# Tourism's Impact on the Environment: A Systematic Review of Energy and Water Interventions

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## V. Abstract

The purpose of this research was to examine longitudinal assessments of the ways in which behavioural and policy interventions have been used to reduce energy and water use in tourism. Although previous research has used single-shot cases or surveys to study interventions there is little knowledge of the extent to which interventions result in sustainable personal or organisational behaviour over time. Therefore this thesis specifically focuses on identifying those studies in the literature that are longitudinal in nature to gain a better understanding of sustainable behaviour change. A systematic review was conducted to identify relevant studies. The systematic search returned a total of 333 papers relating to energy use, and 430 papers relating to water use. After screening and reviewing those returned papers against a predetermined, and specific criteria, only two papers relating to each topic remained. The two papers for each topic were then analysed and specific factors noted. The most effective outcomes of the energy papers were that of investing in modern, efficient technologies, and that of investing in and managing education of staff. The most effective outcomes of the water papers were again that of upgrading to modern, water-efficient equipment, and effective management of water resources. However, a critical finding was the absence of longitudinal studies of interventions which raises significant questions regarding the helpfulness of previous findings based on one-shot studies alone. The research was also the first of its kind looking at long-term interventions within sustainable tourism, and provides many avenues for future research.

# VI. List of Abbreviations

## I. Institutions

| | |
|---|---|
| EASA | European Aviation Safety Agency |
| EC | European Commission |
| EU | European Union |
| GFANC | German Federal Agency for Nature Conservation |
| IATA | International Air Transport Association |
| ICAO | International Civil Aviation Organisation |
| IHEA | International Health Economics Association |
| IIASA | International Institute for Applied Systems Analysis |
| IPCC | Intergovernmental Panel on Climate Change |
| ITP | International Tourism Partnership |
| OECD | Organisation for Economic Cooperation and Development |
| TIANZ | Tourism Industry Association New Zealand |
| UIC | Union Internationale des Chemins de fer (International Union of Railways |
| UN | United Nations |
| UNEP | United Nations Environment Programme |
| UNESCO | United Nations Educational, Scientific and Cultural Organisation |
| (UN)WTO | (United Nations) World Tourism Organisation |
| USAID | United States Agency for International Development |
| US DOE | United States Department of Energy |
| WCED | World Commission on Environment and Development |
| WMO | World Meteorological Organisation |
| WTTC | World Travel and Tourism Council |
| WWF | World Wide Fund for Nature |

## II. Other Abbreviations

| | |
|---|---|
| AR5 | (IPCC) fifth assessment report |
| ATM | air traffic management |
| CAD | Canadian Dollar |
| CSR | corporate social responsibility |
| EV | electric vehicle |
| GDP | gross domestic product |
| GEA | global energy assessment |
| GHG | greenhouse gas |
| GST | Goods and Services Tax |
| GWP | Global Warming Potential |
| HVAC | heating ventilation and air conditioning |
| (K)ESS | (kinetic) energy storage systems |
| LCA | life-cycle assessment |
| LDV | light duty vehicle |
| LED | light emitting diode |
| LPG | liquefied petroleum gas |
| NGO | non-governmental organisation |
| PICO | population/problem, intervention, comparison, outcome |
| PLF | passenger load factor |
| PPM | parts per million |
| ROI | return on investment |
| SME | small and medium-sized enterprises |
| STE | small tourism enterprise |
| TAC | transport, atmosphere and climate (conference) |
| UK | United Kingdom |
| US(A) | United States (of America) |
| USD | United States Dollar |
| UNFCCC | United Nations Framework Convention on Climate Change |
| VFR | visiting friends and relatives |
| VMT | vehicle monitoring technology |

| | |
|---|---|
| WDM | water demand management |
| WLF | weight load factor |

## III. Units of Measurement

| | |
|---|---|
| °C | degrees Celsius |
| J | joule |
| MJ | megajoule |
| kWh | kilowatt hour |
| g | gram |
| t | tonne |
| L | litre |
| m | metre |
| $m^3$ | cubic metre |
| km | kilometre |
| $km^3$ | cubic kilometre |
| p-km | passenger kilometre |

## IV. Chemical Compounds

| | |
|---|---|
| C | carbon/soot |
| $CO_2$ | carbon dioxide |
| $CH_4$ | methane |
| $N_2O$ | nitrous oxide |
| $NO_x$ | nitrogen oxides |
| $O_3$ | ozone |

# 1. Introduction

## 1.1 Introduction

The purpose of this research is to provide a comprehensive, systematic review of interventions that have been undertaken to reduce the impact of inputs to tourism on the environment. The research will look to review, analyse and critique many different intervention methods within two different sub-sectors of tourism regarding environmental impacts.

Although the idea of tourism may be simple the institutions, processes and the impact tourism has on global society is immense (Hall, 2006). For example, colloquially and academically tourism relates to tourists themselves, as well as the tourism industry, but also can be used to refer to the general phenomena of tourism including governmental and non-governmental organisations and also the people, places and processes that make up tourist destinations and landscapes (Hall & Lew, 2009). In all, the scope that tourism occupies means that it is likely to impact on many aspects of the social, economic, political, environmental systems of which modern society is comprised.

This raises many issues, especially those of sustainability and sustainable development. The concept of sustainable development places focus on the balance between economic development and the conservation of natural resources (Hall & Lew, 2009). There is a divide between those who argue these can co-exist and are not antagonistic, and those who are unsure (Ekins, 1993). However, in either case, one can be sure that attaining such an adequate balance requires a major rethinking of many economic, social, political and environmental systems that exist.

In the case of tourism, this focus and this difficulty are also present, especially considering the size and impact that tourism has globally. International tourism arrivals are growing on average by 4 per cent, per year from 2010 to 2015 with over 1.1 billion international arrivals in 2015 alone, and 1.8 billion in forecasted for 2030 (UNWTO, 2016). Domestic tourism has also seen considerable growth with domestic tourism trips being around five times that of its international counterpart (UNWTO, UNEP, & WMO, 2008).

Such substantial and pervasive phenomena are bound to impact upon both the built and natural environments within which they exist. Literature shows that tourism does impact - and is impacted by - many aspects of the environment (Gössling et al., 2007; Li, Ge, & Liu, 2005; Mercer, 2013; Rai & Sundriyal, 1997). However, greater understanding of the impacts and influences of tourism can aid in the mitigation and adaptation of these impacts (Simpson, Gössling, Scott, Hall, & Gladin, 2008). For example, intervention methods that attempt to alter or adapt systemic norms, structures, or behaviours may have the power to mitigate, or aid adaption to the impacts and the eventual environmental consequences that tourism activity contributes to.

## 1.2 Research Background

Tourism is a sector of considerable economic importance at a global and national scale. However, it has increasingly become recognised that tourism is also a significant contributor to environmental change. Notable environmental issues identified in the research literature with respect to tourism include, among others, energy use, greenhouse gas emission, biodiversity conservation and loss, invasive species introduction, water use, landscape change, site degradation and erosion, and souveniring (e.g. see Anderson, Rocliffe, Haddaway, & Dunn, 2015; Mathieson & Wall, 1982; Scott, Peeters, & Gössling, 2010; Simpson et al., 2008). Therefore, considering the size and forecast annual growth of tourism, finding ways to mitigate its environmental impact is essential in creating a sustainable industry.

Many differing ways and means to reduce the environmental impacts of tourism have been proposed in the academic literature. Each of these proposed and actual interventions differ in focus, effectiveness, efficiency, and longevity (e.g. see Hibbert, Dickinson, Gössling, & Curtin, 2013; Johnston, 2014; Rutty, Matthews, Scott, & Matto, 2014). With such a vast amount of research in (and around) the field, it is often difficult for individuals and policy-makers to understand and apply the knowledge created by these interventions appropriately.

Throughout a review of the literature, the author has been unable to find a systematic review within the focus of interventions relating to tourism and its impact on the environment, although there are comprehensive thematic reviews (e.g. see Gössling, 2002;

Gössling et al., 2012). The absence of systematic reviews is something that, as the literature continues to grow, becomes increasingly necessary. This is because as the amount of knowledge within a field grows, it becomes much more difficult to comprehend and utilise. Thus, systematically reviews of the literature aids in synthesising knowledge and becomes a convenient resource for the field (Mulrow, 1994).

The current narrative reviews that exist within the field do well to give an account of the major themes, however, it is easy for these reviews to be impacted by bias and may distort the views of the field. For instance, readers are often unaware of an author's searching techniques, how they may choose to include and exclude articles, and also how they interpret them. For these reasons, the structure and empirical nature of a systematic review is necessary around this stage of a field's growth (Mulrow, 1994).

## 1.3 Research Objectives

The purpose of this research is to provide a comprehensive, systematic review of long term assessments of interventions that have been undertaken to reduce the environmental impact of tourism - thus filling the research gap discussed previously. This will be achieved through effectively reviewing and assessing the many types of behavioural interventions utilised in two different sub-sectors, energy and water, and environmental situations. In doing so, it is possible to gain a better understanding of the potential effectiveness of these interventions, and also the contexts in which they may be an appropriate method of influencing change. The focus of the research is on longitudinal studies of interventions, which have long been recognised as significant in the study of tourism and the reduction of its impacts (Hall, 2016; Hsu, 2000; Tsiotsou & Ratten, 2010). However, no previous study in tourism has sought to specifically focus on research that is conducted on the effectiveness of behavioural or policy interventions to reduce the throughput of resources over two or more points in time.

Within this review an intervention will be defined as an effort or an action that seeks to alter a current state. Specifically within this research (and the author's personal preferences), this must include a pre- and post-intervention measure of the state that is being changed - i.e. a pre- and post-intervention measure of total water use when installing new faucets throughout a hotel. Otherwise very little data (and thus evidence) will be

established from the interventional method. This then provides lacking and ambiguous effectivity and applicability. By default, this definition adds a longitudinal nature to the studies. And thus this study will only return those papers which are longitudinal.

The use of a systematic review will aim to provide an exhaustive overview of knowledge within the field in an empirical fashion. The framework applied aims to limit the impact of biases and external factors upon the literature - effectively giving a transparent account of combined knowledge.

## 1.4 Research Methodology

This systematic review will combine the knowledge of the Cochrane Handbook for Systematic Reviews of Interventions (Higgins & Green, 2011), with the empirical flowchart of PRISMA (The PRISMA Group, 2017). A replicable, Boolean search term is constructed so as to best capture as many relevant papers as possible. In line with the PICO framework (Higgins & Green, 2011), the inclusion criteria were defined so to be clear as to which papers were relevant, and which papers were not. All papers returned by the search were then screened against the PRISMA framework and the inclusion criteria formed. The papers which make it through this process are then reviewed to identify a set of predetermined factors which make up the paper. These factors are documented and then analysed to provide insight into the objectives of this research and associated discussion.

## 1.5 Research Contributions

### 1.5.1 Practical Implications

This review will aim to provide insight for policy-makers, organisations and individuals into effective, efficient and consistent methods for enacting pro-environmental behavioural change within tourism. The review aims to provide an overview of knowledge that attempts to create a convenient and beneficial synthesis to help these parties apply the learnings of the literature.

### 1.5.2 Academic Implications

Through reviewing the large body of literature that encompasses the combination of tourism and the environment, several relevant themes may be found. One of these is that the majority of literature is descriptive - consisting of narrative reviews and research into

phenomena regarding the topics. These types of reviews only look at a small sample of the literature - usually studies with a greater number of citations. In doing this, relevant and possibly informative literature may be missed. Thus, through systematically reviewing the field, this review aims to analyse and synthesise all relevant work and create a greater understanding of what can be done to reduce tourism's impact on the environment.

The exhaustive aspects of this review will therefore identify significant gaps in knowledge regarding the nature and success of behavioural interventions. This should provide avenues for future research within tourism and the environment as well as reporting on which interventions have demonstrated effective, sustainable behavioural change in the actions of either tourists or members of the tourism industry. Essentially the review will provide academics with a greater understanding of what is being researched, and what is not being researched within this specific focus.

## 1.6 Thesis Outline

Following the conclusion of this introductory chapter, the thesis will then move through several chapters in order to introduce the scope and the mains problems that the thesis hopes to shed light on, how the research attempts to do that, and then the discussion surrounding the research and the findings that have come from them.

Specifically, chapter two consists of a thematic literature review. As a part of this, the topic is introduced as a whole providing the scope of the problem, and its global significance. The chapter will then progress into breaking down the problem into separate issues with each input being analysed individually as to mirror the literature review as a whole by investigating their scope and the problems that they poise globally, while also looking at what has, and is currently being discussed relating to them in academic and policy literature.

Methods are discussed in Chapter 3. This chapter will discuss the conduct of the systematic review as well as the application of the PRISMA framework, which is widely used within the systematic review literature (Higgins & Green, 2011; The PRISMA Group, 2017).

Following the 'how' of the research, the thesis will then move in Chapter 4 into a discussion of the results found, and the main implications as assessed by the author. This section hopes to enlighten the audience as to what the current landscape of sustainable tourism, within

the focussed sub-topics, offers in terms of longitudinal studies of interventions and, as a by-product, what is not currently a part of the landscape. These findings should then hope to provide great benefit to those working within the field, and also to help guide future studies where current knowledge may be lacking.

# 2. Literature Review

## 2.1 Introduction

This chapter introduces and discusses varying elements that come together to form the delicate relationships of tourism and some main aspects which tourism effects and is affected by. The chapter begins with an introduction to tourism and the role it plays within the human experience, before later moving into varying sub-topics which will make up the main focuses of the research as a whole.

## 2.2 Tourism and the Environment

The idea of tourism has long been intertwined with both natural and built environments (Lickorish & Jenkins, 1997). As early as the 100AD, wealthy individuals of the Roman Empire participated in leisure travel with the aim of experiencing the cultures, foods, architecture and natural capital of foreign locales, specifically their bathhouses (Jayapalan, 2001).

However, it was not until the early seventeenth century that the idea of modern day tourism began to develop in the West with Grand Tour (Lickorish & Jenkins, 1997). The idea was to educate young, wealthy, European men about the roots of Western civilisation through experiencing the fruits of foreign cultures (Cooper & Hall, 2005). This idea influenced, and was in turn influenced by, the philosophical thinking of John Locke that human understanding is not something that is innate, and rather it is learned.

### 2.2.1 Impacts

L Literature regarding the purpose of tourism often cites ideas of diversity - whether seeking it, or avoiding monotony - in a tourist's motives or intents to participate in tourism (Holden & Fennell, 2013; Iso-Ahola, 1982; Mercer, 2013). Many individuals seek to experience and learn from diverse environments, subsequently selecting plans, behaviours and activities that aim to maximise potential satisfaction (Iso-Ahola, 1982). Here lies another paradox - while tourist activity seeks diversity, it is often diversity itself (e.g. biodiversity, cultural diversity) that has many implications for tourism impact and which tourism eventually homogenises (Mercer, 2013).

However, tourism has wider and more pervasive impacts on the environment and they are very closely interrelated (Scott, Hall, & Gössling, 2012). The complicated nature of the

relationship between tourism and the environment has many dimensions - with many facets of each phenomena affecting others and vice versa, and also with contradictory elements often occurring within the same tourism system (Mathieson & Wall, 1982). For example, the greenhouse gas emissions produced by aviation in a tourist's excursion, may eventually impact upon the climate of their place of visit, which in turn feedbacks on to the tourist and the tourism processes of the place. Or the example of national parks that promote eco-diversity and the preservation of the natural beauties of the locale that rely economically, at least in part, on the custom of leisure tourism that over time may serve to change the nature of the original resource.

## 2.3 Climate Change

Compelling evidence shows that the global climate of today has changed - and is changing - compared to the pre-industrial era (IPCC, 2014; UNWTO et al., 2008). The forces underpinning such a radical change are now understood to be largely anthropogenic, and have led to the age we live in as being assigned the term 'Anthropocene' (Crutzen, 2002). This is reinforced by the most recent IPCC report (AR5) which is now labelled it extremely likely (greater than 95 per cent) that human-made greenhouse gases are the major cause of the climate changes being recorded (IPCC, 2014). Large increases in economic and population growth due to the increased efficiencies and thinking brought on by the industrial revolution have driven the increase of greenhouse gas (GHG) emissions to a level unparalleled for 800,000 years (IPCC, 2014). Such substantial increases are likely to have massive, long-term effects on many aspects of the Earth's climate including the atmosphere, ocean, cryosphere and sea levels (IPCC, 2014). These changes represent what is understood as climate change.

The anthropogenic nature of climate change is caused by many cultural, economic, technological, political, agricultural and social systems and institutions upon which modern society is built. Emissions of greenhouse gases such as carbon dioxide ($CO_2$) and methane ($CH_4$) have significantly increased since the industrial revolution leading to increases in global average surface temperatures (IPCC, 2014). In particular, the atmospheric concentrations of $CO_2$ have dramatically increased as a result of human activity – from 280 parts per million (ppm) before the industrial age, to 366 documented in 2001 (Scholes & Noble, 2001). Carbon dioxide ($CO_2$) is the key GHG as it is often the most apparent as it is

produced through the combustion of fossil fuel, and the decomposition of organic material as often brought on as a result of land use changes (Becken, 2002b). However, other GHGs which are important in the discussion include nitrous oxides ($N_x$), water vapour ($H_2O$), methane ($CH_4$), hydrocarbons (HC), carbon monoxide (CO), sulphur compounds ($SO_x$), ozone ($O_3$) and soot (C) as they produce similar effects at varying levels of strength (Gössling, 2002; IPCC, 2014).

The effects of global climate change reach beyond rising global temperatures, affecting many aspects of the Earth's climate system. In addition to rising temperatures, the IPCC discuss anthropogenic influence over the global water cycle, sea and land ice loss, sea levels, coastal erosion, marine and terrestrial ecosystems, food production, the frequency and severity of natural disasters, and livelihood, health and economic impact upon humans (IPCC, 2014). The pervasive effects of the changes within each of these areas is likely to impact upon the vast majority of the Earth and its inhabitants. For example, shrinking glaciers, increased thermal stratification, arctic sea ice retreat and increased coral mortality and bleaching are all presented by the IPCC as being *very likely* (90 – 100 per cent likelihood) to happen (IPCC, 2014). Other examples of effects include the growth of illnesses into previously cooler regions, extreme heat in more arid zones, increased fire risk and desertification, coral bleaching through warming oceans, reduced snowfall, and thus reduced economic viability of snow-tourism; increased strength and frequency of storms and precipitation (IPCC, 2014).

The continually growing economy and population of the Earth makes it likely that observed effects are likely to continue and worsen as time progresses (IPCC, 2014). This is illustrated by the changing prediction of average global warming temperatures from 2°C in the late 1990s, to somewhere between 3°C and 4°C within the current century (New, Liverman, Schroder, & Anderson, 2011). Such estimates highlight the larger trends of climate change that show that many effects are likely to exceed probable predictions and sometimes even exceed worst-case scenarios such as sea level change (Church et al., 2011, 2013; Willis, Chambers, Kuo, & Shum, 2010), and carbon emissions (Ciais et al., 2010).

## 2.4 Climate Change and Tourism

Tourism is a phenomena that contributes a substantial amount to climate change generally, and carbon emissions more specifically (Becken & Patterson, 2006; Gössling et al., 2007; McKercher, Prideaux, Cheung, & Law, 2010; Rutty, Gössling, Scott, & Hall, 2015; UNWTO et al., 2008). Not only in the use of carbon-based fuel for transportation services, but also energy use generated from coal, gas or petroleum (Becken & Patterson, 2006; Rutty et al., 2015). Thus, in its current state, tourism when assessed at the global scale is not sustainable, and produces a substantial contribution to climate change, specifically with regards to greenhouse gas emissions.

However, while there is substantial evidence that shows there is a very real need to reduce greenhouse gas emissions within the tourism sector, there are substantial barriers to making significant changes. One being the tourism industry which has proven to heavily oppose any taxation policy aimed at limiting/off-setting the use of fossil fuel (Gössling et al., 2005). A position that may contribute to an image of being an environmentally harmful industry rather than that often conveyed of being environmentally neutral while also providing many ecological benefits (Iwand, 2003).

Alongside the growing academic insight has also been the growing popularity, or recognition of, ecotourism which places particular importance on conserving a destination, or at least off-setting one's consumption during the touristic endeavour (Fennell, 2015). The beginning of ecotourism was rather restricted in terms of touristic opportunities, and was often limited only to scientists and birdwatchers who had a heightened awareness of preserving the environments they were observing (Fennell, 2015). However, the growth of ecotourism has been plagued by various philosophical and practical inconsistencies which have seemed to dilute the defining characteristics of ecotourism and taint the idea as a whole (Farquharson, 1992).

Having introduced very briefly some of the main issues, the next sections of the literature review will focus down towards specific inputs (Energy, Water) which are heavily intertwined within the modern incarnation of tourism. Each topic will be introduced and its specific interaction with tourism analysed in terms of scope, problems and potential solutions which have been discussed with academic and non-academic literature.

## 2.5 Energy

Energy is of great importance within the discussion of sustainable tourism, and sustainable development as a larger movement (Dincer, 1999). Energy is of particular importance largely due to the fact that a large percentage of the world's energy use is based on the consumption of fossil fuels (Biesiot & Noorman, 1999).

### 2.5.1 Energy and Tourism

Tourism is one of the largest contributors to global greenhouse gas emissions globally due largely to its heavy involvement with many fossil fuel-dependant, high energy-consuming activities such as transport, travel, accommodation, recreation and general consumption (Becken & Hay, 2007; UNWTO, 2012). It is because of tourism's heavy involvement with fossil fuels that it is considered a highly climate-sensitive sector and this is often considered the tourism industry's most pressing environmental issue (Gössling et al., 2005; Graßl et al., 2003; Sala et al., 2000; Thomas et al., 2004; Wilbanks et al., 2007). It is estimated that tourism's energy use, and the emissions that come from it, is likely to make up greater than 5 per cent of global $CO_2$ emissions directly – with some estimates going up to around 12 per cent (UNWTO, 2012). Considering the most recent IPCC report states that the combustion of fossil fuels contributed to about 78 per cent of the total greenhouse gas emissions from 1970 to 2010, tourism plays a significant role in our global contribution, and our sustainability (IPCC, 2014).

### 2.5.2 Energy Use in Tourism

Generally, there are two ways to look at direct and indirect energy consumption in relation to tourism; destination-based energy consumption, and travel-based energy consumption (Gössling, 2000, 2002). The former being energy consumed during transport at the destination, and all other activities consumed while there. And the latter relating to the energy consumed during the travel to a destination. Each type, and each activity within, consumes varying degrees of energy and will alter greatly depending on how one defines touristic influence, and how one prescribes the measurement of touristic influence to activities which are not wholly consumed by tourists.

Destination-based energy consumption can be comprised of many various activities which may make up part of a tourist's excursion. It can be directly through activities such as

transport around a destination, heating, cooling, cooking, or it can be indirect activities such as through the consumption of food (e.g. preparation, transport), the desalination of sea-water or other general services which are indirectly consumed (Gössling, 2000).

Travel-based energy consumption is comprised of varying transportation means that a tourist make take to get to where they are wanting to go. Depending on the region, the place of origin, and the eventual destination there are likely to be a variety of ways a tourist can travel. Often when tourism is discussed aviation is the imagined means of transport as it is one of the most symbolic images of tourism, and one of the most obvious, high impact and high energy consumption means of travel – comprising between 43 and 54 per cent of all tourism domestic and international consumption (Pratt, Rivera, & Bien, 2011; Scott et al., 2010; UNWTO, 2016). Aviation has also been estimated to account for 2-3 per cent of the world's total fossil fuel use with 80 per cent of that being civil aviation (Penner, Lister, Griggs, Dokken, & McFarlan, 1999).

#### 2.5.2.1 *Scope*

The consumption of energy is one of the major factors that makes up modern tourism and allows much of the hypermobility that can be seen in (and between) many developed societies today (Becken, 2007). The omnipresent nature of transport such as airplanes, cars, buses, trains and ships ensure that mobility is more accessible, and (relatively) cheaper than previously (Becken, 2007). The accessibility of (energy and) transport is a major factor in tourism's continued growth that is likely to see international tourism visitor numbers reach 1.4 billion by the year 2020 (UNWTO, 2016). Overall, it is expected that energy use from international aviation will increase by a factor of 3-6 by the year 2050 depending on different social, cultural and political scenarios (Olsthoorn, 2001; Scott et al., 2012).

Energy is also a major component of many tourism and tourism-influenced activities which take place in destinations such as those mentioned previously – accommodation, transport, recreation, general consumption – both directly and indirectly to varying extents (Gössling, 2000). It is estimated that the average tourist energy use varied between 4.2kg of crude oil consumed, per person, per day when staying in a smaller hotel, and could reach up to 21.5kg of crude oil consumed, per person, per day in a resort-style hotel (Gössling, 2000). After looking broader and accounting for all other destination-based energy use, the

number could be calculated as high as 100kg of crude oil per person, per week while on holiday.

#### 2.5.2.2 *Destination-Based Energy Use*

While some energy used at destinations will be produced locally at the destination, the vast majority of energy will be imported from large, commercial operations which may not be within the same country or region as the destination (e.g. the use of crude oils) (Bruner, Sweeting, & Rosenfield, 2002; Kelly & Williams, 2007). Often the energy use in tourism destinations is disproportionately greater than what might be expected of a similarly-sized communities (Kelly & Williams, 2007). This effect is largely due to the energy-intensive nature of many amenities which tourism destinations typically offer (Tabatchnaia-Tamirisa, Loke, Leung, & Tucker, 1997).

##### 2.5.2.2.1 Accommodation

Accommodation is a major sub-sector of the tourism industry, and one that accounts for a significant amount of resource consumption – including energy (Gössling, 2002). The amount of energy used and consumed differs greatly by accommodation establishment and accommodation type (Gössling, 2002) (Table 1).

Data are very messy and hard to compare by when it comes to accommodation figures especially defining and measuring (sometimes) informal accommodation such as campsites, bed & breakfasts, and second homes (Hall & Müller, 2004). This is increasingly so with the growing popularity of the sharing economy propelled through services such as Airbnb. On New Year's Eve in 2016/17, Airbnb, reported that their service was helping to accommodate two million guests in over 200 countries – up to 1400 times more guests than the same period in 2009, and breaking their previous record of 1.8 million set in August of 2016 (Airbnb, Inc., 2016a, 2016b).

Hotels are often the largest consumers within the tourism accommodation sub-sector, and generally hotel facilities rank within the top five highest energy consumers in the commercial/service building sector (Bohdanowicz & Martinac, 2007). The energy consumed by hotels is often mostly electric – approximately 60 per cent of total energy use, with varying amounts of coal, liquefied petroleum gas (LPG), petroleum, natural gas, wood and steam making up the remaining usage (Becken, 2002b; Becken, Frampton, & Simmons,

2001; Bohdanowicz & Martinac, 2007; Chartered Institution of Building Services Engineers, 1991; Deng & Burnett, 2000; Rosselló-Batle, Moià, Cladera, & Martínez, 2010; Simmons & Lewis, 2001; Wang, 2012; Zmeureanu, Hanna, Fazio, & Silverio, 1994).

The energy consumption profile of a hotel differs greatly from the use of other types of commercial/service buildings as they are usually much more vertically integrated, and also have longer hours of operation (Bohdanowicz & Martinac, 2007; Dalton, Lockington, & Baldock, 2008; Santamouris, Balaras, Dascalaki, Argiriou, & Gaglia, 1996). Hotel (and other accommodation types more generally) energy consumption profiles also differ greatly between hotels of different size, structure, construction, geographical and climatic location, energy systems installed, age of the systems, age of the establishment, maintenance schemes and types and availability of energy (Wang, 2012; Warnken, Bradley, & Guilding, 2005). For example, a higher standard of hotel (a higher star-rating) is likely to also require a higher resource consumption – including energy (Becken et al., 2001; Bohdanowicz & Martinac, 2007; Wang, 2012; Warnken et al., 2005). Factors such as gross floor area, number of guest rooms, number of guests, revenue figures and years since last retrofit are all correlated positively with the total energy use of a hotel (Bohdanowicz & Martinac, 2007; Priyadarsini, Xuchao, & Eang, 2009; Wang, 2012).

*Table 1 - Energy use in tourism accommodation*

| Accommodation Type | MJ/bed night [ab] | Annual Global $CO_2$ Emissions (Mt)[c] (2001)[e] |
|---|---|---|
| Bed & Breakfast | 110 | |
| Camping/Hut | 25 | 7.9 |
| Holiday Village | 91 | 1.8 |
| Hotel | 255 | 55.7[d] |
| Hostel | 39 | |
| Motel | 32 | |

Source: Gössling (2002), Becken et al. (2001), Burnett (1994), UK CEED (1994), Gössling (2001b)

[a] Bed night is a measure calculated by dividing the annual energy use by the number of nights spent by tourists in that accommodation type (Becken et al., 2001).
[b] For reference, an exchange rate of 1kg of crude oil = 42.6MJ is assumed
[c] Based on an emission factor of 43.2gC/MJ (Schafer & Victor, 1999)
[d] Figure also includes hostels and motels
[e] Estimated 5.2 billion nights spent in different accommodation establishments globally during 2001

The vast range of variation between accommodation establishments make it difficult to average energy into specific areas of use within accommodation. However, hotels in Hong

Kong were shown to use approximately 45 per cent of energy for heating, ventilation and air-conditioning (HVAC), 28 per cent for cooking and water heating, and 12 per cent for lighting (Deng, 2003; Deng & Burnett, 2000). HVAC was also found to be the largest user in a study of Jordanian hotels (Ali, Mustafa, Al-Mashaqbah, Mashal, & Mohsen, 2008), and was reported as the leading consumption activity in UK hotels in 1993 (BRE Group, 1993). A study of a Portuguese hotel showed that electrical equipment was the largest use area (slightly less than 50 per cent), closely followed by HVAC activities (around 40 per cent) (Gonçalves, Gaspar, & Silva, 2012). Unfortunately, one cannot expect these figures to be representative of accommodation, or even hotels, as a whole. As Jordan and Hong Kong record relatively high average temperatures and Hong Kong can also be quite humid, the energy profiles (and total use) would be likely to differ in milder destinations such as the UK, New Zealand or Western and Central Europe (Dong, Lee, & Sapar, 2005; Priyadarsini et al., 2009; Wang, 2012).

##### 2.5.2.2.2 Activities

Tourists are usually involved in many various activities during their stay at a destination, and these activities are often cited as the main reason why touristic excursions exist (Pigram, 1983). Activities can be broken down into four categories which encapsulate the majority of attractions that a tourist may seek: natural attractions, human-made attractions not formed for touristic purposes, human-made attractions formed for touristic purposes, and special events (Swarbrooke, 1995). All activities participated in by a tourist consume energy of varying type, and varying quantities – even if that is simply the transport it required to participate in an activity (Becken & Simmons, 2002; Commonwealth Department of Tourism, 1997).

There have now been a number of studies looking into resource use and energy consumption of various touristic activities (Becken & Simmons, 2002; Commonwealth Department of Tourism, 1997; Gössling, 2002, 2011). The energy consumption of the various activities is often seen within the light of a supply chain, accounting for the up and down-stream processes which take place to allow and activity to happen (Becken & Simmons, 2002). This may include things such as office overheads, or the actual marketing the product.

The energy-intensity of touristic activities varies greatly, and again is very hard to provide an adequate average of energy used – especially when estimating a per vacation number (Gössling, 2002). However, Becken and Simmons (2002) provide a very thorough analysis as summarised in Table 2 which was also shown previously within the discussion of section 8.5 **Error! Reference source not found.**. It is (conservatively) estimated that the average long-stay tourist may use 250 MJ of energy for activities – excluding transport, and not distinguishing between tourist groups (i.e. business, recreational, VFR) (Becken et al., 2001; Becken & Simmons, 2002; Gössling, 2002; Kelly & Williams, 2007).

*Table 2 - Energy use of tourism activities (New Zealand, 2000)*

| Activity (Excl. Transport) | MJ per tourist | Estimated $CO_2$ emission per tourist (kg)[a] |
|---|---|---|
| Adventure activities | 57 | 2.46 |
| Diving | 800 | 34.56 |
| Experience centres | 29 | 1.25 |
| Guided walks | 110 | 4.75 |
| Heli-skiing | 1300 | 56.16 |
| Museums | 10 | 0.43 |
| Rafting | 36 | 1.55 |
| Sailing (motor) | 140 | 6.05 |
| Scenic boat cruises | 165 | 7.13 |
| Scenic flights | 340 | 14.69 |
| Visitor centres | 7 | 0.30 |
| Zoos | 16 | 0.69 |

Source: Becken and Simmons (2002); Gössling (2002)

[a] Based on an emission factor of 43.2gC/MJ (Schafer & Victor, 1999) which assumes an average energy intensity, and complete combustion

While not included in Table 2, there are some other popular, high-energy (and high resource) use activities which should be highlighted. Golf and snow tourism are both high-energy use and (relatively) low visitor numbers (Becken & Simmons, 2002). While each have standard energy costs around general infrastructure, they both require high levels of energy for maintenance processes which are associated with providing adequate and suitable environments for the activity to be carried out – snow-machines for ski fields, large-scale garden maintenance for golf courses (UNWTO et al., 2008).

#### 2.5.2.2.3 Transport

Transportation provision, including the infrastructure and operational services is seen to have a large impact upon tourism development with the growth of tourism mirroring the growth of mobility (Adams, 1996; Becken, 2002a; Van Doren & Lollar, 1985). Within tourism, data on the energy use of getting around a destination and to and from activities are quite limited and often will borrow from non-tourism focussed journals (Page, 2004; Reilly, 2008). However, data shows the numbers are quite low, and are likely to only make up one per cent of the energy use of a tourist's entire excursion including all travel-based energy (from origin to destination); and destination-based energy use of accommodation and activities (Hall, Le-Kähn, & Ram, 2017; Peeters & Schouten, 2006). Often the problem lies with the reliance on private light duty vehicle (LDV) instead of public transport whose larger loads help to increase the efficiency of energy use (Cullinane & Cullinane, 1999). Adding to that, LDV-based transport can also impact quite negatively at tourism destinations through the increase of congestion and both air and noise pollution which impact the quality of a destination (Høyer, 2000; Orbaşlı, 2002).

### 2.5.2.3 *Travel-Based Energy Use*

In 2010, 94 per cent of the transport sector was responsible for 53 per cent of the world's primary oil consumption, and accounted for approximately 23 per cent of the total energy-related $CO_2$ emissions (Sims et al., 2014). As discussed previously, tourism's contribution to global energy use and emissions seems to be somewhere between 5 and 12 per cent (Peeters & Dubois, 2010; UNWTO, 2012). As referenced earlier, the human race is more mobile than ever which has allowed for more efficient utilisation of leisure time (Cohen & Gossling, 2015; Høyer, 2000; Page, 2004). In 1992, per capita daily mobility in Norway was calculated to be 33 passenger kilometres (p-km) (Høyer, 2000), while in Sweden, in the year 2000, the per capita daily mobility was calculated at 44 p-km (as cited in Gössling, 2002). And it is estimated, at least in many northern, central and western European countries, that between 40 and 55 per cent of all mobility is that of leisure mobility – mobility for the purpose of leisure (Gössling, 2002; Høyer, 2000; Schafer, 2000).

Aviation is estimated to account for between 43 and 54 per cent of tourism's energy consumption, with an increase to at least 50 per cent expected by 2035 – assuming current tourism growth trends (Pratt et al., 2011; Scott et al., 2010; UNWTO, 2016). Aviation

accounted for 54 per cent of international tourism arrivals annually in 2015 (UNWTO, 2016). These numbers are substantial as vast amounts of aviation energy use is used during tourism travel, and is suggested to be 2MJ per p-km (Becken, 2002a; Gössling, 2000, 2002). It is expected that advances in technology will largely offset the increase in pure tourist numbers with an estimated 32 per cent increase in fuel efficiency estimated between 2005 and 2035 – much less than the industry proposed target of 50 per cent by 2020 (Peeters & Middel, 2006; Scott et al., 2010; UNWTO et al., 2008)

For the aviation industry, fuel use now makes up between 20 to 25 per cent of operational costs (Hanlon, 2007). This fact, combined with the limiting nature of current fuel solutions, and all of the damages that have been, and will be discussed within this research, should be compelling of a reason enough for aircraft manufacturers to work towards more efficient solutions (UNWTO et al., 2008). Boeing, one of the world's largest aircraft manufacturers, produces annual reports relating to the environment, and particularly to commercial aviation (Boeing, 2016; Boeing Commercial Airlines, 2014), and Airbus also produces an "eco-efficiency" app (Airbus, 2017a). Airbus reports that it has invested two billion Euro annually of Airbus Group's 64 billion Euro turnover into what it terms eco-innovations (Airbus, 2017c; Airbus Group, 2016). And while it is overall a positive that apps are created, and the reports are produced, unfortunately no environmental issues of any sort make up the Boeing's vision, or key strategies, and the statistics cited within the reports fail to accurately represent the current state of commercial aviation and rather selectively chose figures which seem positive at face-value (Boeing, 2017).

Of the remaining tourists, private vehicles account for approximately 48 per cent of transport as a whole, and a significant proportion of touristic transport (Gössling, 2002; Høyer, 2000; Paul Peeters & Dubois, 2010). In 2015, 39 per cent of all international arrivals came by road – most often via an LDV, however buses are also included within this statistic (UNWTO, 2016). As is the difficulty with the private nature of LDV statistics, trying to understand the balance of touristic versus non-touristic excursions is relegated to informed estimation, however these estimates are based on aggregated national and international data. As mentioned briefly within the introduction for this research, it is estimated that domestic tourism numbers are five times larger than that of international arrivals – and the majority of those would be made via LDV (UNWTO et al., 2008).

Trains and water-borne craft only make up a small portion of most international tourism arrivals – two and five per cent respectively (Peeters & Dubois, 2010; UNWTO, 2016). Which equates to over 83,000 international arrivals for 2015, and an estimated 413,000 leisure trips domestically (UNWTO, 2016; UNWTO et al., 2008). While it is certainly a smaller tourism sub-sector when compared to aviation and road transport, both trains and water-borne craft make up a great proportion of freighting globally, and are under a similar focus in terms of adaptation and mitigation (Johansson, Patwardhan, Nakićenović, Gomez-Echeverri, & International Institute for Applied Systems Analysis, 2012; Sims et al., 2014).

In terms of tourists themselves, several papers have examined the ways they travel, and how that travel may or may not be affected by climate concerns (Büchs, 2017). Many studies show that the perceived effort of altering the comfort, convenience and affordability for a less impactful alternative is often trumped by aviation for holiday travel (Cohen & Higham, 2011; Cohen, Higham, & Cavaliere, 2011; Hares, Dickinson, & Wilkes, 2010; Juvan & Dolnicar, 2014). Thus, one of the many issues that need to be overcome in relation to energy efficiency is one of understanding how the tourist travels and attempting to alter those notions (Dickinson, Lumsdon, & Robbins, 2011). However, it is shown that, at least for the hyper-mobile, limiting travel is something that is unacceptable (Becken, 2007)..

### 2.5.3 Reducing Energy Use in Tourism

As seen in the above discussion, tourism's contribution to energy use is substantial and likely to continue increasing when assuming current trends (Sims et al., 2014; UNWTO, 2016; UNWTO et al., 2008). Thus, along with other large global sectors, tourism needs to find ways to mitigate and lessen its overall energy use and improve efficiencies (IPCC, 2014; Sims et al., 2014). Green Hotelier (an initiative by the International Tourism Partnership (ITP) – formally IHEI) provides several industry resources for hotels, and accommodation providers, to plan and carry out energy conservation measures (ECMs) which are aimed to improve environmental performance (ITP, 2014a).

#### 2.5.3.1 *Destination-Based Energy Use*

##### 2.5.3.1.1 Accommodation

As discussed within previous sections, it is clear that the accommodation sub-sector within tourism uses a substantial amount of energy through carrying out everyday operations

(UNWTO et al., 2008). Within hotels specifically – which are currently estimated to be the largest consumers of energy within formal tourism accommodation – the majority of energy consumed seems to be around activities of heating and cooling (of water and air), and other ventilation and air conditioning activities (HVAC) (Bohdanowicz & Martinac, 2007; Deng & Burnett, 2000; Gössling, 2002; UNWTO et al., 2008). Additionally, energy use it often measured as they second largest cost to hotel accommodation only behind labour costs (Pace, 2016). It is suggested that an accommodation provider should seek to understand their energy profile broken down into areas/activities, including how much energy is being consumed, trends of consumption, and potential excessive uses (BRE Group, 1993).

There are always impediments when implementing change within businesses, and this consideration is no different for the owner or manager of an accommodation provider. And because of the unique nature of tourism businesses and accommodation providers, there may even be more complexity and more factors to consider when implementing environmental change (Graci, 2008; Tsoutsos, Tournaki, Santos, & Vercellotti, 2013). For many businesses, the main considerations which need to be made before implementing any CSR, or simply environmental initiatives, will be those of resources such as time, money, skills and knowledge (Fraj, Matute, & Melero, 2015; Graci, 2008; Graci & Dodds, 2008; Henderson, 2007; Pryce, 2001; Revell & Blackburn, 2007).

As is key with aspects of a sustainable business, it is important that energy consumption, and environmental sustainability at large, is a strategic focus of the business. This involves ensuring regular measurement and reporting is carried out, and responsibility is taken relating to energy use and efficiency (BRE Group, 1993; Önüt & Soner, 2006; Santamouris et al., 1996). This includes the education and training of staff members and even of hotel guests (Mensah & Blankson, 2013; Önüt & Soner, 2006). It has been shown that environmental issues at large, and energy saving specifically is being given more attention, however there is still a need for education and discussion (Becken, 2013).

##### *2.5.3.1.1.1 Heating, Ventilation and Air Conditioning (HVAC)*

Temperature and the comfort of the guest is a key issue that HVAC activity is most often trying to regulate, and it is found that guests had less temperature complaints in those hotels which had greater energy consumption (Santamouris et al., 1996). It is preferred by

guests that room temperatures in accommodation be between 20 and 25°C and, at least in Singapore, is often settled at a midpoint of 23°C (Priyadarsini et al., 2009). It has anecdotally been shown that a stable temperature of 25°C generated no complaints from guests at a Seychelles hotel (UNWTO et al., 2008).

Systems and equipment can be implemented in order to regulate temperature and HVAC activities, and also help to consume less energy. As HVAC activities are the largest users of energy, there is a high potential for optimisation. And comparably, large reductions in energy consumption can be made with little cost and with a short return on investment (ROI) time (ITP, 2014a).

Thermostats, and devices with in-built thermostats, need to be implemented both centrally, and throughout areas where HVAC is installed (UNWTO et al., 2008). Such device need to be maintained correctly so as to always be accurate in their reading, and so the accommodation can be at a comfortable, yet efficient level (BRE Group, 1993). Thermostats may also need to take account of seasonal variations of outdoor temperature in order to remain efficient (Önüt & Soner, 2006).

As the number of years since the last retrofit is significantly correlated with higher energy use, it has been widely suggested that retrofitting modern, more efficient HVAC technologies is very likely to reduce total energy consumption over time, and is also likely to provide a return on investment over time (Ali et al., 2008; Mak, Chan, Li, Liu, & Wong, 2013; Priyadarsini et al., 2009; Santamouris et al., 1996; USAID, 2013; Yu & Chan, 2007). It has also been suggested that there may be ways for hotels to optimise their HVAC utilisation based on use patterns of the accommodation and only heating/cooling common areas for a limited period of time before and after major demand spikes (BRE Group, 1993; ITP, 2014a; UNWTO et al., 2008). For example, operating fans only when spaces are physically occupied, optimising stop-start times using occupancy data, or even controlling hotel zones separately (ITP, 2014a).

Insulation needs to be a major consideration when building, and again when renovating, accommodation establishments (BRE Group, 1993). For example, installing ceiling fans helps to decrease cooling load on HVAC activities, and also helps to “reuse” warmth in cooler scenarios (Balaras, Droutsa, Argiriou, & Asimakopoulos, 2000). This could include additions

such as increasing thickness of insulation within walls, ceilings and floors which helps to conserve energy (Balaras et al., 2000). Similar with adding extra glazing to windows and installing warm/cool roofs with in-built insulation (Akbari, Levinson, & Rainer, 2005; Balaras et al., 2000; Önüt & Soner, 2006). Draught stripping around openings such as doors and windows; assessing insulating blind and curtain options for windows can also help to regulate temperature and thus conserve energy (BRE Group, 1993).

##### *2.5.3.1.1.2 Water Heating and Cooling*

Regulation of water temperatures for various activities is generally the second largest user of energy within hotels, and would be a generally substantial user in other types of accommodation also (Deng, 2003; Santamouris et al., 1996). Generally, the extent of hot water consumption is dependent on the hotel's star rating, the climatic conditions, and the personal preferences of guests (Santamouris et al., 1996). The actual energy consumption relating to hot water is dictated by the difference between the temperature of water supply, and the desired temperature (Santamouris et al., 1996).

As with HVAC activities, boilers and other water heaters/coolers need to be maintained efficiently, and routinely checked as to their efficiency (BRE Group, 1993; ITP, 2014a; Önüt & Soner, 2006). Processes should be implemented so as to only operate chillers and boilers relative to actual loads which are required by demand (ITP, 2014a). Boilers can be used to optimise for different activities i.e. a configuration for guest hot water temperature, and other configurations for kitchen, laundry, cleaning activities (ITP, 2014a). And as temperature (and thus energy) is lost in transit, more efficient insulation of piping can also reduce total energy use (ITP, 2014a).

##### *2.5.3.1.1.3 Lighting and General Electricity Use*

Artificial lighting is an essential aspect of modern lifestyle as it is highly correlated with GDP growth (Tsao, Saunders, Creighton, Coltrin, & Simmons, 2010), and has been estimated to make up 17 per cent of global electricity consumption (US DOE, 2012). Lighting itself is a relatively small yet significant use of energy (specifically electricity use) within accommodation providers (Ali et al., 2008; Deng & Burnett, 2000; Gonçalves et al., 2012). Life-cycle assessment of new developments in efficient lamps and bulbs show a much increased life and greater efficiency within solid-state light-emitting diodes (LED) light

sources which offer many environmental benefits – including that of energy efficiency (Bergesen, Tähkämö, Gibon, & Suh, 2016; Lim, Kang, Ogunseitan, & Schoenung, 2011; Tähkämö et al., 2013). It is estimated that the use of LED lighting only requires 10 per cent of the energy than that of incandescent lighting (often used in guestrooms, lamps etc.), and the technology is expected to develop so to be substantially more efficient than that of fluorescent commercial lighting which would often be used within common areas of an accommodation provider (Bergesen et al., 2016).

To reduce the use of light where it is not needed, it is suggested that equipment such as photo-cell controls, dimmer controls, and motion sensors be installed (Önüt & Soner, 2006; UNWTO et al., 2008). Photo-cell controls monitor their direct environment for light, and can be programmed to adjust artificial lighting accordingly. Combined with dimmer controls, the artificial light could be used to add to that of natural light and reducing the need for manual oversight which could lead to inefficiencies. These systems would then of course need to be maintained at regular intervals to ensure their proper operation, and the efficiencies they provide. For areas which do not have much natural light, motion sensors can be used (Önüt & Soner, 2006). Motion sensors allow the use of lighting only when the direct environment is being used, and reduces the use of unnecessary light. Many modern hotels are now using card systems within their guestrooms, which are used to enter a room, but are also required to allow electricity to the room (ITP, 2014a; UNWTO et al., 2008). Thus, when a guest leaves their room, removing the card will disconnect non-essential electricity – powering down lighting, televisions, HVAC activities.

More efficient use of natural light, the architecture and interior design of a building can impact how much electricity is used in terms of artificial lighting (Santamouris et al., 1996; Smith, 2004). This is an especially important factor that should be considered when designing common areas such as entrances, staircases, corridors etc. (Önüt & Soner, 2006; UNWTO et al., 2008). Additionally, light-reflective surfaces such as lighter coloured paints can be used to better utilise natural light (BRE Group, 1993; ITP, 2014a).

##### *2.5.3.1.1.4 Activities*

As mentioned in section 2.5.2.2.2 on energy use in activities, it is conservatively estimated that the activities of an average tourist would consume approximately 250 MJ during their

stay – excluding transport costs, and averaging across all variables such as length of stay, international vs. domestic, and tourist type (Becken et al., 2001; Gössling, 2002). Similarly, Becken and Simmons (2002) estimate that the average international tourists uses 880 MJ, while the average domestic tourist consumes 170 MJ. All of these estimates are significant sources of energy use, especially when considering overall tourism numbers, the excluded transport energy use, and the high energy use which some activities are estimated to consume – see Table 2.

As discussed previously several times, the first step to reducing resource use within a business is to assign responsibility; regularly measure, record, and report resource use; combine that data with education and initiatives to reduce resource use (UNWTO et al., 2008). In fact, many of the suggestions made within section 2.5.3.1.1 Accommodation are likely to be useful for tourism activity suppliers when relevant. While often these businesses will not be as diverse, or be as energy-intensive, the ideas of modern, efficient, and maintained equipment is likely to save energy over time. And while it may have a longer ROI based of the factors listed above, should still be considered as an eventually capital-neutral investment.

In terms of reducing demand for an activity, there has been a growth of literature looking to apply the ideas of demarketing, originally proposed by Kotler and Levy (1971), to tourism studies – particularly focussing on heavily unsustainable tourist attractions (Hall, 2014). Through better managing the demand of a popular attraction (i.e. lessening the demand), it is possible to lessen the total strain that is placed upon the local activity infrastructure and the destination as a whole (Beeton & Benfield, 2002). This includes the total energy use of the activity itself. Obviously this is contrary to what many small tourism enterprises (STEs) may be pursuing, but it may be useful in certain scenarios. It is also certainly useful for organisations at a policy level – whether global, regional, state, or local – or industry organisations looking to alter demand patterns (Parks Canada Agency, 2000; Sharpley & Pearce, 2007). Methods to achieve this may include reducing advertising expenditure, pricing increases, and altering or re-allocating supply (Beeton & Benfield, 2002; Samli & Yavas, 1985). However, there are some cautions that have been proposed in the literature, which unfortunately have not been explored thoroughly, but include ideas surrounding inequalities and issues with inaccessibility which may be produced when prices are

increased, or when specific populations are targeted for demarketing (Beeton & Benfield, 2002).

#### 2.5.3.1.2 Transport

The most often pursued idea to reduce destinations transport's energy use is that of encouraging the use of public transport, and simultaneously discouraging the use of private transport (e.g. LDV) (Cullinane & Cullinane, 1999; Hall et al., 2017; Hine & Scott, 2000; Lumsdon, 2006). Thus it can make sense to a tourism enterprise to encourage the use of public transport which will make the enterprise seem more available, while also encouraging a more efficient means of transportation (more so than an LDV) to the activity (Miller, Merrilees, & Coghlan, 2015; Reilly, 2008).

Improving network coverage of buses, trains and subway can go a long way to increasing the attractiveness and use of public transport within a destination (Høyer, 2000; Kelly, Haider, & Williams, 2007). Financial incentives can be created through reducing the ticket costs of transport perhaps to certain attractions or locations. In appropriate locations, it has also been suggested to invest in bicycle hire schemes which allow tourists to travel around attractions within reasonable proximities (i.e. inner cities) which would reduce demand for electricity and fossil fuel-based transport (Høyer, 2000).

Some infrastructure investment to reduce the use of private vehicles have been suggested, such as implementing highway tolls for private vehicles or increased taxes on gasoline (Reilly, 2008). And ways to increase the attractiveness of public transport include providing dedicated lanes for high-occupancy vehicles, or improving network coverage (Kelly, 2006). Unfortunately these methods require massive investments in infrastructure which is simply unattainable for smaller destinations, and the actual implementation is likely to be one that is controversial for many local populations.

### 2.5.3.2 *Travel-Based Energy Use*

The reduction of energy use, and the improving of energy efficiency within tourism transport is of utmost importance for mitigation strategies surrounding tourism (Becken & Hay, 2007; UNWTO et al., 2008).

#### 2.5.3.2.1 Aviation

Aviation fuel efficiency has increased significantly over the past 60 years – approximately 25 per cent more efficient (Peeters & Middel, 2006). This increase in efficiency has largely come about though innovations in aircraft design and jet engine efficiency in commercial aviation (Boeing Commercial Airlines, 2014; UNWTO et al., 2008). Unfortunately, considering the ever-growing tourism numbers, and the near-necessity of aviation for international tourism, there are very few things that STEs, and even destination planners, can do (Kelly et al., 2007). Thus, academia must certainly play its role of increasing pressure for changes to be made within these commercial aviation manufacturers through public pressure or, more likely, through policy advancement. And academia will certainly continue to critique and offer current insight into the topic.

Boeing and Airbus both report that they are looking into alternative fuels (of which the most common is biofuels) which aim to be more energy-efficient, and can be utilised within both new and older engines (Airbus, 2017b; Boeing Commercial Airlines, 2014). And biofuels are also one part of the four-pillars strategy by IATA in responding to climate change (IATA, 2017), along with a key objective being researched by the European Union (EU) (EASA, 2017c), and a focus of the International Civil Aviation Organisation whose 191 member states are producing local action plans in alignment with the overall ICAO action plan (ICAO, 2016). Unfortunately, currently available biofuels are not suitable for use in large-scale, commercial aviation except when mixed in small quantities with existing jet-fuel (Hollenhorst, Houge-Mackenzie, & Ostergren, 2014; UNWTO et al., 2008). Often they are impractical as they need to meet specific requirements of aviation fuel such as keeping liquidity at low temperatures, and providing high amounts of energy (Rye, Blakey, & Wilson, 2010). And there are many other issues that arise around current manifestation of biofuels including high prices, poor net emissions, extensive land use, high water use and competition with food security (Berndes, 2002; EASA, 2017b; Fraiture, Giordano, & Liao, 2008; Rye et al., 2010).

Improved air traffic management systems (ATM) are a second pillar of the IATA four-pillar strategy for climate change (IATA, 2017), and also an important area for the EU within the aviation report (EASA, 2017a). It is estimated that overall fuel reductions of 10 per cent can be achieved through greater efficiency through optimising flight paths, and reducing

congestion (UNWTO et al., 2008). Considered a large step in the way to helping the efficiency of both of these processes is the full operation of a full system of navigational satellites, Galileo, which is being created by the EU and is due to be complete in 2019 (European Commission, 2017a; UNWTO et al., 2008). Also, the EU is developing a new generation ATM system which aims to be the common system (at least within the EU) which will improve efficiencies in both domestic and international flights (European Commission, 2017b). The European Aviation Safety Agency (2017d) estimates that the introduction and eventual implementation of their new system (SESAR) could result in overall fuel savings of between 0.8 and 1.6 million tonnes annually.

Additionally, fuel efficiency greatly depends on the load factors of the aircraft in its operations (UNWTO et al., 2008). A load factor can be represented by passenger load factor (PLF), and by weight load factor (WLF) in terms of a percentage of the total passenger or weight load that an aircraft can carry. A greater amount of people being transported by an aircraft (a higher PLF), reduces the fuel use per p-km, thus it is very important that airlines optimise their flights appropriately so as to operate with more efficient fuel use. It is estimated that typical international passenger load factors are between 70 and 80 per cent, with 90 per cent for that of short, domestic travel (ICAO, 2016; Miyoshi & Mason, 2009; UNWTO et al., 2008). Airlines have been getting more efficient, with PLF and WLF figures increasing since 1980 (ICAO, 2016; Mazraati, 2010). However, passenger load factor is a difficult economic balance for airlines as passengers value greater frequencies of flight as it allows them more flexibility when planning trips, however they often mean a lower PLF (Basfirinci & Mitra, 2015). And it is suggested that passengers, and thus airlines who care highly for their passengers' comfort, do not prefer high PLF as they equal greater discomfort during flight (Brueckner & Zhang, 2010). This is shown by the fact that many low-cost airlines have much higher load factors (between 80 and 90 per cent), compared with those of regional or network airlines whose business models rely to a greater extent on passenger comfort (Miyoshi & Mason, 2009).

Energy efficiency is also very dependent on the specifics of the aircraft and how the passenger is flying. As an example, as a percentage of the actual space on an aircraft, a business-class flyer takes up more space than a passenger in economy, and thus their custom is less energy efficient (UNWTO et al., 2008). This effect is even worse when looking

at first-class travel, and especially amplified when looking at the use of private aircraft for travel (Gössling, Hall, Peeters, & Scott, 2010).

#### 2.5.3.2.2 Road-based transport

While road-based vehicles are reported to make up around 39 per cent of all international tourism arrivals (UNWTO, 2016), they are estimated that they make up a larger per cent of domestic tourism whose total number of trips are reported to be five times larger than that of international tourism (UNWTO et al., 2008). As previously discussed within the section on destination-based transport, greater efficiencies are often found through the use of public rather than private transport (Hine & Scott, 2000; Lumsdon, 2006). Thus, discouraging the use of private transport, while encouraging the use of public transport is a popular method increasing transport efficiencies regarding energy use (Reilly, 2008).

The energy efficiency of fossil fuel-powered light duty vehicles (LDV) has unfortunately not progressed very far even when evaluating back as far as 1973 (Scholl, Schipper, & Kiang, 1996; Van den Brink & Van Wee, 2001). This is because while engines have been getting more energy-efficient, the cars themselves have also been increasing in size and power with more technical equipment (e.g. air condition) which counteracts potential benefits (UNWTO et al., 2008). Thus, the use of smaller, lighter vehicles with more modest features are likely to be more efficient fossil fuel-based transport options than their larger counterparts.

Alternative engine technologies can help to also reduce total energy use (UNWTO et al., 2008). Many electric vehicle (EV) transport options are far more energy efficient than their fossil fuel-based counterparts (Barrero, Mierlo, & Tackoen, 2008; Hawkins, Singh, Majeau-Bettez, & Strømman, 2013). However, as covered within the literature review of emissions, the most important aspect of EVs is the source of the electricity that is used as their fuel, and whether it is renewable or a fossil fuel (Pina, Baptista, Silva, & Ferrão, 2014). Many EVs still have a lot of extra difficulties such as battery capacity, ease of charging and the added weight and volume of required batteries, all of which could be considered unfavourable for a STE (Johansson et al., 2012; UNWTO et al., 2008). Also, assuming a large amount of EVs are implemented, there are worries that similar charging times will place a lot of stress upon local energy infrastructure which can actually lead to inefficiencies and may require the use of reserve fossil fuel energies (Pina et al., 2014).

#### 2.5.3.2.3 Rail-based transport

Generally, trains are more fuel-efficient than other modes of transport, especially when looking at passenger kilometre (p-km) measures (Hillmansen & Roberts, 2007; Smith, 2003). For example, in Sweden, trains consume 1.8 per cent of the country's total energy use, however they carry seven per cent of the total passenger kilometres, and 38 per cent of the total freight tonnes per kilometre (R. A. Smith, 2003). They are similarly efficient in Japan consuming seven per cent of total energy use, and accounting for 30 per cent of passenger kilometres (p-km) (Watanabe, 2015). In Japan, it was calculated that energy use is 402.8 KJ/p-km on rail, while 2,586.3 KJ/p-km via for automobiles (Watanabe, 2015). It is estimated in Japan that 80 per cent of all transport emissions could be eliminated by converting all automobile transport to that of trains – ceteris paribus (Watanabe, 2015). Part of the reason rail is able to be fuel-efficient is that can usually run on electricity, and depending on the generation of that electricity, can also be quite efficient with emissions (Smith, 2003). However, if the source of the electricity is that of requiring fossil fuels, the energy supplied still requires large emissions of many greenhouse gases (Swärd, 2006).

The majority of energy consumed within the direct operations of trains is within the operation of the train itself firstly, and the auxiliary devices secondly (i.e. air conditioning, lighting) (Shinbo, 2012). Unfortunately because of the smaller size of the industry compared to aviation and road vehicles, innovation happens at a slower rate – often borrowing from other industries (Hillmansen & Roberts, 2007). Also slowing innovation is the relatively long life-cycles of trains (usually 30 to 60 years) which, combined with high purchase cost, means that new, modern technologies are not quick to market (Smith, 2003; Swärd, 2006). However, it is because of the long life-cycles of the railways, and train carts themselves, that the substantial manufacturing energy and emission investment that goes their construction is often offset with between four years and a few decades of service (Chang & Kendall, 2011; Chester & Horvath, 2010; Swärd, 2006).

However, there is still room for train networks to become more efficient. The International Union of Railways (UIC - Union Internationale des Chemins de fer), has put together a small database of efficiency-improving (including energy) technologies and processes to help improve the industry (UIC, 2017).

Similar to aviation, the UIC discusses the improved energy efficiencies per p-km that can be achieved through maximising passenger load factors (UIC, 2017). This is an important consideration within the design stage and also within the scheduling of train lines to ensure operation is limited when at low load factors (Chester & Horvath, 2010). Again, it is a difficult economic balance for rail providers as less frequent train service is likely to be less convenient for users, while crowded trains are also likely to be less comfortable.

The UIC and other engineers also recommend the use of (kinetic) energy storage systems ((K)ESS) which utilise the energy created through applying the brakes on trains and transferring it to nearby trains on the same line (Hino & Hara, 2015; UIC, 2017). It is suggested that energy saving of a KESS can be up to 28 per cent and 35 per cent can be seen for high-speed intercity vehicles and commuter vehicles respectively (Barrero, Tackoen, & van Mierlo, 2010; Hillmansen & Roberts, 2007).

There are also several ways that the driving of the train can significantly impact upon the energy efficiency (Shinbo, 2015). Specifically, taking consideration of speed limits changes early can help to avoid wasteful acceleration and deceleration as well as gentle operation on gradients. Energy can also be conserved through the efficient use of coasting where necessary (Shinbo, 2015). Considering these facts, it may be of interest to rail operators to ensure that drivers are well trained in order to conserve energies where possible. It is also suggested that the introduction of technologies for train control can aid in efficiencies as they can accurately assess the times and places to attempt energy conserving movements (Shinbo, 2015).

### 2.5.4 Summary

Energy use is a global concern as energy is an integral part of the modern human existence (IPCC, 2014). The majority of energy used throughout the world has its sources in non-renewable fossil fuels which not only are finite, but also produce harmful emissions when consumed (Biesiot & Noorman, 1999). In order to lessen the impact of energy on the earth, it is important that we look to lessen energy use overall, and also find means of sourcing less harmful energy.

Tourism as a whole is a significant contributor to global energy use (IPCC, 2014; UNWTO et al., 2008). Tourism's high energy use comes down to two factors; the first being that the

pure number of touristic movements is incredibly large, and secondly because many of the critical activities that make up tourism are incredibly energy intensive (Bohdanowicz & Martinac, 2007; Sims et al., 2014; UNWTO, 2016). And it is because of tourism's heavy contribution to energy use that it is considered a highly climate-sensitive sector, and energy is considered tourism's most pressing environmental issue (Gössling et al., 2005).

Thus, there is a substantial literature regarding energy in tourism and how to limit energy's effect on the planet (Becken et al., 2001; Gössling, 2002). Often this literature can be broken into two categories; destination-based energy use, and travel-based energy use. And at a commercial level, it seems as though awareness of the need to reduce energy use is high within the businesses of both of these categories (Becken, 2013). Although, the awareness shown by these tourism providers is often, in larger part, a reaction to the substantial cost of energy to businesses rather than to the environmental importance (Pace, 2016; UNWTO et al., 2008). The most prominent themes of reducing energy use (and its impacts) within tourism are that of improving energy efficiencies through new technologies (Boeing Commercial Airlines, 2014; ITP, 2014a), reducing unnecessary energy usage (ITP, 2014a; Shinbo, 2012), and working to create and use less impactful energies (Boeing, 2016; Pina et al., 2014).

During the review of energy within (and closely surrounding) tourism-based literature, the author was tempted to split the review by what the author was going call Energy Demand and Energy Supply. These headings were to be an attempt to differentiate between possible methods of reducing energy use in relation to those who were "demanding" the energy (i.e. tourists), and those who were "supplying" the energy (i.e. the majority of other tourism stakeholders – providers, NGOs, governments). However, it was assessed that this would be unnecessary and imbalanced given the lack of literature surrounding that of what the author would deem methods to reduce "Energy Demand". This points to a potential gap, or lacking, within the energy-focussed literary field of tourism looking at tourists themselves. Specifically there seems to be a focus that assumes that larger changes should be driven by tourism providers (and other commercial bodies involved) within the industry, and consequently lacking critique and discussion surrounding NGOs, governmental bodies, and especially tourists themselves. While the author does not disagree that commercial tourism providers (and other commercial bodies) have the potential to not only reduce their impacts

substantially, but also lead the change within the industry, it is important to note that there does seem to be several gaps within the literature which should be explored.

## 2.6 Water

The following section of the literature review seeks to introduce the final sub-topic looked at as part of this research – water. The topic of water is one of the largest and more apparent of those which are affected (and have an effect on) tourism (Gössling, Hall, & Scott, 2015). This brief review provides a broad introduction to many aspects that make up water use and thus how wide-spread, and how important the topic is.

### 2.6.1 Water Stress, Scarcity & Quality

The presence and availability of water is something that many people in developed countries take for granted. The same can be said about the benefits that water provides to these people - improved well-being; improved sanitation and hygiene; and in turn, reduced exposure to negative health benefits (Rijsberman, 2006). These benefits, and the omnipresent nature of water in these areas, is starkly contrasted by the upwards of one billion people who do not have access to a consistent, affordable and safe water supply, and instead are faced with many challenges and dangers when sourcing and consuming local water (Gleick, 1998; World Health Organisation, 2016). These dangers manifest themselves in many ways including much higher rates of disease and consequently death, as well as contributions to impoverished conditions, and severely limiting many aspects of a region's development (Grey & Sadoff, 2007; World Health Organisation, 2016).

Water scarcity and quality is a constant threat to the sustainability of many regions (Gössling, 2001a; Seckler, Barker, & Amarasinghe, 1999). Water underpins many major factors of human existence; human livelihoods, food security, industrial growth and environmental sustainability (Rosegrant, Cai, & Cline, 2002). Broadly speaking, growing development and population demands; evolving lifestyles and technologies; and a changing global climate, further increase the consumption of water (Gössling et al., 2012, 2015). In fact, water use has increased by 300 per cent in the last 50 years (Carbon Disclosure Project, 2010), and was predicted to rise 50 per cent between 1995 and 2025 (Rosegrant et al., 2002). These factors tilt the balance of water security to one of water scarcity that places one-third of the global population as living under conditions of water stress - fresh water

supplies below 4,660 litres per day (Arnell, 2004; Vörösmarty, Green, Salisbury, & Lammers, 2000; World Water Assessment Programme (United Nations), 2015). The numbers of those affected by water stress are also likely to increase dramatically under a predicted increase of 4°C global climate change scenario by 2100 (Parry, Arnell, et al., 2009; Parry, Lowe, & Hanson, 2009). Very often, much of the impact of water stress can be relieved through more effective water management processes and procedures (Rijsberman, 2006). To what extent these actions relieve stresses is often difficult to understand and therefore prioritise.

Water stress and scarcity disproportionately affects regions, destinations and locales. Some regions may not be able to cope with their development as well as others, while the outcomes of vast environmental change are going to have different effects depending on the local situation (Arnell, 2004). For instance, coastal and typically more arid regions like south west Asia, Northern Africa, the Middle East and the Mediterranean are affected greatly by water scarcity (Al-Rashed & Sherif, 2000; Downward & Taylor, 2007; García-Ruiz, López-Moreno, Vicente-Serrano, Lasanta–Martínez, & Beguería, 2011; IPCC, 2014; Jiménez Cisneros et al., 2014; Rockström, Lannerstad, & Falkenmark, 2007; Vörösmarty et al., 2000). Water scarcity also poses great threat to small island nations whose resources are limited heavily by their size and resources e.g. Barbados, Malta, Mauritius (Gössling, 2001; Gössling et al., 2012). Or even small locales where the tourism demand is not well accounted for (Cullen et al., 2003).

### 2.6.2 Water and Tourism

Tourism both impacts, and is impacted by fresh water use (Gössling et al., 2012). Like all humans, tourists need and consume water in various ways – including drinking, eating, maintaining hygiene, and participating in activities. And while these uses are inevitable in local populations, the phenomenon of tourism can substantially increase these uses at different times of the year and even different times of the day (Gössling et al., 2012). Therein lies much of the difficulty with tourism – it spans a vast amount of sectors and interests

Generally, international tourism accounts for around one per cent of national water use (Gössling et al., 2012). While the percentage number may indicate relatively low importance, real numbers indicate that per person use of water can often be higher than

even that of agriculture (70 per cent of global freshwater withdrawal) (Becken et al., 2014). Also, these percentages become much higher for destinations of which tourism comprises a greater proportion of their economic activity, again e.g. Barbados, Malta, Mauritius. Herein lies much of the difficulty of developing water security for such destinations. While relying immensely on the economic impact brought on by tourism, tourism itself plays a role in the imbalance of water security (Gössling, 2001a; Waite et al., 2014). Therefore, tourism poses problems for the sustainable development of these regions (Kushner, Waite, Jungwiwattaporn, & Burke, 2012).

Thus it can be seen that water conservation is of importance to tourism in two ways. Firstly, the sustainable development of water-based tourism destinations such as lakes and beaches - directly. But also the management of water use in tourism activities and operations – indirectly (Gössling et al., 2015; UNWTO et al., 2008). As a result, many public policy objectives and strategies are aimed at these factors.

Gössling (2005) states that tourism impacts global water stress in two ways: (1) contributing to the shift of relative water abundance to water scarcity, and (2) contributing to demand through altered consumption patterns during vacation - therefore demand is spatial and temporal (see Charara, Cashman, Bonnell, & Gehr, 2011; Rankin & Rousseau, 2006). For example, Zanzibar tourism arrivals are at their highest when rainfall is at its lowest - i.e. the time when water is most needed by the tourism industry and to refill aquifers (Gössling et al., 2005). The seasonal nature of tourism demand can mean that summer months require around double the water of the winter months (Bruzzi, Boragno, Serrano-Bernardo, Verità, & Rosúa-Campos, 2011).

### 2.6.3 Water Use in Tourism

Tourism's contribution to water usage is expected to steadily increase as a result of several industry trends - increased tourist numbers; higher hotel standards; and increased water-intensity of tourism activities (UNWTO et al., 2008). As Gössling et al. (2012) point out, there are several anticipated changes that are important to consider when thinking about the aforementioned trends and hydrological cycles - changes in precipitation; water runoff; evaporation; and water quantity and quality. Such hydrological changes are likely to lead to lower levels of soil moisture, and increased drought frequency and intensity in prominent

and emerging tourist destinations such as Asia, the Middle East and smaller island regions (GFANC, 1997; Gössling et al., 2012; IPCC, 2014).

#### 2.6.3.1 *Scope*

Annual international tourism arrivals are estimated to reach 1.5 billion by 2020, and 1.8 billion by 2020 (UNWTO, 2016). When also including domestic tourism, this number of tourists increases approximately fivefold assuming a 1:5 international to domestic ratio (UNWTO et al., 2008). Considering the average tourist uses around 83-2000L of water daily, the total water usage of the tourism industry is inevitably going to increase as arrivals increase (Cobacho, Arregui, Parra, & Cabrera Jr., 2005; Gössling et al., 2012; IHEI, 1993; Rico-Amoros, Olcina-Cantos, & Sauri, 2009; Trung & Kumar, 2005). However, it must be pointed out that because of various fixed costs it is likely that the average water consumption per tourist does decrease as numbers increase - at least to a point (Deyà Tortella & Tirado, 2011; Meade & Gonzalez-Morel, 1999).

***Accommodation***

As mentioned in previous sections, accommodation data are becoming less comparable and more informal with the growing popularity of the sharing economy, and the consistent use of informal accommodation such as campsites, second homes, and bed and breakfasts (Airbnb, Inc., 2016a; Hall & Müller, 2004).

Higher hotel standards are predicted as likely to increase water use (Charara et al., 2011; UNWTO et al., 2008). Facilities such as spas and swimming pools use water directly, but hotels indirectly use water through preparing food, and maintenance activities that require water usage (Chapagain & Hoekstra, 2008; Pigram, 1995; Prideaux & Cooper, 2009). Increasing personal incomes; leisure time; education; and transportation and communication technologies correlate with tourism demand, as similarly do tourism expectations (Hall & Page, 2014). Higher levels of expectations and the eventual higher-standard of accommodation demanded is likely to consume significantly greater amounts of water (Bohdanowicz, 2007; Bohdanowicz & Martinac, 2007; IHEI, 1993).

Several factors of accommodation influence the total (absolute), and per person (relative), water use of each facility - such as the geographic location of the accommodation, facilities and services offered by the accommodation, or the infrastructure and cultural context of

the accommodation (Gössling et al., 2012). The geographic location of the establishment dictates the type of climate in which it will exist, which has many factors on the supply and demand of water resources. The geographic location also determines the establishment's distance from resources and infrastructure that influence water use. This distance then dictates the resource use required to exploit those sources.

Hotel structure plays a significant part in the amount of water consumed per person, and it also significantly affects their ability to implement and maintain environmental policies (Hall et al., 2016; Mackenzie & Peters, 2014; McNamara & Gibson, 2008). Langumier and Ricou (1995, cited in Gössling et al., 2012) show varying per person levels of water use between hotel types - up to a difference of 341L per day. These differences can be cause by factors such as level of capital, business culture, marketing initiatives, regulatory and cultural contexts (Hall et al., 2016).

#### 2.6.3.2 *Activities*

Tourism related activities are likely to become more water intensive over time (UNWTO et al., 2008). In a similar vein to rising hotel standards, many tourism activities are also becoming more water-intensive - for example skiing and golf (Agrawala & OECD, 2007; Pickering & Buckley, 2010; Scott, 2006). The growing majority of American, European and Australian ski fields are utilising snow made from water-intensive machines (Pickering & Buckley, 2010; Scott, 2006; Scott, McBoyle, & Mills, 2003). This has come about because of generally warmer temperatures and changes in snow and precipitation patterns leaving many ski fields without adequate amounts of snow during the winter season (Agrawala & OECD, 2007). For example, Australian resorts are predicted to have purchased an extra 700 snow guns by the year 2020 (Pickering & Buckley, 2010). This equates to an extra 2,500-3,000 million litres of extra water required for these resorts each month where snow is needed.

Warmer temperatures also leave many golf courses requiring extra irrigation and maintenance (Balogh & Walker, 1992; Scott et al., 2012; Throssell, Lyman, Johnson, Stacey, & Brown, 2009). The extensive land and water use of golf courses makes them very controversial developments especially in locales which have limited amounts of these resources – such as Cyprus, Malta or Thailand (Boukas, Boustras, & Sinka, 2011; Markwick,

2000; Pleumarom, 1992). The development of golf courses seek to attract more affluent visitors and are often quite luxurious in their construction installing many aspects that increase both absolute and relative water usage. Overall, a single golf course may use around 1 million $m^3$ of water annually (Essex, Kent, & Newnham, 2004; Markwick, 2000). This poses great problems for locales laden with golf courses such as Mallorca whose 269 ha of golf courses demand 3.24 million $m^3$ of water annually (as of 1999) as cited in Essex et al. (2004). This amount of water was estimated to be large enough to supply drinking water for the municipalities of Calvià and Palma on the island.

#### 2.6.3.3 *Infrastructure*

In the construction of infrastructure, water plays a significant role (Gössling et al., 2012). It is estimated that 17 per cent of global water consumption is dedicated entirely to the construction of buildings and infrastructure worldwide (Rosselló-Batle et al., 2010). While it is difficult to define how much of this is dedicated to, or influenced by tourism, it is a substantial consumption that tourism contributes to. Water is said to make up five per cent of the total mass of a finished building (Rosselló-Batle et al., 2010), and even more being consumed in the process of construction such as cleaning or being used as fuel.

#### 2.6.3.4 *Energy*

The creation and use of energy are heavily interlinked with the creation and use of water (UNESCO, 2014). In order to produce energy, substantial amounts of water are often required (e.g. cooling, mining extraction, fuel) (Gössling et al., 2012). Water consumption in energy production varies greatly depending on many aspects (Berndes, 2002), however it is estimated that it can take between 14 - 18L of water to produce 1L of fuel (Worldwatch Institute, 2004).

Air travel itself can entail average fuel consumption of 4.1L per passenger, per 100km of flight distance (UNWTO et al., 2008). Assuming an average, air-based, return tourist trip at 7600km, the amount of water consumed to produce one passenger's fuel may get as high as 5600L (Gössling et al., 2012).

As mentioned previously, each fuel type requires different levels of water consumption in its production (Berndes, 2002). Of these, increasingly popular biofuels are often put forward as the most sustainable alternative (Boeing Commercial Airlines, 2014; IATA, 2013). However,

many alternative fuels may in fact increase overall water usage (Pimentel et al., 2009). UNESCO (2014) currently report that 44km$^3$ or 2 per cent of global irrigation is currently dedicated to biofuel production, and current national biofuel policies and plans will consume up to 180km$^3$ of irrigation water. Gössling et al. (2012) estimate that 1L of biofuel production may require up to 2500L of water consumption. Adding to that, high percentages of food crops in the US and the EU are now being repurposed for biofuel production which has led to increased import quantities of certain produce to meet domestic consumption needs (Gössling et al., 2012; UNESCO, 2014).

#### 2.6.3.5 *Embedded Water*

Agriculture accounts for 70 per cent of total water withdrawals (Gössling et al., 2012; IPCC, 2014). So while it is easy to overlook, food consumption also requires a substantial consumption of water (Liu & Savenije, 2008; Postel, 1998), with up to 90 per cent of an individual's daily water consumption being on that of food (Savenije, 2000). Thus it is easy to see why agriculture is considered the most important factor of sustainable growth and the consumption of water (IPCC, 2014; UNESCO, 2014).

While agricultural (embedded) water use is not limited to tourism, every industry has it role to play in becoming sustainable in this regard – tourism is no exception. Embedded water use is of particular relevance to tourism as eating and gastronomic experiences are often emphasised and are of particular importance to many tourists (Boniface, 2003; Hall & Sharples, 2008; Sun & Pratt, 2014). It is suggested that one-third of all tourist expenditures are on food (Bélisle, 1983; Telfer & Wall, 1996). Additionally, gastronomic experiences often involve consuming higher-order, protein-rich foods which may require greater water consumption (Gössling, Garrod, Aall, Hille, & Peeters, 2011). This is of particular importance, once again, to the smaller locales, or smaller island nations where the increased consumption of food places stress on already over-worked systems, and often requires the importation of food from distant sources (Gössling et al., 2011; McTaggart, 1988; Telfer & Wall, 1996). However, there is much debate around the sourcing of local food versus imported food with regard to sustainability (Telfer & Wall, 1996).

Depending on climate, and various other factors, it is estimated that 1000-2000L of water is required to produce 1kg of cereal (Allan, 1998; Yang, Reichert, Abbaspour, & Zehnder,

2003), or up to 13,500L to produce 1kg of meat (beef) (Rijsberman, 2006). Essentially, 1kg of meat – depending on where it is raised – is equivalent to almost three-fourths of the recommended annual water requirement for one individual including drinking, hygiene, sanitation, and preparing food (Gleick, 1996). Thus food consumption – especially meat consumption – requires substantially more water per person, per day than most other factors discussed within this section (

Table 3).

#### 2.6.3.6 *Water Management*

Tourism's impact on water use is dependent on many factors that influence its use within a given region or destination. Therefore, there is great importance in understanding water use at a more micro level (Gössling et al., 2012). Water use inventories are a very important precursor to water management and security (Eurostat, 2009). From these inventories water use can be understood by category and thus produce more educated and suitable recommendations to deal with water stress (Gössling et al., 2012). This then can inform policies, and the strategies of business managers and tourism stakeholders. In a broad sense, water management strategies can be based on supply side management, or demand side management (Bates, Kundzewicz, & IPCC, 2008; Gössling et al., 2012). Discussion of particular management methods can be found in subsequent sections of this review.

Overall, the consumption of water in its relation to tourism can be seen to be a substantial issue which includes many prominent aspects of tourism, and affect many locales globally. Even when simply looking into direct use, tourism can be seen to have an impact, but as seen in

Table 3, the indirect impacts are often of similar, if not more, significance to locales such as those of fuel and food (Hadjikakou, Chenoweth, & Miller, 2013). Additionally, indirect activities such as these are consumptive in that it is not re-used by the region it is consumed in i.e. they cannot be re-used as greywater (Cazcarro, Hoekstra, & Sánchez Chóliz, 2014).

*Table 3 - Water use categories and estimated use per tourist per day.*

| Water use category - direct | L per tourist per day |
|---|---|
| Accommodation | 84-2000 |
| Activities | 10-30 |
| Water use category - indirect | L per tourist per day |
| Infrastructure | <1 |
| Fossil Fuels | 735 (per 1000km by air/car) |
| Biofuels | 5000+ (per 1000km by air/car) |
| Food | 2000-5000 |
| Total per tourist per day | 2000-7500 |

Source: Gössling et al., (2012); Rijsberman, (2006).

### 2.6.4 Water Quality in Tourism

Water quality is also an important factor when regarding tourism (Gössling et al., 2015). Water quality is directly and indirectly impacted by tourism activity - directly through activities such as boating, fishing and the spread of foreign bodies in waterways, or indirectly via increased pollution such as cleaning and pool chemicals; and the disturbance of delicate ecosystems (Hall & Härkönen, 2006; Kuss, Graefe, Vaske, & National Parks and Conservation Association, 1990; Lazarova, Hills, & Birks, 2003). Tourism activities often exacerbate local problems through increased use, and thus a location without proper sewage treatment would then be further exploited, damaged and local water quality affected.

The damage done by tourism on water quality depends on the concentration and quantity of the polluted material, the level of movement within the water, the current chemical balance of the location, and how competent that location may be in controlling or mitigating the effects of tourism (Gössling et al., 2015). For example, tropical island destinations can demonstrate more pronounced effects because of the chemical makeup of the surrounding waters, heavy concentration of pollutants and the relative lack of effective infrastructure. Such conditions can lead to the growth of microalgae which can unbalance and damage ecosystems, and in turn damage tourist perception of the place as a destination (Englebert, McDermott, & Kleinheinz, 2008; Nilsson & Gössling, 2013).

Water quality also then impacts tourism as certain standards of water quality are often expected (Gössling et al., 2015; Mihalič, 2000). And as noted by Nilsson and Gössling (2013), issues with water quality can impact tourists enough to make them reconsider visiting the

same destination in the future. A reputation for poor water quality can then be very damaging for a location's tourism industry and overall economy.

### 2.6.5 Reducing Water Use in Tourism

Reducing water use is a point of interest for many different industries, policy areas and academic disciplines. Because of the nature of the problem, and tourism's ability to span across other industries, many of the water-saving techniques are broadly applicable or adaptable in different scenarios e.g. general maintenance scheduling. Thus, the papers and ideas that are drawn on within tourism are often from other disciplines or the reporting of macro-level organisations (Brandes, Maas, & Reynolds, 2006; EarthCheck Research Institute, 2014; ITP, 2014b).

There are many suggestions as to how those in the tourism industry could look to reduce its water usage both on the demand side and supply side (Gössling et al., 2012; ITP, 2014b). On the demand side, it is estimated that the installation of water-efficient fixtures and facilities could reduce indoor water consumption by up to 20 to 50 per cent (Cooley, Hutchins-Cabibi, Cohen, Gleick, & Heberger, 2007). While more efficient supply management and abstraction can lead to sustainable water use on the supply side (Efstratiadis & Hadjibiros, 2011; Ngana, Mwalyosi, Madulu, & Yanda, 2003). Overall, potential water savings in the tourism sector are estimated to range between 0-45 per cent, most often falling between the 10-20 per cent range through making more efficient processes and equipment decisions (Calyx Sustainable Tourism & The Rice Group, 2002).

#### 2.6.5.1 *Water Demand*

##### 2.6.5.1.1 Kitchens

Kitchens require the use of water for preparation (washing food), cooking (boiling and cooling food), and cleaning (cleaning dishes) stages of a kitchen's use. It is estimated that kitchens are likely contribute to around 16 to 22 per cent of a hotel's water use - possibly becoming 55 per cent if a hotel does not carry out laundry services in house (Deng & Burnett, 2002; EarthCheck Research Institute, 2014). Smith et al. (2009) explain various ways in which kitchen water use could be reduced. Considering the frequent and substantial water use of commercial dishwashers, more efficient models and processes are likely to

save a lot of water over time. Same for installing further water-saving devices such as taps and nozzles (Barberán, Egea, Gracia-de-Rentería, & Salvador, 2013; Smith et al., 2009).

#### 2.6.5.1.2 Guest Rooms

Guest rooms make up a significant portion of water use within the accommodation sector of tourism specifically - between 25 and 65 per cent of hotel consumption (EarthCheck Research Institute, 2014; PUB: Singapore's National Water Agency, 2015; Trung & Kumar, 2005). Guest rooms use water through showers (56 per cent), toilets (25 per cent), cleaning (10 per cent), and basin (9 per cent) (Smith et al., 2009). Large decreases in water consumption can be made without compromising guest comfort. All faucets and showers can be fitted with more efficient nozzles that use less water, or aerate the flow which also limits splashing and extra wastage (Calyx Sustainable Tourism & The Rice Group, 2002). Also mechanisms for demand and supply side flow control can lower water use (PUB: Singapore's National Water Agency, 2015; Smith et al., 2009). Dual flush toilets with 6 litre/3 litre cisterns can be installed allowing users a choice of water usage (Scenic Rim Regional Council, 2017). Also, regular maintenance checks should be scheduled for investigating inefficiencies and leaking.

#### 2.6.5.1.3 Laundry

Laundry operations contribute significantly to tourism water use - between 5 and 30 per cent of hotel water use (Calyx Sustainable Tourism & The Rice Group, 2002; Smith et al., 2009; Trung & Kumar, 2005). For those without internal laundries, the laundering contractor simply bears the water use instead. Therefore reducing water use is accomplished through addressing demand. One of the simple, and potentially money-saving, ways of doing that is a simple linen and towel reuse scheme that allows guests to opt-out of daily laundry services (Goldstein, Cialdini, & Griskevicius, 2008; Smith et al., 2009; Stipanuk, 2001). In house laundries should use the most efficient methods possible such as more efficient machines, only doing loads at full capacity, and ensuring the water level matches the load level.

#### 2.6.5.1.4 Gardens and Landscapes

Many landscapes and tourism environments require maintenance and upkeep to ensure that they enhance the tourism experience (Hall & Härkönen, 2006). For example, up to 60

per cent of a resort's water consumption may come in the form of landscape and garden maintenance (Trung & Kumar, 2005). Improvements in the efficiency of landscaping and design can help reduce water consumption through irrigation and maintenance of the gardens and landscapes of the tourism sector. It is estimated that more efficient landscaping can lead to a 30-50 per cent reduction in landscaping water consumption while also reducing maintenance workload (Smith et al., 2009; UNWTO, 2012). Such a change requires installing automated water management systems to alert staff to leaks, problems, water needs, optimal watering times which are likely to reduce costs in the long term. A reduction in maintenance costs and water consumption can also come about through the planting of indigenous and more suitable plants to the point where the garden would require very little maintenance, if at all (Carmody & Zeppel, 2009). Similarly, the planting of low water use plants in dry climates will allow less water to be used for the upkeep of a landscape or garden areas (Franco, Martínez-Sánchez, Fernández, & Bañón, 2006). Other techniques such as applying mulch, removing weeds and watering in appropriate conditions can all lead to lower water usage (Scenic Rim Regional Council, 2017).

##### 2.6.5.1.5 Pools and Recreation

Pools require vast water consumption both in filling and maintenance the impact of which can be limited through more efficient techniques. It is estimated that the existence of swimming pools at a hotel can increase the hotel's total water use by 35 per cent (Deyà Tortella & Tirado, 2011). Gössling et al. (2012) suggest that the simplest way to limit their impact is to reduce the size and extravagance of the pool and its features. However, reducing evaporation can lessen water consumption especially in warmer climates. Reducing water temperatures and applying insulating covers can reduce evaporation and save up to 200 litres of water per day for larger pools (Scenic Rim Regional Council, 2017; M. Smith et al., 2009). Similarly to irrigation usage, pool water use can be automatically monitored for leaks, chemical levels and overuse via certain meters and equipment (Scenic Rim Regional Council, 2017).

##### 2.6.5.1.6 Management

Proper management and maintenance can allow for great reductions in the water use of tourism entities. Measuring, understanding and benchmarking current water management allows inefficiencies to be discovered and more adequately located (Trung & Kumar, 2005).

The adoption of many more efficient systems and hardware limits give the tourism stakeholders greater control over water use and water management. Often such tasks are performed rarely or as a side task to be performed and thus lack urgency and attention (Brandes et al., 2006). The identification of a specific responsible position within a business would therefore allow for more in depth planning, implementation and monitoring of water-saving and water rationing.

#### 2.6.5.2 *Water Supply*

In terms of supply side, a larger proportion of recycled water (greywater) can be used for non-potable uses such as toilet flushing and various landscape and irrigation applications (Al-Jayyousi, 2003; Friedler & Hadari, 2006; Lazarova et al., 2003; March, Gual, & Orozco, 2004; Nolde, 2000). Greywater has been used in commercial applications in several countries including the U.S.A., Japan and Australia (Søndergaard, Windolf, & Jeppesen, 1996; Sydney Airport, 2009). Reusing water for toilets and irrigation effectively allows water to be "used" twice - up to 50 per cent saving of water (Brandes et al., 2006), although there is sometimes a degree of consumer resistance.

The idea of desalination is also a major focus of academic research into water management (Gössling et al., 2012; Karagiannis & Soldatos, 2008). Desalination can positively enhance water supply, management and security through providing larger quantities of fresh water (Elimelech & Phillip, 2011; Khawaji, Kutubkhanah, & Wie, 2008). However there are many concerns regarding its resource intensive costs and various negative impacts that desalination systems require (Einav, Harussi, & Perry, 2003; Ghaffour, Missimer, & Amy, 2013; Lattemann & Höpner, 2008). There are worries regarding the desalination of water and the impact it may have on local marine ecosystems (Bernat, Gibert, Guiu, Tobella, & Campos, 2010). Also, distillation techniques of desalination often require very high energy use which in some cases can effectively counteract the water savings via the water used to produce the energy (Alklaibi & Lior, 2005). However, newer technologies (reverse/forward osmosis desalination) show a more energy efficient process and costs are likely to come down as further progress is made (Dashtpour & Al-Zubaidy, 2012; McCutcheon, McGinnis, & Elimelech, 2005; McGinnis & Elimelech, 2007). The net value of desalination systems is still contested but technological trends seem positive (Bermudez-Contreras, Thomson, & Infield, 2008; Gude, Nirmalakhandan, & Deng, 2010; Subramani, Badruzzaman, Oppenheimer, &

Jacangelo, 2011). While this research is certainly not limited to tourism, the potential outcomes could have significant impact upon the actual freshwater usage of tourism infrastructure and its supporting sectors.

### 2.6.6 Summary

Water impacts, and is impacted by, an overwhelming majority of aspects that make up life and modern society that it is impossible to comprehend the full extent of its role. This is certainly true in the realm of tourism where water is depended on considerably. Whether water is being consumed for purposes of basic human needs such as hydration, food, hygiene, or water is used in the provision of services such as fuel production, or the enhancement of experience such as water-based recreation and landscape cultivation all are in relation to tourism in some capacity (Gössling et al., 2012). When these aspects are restricted through limited water availability, or are affected by poor water quality, it can lead to impact upon the reputation of a locale, and has the potential to disrupt local economies (Hall & Stoffels, 2006). And when these aspects are marketed well and sought after by many, it can lead to many stresses that can drastically affect the sustainability of a locale and its inhabitants.

Even though tourism's influence in issues of water is significant, it is often overlooked in comparison to larger and even more omnipresent economies such as agriculture and energy (Gössling et al., 2012). However, as seen in this review, tourism-related water consumption disproportionally affects regions, and can even be the main water-based concern for some countries (IPCC, 2014). Tourism in these scenarios intensifies and exaggerates already difficult circumstances through applying greater pressure on stressed water supplies and infrastructure. Tourism is then in direct competition with many other industries for water resources, and also with individual consumption of local populations which can lead to many difficulties within communities (Ison, Röling, & Watson, 2007; Thiel, 2010). Tourism also affects recreational water quality through increased traffic patterns and waste, and potable water supplies when wastewater is managed poorly (Dillon & Molot, 1997; Kocasoy, Mutlu, & Aylin Zeren Alagöz, 2008). Inadequate management of water quality also then add to the stresses of short freshwater supplies. It is these spatial, temporal, climatic and contextual differences ensure that no location is the same, and places importance on the

continual analysis at a local level as opposed to independent, national, or regional-level, analysis.

Many tourism stakeholders appear wary of the ambiguous value of investing in reducing water use - especially in smaller operations, given the relative cost of water to them (Gössling et al., 2012; Grimstad & Burgess, 2014; van Haastert & de Grosbois, 2010). It is also challenging to imagine how important and how effective a reduction in water use may be. Thus for many individuals it is difficult to motivate action considering the relatively small cost of water use in an organisation (Eurostat, 2009). However, it is suggested that the additional costs of implementing water use reduction measures will pay off in the near future - especially in more arid or water scarce regions (Fortuny, Soler, Cánovas, & Sánchez, 2008; Smith et al., 2009). While the cost of inaction to tourism stakeholders is speculated to be far greater than that of the costs of adaptation as current trends may affect the sustainability of their tourism assets (Gössling et al., 2012).

## 2.7 Summary

Tourism, and the multitude of other industries, processes and factors that make up tourism, significantly impact many various aspects of the environment. As so, tourism contributes significantly to many adverse phenomena of the modern day including those under the ever-threatening umbrella of climate change. Tourism's span of impact reaches issues surrounding water quality and security; food security; global warming and GHG emission; energy use; land use and degradation; biodiversity; globalisation and cultural homogenisation. Many of which unfortunately this review could not touch upon.

Energy is a very serious concern because of the incredibly intensive demand tourism places upon it. Both destination-based activities and travel-based activities require great amounts of energy and often represent a significant proportion of relative global use. The large majority of energy used within tourism (and outside of tourism) is of a non-renewable source that is both limited in supply and the emissions of which are damaging to many environmental systems.

In terms of water, tourism places many (often disproportionate) stresses upon the water security and water quality of many regions and destinations across the globe. Tourism is an intensive user of water because of the many touristic activities which require great amounts

of water. And tourism impacts water quality through the increased traffic and activity that is demanded upon a popular tourism locale.

In light of the issues discussed in this section, this review as a whole hopes to continue to explore, uncover and contextualise many varieties of findings from within the tourism sector through extensive and comprehensive searching. Throughout the in-depth thematic review of the current section, and the systematic searching of the following sections, the author hopes to have created a clear understanding of tourism's impact on the environment, and the state of research regarding the mitigation of those impacts. The following chapter attempts to best explain the methods chosen to examine such a vast field of knowledge spreading over multiple disciplines.

# 3. Methodology

## 3.1 Introduction

This chapter will introduce the methodology that will be used to provide a systematic, and comprehensive search of the literature. This chapter will discuss how each tourism intervention-based paper was first found, and then how each was selected, reviewed and analysed. The discussion will include the reasons why each decision was made, and will also ensure that each step is documented so as to be empirical and transparent.

## 3.2 Systematic Reviews

A systematic review involves the creation of a defined framework is used to select, review and analyse the papers against a clear and predefined eligibility criteria (Higgins & Green, 2011). This begins with the formation of an aligned, documented and exhaustive search term. The goal of the search is to identify all studies that meet the eligibility criteria as available from the literature. All eligible studies are reviewed and analysed with their findings, and main characteristics documented and presented.

The use of systematic review is very popular within medicinal research and the social sciences when testing medicinal and behavioural interventions (e.g. see Buchwald et al., 2004; Polanczyk, de Lima, Horta, Biederman, & Rohde, 2007). This is because the contextual differences of the results in one single study may not be replicable within other contexts and scenarios. Thus by aggregating and reviewing the findings of many similar studies, the clarity and applicability of results increases, and the most effective or efficient methods can be found.

Usually these results are found through the use of what is called a meta-analysis which a systematic review leads into neatly. The meta-analysis allows the large-scale, statistical analysis of the results returned through a systematic review of papers (or of systematic reviews themselves). And as described above, this analysis allows the aggregation of data which can help to ensure statistical significance and increase statistical power.

Systematic literature reviews present great value as it is often very difficult to comprehend and make use of the substantial amounts of information presented within a field (Mulrow,

1994). It is very unlikely that a researcher will be able to read or gather the knowledge of that many papers. Thus as a field grows larger, and as time goes longer a systematic review can be invaluable to many researchers. And as evident with a simple search of tourism on the Scopus bibliometric database which presents over 6,200 different articles, with around another 650 likely to be added during the year 2015.

While not being the same field as the one this review is focused on, the Cochrane Handbook for Systematic Reviews of Interventions (Higgins & Green, 2011) provided a good foundation for methodological planning that was adapted for the problem at hand. This was especially true for the formation of the inclusion criteria following the PICO framework which will be discussed in a later section. The PRISMA flowchart (Figure 1) (Moher, Liberati, Tetzlaff, Altman, & The PRISMA Group, 2009; The PRISMA Group, 2017) was used to aid in structuring and ensuring empiricism within the inclusion and exclusion stages of the review.

## 3.3 Systematic Reviews and Tourism

It was evident during the literature review for this research that there a very few systematic reviews within, or surrounding, the field of tourism. Some examples include Anderson et al. (2015); Weed (2006); and Martin and Assenov (2012). However, it is also important to note, as in the case of the latter two studies mentioned, the systematic nature of them is not well expressed and has ensured that both papers are very difficult to replicate. So while there are already few systematic papers within tourism, even fewer of those are truly systematic and truly replicable.

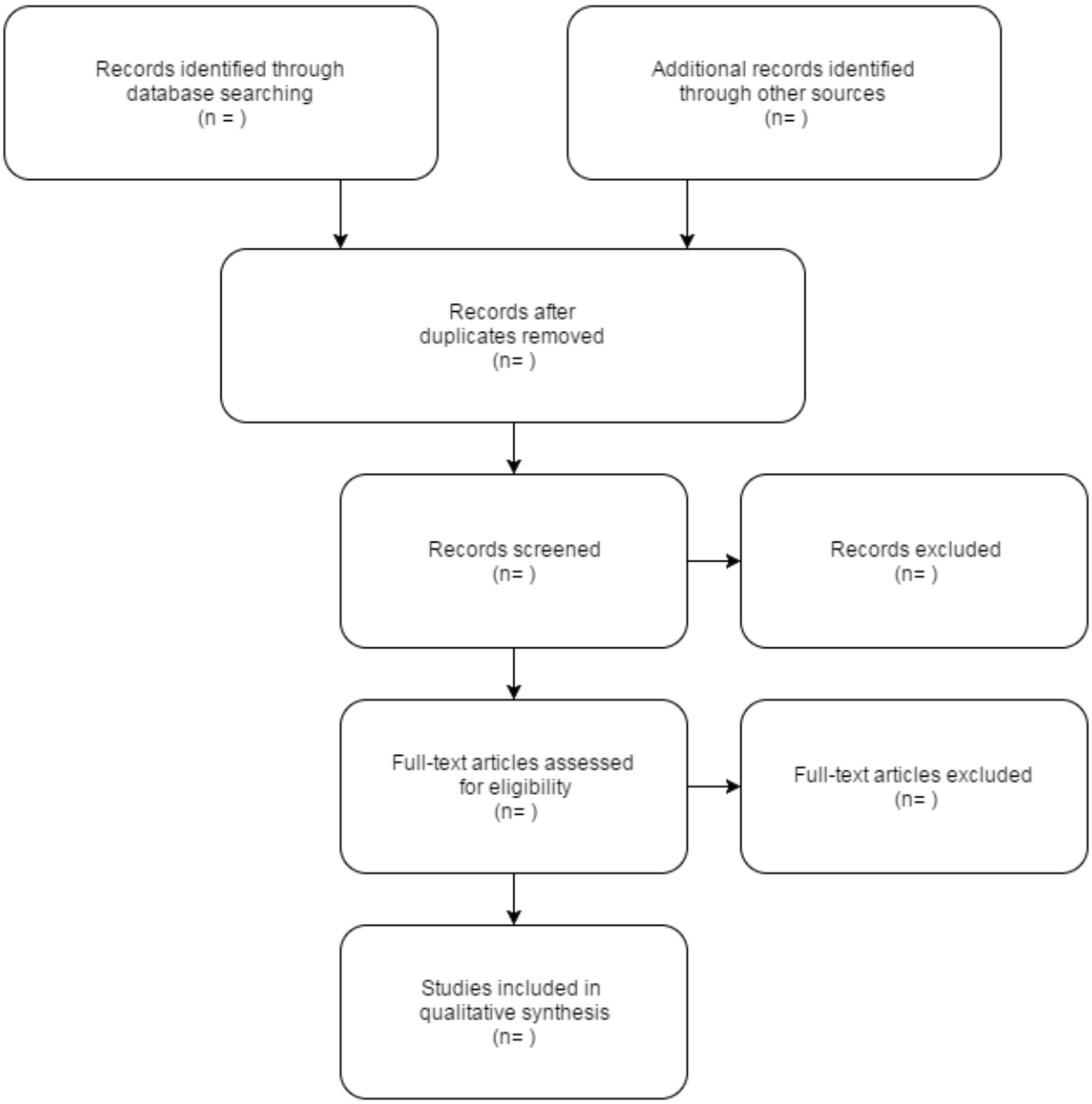


*Figure 1 - PRISMA Flowchart Example*

## 3.4 Searching

The search term of a systematic review is the most important part of the review as it determines what will, and will not, be retrieved - it is the mechanism through which the focus is reached. Thus the formation of the search, and the keywords within, require particular attention. The search process then also relies on the keywords used within the searched papers and can fail without common and accepted definitions and frames of reference.

The search process was decided to be modular in format. This means that a base Boolean search term was created along with several smaller, topic-specific search parameters. See Appendix A for both the base search term, and each topic-specific term.

Within the base Boolean search, four keyword groups were formed each with the purpose of giving the search a structure and a focus. The groups - tourism, action, intervention and environment - were separated by the command “AND” ensuring that every returned paper related to each focus. Each keyword group was made up of relevant keywords pertaining to that focus.

The search also featured some additional commands that ensured necessary control over the returned papers. The first ensured that only English language papers were returned as it is the only language the author is fluent in. The second ensured that the papers were listed as articles or reviews to ensure consistency in inclusion and in review. And lastly only papers published before 2015 were included. As the research began in 2015, it made sense to exclude the year to ensure consistency and empiricism throughout the process. See Appendix A for the full search term.

The topic-specific search terms were added onto the end of the base search to narrow it to the topic at hand. This allowed for much simpler preparation, search and greater consistency between each search. The modular method also made the process more efficient and effective segregation of the sub-topics for both the author and the reader.

The search took place on Scopus. Scopus was chosen as it provides a relatively comprehensive scope when it comes to academic articles in the field of tourism and environmental issues, but also because of the usability and flexibility of the advanced search. Using certain commands the search was designed to only search within the more focused sections of papers - their titles, abstracts and keywords - thus ensuring a narrow search with focused results. As previously alluded to, the use of AND separating the keyword groups ensured that each returned paper was relevant to each specific topic and thus the overall focus. However, Scopus is quite limited in some regards. For example, Scopus is lacking in coverage of business and economic journals which can contain tourism-management literature, and also Scopus has limited coverage of books.

The large majority of the keywords used were developed through research into the keywords used within relevant studies. From there, plurals, spelling differences, synonyms and acronyms were also sought out and included to add further comprehensiveness to the search. The search was then shared with a reference group of tourism academics who research issues of sustainable development within tourism to ensure the appropriateness of the search terms, identify further potential additions or possible flaws, and generate ideas and terms that were culturally diverse.

## 3.5 Selecting

As the total number of returned papers was just over 1000, it was important that there are systematic and well-defined criteria regarding the inclusion and exclusion of papers returned by the search. As mentioned previously, the PICO framework, a commonly used framework for systematic reviews in the medicinal field (Higgins & Green, 2011), was used to help formulate these criteria. The framework requires evaluations to be made regarding a study's Participants, Intervention, Control and Outcome and how they may fit within the researcher's focus. Overall, the framework is designed within the paradigm of evidence-based medicine that seeks empiricism and depth when understanding a topic.

The criteria for this review were very inclusive as this research was, to the author's knowledge, the first systematic review of this topic focus. The intervention focus of the research was estimated to be small relative to the (sustainable) tourism literature in which it would be contained. Thus, a more inclusive method would be likely to retrieve and review a larger quantity than a less inclusive method. This ensured that the review would be more exhaustive and aimed to be more comprehensive.

There was no restriction placed on the participants of a study. As tourism is a global phenomenon that spans countries, industries, public and private sectors, all the way down to individuals, both local and foreign, there are many avenues which researchers may choose to focus on. This research therefore aimed to take all results into account and synthesise findings that are relevant for a wide range of stakeholders.

This review placed no restrictions on the type of intervention, only that there was an intervention. The criteria for reviewing was simply to be a primary study that included a quantitative or qualitative comparison of two states of being (different locations, different

time periods, different systems etc.) the topic of which is related to the focus. Those papers which met these criteria were more than likely a type of intervention and thus were included. Specifically, there was also no restriction placed upon the longitudinal nature of a study as this was determined beforehand to be a point of interest.

In order to include as many temporal and other comparisons as possible, no restriction was placed on the type, or even the presence, of a control. Being a relatively new, under researched field based largely within the social sciences, there was unlikely to be much research that was highly scientific and empirical. Rather much explorative and qualitative research which is often necessary in such a field. Thus the liberal inclusion criteria were more suited.

A liberal inclusion strategy was also used regarding the outcomes of each study. No matter whether an intervention failed, succeeded or was somewhere in between, it was to be included. There was no restriction placed on the type of outcome, neither on how the outcome was measured or how many times it was measured. Once again, the aim was to include as many papers as possible, and from there they would be examined and evaluated further.

## 3.6 Reviewing

Titles and abstracts were then manually scanned to exclude those papers whose topics seemed irrelevant. For the both of the searches, this reduced their total number by around 70 to 85 per cent. The exclusion and inclusion judgement was made by the reviewer making assessments in line with the criteria discussed earlier. At times this was difficult, however the main strategy of the search was one of inclusion and thus, at least in the initial screenings, many papers were given the benefit of the doubt - only to be evaluated more in-depth later.

Once abstracts were scanned, papers were then analysed further to discover their eligibility. This involved in-depth reading of the abstracts, introductions and methodologies to ascertain the content's alignment with the topic i.e. in a tourism context, and regarding an intervention. Several papers were excluded for various reasons. For example, Scarinci and Myers (2014), which describes a framework to synthesise industry standards for hotels, provides great context for other studies, but unfortunately is not explicitly an intervention.

In the end, approximately one quarter of the papers were excluded because they were not interventions judged against the exclusion criteria, and the other three quarters, while possibly applicable in an abstract sense, had a focus distant from tourism and its impacts. Such papers were excluded from the systematic review, however, many of the excluded papers helped to form ideas and context throughout this research and its literature review in particular.

To again ensure a systematic method was used throughout, the inclusion criteria was formed into a single idea which was used to guide the decision of inclusion. For the most part the decision of whether to include a paper was obvious, however, there were a few for which the inclusion criteria was required. As the focus of the search was on that of longitudinal interventions, the inclusion criteria is very specific with that point.

Overall inclusion criteria:

> *Primary study including a quantitative or qualitative comparison of two states of being within the tourism industry (whether different locations, different time periods, or different models) the topic of which is related to the topic focus.*

## 3.7 Analysing

After the final exclusion stage, papers were then read fully and specific details noted. These predetermined details of each study will be documented in order to summarise the studied paper in an efficient and effective manner. The summarisation creates a hub for qualitative analysis, while also ensuring a certain empiricism and consistency that allows quantitative, aggregated analysis of the studied papers. For example, energy saving data can be combined to create an average which would be more representative of the intervention than a single measure. This helps to create a platform for greater understanding and informed critique.

A table was constructed to capture these details and provide a very simple platform for visualising and analysing data for each topic. All of the tables contained several base details such as citation detail, methodology, sample data, intervention type, study location,

longitudinality. In addition to that, some of the topic focuses included topic-specific measures that may be relevant to one topic but not the others.

# 4. Results and Discussion

This chapter presents the results of each sub-topic search and an accompanying discussion. The chapter first discusses the results of the energy literature analysis before discussing water. A general summary of the findings is provided.

## 4.1 Energy

### 4.1.1 Search Results and Discussion

This section presents the results and discussion of the systematic search carried out on the sub-topic of energy. The search term is located in Appendix A.

#### 4.1.1.1 *General Results*

##### 4.1.1.1.1 Background

In total, only two papers matched the inclusion criteria that was set (see Chapter 3). Tellingly, both of the included papers were those that were added manually by the author rather than coming from the actual search term. As will be discussed further within the limitations section, the success of the search term points to a larger issue within the literature.

The literature review performed earlier certainly shows that there is a substantial amount of literature on the subject of energy and ways to reduce it. Within the focus of destination-based energy use, there is a lot of tourism-based research. However, when reviewing travel-based energy use, while there are a few committed academics looking into tourism's energy use and impacts, far fewer tourism-based resources were available with details of first-hand reduction methods. Rather these were sourced from scientific and engineering-based resources.

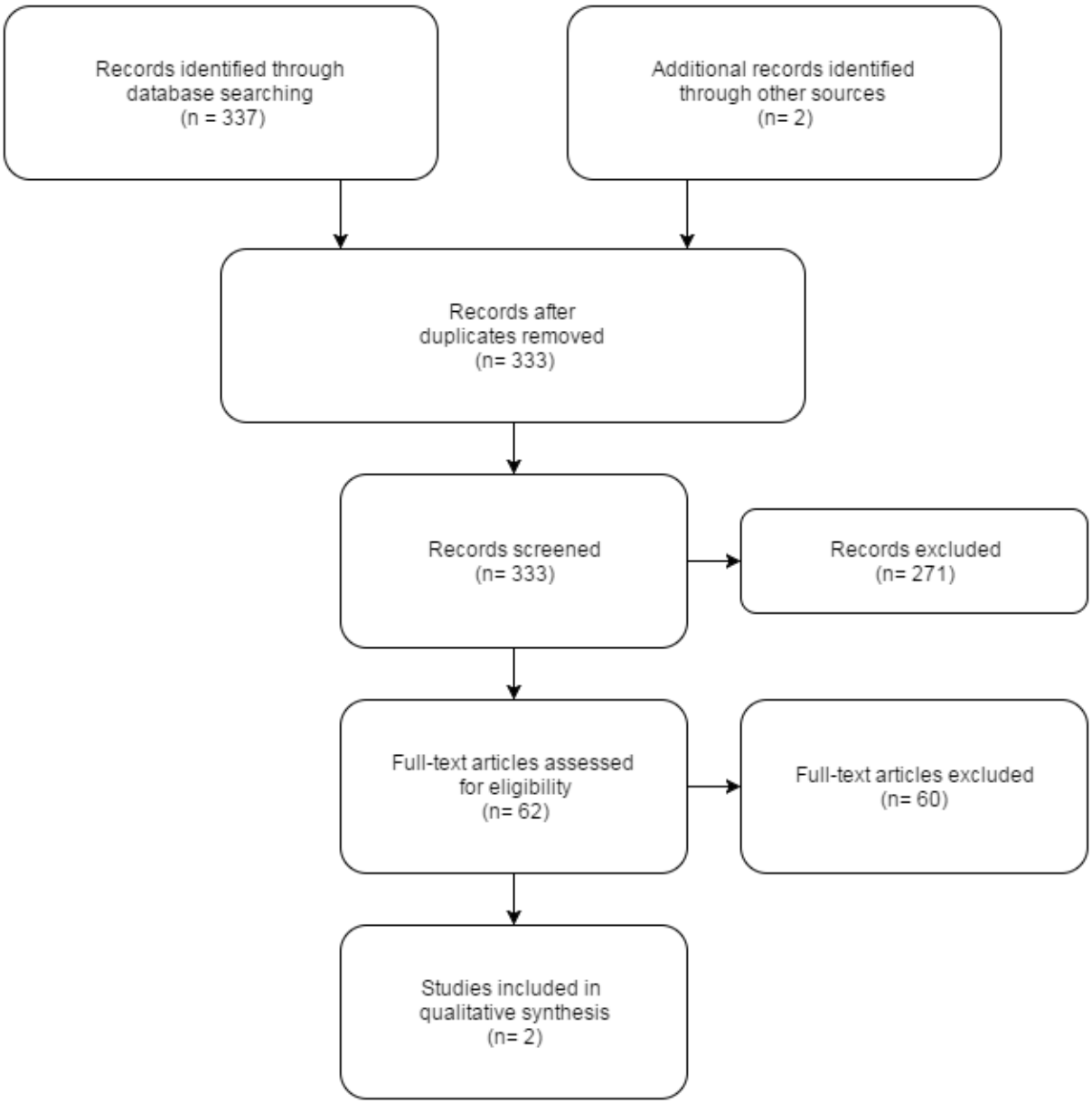


*Figure 2 - Energy Search PRISMA Flowchart*

#### 4.1.1.1.2 Summary of Returned Papers

The first of the two papers returned was by Khemiri and Hassairi (2005) and was the latest paper in a series which has followed the developments of one Tunisian hotel. The paper was originally published in the journal *Renewable Energy*. First audited with regards to Energy and water use in 1987, the hotel was again audited in 1996, with the final audit (and the final data behind the paper) being from 2002. The paper showed that significant energy reductions (54 per cent) were achieved through first auditing the hotel regarding energy use, and secondly informing the hotel managers of specific ways in which to reduce energy use. The specific changes to the hotel were: renovation; improving thermal insulation of hot

water piping; installing more efficient equipment; daily monitoring and control of energy consumption; centrally controlled HVAC systems; implementing further controls over combustion burners.

The second paper was authored by Rutty et al. (2014) and published in the *Journal of Sustainable Tourism*. This was an experiment carried out at a single small tourism enterprise (ski resort) to measure the energy savings of training staff in efficient driving techniques. Firstly, baseline energy use (and the emissions) of daily vehicle movement was measured using vehicle monitoring technology (VMT) for the winter season of 2009/10 for the STE in Canada. Secondly, and prior to the next winter season, staff of the STE were given "eco-driver training". The measurements of stage one were taken during the winter season 2010/11 that followed the eco-driver training. Results showed, along with many other benefits, significant energy reductions with 3200 L of fuel saved during the season – equating to approximately $3000 CAD or $2200 USD at the time.

*Table 4 - Energy Search Table*

| Citation | Methodology | Target Sample | Sample Size | Intervention Type | Study Country | Study Continent | Longitudinal | Reduction Focus | Citations (Scopus) |
|---|---|---|---|---|---|---|---|---|---|
| Khemiri & Hassairi, 2005 | Case Study | Managers | 1 | Educational | Tunisia | Africa | Yes | Destination-based | 3 |
| Rutty et al., 2014 | Experiment | Small tourism enterprise | 1 | Educational/Behavioural | Canada | North America | Semi | Destination-based | 4 |

#### 4.1.1.2 *Statistical Results*

This section will briefly the statistical results as shown within Table 4 – the final search table for the energy sub-topic. The energy search returned two papers, and so this section will look to analyse the selected factors of those two papers. Having only two points of data clearly limits any statistical analysis that can be done, however there are interesting points to be made. Further discussion will continue in the next section.

As discussed, the search only returned two eligible papers – Khemiri and Hassairi (2005); and Rutty, Matthews, Scott and Del Matto (2014). Both papers were manually added by the author at a point throughout the searching process. Each paper was discovered during the literature review performed above. The details of each paper can be found within the summary in Table 4.

The first paper was based in Tunisia, Africa, while the location of the second paper was that of Canada in North America. As there are only two points of data behind this fact, very little can be made of it. However, as there are some interesting observations that have been made, further geographical analysis will be performed in the general energy discussion (Section 0).

Both papers used intervention methods which the author has chosen to describe as educational. This is very interesting in that it may point to an adaptation to the inherent limitations of academic research. For the average academic resources are fairly limited, while educational and simple behavioural approaches can be generally inexpensive for the researcher.

Both studies had a very small sample size of one. This allowed for very in-depth analysis of each situation, however it may also limit large-scale applicability. It is worth mentioning that the second study (Rutty et al., 2014) had many points of data, however the study was carried out at only one STE – thus a sample size of one.

Both papers were longitudinal as to be expected when focussing entirely on interventions. However the first study (Khemiri & Hassairi, 2005) took data at three points in time spanning 15 years of time, while the second study (Rutty et al., 2014) took data at two points in time with the second point a few months following the intervention itself.

As identified within the literature, there were two major categories of energy use in tourism – destination-based energy use, and travel-based energy use. Both papers returned within the systematic search were focussed on destination-based energy use. One focussing on the energy use of a hotel, the other of a STE.

In terms of Scopus citations, both papers were relatively low. The first (Khemiri & Hassairi, 2005) receiving only 3, while the second (Rutty et al., 2014) had 4. This was little different when looking at Google Scholar citations with the first paper having 49, and the second paper having 6 at the time of retrieval.

#### 4.1.1.3 *Results Discussion*

Of the 333 papers screened within the search, the two that made it through all inclusion criteria were the two papers that were added manually by the author. This points to two major factors that limited the amount of papers returned – the characteristics of the search term, and the lack of intervention- (or even experimental) based literature. This was also reflected within the literature review so while the systematic search found few papers, it was indicative of a larger trend in the literature.

In regards to geographical locations, when examining the literature review above, there seemed to be a wide range of locations on which studies are based. However, there are obviously many destination-based energy studies looking at popular, and more threatened destinations, such as Greece (Karagiorgas, Tsoutsos, & Moiá-Pol, 2007; Mavrotas, Demertzis, Meintani, & Diakoulaki, 2003), Cyprus (Katircioglu, Feridun, & Kilinc, 2014), Sweden (Bohdanowicz & Martinac, 2007), and Canada (Kelly & Williams, 2007; Zmeureanu et al., 1994). Plus recently there has been a substantial increase in papers examining energy use and efficiency in Asian (particularly Southeast Asian) hotels (Lu, Wei, Zhang, Kong, & Wu, 2013; Priyadarsini et al., 2009; Wang, 2012). As another example of the wide range of locations, the author was able to find a variety of destination-based tourism energy use studies dedicated to reducing energy use in every continent – even Antarctica. However, none of these papers seek to show change over time.

Both papers used educational intervention methods to create change within their respective samples. As alluded to previously, the author believes one of the primary causes of this to be the resource limitations of academic research. Educational interventions are relatively

inexpensive and in the case of the two returned energy papers, only required meetings with managers, and a report to create change. This can be compared to a technological intervention which can require investment into expensive technologies, or a more in-depth behavioural change which may require on-going sessions or an investment into (or outsourcing of) relevant skills.

According to Scopus, both papers were little cited. To the author, it seems as though the relevance, and applicability, of both of these studies is very high within the sustainable tourism literature. And, as shown through the systematic search, both studies are quite unique within that literature being both primary studies, and both being based entirely within the scope of tourism. Thus, it seems as though their relevance to the literature does not match the amount of attention that they received. At least for Rutty et al. (2014), the recency of the paper may play a part in explaining why the citation numbers are relatively low.

### 4.1.2 General Discussion

While the numbers of the systematic search were low, when their ideas are combined with the thematic literature review (Chapter 2), there are many ways in which energy use and energy consumption can be lessened within tourism. However, the lack of research with respect to the long-term sustainability of change does create issues with respect to the appropriateness of such measures.

#### 4.1.2.1 *Destination-Based Energy Use*

It was shown in the literature review that there have been many ways to go about reducing energy use within a tourism locale. One of the first starting points of many papers was surrounding the ideas of energy management. This often involved common tasks of auditing, comparing benchmarks, and implementing systems of regular measurement and reporting. These processes were suggested to be assigned to a managerial figure who would report, refine processes, and motivate changes within the business. Without these first steps, it would be very difficult to motivate action let alone evaluate progress of reducing energy use and increasing efficiencies (Önüt & Soner, 2006; Santamouris et al., 1996).

The second theme that could be seen throughout the literature review, and the systematic search was that of equipment – specifically maintenance and modernisation. Regular

maintenance schedules need to be implemented for the major sources of energy use within a tourism business. This is suggested to extend life-cycle of equipment, but also ensures a higher standard of efficiency, and thus also energy efficiency. A the same time, the number of years since the last retrofit was found by a number of studies to be correlated to high energy use within tourism providers. Thus upgrading equipment to more modern equivalents is likely to reduce energy use, and is suggested to also have a short ROI (ITP, 2014a; Santamouris et al., 1996). This was shown within the paper by Khemiri and Hassairi (2005) returned by the systematic search. One of the ways the studied hotel got to a 54 per cent reduction of energy consumption was through upgrading piping equipment, and installing more energy efficient equipment.

The third major theme of destination based use was that of efficiency. Specifically, there was a lot of discussion surrounding data collection to optimise automated systems, and also the batching of energy-intense processes. Several of the ITP's (2014a) tips for greatest savings at least cost involves ensuring that systems are operating at the correct levels, for the correct amount of time, during the correct periods. This principle is often seen within the use of HVAC and lighting systems in accommodation providers who may not require these services to such an extent during the day – rather natural ventilation and natural light can be more effectively used (UNWTO et al., 2008). Another example is that of batching laundry or dishwashing loads so as to only operate at full, or the most efficient, loadings (ITP, 2014a). However, a significant issue in a number of studies is that while there is discussion of an intervention that may contribute to energy savings, such as reducing the amount of washing of towels in a room by requesting reuse, accurate information on the actual level of energy savings as compared to reuse is not provided, nor is any information on the sustainability of behavioural change over time (Hall et al., 2016).

#### 4.1.2.2 *Travel-Based Energy Use*

It was shown throughout the literature review (and the systematic search), that the quantity of papers looking at travel-based energy use from tourism sources were low. Rather, the majority of data came from transport and engineering journals, and industry bodies (e.g. Hine & Scott, 2000; IATA, 2017; ICAO, 2016; Shinbo, 2015). This is understandable given that these problems span much more than just tourism, and affect a very large majority of other industries. Focussing on technical aspects of fuel and engine-efficiencies may require

specific knowledge that is often limited to the realm of specific types of engineers and transport planners.

While the majority of the work happens outside of the immediate scope of tourism studies, many of those who most often preside within sustainable tourism studies still critique and provide commentary on the issues and their interaction with tourism (Gössling, 2002; Peeters & Dubois, 2010; Peeters & Schouten, 2006). This may help ensure that tourism and relevant industry bodies are made aware of the importance of research into travel-based energy use and that changes are necessary (e.g. UNWTO et al., 2008).

The first major theme within travel-based energy use was that of more efficient, and less impactful, fuels and engines (UNWTO et al., 2008). Some transport manufacturers and transport providers have made these issues a visible part of their business through publishing reports regarding their research into biofuels and engine efficiencies (Airbus, 2017b; Boeing Commercial Airlines, 2014; Hino & Hara, 2015). Issues of fuel and engine efficiency is also acknowledged by many industry bodies (IATA, 2017; ICAO, 2016). One of the most discussed ideas in this area is that of biofuels. However, biofuels are still mostly used in conjunction with regular fossil fuels, and are currently not viable for full-scale commercial adoption (Rye et al., 2010). There are also issues of food security, and intensive land and water use in the creation of many biofuels which are yet to be solved (Berndes, 2002). For road and rail-based transport specifically, electricity is seen to be the more efficient energy source. However, the use of electricity relies greatly on the original source of energy – whether it is from a renewable source, or produced from fossil fuels (Pina et al., 2014).

The second major theme was that of improving efficiencies in the surrounding processes of travel (UNWTO et al., 2008). These efficiencies can be found through more efficient driving practices (Shinbo, 2015; UNWTO et al., 2008), more efficient route and traffic management (IATA, 2017), and increasing load factors through more efficient scheduling (ICAO, 2016; UIC, 2017). When extrapolated further, (i.e. to railway stations or airports) the ideas raised within destination-based energy-use become useful, and can be applied to these locations. There was also a little discussion regarding

### 4.1.3 Summary

Overall there appears to be a lack of quantitative, longitudinal, intervention-based studies within tourism academia that focus on issues of energy use. This research evaluated 333 different papers returned by a detailed and focussed systematic search, however only two of the papers meet the established criteria. The original search term however, did not return these alone, rather they were added by the author manually as a result of scanning through references in identified literature.

However, there are many practical methods for reducing energy use within tourism as established within the larger literature review (ITP, 2014a; UNWTO et al., 2008). Some methods are technologically difficult, requiring further research and are changes for the future. However, some can be implemented today, and provide quick and decent financial returns for tourism providers (ITP, 2014a). Thus, there are some significant steps which need to be taken within the tourism industry to reduce its energy use, and thus its impact on the environment.

## 4.2 Water

### 4.2.1 Search Results and Discussion

This first section presents and discusses the results of the systematic search carried out on the sub-topic of water. The water search term can be found within Appendix A by combining the full base search term, and the water parameter.

#### 4.2.1.1 *General Results*

##### 4.2.1.1.1 Background

Only two papers matched the inclusion criteria set regarding the water subtopic – see Table 5 and Figure 3. Which was quite disappointing to the author for various reasons; 1) the search may have been lacking in some way, 2) the specific focus may be lacking in literature, and 3) the search platform was limiting.

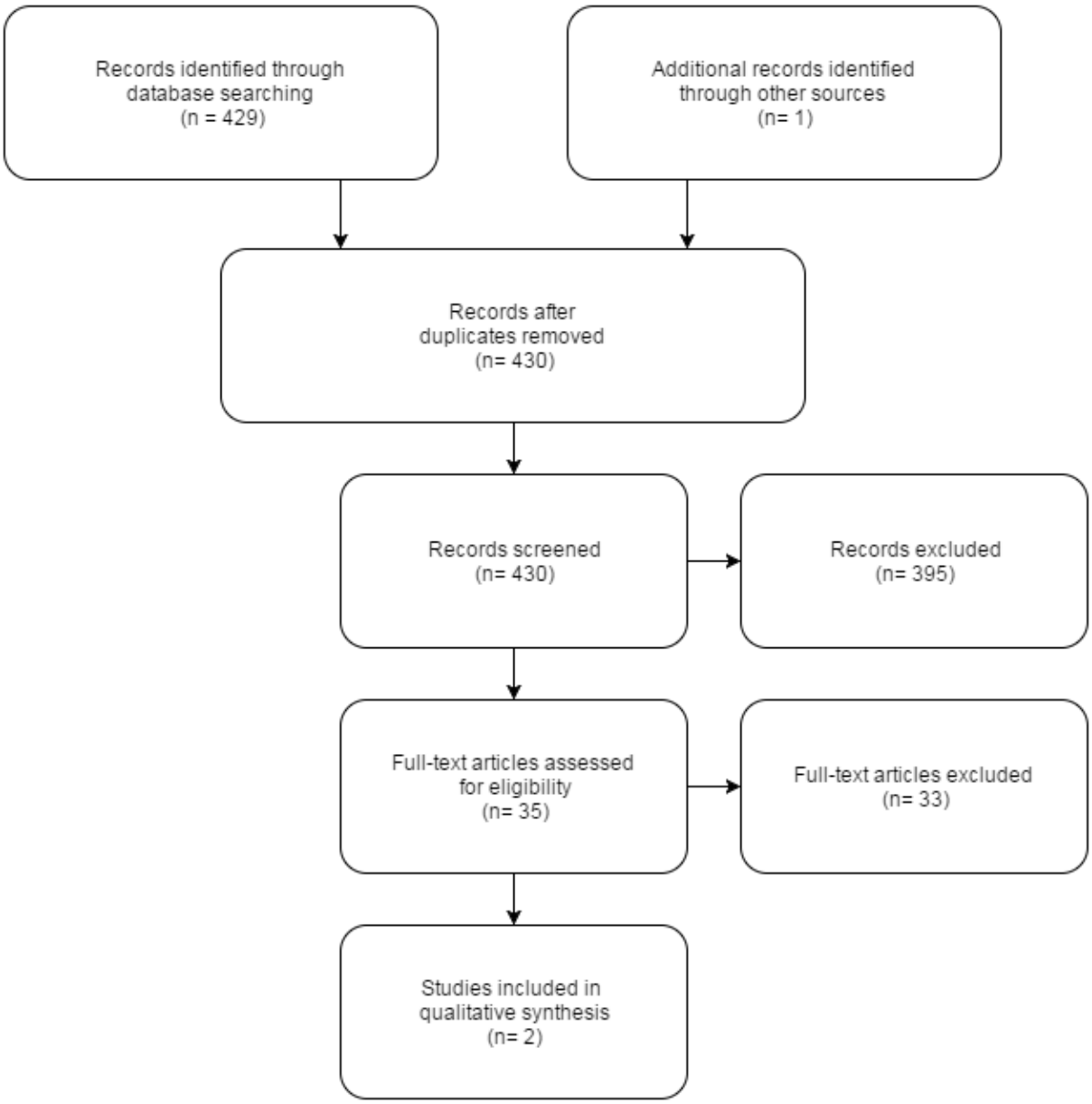


*Figure 3 - Water Search PRISMA Flowchart*

It is inevitable that the final search terms could have possibly been improved upon through further consultation with literature and other academics. However, the author believes that 430 returned articles on such a topic are likely to be fairly representative of the overall field. The role of a systematic review is to strive to exhaust the field of literature, and this review had such a goal. The further discussion of general limitations will be continued within the limitations section in the final chapter.

The literature review performed concurrently with the systematic review brings to light other reasons why the number of identified papers was so low. There seem to be very systemic reasons as to why there is a lack of literature surrounding this specific focus. The

proportion of new research and new data is often directly related to the academic popularity of a topic at a point in time. And while sustainable tourism is a relatively substantial research topic with an active community of prevalent researchers, a very specific, and small, focus such as water is not going to receive the same attention. This narrows the amount of direct literature available for researchers, and instils further limits upon them.

Such limits, and such a reliance on a limited amount of sources, can severely hinder the development and progression of a field as there is an over-reliance on these limited sources. An over-reliance on these sources means that very few papers are actually creating new data points, and thus differentiation and further discussion are limited. These factors can inhibit a field severely and restrict the progress of the field and its impact on the wider society.

The amount of research conducted is also likely to be affected heavily by the cost related to performing such research, and how this may be weighed up against possible benefits. Different research methods have different costs and so some may be performed more often in some focusses than in other focusses. The focus of this research is looking into largely experimental and quantitative research which is often associated with substantial financial costs. And so a researcher has to weigh those costs up against possible benefits (e.g. personal, academic) which can often be dictated by the academic popularity of the topic at that certain point in time.

These pressures and costs surrounding research can push research to be conducted in conjunction with non-academic sources that may provide resources - often in the form of funding. In fact, a substantial portion of research projects cited in many of the papers within the literature review of this research were conducted with at least partial support from industry bodies. Often this support allows researchers to have the confidence and ability (access to resources) to carry out their research. However, it is often important to keep in mind that funding entities have interests in the research being done, and sometimes those interests may make their way into the fabric of the research in that biases may be more pronounced and standards of scientific inquiry less stringent.

The author also recognised during the literature review that there seemed to be a heavy reliance on estimates and opinion with limited measurement, and even less experimentation. This reinforces themes found within a recent systematic review of a similar topic and scope (Hall et al., 2016). This point was also raised throughout Bohdanowicz and Martinac (2007) which discusses the lack of investigation regarding the influence of various operational characteristics within the tourism industry. So while there is a substantial amount of qualitative data (e.g. van Haastert & de Grosbois, 2010; Vernon, Essex, Pinder, & Curry, 2003), very few studies performed quantitative work that may (or may not) reinforce the themes which are revealed through the qualitative methods. Thus the impact and usability of surveys/interviews (Jackson, 2010), case studies (Richins & Scarinci, 2009), or reviews (Dinica, 2006) are not as widespread as what they could be with further analysis.

Additionally, many papers would propose that certain techniques and methods would decrease water usage/consumption by a certain amount (usually given in a range), but often lacked other evidence to reinforce the stated saving. Such proposals would then be echoed in other papers which may or may not mention whether the original source was a suggestion, an opinion, or a measure. In turn, this could lead many readers to infer that the sources were entirely empirical and evidential.

While the author believes it is important to raise this issue, it is also important to understand that many of these measures, ideas, techniques for reducing water use did not necessarily come from tourism studies. Rather they have been adapted from a plethora of other research which has explored the issue of water use. Therefore, not having direct access to the evidence which these techniques have been built upon is sufficient for suggestions. However, it may also be limiting by not being able to provide specific data, and known savings, within a more focussed context.

##### 4.2.1.1.2 Summary of Retuned Papers

The first of the two returned water papers was a study by Schachtschneider (2002) who interviewed six different accommodation providers within Namibia regarding their water management. Each site was analysed and paired with various environmental data of the area, were given a series of different WDM approaches which could be implemented within

their business. The researcher then monitored the implementation of each WDM approach that the managers chose for their locale and followed up with a second measurement of the business' water management. While the results were described, there was no reporting of percentages or numbers regarding the reductions. In addition to changes to the hotel, the study also briefly mentions systems used by the hotel to change tourist behaviour – again, no numbers.

The second study was carried out by Khemiri and Hassairi (2005) and was described above within the energy search, however a second aspect of the audit process was focussed on water management and water use. After being audited in 1987 and 1996, the Tunisian hotel was given suggestions as to lessen the total amount of water used, and also per guest water use. Methods included replacing water-cooling towers with air-cooling towers; the upgrade and renovation of equipment such as taps, other faucets and plumbing; the implementation of systems to manage water use and measure at regular intervals; and implementing maintenance schemes for water equipment. Following the final audit in 2002, it was shown that per guest water consumption was 64 per cent of what it had been in 1996, and 67 per cent of what it was in 1987.

*Table 5 - Water Search Table*

| Citation | Methodology | Target Sample | Sample Size | Intervention Type | Study Country | Study Continent | Longitudinal | Reduction Focus | Citations (Scopus) |
|---|---|---|---|---|---|---|---|---|---|
| Schachtschneider, 2002 | Survey | Managers | 6 | Educational | Namibia | Africa | Semi | Supply & Demand | 3 |
| Khemiri & Hassairi, 2005 | Case Study | Managers | 1 | Educational | Tunisia | Africa | Yes | Supply & Demand | 3 |

#### 4.2.1.2 *Statistical Results*

This section will be dedicated to the discussion of important descriptors of the returned search results. This search returned two results, and so will only be describing those two papers. Unfortunately, very little statistical analysis can be undertaken, however, there are some interesting points to be made.

As seen in Figure 3 the original 430 papers were eventually narrowed down to only two – Schachtschneider (2002); and Khemiri and Hassairi (2005). Both of these studies were located in Africa (Namibia and Tunisia respectively) and went about surveying accommodation managers who had implemented various water demand management (WDM) initiatives at their establishment - including demand and supply side controls promoting education; maintenance and re-use programmes; and supply efficiencies.

Both studies were at least somewhat longitudinal in that the researchers returned to measure a second data point after a period of time. However, in the case of Schachtschneider (2002) no further measures were made – or at least published – following the second measurement so it has been labelled semi-longitudinal. The second measurement made by the researcher was used to create an experimental situation where the first state could be compared to the second state. However, a further measure, say two months on, would have provided an interesting data point that may have allowed for a further extrapolation and generalisation of the results, and may also have uncovered interesting insights. In the case of Khemiri and Hassairi (2005) measures were made of the hotel three times over the period of 15 years. Thus it is labelled as (very) longitudinal.

Both of the interventions were largely educational in that the researchers provided managers with techniques and solutions which may help the mangers reduce water use in and around their establishment. Both studies allowed the managers they were dealing with to choose which techniques they would prefer to implement given their situation, and how the managers then may adapt it those techniques to their situation.

The two studies looked at both supply and demand-side controls. On the demand side, Schachtschneider (2002) looked at re-use programmes for linen and towel re-use - reducing the demand for water. Schachtschneider (2002) also mentions the implementation of methods aimed at tourists, and reducing their demand of water. Khemiri and Massairi

(2005) specifically looked into the upgrading of water-consuming infrastructure and equipment. In terms of supply, the suggestions made to hotel managers were generally surrounding improvement of maintenance programmes and upgraded, low-flow faucets.

Schachtschneider (2002) was first published in *Physics and Chemistry of the Earth* which takes particular interest in geodesy, hydrology and planetary science. While Khemiri and Hassairi (2005) was originally published in *Renewable Energy*. Surprisingly (or not) both of these journals are far from being a tourism journal and reflect the observation that much relevant tourism research is published in non-tourism journals (Coles, Hall, & Duval, 2016). Considering the specific focus of these studies, it is clear that the experimental nature of a science-based journal is likely to return quantitative papers. And while greatly exaggerated, the results of the search do seem to reinforce the qualitative nature of many (sustainable) tourism journals, again seen in the systematic review of Hall et al. (2016).

In all, each of the papers were cited three times in Scopus at the time the author retrieved the search papers. For further context, the Google Scholar citations were 10 for Schachtschneider (2002), and 49 for Khemiri and Hassairi (2005). This was relatively low considering the scope of the journals and the topics covered. However, the studies did seem to simply provide evidence of mainstream (sustainable tourism) academic thought while only adding only another point of data which was typically already being sourced via other means. So one could argue that the actual academic (and career-advancing, and egotistical) value of such studies is minimal, and rather it would be more efficient (and sometimes effective) to simply source data second-hand. Thus the incentives are heavily against sustainable-tourism-focused authors carrying out similar research. Which again points to reasons why the returned systematic search results may have been so low.

#### 4.2.1.3 *Results Discussion*

Water as a sub-topic within this narrowed field of research was the largest sub-topic chosen for this review. This was shown within the large amount of initial search results that were returned, and it was also shown within the literature review where there were many sources of secondary data, and some very in-depth accounts of the topic as a whole. Compared to the other sub-topic chosen for this review, water receives an increased importance and thus also an increased quantity of literature and research devoted to it. The

overall importance of each of these sub-topics seemed to mirror the importance of the macro-level discussions of these topics - with water and water security being of high, even newsworthy importance. However, with regard to the specific focus of this review, the seemingly abundant knowledge within the literature was largely borrowed and adapted, and gathered from outside sources and non-academic sources. Thus, rather than primary studies which specifically looked into varying tourism scenarios and their individual merits, the majority of data was assumptive and often vaguely justified.

### 4.2.2 General Discussion

However, there are general ideas that can be taken from the research into the sub-topic as a whole. Largely these can be found within the water section of the literature review, however should now be viewed a little more critically than previously. As with most research it is more beneficial to attempt to understand everything as a whole, rather than to read into the individual accounts of water savings. Considering the broad array of contexts which the phenomena of tourism interacts within, it is important to remember that what happens in one locale, may not have the same effect in another.

The suggestions of general reviews (and hopefully someday systematic reviews and meta-analyses) is consequently of great use to other academics, and especially to managers looking to apply knowledge of the field. Focussed reviews of the literature at a point in time such as Gössling et al. (2012) or Gössling, Hall and Scott (2015, p. 201) provide an overview of current literature and knowledge from a range of sources that is very beneficial to academics and managers.

#### 4.2.2.1 *Water Demand*

Throughout the literature review, this paper looked to understand the various ways in which water demand may be lessened in a tourism context. The first general theme was to implement water management procedures within these contexts. As the old adage goes “what gets measured gets done”, and a variation of this seemed to ring true throughout the literature. Managers should look to implement management procedures that look to measure use regularly to ensure that changes are providing the desired benefits. This also creates a sense of urgency and importance within management and various stakeholder groups when they are made aware of the facts on a consistent basis.

The second major theme was that of improvements to existing infrastructure to water-saving variants. Facilities such as bathrooms, showers, kitchens, toilets all get used at a very consistent and inevitable rate, and through improving the water efficiency of the infrastructure, can significantly lessen the demand of water that is placed on the local environment, and the local reservoirs. These facilities should be designed into new developments within the tourism industry, while existing infrastructure should look to be retrofit with such equipment, however this can be an expensive endeavour. Overall, the water and energy savings from reduced (hot) water use are likely to recuperate the costs within a reasonable time-frame.

The last major theme was that of indirect uses. Two of the largest uses of water in the world are generally shown to be agriculture and energy (IPCC, 2014). And when tourism meets with either of these major industries is where the largest consumption of water seems to be i.e. food and fuel (Gössling et al., 2012). Unfortunately tourism is almost entirely based-on, and reliant upon, these two industries. The difficulty in reduction arises when considering that tourism also acts as a catalyst to increase the scope, imbalances and overall water use of both agriculture and energy within local and adjacent regions. While there are many tourism papers discussing the economic benefits of gastronomic marketing and its effect on touristic preferences and local economies (Hall, 2012; Rand, Heath, & Alberts, 2003; Torres, 2003) there are very few tourism writings discussing how tourism best play its part in limiting its impact on food, and food's impact on local and foreign environments. As this problem is a lot larger than tourism – a problem for humanity – it is important for tourism as such a large player in the global economy to adapt and implement ways to reduce the demand and consumption of embedded water.

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#### 4.2.2.2 *Water Supply*

The major theme in the reviewing of water supply was the repurposing of non-freshwater – whether that was greywater, or saline water. For many regions, freshwater is becoming much scarcer than what current demand levels require. Thus the repurposing of previously "unused" water allows relief on the stresses of freshwater, and can allow (acceptable quality) freshwater to be redirected where it is most needed (Al-Jayyousi, 2003; Lazarova et al., 2003).

The repurposing of greywater is slowly becoming more commonplace for tourism–related facilities and infrastructure in some countries e.g. U.S.A., Japan, Australia. After adequate filtration, water used for certain scenarios can still be of an adequate quality for other purposes. And where some hygiene and maintenance activities often do not demand the levels of freshwater once assumed, lower quality water often meets the criteria required. Through repurposing greywater for certain activities, freshwater can effectively be "used" twice – effectively doubling supply in those scenarios.

### 4.2.3 Summary

Overall, it was found that there are few sources of primary tourism-based research with a focus on water use. It was also found that even fewer of those were quantitative, longitudinal, or intervention-based. Of the total 430 papers returned within the systematic search of water use in tourism, only two meet the inclusion criteria. The search term only returned one paper, while the other was added manually by the author. Both papers were similar in their approach and also similar in their suggestions.

Both studied hotels and looked at both water supply and demand. These methods for water reduction within the papers were very similar to those suggested within the literature

review. The various methods used within the studies were shown to be effective in reducing water use.

As shown within both the literature review and systematic search, there are a multitude of ways to reduce water use within water demand and water supply. Many of these methods rely broadly on the implementation of managerial practices, and the installation of modern, more-efficient technologies.

Managers should look to implement management procedures and systems that regularly measure, report and review water use. Doing this not only helps to understand if changes are working, but is likely to also create urgency within the business, and ensure inefficiencies are found. This also involves implementing procedures that efficiencies such as batching laundry and dish loads.

The largest reductions in water use seemed to come from that of replacing older equipment with that of a modern, more water efficient counterpart. For example, faucets, showers and toilets use a substantial amount of water, and often use much more water than needed. Thus installing more efficient models will reduce water use. And as these are inevitably and consistently used, often the return on investment can be short.

In terms of water supply, repurposing of water can significantly reduce total water use. As some activities do not require freshwater, greywater can make an effective alternative. Through collecting greywater, and repurposing it for activities such as garden maintenance, or for use in toilets, one can effectively double the use of water.

## 4.3 Summary

Through carrying out the systematic search on the two tourism inputs of energy and water, 763 papers were reviewed. Out of those, only three papers in total meet the inclusion criteria – with Khemiri and Massairi (2005) meeting both the energy and water criteria. Out of the three papers, only one was found automatically by the search (Schachtschneider, 2002), while the other two were added manually by the author (Khemiri & Hassairi, 2005; Rutty et al., 2014). Thus it has (and will again) be concluded that the systematic search methods were lacking in some way, however they were also indicative of the limited nature of intervention-based tourism papers focussing on energy and water use.

Overall, the returned papers provided primary evidence of various ways to reduce both energy and water use within STEs – hotels and a ski resort specifically. The results of all three papers were aligned with the findings of various other papers reviewed as part of the larger literature review performed within Chapter 2. For both sub-topics, within the systematic search and the literature review, the main methods of reducing use within STEs surrounded ideas of management and modernisation. Management to ensure measurement, reporting, and motivation; and modernisation to ensure efficiency and longevity. With regards to travel-based resource use, the major themes were that of efficiency, and specifically discussed biofuels, route optimisation, load factors, driving techniques, and the use of electricity as energy.

# 5. Conclusion and Recommendations

## 5.1 Introduction

This chapter seeks to conclude the findings of the research as whole, as well as evaluating the limitations of the study, and providing recommendations for future research.

## 5.2 Purpose of the Research

The global environment as a whole is being altered through human activity –including touristic activities (IPCC, 2014). And only through understanding the impacts and their sources, may tourism mitigate the effect that it has (Gössling et al., 2012).

This research aimed to evaluate two major stresses of tourism on the environment – energy and water – and ways to limit their use, and mitigate the impact in practical ways. As interventions are generally the way that change is created (whether political, behavioural (social marketing), organisational or educational), this was to be a main focus. The research attempted to review all papers relating to interventions within the focus of tourism demands on energy and water.

## 5.3 Conclusions

The systematic search returned 763 papers, 333 relating to energy, and 430 relating to water. It was found through the process that very few papers focussing on these sub-topics within the field of tourism are quantitative, longitudinal, and intervention-based. In a number of cases where interventions and individual and organisational behaviour change is discussed there is no account of the sustainability of any change, with single-shot studies predominating, with often a focus on attitudes towards change rather than change itself, or no accurate measurement of change in water or energy use over time (see also Hall et al., 2016).

Nevertheless, the research found several major themes regarding both the purpose of the research, and the literature as a whole. It was found that there are many ways which tourism can reduce its impact on the environment starting today, and continuing into the future.

Energy can be reduced within a destination through management and modernisation. Managing energy use more closely allows better reporting and insight into inefficiencies and

intensive uses. Maintaining equipment more effectively can reduce the inefficiencies of older equipment and significantly lower total and per guest energy use. Management and maintenance help to ensure that energy is only used at the time, amount, and length necessary. Through modernising energy-using equipment and processes, a manager is likely to reduce energy use significantly. This involves the purchasing and installation of new equipment, which can be a substantial investment for an STE, has been shown to have a relatively short return on investment.

Energy use can also be reduced while travelling by developing more efficient and less impactful fuels and engines; and more efficient processes and technologies surrounding the activities of travelling. Biofuels are being researched with the aim to eventually replace fossil fuels, however current manifestations of biofuels are costly – both financially and to the environment. It was shown within the literature review and systematic search that driving efficiencies can be improved, and via driver training courses, the efficiencies significantly reduce energy use.

Electricity can generally be an efficient energy, however this is only true should the energy come from renewable source such as solar, wind or hydro-electricity. Otherwise electricity can have a much greater net-impact on the environment than fuelling with and non-renewable energy such as petroleum. This factor therefore becomes a significant element in any assessment of energy interventions, not only is a reduction significant, but also the source of energy. For example, in terms of long term contributions to greenhouse gas emissions and increase in the amount of electricity if produced completely from renewables in a hotel would have less effects that a reduction in electricity used if the electricity was produced from coal.

Water use can also be reduced within tourism through the methods of management, maintenance and modernisation. Similar to that of energy, managing, reporting and constant vigilance of water use is essential in having systematic processes for reducing overall water use (e.g. batching laundry and dish loads). The maintenance of water-using equipment can significantly reduce water use by reducing inefficiencies and ensuring that water is only used when needed (e.g. automatic sprinkler systems). Installing modern water-

efficient equipment generally showed the largest water savings (e.g. water efficient faucets).

Repurposing, or the reusing of water was also shown to provide significant reductions in overall use. Greywater can be used for water needs which do not require freshwater such as toilet flushing and garden irrigation. Through collecting water after its original use, it can then be reused for such activities, thus potentially doubling the use of the water.

## 5.4 Limitations

This review only focussed on what were termed 'tourism inputs' – energy and water. It would be relevant to also look into other important impacts which tourism produces: emissions, pollution and waste, to see if they have a similar lack of relevant studies. Inclusion of these 'tourism outputs', would create a fairly comprehensive review of tourism's impacts from two perspectives. The two chosen sub-topics were based on the number of returned results with water being the largest, and energy being the second largest, compared to the tourism outputs. Nevertheless, it is interesting that inputs receive greater attention in the tourism literature than outputs such as pollution and waste.

However, as discussed previously, although the guidelines for the conduct of systematic reviews were followed the search method could have been potentially improved. It is theorised by the author that there are two major reasons for this: the search term itself, and the search medium. The search term can always be improved, and with evolving focusses and terms within the literature, must always be updated so as to include every variation being used. While the search term was worked on for a substantial amount of time, and was given input by many established academics, it still missed some relevant papers. And thus, it can be assumed that this review as a whole missed relevant papers – even with such a robust literature review. The search medium itself was mainly chosen because of its enhanced functionality with the use of Boolean search terms. However, the sheer size of Google Scholar for instance, may have provided a larger representation of the total literature available although the search functionality is somewhat limited in comparison. However, the improvements to both the nature of the search terms as well as the bibliometric database used become a significant factor for future research.

## 5.5 Future Research

With regards to the conclusions of this research, there seemed to be a lack of interventional, or experimental research within sustainable tourism research – at least within the focus of energy and water. This is a significant finding. Conversely, there are many qualitative studies including surveys and reviews. Quantitative study can often be used to test the ideas and suggestions raised within a qualitative study. Thus, much of the qualitative study performed within the field may be further reinforced through quantitative study and made more applicable and convincing to a wider audience. However, the absence of quantitative longitudinal studies on behavioural, policy and organisational interventions on energy and water use in tourism raises substantial questions as to the sustainability behaviour or technological changes and the value of recommendations made from more qualitative or attitudinally based research.

As this research was only able to focus on inputs to tourism, energy and water, there are still other incredibly significant impacts which also need to be researched to better appraise the state of the literature. The author firstly suggests some common tourism outputs such as emissions, pollution and waste. However, there are other topic of importance to research such as land use, biodiversity (see Anderson, Rocliffe, Haddaway and Dunn (2015)), land degradation, cultural impacts and souveniring for example.

Mentioned quite briefly within the literature review of the energy sub-topic, the focus of most of the papers were on how businesses can alter the ways they operate their business so as to reduce their impact. And while this is an incredibly important aspect to be researched, the author found that the amount of literature focussing on other environmental stakeholders was fewer in comparison. Thus, there seemed to be fewer discussions surrounding the actual actions of tourists, and how to impart behavioural change in this regard. There were a few qualitative papers reviewing the thoughts of tourists and the impact of those thoughts on their travel patterns, and some of them (as reviewed in the literature review) had results that show very challenging prospects for researchers looking to alter behaviour. A further issue that arises is the actual willingness of organisations to make their resource use data available for research in a manner that can actually guage the success of any intervention. Furthermore, such an observation assumes

that energy and water use, along with outputs, are accurately measured in the first place by any operation.

## 5.6 Research Contributions

### 5.6.1 Practical Contributions

The current study has identified many opportunities for a large variety of tourism providers to reduce both their water and energy consumption and thus limit their impact on both the local and global environment. Methods for doing which were discussed in detail in chapters 2 and 4, and again briefly earlier in this chapter.

Sections 2.5 and 4.1 focussed on energy, with sections 2.5.3 and 4.1 discussing the reducing of that energy. This study highlighted that there are a multitude of ways to reduce both destination- and travel-based energy use. While it is difficult to recap all of the possible methods here, the review showed that the most effective way to reduce energy use is to research and install modern, energy efficient equipment. This includes HVAC systems and boilers in hotels, or engines and fuels within vehicles. Usually the return on investment for such purchases is quite short, though this depends on the potential energy savings and cost of energy.

Sections 2.6 and 4.2 focussed on water, with section 2.6.5 and most of 4.2 discussing ways to reduce water use. The study returned a vast array of ways to reduce water use within many different types of businesses in terms of both water demand and water supply. Within water demand, the most effective ways of reduction was that of replacing older equipment with that of a modern, more-efficient counterpart. As with energy, the return on investment still seems short, however is likely to be longer than that of energy related investments. In terms of water supply, the major theme was that of reusing greywater for activities which do not require freshwater, or a higher quality water.

### 5.6.2 Academic Contributions

As far as the author could tell, this is one of the few systematic reviews carried out in the field of sustainable tourism (see Anderson et al., 2015; Hall et al., 2016), and the only one looking at longitudinal interventions specifically. This research has highlighted the substantial gap that exists within both the energy and water topics and the need for

improved longitudinal and comparative studies. It was shown within the actual results of the systematic search that there are very few studies that using interventions or even experimental methodologies. It also showed that very few pieces of research are longitudinal, and rather only capture a measurement at one point in time. Given the central role of time in sustainability, given concerns for inter-generational equity, the lack of longitudinal studies would appear to be a major failing in the search for more sustainable forms of tourism.

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* denotes a reference reviewed as part of the systematic review

# Appendices

## Appendix A

### Base Search Term

#### *Tourism Parameter*

TITLE-ABS-KEY("tourism" OR "business travel*" OR "religious travel*" OR "recreational travel*" OR "leisure travel*" OR "medical travel*" OR "short-term travel*" OR "long-distance travel*" OR "holiday" OR "excursion" OR "touris*" OR "visiting friends and relations" OR "visiting friends or relations" OR "VFR" OR "holidaymaker" OR "visitor" OR “pilgrim*”) AND

#### *Behaviour Parameter*

TITLE-ABS-KEY("behaviour*" OR "pattern*" OR "use*" OR "intention*" OR "knowledge" OR "perception*" OR "rational*" OR "norms" OR "attitude*"OR "practice*" OR “choice*” OR “awareness” OR “recognition” OR “motivation” OR “reason”) AND

#### *Intervention Parameter*

TITLE-ABS-KEY("intervention*" OR "initiative*" OR “mediation” OR "programme*" OR "program*" OR “project*” OR "policy" OR "communication") AND

#### *Environmental Parameter*

TITLE-ABS-KEY(“environment” OR "ecotourism" OR “eco-tourism” OR "ecol*" OR "car-use" OR "car use" OR "bus use" OR "bus-use" OR "public transport*" OR “bicycle” OR "cycling" OR "walking" OR “train” OR “aeroplane” OR “aircraft” OR “aviation” OR "mobility" OR “ferry” OR “cruise” OR “cultur*” OR "travel demand measures" OR "biodiversity*" OR "ecosystem" OR "invasive species" OR "sustain*" OR "pro-environmental*" OR "food" OR "organic food" OR “wine” OR "green consumerism" OR "landscape change" OR "site degradation" OR "landscape degradation" OR "site erosion" OR "landscape erosion" OR "land use" OR "conservat*" OR "green purchases" OR "meat" OR "meat consumption" OR "ethical consumer" OR "eco-diversity" OR "souveniring" OR "environmental consumer behaviour" OR "green consumer behaviour" OR "environment protection" OR "social norms" OR "planned behaviour" OR "off-setting" OR "offsetting" OR "footprint" OR "carbon"

OR "infrastructure" OR "facilities" OR "hospitality" OR "hotel" OR "hostel" OR "motel" OR "lodging" OR "accomodation") AND

### *Miscellaneous Parameter*

AND LANGUAGE("English") AND DOCTYPE("re" OR "ar") AND PUBYEAR < 2015

## Sub-Topic Search Terms

### *Energy*

TITLE-ABS-KEY ( "oil" OR "petrol" OR "coal" OR "electricity" OR "gas" OR "energy" OR "hydro*" OR "nuclear*") AND TITLE-ABS-KEY("use" OR "saving" OR "conservation" OR "reduction" OR "preservation" OR "responsibl*" OR "regulation")

### *Water*

TITLE-ABS-KEY ("water*") AND TITLE-ABS-KEY("saving" OR "conservation" OR "reduction" OR "preservation" OR "use")

## Notes

| | |
|---|---|
| "" | indicates that the word within must be included |
| * | indicates that any variations of the word from that point will be included (i.e. "touris*" includes "tourism" and "tourist") |
| AND | indicates that the previous and following both must be included |
| ar | refers to article |
| DOCTYPE | ensures only the following document types are included |
| LANGUAGE | ensures only the following languages are included |
| OR | indicates that either of the previous and following words may be included |
| re | refers to report |
| TITLE-ABS-KEY | ensures that only the title, abstract and keywords of a paper are searched |