وزارة السياحة
Ministry of Tourism

THE BUSINESS CASE FOR CLIMATE ACTION IN TOURISM

REDUCING GHG EMISSIONS & COST THROUGH SOLAR THERMAL HEATERS

October 2023

ABOUT THE SUSTAINABLE TOURISM GLOBAL CENTER (STGC)

The Sustainable Tourism Global Center (STGC) is the world's first multi-country, multi-stakeholder global coalition, incubated within the Ministry of Tourism of Saudia Arabia, that will lead, accelerate, and track the tourism industry's transition to net-zero emissions, as well as drive action to protect nature and support communities. It will enable the transition while delivering actionable and easy-to-use knowledge, tools, best practices, financing mechanisms and innovation into the tourism sector. The STGC was announced by His Royal Highness the Crown Prince Mohammed Bin Salman during the Saudi Green Initiative in October 2021 in Riyadh, Saudi Arabia. His Excellency Ahmed Al Khateeb, Minister of Tourism for Saudi Arabia then led a panel discussion during COP26 (November 2021) in Glasgow, United Kingdom, to elaborate on how the Center will deliver on its mandate with founding country representatives and experts from partner international organizations.

HIGHLIGHTS

- Travel & Tourism is one of the world's largest sectors, accounting for over 10% of global GDP and 1 in 10 jobs on the planet in 2019. The sector accounted for 1 in 4 jobs new jobs created globally.
- Travel & Tourism is not only impacting but significantly impacted by climate change and environmental degradation. Without concerted action, Travel & Tourism emissions will rise by 20% by 2030.
- For the sector to achieve a reduction of GHG emissions by 40% from the 2019 baseline, actionable and accessible solutions are needed, combined with additional amounting to US$ 220-310 billion a year through to 2030.
- In 2019, facilities, including operations and construction, accounted for 30% of all Travel & Tourism emissions. Of this 30% of emissions linked to facilities, 74% comes from heating, cooling, and the powering of buildings.
- The two cases assessed focus specifically on the potential of solar thermal heaters as a solution for hotels, large and small.
- The cases examine the use of regular flat plate collectors, given they are widespread, have a relatively high efficiency, between 40% and 70%, and are very accessible cost-wise. What is more, they have a simple design, are easy to manufacture and maintain and are easily scalable. In fact, about 90% of all solar thermal heaters globally use this technology.
- In the real-life case of the hotel in the Caribbean, the project recovered its investment in less than a year, and effectively benefited from 29 years of free hot water. Using solar thermal heaters, the annual operating costs were US$ 1,555, compared to the annual operating costs of natural gas which amounted to US$5,875 annually. This implied US$ 4,320 annual savings; whilst for electricity, the savings reached US$ 104,802 annually.
- The Caribbean case also revealed significant health and environmental benefits, notably the reduction in GHG emissions of 99.4%; reductions in ecosystem damages by 98.1% and human health damages by 99.0%. From a CO2 perspective, 351 metric tons were saved from the switch from diesel generators to solar thermal heaters.
- In the potential case of the Jeddah-based hotel in Saudi Arabia, the project would recover its investment in less than six years, and effectively benefit from 24 years of free hot water. Using solar thermal heaters, the annual operating costs would be US$ 993, compared to the annual operating costs of natural gas which amount to US$3,966 annually. This implies US$ 2,973 annual savings; whilst for electricity, the savings reach US$ 13,576 annually, or a 93% reduction in operating costs.
- The Jeddah hotel case also showcased significant health and environmental benefits, notably the reduction in GHG emissions of 99.2%; reductions in ecosystem damages by 97.7% and human health damages by 99.6%. From a CO2 perspective, 175.9 metric tons would be saved from the switch from diesel generators to solar thermal heaters.

INTRODUCTION

Travel & Tourism is one of the world's largest sectors, accounting for over 10% of global GDP and 1 in 10 jobs on the planet in 2019. In fact, prior to the pandemic, Travel & Tourism accounted for 1 in 4 jobs new jobs created globally. Whilst the sector was faced its worst crisis in history as a result of the COVID-19 pandemic, it has bounced back with forecasts predicting the continued growth of the sector to 2030 and beyond.

The climate and biodiversity crises are effectively jeopardizing the future of Travel and Tourism. From the growing scepticism of youth to deteriorating ecosystems and increasing destinations at risk to overwhelmed communities. And, without concerted action, Travel & Tourism emissions will rise by 20% by 2030[i], further harming our planet. Many destinations, including island states, are especially vulnerable to the risks and impacts of climate change, requiring the Travel & Tourism sector to be part of the solution.

The climate and biodiversity crises are effectively jeopardizing the future of Travel and Tourism. From the growing scepticism of youth to deteriorating ecosystems and increasing destinations at risk to overwhelmed communities. And, without concerted action, Travel & Tourism emissions will rise by 20% by 2030[ii], further harming our planet. Many destinations, including island states, are especially vulnerable to the risks and impacts of climate change, requiring the Travel & Tourism sector to be part of the solution.

To act on this urgent agenda and achieve a reduction of 40% of Travel & Tourism related GHG emissions from the 2019 baseline by 2030, will require all key stakeholders, small and large, public, and private, to come together to commit, invest and accelerate to change. According to Systemiq and STGC, additional investments required in travel & tourism

transport and facilities, nature and resilience would amount to US$ 220-310 billion a year through to 2030[iii]. Yet to ultimately achieve progress, coordination, and collaboration across stakeholders will be needed as well as actionable and accessible solutions, tools as well as best practices to inspire and facilitate the transition.

In this case studies in action series, the Sustainable Tourism Global Center (STGC) explores specific climate and environmental challenges faced by the Travel & Tourism sector. Each edition will delve into a distinctive challenge, and through concrete and quantifiable examples, provides insights and solutions for key stakeholders, which will ultimately benefit people and planet alike.

In 2019, facilities, including operations and construction, accounted for 30% of all Travel & Tourism emissions[iv]. Of this 30% of emissions linked to facilities, 74% comes from heating, cooling, and the powering of buildings[v]. In light of the emissions and costs related to running facilities, it is essential to provide alternative solutions to hotels, small and large. In this context, this edition explores the implications both from an emissions and costs perspective in the deployment of solar thermal heaters using two case studies, one for a hotel in the Caribbean and the second for a hotel in Jeddah, Saudi Arabia.

THE CHALLENGE: FACILITIES' ENERGY USE IMPACT ON EMISSIONS & COSTS

Facilities accounted for 30% of the estimated 5.2 GT of CO2 emissions generated by the Travel & Tourism sector in 2019. Of this 30% of emissions linked to facilities, 74% came from heating, cooling, and the powering of buildings[vi]. In fact, just the heating, ventilation and air conditioning, accounted for half of the sector's operational emissions.

As such, to reduce the emissions relating to the operations of facilities, it is essential to enhance the efficiency of heating and cooling system, switch to renewable energy sources, and retrofit existing building where possible.

In the case of new constructions, it is important to consider the use of low carbon materials or even recyclable materials. Looking to the future, hotels should be designed to optimize energy efficiency, using high quality insulations, and making the most of natural heating and cooling solutions. Ultimately, sustainable construction and retrofitting represents a tremendous opportunity to build resilience in facilities.

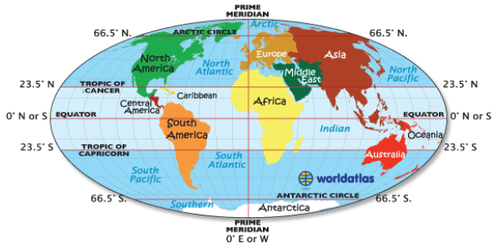
Specifically, given the emissions and costs associated to powering facilities, solar thermal systems, which transform solar irradiation into a source of heat, can be a viable solution to heat water, building conditioning or even to generate electricity.

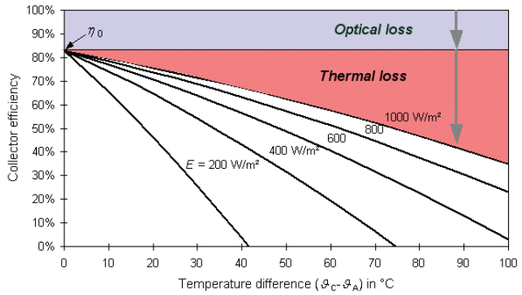
THE CASE: THE VALUE OF SOLAR THERMAL HEATERS

Travellers are increasingly making sustainability a priority as they travel, with 70% more likely to choose an accommodation if it has implemented sustainability practices[vii]. This shift is aligned with a 2022 Expedia study revealing that 9 in 10 travellers look for sustainable travel options[viii]. The growing focus of travellers on sustainability, combined with the economic benefits associated with these solutions provides unique opportunity for hotels, both small and large, to proactively address the emissions related to their facilities.
Solar thermal systems specifically, can be more sustainable and cost-effective approach when compared to more traditional sources of energy. While solar power is increasingly being considered as a sustainable alternative to other sources of energy, yet globally it still only accounted for 3.6%[ix] of global energy generation in 2021.

The two cases assessed focus specifically on the potential of solar thermal heaters for hotels, large and small. While there are a multitude of technologies, the cases examine the use of regular flat plate collectors, given they are widespread, have a relatively high efficiency, between 40% and 70%, and are very accessible cost-wise. What is more, they have a simple design, are easy to manufacture and maintain and are easily scalable. In fact, about 90% of all solar thermal heaters globally use this technology.

For the case studies, it is important to consider different curves depending on the latitude and location of the hotel in the world, as they are key to estimating the efficiency of the collection for the flat plate collector. In effect, for most projects in temperate areas, between 30^0 and 60^0 in the Northern and Southern latitudes, the 200 W/m2 should be used; while in tropical and subtropic areas, between 11^0 and 30^0, the 400 W/m2. Finally, for equatorial areas, 0^0 and 10^0, the 600 W/m2 curve should be employed.





The two cases used in this edition focus on hotels in different parts of the world, the first is located in the Caribbean, at 14^0 latitude; whilst the second is located in Jeddah Saudi Arabia, at 21^0 latitude.

CASE 1: CARIBBEAN HOTEL

The first hotel is in the Caribbean, and has 250 rooms and 375 beds, with a maximum of 400 guests, implying that at 90% capacity in the high season, notably in November, December and January, there could be 360 guests in the hotel. In terms of context, all electricity on the island is generated using imported fossil fuels through diesel generators, with the fuel costing US$ 0.34 /kWh. Prior to the shift to solar thermal systems, all hot water was produced using electric heaters.

The first step to assessing the value of solar thermal systems was to calculate, the hot water demand:

- The hot water demand is approximately 40 liters per person per day, for 360 guests.
- The demand for kitchen and laundry is estimated at 5,500 liters per day.

As such the daily hot water demand for the hotel amounted to (360x40) + 5,500, which is 19,900 liters per day. It is essential however to integrate an overcapacity of 20% for future growth. The total daily hot water required amounts to 23,880 liters per day (19,000 liters x 1.2). On this basis, the storage tank which is closest in terms of capacity on the market is 25,000 cubic meters.

Based on the storage tank size, the specific heat for water and the temperature differential between cold and hot water, the heat capacity of the storage tank can be calculated and was estimated to 1073 KWh.

Another important factor in assessing the value of solar thermal systems is determining the daily solar irradiation in the worst-case scenario at the latitude of the hotel. The information required is easily and freely available online . In effect, in this case, the worst case would be in August with 5.67 hours/day with 1000 W/m2. Despite lower occupancy rates in the summer, it is important to plan for a worst-case scenario.

The collector's yield can then be determined, employing the minimum solar radiation need for the site, in this case the month of August, which is 5.67 KWh per square meter, times the efficiency of the collector, in this case 47%. As such the collectors yield is 2.27 kWh per meter square per day.

Establishing the collection area is then key to see if, based on need, the flat plates will fit on the roof of the hotel, given the available area for the hotel is 810 m2. In this case, the needed area amounted to 473 m2, making the shift entirely feasible.

The cost of the flat plate collectors themselves was US$ 70,000. However, other materials are needed notably, the water tank, amounting to US$ 3,500, as well as the pump, valves, and additional piping, which cost an additional US$2,500. **The total capital cost of the solar thermal system at the time of purchase was US$ 76,000.** If this project was done today, the total cost would amount to US$77,761.

Using the traditional system of diesel electricity to heat the water, the hotel was paying approximately **US$ 106,300 per year.** Since the capital cost of the solar thermal system cost US$ 76,000 and has a service life of 30, **the project would recover its investment in less than a year, and effectively benefit from 29 years of free hot water.**

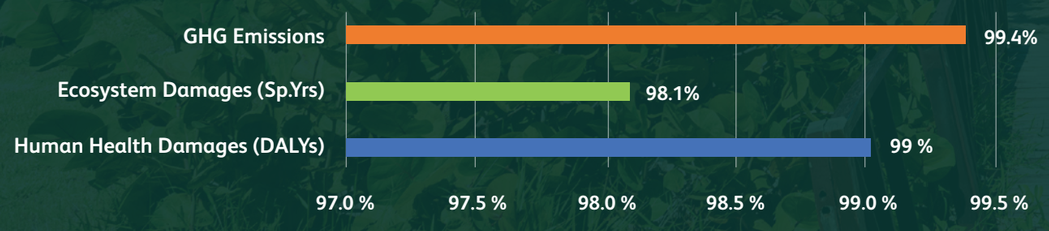
At the time the project was conducted, the interest rate was 3%, with a repayment period of 30 years. Looking at Table 1, a comparison can be made between the annual operating costs of natural gas, electricity, and solar thermal heaters. Using solar thermal heaters, the annual operating costs were US$ 1,555, compared to the annual operating costs of natural gas which amounted to US$5,875 annually. This implied US$ 4,320 annual savings; whilst for electricity, the savings reached US$ 104,802 annually.

Table 1

Annual Percentage Rate (annual interest) =	3%
Repayment Period (years) =	30
Service life of solar heaters (years)	30
Annual Capital Costs =	$ 3,967
Annual Operating costs =	$ 1,555
Annual total costs =	$ 5,523
Cost per liter of hot water (USD)	$ 0.001
Annual operating costs natural gas	$ 5,875
Annual operating costs electricity	$ 106,357
Annual operating savings compared to a natural gas water heater	$ 4,320
Annual operating savings compared to an electrical water heater	$ 104,801

Based on the consideration that there is a shift to 100% diesel generation for electricity, there were significant health and environmental benefits. Indeed, shifting from electric to solar thermal water heaters led to reductions in GHG emissions of 99.4%; reductions in ecosystem damages by 98.1% and human health damages by 99.0%. From a CO2 perspective, 351 metric tons were saved from the switch from diesel generators to solar thermal heaters.

Table 2



The estimate of the economic benefits/cost ratio of the project amounts to 8.4. **This means that the hotel got US$ 8.4 of benefits per dollar spent.**

CASE 2: JEDDAH HOTEL, SAUDI ARABIA

To provide a comparison for a hotel in a different country, a hotel with a similar size was used as an example in Jeddah, Saudi Arabia. Again, in this case, the hotel has an estimated 250 rooms and 375 beds, with a maximum of 400 guests, implying that at 90% capacity in the high season, there could be 360 guests in the hotel. In terms of context, all electricity is generated locally with 62% linked to oil and 38% from natural gas, with the fuel costing US$ 0.07 /kWh.

The first step to assessing the value of solar thermal systems was to calculate, the hot water demand:

- The hot water demand is approximately 40 liters per person per day, for 360 guests.
- The demand for kitchen and laundry is estimated at 5,500 liters per day.

As such the daily hot water demand for the hotel amounted to (360x40) + 5,500, which is 19,900 liters per day. It is essential however to integrate an overcapacity of 20% for future growth. The total daily hot water required amounts to 23,880 liters per day (19,000 liters x 1.2). On this basis, the storage tank which is closest in terms of capacity on the market is 25,000 cubic meters.
Based on the storage tank size, the specific heat for water and the temperature differential between cold and hot water, the heat capacity of the storage tank can be calculated and was estimated to 696.0 KWh.

Another important factor in assessing the value of solar thermal systems is determining the daily solar irradiation in the worst-case scenario at the latitude of the hotel. The information required is easily and freely available online . In effect, in this case, the worst case would be in December with 4.02

hours/day with 1000 W/m2. Despite lower occupancy rates in the summer, it is important to plan for a worst-case scenario.

The collector's yield can then be determined, employing the minimum solar radiation need for the site, in this case the month of December, which is 4.02 KWh per square meter, times the efficiency of the collector, in this case 47%. As such the collectors yield is 1.918 kWh per meter square per day.

Establishing the collection area is then key to see if, based on need, the flat plates will fit on the roof of the hotel, given the available area for the hotel is 810 m2. In this case, the needed area amounted to 445 m2, making the shift entirely feasible.

The cost of the flat plate collectors themselves was US$ 70,000. However, other materials are needed notably, the water tank, amounting to US$ 3,500, as well as the pump, valves, and additional piping, which cost an additional US$2,500. **The total capital cost of the solar thermal system at the time of purchase was US$ 76,000.** If this project was done today, the total cost would amount to US$77,761.

Using the traditional system of diesel electricity to heat the water, the hotel would be paying approximately **US$ 14,569 per year.** Since the capital cost of the solar thermal system cost US$ 76,000 and has a service life of 30, **the project would recover its investment in less than six years, and effectively benefit from 24 years of free hot water.**

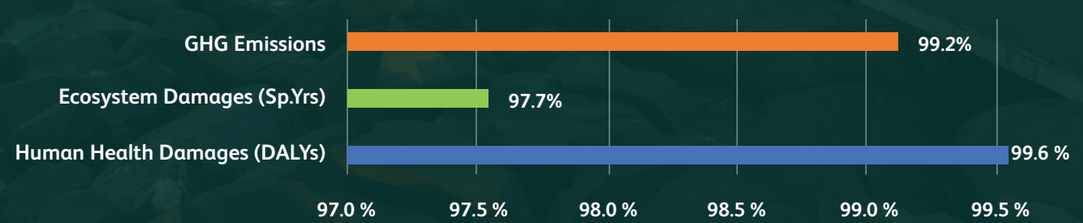
If this project were conducted now, the interest rate would be 6%, with a repayment period of 30 years. Looking at Table 3, a comparison can be made between the annual operating costs of natural gas, electricity, and solar thermal heaters. Using solar thermal heaters, the annual operating costs are US$ 993, compared to the annual operating costs of natural gas which amount to US$3,966 annually. This implies US$ 2,973 annual savings; whilst for electricity, the savings reach US$ 13,576 annually, or a 93% reduction in operating costs.

Table 3

Annual Percentage Rate (annual interest) =	6%
Repayment Period (years) =	30
Service life of solar heaters (years)	30
Annual Capital Costs =	$ 3,583
Annual Operating costs =	$ 993
Annual total costs =	$ 4,576
Cost per liter of hot water (USD)	$ 0.001
Annual operating costs natural gas	$ 3,966
Annual operating costs electricity	$ 14,569
Annual operating savings compared to a natural gas water heater	$ 2,973
Annual operating savings compared to an electrical water heater	$ 13,576

Based on the consideration that there is a shift to 100% diesel generation for electricity, there are significant health and environmental benefits. Indeed, shifting from electric to solar thermal water heaters could lead to reductions in GHG emissions of 99.2%; reductions in ecosystem damages by 97.7% and human health damages by 99.6%. From a CO2 perspective, 175.9 metric tons would be saved from the switch from diesel generators to solar thermal heaters.

Table 4



The estimate of the economic benefits/cost ratio of the project amounts to 1.71. This means that the hotel will get US$ 1.71 of benefits per dollar spent.

LOOKING AHEAD: SOLUTIONS

While ambitious sustainability commitments have been made by the Travel & Tourism sector, concerted action, bringing together all key stakeholders is needed to accelerate this change and meet the sector's goals.
In 2019, facilities, including operations and construction, accounted for 30% of all Travel & Tourism emissions. Of this 30% of emissions linked to facilities, 74% comes from heating, cooling, and the powering of buildings. Given the significance of emissions of facilities, particularly as they relate to hotel operations, effective solutions which are good for both business and planet are needed.

The cases, showcasing examples in different parts of the world, with widely different energy mixes, reveals the benefits of implementing regular flat plate collectors as solar thermal heaters. These are not only accessible, but have a relatively high efficiency, between 40% and 70%, and are cost-effective. What is more, they have a simple design, are easy to manufacture and maintain and are easily scalable.

Specifically the case of the hotel in the Caribbean island reveals that the project recovered its investment in less than a year, and effectively benefited from 29 years of free hot water. While in the case of Saudi Arabia, such a project would also be tremendously beneficial, although the recovery time would be closer to seven years as a result of the low oil prices.

Both casesalso revealed significant health and environmental benefits. The Caribbean hotel had a reduction in GHG emissions of 99.4%; reductions in ecosystem damages by 98.1% and human health damages by 99.0%. From a CO2 perspective, 351 metric tons were saved from the switch from diesel generators to solar thermal heaters. Similarly, the Jeddah hotel would also experience notably reductions in GHG emissions of 99.2%; reductions in ecosystem damages by 97.7% and human health damages by 99.6%. From a CO2 perspective, 175.9 metric tons would be saved from the switch from diesel generators to solar thermal heaters.

Looking ahead, based on the price per ton of C02 averted, which is approximately US$ 59.00, the hotels could technically also sell carbon credit, although there are questions around potential certification. If this could be done, the Caribbean hotel

could in fact get additional revenues of US$4,000 per year from international carbon credits through the substitution of a natural gas water heater. Should the hotel be substituting an electricity water heater, the potential annual revenues from international carbon credits could amount to US$ 20,730.68 in revenues.

Beyond the data outlined in the context of this report, STGC wishes to support hotels, small and large, in their transition to net zero. As such, the beta version of this simple and easy to use tool created to assess the potential impact of using solar thermal heaters, both on your business and on the broader environment.

Ultimately, we hope that through a better understanding of the benefits of solar thermal heaters, hotels, small and large, will be better equipped to make informed decisions as they implement solutions which will not only reduce emissions and tackling the climate crisis, but positively impact their bottom line.

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ENDNOTES

i. https://www.systemiq.earth/wp-content/uploads/2022/11/Better-Travel-Tourism-Better-World.pdf
ii. https://www.systemiq.earth/wp-content/uploads/2022/11/Better-Travel-Tourism-Better-World.pdf
iii. https://www.systemiq.earth/wp-content/uploads/2022/11/Better-Travel-Tourism-Better-World.pdf
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v. https://www.systemiq.earth/wp-content/uploads/2022/11/Better-Travel-Tourism-Better-World.pdf
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