emissions should be taken into account.

3.2.6. Heat pumps / Combined heat and power plant

Heat pumps have the advantages of efficiency, sustainability and cost savings compared to gas and oil-fired heating systems. Heat pumps use energy from the ambient air, water or the ground to generate heat, whereas gas and oil-fired heating systems have to burn fuel. Heat pumps generate heat without the use of fossil fuels and therefore have lower CO_2 emissions. And in the long run, heat pumps can be more cost-effective because they use less energy. When planning to use a heat pump, the assessment should also cover the local climate and temperatures.



Combining a photovoltaic system and a heat pump can also enable a decentralised energy supply and reduce the need for electricity from the grid. If a heat pump is connected to a photovoltaic system and also to an energy storage system, the self-generated solar electricity can be used more efficiently, thus saving energy costs. The heat pump can use the solar electricity to generate heat instead of drawing electricity from the public grid. The energy storage system can store surplus solar electricity that would otherwise be fed into the grid unused and use it for the heat pump when solar energy is not available. In this way, one can reduce the energy demand of the heat pump and at the same time reduce the dependence on fossil fuels.

Replacing fossil-fuelled heating systems with heat pumps is part of the electrification drive. This plays an important role in achieving climate targets, as it allows the use of renewable energy to be increased and CO_2 emissions to be reduced. Electric appliances and systems are generally more efficient and have lower energy consumption than their fossil-fuelled counterparts. In addition, green electricity from renewable sources.

3.2.7. Facade air-collector

A façade air collector is a component used in building energy efficiency. It is a system that is mounted on the outside of a building façade and uses the outside air to provide heating or cooling for indoor use.

The system works in a similar way to a heat pump, using a heat exchanger to take the energy from the outside air and convert it into a suitable form for indoor use. A façade air collector can be used to heat and/or cool buildings, contributing to energy efficiency and reducing energy consumption.

Façade air collectors are a cost-effective and environmentally friendly alternative to conventional air conditioning and heating systems because they use energy from the environment instead of generating or importing it.

Beside the wall mounted air collector there are many types of façade air collectors available, the type of collector used will depend on the specific needs and requirements of each building:

- Venturi air collector: This type of collector uses a venturi shaped structure to create a pressure difference and draw in air, which is then heated as it passes over the heat exchanger.
- Roof-mounted air collector: This type of collector is installed on the roof of a building and uses the natural airflow on the roof to capture and heat air.
- Louvered air collector: This type of collector uses louvers or slats to direct air into the collector where it is heated.
- Inclined air collector: This type of collector is installed on a slope or incline and uses the natural airflow to capture and heat air.


TUI BLUE Montafon

3.2.8. Biogas

Biogas is produced from energy crops, wastewater, green waste, manure or recycled biomass and is a carbon dioxide CO_2 neutral energy source that can be used for all heating purposes, including cooking. Like natural gas, biogas can be compressed, transported and stored in tanks. Existing boilers can often be converted to biogas. As a renewable fuel, biogas is eligible for energy subsidies in many parts of the world, making it an attractive option. At no time should the production of biomass for biogas generation compete with food production.

Examples of where this fuel source can be used in a typical hotel operation include:

- In the kitchen as a substitute for natural gas or LPG
- As a substitute gas for a solar water heating system
- For garden machinery as a substitute for petrol or diesel
- For gas-powered clothes dryers

3.3. Energy storages

Energy storage is an important component for a sustainable hotel that does not use fossil fuels. By storing surplus energy, hotels can use energy efficiently while reducing their dependence on external energy sources. There are different types of energy storage suitable for use in hotels. These range from battery storage to compressed air storage to power-to-gas and ice storage.

3.3.1. Battery storage systems

Battery storage systems are an important component of a sustainable energy concept for hotels. They make it possible to store the electricity generated from renewable energy sources and to retrieve it when needed. This allows hotels to reduce their dependence on external electricity suppliers and make their energy supply more sustainable.

Through the intelligent control of the battery storage, the energy demand of the hotel can be optimised. For example, the power demand during peak load times can be balanced by using battery storage. In addition, battery storage can also serve as an emergency power supply and provide the hotel with energy in the event of a power failure.

The selection of the appropriate battery storage technology depends on various factors, such as the size of the storage, the performance, the lifetime and the costs. There are different types of battery storage on the market, such as lithium-ion batteries, lead-acid batteries or redox flow batteries. Each technology has its advantages and disadvantages, and the choice of the appropriate technology depends on the specific requirements of the hotel.

Battery storage can be a valuable addition to a sustainable energy concept for hotels. Through intelligent control and the choice of suitable technology, hotels can increase their energy efficiency, save costs and at the same time make an important contribution to climate protection.

3.3.2. Compressed air storage

Compressed air storage is another way to use renewable energy in a sustainable energy concept for hotels. The principle of a compressed air storage is simple: surplus energy from renewable sources such as wind and solar energy is used to compress air in a container. When there is a demand, the compressed air is released again and drives a turbine to generate electricity. Compared to battery storage, compressed air storage systems have a longer lifespan and can store larger amounts of energy. In addition, they can be flexibly scalable and also serve as a heat source to heat the hotel. However, they are more expensive to purchase and maintain than battery storage systems and require special infrastructure, such as a suitable compressed air network.

The choice of a suitable compressed air storage unit depends on various factors, such as the size of the storage unit, the compression capacity, the storage volume and the cost. There are different types of compressed air storage on the market, such as adiabatic compressed air storage or isothermal compressed air storage.
Compressed air storage can be an interesting alternative to battery storage to use renewable energy in a sustainable energy concept for hotels. By choosing the appropriate technology and careful planning and installation, hotels can increase their energy efficiency and make an important contribution to climate protection.

3.3.3. Power-to-gas

Power-to-gas (PtG) is an innovative approach to storing surplus energy from renewable sources that can also be relevant for hotels. PtG uses electrolysis to produce hydrogen from surplus electricity. The hydrogen can then be used for various purposes, such as fuel for fuel cell vehicles or to generate electricity and heat in a combined heat and power (CHP) plant. In addition, the hydrogen can be converted into methane, which can be stored and transported as a renewable gas.
A PtG plant can thus serve as a temporary storage facility for surplus electricity and flexibly supply energy when renewable energy production fluctuates. PtG also offers the possibility of integrating renewable energy in the form of gas into existing infrastructure such as the gas network. Thus, PtG can also be used as part of a smart energy concept for hotels.
However, there are some challenges with PtG technology. The electrolysis of water requires a lot of energy, which reduces the efficiency of the technology. In addition, the costs for the PtG plant and hydrogen production have to be taken into account. The economic viability of PtG also depends on the availability of renewable energy and the infrastructure for storing and transporting gas.
In summary, PtG offers a promising possibility to store surplus energy from renewable sources and to use it flexibly. For hotels, PtG can be a sustainable and flexible alternative to conventional energy sources if the technology is carefully planned and integrated into the existing energy concept.

3.3.4. Ice storage

An ice storage tank, which consists of a cistern with concrete walls and large spirals of pipes, is part of an ice storage heating system alongside a brine-to-water heat pump.
During operation of the ice storage heating system, the first heat exchanger extracts the energy from the liquid water and transfers it to the heat pump. The resulting heat can be used for heating and hot water production. Through the regeneration heat exchanger, heat is supplied to the cistern from the solar air absorber or another heat source.

Another advantage of ice storage heating is the use of crystallisation energy. The ice energy storage tank supplies energy even when the water freezes into ice. An ice storage tank with a volume of ten cubic metres provides the same amount of energy as burning 110 litres of heating oil.
The advantages of ice storage heating are the use of free ambient heat, geothermal heat and crystallisation energy, a regeneration process that can be repeated at will, safe and economical operation, and permit-free installation because no deep drilling is required.

3.4. Heating, ventilation and air conditioning (HVAC)

Precisely determine the need for thermal comfort and efficiently serve it with the latest technology.

Sufficient thermal insulation of roofs and exterior walls of air conditioned or heated areas as well as insulating pipes, storage tanks and other surfaces in hot or chilled water distribution systems can achieve significant energy savings.

3.4.1. Insulation of exterior walls and roofs of air conditioned and heated spaces

Insulating exterior walls and roofs of air-conditioned and heated spaces helps to reduce heat transfer, leading to a more energy-efficient and comfortable living or working environment. By reducing heat transfer, insulation helps to keep interior spaces cooler in the summer and warmer in the winter, reducing the workload on heating and cooling systems, which can lower energy bills and increase equipment longevity. Additionally, insulation can improve indoor air quality by reducing drafts, moisture intrusion, and limiting the growth of mould and other allergens.

To insulate exterior walls and roofs of air conditioned and heated spaces, you can use different types of insulation materials, including:
Fiberglass Batts: This is a popular option and can be easily installed between wall studs or in attics.
Spray Foam: Spray foam insulation can be applied to wall cavities and roof spaces and forms a complete air barrier.
Rigid Foam: Rigid foam boards can be attached to the exterior of walls or used as roof insulation and provides high R-value insulation.
Blown-In Cellulose: This type of insulation can be blown into wall cavities or attics to provide a dense layer of insulation.
Reflective Insulation: Reflective insulation is made up of radiant barrier sheets that reflect heat away from the building.

It's recommended to choose an insulation material with a high R-value (measure of resistance to heat flow) that is appropriate for your climate, building type, and budget. Professional installation is recommended to ensure proper insulation and maximize energy savings.

3.4.2. Insulation of pipes and surfaces in hot water and chilled water distribution systems

Insulating pipes and surfaces in hot water and chilled water distribution systems is important for several reasons:

- Energy efficiency: Insulation helps to reduce heat loss in hot water pipes and heat gain in chilled water pipes, leading to a reduction in energy consumption and lower energy bills.
- Temperature control: Insulation helps to maintain the desired temperature of the water in the pipes, preventing it from cooling too quickly in hot water systems and from warming too quickly in chilled water systems.
- Comfort: In heating systems, insulation helps to prevent condensation and drips from forming on pipes, improving the overall comfort and safety of the building.
- Noise reduction: Insulation helps to reduce the noise created by water flowing through pipes, improving the acoustics of the building.

In summary, insulating pipes and surfaces in hot water and chilled water distribution systems improves energy efficiency, temperature control, comfort, and noise reduction.

Here are a few methods for insulating pipes and surfaces in these systems:

- Pipe insulation: This can be done using materials such as fiberglass, foam, or elastomeric foam. The insulation is wrapped around the pipes and secured with tape or wire.
- Surface insulation: This can be done using materials such as foam board insulation or reflective insulation. These materials are applied directly to the surface and then covered with a vapour barrier to prevent moisture build-up.
- Insulated jackets: Pre-manufactured insulated jackets can also be used to cover pipes and equipment. They come in a variety of materials, including foam and fiberglass, and are easy to install.
- Insulated valves and fittings: Installing insulated valves and fittings can help reduce heat loss at these points in the system.

Note: It is important to ensure that the insulation material and thickness used is appropriate for the temperature range and service conditions of the specific system.

3.4.3. Insulate all refrigerant suction lines of air conditioning systems

Insulating refrigerant suction lines in air conditioning systems helps to reduce heat loss and prevent condensation from forming on the outside of the pipes. This helps to maintain the temperature and pressure of the refrigerant, improving the efficiency of the system and preventing the growth of mould and mildew.

Additionally, insulating the pipes reduces noise transmission from the refrigerant moving inside the pipes to the surrounding environment.

It is important to follow the manufacturer's instructions and guidelines when installing insulation to ensure that it is installed correctly and provides the intended benefits.

3.4.4. Protect all pipe insulation that is exposed to the elements

Exposed pipe insulation can deteriorate rapidly due to weather and environmental factors, leading to decreased insulation performance and potential failure. Protecting exposed pipe insulation with a weather-resistant covering helps to extend its lifespan and maintain its insulating properties, ensuring the efficient operation of the piping system and reducing the risk of energy waste and system failure.

To protect exposed pipe insulation, you can use the following methods:

- Encapsulation: Wrap the insulation with a weather-resistant material, such as a polyethylene or PVC jacket, to protect it from moisture, UV rays, and other environmental factors.
- Coating: Apply a protective coating, such as silicone or polyurethane, to the insulation surface to prevent moisture penetration and extend its lifespan.
- Covering: Install a physical cover, such as a metal or plastic shroud, over the exposed insulation to protect it from the elements.
- Painting: Use a paint specifically designed for insulation materials to protect against UV rays and weather damage.

It's important to choose the right method based on the specific requirements of your piping system and the environmental conditions it will be exposed to.

3.4.5. Heat recovery ventilation

Heat recovery ventilation systems in hotels are used to provide fresh air to the building while conserving energy. These systems work by extracting heat from the outgoing air and using it to warm the incoming air, thus reducing the amount of energy required to heat the building. This results in a more comfortable indoor environment, lower energy bills, and improved indoor air quality. Additionally, these systems can help reduce the amount of pollutants and allergens in the air, making them especially beneficial for hotels where guests may have sensitivities to indoor air quality.

A heat recovery ventilation (HRV) system typically consists of two main parts: an air-to-air heat exchanger and a ventilation unit. The ventilation unit draws air from the inside of the building and passes it over the heat exchanger, where the outgoing air gives up its heat to the incoming air. The warmed incoming air is then distributed throughout the building, while the cooled outgoing air is exhausted outside. This process allows the HRV system to provide fresh air to the building while conserving energy, as it reduces the amount of energy required to heat the incoming air. Additionally, the heat exchanger can also filter out pollutants and allergens, improving indoor air quality.

Heat recovery ventilation (HRV) systems offer a number of benefits, including:

- Energy efficiency: HRVs conserve energy by extracting heat from outgoing air and using it to warm incoming air, reducing the amount of energy required to heat the building.
- Indoor air quality: HRVs can improve indoor air quality by removing pollutants, allergens, and moisture from the air.
- Increased comfort: HRVs provide a constant supply of fresh air to the building, which can improve indoor air quality and make the environment more comfortable for occupants.
- Cost savings: By conserving energy and reducing the need for heating, HRVs can result in lower energy bills.
- Improved health: HRVs can help reduce the levels of indoor pollutants, which can improve respiratory health and reduce the risk of certain respiratory illnesses.
- Increased longevity of building components: By removing excess moisture and controlling indoor air quality, HRVs can help extend the life of building components, such as walls, floors, and ceilings.
- Reduced greenhouse gas emissions: By conserving energy, HRVs can help reduce greenhouse gas emissions associated with heating and cooling buildings.

3.4.6. Use of fans and natural ventilation

Optimizing the use of fans and natural ventilation is important because it can lead to significant energy savings and improved indoor air quality, also being influenced by the building design and its layout.
The advantages are:

- Energy savings: By using fans and natural ventilation to control air flow and temperature, buildings can reduce their reliance on mechanical heating and cooling systems, which can be energy intensive.
- Improved indoor air quality: By circulating fresh air into a building and removing stale air, fans and natural ventilation can help improve indoor air quality and reduce the levels of pollutants and allergens in the air.
- Increased comfort: By controlling air flow and temperature, fans and natural ventilation can help create a more comfortable indoor environment for building occupants.
- Reduced greenhouse gas emissions: By reducing the energy required for heating and cooling, optimizing the use of fans and natural ventilation can help reduce greenhouse gas emissions associated with buildings.
- Cost savings: By reducing energy usage and improving indoor air quality, optimizing the use of fans and natural ventilation can result in lower energy bills and improved health outcomes, which can lower healthcare costs.

There are several strategies to optimize the use of fans and natural ventilation in a building:

- Conduct a thorough assessment: Conduct a building assessment to determine the best strategies for optimizing the use of fans and natural ventilation. This may include evaluating the building envelope, mechanical systems, and the indoor environment.
- Control air flow: Install fans and vents to control air flow and promote natural ventilation. The fans can be used to draw fresh air into the building and exhaust stale air, while vents can be used to control the amount of fresh air entering the building.
- Maximize natural light: Maximize the use of natural light by installing windows and skylights, and by positioning desks and other furniture near windows.
- Monitor indoor air quality: Install sensors and other monitoring equipment to monitor indoor air quality, temperature, and humidity levels. This information can be used to adjust fan and ventilation systems to ensure optimal indoor air quality.
- Use passive cooling strategies: Implement passive cooling strategies, such as shading devices and green roofs, to reduce the need for mechanical cooling.

3.4.7. Avoiding loss of refrigerants

Loss of refrigerants can lead to several issues, such as:

- Inefficiency: Loss of refrigerant means that the cooling system has to work harder to maintain the desired temperature, leading to increased energy consumption and higher costs.
- Environmental impact: Refrigerants are often potent greenhouse gases, and their release into the atmosphere can contribute to climate change.
- Safety: Some refrigerants are flammable or toxic, and their release can pose a safety risk to people and the environment.

Therefore, it is important to avoid the loss of refrigerants in order to maintain the efficiency and safety of the cooling system and reduce its impact on the environment.

Currently, there are a few options for refrigerants with little emission potential, including:

- Carbon Dioxide (CO_2): CO_2 is a naturally occurring refrigerant that has zero ozone depletion potential. Nevertheless, as CO_2e emissions should be reduced and avoided as good as possible, the use of CO_2 even in a closed system should be checked carefully.
- Ammonia (NH3): Ammonia is a natural refrigerant that has zero ozone depletion potential and a low global warming potential.
- Hydrofluorolefins (HFOs): HFOs are synthetic refrigerants that have zero ozone depletion potential and a low global warming potential.
- Water: Water can be used as a refrigerant in certain applications, although it is not typically used in traditional refrigeration systems.

It's worth noting that the selection of a refrigerant will depend on the specific application and requirements, such as cooling capacity and efficiency, safety, availability and cost.

3.4.8. Air purification technologies

An air purification system is a device or device system designed to remove pollutants, allergens, and other harmful particles from the air in a room or enclosed space. The specific method used to purify the air may vary, but commonly used methods include filtration through materials like HEPA filters, ionization, UV-C light, and activated carbon. The goal of air purification systems is to improve indoor air quality by removing or reducing the concentration of harmful particles, such as dust, pollen, pet dander, mould spores, and other allergens, as well as pollutants such as smoke, chemical vapours, and volatile organic compounds.

Overall, using air purification systems in hotels can provide numerous benefits, including improved indoor air quality, increased guest satisfaction, enhanced reputation, improved health, and reduced maintenance costs.

There are several reasons why hotels may choose to use air purification systems:

- Improved Indoor Air Quality: By removing harmful pollutants and allergens from the air, air purification systems can improve the indoor air quality of a hotel, creating a more comfortable and healthier environment for guests and staff.
- Increased Guest Satisfaction: Guests expect high levels of cleanliness and comfort when staying in a hotel, and clean air is a key component of that experience. By installing air purification systems, hotels can demonstrate their commitment to providing a safe and healthy environment for guests.
- Enhanced Reputation: Hotels that invest in air purification systems can differentiate themselves from competitors and enhance their reputation as a clean and modern establishment, which can help attract more guests and improve overall customer satisfaction.
- Improved Health: Exposure to pollutants and allergens can exacerbate respiratory issues for some people, and air purification systems can help reduce these risks for hotel guests.
- Reduced Maintenance Costs: By removing pollutants and allergens from the air, air purification systems can help reduce the frequency and costs of cleaning and maintenance, making them a cost-effective solution for hotels in the long term.

The process of installing an air purification system can vary depending on the specific system, but here are the general steps involved in the installation process:

· Choose a suitable location: The air purification system should be placed in a location that allows for proper airflow and circulation of purified air throughout the room.

· Prepare the location: Clean the area where the air purification system will be installed and ensure that it is free of obstructions.

It's important to note that some air purification systems may require professional installation, particularly those that are more complex or require more extensive modifications to the existing HVAC system. In these cases, it's recommended to consult with a professional to ensure that the installation is done correctly and safely.

3.4.9. Swimming pool heating

When implementing a heated swimming pool, the following factors shall be considered:

- Location: Choose a suitable location that takes into account access, privacy, views as well as access to required infrastructure, e.g. pipes and pumps.
- Size and shape: Determine the appropriate size and shape of the pool to fit the space and meet your needs.
- Safety features: Consider safety features such as fencing, alarms, and covers to ensure that the pool is secure and safe for all users.
- Professional help: Consider working with a professional pool builder and/or designer to ensure the pool is constructed to meet industry standards and your specific requirements.
- Heating system: Choose a heating system that is efficient, cost-effective, and suitable for your climate and usage patterns.

Reducing energy consumption in heated swimming pools can be achieved through the following methods:

- Efficient heating system: Choose an energy-efficient heating system, such as a heat pump or solar panels, to reduce energy costs.
- Insulation: Install insulation around the pool and equipment to minimize heat loss and reduce energy consumption.
- Pool covers: Use a pool cover to reduce heat loss and conserve energy, especially during periods of non-use.
- Thermostat control: Install a programmable thermostat to control the pool temperature and regulate energy consumption.
- Water circulation: Ensure proper water circulation to distribute heat evenly and reduce energy consumption.
- Energy-efficient lighting: Install energy-efficient lighting, such as LED lights, to reduce energy consumption and lower costs.
- Regular maintenance: Regular maintenance of the heating system and equipment can help reduce energy consumption by ensuring that the system is operating efficiently.
- Energy-saving habits: Encourage energy-saving habits among guests and staff, such as turning off lights and equipment when not in use, and reducing time spent heating the pool.

By implementing these energy-saving strategies, you can significantly reduce energy consumption in your heated swimming pool and lower your energy costs.

Robinson Club Cala Serena


Grupotel Farrutx

3.5. Lighting

A lighting concept should be the basis of all lighting, which is efficiently implemented with the latest energy-saving technology.

Hotels should avoid the use of incandescent and halogen lamps and instead utilize energy-efficient alternatives, such as light emitting diodes (LEDs).

3.5.1. Lighting design and layout

Professional lighting design helps to consume less energy by ensuring that the light in a space is used optimally. A lighting design should ensure that the brightness in the room is set to a comfortable level without over- or under-lighting. And the use of daylight should be encouraged as much as possible, as it is free and energy efficient.

Good lighting design should ensure that the lighting in the room is only switched on when it is actually needed. This can be achieved by using timers or motion detectors.

Lighting design should focus on the use of energy-efficient lighting solutions such as LED lamps, which consume less electricity and have a longer lifespan.

With all this, the design helps to reduce energy consumption by ensuring that the light in a space is used efficiently. In addition, professional lighting design can also help to create a pleasant ambience.

3.5.2. Energy efficient LED lamps

Replacing conventional lighting systems with energy-efficient lighting solutions such as LED lamps can help to reduce CO_2 emissions, as the following points have a positive impact on building performance.

- Efficiency: Energy-efficient lighting solutions consume less electricity than conventional systems, which leads to a reduction in energy consumption and thus CO_2 emissions.
- Lifespan: LED lamps have a longer lifespan than conventional light bulbs, leading to a reduced need for replacement and thus a reduction in energy consumption and CO_2 emissions.
- Production: The production of LED lamps requires less energy than the production of conventional light bulbs, which contributes to a reduced CO_2 impact.
- Disposal: Energy-efficient lighting solutions contain fewer hazardous substances than conventional systems and are easier to recycle, which contributes to a reduction in CO_2 emissions.

Overall, replacing conventional lighting systems with energy-efficient solutions helps to reduce energy consumption and thus CO_2 emissions and is an important step towards a more sustainable future.

3.5.3 Occupancy sensors to control the operation of lighting circuits

Installing presence sensors can save energy by enabling automatic control of lighting and other electrical devices. These sensors monitor the room and switch the lights and other appliances on and off depending on whether someone is in the room or not. This prevents lights and appliances from running unnecessarily when they are not in use. This leads to a reduction in energy consumption and thus to savings in energy costs.

The following are some key details about occupancy sensors for lighting control:

- Types of Sensors: Occupancy sensors can use infrared, ultrasonic, or passive infrared (PIR) technology to detect motion. Infrared sensors use an infrared beam to detect movement, while ultrasonic sensors use high-frequency sound waves. Passive infrared sensors detect changes in infrared energy in a room caused by movement.

- Operation: Occupancy sensors can be connected to a lighting circuit and can be set to automatically turn the lights on when someone enters a room. The sensors can also be set to turn the lights off after a set period of time, such as 15 minutes or 30 minutes, if the room is unoccupied. This helps to conserve energy and reduce electricity costs.
- In addition, sensor-controlled lighting can also help reduce light emissions/pollution, especially outdoors.
- Adjustable Settings: Occupancy sensors typically have adjustable settings, such as the sensitivity of the motion detection, the time delay before turning the lights off, and the minimum and maximum light level. This allows users to customize the operation of the sensors to suit their specific needs.
- Energy Savings: Occupancy sensors can help to conserve energy and reduce electricity costs by automatically turning lights on and off as needed. By reducing the amount of time that lights are left on when a room is unoccupied, occupancy sensors can help to reduce energy usage and save money.
- Convenient and Efficient Lighting Control: Occupancy sensors provide convenient and efficient lighting control by automatically turning lights on and off as needed. This eliminates the need for manual control of lights and provides a more comfortable and efficient lighting environment.

Overall, occupancy sensors are a useful and cost-effective way to control the operation of lighting circuits and help conserve energy and reduce electricity costs.

3.6. Water supply and fixtures

Water is valuable and consumption should be planned to conserve resources for several reasons:

- Essential for life: Water is necessary for all living things to survive and is a key component of all biological processes.
- Scarcity: In many parts of the world, fresh water is scarce, making it a valuable resource for communities and nations.
- Agricultural and Industrial Uses: Water is used in many industrial processes, such as manufacturing, energy production, and agriculture.
- Health and Sanitation: Clean water is crucial for maintaining good health and hygiene, and is essential for preventing the spread of water-borne diseases.
- Recreational Uses: Water is also valuable for recreational activities, such as swimming, boating, and fishing.

Overall, water is a finite and crucial resource, making it valuable to individuals, communities, and nations.

3.6.1. Water conditioning systems

Water conditioning systems are required in many resort locations to 'soften' the water supply, removing calcium and magnesium ions before the water can be used in hot water boilers
or potentially across all the resort. 400 to 550 litres of potable and service water consumption per person per day is a reference value for water consumption but it highly depends on hotel product, layout and quantity of pools and other water features).

Depending on the water quality on site, electronic water treatment is recommended as an alternative to traditional ion exchange water softeners or chemical-based water softeners.

An electronic water softening system is an efficient and energy-saving device designed to eliminate the problems of hard water, whilst retaining the natural benefits. This is achieved by changing the properties of the particles of precipitated compounds, by aiding the ability of crystals to form their shape, and by altering the solubility of compounds within liquid.

This is achieved by promoting crystal growth in the bulk of the water, rather than on surfaces like pipe walls, shower heads or heat exchangers. These crystals flow with the water, have less or no
surface charge and will therefore not adhere to other surfaces.

Key advantages of electronic water treatment systems over ion exchange softeners include:

- They are virtually maintenance-free
- They expend the least amount of energy
- Compared to ion exchange softeners, they do not use water that must be backwashed, regenerated and rinsed
- Unlike ion exchange water softeners, they do not require salt regeneration and do not discharge wastewater with very high concentrations of calcium and sodium (which would reduce their irrigation value).

3.6.2. Shower flow rates

The maximum flow rate of showers installed in guest rooms, staff locker rooms and other hotel areas shall not exceed 8 litres per minute (l/min). Showerheads that generate higher flows of wastewater and energy should be replaced with high-efficiency showerheads or fitted with effective water saving devices such as flow restrictors or shower flow regulators.

- High-efficiency showerheads are designed to provide your clients with a satisfying shower flow while using only 8 L/min at the lowest limit. They are readily available on the market in a variety of qualities, materials and styles.
- Flow restrictors are small, perforated discs, made of copper, stainless-steel or hard plastic, that are placed upstream of the showerheads to restrict

their output to more than 8 L/min.

- Shower flow controllers are water conservation devices that are installed upstream of the showerheads to reduce their maximum output to 8 or 10 L/min, depending on the flow controller model used.
- Flow controllers are more sophisticated and generally perform better than flow restrictors. For example, some are equipped with a pressure compensating feature that allows them to generate their nominal flow over a wide range of water pressures.

3.6.3. Water saving / efficient taps

It is very common to find wasteful taps that consume 10 to 25 litres per minute (L/min) in hotel areas where such high flows are completely unjustified, wasteful and costly. Allowing taps to generate needlessly high flows wastes water and energy, increases splashing problems, and provides no benefits. A possible exception is a tap that is used solely to fill the bathtub – a hotel would not wish to frustrate its customers by it taking longer than necessary to run a bath.

The maximum flow output of taps should ideally be limited to:

- 5 L/min in customer bathrooms; and
- 8 to 10 L/min in all bars, kitchens, laundry and other work areas

The taps that are used to fill cooking pots and the pot washing sinks are among the few hotel taps that may need to generate flows greater than 10 L/min. The measures that can be taken to reduce the output of inefficient taps include:

- Fitting taps with aerators that are designed to generate the desired flow rate.
- Partially closing angle valves that are often installed on the pipes that convey water to the tap.
- Using flow restrictors to reduce the output of high-flow taps.

When installing new taps, the supplier should ensure they are positioned correctly so that the water stream they produce is easy to access and away from the edge of the sink.

3.6.4. Water-efficient toilets

It makes sense to ensure that toilets are as water efficient as possible. Ideally, all toilets installed in customer, staff and public bathrooms should be dual-flush models, which use a partial flush for liquid wastes and a full flush of six litres or less.

Additional, dry urinals in public toilets shall be taken into consideration. A dry urinal (also waterless urinal) is a urinal with a drain but without a water flush. Conventional urinals require at least three litres of water per flush, while waterless ones function entirely without water or flushing device.

Some of the issues that should be considered when selecting water-saving toilets are summarized below:

- Ensure the double-flush mechanism is clear and there is no ambiguity over how it should be operated by both customers and employees.
- Dual-flush toilets save water only if the users understand how they work and are able to operate them easily. Select toilets that are made by reputable manufacturers that have a proven track record.
- Select toilets that can be easily maintained with the resources and spare parts that are available in the local market.
- Standardize the types of toilets, fill valves and flush valves that are installed in the hotel in order to facilitate repairs and maintenance operations

3.6.5. Water conservation measures in irrigation operations

The maintenance of landscaped areas can be a water-intensive activity.
Measures that can be implemented to reduce water consumption and costs are summarized below:

- If possible, use treated wastewater for irrigation. However, ensure that the way in which the treated wastewater is used complies with applicable legal requirements and does not endanger the health and safety of staff members and customers.
- Install a water meter on the irrigation system to measure the amount of water consumed in the grounds and gardens.
- Regularly record and monitor the consumption of irrigation water, set targets and expect improvements in water efficiency.
- Install drip irrigation system in garden beds and similar areas.
- Install fixed sprinkler systems in lawns so that these areas can be easily irrigated at night to reduce evaporation to a minimum.
- Irrigate lawns, garden beds and other landscaped areas during the coolest hours of the day (preferably between sunset and sunrise) to minimize losses from evaporation.

3.6.6. Grey water treatment & reuse system / Use of treated water for irrigation

Grey water recycling systems are used to recycle wastewater that does not contain food or human waste. Typically, water from baths, showers, sinks and laundry is sent to an on-site treatment system where it is treated to a level where it can be safely reused for toilet flushing and irrigation.

Hotels can significantly reduce water use by installing separate grey water recovery systems, which require less treatment than black water treatment systems (including food and human waste). Grey water treatment systems (again where legally permitted) are ideally integrated as part of new hotel developments. However, if the hotel is undergoing a major renovation, retrofitting the grey water recovery system may be an option and should be considered during the design phase.

Garden irrigation: Hotels not connected to municipal or municipal wastewater collection and treatment systems should evaluate the technical feasibility of treating wastewater on-site and reusing treated wastewater for irrigation, where legally permitted.

Where possible, the use of treated wastewater for irrigation offers hotels a way to significantly reduce overall water demand, as well as an environmentally responsible alternative to wastewater treatment. However, due to the serious health risks associated with improperly treated wastewater, it should not be considered unless hotels are willing to invest in the technology and skills required to convert their wastewater into water that can be safely used for irrigation.

3.6.7. Rainwater harvesting

In many areas of a hotel, with proper system design, clean water can be collected and reused in various areas of hotel operations without treatment. Significant water savings can be achieved by capturing the stream of clean water that would otherwise be discarded.

Potential sources of clean water flow as a by-product of certain engineering processes include: condensate from cooling coils in air handling units and air conditioning fan coil units, chilled water from water-cooled chillers, and melt water from ice machines.

Natural rainwater harvesting is another potential source of clean water at certain times of the year in many tourist destinations. Rainwater can be collected directly from building roofs and used for various purposes, rather than channelling rainwater from the outside to a central storm water or sewage collection system.

Whether it is rainwater or clean condensate, with appropriate piping, this clean water source can be sent to a central collection point for further distribution, or directly into existing supply lines. This water can be used for purposes such as watering, cleaning floors, and filling decorative garden ponds.

Depending on the type of water to be collected and its use, standard water testing is recommended to ensure the water is fit for purpose.

3.6.8. Swimming pool features and equipment

Swimming pools are energy and water intensive facilities. However, certain design and operational changes can minimize consumption of these resources. Pool features such as decorative sprinklers and water slides require large, energy-intensive water pumps, many of which account for only a small percentage of a customer's time on holiday. The energy requirements of these water features can be reduced by:

- Use of timers to control high volume sprays, for example, only 20 minutes per hour rather than continuous sprays.
- Controlling smaller water features, e.g. equip the water curtain for customers to play, with a timer that customers can start when needed. The chosen timer should be very robust.
- Controlling the operating hours of the waterslides, rather than running them all day.

Energy and water can also be saved by selecting equipment and operations such as:

- Selection of pumps with the appropriate capacity for pool capacity for general pool circulation and filter backwashing. The performance of the pool pump should be sufficient to filter the entire pool volume in 6 hours, allowing for 4 pool turnovers per day. Energy is wasted when the pump has a larger capacity and the filter tank volume exceeds 4 revolutions per day.
- Choose an appropriate pool filtration system with a clear viewing window or "sight glass" for easy visual inspection of water purity during backwashing.
- Choose a non-slip pool deck surface that can be swept and mopped rather than hosed down.

Atlantica Crete Aktizeus

4.

Control & Monitoring system

4. Control and monitoring system

4.1. Building management system (BMS)

A BMS is a system composed of computer hardware and software, the core function of which is to control a hotel's engineering and energy systems. Installing a building management system (BMS) in a hotel offers several advantages for the asset and facility management, including:

- Energy efficiency: The BMS can help optimize energy usage by controlling and monitoring heating, ventilation, and air conditioning (HVAC) systems, firefighting systems, water consumption, lighting, and other equipment.
- Improved guest comfort: The BMS can help ensure consistent temperature and air quality throughout the hotel, leading to a more comfortable stay for guests.
- Increased operational efficiency: The BMS can automate tasks, reducing the workload for hotel staff, and improve maintenance scheduling, reducing downtime and repair costs.
- Detect problems: Promptly detects problems with the operation of HVAC, lighting, water supply and other engineering systems.
- Monitoring: Continuously monitors the usage of water and energy in key systems and hotel areas, thereby providing information on usage for reporting and performance trends. By utilizing Artificial Intelligence (AI) in a building management system advanced analytics and hyper-connectivity are possible predicting the performance of subsystems in a building better.
- Cost savings: By optimizing energy usage and reducing operational costs, the BMS can result in significant cost savings for the hotel.
- Better decision-making: The BMS can provide real-time data and analytics, enabling hotel managers to make informed decisions about energy usage, maintenance, and other operations.

Depending on the scope of the BMS, additional meters or devices may be required in order to track the consumption of water and electricity. Examples of this targeted monitoring include tracking water consumption in pools and irrigation systems, electricity consumption of large guest room blocks in the hotel, major pieces of equipment and electricity consumption of boilers, kitchen and laundry equipment. Meter readings should be taken to regularly calculate consumption of water and electricity.

Overal, a BMS can help hotels improve guest satisfaction, increase operational efficiency, and save costs.

4.2. Energy management system for guest rooms

Energy management systems in guest rooms are designed to avoid energy wastage caused by leaving lights and heating/cooling on when guests leave the room.

- Energy-saving switching systems use special switches next to the door to control the operation of room lighting and heating/cooling systems. Once inside the room, the customer inserts the key card or key ring into the switch, which activates the lights, outlets and heating/cooling system.
- Occupancy sensor controllers rely on motion sensors and typically door switches to detect occupancy in a room. When the controller detects people, it activates the lights and lets the heating/cooling system run normally, keeping the room at the temperature set by the customer.
- The TV is preferably controlled by the guest room's energy management system to reduce power consumption in standby mode.
- Guest room energy management systems should be designed in such a way that occupants cannot easily bypass them (for example, energy saving switches should only be used with the appropriate card or key ring).

Advantages:

- Energy Efficiency: Energy management systems help in optimizing energy usage and reducing energy waste in hotel guest rooms, leading to lower energy bills and increased energy savings.
- Improved Comfort: The systems allow for customizable temperature and lighting controls, providing guests with a more comfortable and personalized experience.
- Enhanced Guest Satisfaction: By offering a comfortable and energy-efficient stay, hotels can improve guest satisfaction, leading to repeat business and positive reviews.
- Better Environmental Stewardship: Energy management systems contribute to a more sustainable and eco-friendly operation, helping hotels to reduce their carbon footprint and improve their environmental reputation.
- Increased Staff Productivity: By automating many tasks, such as adjusting temperature and lighting based on occupancy, energy management systems can free up staff time for other tasks.
- Improved Data and Analytics: Energy management systems often provide data and analytics that can help hotels better understand their energy usage and identify opportunities for further optimization and cost savings.

TUI BLUE Seno, Turkey

4.3. Window and patio door sensors

Guest room windows and patio doors should be equipped with sensors to disable the HVAC system when opened. Although optimally installed during the construction phase, sensor retrofits should still be considered - the return on investment will be worth it. These simple sensors can ensure that customers cannot operate the heating/cooling system in their rooms unless windows and patio doors are properly closed, saving significant energy.

Some points to consider:

- Sensors shall be installed on all operable guest room windows, patio and balcony doors.
- The system should be designed to shut off the HVAC only if a window or patio door is left open for a specified amount of time (e.g., 30 seconds).
- In order not to inconvenience customers, the system should automatically turn the air conditioner back on after the windows or patio doors are closed again.

4.4. Digitalisation and Cloud Software Solutions

Digitisation and cloud software can help in running an energy-efficient building operation in the following ways:

- Real-time monitoring: Real-time monitoring and analysis of the building's energy consumption helps to identify and implement energy efficiency measures. Efficient ways of working can be improved by using cloud-based solutions for this monitoring.
- Remote access to data: With cloud software, energy data can be accessed from anywhere, allowing the operator to monitor the building's energy consumption from a remote location and make necessary adjustments.
- Automated reporting: Digital tools can automatically generate energy consumption analyses and reports that allow the operator to track progress in improving the building's energy efficiency.
- Centralised management: Available cloud-based or centrally located solutions allow all the building's data and systems to be centrally managed and integrated, making it easier to monitor and optimise energy consumption.

Overall, digitalisation and cloud software can help in the operation of an energy-efficient building by improving the monitoring and management of energy consumption and supporting the operator in the implementation of energy efficiency measures.

Whenever digital solutions are used, aspects of cyber security and sudden power failure should also be investigated and taken into account.

5. Certification

5. Certification

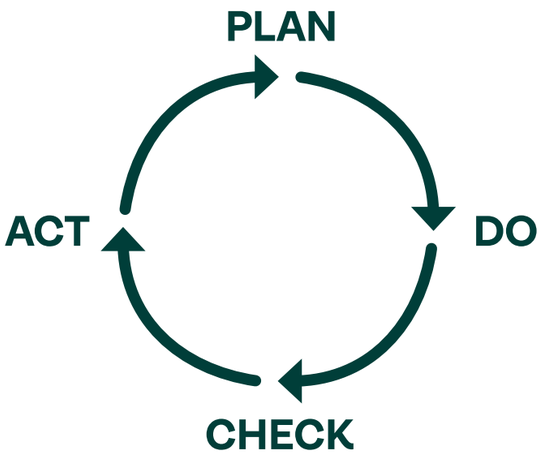
Certifications are tools that can drive up social and environmental standards, improve quality, enhance resource efficiency and build trust from customers and employees.

For managing energy and resource efficiency in hotel operations, all TUI Hotels & Resorts shall implement a certification scheme recognized by the Global Sustainable Tourism Council (GSTC), for instance Travelife, Earth Check or Green Globe. Certifications of process-oriented management systems according to ISO 14001 (environment), EMAS (environment) or ISO 50001 (energy) with underlying action plans can add additional value to energy and water reduction.

Building certification, like BREEAM, LEED or DGNB, can reveal further potential for energy and resource savings for new builds or refurbishments.

5.1. Management Systems Certification

Management systems require the clear definition and documentation of corporate processes. They also ensure that companies regularly check whether and to what extent set targets have been achieved. Targeted optimization potential regarding energy consumption, use of appliances and reduction of negative impacts on the environment can be derived from this. A management system helps companies to improve continuously and efficiently - and thus to work systematically on the company's success.



Usually, management systems follow the Plan-Do-Check-Act (PDCA) cycle for continuous improvement and show this systematics:

- Policy: Showing clear commitment of management and legal compliance
- Relevant aspects: Identifying topics and issues that are material to the hotel including relevant stakeholders
- Targets: Based on relevant aspects, setting improvement targets
- Measures: Setting appropriate measures to achieve the set targets, backed up with KPIs
- Implementation of measures
- Data and documentation: Ensuring adequate documentation of all processes, data collection and KPI tracking
- Control: Implementing control measures like internal audits or management review
- Adjustment: Adjusting processes when gaps have been identified

5.1.1. ISO 14001: Environmental Management System Certification

This international ISO 14001 standard of the International Organization for Standardization (ISO) specifies requirements for an environmental management system that enables a hotel to improve its environmental performance, meet legal and other environmental obligations, and achieve environmental targets.

ISO 14001 is applicable to organizations of all types and sizes and to different geographical, cultural, social or environmental conditions. An ISO 14001 certification of an existing building or of suppliers being involved in hotel construction or refurbishments can show the following benefits:

Increased resource efficiency reduces environmental impacts and consumption and environmental costs

- Improved coordination of environmental protection activities ensures effective and fast results with less effort
- Active contribution to environmental protection increases confidence in the hotel / company and improves the image in the long term
- Compliance with the law and proof of it can provide a sustainable competitive advantage
- International recognition of the hotel's environmental management system

5.1.2. ISO 50001: Energy Management System Certification

ISO 50001 enables an hotel to continuously improve its energy-related performance. By this, the company increases energy efficiency while optimizing energy use.

Energy management system records all energy flows in the hotel / company. The energy efficiency of energy-consuming systems / equipment and processes/activities is determined. The aim of ISO 50001 is to continuously improve existing energy efficiency and reduce carbon emissions. To this end, both technical measures and strategic and organizational management approaches are implemented and can also lead to cost benefits. The ISO 50001 standard includes the specifications for systematic energy management.

Special attention is paid to hotels and their parent companies that are already legally obliged to carry out an energy audit. For these companies, a certified energy management system can already lead to compliance with legal requirements and thus save costs for additional audits.

5.1.3. EMAS: Eco Management and Audit System

The Eco-Management and Audit Scheme (EMAS) was developed by the European Union and is a joint system of environmental management and environmental auditing for organizations and businesses that want to improve their environmental performance. Compared to the ISO 14001 standard, EMAS places higher demands on the continuous improvement of environmental performance since an improvement in environmental performance must take place.

EMAS organizations operate a sustainable environmental management system on their own initiative, which goes beyond the requirements of other international standards. They submit to additional quality criteria and monitoring mechanisms: state-supervised, independent environmental verifiers regularly check the environmental performance on site. In addition, an environmental statement informs the public about the improvements in environmental protection and the company must be officially registered.

Further information:
https://ec.europa.eu/environment/emas/index_en.htm

5.2. Building certifications

The certification of hotel properties is increasingly seen by investors as a mandatory criterion in the development as well as the purchase of hotel properties, in order to take into account the real estate aspects of sustainability and to ensure a long-term increase in the value of the property. The most common real estate certification systems are LEED (widespread in American, Central American and South American destinations), BREEAM (widespread in European destinations) as well as DGNB mainly for properties in Germany. The systems differ in their criteria and their weighting as well as the process for obtaining the certificate. A brief overview is given here.

5.2.1. BREEAM (Building Research Establishment Environmental Assessment Method)

BREEAM is a British sustainability standard and certification scheme for real estates that is used for many buildings, especially in Europe. It recognizes and reflects the value in higher performing assets across the built environment lifecycle, from new construction to in-use to renovation and refurbishment. BREEAM does this through third party certification of the assessment of an asset's environmental, social and economic sustainability performance.

The criteria have since been adapted to the hotel industry, both for new buildings and for existing properties. The standard for new builds covers the following ten categories:

- Energy: Consumption and CO_2 reduction
- Water: Consumption and efficiency
- Materials: Environmental impacts and impacts of building materials used, including life cycle impacts
- Transport: CO_2 emissions caused by transport and location-related factors
- Waste: Waste generation and efficient avoidance
- Environment: Minimizing risks to air and water
- Health and Wellbeing: Indoor and outdoor related
- Management: Holistic management strategies, operational and process management
- Land use and ecology: ecological conservation and upgrading of the site; Factors for safety and prevention of incidents
- Innovation: Consideration of innovative solutions

For existing properties, emissions and resilience are two additional factors to be taken into consideration:

- Emissions: Minimize risks to air and water
- Resilience: A building's exposure to physical, climate and social risks, pollution of local water bodies, damage to people and property

Further information:
https://bregroup.com/products/breeam/

5.2.2. LEED (Leadership in Energy and Environmental Design)

LEED is an internationally recognized certification system for green building. It certifies through independent third parties that a building has been constructed and designed in an environmentally friendly manner. A LEED certification involves four main steps:

- Register your project by completing key forms and submitting payment.
- Apply for LEED certification by submitting your completed certification application through and paying a certification review fee.
- Review: Your LEED application is reviewed by Green Business Certification Inc. (GBCI).
- Certify: Receive the certification decision from GBCI. If you've earned LEED certification: congratulations!

LEED evaluates properties based on a variety of criteria in the following categories:

- Maximum energy savings
- Efficient use of water
- Reduced greenhouse gas emissions
- Healthier indoor air quality
- Increased use of recycled materials
- Optimum utilization of resources and sensitivity to their impacts
- Reduced maintenance and operation costs

Further information: https://www.usgbc.org/leed

5.2.3. DGNB (German Sustainable Building Council)

DGNB is a non-profit organization founded in 2007. The DGNB promotes sustainable building in a variety of ways, mainly in Germany but also in the rest of the world.

The DGNB System evaluates the overall performance of a building based on several criteria. If these criteria are fulfilled in an outstanding way, the building receives a certificate or pre-certificate in platinum, gold, silver or bronze for existing real estate. Detailed criteria cover the following six areas:

- Environmental quality
- Economic quality
- Sociocultural and functional quality
- Technical quality
- Process quality
- Site quality

Further information: https://www.dgnb.de/en/

ROBINSON CLUB Jandia Playa, Corralejo

5.3. Certification of hotel operations

5.3.1. GSTC Certification (Global Sustainable Tourism Council)

The Global Sustainable Tourism Council® (GSTC) establishes and manages global standards for sustainable travel and tourism, known as the GSTC Criteria. They are the result of a worldwide effort to develop a common language about sustainability in tourism. They are arranged in four pillars: (A) Sustainable management; (B) Socioeconomic impacts; (C) Cultural impacts; and (D) Environmental impacts.

GSTC-Recognized Standards are sustainable tourism standards that adhere to and are equivalent to the GSTC Criteria. This means that the GSTC Criteria are included within the set of standards owned by a Certification Body, by a municipal, provincial, or national tourism authority, by specialized tourism organization, or by large tourism businesses with multiple business units. Examples of GSTC-Recognized Hotel Standards are Travelife, Green Globe, Earth Check or Green Star Hotel.

Using not only a GSTC-recognised standard but also an accredited certification body ensures that the GSTC has reviewed and verified the standard as well as the auditing process.

Further information: https://www.gstcouncil.org/

5.3.2. Travelife

Travelife – as one example of a GSTC-Recognized Hotel Standard - is a global accommodation sustainability certification body. The Travelife Certification requirements for hotels cover the three main areas where the accommodation sector has the most impact.

The Environment
Properties are required to monitor and minimise their environmental impacts across energy, water, waste, wastewater, hazardous substances and biodiversity.

People
Travelife certified accommodation must comply with all labour laws and treat their staff fairly. They also must show that they are actively protecting and respecting human rights, training all of their staff about how to identify and report signs of child exploitation and abuse.

Communities
Properties with a Travelife certification must be proactive when it comes to supporting their local community. This includes things like giving information to guests about respecting the local way of life, ensuring they do not hinder community access to important resources and services and supporting a local charity or community improvement initiative.

Further information:
https://travelifestaybetter.com/

6.

Communication & Stakeholders

6. Communication & Stakeholders

6.1. Guest communication

Communicating to customers about the hotel's sustainability activities is an effective way of encouraging them to support the initiatives where they can have an impact, such as water and energy conservation. However, to engage customers, the communication should be clear, concise and in the right "tone of voice".
The personal exchange with guests is one of the most effective ways to communicate about sustainability underlining the hotel's sustainability commitment.
Typical sustainability communications focus on energy and water conservation as well as waste management which can significantly contribute to less energy or water consumption.
A few examples include:

- Highlight sustainability achievements: Share the hotel's sustainability achievements with guests, such as reducing energy usage or increasing recycling efforts.
- Incorporate sustainability messaging into guest communications: Include information about the hotel's sustainability initiatives and practices in pre-arrival emails, in-room information folders, and other guest communications.
- Guest room information cards which provide tips on what the customers can do to minimise their impacts while staying in the hotel
- Signage placed next to light switches or AC controls to remind customers to turn them off before leaving the room
- Specific guest room signage explaining how the customers can participate in towel and linen reuse programmes
- Information posted in common areas about local environmental and community initiatives and how customers could participate or contribute
- Website information: Including information on the hotel's sustainability initiatives and practices on the hotel's website, making it easily accessible for guests who are researching their options.

Digital solutions such as apps or screens can be a suitable tool for making this information available to guests in a cost-efficient, simple and resource-saving manner. By effectively communicating their sustainability efforts, hotels can not only promote their initiatives but also encourage guests to be more environmentally conscious during their stay.

6.2. Staff training

Encouraging staff to adopt responsible energy and water conservation practices during their work throughout the hotel is important to increase energy efficiency.
For that reason, general staff trainings as well staff trainings on specific sustainability aspects of daily duties raises awareness and can lead to saving in energy and water consumption. Displaying energy, water and waste messaging in staff communal areas can support these trainings.

Recommendations for training content include:
General trainings, for instance:

- Orientation training: Including information on the hotel's sustainability initiatives and practices in the orientation training for new staff members.
- On-going training: Providing ongoing training sessions for staff members to keep them updated on the latest sustainability practices and initiatives.
- Hands-on training: Offering hands-on training opportunities for staff members, such as learning how to properly sort recyclables or how to conserve energy in guest rooms.
- Employee recognition programs: Implementing employee recognition programs that reward staff members for their contributions to the hotel's sustainability efforts.
- Involvement in sustainability initiatives: Encouraging staff members to participate in the hotel's sustainability initiatives, such as beach clean-up days or community garden projects.
- Employee sustainability committees: Establishing employee sustainability committees that meet regularly to discuss and implement sustainability initiatives within the hotel.

Food & Beverage Practices, for instance:

- Minimise lights and air-conditioning before and after service
- Do not tamper with air conditioning settings; keep doors closed to avoid cool air escaping
- Ensure all unnecessary machinery is switched off when not needed (plate warmers, toasters, coffee makers, etc.)
- Only set the freezer as cold as is necessary to store the food

Sustainable Office Management and Front Office, for instance:

- Master switches are available for all equipment that does not need to run continuously
- Sleep mode for certain devices such as PCs is set
-
- Technical Department, for instance:
- Power saving mode is enabled on all devices that allow it
- All equipment and machinery is regularly maintained and this is properly documented
- If leaks or damage are discovered, these should be repaired promptly

Carry out the training yourself or engage external experts. The training should be practical and contain practical examples and be repeated regularly.

6.3. Other stakeholders

Apart from regular trainings of staff or guest communications, active stakeholder management is crucial to ensure their interests are taken into consideration.

Since stakeholders might vary from hotel to hotel an initial identification of stakeholders and their interests is a useful exercise before getting into contact with them. Major stakeholder groups for hotels – apart from guests and staff – are suppliers, municipality and policy makers, hotel owners, the community and NGOs.

A good relationship with suppliers, especially during a refurbishment or any construction project, can help to ensure work is done on time, costs are met and all relevant sustainability measures are considered. In addition, suppliers need to accept TUI's Supplier Code of Conduct (https://www.tuigroup.com/en-en/about-us/compliance/suppliers_code_of_conduct) and ensure that all requirements are fulfilled.

Measures to improve energy efficiency may be eligible for financial support. The municipality or local policy makers might be aware of local funding schemes or available subsidies for these measures.

Excursus: Pathway to Net Zero

To meet the ambitions of the Paris Climate Agreement and limit global warming to +1.5°C above pre-industrial levels, we need to manage and mitigate greenhouse gas (GHG) emissions to a credible version of zero by adopting a systems thinking approach to our anthropogenic activities and impacts. The EU aims to be climate-neutral by 2050 – an economy with net-zero greenhouse gas emissions. This objective is at the heart of the European Green Deal and in line with the EU's commitment to global climate action under the Paris Agreement.

According to the United Nations Environment Program, the built environment accounts for 39 percent of gross annual carbon emissions worldwide, a figure comprising both operational carbon, the ongoing carbon emissions from its day-to-day use, and embodied carbon — all the CO_2 emitted in producing materials[1]. This highlights the urgent need to drastically reduce CO_2 emissions, ideally to a Net Zero level.

To become Net Zero by 2050 latest is a challenge and a responsibility at the same time. In the area of construction, the UKGBC has developed a comprehensive high-level guidance for construction and refurbishments[2], following a 'reduction first' approach to achieving Net Zero. According to this, a building project should follow the following five steps:

1 https://www.weforum.org/agenda/2022/09/construction-industry-zero-emissions/

2 https://www.ukgbc.org/ukgbc-work/net-zero-carbon-buildings-framework/

1. Establish a Net Zero scope

To define the scope for Net Zero, a whole life carbon assessment should be done to identify a building's carbon impact. Apart from CO_2 emission due to operational energy consumption, also the embedded CO_2 of materials and products during the construction phase as well as their end of life recycling, disposal) needs to be taken into consideration. This should be verified by an external party.

2. Reduce construction impacts

Buildings aiming for Net Zero should consider all embodied impacts from the product and construction phase to the practical completion of the building. Reporting on embodied carbon impacts in the life cycle of a building is currently challenging, yet a modelled assessment of impacts should be carried out. This assessment is valuable for making early design decisions aimed at minimising the building's whole-life carbon impacts, taking the supply chain into consideration.

3. Reduce operational energy use

Investing in energy efficiency and demand reduction is the most cost-effective way to relieve the infrastructure required for a Net Zero energy system. Buildings should aim to reduce energy demand and consumption in order to reduce the amount of overall electricity consumption and CO_2 emissions, from the electricity grid as well as from renewable energy sources.

4. Increase renewable energy supply

Producing our own electricity from renewable energy relieves the burden on the electricity grid, lowers electricity costs and reduces CO_2 emissions. Where this is not possible, e.g. due to a lack of open space, the purchase of green electricity is an alternative, e.g. via so-called Power Purchase Agreements (PPA).

5. Neutralization of residual CO_2 emissions

Neutralization of residual CO_2 emissions: When all feasible mitigation measures of a construction phase have been adequately exhausted, carbon removal can be used to cover the remaining CO_2. The amount of carbon removal should be proportionate to the remaining CO_2 in order to achieve Net Zero. The carbon removal should follow renown technologies and frameworks.

Contacts:

TUI Hotels & Resorts
SustainabilityTHR@tui.com

This document has undergone a general plausibility check by Fraunhofer IAO.
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