INTRODUCTION

Currently, the world is facing a global health, social and economic emergency as a result of the COVID-19 pandemic. Policymakers, destination managers and tourism stakeholders have a major role in responding and adjusting to this challenging new environment, with a significant opportunity to explore and frame the new, post COVID-19 sustainable strategies to build responsible tourism recovery plans.

Tourism is among the most affected industries with a massive fall of international demand, due to slow virus containment, low traveller confidence and global travel restrictions (UNWTO, 2020). In May 2020, 75% of global destinations placed a complete stop on international tourism, which caused extraordinary socio-economic impacts for the tourism industry. Tourism declined by 74% in international tourist arrivals during 2020, resulting in an estimated economic loss of over US$ 2 trillion in global GDP; risking nearly 120 million direct tourism jobs (One Planet Sustainable Tourism Programme, 2020; UNWTO, 2020; UNWTO, 2021). There are additional environmental impacts, however, these are proving difficult to quantify at the moment. Nevertheless, the pandemic has raised the awareness of the crucial role sustainability needs to play in the responsible recovery of the tourism industry and the need to transform tourism operations. Climate action continues to be of utmost importance for tourism.

Pre COVID-19, there was an increase of awareness and attention on the need for assessing the Carbon Footprint of tourism at national and regional levels globally (Patterson & McDonald, 2004; Beckan & Patterson, 2006; Grimm et al., 2008; Perch-Niesen et al., 2010; Dwyer et al., 2010; Hoque et al., 2010; Konan & Chan, 2010; Farreny et al., 2011; Filimonau et al., 2013; Sun, 2014; Cadarso et al., 2014; Sanyé-Mengual et al., 2014; Björnsson, 2014; Sharp et al., 2016; WAWRG, 2018; Rico et al., 2019; Kitamura et al., 2020). It is vital that the carbon footprint is assessed and understood so that the state government can make informed decisions, compare carbon footprints internationally, and prepare appropriate reduction plans and policies. Additionally, it enables the government to easily monitor that tourism is making the necessary emission reductions. Despite many experts proclaiming this knowledge, many global emission reduction plans continue to ignore the tourism industry. Moreover, there are many analytical approaches to assess the carbon footprint of tourism. Bottom-up approach assesses the micro-systems whilst the top-down approach assesses the macro-systems. Often, many international tourism carbon footprint studies combine approaches to create a hybrid approach that accounts for the full scope of greenhouse gases emissions (Patterson & McDonald, 2004;

Beckan & Patterson, 2006; Hoque et al., 2010; Perch-Niesen et al. 2010; Dwyer et al., 2010; Filimonau et al., 2013; Sharp et al., 2016; Kitamura et al., 2020). From combining the approaches, studies can overcome the limitations of using only one approach. Thus, COVID-19 has offered an opportunity for responsible tourism recovery plans to include assessing the carbon footprints of tourism nationally as a priority, to implement appropriate decarbonising tourism strategies.

Most human activities require energy directly or indirectly from the combustion of fossil fuels or the removal of carbon sinks (i.e., forests or peatlands), which leads to the creation of the greenhouse gases and results in climate change impacts (Dwyer & Spurr, 2010; Sharp, et al., 2016). Climate change and tourism have adverse effects on each other and like all other industries, tourism is expected to make necessary emission reductions. Pre COVID-19, tourism was thriving globally, with 1.5 billion international tourist arrivals in 2019, a 4% increase from 2018 which was also predicted for 2020. Lenzen et al. (2018) estimated that the tourism industry is responsible for 8% of the overall global emissions with an annual carbon footprint of 4.5 gigatons of carbon dioxide equivalent in 2013 and it is estimated to reach 6.5 gigatons of carbon dioxide equivalent by 2025. UNWTO (2020) had urged that this growth needs to be managed sustainably to seize the opportunities tourism generates. It remains uncertain what form tourism will take post COVID-19 and it is a matter of critical debate. However, there is a considerably amount of encouragement for governments, policymakers and stakeholders to use this recovery as an opportunity to develop tourism sustainably with a special focus on decarbonising the industry as this is the other major crisis humanity faces.

The first purpose of this study is to identify if the carbon footprint of Irish tourism has been established and to determine what level of strategies are in place to decarbonise the in Ireland pre COVID-19 and post COVID-19. This will be completed by conducting a content analysis of Irish national plans. The second purpose of this study is to compare international tourism carbon footprint findings to identify any similarities or differences. Consequently, establishing if a baseline carbon footprint can be generated for Irish tourism pre COVID-19 and identifying which approach is most suitable for assessing the carbon footprint of Irish tourism post COVID-19. This will be accomplished by conducting a comparative analysis of international tourism carbon footprint studies.

LITERATURE REVIEW

The current theory from international literature has been discussed in the context of assessing the carbon footprint of Irish tourism post COVID-19. Initially, this provides background data on Ireland's greenhouse gas emissions and the performance of the Irish tourism industry to date, before highlighting the current national plans that are in place to mitigate climate change impacts and aid the responsible recovery of tourism. Based on observations, the understanding of the different analytical approaches is interpreted along with an example of the approaches being implemented in other international studies at national or regional levels. Therefore, identifying if there is a unified approach used to assess the carbon footprint of tourism.

Tourism, Climate Change and COVID-19

Tourism has been severely struck by COVID-19. Some believe the pandemic has opened the doors for how the post-pandemic tourism recovery could serve as a catalyst for sustainable tourism transformation, which has been discussed for many years but has failed to be implemented (Chang, McAleer and Ramos, 2020; Scott, 2021; Sharma, Thomas and Paul 2021). The UNEP and UNWTO (2005) define sustainable tourism as:

'Tourism that takes full account of its current and future economic, social and environmental impacts, addressing the needs of visitors, the industry, the environment and host communities'.

Sustainable tourism development is a continuous process that requires the informed participation of all relevant stakeholders, strong political leadership, constant monitoring of impacts and necessary mitigation and adaptive strategies. With the development of vaccines, a post COVID-19 pandemic era can be foreseen, however, the same cannot be said of the climate change crisis. Consequently, it is vital that stakeholders (public and private) and world leaders collaborate together to strive for sustainable tourism development in post- pandemic tourism recovery plans. The first climate change challenge faced by tourism is the transition towards a low-carbon economy. Thus, it is crucial to decarbonise tourism to achieve emission reductions - consistent with the targets of the Paris Climate Agreement. As a result, tourism cannot be considered sustainable if it fails to decarbonise the industry to mitigate climate change (Scott, 2021). Hence, it is vital that the carbon footprint of tourism is assessed to inform policymakers and stakeholders so that appropriate decarbonising strategies can be implemented, and tourism can be considered a sustainable industry.

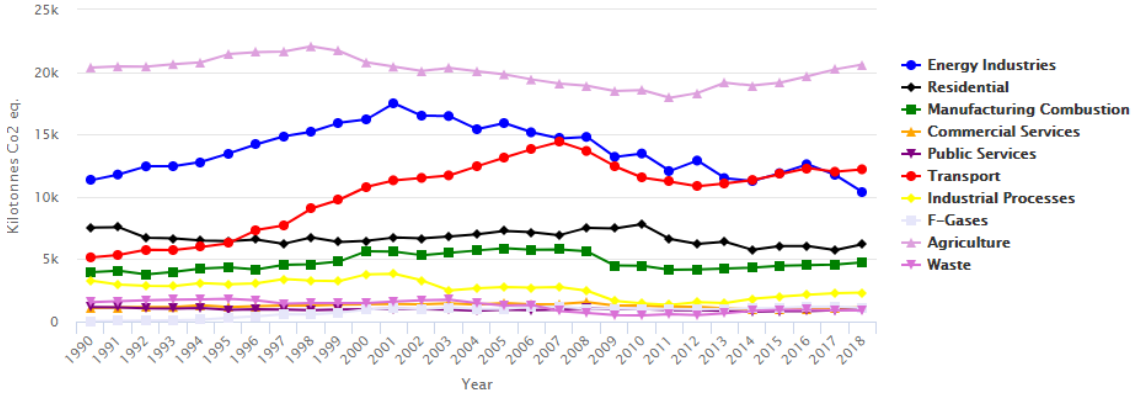
With the support from UNWTO, One Planet Sustainable Tourism Programme (2020) aims to support the development and implementation of responsible tourism recovery plans which contribute to the Sustainable Development Goals and the Paris Agreement – to enhance the resilience of tourism by balancing the needs of people, planet and prosperity Their vision

recommends six lines of action to guide this recovery, climate action being one of them. Their recommended strategies for climate action are monitor and report emissions from tourism operations, accelerate the decarbonisation of tourism operations and engage the tourism sector in carbon removal, through both natural and technological methods is necessary. For years, many experts have highlighted the importance of understanding the role of tourism and emissions, but global analysis and reduction plans continued to ignore the tourism industry (Dwyer & Spurr, 2010; Sharp, et al., 2016; Rico, et al., 2019; Dogru et al., 2019; Scott, 2021). Ireland is vulnerable to climate change impacts such as sea-level rise, increased storm frequency and changing precipitation patterns (Department of Communications, 2015; Climate Change Advisory Council, 2019). The need to assess the carbon footprint of tourism to plan for climate change mitigation and sustainability is essential for the responsible recovery and resilience of tourism post COVID-19.

In Ireland in 2019, according to Fáilte Ireland (2021) domestic tourists increased by 6.4%, Northern Ireland tourists decreased by 4.6% and oversea tourists reached 9.6 million with a 0.7% increase from 2018. Mainland Europe, North America and Britain remain to be the largest overseas markets, who mainly arrive by air. Global demand for air travel has grown by 60% over the last ten years due to higher incomes, higher levels of education, population growth and urbanisation. Aviation represents between 1.7%-2.3% of global Carbon Dioxide (CO_2) emissions (Becken & Shuker, 2019). Transport is considered the highest emissions contributor; however, other tourism-related activities can contribute significantly higher greenhouse gas emissions because of their high energy intensity (Rico, et al., 2019). Although tourism benefits the Irish economy with a 1.5% revenue increase in 2019 reaching €9.5 million (Fáilte Ireland, 2019; Failte Ireland 2021), it can be worrying for Irelands emissions. Particularly, agriculture, transport, and energy emissions which are Irelands highest emitting sectors and are vital to tourism. Therefore, it is necessary to determine what level of emissions is the tourism industry responsible for from those sectors.

In 2019, tourism was set to increase its emissions by at least 25% by 2030, globally. However, as international travel came to a halt during the pandemic, it is estimated that global emissions will have declined by 8% (One Planet Sustainable Tourism Programme, 2020). In 2018, Ireland's greenhouse gas emissions were estimated to be 60.51 Million tonnes CO_2eq ($MtCO_2eq$), which is lower than emissions in 2017. However, this decrease only occurred in three sectors: energy industries, waste and F-gases. Whilst, greenhouse gas emissions had increased in other sectors, as seen in figure 1.

Figure 1. Greenhouse gas emissions share by sector in 2018 provisional estimates

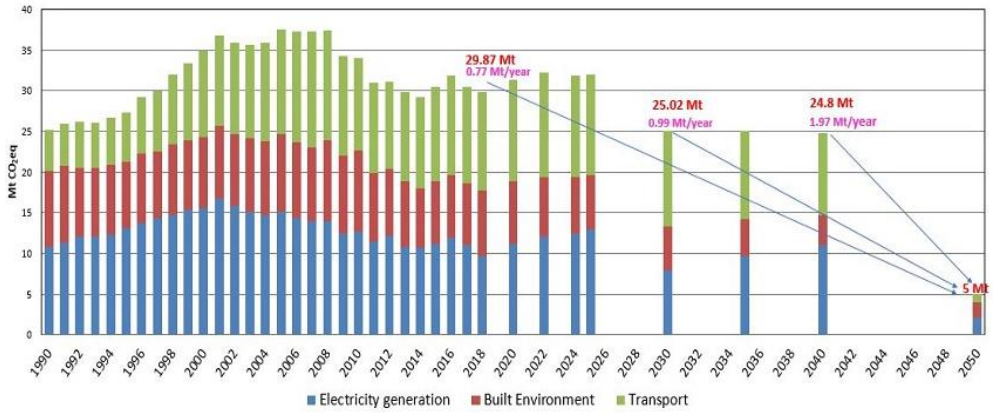


Sourced: EPA (2020)

Under the European Union, Ireland must reduce emissions by 30% by 2030. Since 2016, Ireland has continued to breach the EU reduction targets and the carbon budget will be exceeded over the period 2021-2030 (EPA, 2020). Although, the Environmental Protection Agency (EPA) and Sustainable Energy Authority of Ireland estimates that COVID-19 has caused almost a 6% emissions reduction. EPA warn that any economic rebound from the pandemic could bring emissions back to previous levels (McCormack, 2021). Hence, if emissions resume to pre COVID-19 levels, going forward the state will be penalised by the European Union for not meeting the reduction targets in 2030 and Ireland's long-term decarbonisation goals will be extremely difficult to achieve.

Ireland's national policy plans state the ambitious long-term vision of transitioning towards a low-carbon economy by reducing emissions by 80% in 2050 (Government of Ireland, 2015; Government of Ireland, 2017; Government of Ireland, 2019; EPA, 2020). The extent of the challenges ahead and the need for drastic reductions immediately to achieve the ambitious vision by 2050, is visible in Figure 2.

Figure 2. Emissions reduction required per annum to meet the 2050 target based on 2019 projections



Sourced: EPA (2020)

This theory suggests the need to assess the carbon footprint of the tourism industry to empower the state government to identify whether the tourism industry is committed to emission reductions as much as other industries and compare the carbon footprint of tourism against international studies. Once the carbon footprint is understood, appropriate and realistic emission reduction goals for tourism can be assimilated and implemented. For this study, it is necessary to conduct a cross-content analysis of Irish national plans to identify if the carbon footprint of Irish tourism has already been established and to determine what strategies are in place to decarbonise the Irish tourism industry.

Carbon Footprint

Recently, the carbon footprint term has increased in public appearance and is used regularly to debate reduction action against climate change (Wiedmann & Minx, 2008). The carbon footprint is an accounting assessment tool to determine how carbon-intensive production and consumption of goods and services are, within an industry. It allows areas of high emissions to be identified, managed, and eliminated or reduced (Dwyer & Spurr, 2010; Rico, et al., 2019). The carbon footprint offers a comprehensive and understandable method to measure greenhouse gas emissions, as it puts a weight-number on the environmental impacts human activities cause. It involves collecting activity data from each greenhouse gas emissions source and converting it into emissions levels. The carbon footprint of tourism can be assessed at many levels: a single tourism product, individual tourists, individual operators, industry sectors, regional, nationally, and globally (Dwyer & Spurr, 2010). Generally, there are two approaches concerning what a carbon footprint should cover: CO2 alone or CO2eq (the six most malicious greenhouse gases) (Björnsson, 2014). Wiedmann and Minx (2008, p4), define carbon footprint as

'a measure of the exclusive total amount of CO2 emissions that is directly and indirectly caused by an activity or is accumulated over the life stages of a product'.

However, this definition does not include the six most malicious greenhouse gas emissions.

Carbon Trust (2017) defines carbon footprint as

'*A carbon footprint is the total greenhouse gas (GHG) emissions caused directly and indirectly by an individual, organisation, event or product, and is expressed as a carbon dioxide equivalent (CO2e). A carbon footprint accounts for all six Kyoto GHG emissions carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride'*

These two definitions encompass the two approaches and inevitably suggest that both direct and indirect emissions caused by human activity need to be measured.

Carbon Footprint Measurements

Tourism produces direct and indirect greenhouse gas emissions through its purchases of goods and services. Direct emissions are generated directly from tourist activities. It is argued that by only assessing CO2, only the direct emissions are measured (Dwyer & Spurr, 2010; Sharp, et al., 2016). Therefore, it is recommended that carbon footprint measurements assess all greenhouse gas emissions in the form of CO2eq as indirect emissions can be much higher as a result from intermediate input, due to other emissions causing activity related to the industry; usually embedded in international trade (Sharp, et al., 2016). Excluding indirect emissions would underestimate the total carbon footprint generated by tourism, as they include emissions linked to the electricity. For example, heating, air-conditioning, lighting, cooking, and growing food products in hotels (Sun, 2014; Cadarso et al., 2016). It is estimated that CO2 has a life expectancy of 100 years in the atmosphere and CO2eq weights all the greenhouse gas emissions using CO2's 100-year life expectancy. Furthermore, CO2eq is the standard international unit of measurement and is used in most international agreements, such as the *United Nations Framework Convention on Climate Change* and Kyoto Protocol (Björnsson, 2014). To fully understand the greenhouse gas emissions from tourism its necessary to measure the direct and indirect emissions. Additionally, it is essential for assessments to maintain the standardised CO2eq measurement to ensure international carbon footprints can be easily compared and monitored regularly.

Analytical Approaches to Measure the Carbon Footprint of Tourism

Within the literature there are the options of three analytical approaches for assessing the carbon footprint of the tourism industry:

1. Internet-based approaches: the European Tourism Indicator System (ETIS) toolkit and recommended carbon footprint calculators.
2. Comprehensive approaches: the bottom-up approach which is based on the Life-cycle analysis (LCA) or the top-down approach based on Environmental Input–Output (EIO) analysis.
3. Hybrid approaches: a combination of both LCA-EIO.

Internet-Based Approaches

These approaches are already available online for users to enter their data. ETIS was created by the European Union to encourage destinations to adopt a more intelligent sustainable approach to tourism planning. It helps to manage and monitor sustainability in destinations and deems useful for policymakers, tourism enterprises and other stakeholders (European Union, 2016). The indicators are categorised into destination management, economic impact, social and cultural, and environmental impact. This study focuses on environmental impacts, as seen in Figure 3.

Figure 3. The environmental impacts from the ETIS toolkit

Section D: Environmental impact		
Criteria	**Indicator reference#**	**ETIS core indicators**
D.1 Reducing transport impact	D.1.1	Percentage of tourists and same-day visitors using different modes of transport to arrive at the destination
	D.1.2	Percentage of tourists and same-day visitors using local/soft mobility/public transport services to get around the destination
	D.1.3	Average travel (km) by tourists and same-day visitors from home to the destination
	D.1.4	Average carbon footprint of tourists and same-day visitors travelling from home to the destination
D.2 Climate change	D.2.1	Percentage of tourism enterprises involved in climate change mitigation schemes — such as: CO_2 offset, low energy systems, etc.— and 'adaptation' responses and actions
	D.2.2	Percentage of tourism accommodation and attraction infrastructure located in 'vulnerable zones'

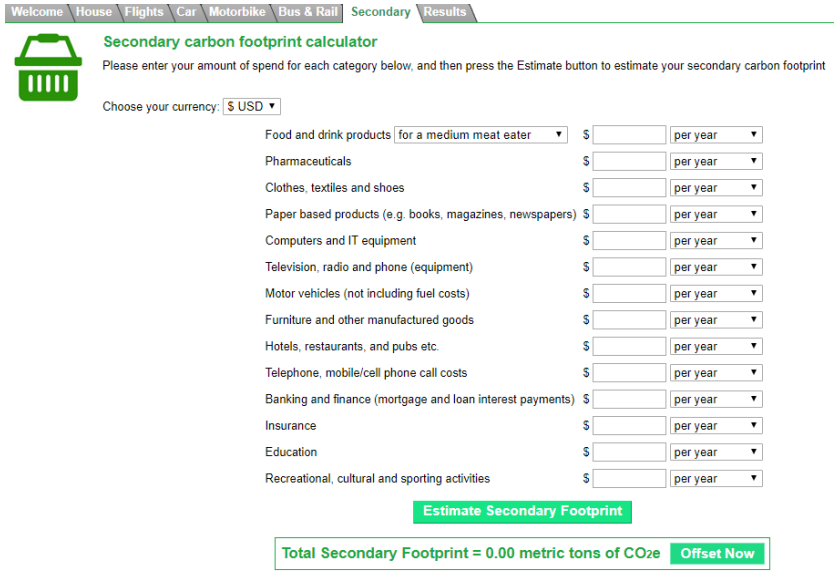
Sourced: European Union (2016)

The benefits from this approach include pre-developed surveys, destination profiles and datasheets, and formulas to facilitate the measurement. However, the limitations of this approach include that the carbon footprint measurement only focuses on direct transport CO2 emissions. This approach was previously attempted in Ireland to get the carbon footprint of tourists arriving at the regions Clare, Sligo and Donegal (WAWRG, 2018). However, the approach was found to be problematic, so the recommended carbon calculators were used instead.

There are three recommended free internet-based carbon calculators for personal, businesses, institutions and local authorities use. The calculators' highlight areas that have the greatest effect on climate change and offer advice on how to reduce or offset your carbon footprint (One

Planet, 2018; EPA, 2020). The *Carbon Calculator* is more comprehensive than the *WWF calculator* and uses the factors produced from DEFREA 2017 Supply Chain factors to assess emissions, which was originally designed for businesses in the UK to use, but the scope of application has dramatically extended to a number of other European countries, Australia and New Zealand (Filimonaua *et al*,2011). Additionally, it measures the carbon footprint of aviation, transport and secondary expenditure (i.e., hotels, pubs and restaurants, retail and recreational, cultural and sporting activities) in CO2eq, which are the main sectors in the tourism industry, as seen in Figure 4.

Figure 4. Carbon calculator meausres transport, home, and secondary emissions



Source: Carbon footprint (2020)

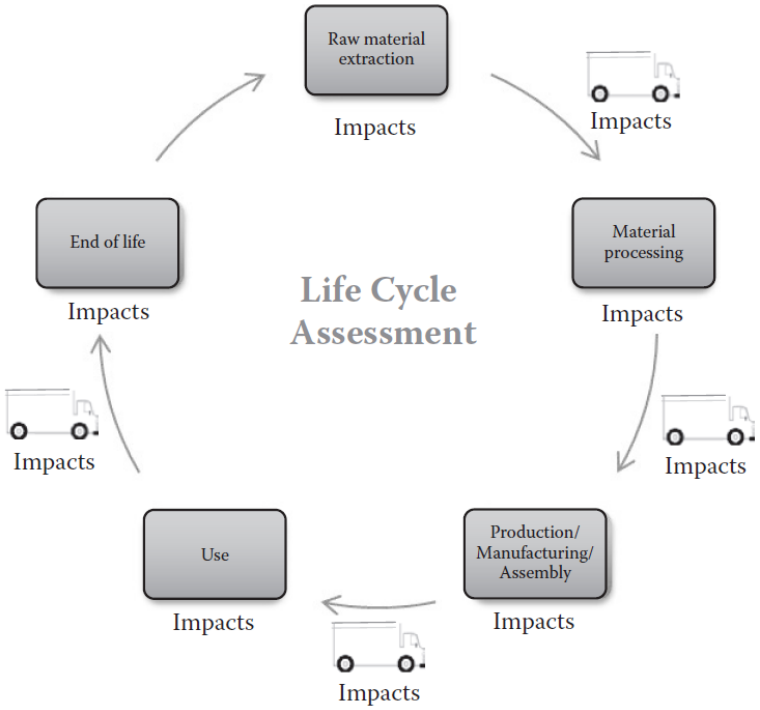
This calculator was used to measure the carbon footprint of transport in specific regions in Ireland (WAWRG, 2018). The WWF calculator was used to measure the carbon footprint of German tourists to specific destinations (WWF, 2008). However, the WWF calculator is limited to direct emissions only. Whilst the Carbon calculator is limited to assessing only some of the indirect emissions. The CARMACAL calculator won an award for innovation from UNWTO and WTTC (One Planet, 2018). It is business orientated calculator for tour operators, travel agencies or entire destinations, measuring direct and indirect emissions. However, this calculator can be expensive.

Bottom-up approach and Life-Cycle Analysis

The bottom-up approach is consistent with the consumption-based view of greenhouse gas emissions accounting and usually based on process analysis. This approach is very data-heavy, time-consuming and requires more resources, but as a result, has a high level of accuracy (Becken & Patterson, 2006; Vuuren et al., 2009; Lin et al., 2013; Björnsson, 2014). Perch-

Niesen et al. (2010) found it to be the most accurate approach. It focuses on details from the energy system and insights into technology development. Tourists behaviour is the center of this approach. This approach has clear advantages for looking at micro-systems but lacks macro-economic feedback (Vuuren et al., 2009; Lin et al., 2013; Sun, 2014). This approach alone was implemented to assess the carbon footprint of Antarctica and Iceland (Farreny et al. 2011; Björnsson, 2014). These studies were limited to direct emissions and don't analyse the full scope impact of tourism emissions. Therefore, it is recommended to combine it with the LCA. They share the same characteristics, however, LCA is more comprehensive and it evaluates the direct and indirect emissions based on the environmental damages that may be associated with the production, use, and disposal of a product or service, as seen in Figure 5.

Figure 5. Life cycle assessment concept



Sourced: (Franchetti & Apul, 2012)

Furthermore, it can estimate the carbon footprint of a person, industry, organization, community or nation (Franchetti & Apul, 2012). Barcelona City assessed the direct and indirect emissions with this approach and used the ISO 14040:2006 data (Rico, et al., 2019). ISO 140672018 (updated version) provides globally agreed principles, requirements, and guidelines for the quantification and reporting of the carbon footprint of a product (Naden, 2018; The International Organisation for Standardisation, 2018). It has been accepted as the International Standard.

2.3.4 Top-down approach and Environmental Input-output Analysis

The top-down approach is usually built on the EIO analysis and focuses on a more comprehensive economic context of the entire economy. Consequently, requires knowledge of specialized matrix calculations using monetary information (Vuuren et al., 2009). For example, the Tourism Satellite Accounts (TSA), which exists in over 70 countries worldwide and is internationally recommended. It is a statistical tool that keeps track of demand for goods and services linked to tourism. TSA is used as the economic data against environmental accounts, estimating both direct and indirect emissions. TSA was generated from the *System of National Accounts* from 1993 which the *Commission of the European Communities, International Monetary Fund, Organisation for Economic Cooperation and Development, United Nations* and the *World Bank* encouraged, and UNWTO approves (Dwyer & Spurr, 2010; Björnsson, 2014; Sun, 2014). Though, it is less time consuming and superior for the macro-systems: industrial sectors, individual businesses, larger product groups, and government. There are limitations to assessing macro-systems, such as not having enough detailed information to monitor minor changes. As a result, it neglects the use and end-of-life phases in the life-cycle of products or services. Furthermore, there are issues of incompleteness, truncation errors and that it is based on historic evidence. Consequently, assuming historic behaviour to be relevant for future systems (Vuuren et al., 2009; Lin et al., 2013). Perch-Niesen et al. (2010) found this approach to be inaccurate in Switzerland compare to the bottom-up approach. However, Hawaii and Spain found this approach useful to assess the carbon footprint (Konan & Chan, 2010; Cadarso et al., 2015). Subsequently, if a destination is listed on the TSA, then this approach is useful for assessing the carbon footprint of tourism. Unfortunately, Ireland does not appear on TSA.

2.4.5 Hybrid Approach

A hybrid approach is sometimes considered to be the best approach as it combines the data and strengths from the bottom-up and top-down approaches. For example, improving the accuracy of carbon footprint calculations by replacing monetary data with physical data to solve the problem of price heterogeneity. In addition, this allows tourists behaviour (distance travelled, nights stayed) to be better modelled within the input-output framework (Becken and Patterson, 2009; Lin et al., 2013; Sun, 2014; Sharp, 2016). There is evidence of many destinations implementing a hybrid approach to assess the carbon footprint of tourism: Australia, Switzerland, Taiwan, Iceland, Spain and even the global tourism emissions (Dwyer & Spurr, 2010; Sun, 2014; Sharp, et al., 2016; Cadarso et al., 2016; Lenzen et al., 2018). Adoption of

hybrid input-output models for tourism, especially with respect to the treatment of aviation and accommodation by modelling flight-miles and room nights instead of monetary units, will reduce estimation errors.

The literature gives valuable insight and understanding of the advantages and limitations of different analytical approaches to assess the carbon footprint of tourism. For this study, it is necessary to conduct a comparative analysis of international tourism carbon footprint studies. To compare international findings and identify any similarities or differences. As a result, establishing if a baseline carbon footprint figure can be generated for tourism and identifying which approach will work best for assessing the carbon footprint of Irish tourism.

METHODOLOGY

The research methodologies conducted within this study comprises of a quantitative content analysis of Irish national plans and a comparative analysis of international tourism carbon footprint studies. As a result, utilizing the secondary data that is publicly available. A content analysis is a scientific tool and the only research methodology used to determine textual meaning. Krippendorff (2004, p18) defines the methodology as

'a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use'.

A content analysis draws conclusions from certain premises and samples through an inductive, deductive or abductive process (Gheyle & Jacobs, 2017). This analysis can have a quantitative or qualitative approach. Quantification is important in many scientific studies and is a deductive approach that is categorised by a priori coding scheme, then described using statistical tools. In contrast, qualitative is an inductive approach that has proven successful, particularly, in political, psychotherapeutic, ethnographic, discourse and computer text analysis (Krippendorff, 2004; Gheyle & Jacobs, 2017). It is not pre-defined and requires the construction of categories whilst reading through texts, and then these findings are coded.

This research conducted a quantitative content analysis of major Irish national plans, to determine the current state of play concerning the carbon footprint of Irish tourism. The content was extracted and categorised, with the aim of identify to what level the carbon footprint of Irish tourism has been discussed, assessed and planned for decarbonisation by the state.

Additionally, a comparative analysis is used to understand the complex phenomenon by identifying similarities and differences in studies (Rihoux & Ragin, 2009). Hantrais(2008) states that

'comparative research is the term widely employed to describe studies of socities, countries, cultures, systems, institutes, social structures and change over time and space, when they are carried out with the intention of using the same research tools to compare systematically the manifestations of phenomena in more than on temporal or spatial sociocultural setting'.

For this study, a comparative analysis of international studies was completed to distinguish similarities and differences between international tourism carbon footprint studies, both at regional and national levels. As a result, identifying if there is a baseline carbon footprint of tourism by comparing international data and identifying which approach will work best for assessing the carbon footprint of Irish tourism.

FINDINGS AND DISCUSSION

According to Scott (2021) tourism plans lack climate change content and strategy. Climate action plans for tourism destinations remains rare. Therefore, it is necessary to conduct a quantitative content analysis of relevant Irish National plans, as seen in Table 1. To determine the level of discussion and planning to decarbonise the tourism industry in Ireland. The content that was related to carbon footprint and decarbonising the Irish economy was extracted from the 35 Irish national plans, then it was categorised accordingly, to recognize the extent of how many national plans discuss the extracted content, as illustrated in Table 2.

Table 1. A quantitative content analysis of Irish national plans

National Discussions and Plans in Ireland	
The Irish Government	
Tourism Recovery Plan 2020 - 2023	(Tourism Recovery Taskforce, 2020)
Tourism Action Plan 2019-2021	(Department of Transport, Tourism and Sport, 2019)
Climate Action Plan 2019	(Government of Ireland, 2019)
Project Ireland 2040 2019	(Government of Ireland, 2018)
Project Ireland 2040 The First Year: Annual Report 2018	(Government of Ireland, 2019)
National Mitigation Plan 2017	(Department of Communications, Climate Action and Environment, 2017)
Ireland's Transition to a Low Carbon Energy Future 2015-2030	(Department of Communications, Energy and Natural Resources, 2015)
PEOPLE, PLACE AND POLICY GROWING TOURISM TO 2025	(Department of Transport, Tourism and Sport, 2015)
The National Energy Efficiency Action Plan 2017-2020	(Department of Communications, Climate Action and Environment, 2017)
National Peatland Strategy	(Department of Culture, Heritage and the Gaeltacht, 2018)
National Biodiversity Plan 2017-2021	(Department of Culture, Heritage and the Gaeltacht, 2017)
National Aviation Policy	(Department of Transport, Tourism and Sport, 2015)
National Renewable Energy Action Plan	(Government of Ireland, 2009)
BIOECONOMY IMPLEMENTATION GROUP 2019	(Department of Communications, Climate Action and Environment and Department of Agriculture, Food and the Marine, 2017)
Fáilte Ireland	
Fáilte Ireland Tourism Destination Towns Guidelines	(Fáilte Ireland, n.d)
Fáilte Ireland Climate Change: Our Carbon Strategy 2012	(Fáilte Ireland, 2012)
Fáilte Ireland & Heritage Council: Climate Change, Heritage & Tourism 2009	(Fáilte Ireland, 2009)
Fáilte Ireland Ecotourism Handbook	(Fáilte Ireland, 2009)
Fáilte Irelands Green Marketing Toolkit 2011	(Fáilte Ireland, 2011)
Fáilte Ireland a Strategy for Investment 2016-2022	(Fáilte Ireland, 2016)
Fáilte Ireland Environmental Sustainability in Business	(Fáilte Ireland, n.d)
Fáilte Ireland Driving Tourism Sustaining Communities 2017	(Fáilte Ireland, n.d)
Fáilte Ireland Ecological Survey 2018	(Fáilte Ireland, 2019)
Fáilte Ireland Food Tourism Activity Plan 2014-2016	(Fáilte Ireland, n.d)
Visitors Attitudes on the Environment 2008	(Fáilte Ireland, 2012)
Fáilte Ireland Reducing your utility costs in 2012 Can you afford not to?	(Fáilte Ireland, 2012)
Water Management Minimisation Good Practice Guide 2018	(Fáilte Ireland, n.d)
Fáilte Ireland Annual Report 2018	(Fáilte Ireland, 2019)
Fáilte Ireland Annual Report 2017	(Fáilte Ireland, 2018)
Fáilte Ireland Annual Report 2016	(Fáilte Ireland, 2017)
Climate Change Advisory Council	
Annual Review 2019	(Climate Change Advisory Council, 2019)
Irish Tourism Industry Confederation	
Tourism an Industry Strategy for Growth to 2025	(Irish Tourism Industry Confederation, 2018)
Environmental Protection Agency	
Ireland's National Inventory Report 2019	(EPA, 2019)
Sustainable Tourism Development	(EPA, 2007)
Personal & Household Carbon Calculators 2020	(EPA, 2020)

Table 2. Categorised content extracted from Irish national plans

Constructed Category	Extracted Content	Percentage of plans that mention extracted content
Tourism	Carbon Footprint of Irish Tourism	0%
	Decarbonise Tourism	0%
	Sustainable Tourism	51%
Economy	The Government involvement (e.g., investment, policy, regulations etc.)	71%
	Local Authorities involvement	69%
	Circular Economy	11%
	Carbon Neutrality/ Low Carbon Economy	46%
	Sharing Economy	11%
	Bioeconomy	17%
	Educate / Training/ Research	77%
	Collaboration for sustainability	60%
Planning	Short-term Planning	43%
	Long- term Planning	74%
Climate Change/ Emissions	Climate Change Mitigation & Adaptation Strategies	54%
	Biodiversity	43%
	Greenhouse Gases	49%
	Environmental impacts	66%
	EU Emissions Trading Scheme (ETS)	26%
Carbon	Carbon Policy/ Regulation & Legislation/ Practice	69%
	Carbon Footprint	31%
	Carbon Management	14%
	Carbon Offsetting	14%
	Decarbonising	26%
	Carbon Capture/ Storage / Sink	29%
	Carbon Sequestration/ Absorption	26%
	Carbon Budget	17%
	Carbon Tax/ Pricing	20%
	Carbon Credits	9%
Technology, Infrastructure, Energy	Reduce Water, Energy and Waste Consumption	34%
	Low Carbon/ Sustainable Renewable Technology	46%
	Low Carbon/ Sustainable Buildings/ Infrastructure	40%
	Low Carbon/ Sustainable Funding/ Investment/ Mortgages	23%
	Retrofitting	26%
	Renewable Energy/ Heat/ Bioenergy	40%
Transport	Aviation Emissions Reduction Solutions	20%
	Reduce Travel Distance	14%
	Sustainable Mobility	11%
	Veloroutes/ Bike Lanes	9%
	Walking Routes	14%
	Reduce Reliance on Cars/ Car Traffic	14%
	Electric Vehicles	23%
	Alternative Fuel (Bio, Hydrogen)	31%
	Car Sharing	6%
	Public Transport	43%
	Zero Carbon Public Transport	14%
	Blueways	14%
	Greenways	34%
Consumers	Change Behaviour & Attitudes	40%
	Dietary Change	11%
	Sustainable Production, Management, Purchasing & Consumption	49%
Agriculture	Sustainable Agriculture/ Food Production	26%
	Agriculture Impacts	20%
	Agricultural Diversification	17%
	Holistic Planned Grazing	9%
	Forestry/ Afforestation/ Reforestation	40%

Initial findings from the quantitative content analysis indicate a serious gap in knowledge as the carbon footprint of Irish tourism has not been assessed and lacks serious discussion. Thus, proving reduction plans and recovery plans continue to ignore the tourism industry emissions (Dwyer & Spurr, 2010; Sharp, et al., 2016; Rico, et al., 2019; Dogru et al. , 2019). Only four government plans discuss sustainable tourism, and so the tourism industry lacks the appropriate and necessary knowledge to implement realistic decarbonising strategies for the tourism industry. Consequently, proving that Ireland's vision to transition towards a low-carbon economy, by 2050, will be difficult to achieve (Government of Ireland, 2015; Government of Ireland, 2017; Government of Ireland, 2019; EPA, 2020). In 2012, Fáilte Ireland stated their intention to assess the carbon footprint of Irish tourism, however, there has been no evidence of this assessment to date (Fáilte Ireland, 2012). Fáilte Ireland are advocates for sustainable tourism with 70% of their plans mentioning it. Yet, there is very little evidence and a serious lack of detailed discussions around the opportunities and strategies to decarbonise the Irish tourism industry. Moreover, there is very little information available, incentives or plans in place to influence the desired behavioural change of Irish tourists, Irish tourism stakeholders and the Irish tourism industry to assess, reduce or offset their carbon footprint. As a result, these findings confirm the previous research findings (Scott, 2021),that although there is evidence of ambition of countries committed to net-zero emission targets by 2050, it remains uncertain how these goals will be achieved. As a result, the Irish tourism industry cannot be considered sustainable as it has failed to assess the carbon footprint of tourism to determine appropriate decarbonisation strategies to mitigate climate change.

From completing a comparative analysis of international studies that assessed the carbon footprint of tourism, it was identified that there is still a need for a consistent and unified approach (Sun, 2014). As the international tourism carbon footprint data is not directly comparable across studies because there are no similarities between the analytical approaches used, the scope and system boundaries used in the studies (i.e. domestic, inbound, outbound and exports), the timeframe of assessment (i.e. a year or peak season) and units of measurement are different (i.e. CO2 only or CO2eq). Hence, yielding an inconsistent basis for comparison, as seen in Table 3.

Table 3. Comparative analysis of international studies assessing the carbon footprint of tourism at national and regional levels

Carbon Footprint of Tourism at a National Level											
Sourced Articles	Grimm et al. (2008)	Björnsson (2014)	Sharp et al. (2016)	Perch-Niesen et al. (2010)	Dwyer & Spurr (2010)	Sun (2014)	Cadarso et al. (2015)	Farreny et al. (2011)	Patterson & McDonald (2004)	Becken & Patterson (2006)	Kitamura et al. (2020)
Destination	**Mexico**	**Iceland**	**Iceland**	**Switzerland**	**Australia**	**Taiwan**	**Spain**	**Antarctica**	**New Zealand**	**New Zealand**	**Japan**
Analysis Approach	Internet based calculator	Bottom-up/ LCA	Hybrid	Hybrid	Hybrid	Top-down/ Input–output	Top-down/ Input–output	Bottom-up/ LCA	Hybrid	Hybrid	Hybrid
Scope of Impact	Direct	Direct	Direct & indirect	Direct	Direct, indirect & imports	Direct & indirect & imports	Direct & indirect & imports	Direct	Direct & indirect	Direct	Direct & indirect
Year Data Extracted	2007	2011 (Summer only)	2010-15 (2013 for average tourist)	1998	2003-04	2007	2007	2008-09	1997-98	1997-98	2017
Unit of Measurement	CO2eq	CO2	CO2eq	CO2eq	CO2eq	CO2eq	CO2	CO2	CO2	CO2	CO2eq
Total Carbon Footprint	-	-	6.4 Million tons CO2eq	2.29 Million tons CO2eq	54.4 Mt CO2eq	15 Mt CO2eq	6,219 kt CO2	198,843 Tons CO2	6.8 Mt CO2	2689 Kt CO2	136 Mt CO2eq
Average Tourist Carbon Footprint	7.218 kg CO2	50.2 kg CO2/ per day	1350 kg CO2eq	-	-	-	-	490 Kg CO2/ per tourist	-	-	-

Carbon Footprint of Tourism at Regional Level									
Sourced Articles	Grimm et al. (2008)	Sanyé-Mengual et al. (2014)	Rico et al. (2019)	Hoque et al. (2010)	Filimonau et al (2013)	Konan & Chan (2010)	WAWRG (2018)	WAWRG (2018)	WAWRG (2018)
Destination	**Majorca, Spain**	**Menorca**	**Barcelona, Spain**	**Queensland, Australia**	**Algarve, Portugal**	**Hawaii, USA**	**Clare, Ireland**	**Sligo, Ireland**	**Donegal, Ireland**
Analysis Approach	Internet based calculator	Bottom-up/ LCA	Bottom-up/ LCA	Hybrid	Hybrid	Top-down & input-output	Internet based calculator	Internet based calculator	Internet based calculator
Scope of Impact	Direct	-	Direct & indirect	Direct & indirect	Direct & indirect	Direct & indirect	Direct	Direct	Direct
Year Data Extracted	2007	2010-2011 (Summers only)	2015	2003-04	-	1997 & 2005	2017 (Summer)	2017 (Summer)	2017 (Summer)
Unit of Measurement	CO2eq	CO2	CO2eq	CO2eq	CO2eq	CO2eq	CO2	CO2	CO2
Total Carbon Footprint	-	-	9.6 Mt CO2eq	12.01-13.86 Mt CO2eq	-	5.2 Mt CO2eq	-	-	-
Average Tourist Carbon Footprint	94 kg CO2eq/ tourist per day	14.6 kg CO2/ tourist per day	96.93 kg CO2eq/ tourist per day	-	627.5 kg CO2eq/ tourist per day	-	218 kg CO2eq/ per tourist	118 kg CO2eq/ per tourist	158 kg CO2eq/ per tourist

The hybrid approach and CO2eq unit of measurement are the dominant choices amongst international studies and are internationally standardised. However, there is a need for a unified timeframe (i.e. assessing tourism data per year) and scope of impact (i.e. assessing direct and indirect emissions). Additionally, it was identified for the need for global TSA, as there is data available for only 70 countries. Consequently, barriers are created for implementing a unified approach.

CONCLUSION

In conclusion, it is evident that humankind is facing a climate crisis and global greenhouse gas emissions need to be reduced drastically and immediately to mitigate climate change. The UNWTO and tourism industry leader's rapid response to the COVID-19 crisis, with the establishment of a Global Tourism Crisis Committee, is needed to decarbonise the tourism industry to build climate-resiliency. For tourism, the transition requires improved communications and knowledge, increased research capacity, and strategic policy and planning engagement (Scott, 2021). The COVID-19 crisis has offered the tourism industry an opportunity to explore and frame the new, post COVID-19 sustainable strategies to build responsible tourism recovery plans. Furthermore, it offers an opportunity for countries to assess

and compare their carbon footprint data pre COVID-19 and post COVID-19; especially in the countries that have access to their TSA.

This study intended to enhance the understanding of the importance of assessing the carbon footprint of tourism whilst investigating the benefits and limitations of the different analytical approaches used to measure the carbon footprint. Tourism is a major contributor to greenhouse house gas emissions and is continuing to expand. Like all industries, the tourism industry is expected to decarbonise and to complete these reductions successfully, all industries need to analyse their carbon footprint in as much detail as possible. Policymakers need this detailed research information to ensure efficient resource allocation occurs and that appropriate mitigation and adaption strategies are implemented. Hence, it is essential for Ireland to assess the carbon footprint of the tourism industry to determine the progress being made to improve the environmental performances and to establish whether Irish tourism is transitioning towards a low-carbon industry.

Ireland has failed to meet the greenhouse gas emissions reduction targets for the last four consecutive years and has the third-highest emissions in the European Union, at 13.3 tonnes of CO2eq per capita (CSO, 2019). In 2019, the Irish Government launched the first Climate Action Plan to drastically reduce emissions and transition towards a low-carbon economy, by 2050. However, from completing a quantitative content analysis this study identified that the carbon footprint of tourism has not yet been assessed and the tourism industry lacks serious decarbonisation discussion within all national plans pre COVID-19 and post COVId-19. Thus, Ireland is failing to seize the opportunity to restart tourism in a sustainable approach. As tourism cannot be considered sustainable it fails to decarbonise - to mitigate climate change (Scott, 2021). Moreover, a comparative analysis was conducted to compare the findings of international tourism carbon footprint studies. This study established the need for a unified: carbon footprint approach, scope impact, timeframe and unit of measurement - as the international studies could not be utilised to form a baseline carbon footprint for tourism. However, it was identified that the hybrid approach is the best approach to assess the carbon footprint, as they overcome the limitations of using only one approach.

Unfortunately, Ireland is unable to assess the carbon footprint of tourism by using the top-down approach or a hybrid approach due to the lack of economic data and Ireland, like many other countries, is not reordered under the TSA. Consequently, to assess the carbon footprint of Irish

tourism the bottom-up and LCA approach or the EPA recommended carbon calculator are the only assessment approaches that can be utilized by Ireland until the TSA are available.

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