

OVERVIEW AND HOTSPOTS ANALYSIS OF THE TOURISM VALUE CHAIN IN MAURITIUS



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Executive Summary

In 2017, WRAP (Waste and Resources Action Plan, UK) and UDP (Danish Technical University) conducted an assessment of the environmental hotspots associated with the tourism sector in Mauritius. This was complemented by a series of workshops and consultations made by Travel Foundation, UN Environment in collaboration with the Ministry of Tourism in Mauritius. The purpose of the assessment was to support policy makers, businesses and international organisation in finding feasible solutions to reduce greenhouse gas emissions and improve resource efficiency (RE) in tourism value chains in Mauritius. The methodology used was based on the 2017 Life Cycle Initiative overarching methodological framework for hotspots analysis.¹

Environmental hotspot is a process which accounts for a significant proportion of the negative environmental impact in the value chain. Value chain is the entire sequence of activities or parties that provide or receive value in the form of products or services (e.g. suppliers, outsourced workers and contractors).

The aim was to use a combination of a top-down approach (using national input-output databases) and a bottom-up approach (using hotel Survey data). Many of Mauritius's tourism value chains extend beyond its national boundaries, as there is a great reliance on imports. However, these were not covered in the national input-output database used, and therefore is poorly represented in this analysis. While a supporting analysis of imports was also undertaken, it too lacked sufficiently detailed data. Due to difficulties in obtaining survey data from the hotels and the lack of detailed information on imports, the final hotspot analysis was based on top down approach only, and supplemented with our experience from other project counties.

In order to better understand the location and context for environmental hotspots, during this analysis the tourism value chain for Mauritius was mapped to illustrate how the tourism sector operates. The mapping also illustrated how it is supported by other sectors of the economy (e.g. energy and water supply infrastructure, building and construction, facilities management, food and beverage, transportation), what activities are in scope of value chains for this study for Mauritius (see **Figure 4** below), how expenditure in the tourism sector is distributed in the economy (see **Figure 5** below) and which value chain actors are able to control or influence the environmental hotspots identified during the analysis (see **Figure 6** below). It should be noted that the interaction between the tourism sector in Mauritius and other sectors of the economy is comparatively low compared to other project countries, suggesting that ongoing implementation efforts in Mauritius need to focus on suppliers of imported goods and services from other countries (See **Figure 8** and **Figure 9** below for more information on the main countries that Mauritius imports from). Further information on the approach taken to map and define the Mauritius tourism value chain can be found in **Section 3.2** below).

¹ Source: <http://www.lifecycleinitiative.org/new-hotspots-analysis-methodological-framework-and-guidance/>

The environmental hotspots identified for the tourism sector in Mauritius are broadly split between:

- Impacts relating to the production, transportation and consumption of food and beverage products (e.g. meat, fish and seafood and fresh produce production and shipment, food loss and waste, energy used in refrigeration, preparation and cooking of food).
- Impacts relating to the provision of services to the sector from other sectors of the economy (e.g. power generation and energy and water supply);
- Impacts arising from deficiencies in national infrastructure (e.g. the lack of recycling infrastructure, dated waste and water infrastructure which can lead to environmental pollution and preventable GHG emissions);
- Impacts relating to the built environment in the tourism sector (e.g. hotel and restaurant energy use heating, ventilation and air conditioning lighting, preparation of food; water use in washing and sanitation, cleaning of rooms and public spaces; and for leisure activities, like swimming pools and spas);

A summary of environmental impact hotspots by tourism activity and impact category can be found in [Table 1](#) below. More detail on the approaches taken to hotspots analysis and key findings can be found in **Section 4** of this report.

WRAP and UDP have produced a long list of solutions, based on those identified in Dominican Republic and Philippines workshops in November 2017. At these workshops, stakeholders were consulted to seek their views on the range of solutions and interventions that could be implemented to address hotspots, primarily in tourism business value chains but with some reference to the national-level solutions and interventions required to enable or support actions by private sector tourism companies. Those solutions and interventions suggested at the workshop were then supplemented through desktop research and further discussions with stakeholders to arrive at an agreed long list of potential solutions and interventions, which, in turn, were split into solutions relevant to tourism business value chains and those requiring interventions at a national-level, either through the development of government policies and strategies or through improvements in national or regional infrastructure. For Mauritius, these solutions have been tailored based on inputs from the in-country partner report.

To summarise, the long list covers the following range of solutions and interventions:

Business value chain solutions and interventions: have the potential to be implemented by individual tourism businesses and value chains or via collaborations between tourism businesses and/or the public sector. Some business value chain solutions would benefit from a supportive government policy and strategy framework, like the options for national-level solutions identified below.

- **Sustainable purchasing and value chain initiatives:** that enable multiple hotspots across all impact categories to be addressed, including sustainable procurement policies and practices; appointing a 'green procurement champion'; adopting

voluntary sustainability standards for key raw materials (e.g. seafood, timber and paper, textiles); supplier accreditation, environmental KPIs and benchmarking and shared / consortia-based supplier platforms and databases to help identify reliable, high-performing suppliers; the use of product/packaging specifications (product life requirements for hotel furniture and electrical items) and healthy, sustainable menus (e.g. local, seasonal sourcing of food).

- **Improving operational practices:** including the provision of information to guests to help them make environmentally friendly choices when choosing or buying goods and services; adopting healthy, sustainable menus to reduce the environmental ‘food print’ of food served in destinations; measuring and monitoring food waste; reviewing food storage, preparation and cooking practices (e.g. portion control) and using data analytics to improve inventory management and demand forecasting to reduce food waste; donating uneaten food and establishing food recycling programmes to produce compost and renewable energy.
- **On-site energy management and efficiency:** making significant improvements in energy use by: developing an energy and GHG policy; conducting and acting on the findings of energy audits; specifying energy efficiency and GHG emission improvements in HVAC systems, hotel room energy management systems and electrical equipment (including laundries); and increasing the amount of in-situ renewable energy generation. The Programme National d’Efficacité Énergétique (PNEE) has energy audited 23 hotels and provided recommendations, identifying potential to reduce energy use by 30%, with return on investment as short of 1.6 years².
- **Sharing best practice and site visits:** the potential for an intermediary, such as a university or independent organisation to share best practices achieved amongst the hotels and restaurants, to learn from other’s experiences of implementing solutions (e.g. food waste reduction, energy management, water efficiency).
- **Team training and cross-functional training:** training within and across teams to enable members to minimise their contribution to environmental hotspots and that equips them to help deliver a range of solutions and interventions – e.g. sustainable procurement approaches, monitoring and measuring resource use (food and beverages, water and energy) as well as eco-design tools and techniques for buildings and rooms.

National-level solutions and interventions:

National-level solutions that have been ranked and grouped based on their likely impact and require either action led by government policy-makers and/or that call for public or public/private sector investment in national and local infrastructure to address identified hotspots. They include:

- **Implementing the National Tourism GHG / Energy Policy:** policies on renewable energy and energy efficiency can provide essential context for business action. Mauritius already has a strategy for tourism as a part for its long term Energy strategy, but these ambitions need to be implemented into regulation and fiscal incentives. It

² <http://www.pnee.mu/?lang=en>

is worth noting that a cross-ministerial Three year Strategic Plan (2017/18-2019-2020)³ already highlights the fact that the tourism sector should adopt energy-saving technology and that investments should be made in renewable energy; whilst policy initiatives from the Ministry of Energy and Public Utilities (MEPU) have included consideration of the mandatory use of solar hot water systems in hotels, low energy lighting, appliances and HVAC, with a longer-term ambition to promote zero carbon footprint holidays. A roadmap plan also exist to encourage uptake of marine renewable energy technologies (offshore wind, sea water air conditioning and wave power)⁴

- **Improving the production and conversion of energy:** build on existing renewable energy infrastructure projects to reduce dependency on imported fossil fuels for the generation of energy and review MARENA's five-year renewable energy strategic plan in line with the requirements of the Renewable Energy Agency Act (2015) and the goals set out in the Government of Mauritius Long-term Energy Strategy (2009-2025)⁵.
- **Mandatory and voluntary standards for efficient use of resources and energy in hotels and restaurants:** Mauritius Standards Bureau⁶ has prepared a standard on sustainable tourism, the MS165. The Mauritius Standards Bureau and the Ministry of Tourism are working on the international accreditation to the GSTC. This standard could be an opportunity to create mandatory standards for efficient use of resources and measurement of emissions in all hotels with more than 100 rooms. Voluntary for hotels with 50+ rooms. There is also a potential to look at mandatory and voluntary standards for the use of solar hot water systems in hotels, already expressed in national energy strategy to 2025, and efficient air conditioning (e.g. by not allowing temperatures to be set below 20 degrees celsius).
- **National food waste strategy for the tourism sector:** develop a national food waste strategy in line with UN SDG target 12.3 to halve food loss and waste by 2030, with specific components and targets for the tourism sector, including food waste reduction targets, incentives to redistribute surplus food to charitable organisations and the provision of food waste recycling infrastructure to enable the production of renewable energy from biogas and compost for use in agriculture. Implementation of the strategy could include a voluntary agreement with the tourism sector; a consumer/tourist focused behaviour change campaign in collaboration with tourism operators, hotels and restaurants; and a national food waste quantification and best practice platform.

³ **Source:** THREE YEAR STRATEGIC PLAN 2017/18-2019/20: http://budget.mof.govmu.org/budget2017-18/2017_183-YearPlan.pdf

⁴ http://publicutilities.govmu.org/English/Documents/Doc_2018/Mauritius%20Marine%20Energy%20Roadmap.pdf

⁵ Please see: <https://sustainabledevelopment.un.org/content/documents/1245mauritiusEnergy%20Strategy.pdf>

⁶ <http://studylib.net/doc/5494257/sustainable-tourism-ms-165---mauritius-standards-bureau>

Enhance legislation on waste management to optimise waste management: Mauritius has regulation covering waste management⁷. This could be enhanced to promote higher rates of recycling, energy recovery (including biogas) and composting, and reduce the reliance on landfill as the landfill of Mauritius at Mare Chicose will reach its saturation point by end 2019. Currently the Solid Waste Management Division (SWMD) is planning to conduct a study on the production of biogas from food waste.

Strong integration of sustainability in National tourism development plan: Mauritius currently has a new strategy plan to guide the development of the tourism sector 2018-2021, the last plan expired in 2015⁸. In the previous Strategy Plan, sustainability was acknowledged, but not prioritised in the form of subsidies, marketing or concrete proposals. In the current Strategic Plan, climate change has been recognised as a threat, and environmental sustainability is contemplated in strategy four that aims to foster sustainable tourism development, whose actions focus on encouraging and assisting tourism businesses in the adoption of MS165 standard to be environmentally compliant.

Making the transportation network more sustainable: the EU [Sustainable Transport for Areas with Tourism through Energy Reduction \(STARTER\)](#) project identifies that “the seasonality of tourism demand leads to rising demand for transport and mobility services during the high season, which impacts heavily the traffic in specific touristic regions... dealing with the challenges posed by seasonal traffic is not simply the task of the authorities: main players of the transport sector, environmental organisations and the tourism sector should join forces to resolve related issues... The concept of ‘Local Travel Plan Networks (LTPN)’ can be used to shift tourist travel to more sustainable mobility options”. It is worth noting that the Ministry of Public Infrastructure and Land Transport in Mauritius, already has plans that include the use of energy-efficient, low emission vehicles For example, hybrid vehicles enjoy 50% discount on yearly licence, which seems to be working well. According to the Global Fuel Economy Initiative recommendations,⁹ further measures to improve traffic control are needed, such as grade separated junction, promotion of mass transport (LRT) and introduction of bus priority lanes along the main traffic corridors.

A summary of environmental impact hotspots by tourism activity and impact category can be found in **Table 1** below. More detail on the approaches taken to hotspots analysis and key findings can be found in section 5 of the report, with a further summary table of hotspots organised by impact category and lifecycle stage in Annex E of this report.

⁷ <http://environment.govmu.org/English/Pages/swmd/SWMD-Legislation.aspx>

⁸

<http://download.govmu.org/files/2016/IMPLEMENTATION%20OF%20SUSTAINABLE%20TOURISM%20STRATEGIES%20.pdf>

⁹ *Global Fuel Economy Initiative 2018 presentation*

https://wedocs.unep.org/bitstream/handle/20.500.11822/25177/DevelopmentFuelEconomyPolicies_Mauritius.pdf?sequence=3&isAllowed=y

Table 1: Summary of hotspots by environmental impact indicator for the tourism sector in Mauritius

Summary of hotspots across environmental impact categories - Mauritius				
Rank	GHG	Energy	Water	Waste
1	Primary production of meat and dairy products: methane emitted through bovine enteric fermentation (digestion) and production of manures. In the case of Mauritius, these are largely imported, but we know from other SIDS countries that this is a consistent hotspot. Even without these, domestic food production is the main GHG hotspot in Mauritius.	Electricity and fuel use in hotel and MICE establishments: lighting, heating, ventilation and air conditioning (HVAC) of rooms, public spaces, back of house areas, including cooking. Hotels in Mauritius account for 19% of the commercial sectors energy demand ¹⁰ . NOTE: Bhujun and Bahadoor (2016) benchmarked the electricity and water use of hotels in Mauritius. Those using Room Energy Management Systems consume about 37.5% less electricity than those not using it, demonstrating its value.	Primary production of food crops: most of water use in tourism value chains is irrigation in crop production, feed production and for livestock (drinking and cleaning water).	Food waste in hotels, restaurants and MICE establishments: average of 7-12% meat waste in kitchens, with some hotel surveys indicating overall food waste levels at up to 40%. Unused food is likely to account for a large proportion of organic waste in Mauritius, and presents a high potential for biogas generation via anaerobic digestion.
2	Electricity, fuel and refrigerant use in hotel and restaurants: electricity, gas and water supply accounts for 18% of GHG emission according to our top-down analysis. Hotels in Mauritius are relatively efficient (however PNEE study identified many areas with potential for improvement), but the electricity generation is at this moment still heavily reliant on fossil fuels.	Processing and packing of meat and dairy products: slaughterhouse processing and energy used in chilled storage and refrigeration contributes to post-farm gate emissions. NOTE: the vast majority of meat (mutton and goat meat) is imported into Mauritius, whereas 47,000 tonnes of poultry meat is produced domestically.	Water use in hotels and restaurants: guest washing and sanitation, cleaning of rooms and public spaces, laundry services, food preparation and cooking, irrigation of grounds, swimming pools.	Primary production of fresh produce: in-field, unharvested crops and immediate post-harvest crop waste due to supply chain quality requirements and poor demand forecasting (estimates are up to 20% losses/waste).
3	Primary production of fresh produce: emissions from use of fertilizers and methane emissions from organic wastes. Fuel use for in-field operations. NOTE: Mauritius produces fresh	Processing and packing of fresh produce: energy use in the processing and packing of produce, energy use in product chill chain or for freezing of produce post-harvest.	Primary production of produce: water used to grow fruit, vegetables and other food crops dominates water use across the life cycle.	Lack of capacity in waste infrastructure: in 2016 Mauritius produced 445,000 tonnes of waste, of which only 30,000 tonnes was

¹⁰ Source: the [Worldwatch Institute \(2015\)](#).

Summary of hotspots across environmental impact categories - Mauritius				
Rank	GHG	Energy	Water	Waste
	produce (particularly green vegetables, potatoes and some fruits – e.g. pineapples) – domestically.			recycled ¹¹ (more if composting is counted). Investments are required in recycling infrastructure, more landfill infrastructure which should be taxed and adding methane collection to existing landfill after closure.
4	Sewage and waste disposal from hotels: Hotel generate large amount of organic waste, which leads to methane emissions. Reduction and increased composting on food waste can significantly reduce these, as well as improvement to infrastructure by adding anaerobic digester to both sewage treatment and as food waste treatment options, creating biogas instead of GHG emissions. Biogas could also be collected from landfill.	Transportation: high energy use in transportation and distribution of food products, particularly for imported goods.	Water resource management: despite the presence of a National Water Policy (2014) a lack of public infrastructure, regulation and enforcement leads to sub-optimal use of water resources and pollution from untreated wastewater and places a burden on hotels to provide water supplies via boreholes and expensive coastal desalination plants and has an impact on the natural environment.	Lack of plastic and paper recycling: current lack of private and public sector infrastructure for collection and recycling of plastic and paper.
5	Primary production on beverage: used in hotels and restaurants in Mauritius account for 45,000 tonnes of CO ₂ e emissions.		Water use in the energy sector: water used in cooling in power generation, emitted as steam and not returned to water source.	Single use items: e.g. plastic packaging, cleaning product containers could be reduced through investigation of reuse/refill systems.

¹¹ **NOTE:** National data on waste arisings associated specifically with hotels and restaurants is not available. Source: [The Ministry of Social Security, National Solidarity, and Environment and Sustainable Development](#)

1. Introduction

1.1. Background

The project "Transforming Tourism Value Chains in developing countries and Small Island Developing States (SIDS) to accelerate more resilient, resource efficient, low carbon development" has been developed in the framework of the International Climate Initiative financed by the German Federal Ministry for the Environment, Nature conservation, Building and Nuclear Safety. The project proposes to transform tourism activities along two key tourism value chains associated with accommodation, so as to reduce carbon emissions and improve resource efficiency by implementing low carbon development actions integrated with sustainable consumption and production patterns. This four-year project has two phases: an assessment phase (2017/2018) and an implementation phase (2019/2020). The goals of the assessment phase are to define tourism value chains with high resource use and to identify and assess key environmental indicators for greenhouse gas (GHG) emission and resource consumption impacts (presented as 'hotspots') within these chains.

This is one of four country reports, the other three being the Dominican Republic, the Philippines and Saint Lucia.

1.2. Purpose

This document is a project report for Mauritius. Its purpose is to support decision making of key stakeholders within the Transforming Tourism Value Chain's project to prioritise feasible solutions to reduce GHG emissions and improve resource efficiency (RE) in the target value chains during the project's implementation phase and beyond the project timeline in Mauritius. The Document may also be useful for other tourism stakeholders, e.g. destination management and civil society organizations, policy makers and other public-sector bodies that design, develop, regulate or manage tourism destinations. This document also provides the context to involve businesses and other private sector actors in the development of policy recommendations and definition of action plan priorities.

The report has been produced by WRAP, with information collated by local partners¹² at the Travel Foundation and with the support of both UN Environment and UDP. The STAG in Mauritius is co-chaired by the Ministry of Tourism, and comprised of members from the Energy Efficiency Management Office (EEMO) (under the aegis of MEPU), Ministry of Social Security, National Solidarity, and Environment and Sustainable Development (MSSNSED), Mauritius Council of Social Service (MACOSS), Food and Agricultural Research and Extension Institute (FAREI) under the Min. of Agro-Industry, Mauritius Renewable Energy Agency

¹² The Department of Tourism, the Philippines Center for Environmental Protection and Sustainable Development Inc., (PCEPSDI); Mauritius: Ministry of Tourism & External Communications and the Ministry of Environment – Sustainable Development; National Emergency Centre and Beach Authority, and Travel Foundation. Dominican Republic: Association of Hotels Playa Dorada, Ministry of Environment and el Programa Nacional de Producción Más Limpia; The Commission of the Organization of Eastern Caribbean States: representing 6 member states, and Ministry of Tourism of Saint Lucia.

(MARENA), Association of Hoteliers and Restaurants In Mauritius (AHRIM), Business Mauritius (BM), Association des Hôtels de Charme (AHC), United Nations Office in Mauritius, University of Mauritius (UoM) has also reviewed, contributed and validated the findings. The report assesses the accommodation value chain and its impacts at the national level (based on published data). The report also includes an assessment at hotel level to provide background information on GHG emissions levels and resource efficiency in Mauritius. The findings of this report and associated hotspots have been discussed during a workshop held in June 2018. Based on the identified hotspots, a long list of potential mitigation solutions were produced that were also validated through a consultation process with industry and experts in the workshops. The result was a number of priority areas for action and implementation. Supplementary information and data are contained in the following Annexes:

- A. Mauritius Tourism Sector Country Context Report;
- B. Survey of the Tourism Value Chain;
- C. UDP Climate Change Policy Analysis – Republic of Mauritius;
- D. UDP Climate Change Policy Comparison table;
- E. Summary table of environmental impact hotspots for the Mauritius tourism sector organised by impact category and product life cycle stage; and
- F. Long-list of business value chain and national-level solutions and interventions captured during 2018 country workshops.

1.3. Scope of the report

The scope of the report assesses the accommodation and food and beverage value chain. This approach has been used as Mauritius has a variety of all inclusive, half board and guest house model operating. The value chain approach to tourism covers all stakeholders involved in delivering a tourism experience in the accommodation service (dinning, recreation, leisure, shopping, etc). The analysis covers all goods and services in the respective value chains and the life cycle impacts created by the international and in-country manufacture, storage, distribution, consumption and disposal of these goods and services. Therefore, tourist travel into the country is excluded, but impacts embedded in imported goods and services are included. This enables a strategic way of identifying and prioritizing critical issues along the chain; and facilitates the development of targeted solution interventions in order to achieve maximum impact.

The first section of the report (National Context) is an introduction to the Mauritius, to understand the context and scale of the tourism industry. The remainder of the report focuses on the activities related to the first assessment phase of the project. Firstly, the outcome of the value chain mapping are discussed followed by the agreed boundaries and the selected sustainability indicators used in the project. It then details the rationale, methodology and outcome of the national level data and local level hotel assessments conducted over five months in 2017. The local assessments serve to understand the structure of the tourism value chain at the company (e.g. hotel) level, such as different types of accommodation, their activities and impact. The report then highlights the quantitative energy and consumables data that was evaluated using tools and models available to UDP and WRAP respectively. This is to provide an initial assessment of the GHG impacts and range in the impacts, at the

company-level. Leading from the national assessment and the pilot activity, WRAP developed the long-list of solutions and provided inputs for further prioritization. The quantitative data collected in 2017 has been detailed in this report. The result is the hotspots analysis and the associated long list of potential mitigation options.

For Mauritius, the project is focusing on policy recommendations for, and capacity building in low carbon tourism operations. This report will therefore summarise policy intentions, detailed in both UDP's report and by the in-country partner. This will lay the foundation for a future report on policy recommendations, as a result of the hotspots analysis and the associated policy context reports (detailed in annexes).

2. National Context

2.1. Overview

The current and forecast levels of travel and tourism in Mauritius have considerable environmental and social impacts. Through the Transforming Value Chains project, we seek to prioritise the activities which contribute the most to critical environmental impacts. We then outline potential solutions & interventions aimed to reduce greenhouse gas emissions and improve resource efficiency in key tourism sector value chains with high resource use.

This section provides an overview of the Tourism Sector in Mauritius presented as a summary of a detailed report provide by the Travel Foundation. For the full report please refer to **Annex 1**. This section provides an overview of the tourism sector covering geographical information and the economic and employment contribution of tourism to the national economy. This is followed by a summary of visitor arrivals, the typical visitor stay and expenditure, an overview of the accommodation sector, and any accreditation or certification schemes present in Mauritius.

2.2. Geography of Mauritius and Tourism Sector Overview

The Republic of Mauritius is an island nation in the Indian Ocean about 2,000 kilometers (1,200miles) off the southeast coast of the African continent. The total land area of the country is 2,040km² (790sq mi). The Republic of Mauritius comprises the two main islands of Mauritius and Rodrigues, and several outlying islands.

Tourism is one of the key pillars of the Mauritian economy and one of the largest employment sectors. Travel & Tourism generated 41,500 jobs directly in 2017¹³ (7.2% of total employment) a number forecast to fall by 1% . This includes employment by hotels, travel agents, airlines and other passenger transportation services (excluding commuter services). It also includes, for example, the activities of the restaurant and leisure industries directly supported by tourists. In 2017, the total contribution of Travel & Tourism to employment, including jobs indirectly supported by the industry was 22.6% of total employment (131,000

¹³ WTTC Travel & Tourism Economic Impact 2018 Mauritius, 2018 <https://www.wttc.org/-/media/files/reports/economic-impact-research/countries-2018/mauritius2018.pdf>

jobs). This percentage is expected to fall by 0.3% in 2018 to 130,500 jobs and rise by 1.8% pa to 156,000 jobs in 2028 (25.8% of total)

The economic value of tourism to the national economy is therefore significant. It should be noted however that Mauritius has not prepared a Tourism Satellite Account (TSA) for the sector since 2010 and that more up-to-date data on the economic contribution of the sector had to be drawn from several available sources, namely the 2015/2018 report of the World Travel and Tourism Council and the 2016/17 Annual Report of l'Association des Hôteliers et Restaurateurs de l'île Maurice (AHRIM), an industry representative body. In its 2015 report on the economic impact of tourism in Mauritius the World Travel and Tourism Council (WTTC)¹⁴ concluded that tourism made up MUR34.2bn (USD982.9mn), 7.4% of total GDP in 2017 and is forecast to rise by 1.6% in 2018, and to rise by 4.6% pa, from 2018-2028, to MUR54.3bn (USD1,561.8mn), 8.1% of total GDP in 2028.

Considering indirect economic impacts¹⁶ by travel and tourism the WTTC report estimated that the total economic contribution of the sector in 2014 was MUR 110.0bn (USD3,167.0mn), 23.8% of GDP in 2017, and is forecast to rise by 2.5% in 2018, and by 4.5% pa to MUR174.5bn (USD5,021.4mn), 26.1% of GDP in 2028.

In 2016, 97.8% of tourist arrivals were by air with the remaining 2.2% by sea.¹⁵ The categories of tourist arrivals by purpose of visit recorded by Statistics Mauritius are:

- Holiday – 1,220,047 tourist arrivals
- Business – 44,133 tourist arrivals
- Transit – 21,302 tourist arrivals
- Conference – 6,264 tourist arrivals
- Sports – 2,120 tourist arrivals
- Other, not stated (assumed to include visiting friends and relatives - VFR) – 951,361 tourist arrivals

Tourist arrivals rose from 103,000 in 1977 to 656,450 in 2000, a more than six-fold increase. This growth presents a challenge for the tourism industry to do so, while reducing GHG emissions and improving resource efficiency. About 67% of the tourist arrivals are of European origin, with France supplying nearly half. The nearby Reunion French Territory is the most important short haul source market accounting for about 13% of total tourist arrivals. Asian residents provided 6% of tourist arrivals, almost half of which originated from the Indian Sub-Continent.

In 2000, the total number of nights spent by tourists was estimated to be about 6.5 million, representing an increase of 13% over 1999. In 2016 the length of the average tourist stay was 10.4 nights.¹⁶ Average visitor expenditure is 4,219 MUR (US\$124) per night. A breakdown of this expenditure is provided in Annex 1.

¹⁴ WTTC Travel & Tourism Economic Impact 2018 Mauritius, 2018 <https://www.wttc.org/-/media/files/reports/economic-impact-research/countries-2018/mauritius2018.pdf>

¹⁵ Statistics Mauritius

¹⁶ Statistics Mauritius

Responsibility for tourism in Mauritius falls under the Ministry of Tourism, which determines tourism policy. The stated [mission of the Ministry of Tourism](#) is:

- To propel the tourism sector as a key engine of growth.
- To enhance the visibility of Mauritius as a top-class tourist destination in traditional, emerging and new markets.
- To broaden the tourism product portfolio to include eco-tourism, spa and wellness tourism, cruise tourism, cultural tourism, business tourism and sporting events.
- To promote Mauritius as a clean and safe tourist destination.

In pursuit of its mission the Ministry has identified a range of aims and objectives. These are set out in the full national context report in **Annex 1**. Under the aegis of the Ministry of Tourism two independent government bodies have been established; The Mauritius Tourism Authority and the Mauritius Tourism Promotion Authority (MTPA) (see Annex 1 for additional information on the MTPA).

In 2016 there were approximately 119 operational hotels providing a total of 13,710 guest rooms¹⁷. In addition, there were 231 guest houses providing 2,212 guest rooms; 120 hotels providing 13,710 guest rooms; and 961 tourist residences providing 5,413 guest rooms. Of the total number of hotel guest rooms available, 73% are under national or international management groups. A [2 year moratorium](#) on construction of new hotels was announced in 2014 to restore the balance of supply and demand of accommodation.

In addition to the formal accommodation sector, anecdotal evidence suggests that there may be an unregistered informal accommodation segment, focussed on the rental of private residences. The tourist authorities are aware of this situation and are actively enforcing registration regulations. The Travel Foundation conducted some outline research on many of the best-known tourism booking engines, the results are as follows:

- Booking.com lists 394 properties in Mauritius
- Airbnb lists around 360 properties
- Trip Advisor lists 1237 'holiday rentals', 194 'hotels' and 897 'restaurants' (not including a number of fast food outlets)

2.3. Resource Efficiency

No specific Ministry has overall control of the Food and Beverages sector, which may be deemed as falling under 3 principle Ministries or bodies as follows:

- Food and Beverage Outlets – The Tourism Authority
- Food and Beverage safety – Ministry of Agriculture and Food Security
- Primary food production - Ministry of Agriculture and Food Security
- Food production enterprises – Ministry of Industry

¹⁷ Ministry of Tourism, 2016 Tourism Statistics

- The Ministry of Public Utilities (MPU) is responsible for the design and implementation of energy policy. There are 8 organisations that fall under the purview of the Ministry (details of these are provided in **Annex 1**).

Independent Power Producers produce around 60% of the total electricity generated and the Central Electricity Board (CEB) produced the remaining 40%.

Mauritius has no known oil, natural gas or coal reserves, and therefore depends on imported petroleum products to meet most of its energy requirements.¹⁸ Local and renewable energy sources are biomass, hydro, solar and wind energy. Biomass energy consists mainly of bagasse, a by-product of the sugar industry, and contributes about 22% of the primary energy supply. Fuel wood and charcoal are minimally used. Hydropower plants, with a combined installed capacity of 59 MW, is virtually the entire hydro potential.

The [Long-Term Energy Strategy 2009-2025](#): (October 2009, Ministry of Renewable Energy and Public Utilities): made mention of energy efficiency in the tourism industry. The strategy to raise tourist numbers to two million will be supplemented with specific measures for ensuring sustainability of energy use in the sector. In the long-term, the strategic objective is to promote zero-carbon-footprint holidays, thereby enhancing the competitiveness of our tourism sector. The energy strategy has identified 6 areas of focus for the tourism sector. These are outlined in **Annex 1**.

[SWITCH Africa Green project](#) published recommendations for Mauritius. These relate to a need for a new tourism strategy, new tourism brand, helping SMEs in the tourism sector, reiterating the need for energy efficiency improvement and also the need to develop day trip destinations around Mauritius (to move away from the image of beach holiday destination with not much else to see), including surrounding infrastructure such as roads.

2.4. Voluntary Standards and Certification

The Government of Mauritius has approved the implementation of a Hotel Classification System in Mauritius, with the announcement of [Tourism Authority \(Hotel Classification\) Regulations 2015](#). The Tourism Authority (TA) is the implementing agency.¹⁹ The Tourism Authority operates a 'star rating' system to categorise hotels. Of the hotels which have been registered and inspected to date, 15 are 2 star, 26 are 3 star, 26 are 4 star and 32 are 5 star.

The Ministry of Tourism is working in collaboration of Mauritius Standard Bureau (MSB) to revise the [MS 165 Sustainable Tourism Standard](#). The aim of the Certification Scheme is to promote sustainable tourism in Mauritius for any tourism business or any tourism-related activity, helping tourism enterprises enhance corporate image, differentiate product and services, and improve environmental performance. This Standard is generic and is intended

¹⁸ Statistics Mauritius 2016

¹⁹<http://tourismauthority.mu/userfiles/file/tourismauthority/star-rating/Hotel%20Classification%20System%20in%20Mauritius.pdf>
(<http://tourismauthority.mu/userfiles/file/tourismauthority/star-rating/HOTEL%20CLASSIFICATION%20REGULATIONS.PDF>)

to be applicable to tourism businesses regardless of their type, size or location. The revision process potentially presents an opportunity to implement some recommendations from this project.

According to [TUI](#), [Green Globe](#) and [Green Key](#) other certifications used on the island include:

- a. **Green Globe:** Green Globe is a certification for sustainable tourism in the global travel and tourism industry. Mauritius currently has 11 hotels certified with GG²⁰. Recognized by Global Sustainable Tourism Council (GSTC).
- b. **Green Key:** It is an international European certification program currently found in 53 countries, which certifies improvement processes in the environmental management of hotels, campsites and other hotel establishments around the world. Two (2) hotels in Mauritius are Green Key certified²¹.
- c. **EarthCheck:** A benchmarking, certification and advisory group for travel and tourism. EarthCheck Certified is certified by the [Global Sustainable Tourism Council](#) (GSTC) and has been approved by the [CDP](#). There appear to be at least four (4) hotels certified by EarthCheck in Mauritius according to the information on their website²².
- d. **Travelife:** It is a certification created by tour operators to improve sustainability of both tour operators, travel agencies and hotels worldwide. Eleven hotels are Travelife certified in Mauritius²³.
- e. **Blue Flag:** It is a recognition that is regularly awarded, to the beaches and marinas that have complied with the rules and requirements of the Blue Flag. There are currently no beaches in Mauritius with Blue Flag certification, but one is in pilot stages.

The aforementioned schemes highlight the high level of awareness off environmental issues and a willingness to address them at a hotel level in Mauritius.

2.5. Climate Change- policy summary

Due to its high economic importance, the [Third National Communication](#) identifies tourism as a vulnerable sector to climate change and outlines various climate change-related impacts observed in the coastal areas. These impacts include:

- Increasing costs for various tourism operations
- Reduction in tourist arrivals, due to an increase in mean annual temperature along with an
- increase in temperature extremes ([Tourism Council, 2015](#); [GoM](#));
- A reduction in beach width of up to 10 metres over 8 years due to sea level rise ([IPCC 2013](#)).

In April 2007, the Government of Mauritius adopted the “[Outline of the Energy Policy 2007-2025- Towards a Coherent Energy Policy for the Development of the Energy Sector in](#)

²⁰ Source: <https://greenglobe.com/members/africa/>

²¹ Source: <http://www.greenkey.global/green-key-sites/>

²² Source: <https://earthcheck.org/news/2017/july/sun-resorts-in-mauritius-recognised-for-their-commitment-to-sustainability-by-earthcheck/>

²³ Source: <http://travelifecollection.com/home>

[Mauritius](#)” which outlines in broad terms the government’s long term vision for the energy sector. Based on this outline, an energy study jointly funded by the EC and UNDP/UNEP was carried out from August to December 2007. The aim of the study was to support the development of a 25 year comprehensive energy policy, including a Master Plan for Renewable Energy sources. The Long-Term Energy Strategy outlines several mitigation actions specifically related to tourism sector and aiming at improving energy efficiency:

- develop a well-defined energy strategy for the tourism sector;
- encourage retrofitting of existing hotels with the latest energy efficient technologies and
- mandatory sustainable building design for new hotels;
- mandatory use of solar hot water systems in hotels as far as practicable;
- introduction of low-energy lighting/appliances/air-conditioning and cooling devices throughout the hotel industry;
- promotion of low-energy and eco-friendly airport transfer policies;
- encouraging hotels to provide facilities on optional basis to allow tourists to offset the carbon impact of their flights by investing in sustainable energy schemes in Mauritius; and
- incentive schemes to promote and develop an eco-friendly tourism industry.

For national policies relating to Energy, Food and Beverage, Transport, Agriculture, and Waste please refer to the full national context report in **Annex 1**.

The Republic of Mauritius submitted its NDC in September 2015 and ratified the Paris Agreement in April 2016 during the 21st Meeting of the Conference of Parties (COP 21). The NDC states a 30% emissions cut by 2030, relative to the business as usual scenario of 7 million metric tonnes CO₂e and is reliant on international support. This target shall be achieved by the government through a responsible and environmentally sustainable policy regarding energy production, waste management and physical infrastructural development, in addition to mainstreaming climate change education for sustainable development. The NDC identifies the following mitigation actions:

- smart use of marine resources;
- expansion in solar, wind and biomass energy production and other renewable energy sources;
- sustainable consumption and production in all sectors of the economy;
- gradual shift towards the use of cleaner energy technologies, such as LNG, among others;
- modernisation of the national electricity grid through the use of smart technologies, which is a prerequisite to accelerate the uptake of renewable energy;
- efficient use of energy through the deployment of appropriate technologies in all sectors of the economy and awareness raising on energy conservation;
- sustainable transportation, including promotion of energy efficient mass transportation systems based on hybrid technologies and cleaner energy sources;
- climate smart agriculture including bio-farming;
- sustainable and integrated waste management, including waste to energy;

- sustained tree planting programme within the context of the cleaner, greener and safer initiative; and
- leapfrog to low global warming potential refrigerants.

3. General methodology on hotspot analysis, data collection and processing

3.1. Concepts and Definitions

This project and report have followed the 2017 Life Cycle Initiative overarching methodology for hotspots analysis²⁴. This allows for the rapid assimilation and analysis of a range of information sources, including life cycle based and market information, scientific research, expert opinion and stakeholder concerns. The outputs from this analysis can then be used to identify potential solutions and prioritize actions around the most significant governance, economic, environmental and/or social sustainability impacts or benefits associated with a specific country, city, industry sector, lifestyle, product portfolio, product category or individual product or service.

The Life Cycle Initiative (2017) identifies that hotspots may be defined in two ways. Firstly, a hotspot may be a life cycle stage (such as material sourcing, processing, manufacturing, transport, retail, use and disposal) whose contribution to the impact category (such as global warming potential) is greater than even distribution of that impact across the life cycle stages. For example, if 5 life cycle stages are defined, a hotspot should be at least 20% of the impact category. Secondly, hotspots may be all life cycle stages collectively contributing more than 50% to any impact category, ensuring that most of the impact is considered. In this project, the second approach is taken to ensure that the impact of data uncertainty on addressing hotspots is minimised.

Hotspots analysis comprises 8 stages, as illustrated in **Figure 1** below.

²⁴ <http://www.lifecycleinitiative.org/new-hotspots-analysis-methodological-framework-and-guidance/>

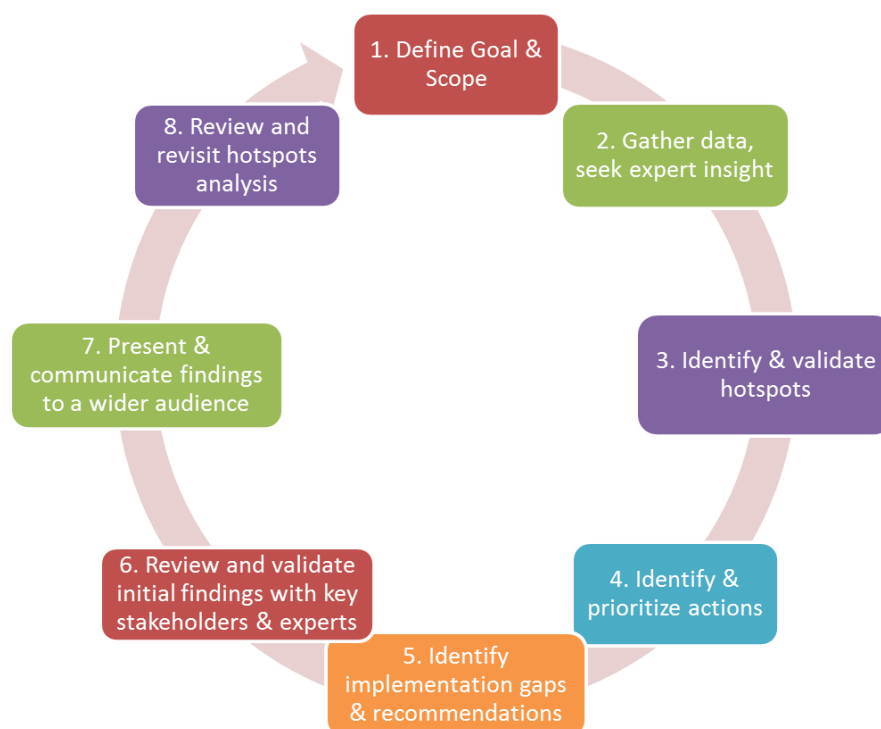


Figure 1: 8 Stages of Hotspots Analysis

The goal and scope, are established in the introductory section of this report. The remainder of this report goes through to step 7 of the hotspots analysis framework.

3.2. Value Chain Mapping (System Boundary)

The project has adopted the definition of a value chain contained in the second committee draft of ISO14001: “the entire sequence of activities or parties that provide or receive value in the form of products or services (e.g. suppliers, outsources, workers, contractors, investors, R&D, customers, consumers, members)”²⁵. **Figure 2** below further illustrates this definition noting how there are stakeholders that are not necessarily part of the supply chain, but that perceive social, economic and environmental value and impacts from the series of activities required to deliver a product or service.

Mapping and managing value chain is all about extending line of sight and influence beyond the traditional areas of focus and looking to limit risk and add value at each stage. It looks both upstream to the suppliers and materials, and downstream to the customers and reuse/disposal, to identify key risks and opportunities for business.

²⁵ ISO14001 CD2, 2013, in UNEP and UDP (2017) Eco-Innovation Manual <http://unep.ecoinnovation.org/>



Figure 2: The difference between supply chain and value chain

Clear boundaries are essential to ensure that appropriate information is obtained and used within the hotspots analysis. Whereas a supply chain includes the activities of all parties involved in fulfilling a customer request, such as a product or service, a value chain also includes the customer themselves and the impact of subsequent waste. The value chain map for tourism in Mauritius is shown in [Figure 4](#). It identifies the activities and actors involved in the provision of tourism services, all of which are within the scope of the project.

The expenditure by hotels and restaurants is then quantified where information is available in [Figure 5](#). Significant areas of expenditure are outlined in red. Minor expenditure across 44 sectors is grouped together, amounting to USD 5 million in 2013. Imports procured directly by hotels and restaurants are also shown separately, and this is discussed further in the section on data limitations. The analysis of expenditure suggests that imports, support services, and food and beverage products are key elements in the value chain.

In addition, [Figure 3](#) shows the proportion of income to a sector from hotels and restaurants. This shows that hotels and restaurants account for less than 0.5% of income to any other sector of the economy within Mauritius. This shows that the sector is a relatively insignificant customer of domestic businesses and in combination with the data on imports in these sectors suggests that it may have a greater potential influence on imported products than those domestically produced.

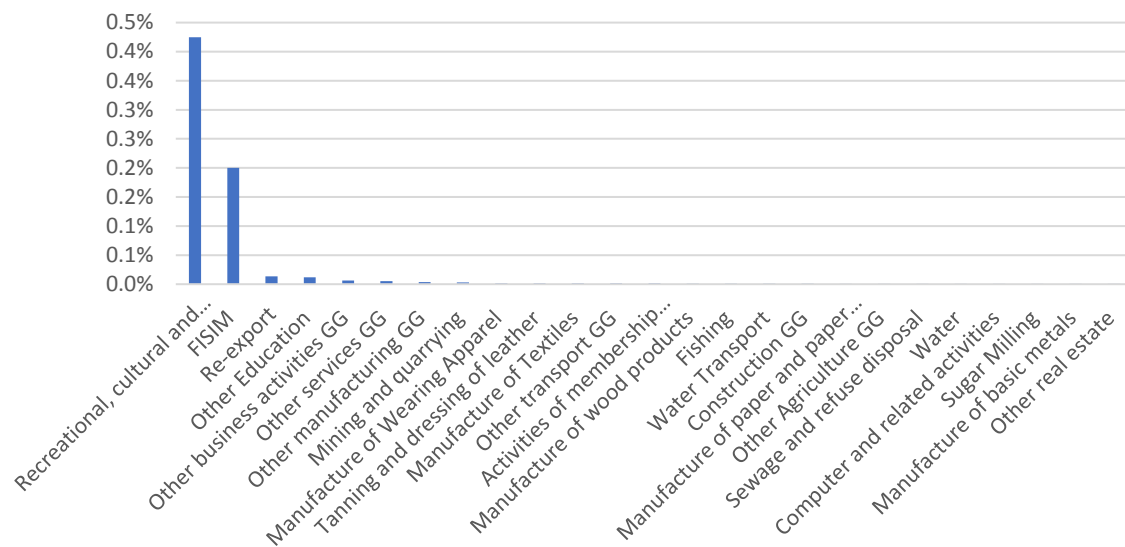


Figure 3: proportion of income to a sector from hotels and restaurants (Source: Lenzen et al 2013).

Figure 6 then highlights those supply chain actors able to control or influence the environmental hotspots identified in **Section 4** below.

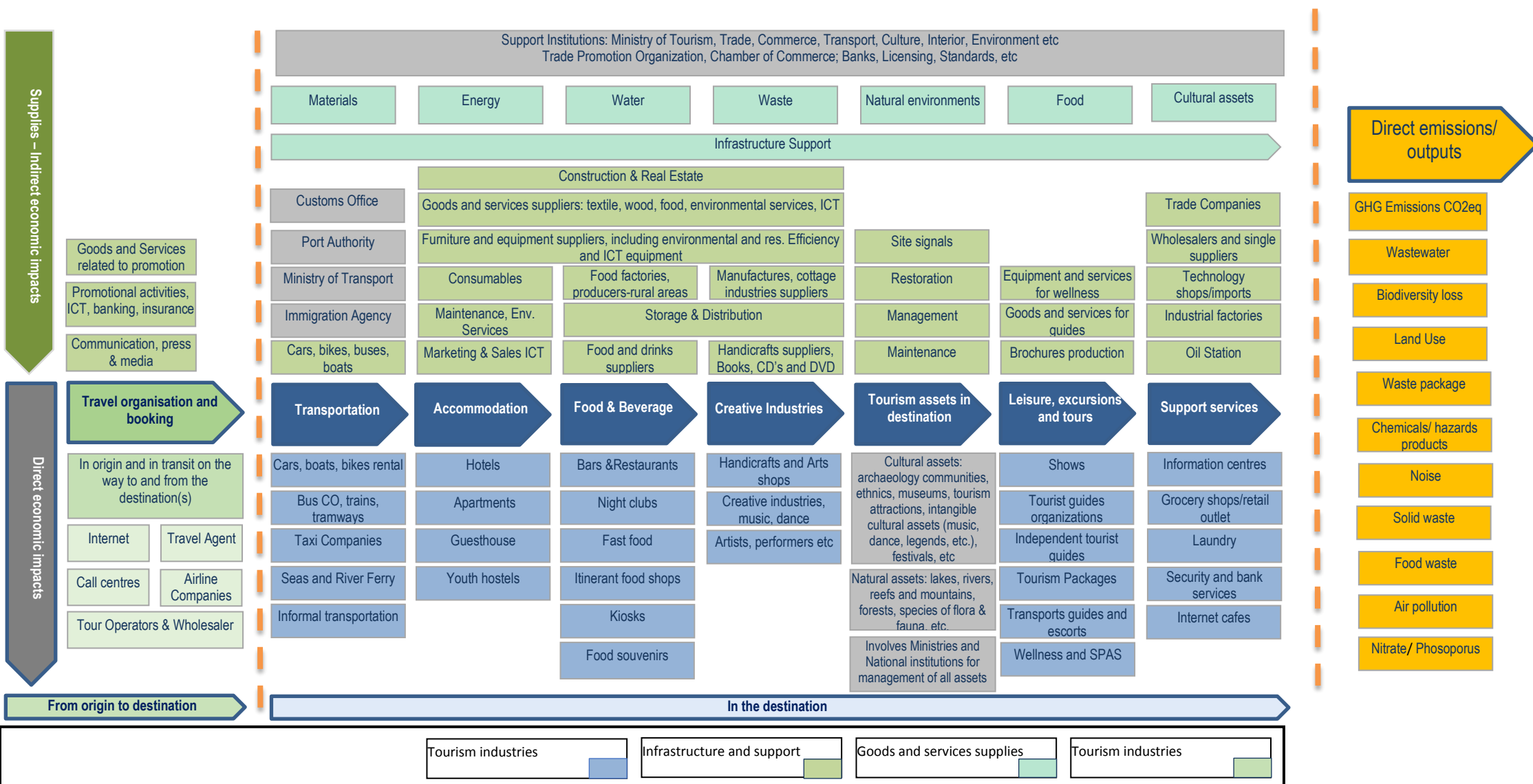


Figure 4: Value chain map for tourism in Mauritius. Adapted by UN Environment from ITC WTO (2015)

Figure 5: Expenditure by hotels and restaurants across the value chain in Mauritius, 2013 (Source: Lenzen et al 2012, 2013).

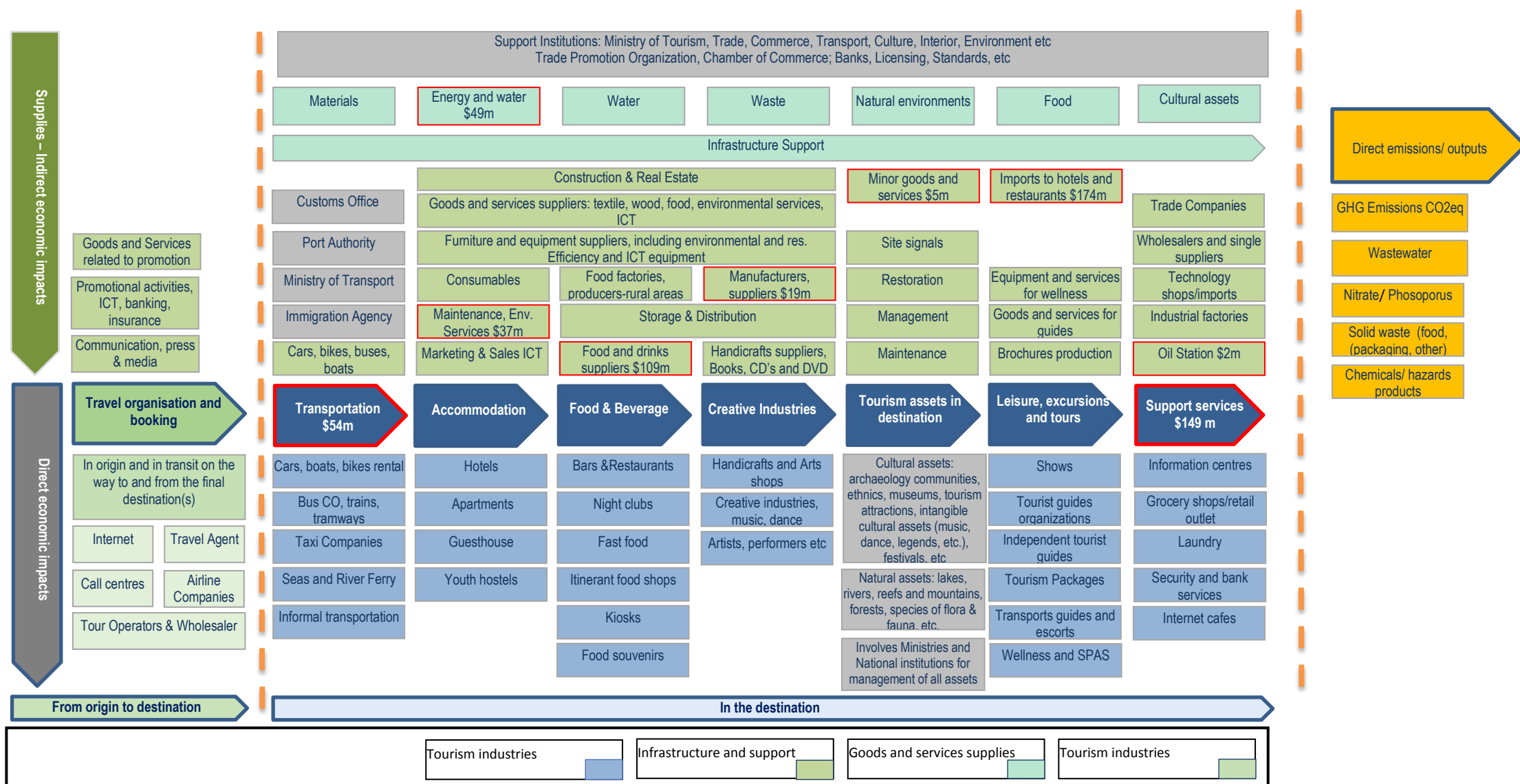
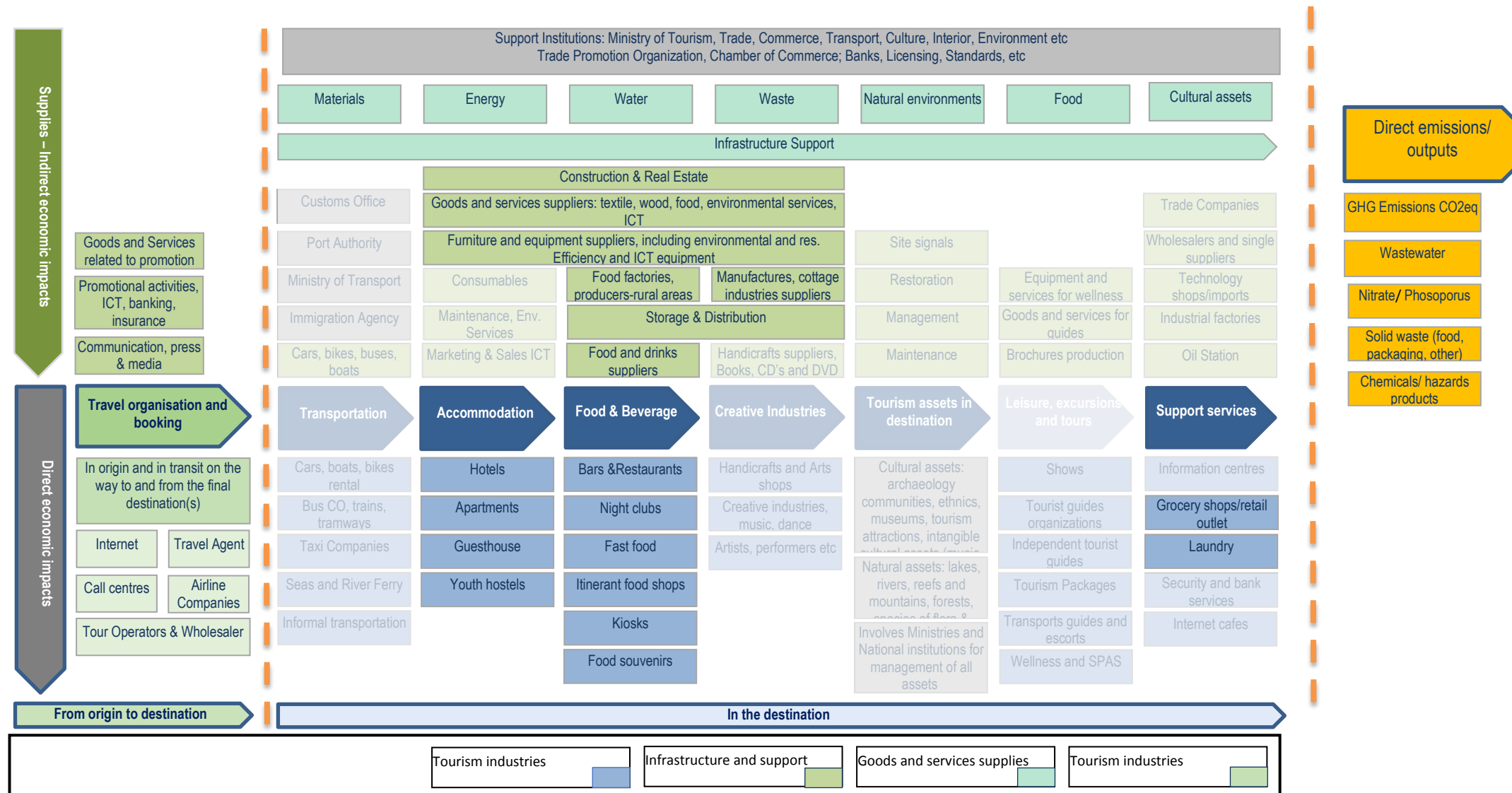


Figure 6 : Value Chain actors able to control / influence environmental hotspots



Revisiting the value chain maps in [Figure 4](#) and [Figure 5](#), organisations who influence or control the anticipated hotspots identified in Mauritius (see [Section 5](#) below) are highlighted in [Figure 6](#) above. Based on the literature review and top-down assessment conducted as part of the hotspots analysis, agriculture and food and beverages appear to represent the hotspots for GHG emissions associated with hotels and restaurants. The high proportion of imports suggests that many of these impacts occur overseas. Meat and dairy products and fresh produce are also a hotspot in terms of water use.

4. Identification of Hotspots

4.1. Introduction

This section provides information on the methodologies and processes used to collect data to inform the hotspots analysis for the tourism sector in Mauritius. It starts by providing a summary of the two approaches taken, the methodologies used and the key findings from each. This is followed by a short discussion of the inherent data limitations in both approaches; and how supplemental research was required to sense check the top-down view of environmental hotspots in order to address a significant data gap that resulted from a lack of bottom-up hotel survey data. Finally, an analysis of imported goods was conducted to check their significance and any implications for the hotspots analysis.

Two approaches have been taken to gathering data and identifying hotspots. The first approach has been to gather data at a national level (a top-down approach) relevant to the goal and scope of the study, and the second to collect data from individual organisations in the Mauritius tourism sector (a bottom-up approach).

The aim was to use a combination of a top-down approach (using national input-output databases) and a bottom-up approach (using hotel Survey data). However due to difficulties in obtaining survey data from the hotels, the final hotspot analysis was based on top down approach only, and supplemented with our experience from other project countries.

In addition two data sources on imports were analysed. One for general economy, which showed us which countries are exporting to Mauritius Tourism supply chains, but not what those exports are. The second data source shows the types of food and beverage imported into Mauritius. The most emission intensive foods – beef, dairy and rice, are largely imported in Mauritius, therefore likely adding to food hotspot.

The top-down approach offers a rapid way of approximating the greenhouse gas emissions, energy use and water footprint associated with the tourism value chain using national statistics collated in a consistent manner.

The bottom-up approach gathers data through a survey of individual hotels should enable data at a greater degree of resolution where and comparison to the national data. However, surveying hotels encountered delays and the (late) survey results were only scanned to cross check validity and not formally analysed.

4.2. Top-down Approach and Results

The top down approach builds on the work of Lenzen et al²⁶ to construct the EORA database. The Eora multi-region input-output table (MRIO) database provides a time series of Input Output tables with matching environmental and social satellite accounts for over 180 countries. Input Output tables provide data regarding the economic spending of sectors within an economy in other sectors, and the economic output that results. In short, these tables can tell us how much is spent in all sectors of the economy (inputs) to produce one US\$ of value in a given sector (output). Using this data, we can calculate the cascade effect of spending within an economy. For example, \$1 spent in the electricity sector requires the electricity sector to spend a given fraction of a dollar on fuels and so on.

Where the total environmental impact of a sector, and its total economic output for a given year, are known, the environmental impact per dollar of economic output for each sector can be calculated. At a high level, this allows the direct and indirect environmental impact of spending in a given sector to be calculated. The raw data is drawn from the UN's System of National Accounts and COMTRADE databases, Eurostat, IDE/JETRO, and numerous national agencies. By mapping the economic interactions of hotels and restaurants with other sectors of the economy, the impact incurred through expenditure by hotels and restaurants can be identified and quantified. The expenditure by hotels and restaurants is quantified in **Figure 5** above. **Figure 7** below translates this expenditure into environmental impact, showing greenhouse gas emissions and water footprint.

A top down approach has a number of strengths and weaknesses. By capturing all of the data from a sector (e.g. food and drink manufacturing), a top-down approach allows a comprehensive view of the impacts of a system. However, it is constrained by the availability of data in a suitable format. For example, data may be available for the sector “accommodation”, or for “accommodation and restaurants”, which will lead to results that cannot be used to separately benchmark the impacts of these two sectors of a tourism value chain with those in other countries where the data is available for both sectors separately. Inferences and assumptions are also required to sub-divide activities (e.g. imports) to identify the relevant emissions. The top down approach does not include product specific information; therefore, it needs to be complemented by the bottom-up approach, for a detailed accounting of the environmental impacts at the product and activity level.

Figure 7 shows that the greatest contributions to greenhouse gas emissions related to hotels and restaurants (including embedded emissions in value chains) are from food (meat, fish, fruit, vegetables, oils, fats, products of market gardening and horticulture), electricity and gas; and sewage and waste disposal based on the national data. When considering the water footprint, food crops and beverages are the dominant causes of demand. This is due to the

²⁶ Lenzen, M., Kanemoto, K., Moran, D., Geschke, A. Mapping the Structure of the World Economy (2012). *Env. Sci. Tech.* 46(15) pp 8374-8381. DOI:10.1021/es300171x Lenzen, M., Moran, D., Kanemoto, K., Geschke, A. (2013) Building Eora: A Global Multi-regional Input-Output Database at High Country and Sector Resolution, *Economic Systems Research*, 25:1, 20-49, DOI:10.1080/09535314.2013.769 938

amount of water required in agriculture to produce crops, and the relatively small amount required for other products. Translating economic expenditure into environmental impact demonstrates that expenditure is not a proxy for impact and should not be used as a basis for actions to reduce the environmental impacts of Tourism Value Chains. It also shows that the results can vary depending on the environmental issue under analysis.

It should be noted that in the case of Mauritius no national-level data is available to allow hotels and restaurants to be divided. However, if the distribution of spending for a hotel is known, the same approach can be used to calculate the hotel-specific hotspots. This underlines the importance of taking both a top-down approach to obtain rapid results, and a bottom up approach or supplementary desktop research to validate the findings at a finer level of detail where data is available.

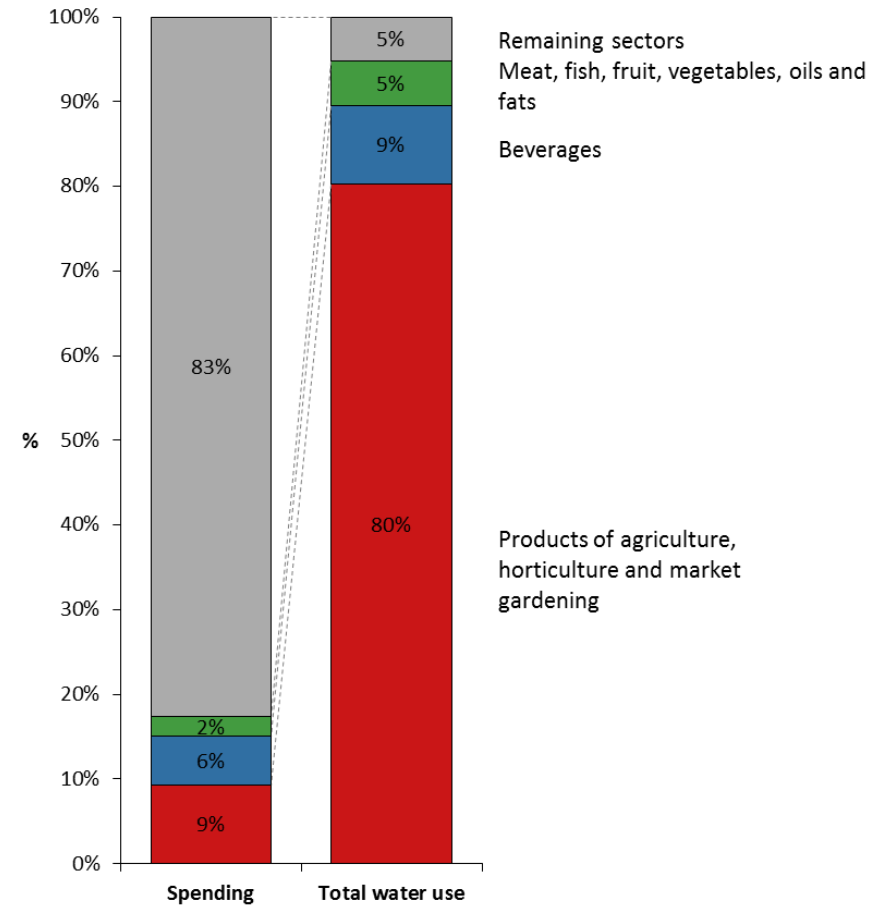
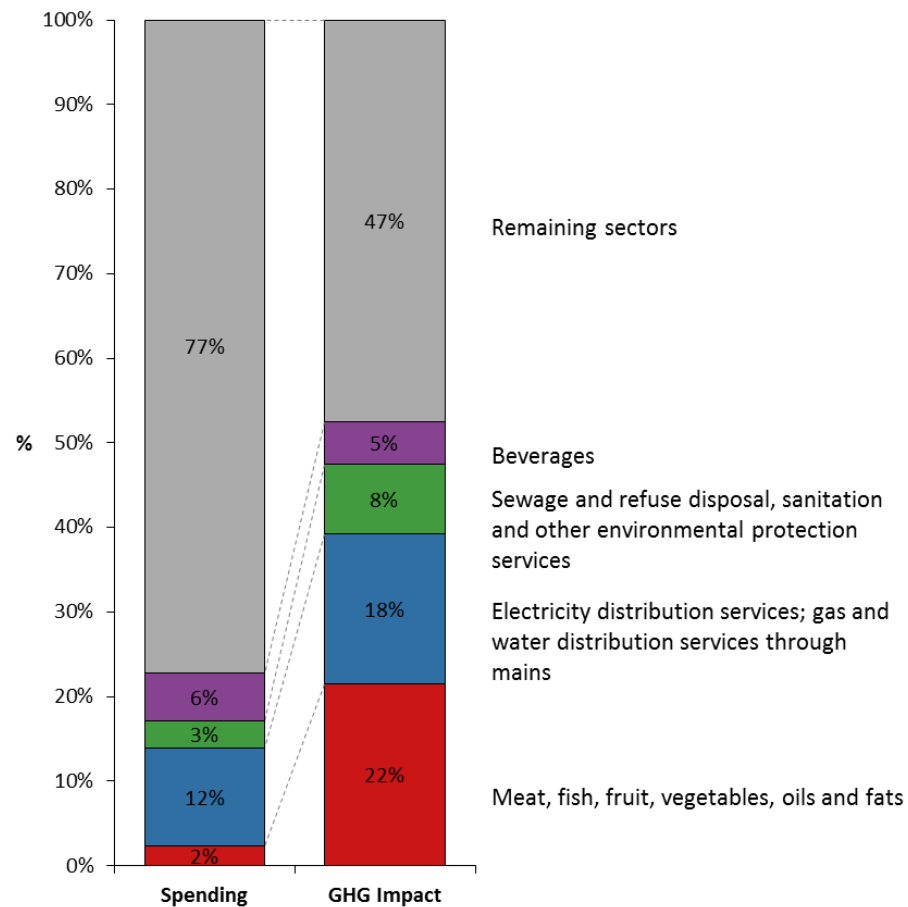


Figure 7: Expenditure and environmental impact of Hotels and Restaurants in Mauritius. The chart on the left shows GHG emissions, and the right chart shows water use. **Data source:** Environmentally Extended Input Output tables: Eora Version 199.82, 2013 data (<http://www.worldmrio.com/>).

4.3. Bottom-up Approach and Results

The bottom-up approach is based on a survey of individual hotels in the tourism value chain. The strength of the bottom-up approach is usually the higher level of detail and the traceability due to higher transparency. The approach can also allow for the inclusion of additional products which may not be identifiable through national data (e.g. non-apparel and apparel textiles), which can provide more guidance on potential interventions where these relate to a hotspot. However this was not achieved throughout the given timescales in Mauritius, and no survey data was used in findings.

The survey used in the bottom up approach can be found in **Annex 2**. It covers a range of topics, however for the purposes of the pilot assessments the purchasing data for hotels was crucial to enable WRAP to complete the hotspots analysis. The survey was administered by the in-country partners in the Mauritius, who surveyed 26 hotels. The survey was anonymised to ensure we had co-operation from hotels surveyed and is reported in this format for the purposes of this report.

However, in Mauritius analysis at a hotel level was very challenging due to the level of data required to input into the WRAP hotspots tool. This information is usually largely extracted from the accounts departments of participating hotels. Unfortunately, in the case of Mauritius, accounts departments, were generally not prepared to prioritise the acquisition of this information, thereby resulting in either incomplete survey returns or significant delays in the submission of completed surveys. As a result, WRAP was unable to include a hotel level hotspots analysis based on survey data.

Therefore, for Mauritius, the top-down data was sense checked against a range of national statistics and reports, and feedback from workshops and the advisory group. Some of these supplemental data sources are discussed in **Section 5** below.

4.4. Data limitations

A top down approach has a number of strengths and weaknesses. By capturing all the data from a sector (e.g. food and drink manufacturing), a top-down approach allows a comprehensive view of the impacts of a system. However, it is constrained by the availability of data in a suitable format. For example, data may be available for the sector “accommodation”, or for “accommodation and restaurants”, which will lead to results which cannot be used to benchmark the results of a tourism value chain with that in other countries. Inferences and assumptions are also required to sub-divide activities (e.g. imports) to identify the relevant emissions.

Databases such as Eora contain information on the value of imports in a country, including in their country of origin. The environmental impacts in the country of origin can be attributed to these imports. However, Eora do not provide details on the nature of the imports, nor to which sector specific items are being imported. This means that whilst we may know what is imported to a country and from where, we cannot use the model to attribute specific imports

and therefore combine imports into the analysis of sectors contributing to hotspots. Supplementary data from literature and surveys of hotels is therefore required to allow understanding of the significance of imported products.

In a business context, financial/economic data are usually easier to come by, and better understood by stakeholders, than material flow data that is usually required for Life Cycle Assessment. The survey therefore allows both sets of information to be provided by a hotel for the bottom-up approach.

4.5. Implications of imported products on the hotspots analysis

Databases such as Eora contain information on the value of imports to a country, including the country of origin. The environmental impacts in the country of origin can be attributed to these imports. However, Eora do not provide details on the nature of the imports, nor to which sector specific items are being imported. This means that whilst we may know what is imported to a country and from where, we cannot use the model to attribute specific imports and therefore combine imports into the analysis of sectors contributing to hotspots. Supplementary data from literature and surveys of hotels is therefore required to allow understanding of the significance of imported products.

The effect of excluding imports on the identification of hotspots is assessed by comparing the results against the bottom-up data, and sense checking the importance of imports through other data sets.

Figure 9 shows the proportion of imports by hotels and restaurants by country of origin, by value. This shows that although they account for a high proportion of imports from Sri Lanka, Uganda and other countries, overall, a greater value of imports are from South Africa, India, China and France.

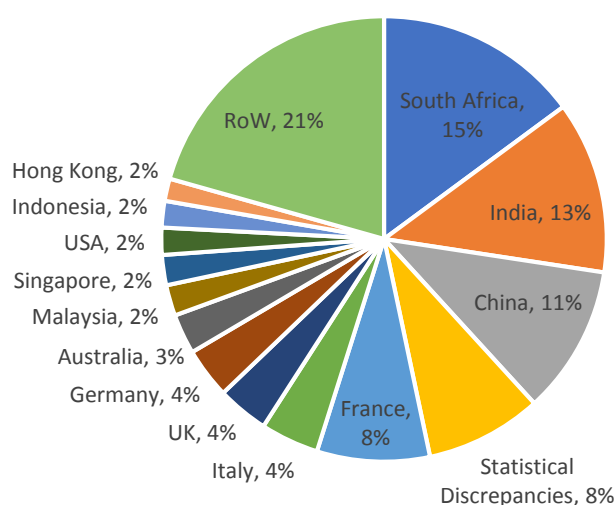


Figure 8: Proportion of imports to hotels and restaurants by value, 2013 (Lenzen et al 2013).

[FAOstat](#) and the UNFCCC 3rd National Communication (section 1.7.2) suggest that Mauritius imports approximately three quarters (~75%) of their food and beverage needs. The most

significant imported produce for 2013 is shown in **Table 2**. It should be noted that wheat is not produced on Mauritius and milk and bovine meat are only produced in small quantities. The most significant domestic production is of sugar (405,000 tonnes) vegetables, other (52,000 tonnes), poultry meat (47,000 tonnes), beer (39,000 tonnes) and potatoes and pineapples (each 16,000 tonnes). 2013 data has been selected as this is the year for which top-down data is available for comparison with the bottom-up data. This suggests that the hotspots identified through national data could underestimate the importance of goods and services procured by hotels, such as bovine meat and wheat products. This will be discussed further in review of specific indicators and survey responses.

Most NET imported products by weight (2013)		Proportion of total consumption
Product	Quantity (000 tonnes)	Percentage
Wheat and products	149	100%
Milk excluding butter	142	97%
Maize and products	100	100%
Rice	58	98%
Fruit	55	63%
Vegetable oils	37	90%
Fish	29	78%

Table 2: Most imported products, 2013 (Source: FAOStat)

No data was provided through the survey, which would allow an exploration of other items which may be imported for use in hotels and restaurants (e.g. textiles, fabricated metal products).

The top-down analysis showed that emissions and resource use embedded in food served in hotel and restaurants are a hotspot for in-country emissions. The food import analysis shows that this is even more likely to be the case for value chains extending outside Mauritius, as Mauritius imports nearly all of its high-impact foods from abroad (beef, milk, fish and rice).

In other countries where value chains were analysed for hotspots and more data was available, animal meat, especially beef, consistently became a number one hotspot. This is likely to be the case in Mauritius as well, even though Mauritius cuisine is based more heavily based on fish and seafood, which is helpful in regards to GHG emission intensity and should be further encouraged.

It should be noted however, that almost all beef and much of the fish are imported, actions to reduce the impacts will thus not necessarily be reflected in Mauritius own territorial emissions, unlike actions on reducing energy use.

5. National Baseline for the Environmental Impacts of the Tourism Value Chain

The top-down analysis provides information on the environmental impacts which occur within a country. For different indicators, these are commonly referred to as production-based, territorial, national or domestic impacts. The results presented in this section are consistent with national accounting frameworks such as the United Nations Framework Convention on Climate Change (UNFCCC) for greenhouse gas emissions but do not include the impacts of the Tourism Value Chain which occur overseas, in particular imported goods.

Greenhouse Gas Emissions - GHG emissions associated with hotels and restaurants are estimated to be 0.9 million tonnes CO₂eq. According to the World Resources Institute Climate Analysis Indicators Tool ([WRI CAIT](#)), GHG emissions in Mauritius in 2013 were 5.6 million tonnes CO₂eq (which is confirmed in the newest [2017 National Environmental accounts](#)), suggesting that hotels and restaurants are associated with 16% of national greenhouse gas emissions (these include emissions embedded in food and materials that hotels purchase, i.e. scope 3 emissions). This is illustrated in **Figure 9**. This compares to 0.26 million tonnes CO₂eq from industrial processes, 1.4 million tonnes CO₂eq from waste and 3.9 million tonnes CO₂eq from energy generation. A recent study from Lenzen et al²⁷ puts tourism emissions in Mauritius at ~ 70% in an estimate including air travel (which are excluded here).

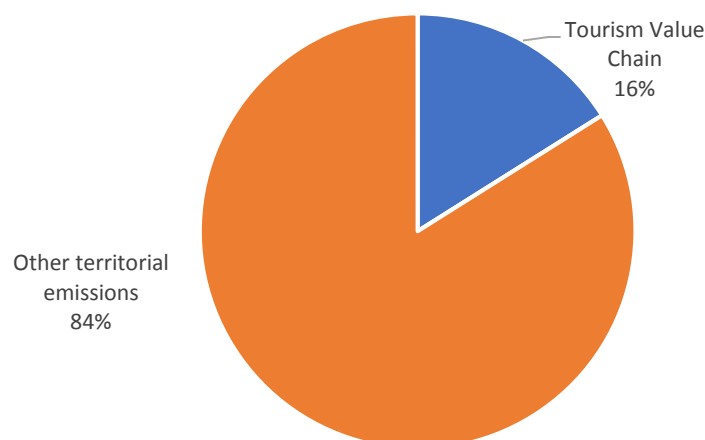


Figure 9: Proportion of national greenhouse gas emissions associated with the Tourism Value Chain in Mauritius, 2013

The emissions in the supply chains (Scope 3) are greater than the emissions from use of energy (Scope 1 and 2) in the hotels. This is in line with the analysis of other Small Island Developing States in the Transforming Tourism Value Chains project.

²⁷ Lenzen et al (2018) The carbon footprint of global tourism, *Nature Climate Change* **volume 8**, pages 522–528 (2018)

The two main hotspots are food and electricity. Food accounts together for about ~30% of the GHG emissions associated with hotels and restaurants, and electricity and gas services make up ~18%.

Water - Over 98% of the water associated with hotels is considered as scope 3, with 2% of water associated with hotels and restaurants through direct activities. [Mekonnen and Hoekstra \(2011\)](#) suggest that over 74% of the water footprint of Mauritius, 1929 Mm³, is occurring overseas. Of the 663 Mm³, the top-down analysis suggests 8.1 Mm³ are associated with hotels and restaurants in Mauritius. This is equivalent to just over 1% of the domestic water footprint and the majority of this is green water. The blue (abstracted) water footprint is dominated by production of beverage products and fish products. These account for 54% of abstracted water associated with hotels and restaurants, suggesting that this is a key area for water efficiency improvements.

In combination with the information available on expenditure on imports, the data from Mekonnen and Hoekstra suggests that the top-down water footprint underestimates the impact of tourism in Mauritius.

Energy – **Figure 12** shows that the largest use of energy for hotels is scope 3, which accounts for 86% of energy use. Direct combustion of fuels (e.g. for transportation) accounts for less than 1% of energy use. The difference to greenhouse gas emissions highlights the importance of non-energy emissions of greenhouse gases, such as emissions from agriculture, forestry and metal processing.

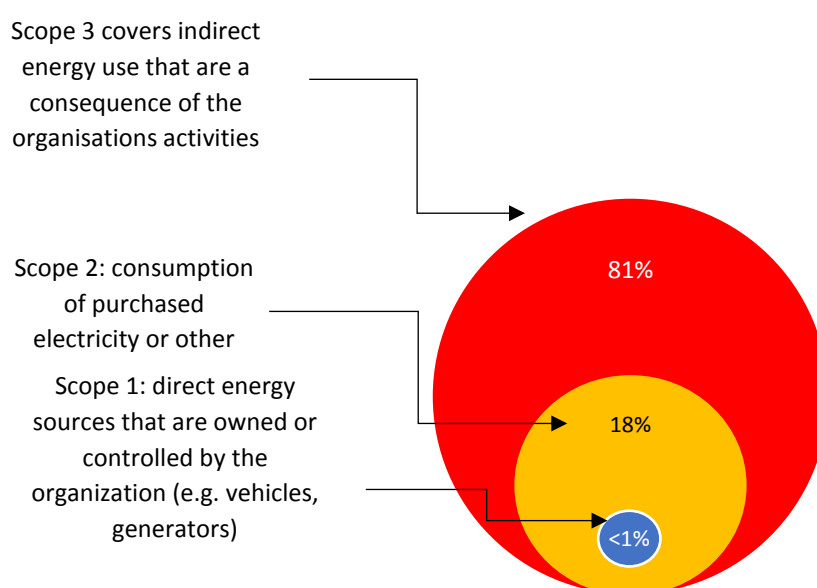


Figure 10: Energy use across the hotel and restaurant value chain. (NB scope 3 excludes employee commuting and tourist travel to Mauritius)

This pattern is distinct from the other Small Island Developing States assessed as part of the Transforming Tourism Value Chains project and therefore has been assessed in further detail.

According to the World Resources Institute Climate Analysis Indicators Tool ([WRI CAIT](#)), GHG emissions associated with electricity production in Mauritius in 2013 were 2.35 million tonnes CO₂eq. [Statistics Mauritius \(2014\)](#) suggests that commercial and distributive trade consumed 36% of electricity, and therefore would be associated with 36% of electricity greenhouse gas emissions. The analysis based on Lenzen et al suggests that 7% of the 2.35 million tonnes CO₂eq is associated with hotels and restaurants. If the figures are correct, this would mean that hotels and restaurants use 19% of electricity consumed by the commercial and distributive sector.

Older national statistics ([Environment-Economic Accounts for Mauritius, 2002 to 2009](#)) usefully reported energy and GHG emissions for hotels and restaurants. According to these statistics hotels and restaurants used 32.2 ktoe of energy directly, producing 90 ktCO₂ (CO₂ only, related to energy use only).

[Bhujun and Bahadoor \(2016\)](#) benchmarked the electricity and water use of hotels in Mauritius against other hotels within Mauritius and overseas. Those using Room Energy Management Systems consume about 37.5% less electricity than those not using it. They noted significantly lower electricity benchmarks in Mauritius than Singapore (at least 70% lower) and EU countries (at least 50% lower). While hotels in Mauritius seem relatively efficient, they depend on grid electricity which is generated mostly from fossil fuels and has relatively high carbon intensity at about 800 gCO₂e/KWh.

Electricity use of 23 hotels was also audited through the PNEE project. Air conditioning and kitchens came out as the largest users of electricity and a number of very practical solutions were proposed, such as setting the minimum temperature to 20 degrees and use of timers in the kitchen to turn off the appliances at night and outside cooking times.

Electricity consumption categorized by usage in all 16 hotels

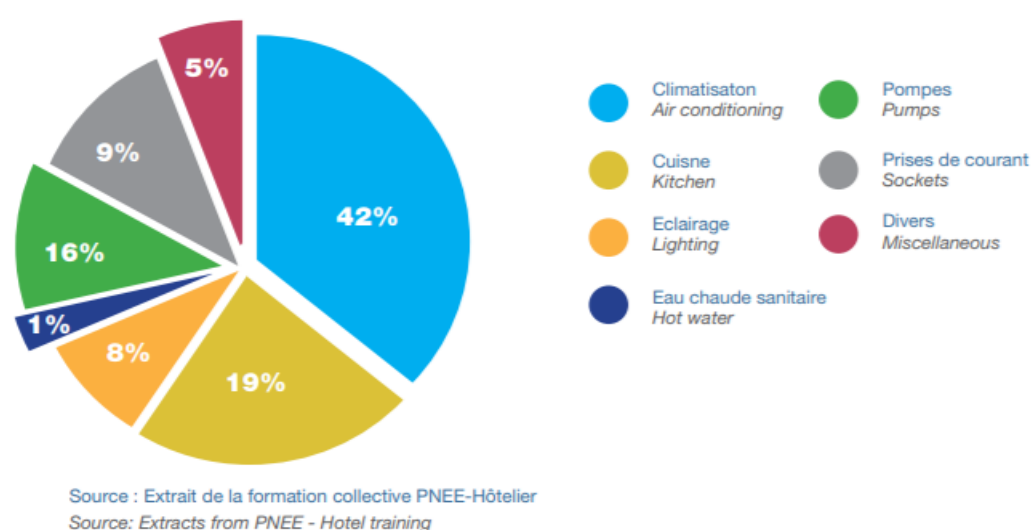


Figure 11 Electricity consumption in the audited hotels in the PNEE project

Waste – [The Ministry of Social Security, National Solidarity, and Environment and Sustainable Development](#) identifies that waste in Mauritius in 2016 was 475,000 tonnes, of which 30,000

tonnes was recycled. The Mare Chicose Landfill, which is the sole landfill on the island, is expected to reach saturation in 2018/2019, highlighting the urgency for action on waste. A new privately owned composting plant with a capacity of 110,000 recently became operational (it's unclear whether it operates to full capacity). National data on waste arisings associated specifically with hotels and restaurants is not available. [Statistics Mauritius \(2017\)](#) identify that in 2013 only 2243 tonnes of waste was discarded from sources other than agriculture, households, manufacturing and construction.

While we were unable to collect primary data from hotels in Mauritius, WRAP experience from other countries suggests that food waste is the predominant type of waste from hotels, typically accounting for 30-50%^{28,29} of waste generated by the hotels. Analysis of waste statistics in Mauritius support this notion, as according to both the [Global Material Flows Database](#) and the [Ministry of Social Security, National Solidarity, and Environment and Sustainable Development](#), unused food appears to make up a high proportion of total waste.

The Partnership for Action on Green Economy (PAGE) brings together five UN agencies – UN Environment, International Labour Organization, UN Development Programme, UN Industrial Development Organization (UNIDO), and UN Institute for Training and Research to provide holistic support to countries on inclusive green economy, ensuring coherence and avoiding duplication. As part of this UNIDO are working on better understanding of waste arisings and management options in Mauritius, due to complete in June 2018. Although this provides more detail on supply chains relevant to hotels and restaurants, no data on waste arising from these premises is identified.

Although there is no requirement for separate collection of waste, [UNIDO \(2016\)](#) identifies several registered companies have established an active and essential formal recycling sector. Materials recycled include plastics, card, glass, textiles and food waste. [UNIDO \(2016\)](#) also identify a wide range of stakeholders who can influence waste management options.

²⁸ <http://www.wrap.org.uk/content/dragon-hotel>

²⁹ <http://www.wrap.org.uk/sites/files/wrap/Hotel.pdf>

6. Summary of the Environmental Hotspots

Table 3 below summarises the environmental impact hotspots in the tourism value chain. Organisations who can influence or control hotspots are identified in **Figure 6** : Value Chain actors able to control / influence environmental hotspots above.

Food accounts for about ~30% and Electricity and Gas services for about ~18% of the territorial GHG emissions associated with hotels and restaurants. As most dairy and ruminant meat is imported, food contributions are likely much higher taking whole value chains into account. Food, particularly agriculture is also a hotspot for water, both in Mauritius and abroad.

Sewage and Waste management is the third largest contributor to GHG emissions, highlighting the importance of both minimising waste and optimal treatment with biogas generation or capture.

Within energy, HVAC and kitchen electricity use presents the biggest contribution. Although most hotels have taken some action to reduce their energy consumption, there is substantial opportunity to do more to support the hotels in implementing solutions to better address this hotspot in the tourism value chain during the next implementation phase of this project.

Summary of hotspots across environmental impact categories - Mauritius				
Rank	GHG	Energy	Water	Waste
1	Primary production of meat and dairy products: methane emitted through bovine enteric fermentation (digestion) and production of manures. In the case of Mauritius, these are largely imported, but we know from other SIDS countries that this is a consistent hotspot. Even without these, domestic food production is the main GHG hotspot in Mauritius.	Electricity and fuel use in hotel and MICE establishments: lighting, heating, ventilation and air conditioning (HVAC) of rooms, public spaces, back of house areas, including cooking. Hotels in Mauritius account for 19% of the commercial sectors energy demand ³⁰ . NOTE: Bhujun and Bahadoor (2016) benchmarked the electricity and water use of hotels in Mauritius. Those using Room Energy Management Systems consume about 37.5% less electricity than those not using it, demonstrating its value.	Primary production of food crops: most of water use in tourism value chains is irrigation in crop production, feed production and for livestock (drinking and cleaning water).	Food waste in hotels, restaurants and MICE establishments: average of 7-12% meat waste in kitchens, with some hotel surveys indicating overall food waste levels at up to 40%. Unused food is likely to account for a large proportion of organic waste in Mauritius, and presents a high potential for biogas generation via anaerobic digestion.
2	Electricity, fuel and refrigerant use in hotel and restaurants: electricity, gas and water supply accounts for 18% of GHG emission according to our top-down analysis. Hotels in Mauritius are relatively efficient (however PNEE study identified many areas with potential for improvement), but the electricity generation is at this moment still heavily reliant on fossil fuels.	Processing and packing of meat and dairy products: slaughterhouse processing and energy used in chilled storage and refrigeration contributes to post-farm gate emissions. NOTE: the vast majority of meat (mutton and goat meat) is imported into Mauritius, whereas 47,000 tonnes of poultry meat is produced domestically.	Water use in hotels and restaurants: guest washing and sanitation, cleaning of rooms and public spaces, laundry services, food preparation and cooking, irrigation of grounds, swimming pools.	Primary production of fresh produce: in-field, unharvested crops and immediate post-harvest crop waste due to supply chain quality requirements and poor demand forecasting (estimates are up to 20% losses/waste).
3	Primary production of fresh produce: emissions from use of fertilizers and methane emissions from organic wastes. Fuel use for in-field operations. NOTE: Mauritius produces fresh	Processing and packing of fresh produce: energy use in the processing and packing of produce, energy use in product chill chain or for freezing of produce post-harvest.	Primary production of produce: water used to grow fruit, vegetables and other food crops dominates water use across the life cycle.	Lack of capacity in waste infrastructure: in 2016 Mauritius produced 445,000 tonnes of waste, of which only 30,000 tonnes was recycled ³¹ (more if composting is

³⁰ Source: the [Worldwatch Institute \(2015\)](#).

³¹ NOTE: National data on waste arisings associated specifically with hotels and restaurants is not available. Source: [The Ministry of Social Security, National Solidarity, and Environment and Sustainable Development](#)

Summary of hotspots across environmental impact categories - Mauritius				
Rank	GHG	Energy	Water	Waste
	produce (particularly green vegetables, potatoes and some fruits – e.g. pineapples) – domestically.			counted). Investments are required in recycling infrastructure, more landfill infrastructure which should be taxed and adding methane collection to existing landfill after closure.
4	Sewage and waste disposal from hotels: Hotel generate large amount of organic waste, which leads to methane emissions. Reduction and increased composting on food waste can significantly reduce these, as well as improvement to infrastructure by adding anaerobic digester to both sewage treatment and as food waste treatment options, creating biogas instead of GHG emissions. Biogas could also be collected from landfill.	Transportation: high energy use in transportation and distribution of food products, particularly for imported goods.	Water resource management: despite the presence of a National Water Policy (2014) a lack of public infrastructure, regulation and enforcement leads to sub-optimal use of water resources and pollution from untreated wastewater and places a burden on hotels to provide water supplies via boreholes and expensive coastal desalination plants and has an impact on the natural environment.	Lack of plastic and paper recycling: current lack of private and public sector infrastructure for collection and recycling of plastic and paper.
5	Primary production on beverage: used in hotels and restaurants in Mauritius account for 45,000 tonnes of CO ₂ e emissions.		Water use in the energy sector: water used in cooling in power generation, emitted as steam and not returned to water source.	Single use items: e.g. plastic packaging, cleaning product containers could be reduced through investigation of reuse/refill systems.

Table 3: Summary of hotspots by environmental impact indicator for the tourism sector in Mauritius

To elaborate on the information contained in [Table 3](#): Summary of hotspots by environmental impact indicator for the tourism sector in Mauritius above, the environmental impact hotspots identified for the tourism sector in Mauritius are broadly split between:

- Impacts relating to the production, transportation and consumption of food and beverage products (e.g. meat, fish and seafood and fresh produce production and shipment, food loss and waste, energy used in refrigeration, preparation and cooking of food).
- Impacts relating to the provision of services to the sector from other sectors of the economy (e.g. power generation and energy and water supply);
- Impacts arising from deficiencies in national infrastructure (e.g. the lack of recycling infrastructure, dated waste and water infrastructure which can lead to environmental pollution and preventable GHG emissions);
- Impacts relating to the built environment in the tourism sector (e.g. hotel and restaurant energy use heating, ventilation and air conditioning lighting, preparation of food; water use in washing and sanitation, cleaning of rooms and public spaces; and for leisure activities, like swimming pools and spas);

Further detail on the nature of the hotspots and their drivers is provided in Annex E.

7. Solutions to Address Environmental Hotspots

During the year of 2017, consultative workshops were held in each of the four target countries to build a better understanding of the environmental hotspots associated with tourism. A literature review has also been carried out to identify potential actions. Together, these form the long list of potential actions identified below. These actions will subsequently be reviewed for their feasibility and impact to enable shortlisting in 2018. Some actions may be recommended even where their impact may not be quantifiable (e.g. the adoption of a policy), as they may be an enabling action which allows other activities to occur which may be quantifiable.

In Mauritius, the objective is to identify solutions which can be delivered through government policy, and all actions listed below should be read in this context.

However, for completeness and to help identify situations where national policy interventions can support business action, the long list of solutions has been split into business-level solutions, which are presented first and segmented by topic, followed by national-level solutions that have been ranked and grouped based on their likely impact, that require actions led by government policy-makers and/or that call for public or public/private sector investment in national and local infrastructure to address identified hotspots.

Where appropriate some solutions are presented as both business and national-level solutions as action can be taken by individual businesses but may benefit from a supporting national policy or legal framework – e.g. a circular economy policy package could support the development and procurement of sustainable products and services by businesses; or a national food waste strategy would support actions by business to quantify and reduce their food waste.

The next stage of the project will involve shortlisting solutions and at this stage some items on the long list may be brought together under an overarching policy ambition. For example, requiring hotels to achieve [MS 165 Sustainable Tourism Standard](#) or other environmental certification, or incentivising investments could deliver multiple items on the long list.

To summarise, the long list covers the following range of solutions and interventions:

Business value chain solutions and interventions: have the potential to be implemented by individual tourism businesses and value chains or via collaborations between tourism businesses and/or the public sector. Some business value chain solutions would benefit from a supportive government policy and strategy framework, like the options for national-level solutions identified below.

- **Sustainable purchasing and value chain initiatives:** that enable multiple hotspots across all impact categories to be addressed, including sustainable procurement policies and practices; appointing a 'green procurement champion'; adopting voluntary sustainability standards for key raw materials (e.g. seafood, timber and

paper, textiles); supplier accreditation, environmental KPIs and benchmarking and shared / consortia-based supplier platforms and databases to help identify reliable, high-performing suppliers; the use of product/packaging specifications and healthy, sustainable menus (e.g. product life requirements for hotel furniture and electrical items, local, seasonal sourcing of food).

- **Improving operational practices:** including the provision of information to guests to help them make environmentally friendly choices when choosing or buying goods and services; adopting healthy, sustainable menus to reduce the environmental ‘food print’ of food served in destinations; measuring and monitoring food waste; reviewing food storage, preparation and cooking practices (e.g. portion control) and using data analytics to improve inventory management and demand forecasting to reduce food waste; donating uneaten food and establishing food recycling programmes to produce compost and renewable energy.
- **On-site energy management and efficiency:** making significant improvements in energy use by: developing an energy and GHG policy; conducting and acting on the findings of energy audits; specifying energy efficiency and GHG emission improvements in HVAC systems, hotel room energy management systems and electrical equipment (including laundries); and increasing the amount of in-situ renewable energy generation. The Programme National d’Efficacité Énergétique (PNEE) has energy audited 23 hotels and provided recommendations, identifying potential to reduce energy use by 30%, with return on investment as short of 1.6 years³².
- **Sharing best practice and site visits:** the potential for an intermediary, such as a university or independent organisation to share best practices achieved amongst the hotels and restaurants, to learn from other’s experiences of implementing solutions (e.g. food waste reduction, energy management, water efficiency).
- **Team training and cross-functional training:** training within and across teams to enable members to minimise their contribution to environmental hotspots by equipping them to help deliver a range of solutions and interventions – e.g. sustainable procurement approaches, monitoring and measuring resource use (food and beverages, water and energy) as well as eco-design tools and techniques for buildings and rooms.

National-level solutions and interventions:

National-level solutions that have been ranked and grouped based on their likely impact and require either action led by government policy-makers and/or that call for public or public/private sector investment in national and local infrastructure to address identified hotspots. They include:

- **Implementing the National Tourism GHG / Energy Policy:** policies on renewable energy and energy efficiency can provide essential context for business action. Mauritius already has a strategy for tourism as a part for its long term Energy strategy, but these ambitions need to be implemented into regulation and fiscal incentives. It

³² <http://www.pnee.mu/?lang=en>

is worth noting that a cross-ministerial Three year Strategic Plan (2017/18-2019-2020)³³ already highlights the fact that the tourism sector should adopt energy-saving technology and that investments should be made in renewable energy; whilst policy initiatives from the Ministry of Energy and Public Utilities (MEPU) have included consideration of the mandatory use of solar hot water systems in hotels, low energy lighting, appliances and HVAC, with a longer-term ambition to promote zero carbon footprint holidays. A roadmap plan also exist to encourage uptake of marine renewable energy technologies (offshore wind, sea water air conditioning and wave power)³⁴

- **Improving the production and conversion of energy:** build on existing renewable energy infrastructure projects to reduce dependency on imported fossil fuels for the generation of energy and review MARENA's five-year renewable energy strategic plan in line with the requirements of the Renewable Energy Agency Act (2015) and the goals set out in the Government of Mauritius Long-term Energy Strategy (2009-2025)³⁵.
- **Mandatory and voluntary standards for efficient use of resources and energy in hotels and restaurants:** Mauritius Standards Bureau³⁶ is preparing standard on sustainable tourism, which could be an opportunity to create of mandatory standards for efficient use of resources and measurement of emissions in all hotels with more than 100 rooms. Voluntary for Hotels with 50+ rooms. Also look at this as a vehicle for mandatory use of solar hot water systems in hotels, already expressed in national energy strategy to 2025 and efficient air conditioning (e.g. by not allowing temperatures to be set below 20degC)
- **National food waste strategy for the tourism sector:** develop a national food waste strategy in line with UN SDG target 12.3 to halve food loss and waste by 2030, with specific components and targets for the tourism sector, including food waste reduction targets, incentives to redistribute surplus food to charitable organisations and the provision of food waste recycling infrastructure to enable the production of renewable energy from biogas and compost for use in agriculture. Implementation of the strategy could include a voluntary agreement with the tourism sector; a consumer/tourist focused behaviour change campaign in collaboration with tourism operators, hotels and restaurants; and a national food waste quantification and best practice platform.
- **National circular economy policy package:** development of a circular economy policy package that encourages and promotes the development of more sustainable, innovative products and services, including consideration of circular / sustainable

³³ **Source:** THREE YEAR STRATEGIC PLAN 2017/18-2019/20: http://budget.mof.govmu.org/budget2017-18/2017_183-YearPlan.pdf

³⁴ http://publicutilities.govmu.org/English/Documents/Doc_2018/Mauritius%20Marine%20Energy%20Roadmap.pdf

³⁵ Please see:

<https://sustainabledevelopment.un.org/content/documents/1245mauritiusEnergy%20Strategy.pdf>
³⁶ <http://studylib.net/doc/5494257/sustainable-tourism-ms-165---mauritius-standards-bureau>

product, service and business model design and procurement, the promotion of sustainability standards and certification in tourism, energy efficiency and product life extension for electrical and electronic products. This should include the creation of incentives to drive the procurement of more sustainable products and services and promoting demand for certified sustainable products.

- **Enhance legislation on waste management to optimise waste management:** Mauritius has regulation covering waste management³⁷. This could be enhanced to promote higher rates of recycling, energy recovery (including biogas) and composing, and reduce the reliance on landfill.
- **Strong integration of sustainability in National tourism development plan:** Mauritius currently a national strategic plan to guide the development of the tourism sector. However, sustainability is not addressed to the level it requires.
- **Making the transportation network more sustainable:** the EU Sustainable Transport for Areas with Tourism through Energy Reduction (STARTER) project identifies that *“the seasonality of tourism demand leads to rising demand for transport and mobility services during the high season, which impacts heavily the traffic in specific touristic regions... dealing with the challenges posed by seasonal traffic is not simply the task of the authorities: main players of the transport sector, environmental organisations and the tourism sector should join forces to resolve related issues... The concept of ‘Local Travel Plan Networks (LTPN)’ can be used to shift tourist travel to more sustainable mobility options”*. It is worth noting that the Ministry of Public Infrastructure and Land Transport in Mauritius, already has plans that include the use of energy-efficient, low emission vehicles. For example, hybrid vehicles enjoy 50% discount on yearly licence, which seems to be working well. According to Global Fuel Economy Initiative recommendations,³⁸ further measures to improve traffic control are needed, such as grade separated junction, promotion of mass transport (LRT) and introduction of bus priority lanes along the main traffic corridors.

Table 4 below summarises the solutions, their source and the relevant hotspot the solution connected to. In the next stage of this project (shortlisting of solutions) we will assess their potential contribution related to GHG and resource efficiency savings, to addressing the hotspots.

³⁷ <http://environment.govmu.org/English/Pages/swmd/SWMD-Legislation.aspx>

³⁸ Global Fuel Economy Initiative 2018 presentation

https://wedocs.unep.org/bitstream/handle/20.500.11822/25177/DevelopmentFuelEconomyPolicies_Mauritius.pdf?sequence=3&isAllowed=y

Table 4: Long list of business value chain and national-level solutions and interventions.

i = indirect solution for hotspot

d = direct solution for hotspot

Long list of solutions	Hotspots in Tourism Value Chain - Mauritius																			
	GHG					Energy					Water					Waste				
	Bovine meat and dairy products	Electricity use in tourism value chain	Sewage and waste disposal	Primary production of fresh produce	Beverage	Electricity used for Hotel and restaurant activities	Meat and poultry products	Fresh produce	Transportation	Preparation and cooking of food	Water used in agriculture	Water use in hotels and restaurants	Primary production of produce	Water resource management	Water use in the energy	Food waste in hotels and restaurants	Fresh produce	Waste management infrastructure	Increase plastic and paper recycling	Single use items
Share best practice / visits	i	i	i			i	i		i	i					i					
Provision of training for functions / across teams	i	i				i	i					i				i			i	i
Adopt a sustainable procurement / purchasing policy	i	i		i	i	i	i	i			i		i				i		i	i
National circular economy policy package		i	i			i	i				i	i	i	i		i			i	i
Create incentives for purchasing more sustainable items	i	i		i	i		i	i			i	i	i	i		i	i		i	i
Promote the demand for certified products	i			i			i	i			i		i				i		i	
Define sustainable product specifications for hotspots	i			i			i	i			i		i				i		i	i

Long list of solutions	Hotspots in Tourism Value Chain - Mauritius																			
	GHG					Energy					Water					Waste				
	Bovine meat and dairy products	Electricity use in tourism value chain	Sewage and waste disposal	Primary production of fresh produce	Beverage	Electricity used for Hotel and restaurant activities	Meat and poultry products	Fresh produce	Transportation	Preparation and cooking of food	Water used in agriculture	Water use in hotels and restaurants	Primary production of produce	Water resource management	Water use in the energy	Food waste in hotels and restaurants	Fresh produce	Waste management infrastructure	Increase plastic and paper recycling	Single use items
Supplier accreditation	i	i		i	i			i					i				i		i	i
Champion for green procurement	i	i		i	i			i					i				i		i	i
Agree a replacement schedule for equipment / furniture		d				d													i	i
Replacing high impact food for low impact	d			d	i		d	d			d		i				i			
Ban single use items			i																i	d
Create cleaner production awards	i			i	i		i	i			i		i	i			i			
Create environmental protocols for suppliers	i			i	i		i	i			i		i	i			i			
Programme to encourage purchase of local crafts																				
Setting specification for room design		d				d						i			i					

Long list of solutions	Hotspots in Tourism Value Chain - Mauritius																			
	GHG					Energy					Water					Waste				
	Bovine meat and dairy products	Electricity use in tourism value chain	Sewage and waste disposal	Primary production of fresh produce	Beverage	Electricity used for Hotel and restaurant activities	Meat and poultry products	Fresh produce	Transportation	Preparation and cooking of food	Water used in agriculture	Water use in hotels and restaurants	Primary production of produce	Water resource management	Water use in the energy	Food waste in hotels and restaurants	Fresh produce	Waste management infrastructure	Increase plastic and paper recycling	Single use items
Build a consortium with other businesses to enable changes in procurement practices	i	i		i	i		i	i			i		i				i			
National food waste strategy	i			i	i		i	i			i		i			d	i	d		
Provision of information to guests	d	d	i		i	d	d				i	i			i	i				
Diversify menus / Offer a local /seasonal meal to tourists	d			d			d	d		i	d		d			i	i			
Make some products available on request only	d			i			d	i		i	i		i			i	i			d
Monitor and measure food waste	i			i			i	i		i	i		i			d	i			
Review cooking and storage practices	i	i		i		i	i	i		d	i		i		i	i	i			
Communicate with customers and review portion and plate sizes	d			i			d	i		i	i		i			d	i			

Long list of solutions	Hotspots in Tourism Value Chain - Mauritius																			
	GHG					Energy					Water					Waste				
	Bovine meat and dairy products	Electricity use in tourism value chain	Sewage and waste disposal	Primary production of fresh produce	Beverage	Electricity used for Hotel and restaurant activities	Meat and poultry products	Fresh produce	Transportation	Preparation and cooking of food	Water used in agriculture	Water use in hotels and restaurants	Primary production of produce	Water resource management	Water use in the energy	Food waste in hotels and restaurants	Fresh produce	Waste management infrastructure	Increase plastic and paper recycling	Single use items
Use of data / analytics to better predict demand for food and drink	i			i			i	i		i	i		i			d	i			
Staff training on the importance of food	i			i	i		i	i			i		i			i	i			
Donate uneaten food	i			i	i		i	i			i		i			i	i			
Food recycling programmes																		d		
Enhance legislation on waste management to optimise waste management											i					i	i	d	i	i
Energy Audit		d				d			i	i					i					
Frequency Convertors		i				i				i					i					
Train architects in energy efficient design		d				d						i			i					
Mandatory standards for efficiency in large hotel		d				d			i	i		d			i	d				
Improve access to finance		i				i			i	i		i			i					
National GHG / Energy Policy	i	i				i	i		i	i					i			i		

Long list of solutions	Hotspots in Tourism Value Chain - Mauritius																			
	GHG					Energy					Water					Waste				
	Bovine meat and dairy products	Electricity use in tourism value chain	Sewage and waste disposal	Primary production of fresh produce	Beverage	Electricity used for Hotel and restaurant activities	Meat and poultry products	Fresh produce	Transportation	Preparation and cooking of food	Water used in agriculture	Water use in hotels and restaurants	Primary production of produce	Water resource management	Water use in the energy	Food waste in hotels and restaurants	Fresh produce	Waste management infrastructure	Increase plastic and paper recycling	Single use items
Company GHG / Energy Policy	d	d				d	d		i						i	d		i		
Improve production / conversion of energy		i				i				i					i					
Own PV, biomass, wind turbines		i				i			i	i					i					
Improve efficiency and climate-friendliness of HVAC		d				d				i					i					
Increase efficiency of other electrical equipment		d				d				d					i					
Room energy management systems		d				d				i					i					
Transportation Network									d											
Laundry		d				d						d			i					

8. Key Environmental Indicators

UN Environment (2017) [Recommended key environmental indicators for the tourism private sector](#) identifies major environmental indicators that would help the tourism private sector to contribute to the [Sustainable Development Goals](#) (SDGs) and Paris Agreement using Life Cycle perspective. Based on the assessment of hotspots in the Philippines and Dominican Republic, St Lucia and Mauritius, the following indicators are recommended:

Key Environmental Indicator	Level	Units	Evidence / Source which could be used for monitoring
Total energy use	Total and by functional unit	Megajoules, MJ	Grid electricity, renewable electricity, combustion of fuels.
Total volume of solid waste generated	By waste type, total and functional unit	Kilogrammes, kg	Surveys, national waste statistics
Total quantity of animal meat by meat type	Total and by functional unit	Kilogrammes	Purchase ledger
Corporate carbon footprint	Total and by functional unit	Kg CO ₂ eq	Corporate Social Responsibility Reports
Total Volume of Water Use	Total and by functional unit	Volume	Metering
Water Footprint (ISO14046)	Total and by functional unit	Volume	Databases (e.g. within LCA software)

Table 5: Recommended key environmental indicators.

Based on the surveys undertaken, data on energy use on site by hotels and restaurants is frequently collected and recorded. Data on waste and purchases is infrequently collected. Water footprinting is not undertaken on a regular basis by any organisation surveyed and corporate carbon footprint is infrequently reported. In order to use the recommended indicators there is a need for additional commitment from hotels and restaurants, along with the capacity building being provided through this project. Improvement of organisation structures for reporting and co-ordination with public utilities and suppliers will be required to generate the required information.

9. Conclusions

The hotspots analysis process has identified several challenges related to effectively providing a baseline for greenhouse gas emissions and resource efficiency of hotels.

Through databases such as Eora, territorial impacts can be identified for a range of environmental issues. However, whilst imports from overseas are quantified in terms of total expenditure, they are not identified as specific products. So, whilst it may be known how much has been spent by a sector on imports from a certain country, it is not possible to use the same database to identify what these imports are. Additional measures must therefore be taken to understand the importance of imported produce.

One way to address this is to obtain data directly from organisations within the tourism value chain. To this end, a survey has been undertaken to gather data. However, some systematic issues are that accounts departments either do not have data available in a suitable format or are unable to provide data on purchases.

However, despite this, there is a high degree of alignment between the hotspots indicated by databases (excluding imports) and the national literature, and the contribution of tourism value chains to territorial energy demand, greenhouse gas emissions and water footprint has been quantified. The two main hotspots are food and electricity. Food accounts for about ~30% of the GHG emissions associated with hotels and restaurants, and Electricity and Gas services account for ~18%.

Over 80% of the water footprint of hotels and restaurants can be attributed to products of agriculture, horticulture and market gardening in Mauritius. Beverages are the next most significant category.

Alignment between the national databases and literature suggests that the omission of imports does not adversely impact the identification of hotspots in tourism value chains, though it will inevitably affect the quantification of the hotspot. Approximately 40 potential actions have been identified which can address the hotspots for the different environmental issues.

Sufficient data has been gathered to allow the project to progress to the next stage of shortlisting and prioritising interventions which can address hotspots in the tourism value chain, whilst continuing to collect information from individual organisations to increase the level of insights and aid quantification of impacts and opportunities.

A key recommendation from this report is that there should be subsequent follow-up activities agreed with all project partners, to further comment on and develop policy recommendations in each country. This report will provide the evidence and basis from which Travel Foundation will deliver the Mauritius National Action Plan, with support from the STAG and technical partners WRAP and UDP.