Envisioning Tourism in 2030 and Beyond

The changing shape of tourism in a decarbonising world

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Foreword

Our starting point for this research was the need to better understand, or "envision", how the travel and tourism world will look in 2030 and beyond, as we transition towards a net zero emissions economy. The Travel Foundation, as a partner organisation for the Glasgow Declaration on Climate Action in Tourism, supports its call on all businesses, destinations and supporting organisations to make a plan and implement it. But how can any organisation effectively plan for the future if it doesn't know what that looks like?

Our intention is not to prescribe a roadmap or set of measures. We explicitly explored scenarios in which travel and tourism's projected growth could be compatible with achieving the climate targets laid out in the Glasgow Declaration, which stem from the Paris Agreement. The fact that there is only one future scenario that resembles business-as-usual in a decarbonising world - even with several pain points built in - does not make it the project team's recommended route. It simply makes it the reality we face.

We have delayed action for too long, and as a result, our options have narrowed. This assessment should act both as wakeup call and motivation to act. There is huge opportunity for travel and tourism in a decarbonising world, but we must act with urgency and unite in our vision for a "good" transition.

The big take home message is that we have moved into a new paradigm where the only option is systems transformation. We should therefore call out the many overly optimistic strategies and plans which assume – implicitly or explicitly – that we can carry on as usual in the (blind) hope that technology and offsetting will see us through.

We also want to bring attention to the need for fairness and equity in the way tourism transitions to net zero. The policies we draft, the investments we make and the products we develop will either exacerbate or lessen existing inequalities. Will vulnerable communities once again be handed the worst deal? Or will underrepresented voices be listened to and acted upon? We sought to include a diverse range of perspectives as we developed our analysis, but this is only the beginning of the discussion. And going forward we must further explore additional scenarios that complete our vision of 2030 -- and deeply consider what we must prioritise in order to build resilience for the many challenges ahead.

Let's also make it the start of significant collaboration to ensure tourism is part of the solution. A "good" transition is within our reach, but we need to think and act differently if we are to grasp it and make it reality.

Jeremy Sampson,
CEO, the Travel Foundation

Overview

The aim of this study is to explore what a thriving, decarbonising tourism sector could look like in 2030 and 2050. We used a systems dynamics model (GTTM^{dyn}) to test various decarbonisation pathways that would allow us to reach the targets outlined in the Paris Agreement. We have concluded that there is only one plausible decarbonisation scenario that would enable the tourism sector to continue to grow as expected, thereby maintaining its significant contribution to socio-economic development, while complying with the net zero target.

The GTTM^{dyn} model provides plausible future scenarios at the global scale. The model's scope includes direct emissions from the transport and accommodation industries, including all trips, domestic and international, of at least one night away from home, for holiday/leisure, business or visiting friends and family and by all modes of transport (air, car, other: rail, bus, ferry). The range of measures we considered were the following:

1. **Sustainable aviation fuel**
2. **Electrification and efficiency**
3. **Infrastructure improvements**
4. **Taxes and subsidies**
5. **Offsetting**
6. **Travel behaviour**
7. **Travel speed**

We found only one decarbonisation scenario that offers similar levels of growth in global revenue, trips and guest nights to the business-as-usual forecasts – roughly doubling all three by 2050 (+102% trips, +80% revenue, +91% guest nights), compared to 2019.

We called this future model the Tourism Decarbonisation Scenario (TDS). In this scenario, the shape of tourism changes due to a shift in transport modes and a reduction in distances travelled:

— **The biggest increases will come from shorter distance (up to 900 km return) trips and those by car, rail, coach and ferry. Shorter distance trips will be 81% of all trips by 2050 (increasing from 69% in 2019).**

— **Long distance trips (return journey >7,000km) will also grow but less quickly, and will account for 3.5% of all trips by 2050 (from 6.0% in 2019).**

— **In 2019, nearly all long-distance travel was by air, but in 2050 28.5% could be by other modes of transport, mainly high-speed rail.**

Achieving this future will be a significant undertaking, but failing to address it will result in even larger human costs and sectoral risks for travel and tourism. In the report we provide reflections on key issues and challenges that we will face in the Tourism Decarbonisation Scenario, and aim to spark further dialogue about the (radical) actions and challenging discussions related to:

— **What issues individual sectors of the travel industry need to consider and action**

— **The political and business will and the right incentives to invest, at a huge scale, in clean energy solutions for travel and tourism including sustainable aviation fuels, electrified railways, and net zero aircraft technology.**

— **What is fair in terms of who pays for this huge investment, and how.**

— **What is fair in terms of optimising global travel distribution, supporting countries which are most dependent on tourism and long-haul markets.**

— **Planning for a resilient, low carbon tourism based on a future that is far from business-as-usual.**

Introduction

The urgency of climate action is evident. According to the IPCC (2021), the remaining carbon budget that allows us to keep global temperature warming below 1.5C degree, as outlined in the Paris Agreement, is approximately 400 billion tonnes CO_2. At current levels of emissions, the remaining budget in average emitter countries will run out in 8 years, while high emitting countries will use up their share even faster.

Tourism is a major contributor to global climate change and the sector is set to continue growing rapidly in the coming decades. In a business-as-usual scenario, by 2050, tourism related emissions will rise steeply (up 73% compared to 2019). In such a scenario, tourism will use a staggering 66% of the remaining climate budget between 2023 and 2100. To avoid the devastating consequences of climate change, the world, including tourism, needs to halve its emissions by 2030 and reach net zero by 2050. The clock is ticking. As the UN (2022, para. 3) describes, ''transitioning to a net-zero world is one of the greatest challenges humankind has ever faced. It calls for nothing less than a complete transformation of how we produce, consume and move about."

While significant efforts have been made to unite the sector behind climate action, the implementation of strategies and tangible results are not numerous enough to adequately tackle climate change. The Glasgow Declaration on Climate Action in Tourism supports a global commitment to halve CO_2 emissions by 2030 and reach net zero by 2050. The declaration was launched at COP26 and aims to provide consistent global support and guidance for any stakeholder in travel and tourism to develop a practical climate action plan.

The Envisioning Tourism in 2030 report intends to support tourism stakeholders as they plan for a future that is consistent with global climate targets, by modelling what a thriving, decarbonising tourism sector could look like in 2030 and 2050.

Envisioning the future based on scientific knowledge and system dynamics modelling can help stakeholders in, and outside, the tourism sector to understand the global picture and plan for a net zero future. Therefore, this study aims to spark further dialogue about the (radical) actions and challenging discussions that are pivotal for the sector to succeed in its transition. The study outlines the only plausible decarbonisation pathway that allows the sector to grow, while complying with the targets in the Paris Agreement.

The **Tourism Decarbonisation Scenario (TDS)** in the report, which achieves net zero by 2050, does allow growth, but this deviates significantly from the traditional growth paradigm. Growth is redistributed across sub-sectors and geographies due to a modal shift and reduction in travel distances. Sub-sectors that are faster in their transition are prioritised while others taking longer are temporarily limited. The distribution of global tourism revenue will shift as well, making certain industries, such as the accommodation industry, benefit significantly. To speed up infrastructure development and the uptake of green energy resources, substantial amounts of investments are needed. However, instead of calling for more money to be invested in travel and tourism, we call for the redistribution and smarter and more equitable use of available investments, subsidies and resources. To enable such system-wide changes, political and institutional support and global collaboration to foster a fair and just transition are crucial.

— **The report starts with an outline of the status quo (Part 1) looking at the tourism sector's image related to climate change, its contribution to global emissions as well as to global commitments to climate action, the conditions that may foster or hinder reaching the goal at the global systems level and future scenario assumptions already made.**

— **In Part 2 we introduce the GTTM^{dyn} model that we used to create the Tourism Decarbonisation Scenario (TDS).**

— **In Part 3 we describe the shift from multiple pathways to the one plausible decarbonisation pathway that we found, and the related interventions needed.**

— **In Part 4, the anticipated sub-sector level implications of the TDS are introduced, followed by the implications of the changed conditions for tour operators, national tourism organisations (NTOs) and destination management organisations (DMOs). Moreover, the social, political and institutional acceptance of the scenario is reviewed. Last but not least, questions around global equity and fairness, a key component in the TDS, are addressed.**

List of Figures

1

The status quo

The tourism sector's image related to climate change

It has long been debated whether tourism is a blessing or curse. Similar to many of the socio-economic developments induced by tourism, the relationship between tourism and anthropogenic climate change is multifaceted. Tourism is known to be a significant contributor to global greenhouse gas emissions. This emissions contribution stems mostly from travellers from high-income countries and covers not only travel-related carbon footprints, but also other components of the tourism supply chain (e.g., the production and consumption of food and accommodation). While tourism has long been regarded as a viable economic growth strategy, boosterism policies of the past have led to the overexploitation of natural resources (Peeters et al., 2018) and the increase of harmful emissions. Although climate-change related impacts are widely known and often reported by the media, adaptive actions are slow and many of the costs remain unaccounted for (Epler Wood et al., 2019).

On the other hand, tourism is known to be a sector particularly sensitive to socio-economic and environmental impacts caused by climate change (Scott et al., 2012). As the United Nations World Tourism Organization declared it (World Tourism Organization (UNWTO) & United Nations Environment Programme (UNEP), 2008), climate change is the biggest threat to sustainable tourism development in the 21st century. Climate-induced changes are expected to alter the geographical and seasonal distribution of global tourism demand (Scott & Gössling, 2022b) thereby significantly impacting upon destination competitiveness and economic growth possibilities, putting the livelihoods of many at risk (World Tourism Organization (UNWTO) & International Transport Forum, 2019).

Tourism undoubtedly is a double-edged sword and, despite the fact the first debates about tourism and climate change were published back in the 1980s, it took decades for the topic to gain prominence in both academic and policy circles (Scott & Gössling, 2022b). Recently, the COVID-19 pandemic, social activism and increased government interest in destination management have strengthened calls for the decarbonisation of the sector. It is widely acknowledged however, that the decarbonisation scenario poses significant challenges to particular tourism sub-sectors, especially aviation (Gössling et al., 2021), the biggest contributor to tourism-related CO_2 emissions (World Tourism Organization (UNWTO) & International Transport Forum, 2019).

Despite the tourism system's strong adaptive capacity and its efforts to portray itself as highly committed to the climate agenda (Becken, 2019) progress has been criticised for:

- **a slow pace due to lack of concrete actions (Scott & Gössling, 2022a);**
- **a lack of coherence between tourism policy and national/global climate policy (Gössling & Lyle, 2021; Scott & Gössling, 2022b);**
- **the problematic accuracy of tourism climate indices (Scott et al., 2012);**
- **the measuring of sector emissions;**
- **knowledge gaps related to efficient decarbonisation strategies and the implications of various transition pathways (Scott & Gössling, 2022b);**
- **contested views over climate change (Atzori et al., 2019);**
- **and visitors' reluctance towards adopting pro-environmental behaviour (European Travel Commission, 2021; Lamers et al., 2018).**

While tourism is known to be a vehicle for economic development, it must be recognised that the traditional high-volume growth paradigm is incompatible with the decarbonisation scenario (Gössling & Higham, 2021). The challenge therefore lies in the identification of new business and destination management models that follow the net zero trajectory, while sustaining or even growing the sector's contribution to economic and social prosperity.

Although the challenge ahead of us is big, recent actions prove that unprecedented steps are being taken towards achieving the goal.

- **The French government recently banned short-haul flights on routes where other, less polluting alternatives are available. The action is expected to remove 12% of domestic flights.**
- **Austria has introduced similar policies (although as a condition for providing financial aid to Austrian Airlines), eliminating domestic flights where alternative travel options (under 3 hours) are available.**
- **Spain and Germany are considering taking similar steps.**
- **Germany, has doubled taxes on tickets for short-haul flights.**
- **In June 2022, the Dutch government became the first in the world to announce a reduced cap on airport capacity for environmental reasons.**
- **Several new routes have been launched for night-train journeys in Europe.**
- **The Spanish government has announced that all commuter and mid regional journeys of less than 300km run by the national rail operator Renfe will be free from 1 September until at least December 2023.**
- **Electric ferries have been pioneered in Norway. By 2026, western Norway's fjords will only allow zero-emission electric ferries, cruise ships, and tourist boats.**
- **NGOs and environmental activist groups have strengthened their response to greenwashing and misleading marketing practices as the recent lawsuit against KLM proves.**

The tourism sector's contribution to global emissions

In a review of the rapidly growing field of climate change and tourism scholarship, only 8% of articles examined greenhouse gas emissions/footprints (Scott & Gossling 2022). Therefore, while our understanding of sector emissions is improving, many uncertainties remain at tourism sub-sector and destination levels, particularly with respect to emissions related to travelling to destinations and supply-chains (scope three emissions).

To understand tourism's overall contribution to emissions, it is critical to recognise that empirical studies use different data sources, methodologies (e.g., input-output framework, life-cycle analysis), temporal periods (e.g., varying references), units of measurement (e.g., Mt, Gt, percentages), and emission scopes (e.g., direct, indirect), which collectively make comparisons "nearly incomparable" (WTTC, 2021a, p. 12). Nevertheless, a few commonalities across all academic publications include the significant role of air transport as the largest contributor to sectoral emissions, along with a projected increase in overall greenhouse gas emissions across all scopes. The need for robust and publicly available data (both emissions and tourism activity) is also consistently highlighted, along with an increasing call for robust measurements and extrapolations (i.e., systematic, representative, audited) across all geographic scales.

Global estimates of CO_2 emissions from travel and tourism vary depending on baseline, data sources, and methodology. The first global estimate was published in Scott et al. (2008), indicating that in 2005, 5% of global emissions were from the tourism sector, of which 3.7% is attributable to transportation. The study underscored that transportation represents the largest component of sectoral emissions at 75% (40% air, 32% car, 3% other transport), followed by accommodations (21%) and other tourism activities (4%). In a follow-up study, Lenzen et al. (2018) included the carbon embodied in sectoral goods and services (e.g., food, beverages, retail shopping), increasing tourism's carbon estimate to 8% of global greenhouse gas emissions (from 3.9 to 4.5 Gt-CO_2e between 2009 and 2013). The study similarly found that the transport sector generates the largest share of the total (49%), with new insights on the high contribution of retail (12%), as well as food and beverage services (10%). Importantly, the study found that most of tourism's carbon footprint is exerted by, and in, high-income countries. For example, approximately 50% of the global tourism footprint is caused by travel between countries with a per capita GDP of more than US$25,000, with the United States topping the carbon footprint ranking.

Gossling and Peeters (2015) note that vast differences in estimates, of up to three orders of magnitude, are evident in the literature (e.g., emissions per tourist trip can vary between 0.001 and 9.3t CO_2), with overall data indicating that both cruise and air travel are the major emission factors (e.g., private aircrafts or super yachts will result in considerably larger emissions per tourist trip, along with longer distances travelled). In 2016, the United Nations World Tourism Organisation (UNWTO) and the International Transport Forum (ITF, 2019) estimated that 5% of overall global emissions was from transport-related international and domestic tourism (or 22% of global transport emissions), with a larger share of emissions from aviation in the former and surface transport in the latter. Simonsen et al. (2018) estimated that in 2016, global cruise tourism emitted 24-30 million tonnes of CO_2, with per passenger trip emissions ranging from 1.2 to 9t CO_2 (Walnum, (2011); Lamers & Amelung (2007), respectively).

Looking forward, all available studies forecast a growth in sectoral CO_2 emissions. Lenzen et al. (2018) projects that, by 2025 under a business-as-usual scenario, a 3% growth pattern would lead to tourism-related emissions of 6.5 $GtCO_2e$, and under a "very optimistic assumption" the carbon footprint can be limited to 5$GtCO_2e$. The UNWTO (2019) estimates that tourism's greenhouse gas emissions will increase to 5.3% of the global total by 2030, with transport-related emissions from international tourism expected to grow by 45% from 2016 (458 to 665 million tonnes of CO_2), primarily from air travel which will represent over 86% of emissions in 2030s across all regions. Transport-related emissions from domestic tourism are also projected to increase (+21% from 2016 to 2030), with shifts across all transport types (aviation, cars, rail) depending on region (UNWTO 2019).

Overview of global commitments to climate action in travel and tourism

Global Declarations

Djerba Declaration on Tourism and Climate Change, 2003

Davos Declaration, 2007

Glasgow Declaration: A Commitment to a Decade of Tourism Climate Action, 2021

Tourism Commitment Examples

Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)

Call to Action for Decarbonization of Shipping (Getting to Zero Coalition, supported by CLIA)

Net Zero Methodology for Hotels

SUNx Malta's Climate Friendly Travel Framework

Tourism Declares a Climate Emergency

Cross–Sector Commitment Examples

B Corp Climate Collective

Cities Race to Zero initiative

Science-Based Targets initiative

SME Climate Hub

UNFCCC Race to Zero

To date, there have been three major tourism declarations on tourism action and climate change: Djerba in 2003, Davos in 2007, and finally the "Glasgow Declaration: A Commitment to a Decade of Tourism Climate Action" in 2021. In support of the Paris Agreement, the Glasgow Declaration was developed as "a catalyst for increased urgency about the need to accelerate climate action in tourism and to secure strong actions and commitments to support the global goals to halve emissions over the next decade and reach net zero emissions as soon as possible before 2050" (One Planet Sustainable Tourism Programme, 2021). Drafted by UNWTO, UNEP, VisitScotland, Tourism Declares a Climate Emergency, and The Travel Foundation, with inputs from 30+ organizations involved with the One Planet Network, the declaration recognises that the window of opportunity to take action to avoid worst-case scenarios is closing. Tourism stakeholders are asked to become signatories to the declaration by agreeing to the following:

- **"As signatories we commit to deliver climate action plans within 12 months of signing and implementing them accordingly;**
- **If we already have plans, we commit to updating or implementing them in the same period to align with this declaration;**
- **We commit to report publicly both on progress against interim and long-term targets, as well as the actions being taken, at least annually" (One Planet Sustainable Tourism Programme, 2021).**

To ensure alignment, five pathways for the climate action plans are outlined: measure, decarbonise, regenerate, collaborate, and finance.

The Glasgow Declaration creates a collaborative spirit around needed action, especially for those stakeholders who have joined the sector in the last 15 years, and brings in

important concepts of a "just transition" and calls for transparency (Scott et al., 2021). Based on the lessons of the previous "declaration", how the sector mobilises to create an enabling environment for integrated policy, expands upon challenging but realistic actions, fills critical knowledge gaps, and brings underrepresented voices and solutions to the table will determine the achievability of Glasgow Declaration targets.

Examples of how the tourism sector has mobilised include:

— **CORSIA**
The Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) holds voluntarily participating International Civil Aviation Organization (ICAO) member states (of which there are 115 committed from January 2023) to offsetting obligations as a complement to carbon reduction measures through to 2035 (ICAO, 2022). CORSIA has the goal to "stabilize international civil aviation at net CO_2 emissions at 2019 levels, from 2021" (IATA, 2022) meaning only emissions rising above the 2019 level need to be offset. Consequently no offsetting will happen for any airline until the airline fully recovers from COVID-19. Furthermore, CORSIA is meant to be a stopgap, until low-emissions technologies are widely available. Participation will be mandatory for high-emitting air travel countries starting in 2027, though many have opted to begin participation in 2021. Of note, Brazil, Russia, India, and China are choosing not to opt in until it is mandatory in 2027 (ICCT, 2020). Emissions units approved by ICAO's technical advisory body align with internationally accepted certification criteria, yet there is continued debate about the general effectiveness of offsets as we discuss in a later chapter.

— **The Cruise Lines International Association (CLIA)**
CLIA committed on behalf of global cruise lines in 2018 to reducing carbon emissions globally by 40% by 2030 against a 2008 reference (CLIA, 2018), and in 2022 announced it is on track for the 40% reduction and pursuing net zero by 2050 (CLIA, 2022a), utilizing advanced technologies and investing in research and development. The effect of these efforts remains to be seen, as challenges with measurement, uncertain availability of advanced technologies, the long lifetime of the current global fleet, and reporting continue. CLIA chairman, Pierfrancesco Vago, makes clear that the cruise industry's journey to net zero requires governments and policymakers to encourage investment and innovation of sustainable fuels at scale and to develop required infrastructure on land (CLIA, 2022b).

— **Tourism Declares a Climate Emergency**
Tourism sector stakeholders from destinations, accommodations, inbound and outbound tour operation, online travel agencies and travel agencies, non-profits, academia, etc. have also rallied around shared commitments. Tourism Declares a Climate Emergency ("Tourism Declares") was launched in 2020 as a way for tourism sector stakeholders to mobilise and commit to climate action planning based on the latest science, bringing them into a community of knowledge-sharing and empowerment. Signatories to Tourism Declares commit to delivering a climate action plan within 12 months of signing, report on progress, share information across networks, and work in collaboration with other signatories. (Tourism Declares, 2022). Tourism Declares was part of the drafting team of the Glasgow Declaration, and the signatory requirements are aligned.

— **Net Zero Methodology for Hotels**
While not a commitment, worth mentioning is the Net Zero Methodology for Hotels, developed jointly between Tourism Declares, Greenview, the Pacific Asia Travel Association (PATA), Sustainable Hospitality Alliance, and the World Travel & Tourism Council (WTTC), which offers guidance to support hotels and the wider hotel industry as they make net zero commitments and seek to achieve them. The methodology sets out a recommended approach for hotels of any size that can be adapted and includes milestones to achieve every five years (Greenview, 2021).

— **SUNx Malta Climate Friendly Travel Framework**
SUNx Malta's Climate Friendly Travel Framework utilises a four-step approach for any tourism stakeholder or community to transform to low-carbon, SDG-linked, 1.5-degree operations, in a way that works for them. Noting the limited engagement of travel and tourism stakeholders in Nationally Determined Contributions and the UNFCCC Registry of climate neutral ambitions, SunX Malta aligned with the UNFCCC to serve as a conduit to the registry. Participating travel and tourism stakeholders commit to climate friendly travel, establish "fact-based" measurements, create a 2050 plan, file the plan in the travel registry, and receive support on their journeys (SunX Malta, 2022). Options exist within both Tourism Declares and the Climate Friendly Travel Registry for those entities that already have plans.

— **United Nations Framework Convention on Climate Change (UNFCCC) Race to Zero**
In addition to these tourism-specific options, tourism stakeholders are actively engaging with robust, cross-sector net zero commitment programs, such as UNFCCC's Race to Zero, a coalition of leading net zero initiatives for non-state actors. Participating net zero initiatives and networks are carefully vetted to become partners and include programs such as the B Corp Climate Collective, the Science-Based Targets initiative, the SME Climate Hub, and the Cities Race to Zero initiative, among others, which offer a range of supports for stakeholders with different needs (UNFCCC, 2022).

In summary, there is no shortage of net zero commitment programs and support communities of which tourism sector stakeholders can choose to be a part. However, like the sector itself, the engagement opportunities appear fragmented and confusing. The tourism sector would benefit from unified clarifications and guidance on each program, including benefits for different types of stakeholders, limitations, and expectations. Navigating the programs and support communities must be as straightforward as possible to achieve buy-in at the scale required.

Overview of conditions that may foster or hinder reaching the goal at the global systems level

The decarbonisation of the global economy is dependent on a range of interrelated economic, technological, social, political and institutional factors that may act as drivers or barriers (Intergovernmental Panel on Climate Change (IPCC), 2021). Given the significant role tourism plays in global economic development, the transition to a low carbon economy will require the sector to fully align its policies and actions with the global climate agenda (Scott & Gössling, 2022b). To succeed, tourism needs effective and just climate policies as well as collaboration at the local, national, regional and global scale.

Technology - financial, economic, political barriers

Amongst drivers of change, technological advancements are probably the most pertinent. Tourism, and especially the accommodation and aviation industries, have largely benefited from the deployment of low carbon technologies (Becken, 2019). As stated by the International Tourism Partnership (2017), the technology currently available is sufficient to completely decarbonise the hotel industry. Smart building designs, energy-efficient appliances including lighting and motion sensors, low-flow water fixtures, the use of renewable energy sources, and smart systems for controlling heating, lighting and air-conditioning can help reduce the carbon footprint in hotels and other buildings (Becken, 2019; Schroeter, 2022). In the transport sector the electrification of all types of ground transport is gaining momentum. The deployment of electric cars, the electrification of mass transport (buses/coaches/passenger rail) and the development of electric vehicle charging infrastructure hold potential (Scott & Gössling, 2022a).

In terms of aviation technology, the main developments discussed in the literature are the deployment of sustainable aviation fuels (SAFs) and electric flights (Gössling et al., 2021). While in 2019, the amount of SAF produced globally was only 0.1% of the 300 million tons of jet fuel used in commercial aviation, there is a possibility that by 2030 SAFs can cover (still only) 1% of global jet fuel demand (World Economic Forum, 2020). However, due to resource limitations, the implementation of projects is relatively slow. Several countries such as Norway, Finland, Sweden, France, Spain, and Germany have, or are planning to introduce SAF obligations (World Economic Forum, 2020). A range of other technological solutions focus on reducing the weight of the aircraft while improving their fuel efficiency, optimizing routings or training pilots (International Civil Aviation Organization (ICAO), 2016).

While these technological developments may act as catalysts of change there are a range of challenges that need to be overcome. First of all, the wide-scale adoption of these technologies is slow due to financial, economic and political challenges. Furthermore, some of the new technologies are still in a preliminary phase and will take time to be fully developed (Scott & Gössling, 2022a). It is also widely accepted that, without strong policies, emissions growth is likely to continue (e.g., it is expected that emissions from aviation will double or triple by 2050 (ICAO, 2020)), outpacing current decarbonisation efforts. Finally, to succeed, technological advancement should be accompanied by management and behavioural innovation, which is rarely the case (Becken, 2019).

Traditional growth paradigm

The traditional growth paradigm is one of the main factors that hinders wide-scale transformation. The global tourism system has mostly been defined by the desire for growth of the distances tourists travel. This is clearly shown by the relatively strong growth of medium- and long-haul markets and air-based travel with which the decarbonisation scenario is largely incompatible. This trend has been enabled by a desire to travel further (Peeters, 2017) and the low cost and high speed of air travel. The size of the sector makes it possible to advocate for growth, as tourism is portrayed as a vehicle of socio-economic development. However, when economic interests are so strong, and power is often accumulated in the hands of the few, shifting to alternative business models (e.g. shorter distances travelled or alternative modes of transportation) is difficult to achieve. Therefore, shifting away from the pursuit of purely economic gains is an important condition, requiring public sector interventions.

Government support and policy innovation

Without doubt, government regulation and policy innovation are needed to reach global climate goals. However, government support, as a requirement to foster change, is largely missing (Scott & Gössling, 2022a). While in recent years government interest in destination management has increased (Becken, 2019; World Travel and Tourism Council, 2021b) as well as the number of science-based targets, subsidy schemes and policies aiming at mitigating climate risk, government interventions remain limited (Scott & Gössling, 2022a). Furthermore, most climate mitigation polices are made within environment, or other policy domains. Often, tourism policies are misaligned with those environmental policies leading to transition risks that are not well-understood. This points to the need for integrated tourism policymaking.

Behaviour change

Organisational behaviour change (Lamers et al., 2018) and commitment to act in both the supply and demand side are crucial preconditions to halving emissions by 2030 and reaching net zero by 2050. While the number of climate pledges has increased significantly, indicating a stronger sense of corporate, government and social responsibility, the number of actions taken remain somewhat behind. Various conditions may foster, or hinder, behaviour change of actors along the tourism supply chain. Some of the conditions have been outlined above, however one factor that plays a crucial role is demand. Influencing pro-environmental behaviour of travellers is a very complex matter and, as several studies show, willingness to adopt sustainable travel behaviour remains low (see e.g., European Travel Commission, 2022). Behaviours can change, but mainly due to changes in supply and regulations (Papp et al., 2022). Therefore, businesses need to take the lead and shape demand by adjusting their product portfolios and operations, leaving sustainability as the only choice.

Review of future scenario assumptions already made

COVID-19 led to a 7% reduction in greenhouse gas emissions globally in 2020, providing "a tangible reference to the magnitude of effort still ahead in order to achieve the goals of the Paris Agreement, which will require around 7% reduction of emissions on an annual basis throughout the next decade" (UNWTO, 2021). As UNWTO previously acknowledged, "tourism must advance by decoupling growth from emissions in order to grow within the agreed targets. Transforming tourism for climate action requires embracing a low-carbon pathway with awareness and optimization as key elements" (UNWTO, 2019).

A number of attempts have been made by tourism sub-sectors to develop future scenarios for tourism, providing critical orientation and guidance on the net zero journey. As is often the case with tourism, fragmentation in the sector creates alignment challenges, and the success of a net zero approach is subject to political, legal, economic, demographic, social, and technological influences (Vorster et al., 2012).

In 2012, three possible 2050 scenarios for long-haul tourism in the context of climate change were put forward by academia, two of which were "feared" or "undesirable" and one of which was "desired" (Vorster et al., 2012). The future scenarios developed include: i) to decarbonise and grow (green lantern); ii) to do nothing, grow in the short term, but eventually face Armageddon (grim reaper) iii) to do too little too late and slow down (fallen angel). Each pathway has its own assumptions and is dependent on certain conditions. Achieving the green lantern scenario requires strong and innovative leadership from governments and business, and behaviour change from tourists. Vorster et al. (2012) warn that stakeholders must prepare for the feared or undesirable scenarios, and that the only certainty in scenario planning is uncertainty.

With recognition that aviation is the largest source of carbon emissions in the tourism sector, Vorster et al. point out that due to the long lead-times in technological developments in the sub-sector, many of the "technological, infrastructural and operational efficiency improvements that will reach maturity by 2030 are already in the pipeline. The major uncertainty in terms of decoupling aviation growth from emission growth relates to the period of 2030 to 2050".

The aviation sector has generated several scenarios and roadmaps, including July 2022's Making Net-Zero Aviation Possible, a 1.5 degree-aligned, industry-backed aviation sector transition strategy offered by the Mission Possible Partnership (MPP), led by the Energy Transition Commission, the Rocky Mountain Institute, the We Mean Business Coalition, and the World Economic Forum. The Aviation Transition Strategy builds upon many initiatives announced for air travel, including:

- **Waypoint 2050, Air Transport Action Group (highlighted below)**
- **Report on the Feasibility of a Long-Term Aspirational Goal (LTAG) for International Civil Aviation CO_2 Emissions Reductions, ICAO (highlighted below)**
- **Decarbonising Air Transport, International Transport Forum (ITF)**
- **Horizon 2050: A Flight Plan for the Future of Sustainable Aviation, Aerospace Industries Association (AIA) and Accenture**
- **Destination 2050, European aviation industry associations**
- **2021 Aviation Climate Action Plan, US Federal Aviation Administration**
- **PtL [Power to Liquid] Roadmap, government of Germany**
- **Decarbonisation Road-Map, Sustainable Aviation for the United Kingdom**
- **Roadmap to Climate Neutral Aviation in Europe, Transport & Environment**

Making Net-Zero Aviation Possible looks at two scenarios through to 2050, against a business-as-usual scenario. The first, termed "Prudent," includes utilization of technologies that are either currently on the market or will be in coming years. The second scenario, "Optimistic Renewable Electricity," includes access to "abundant and cheap clean electricity," which allows for faster than expected adoption of electricity-based technologies (Mission Possible Partnership, 2022).

Waypoint 2050, developed by the Air Transport Action Group (ATAG), the commercial aviation industry body, offers three scenarios for how aviation could "use technology, operations, infrastructure, sustainable aviation fuels, and out-of-sector carbon reductions" to reach net zero by 2050 (2021). The scenarios include: 1) "pushing technology and operations," 2) "aggressive sustainable fuel development," and 3) "aspirational and aggressive technology perspective." Recognizing that air transport emissions fall into the "hard to abate" emissions category (Citigroup, 2021), in addition to industry efforts, Waypoint 2050 "assumes the right level of support from governments, the finance sector, the energy industry and research institutions" (Air Transport Action Group, 2021).

The ICAO's Committee on Aviation Environmental Protection (CAEP) released the Report on the Feasibility of a Long-Term Aspirational Goal (LTAG) for International Civil Aviation CO_2 Emission Reductions in March 2022. An observation is made in the report that, while significant emissions reductions are possible, none of the scenarios reach zero emissions by sector efforts in technology, operations, and fuels alone. It is also noted that while three scenarios are offered, any

number of technological, operational, and fuel improvements may result in alternative paths that achieve similar results. Looking at these factors, scenarios offered represent: 1) "high readiness/attainability and low aspiration," 2) "middle readiness/attainability and middle aspiration," and 3) "low readiness/attainability and high aspiration." The scenarios are contextualised in a baseline scenario, "which represent emission reductions through fleet evolution based on aircraft technology frozen at a 2018 level and with no additional improvements for operations and fuels" (ICAO, 2022).

Additional outlooks and guidance on specific types of aviation technologies and policies are offered by the World Economic Forum's Clean Skies for Tomorrow Coalition, including Delivering on the Global Power-to-Liquid Ambition, Sustainable Aviation Fuel Policy Toolkit, and Sustainable Aviation Fuels as a Pathway to Net-Zero Aviation. In May 2021, the International Energy Agency (IEA) released a detailed Net Zero by 2050 roadmap, with indirect inclusion of the tourism sector. Scott and Gössling (2021a) compiled the strategies related to tourism, in the areas of air, marine, rail, bus, and automobile transportation; hotels/motels, resorts, and other accommodation; agriculture; and cost of travel (i.e., carbon prices) and contend that if the tourism sector were to follow the IEA roadmap, it would be as "transformative for tourism as the internet was." However, there is a disconnect in that current "international air travel and tourism growth projections from the tourism sector are not compatible with the IEA net-zero scenario" (Scott and Gössling, 2021a).

In November 2021, the World Travel & Tourism Council (WTTC), UNEP, UNFCCC, and Accenture released A Net Zero Roadmap for Travel & Tourism, with industry profiles for accommodations, tour operators (asset light), tour operators (asset heavy), aviation, cruises, and online tour operators (OTAs) and travel agents, with inputs from 250 large companies. This comes twelve years after WTTC's first ambitious 2009 pledge that industry members would reduce carbon emissions by a minimum of 25% by 2020, when in fact emissions rose by 40% (Scott and Gössling, 2021b). By looking at the most comprehensive scenarios offered from within the tourism sector to-date, it can be determined that the "highly optimistic assumptions in the roadmap are not consistent with the IEA [International Energy Agency] (2021) and other net zero scenarios, nor the scientific literature on emission reduction in the sector" (Scott and Gössling, 2022b).

In conclusion, there is an urgent need for tourism researchers and the tourism sector to "assess the implications of Paris Agreement compatible emission scenarios for global tourism and determine which may represent preferable policy pathways that support more economically efficient or rapid tourism decarbonisation, and better support of tourism development consistent with the United Nations' Sustainable Development Goals (SDGs) and principles of climate justice" (Scott and Gössling, 2021a). Because climate mitigation polices and tourism policies are generally misaligned, policy makers need clear guidance about the challenges and opportunities for decarbonising the global tourism industry.

Perspective:

Netherlands Board of Tourism and Conventions (NBTC)

Perspective 2030, our guiding vision for the Netherlands towards 2030, has the sustainable development of the destination as its core premise. When published in 2019, the Netherlands Board of Tourism and Conventions (NBTC) decided to approach destination management from a whole new perspective: one that prioritizes the common interest of visitors, businesses and local residents alike. Ensuring that tourism in the Netherlands contributes to the prosperity and well-being of all Dutch people.

In Perspective 2030, sustainability plays a significant role. Sustainability is a must, we say. That is why NBTC, together with several other key stakeholders in the Netherlands, co-signed the Glasgow Declaration and, again with many partners, developed a roadmap towards Climate Neutral Tourism. In this roadmap we describe the responsibility we have, as a destination, to work towards climate neutral tourism. All the good that tourism can bring and which we want to stimulate, also carries the responsibility to mitigate the negative aspects as much as we can. It is clear that when it comes to the issue of climate neutrality, we still have a long road ahead of us.

On this road we sometimes encounter uncomfortable truths. The scenario put forward in Envisioning Tourism in 2030, might be one of those truths: that there is in fact, only one path towards meeting the goals set in the Paris Climate agreement and that even when following that path, we still might miss our targets for 2030. The measures put forward in this scenario are not easy to implement either: we need a significant shift in the way we travel, put a focus on shorter distance trips and do everything in our power to accelerate the development of more sustainable ways of travelling.

But while this all won't be easy, there is a lot of hope and perspective in this scenario as well. In this scenario, we see growth for the sector as a whole, both in number of trips and revenue. This scenario vehemently refutes the notion that tourism would have to cease to exist or that we should stop flying all together. This is important: we have to safeguard the values and positive impact travel can bring for future generations as well. This also means, however, that we need to start asking the right questions. Not if or what we should do, but how we can transition as fair and equitably as possible. It is all about how we can accelerate, create the right incentives and plan now for a resilient, low carbon tourism in the future.

Envisioning 2030 shows us that, however hard it is going to be to achieve this, this change will offer immense opportunities for destinations, businesses and travelers. We believe, therefore, that we should start this change right now and work together towards this new reality.

Ewout Versloot,
Strategist

2

Envisioning Tourism in 2030
Modelling scenarios for emission pathways

The GTTM^{dyn} model

Global tourism and transport can be considered a dynamic, complex system. To better understand the underlying relationships amongst components of the system, a systems dynamics model (SDM) can be used. For this specific research, the so-called GTTM^{dyn} model was applied.

The GTTM^{dyn} model provides estimations for the global tourism system (up to the year 2100), including all overnight trips, international and domestic. The main outcomes describe the annual global guest-nights, trips and passenger-kms per mode (air, car, other) and twenty distance classes, CO_2 emissions, revenues in tourism, tax income, and subsidy cost.

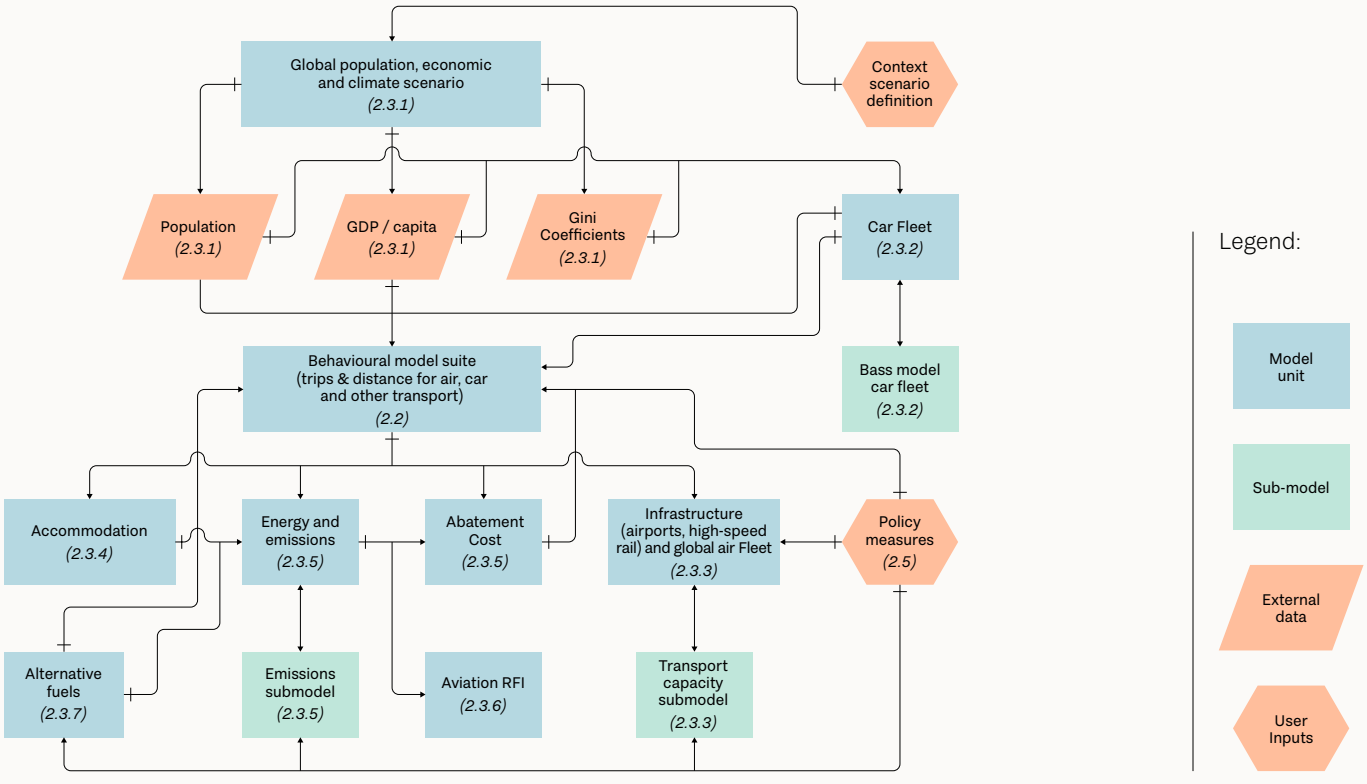
- The scope of the GTTM^{dyn} model is the tourism and related transport system. The model therefore includes all visitor flights, accommodation and travel by car or other transport mode (rail, ferry, bus), staying at least one night away from home for the purpose of holiday/leisure, business, or visiting friends and relatives.
- About 90% of the aviation sector serves overnight tourism (the other 10% of aviation is mainly freight). For the high-speed rail sector, tourism accounts for 20% to 40% of passengers. For the car industry and conventional public transport, the share belonging to the tourism sector is about 10%. In the GTTM^{dyn} model, public transport, high-speed rail, busses and ferries and similar alternatives are grouped under the category ''other'".
- Destination Management Organisations, National Tourist Organisations, tour operators and travel agents have comparatively low emissions and therefore are not calculated in the model. For example, emissions from tour operator offices are not included, but all emissions involved in the trips from their clients are.
- The model covers all direct (scope 1 and 2) emissions from the sector except those for tourism activities (excursions, visits to museums, etc.) and food. Food is excluded because it would require being able to assess the global difference between eating during travel, and eating at home.
- Scope 3 emissions for electricity and fuel production and logistics have also been included (emissions for food production, local tourism activities and events are excluded).

How does the GTTM^{dyn} model work?

The model is composed of a range of sub-models, and external data sources as shown in Figure 1. The model has an underlying database consisting of a suite of Microsoft Excel files that provide a variety of data inputs, ranging from calibrated model coefficients to socio-economic and demographic data and assumptions. The user of the model can choose from several global climate mitigation scenarios, logical combinations of a global emission pathway, and temperature rises. Each scenario generates abatement costs; the costs for reducing the emissions per ton of CO_2. It also includes assumptions about default (business-as-usual) technological developments like energy efficiency, emissions related to electricity production and infrastructure building, prices for transport and accommodation, and car, rail and air transport fleet characteristics. The model generates output for a large number of parameters, of which the number of trips, the distances travelled, the revenues, taxes and subsidies and of course the CO_2 emissions and radiative forcing, (the physical measure that determines the net heating of the atmosphere) are the most important.

The input for the model can be distinguished between exogenous (givens that fall outside the scope of the model), and endogenous (variables calculated within the model) elements. The main endogenous elements include abatement costs, number of trips by transport mode and distance class (60 in total) and total distances travelled, aircraft and car fleet sizes, aircraft-fleet age distribution, airport investments, airport capacity, high-speed rail network capacity, CO_2 emissions, radiative forcing, tourism revenues and expenditures, biofuel prices, (bio)fuel shares and technological developments for energy efficiencies and emission factors such as the function of carbon cost. Exogenous elements are global socio-economic growth in terms of GDP/capita, equity (GINI factor) and global population, the global emissions and associated temperature rise (global means for activities of humanity) ranging from 1.5°C to 4.5°C, reference technology development in terms of energy efficiency, emission factors, transport speed and aircraft utility, reference costs for accommodation, fossil and alternative fuels and energy, air tickets, rail and public transport tickets and high-speed rail investments. The model also includes some internal 'goals' to find an equilibrium for considerations such as aircraft seat-occupancy rate, airport capacity use and share of turboprops.

Figure 1. *Overview of the GTTM^{dyn} sub-model*[1]



[1] *Source: (Peeters, 2017). The numbers refer to sections in the source.*

The time horizon

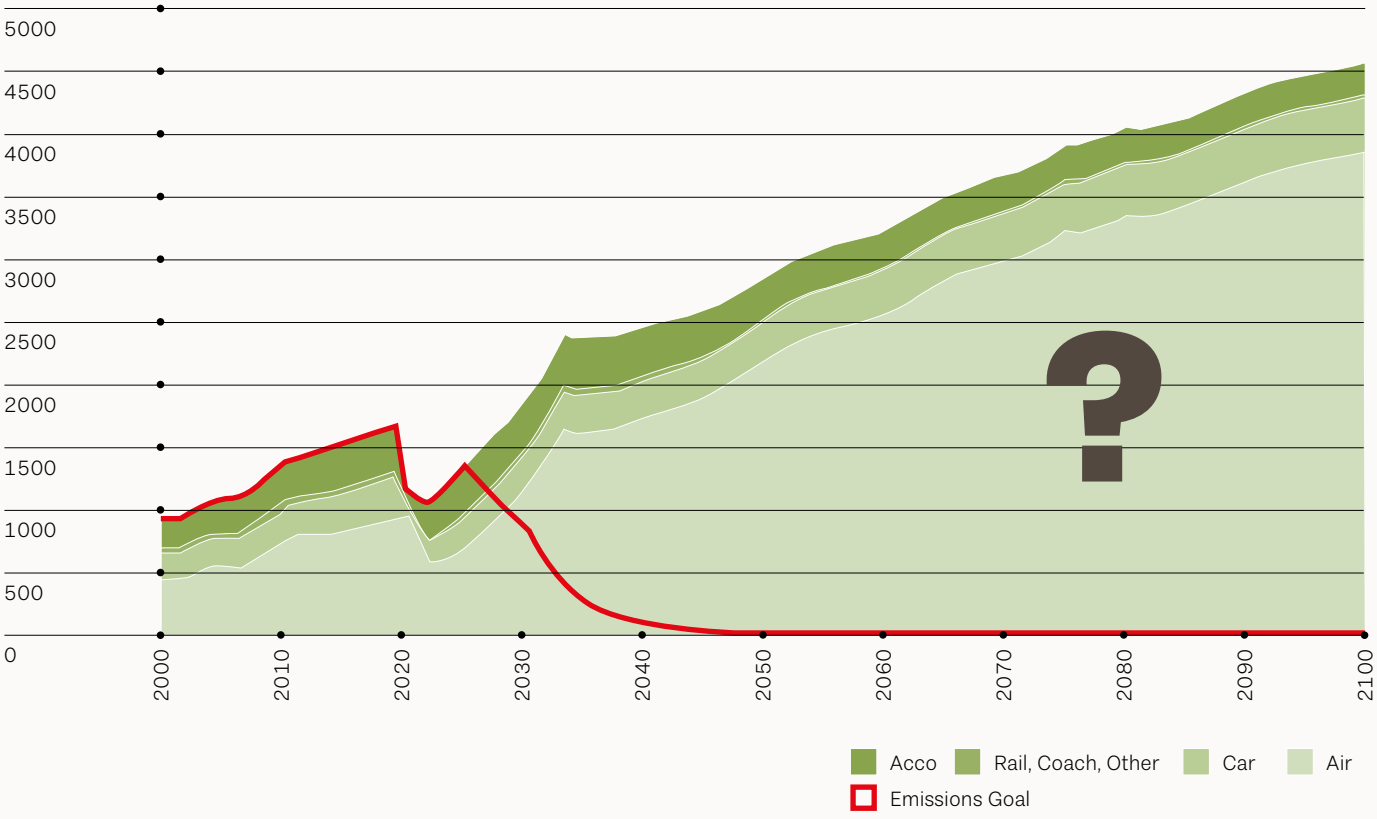
While socio-economic models normally have a time horizon of one or two decades, in this case, there is a need for a much longer timespan. Climate models have centuries-long time horizons because the processes and time lags between emissions and impact on temperature take long periods. For instance, whether the 2°C goal agreed in Paris is successfully met, can only be assessed by looking up to the year 2100 or even beyond. Likewise, the tourism system has some very long timespans between decisions taken now and impacts in the future. These decisions include development of infrastructure such as high-speed rail and airports, as well as the overall life-cycle of an aircraft type which may span many decades. Furthermore, infrastructure is used for up to a century. The sunk cost for such infrastructure is huge, which is a strong factor in the inertia of the system and the slow pace of change.

The GTTM^{dyn} model has a default setting, which delivers a reference, or business-as-usual (BAU), scenario. All policies and interventions are set to what is currently considered usual. This BAU scenario forms a basis for comparison of the pathways and scenarios we develop, but it also outlines the problem, the gap, that exists between emission-reduction goals and pledges and the BAU-development.

Figure 2. depicts the BAU development of CO_2 emissions between the year 2000 and the end of this century. Note, this BAU scenario also includes an assumption of an improvement in fuel efficiency of aircraft, trains and cars in line with past trends.

The 2019 crisis shows a clear dip in emissions, but following that, growth will continue up to the end of the century. The growth of tourism trips is mainly caused by the combination of income and population growth. The increase in distances travelled is caused by income growth and the continued reduced cost of air travel per passenger kilometre. Of course, such emissions growth is incompatible with reaching the 50% emission reduction in 2030 and net zero in 2050. The challenges are enormous.

Figure 2. *Business-as-usual (BAU) CO_2–emissions per main element of the tourism system*



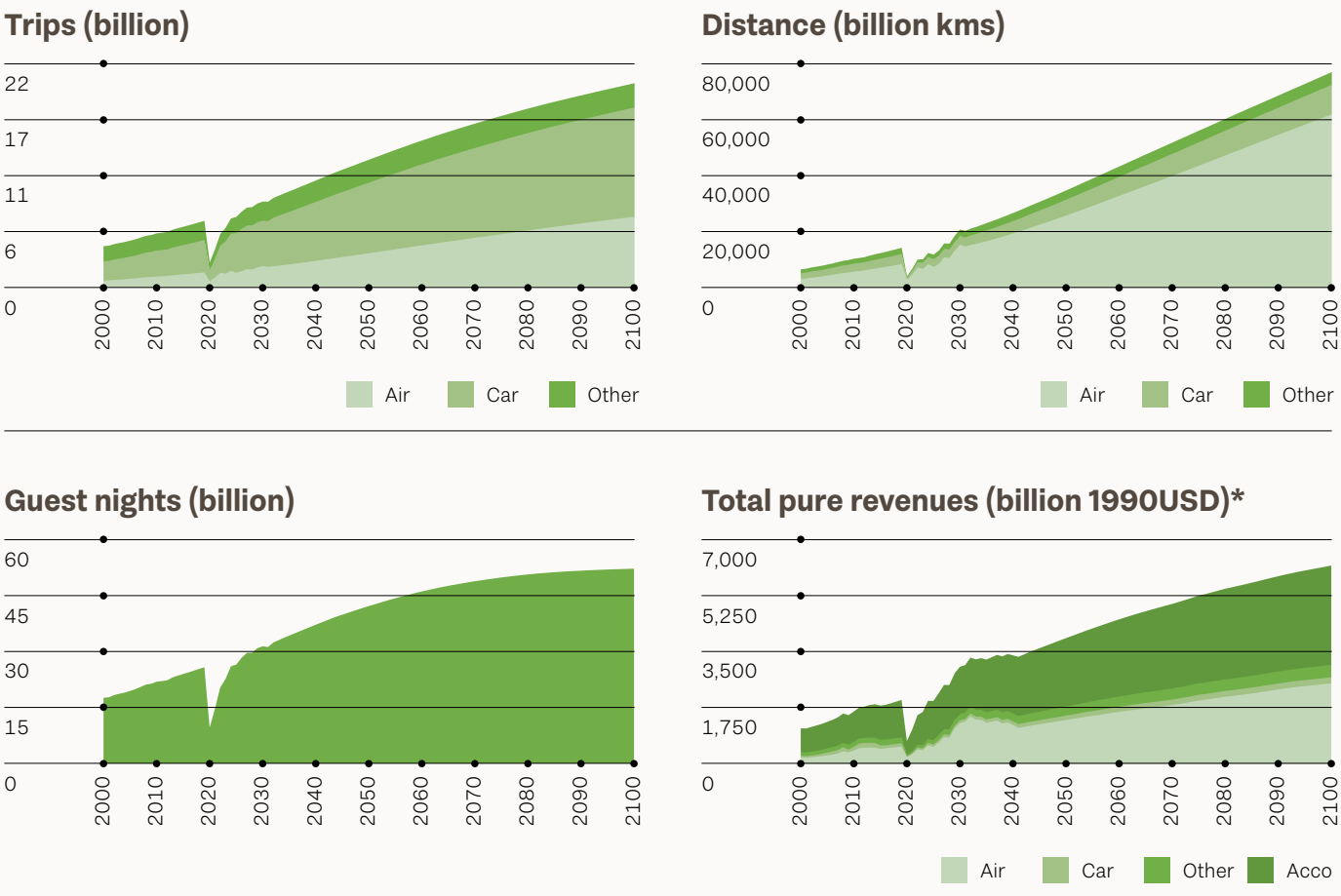
[2] *The red line is showing the tourism emissions goal.*

Choosing the reference year – 2019

When reducing emissions, the question immediately arises: reduction compared to what year? It is important to have a clear understanding of the impact of a chosen reference year on the challenge to reach the goal. Since tourism's emissions have continuously grown in the past decades, except for the period during the COVID-19 pandemic, the later the reference year, the less ambitious the reduction effort will be in the short-term. Unfortunately, there is no consensus on the reference year, but of course, the reference year will only move the emissions red line up or down in the year 2030, which means that it shifts the distribution of the reduction between the first decade and further decades up to 2050. This is because the final emissions always need to go to zero by 2050. In our study we use 2019 to align with the reference year set by the Glasgow Declaration for Climate Action in Tourism. Figure 2. clearly shows how far the BAU scenario is from the red line emission reduction goals in 2030 and 2050, with significant growth instead of significant reductions.

The GTTM^{dyn} model also provides a range of other information about the global tourism system. Figure 3. shows an ensemble of developments for the number of trips, distances travelled, guest-nights and tourism revenues in the BAU scenario. The number of guest-nights has the slowest growth (by 140% between 2000 and 2050), while the number of trips develops faster (210%) and the distances we travel increases much faster (430%). The average distance between home and destination per trip will increase from 1,100km in 2019 to almost 1,500km in 2050. The total revenue generated from tourism will grow between 2000 and 2050 by 260%. Another interesting observation is that when it comes to the number of trips the car dominates the picture, while when looking at distances travelled, this is air transport. But in terms of revenue, the most money appears to be made by the accommodation sector and not transportation.

Figure 3. *BAU scenario: development of trips by transport mode, distances travelled by transport mode, revenues by tourism sector and number of guest-nights*



* *Currency values are pegged at 1990 US Dollar prices to avoid issues of inflation. Translated to 2019, this would roughly double all values.*

What can be done to reach the 2030 and 2050 goals?

The GTTM^{dyn} model allows the user to choose from 40 different interventions in the global tourism system. The interventions include policies, measures, and assumptions and are arranged in five categories:

1 **Alternative fuels & energy sources:** Alternative fuels refer to four bio-fuel stocks and synthetic e-fuels for aviation while alternative energy refers to applying renewable electricity.
2 **Technology:** Efficiency improvements and electrification.
3 **Infrastructure policies:** Infrastructure policies which change the amount of investment in high-speed rail, or limit airport capacity.
4 **Travel speed developments:** As the mode of travel choice depends both on travel cost and travel time, the average speed of a transport mode is of importance and can be changed for all three categories in the model.
5 **Taxes & subsidies:** Taxes comprise carbon tax, individual taxes, and subsidies on transport modes.
6 **Travel behaviour:** The behavioural model of GTTM^{dyn} is formed by an extremely complex interplay between cost, travel time, psychological reference values and calibrated factors for the value of travel time and travel distance. The inclination to travel is based on a complex relationship between the average income per-capita and its distribution over the global population. Both the inclination to travel (number of trips per year) and the value of distance can be changed in the model. The value of distance factor is a rather new idea in modelling transport and travel choices. It represents the tendency that when people have to choose between two destinations that are equal in all aspects, except the distance to home, they generally prefer the destination furthest away. Furthermore, there has been a decline of the average length-of-stay for many decades and the assumption is that it will continue to slowly decline. However, this assumption may be changed in the model.
7 **Offsetting:** Here we assume the effectiveness of offsetting schemes. Furthermore, a choice can be made between the ICAO CORSIA (ICAO, 2018) offsetting system for international aviation, or an offsetting system defined by the model user. In the latter case, you can also define the share of aviation that does apply offsets and the share of global offsets that is assigned to aviation.

Perspective:

Government of Chile

Chile is a country highly exposed to the consequences of climate change and, in particular, our tourism industry faces high risks. Our geography is marked by an extensive coastline and wide mountain territories, places that attract a significant number of national and foreign tourists and are especially vulnerable to the effects of the climate crisis.

The challenge for tourism is enormous. The reduction and offsetting of carbon emissions by the industry is insufficient to achieve the decarbonization goals, while advances in electrification and energy efficiency do not have the necessary speed, so it is essential to look for alternatives that allow the development of a much more sustainable activity. The data indicates that rapid growth in highly polluting long-haul flights must be curbed worldwide, and this will generate changes in the tourism industry in Chile. We are a distant country, with almost insular characteristics, so we depend to a greater extent on long-distance visitors, who have fewer alternative transport options. That is why it is necessary for the airline industry to be able to seek and apply solutions that allow less pollution.

Given the scenario described, tourism has the task of reorienting or deepening strategies aimed at its domestic and near-proximity markets. Offering medium and short-distance services and destinations, which can be complemented by more sustainable modes of transport, such as trains, cars or ferries, is essential to contribute to the task of reducing emissions. This is a change that can also be directed to different tourist profiles.

In Chile we have the opportunity to take concrete actions such as designing, planning, mitigating and launching experiences, accommodation or tourism services with near-zero emissions, as well as carrying out an extensive review of existing products in order to promote change. It is important that carbon management is incorporated into the design of public policies and in the development of products so that the carbon footprint of tourists, customers, markets, or products is taken into account. We are working on our Plan to Strengthen Tourism Sustainability, and we will continue to promote the S Seal, which guarantees visitors that a tourist service meets global sustainability criteria, in the socio-cultural, environmental and economic fields.

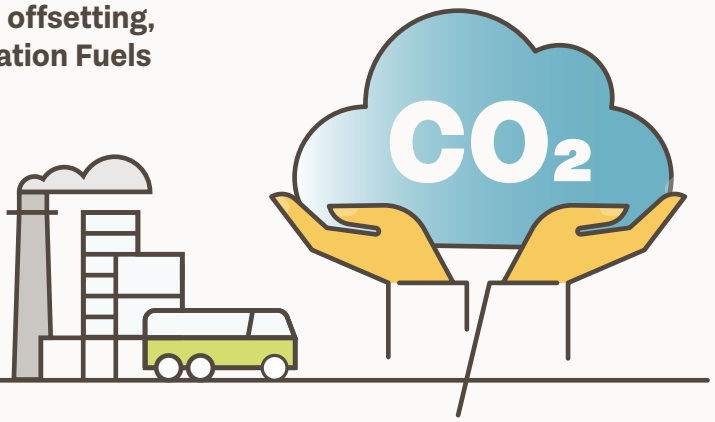
However, we call on the entire tourism industry to coordinate efforts, work together and seek the most successful tools worldwide to advance in the task of reducing emissions. Innovation, the application of technology and the exchange of data are the paths that have shown, in international experiences, to give favorable results in terms of sustainability. Therefore it is essential that the public and private sectors share strategies or results that contribute to making tourism an even greener industry. The implementation of recommendations or measures incorporated in international agreements should be an obligation at the level of public institutions and also for the private sector. The task is enormous, but taking action as soon as possible will allow effective results to be achieved in the medium and long term.

Verónica Kunze,
Undersecretary of Tourism

3

From single pathways to the tourism decarbonisation scenario (TDS)

Initially, we envisaged to assign a combination of the 40 interventions GTTM^{dyn} provides, to four 'world-view' pathways which consisted of combinations of strong versus weak governments and strong competitive versus cooperative private sectors. Unfortunately, this exercise did not deliver any scenario that could come close to reaching the emission reduction goals. Therefore, we started afresh and first explored the groups of interventions most discussed by the sector and policymakers in travel and tourism. These are offsetting, technological improvements, Sustainable Aviation Fuels (SAF) and taxes & subsidies.



Single pathway– **Offsetting**

Offsetting one ton of CO_2 means that you pay someone else to additionally reduce their emissions by one ton of CO_2. A significant part of reductions elsewhere is not related to reduced use of fossil fuel, but to storing emissions in forests or applying carbon capture and storage (CCS) in, for instance, depleted oil and gas fields. Note, that storing emissions in forests is a risky form of offsetting because trees increasingly live for shorter lengths of time, partly due to climate change (Fairman et al, 2022). Applying CCS also has the risk of stored CO_2 escaping and its capacity is far from sufficient. Furthermore, current CCS is generally combined with extracting more oil or gas from those depleted fields, thus causing more, not fewer emissions.

Under the assumption that you are not able to avoid your ton of CO_2, offsetting proposes that your ton is neutralised if you help another to reduce, which, without your help, would have continued to be emitted. Unfortunately, there are many flaws in this reasoning as has been signalled by Anderson (2012) and shown by Cames et al. (2016). The latter report showed that only 2% of all offsets they studied (over 5700 projects) did deliver the promised reductions and were likely to be additional. 85% of the offsetting projects was certainly not doing so. Therefore, we assume by default that the effectiveness of offsets is some 20% only. Also, recent research shows that large forestry-based offsets might even cause additional climate impacts rather than reducing them (Guizar-Coutiño et al., 2022; West et al., 2023).

The international aviation community has developed a big offsetting program, CORSIA, that requires all participating airlines to offset all emissions above the 2019 level, but with domestic flights exempted. One problem is that CORSIA can only ever hope to flatten net emissions to 2019 levels, yet the climate targets require more ambitious reductions. Another problem is that, in a 1.5°C world, all emissions will have to reduce to zero, meaning that the offsets become too scarce. So CORSIA becomes irrelevant when aviation emissions dip below the 2019 baseline (as they must as soon as possible). Offsetting can only ever be seen (at best) as a short-term stopgap option or (at worst and increasingly more likely) a diversion of investment from longer-term emission reduction strategies. We therefore did not include offsets in our Tourism Decarbonisation Scenario.

Single pathway– **Technology**

Another potential solution we explored is technology. With technology we mean two things: improved energy efficiency and innovation towards alternative zero-emissions technology. We assumed that by 2050, in a 1.5°C scenario, all electricity will be from renewables and that all cars, buses, trains, ferries, and all accommodation will be fully electric. These assumptions are realistic as several countries show they are already on track (e.g., Norway with electric cars, Switzerland and the Netherlands with electric rail and buses, and China where a huge electric high-speed rail network was built in less than two decades (Cheng et al, 2020)). Most of these transitions will come from outside the tourism sector, but this does not mean that the tourism sector should not accelerate the change, by actively developing the electrification of accommodation, providing charging infrastructure and financially participating in renewable energy production. This will indeed make all tourism zero-emissions by 2050, except aviation.

For aviation, several initiatives have been taken to develop battery-powered electric aircraft. However, the problem with batteries is that these are ten to fifteen times too heavy to enable an aircraft with useful performance. A far more promising solution is being explored by several companies including UK/US start-up ZeroAvia and aircraft manufacturer Airbus. This solution replaces the battery with fuel cells and a hydrogen tank. Technology to do this has existed since the 1990s, but there has never been pressure or incentives to further develop it. A conventional new aircraft type (e.g. the Airbus A320NEO or the Boeing B787 Dreamliner) takes 6 to 12 years between the decision to develop it and entry into service (EIS - the date it starts to be produced and to replace older aircraft in the fleet). Of course, it will also take decades before the whole global fleet of 26,000 aircraft is replaced, because aircraft have an economic lifetime of 25-30 years. Figure 4. shows that technology contributions may reach zero emissions, but only at the end of this century, which would be far too late to achieve the 1.5°C scenario.

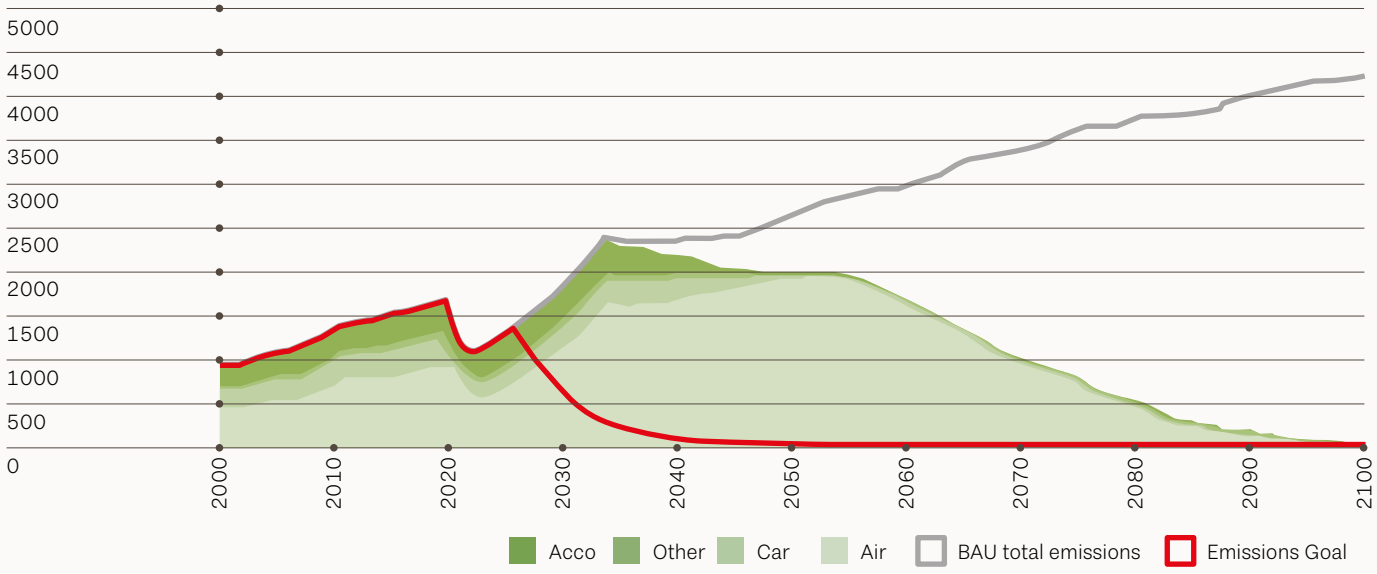


Figure 4. *The maximum technology scenario*[3]

[3] *It assumes the aircraft manufacturing sector stops developing fossil fuel engines (turbofans, turboprops) and concentrates entirely on developing hydrogen fuel cell electric aircraft of which the EIS of short haul aircraft will be 2035, medium haul 2045 and long haul 2055.*

Single pathway – **Sustainable Aviation Fuels**

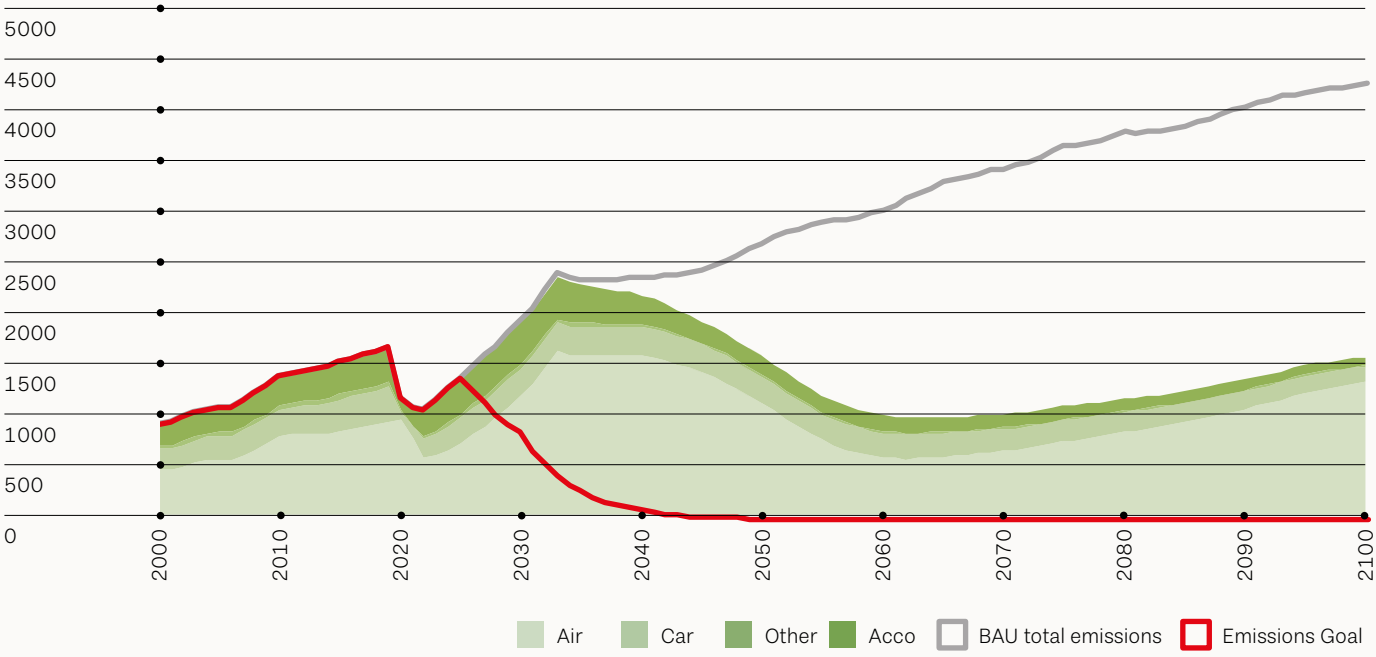
A faster solution could be found in the use of sustainable aviation fuels (SAF). SAF comes in three forms: bio-fuels, SAF made from waste, and synthetic SAF also known as e-fuels or Power-to-Liquid.

Bio-fuels have been helpful to get experience with technical, regulatory and safety issues burning such fuel in aero-engines. However, the sustainability consequences of bio-fuels in terms of climate impacts caused by growing the crops, and issues with competition of land-use for agriculture and nature, are prohibiting the scaling-up required to provide all aviation with bio-fuels.

For waste SAF, the situation is a bit better, because there is no need to grow additional crops. However, in a 1.5°C world, agriculture has to significantly improve its efficiency and thus reduce its waste which will limit supplies. Furthermore, most of this 'waste' could better be used to improve soil-quality, the loss of which is one of the major issues humanity faces in a world with a growing population. So again, there are increasing issues with feedstock availability.

E-fuels or Power-to-Liquid (PtL) is a relatively new solution in which SAF is produced directly from CO_2 captured through direct air capture (DAC) from the atmosphere. In this way the carbon cycle is fully closed. When the large amount of energy required to power this e-fuel (electric fuel) production and DAC is sourced from renewable electricity, the climate impact will be at least 95% reduced (per kg of fuel). However, the demand for renewables in a 1.5°C world will be very large, while the supply is limited by a range of physical limitations living on a planet with a fixed size. Figure 5. and 6. show the results of a maximum subsidy-driven and more equitable SAF.

Figure 5. *The impact of maximum SAF (e-fuels only, high subsidy on e-fuel and no taxes on kerosine)*



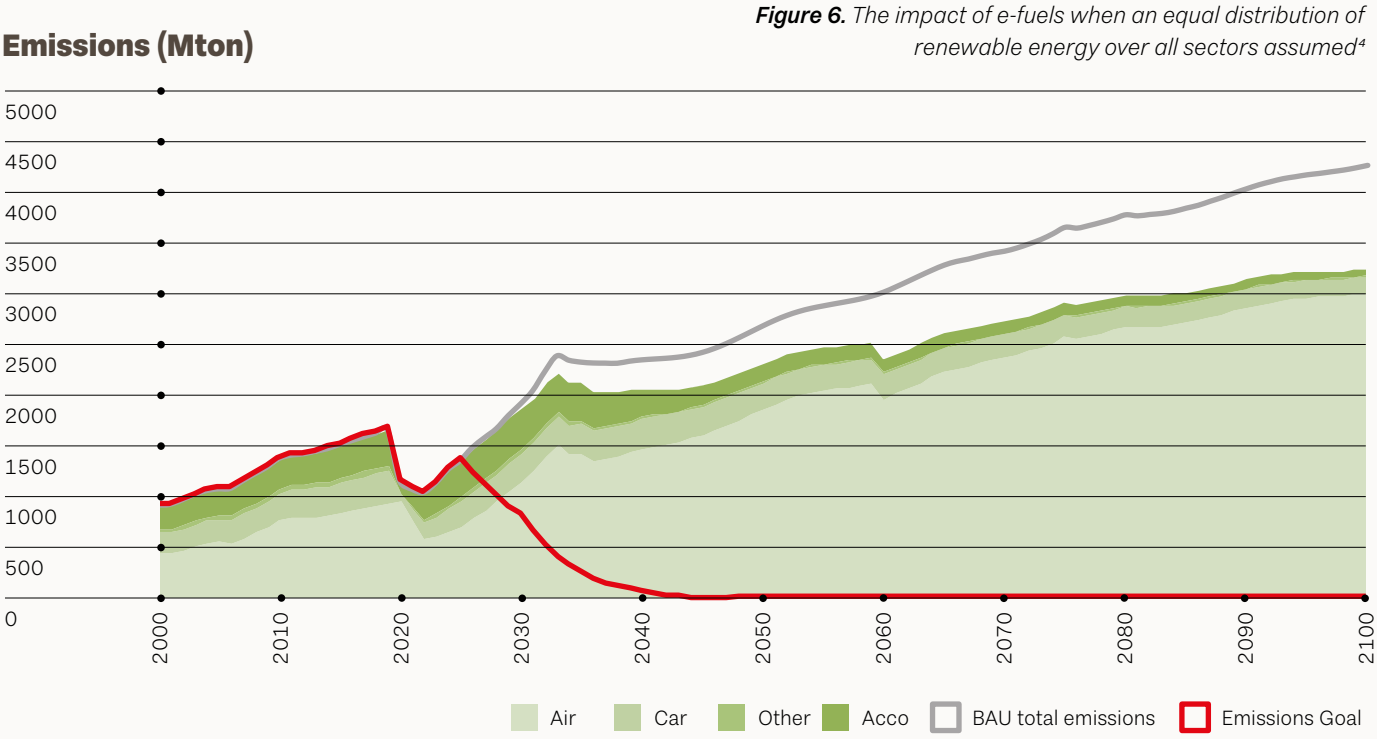


Figure 6. *The impact of e-fuels when an equal distribution of renewable energy over all sectors assumed*[4]

[4] *Max 5% for aviation*

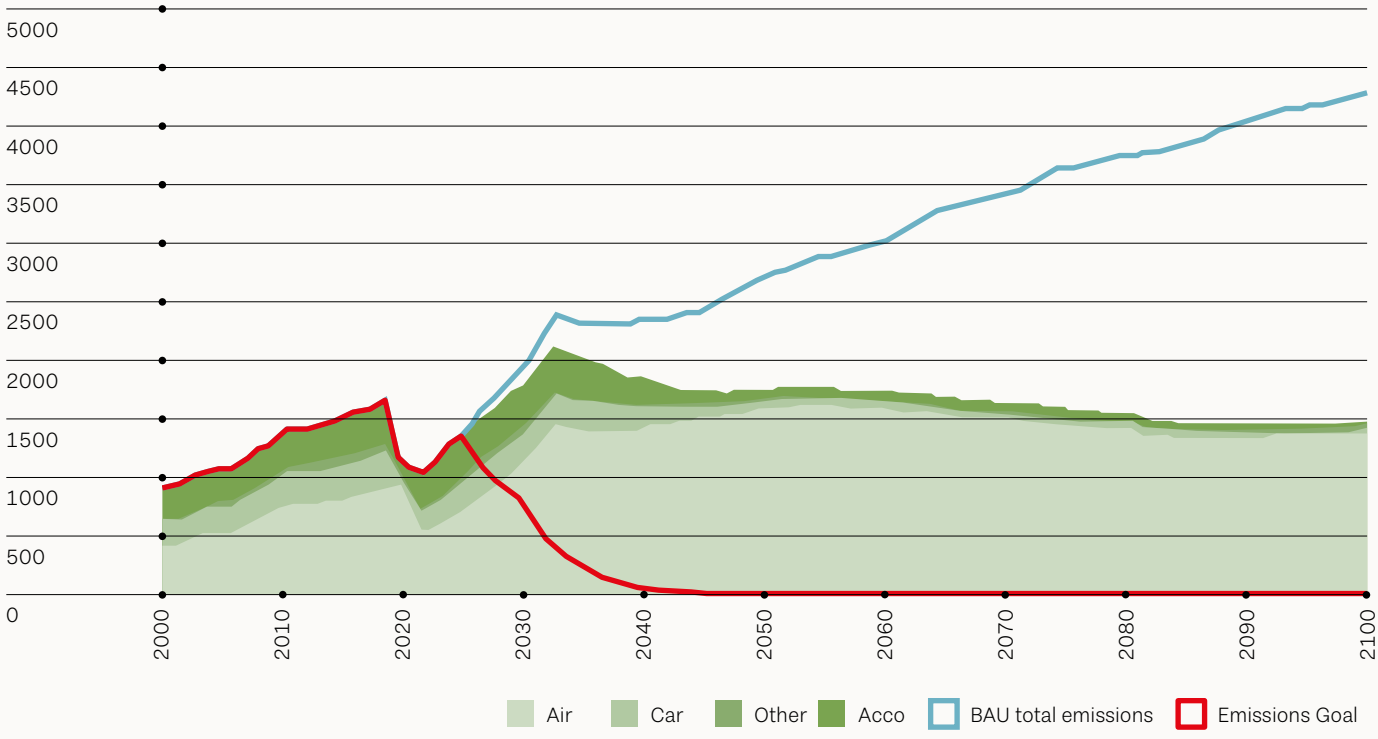
Single pathway– **Taxes and subsidies**

Environmental non-governmental organisations (NGOs) often argue for taxes on CO_2 or aviation and cars and for the introduction of subsidies on alternative, low-carbon emissions transport. We have explored this and tried applying very high taxes like a carbon tax that increases from $150 per ton CO_2 in 2025, to some $600 per ton CO_2 in 2040 and after. We also explored applying a ticket tax on aviation of 200%, tripling ticket costs compared to the BAU scenario between 2025 and 2100. A subsidy of 50% to rail and public transport was also applied. We explored taxing the car, but that has a small negative impact on emissions, because it would shift part of car users to air travel, even in higher-distance classes.

The result of this in the modelling is that emissions will stop growing, but do not significantly reduce as Figure 7. shows. The main problem with taxes is that a ticket tax only temporarily reduces growth and will not affect the emissions per passenger-kilometre, or the energy efficiency. A carbon tax will improve the efficiency as well, but that will reduce the volume effect and it cannot reduce emissions to zero.

In fact, for the Tourism Decarbonisation Scenario, we applied only subsidies and not taxes. Given the increase in costs associated with mandating much more expensive SAF, the effect of taxation was negligible.

Figure 7. *The impacts on global tourism emission applying maximum taxes and subsidies*

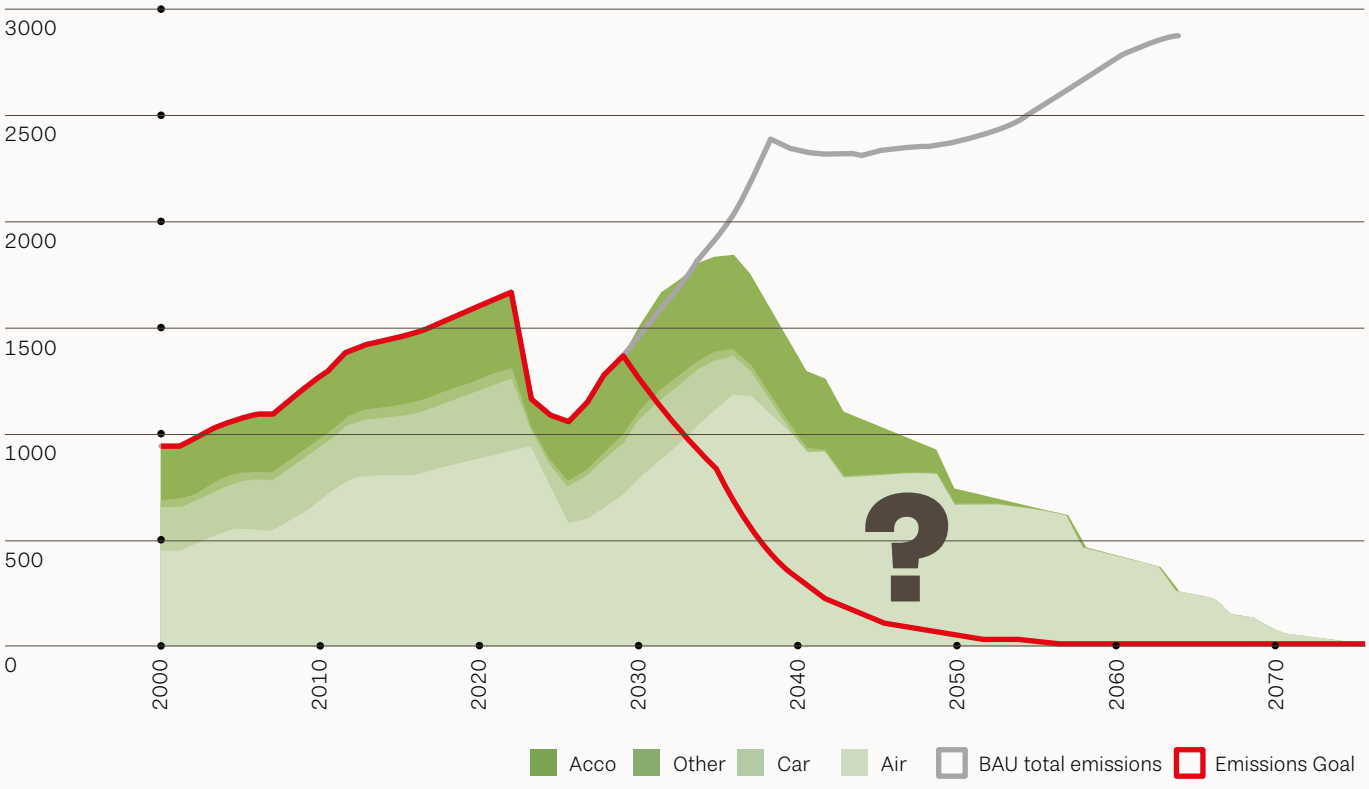


Combining the mitigation interventions

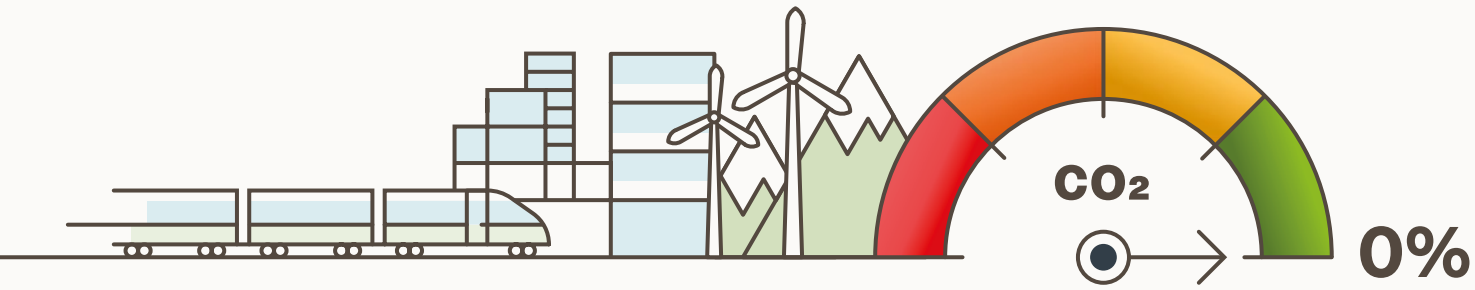
From these four exercises we learnt that none of the most discussed mitigation interventions can achieve zero-emissions by 2050 by themselves. Offsetting becomes increasingly ineffective in a 1.5°C world, technology delivers zero-emissions but way beyond the 2050 zero emissions target, e-fuels run against limitations posed by equitable renewable energy use and taxes have some theoretical limitations as these do not change the system itself, only push it to lower emissions, but not to zero.

When combining all conventional measures at high levels, we were still far from reaching the net zero target of 2050 (see Figure 8.). Therefore, we concluded that further intervention was required, particularly in the growth of air transport. In the next section we introduce the optimal mix of interventions, including the measure proposed to slow aviation growth until the sector can fully decarbonise.

Figure 8. *The considerable gap that remains between emissions and the decarbonisation pathway, missing the net zero 2050 target by over a decade, when all measures except limits on flight capacity are applied*



The TDS Scenario – **The optimal mix of interventions**



Once it became evident that none of the initial pathways reached the 2030 and 2050 goals, we decided to model a scenario that does reach the goals, in the most economically efficient way.

The next section describes what needs to change to reach at least the 2050 goal, without simply closing the tourism sector. The outcomes might be surprising for many as, overall, the positive opportunities by far outweigh the negatives.

We call this scenario the Tourism Decarbonisation Scenario (TDS).

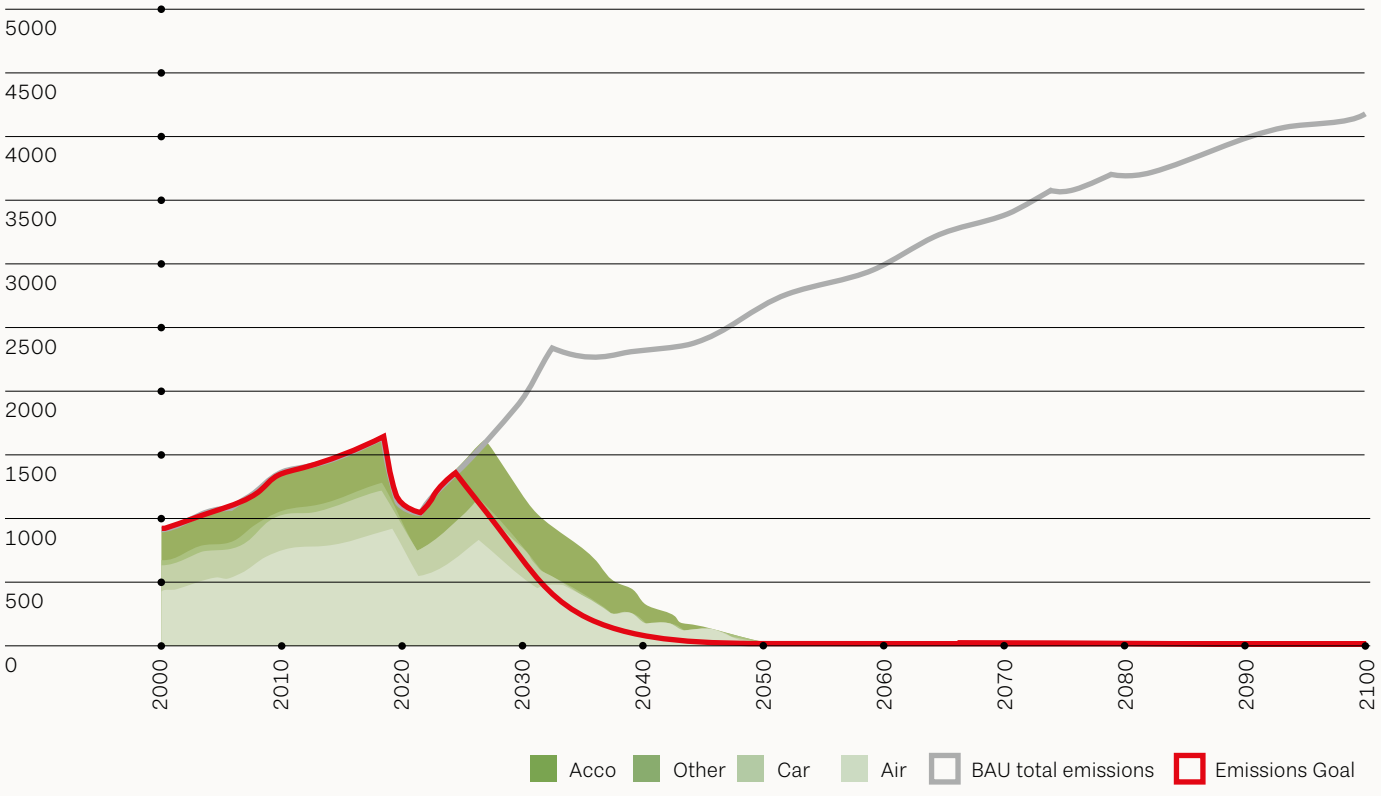
It should be noted that even in the TDS scenario, we have found that the 2030 goal is technically beyond reach – although rapid reductions in emissions are occurring by 2030, emissions are only halved by early 2036. Only when assuming that COVID-like bans of flying are applied, can a 50% reduction be achieved by 2030. The main reason is the lack of time. After twenty years of discussion, particularly within the aviation sector, at both national and international levels, no emission reductions were achieved and there has been no efficiency improvements beyond the business-as-usual situation. Time has become too short for the necessary responses to achieve 50% by 2030, which should be a wake-up call for the challenge ahead. Until now the inertia in the global tourism system has been too large.

The TDS combines all effective measures available with an additional policy of slowing the rate of growth of aviation and capping longest haul trips to 2019 levels (about 120 million return trips). These trips (over 16,000kms return trip, equivalent to flying from Shanghai to Sydney - or further -and back) made up just 2% of all trips in 2019 but are, by far, the most polluting. If left unchecked, they will quadruple by 2050, accounting for 41% of tourism's total emissions (up from 19% in 2019) yet still just 4% of all trips.

Visualization of the TDS-scenario

In this scenario the outcome is that the total amount of CO_2 emissions (cars, aviation, other transport and accommodation) has been reduced to almost reach the zero-emissions situation by 2050, meaning that the Glasgow Declaration target has been achieved (see Figure 9.). Although this is the only scenario that allows us to reach the 2050 goal, reaching the 2030 goal remains challenging: the inertia of the system, the fact that the interventions assumed are very strong and cannot be implemented swiftly, means that emissions stay above the goal pathway up until 2050. And this accounts for all tourism subsectors, though 'other transport' comes closest to the 2030 goal and air transport the least.

Figure 9. *The Tourism Decarbonisation Scenario – showing emission compared to the emission goals pathway*[5]

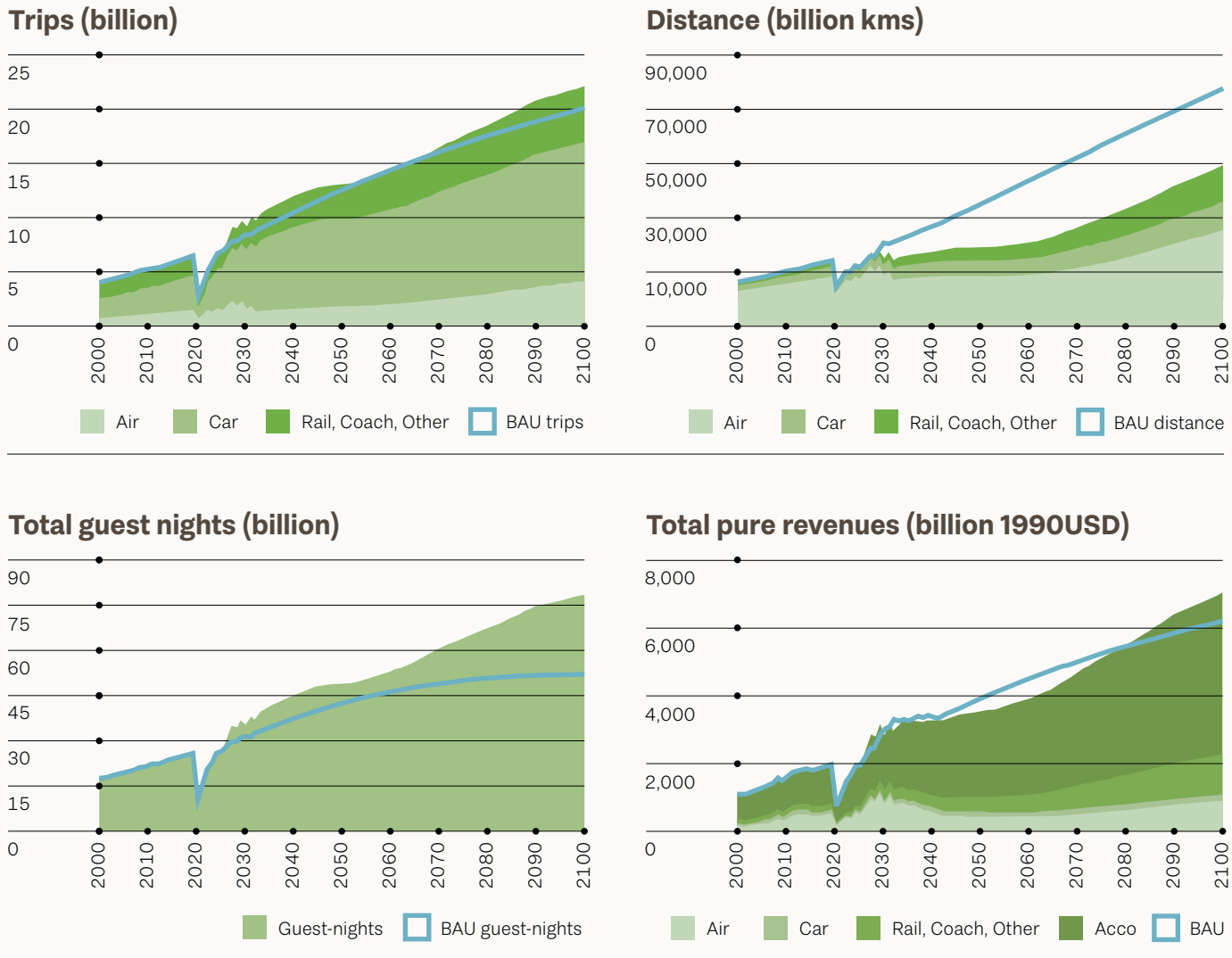


[5] *Figure 9. shows to what extent the Tourism Decarbonisation Scenario reaches the two goals for 2030 and 2050. Even though the 2030 target is not reached, the emissions pathway is certainly strongly going the right way and preparing for the zero-emissions in 2050. Furthermore, with 2019 as a reference year, the goal is reached in 2031. With 2005 this will be achieved in 2036.*

What else changed in the TDS-scenario?

- First, tourism grows in a very similar way to the BAU scenario. The number of trips does not need to be reduced. The number of nights can even be increased substantially (see Figure 10.) while still reaching the zero emissions goal in 2050 and beyond.
- The only big change is the distances we travel. Distances travelled need to remain at about the 2019 level up till 2050 and, only then, will slowly rise again because of new aviation technology coming onto the market after 2050.
- Also, air transport will have to reduce the growth of its number of trips and particularly distances covered.
  - The number of trips grows only slowly up to 2030 and then flattens. After 2050, the number of air trips starts to grow again.
  - For average distances travelled by aircraft, there will be a reduction of 19% compared to 2019 until 2050 after which, growth may start again without causing any emissions.

Figure 10. *TDS-scenario development of trips per transport mode, distances per transport mode, revenues per tourism sector and overall guest-nights*[6]

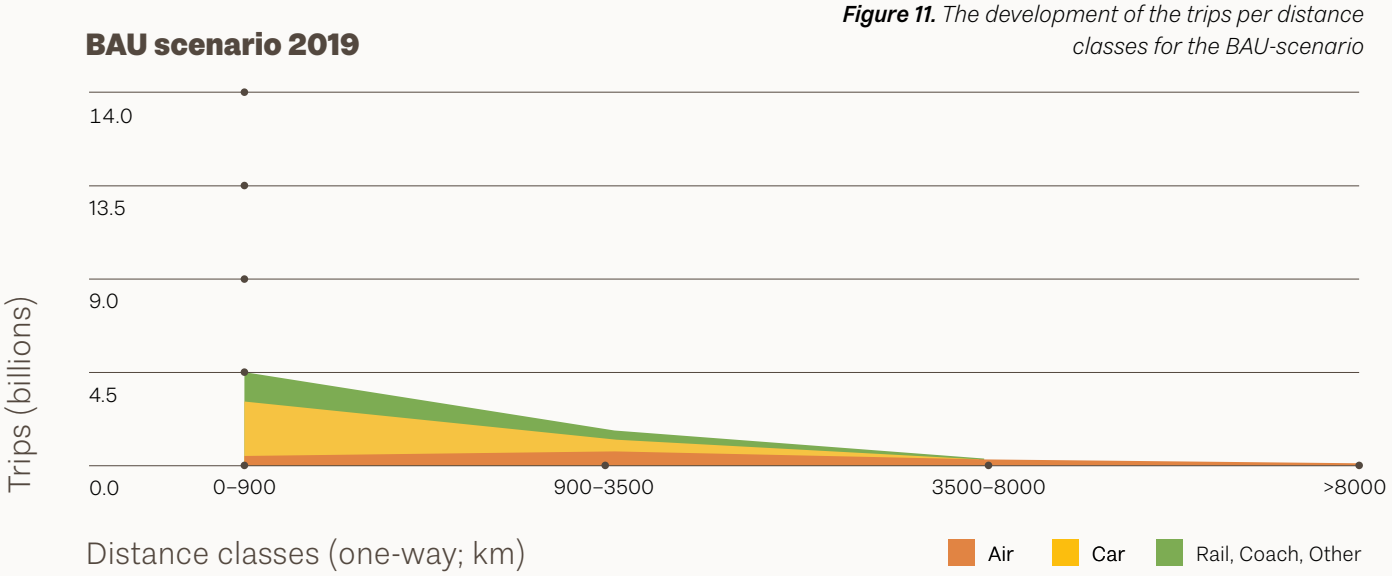


[6] *The blue lines provide the reference scenario totals*

Distance travelled: a crucial factor in reducing emissions

Adjusting global distance travelled is crucial for achieving zero emissions by 2050. This may have consequences for smaller destinations which are dependent to a substantial extent on long-haul travel. We have therefore analysed the development of the distance distribution in both the BAU (Figure 11.) and the TDS scenario (Figure 12.). In both scenarios there is much growth in the number of trips, but whereas in BAU the longest distances grow fastest, this growth is about halved in TDS and starts to accelerate again after 2050. So, for destinations, the current situation could potentially be maintained with respect to long-haul travel, but the future will initially show a slow-down of growth of that market. Also, note that most trips are shorter than 3,000km (or 6,000km return).

Figure 11. *The development of the trips per distance classes for the BAU-scenario*



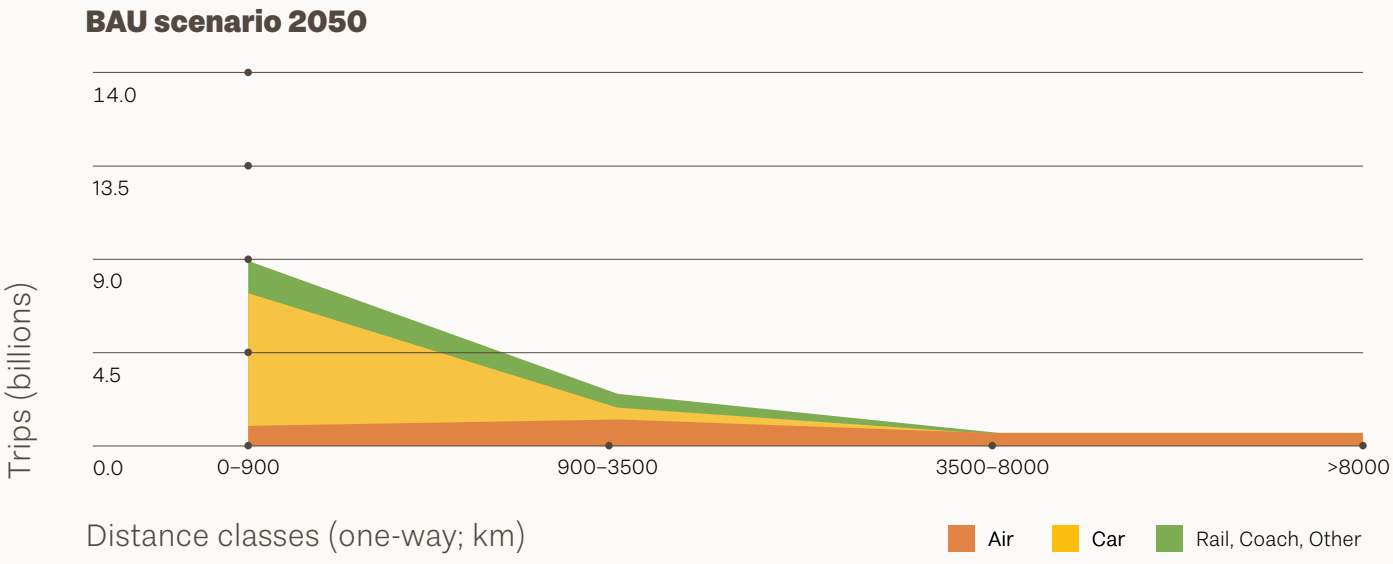
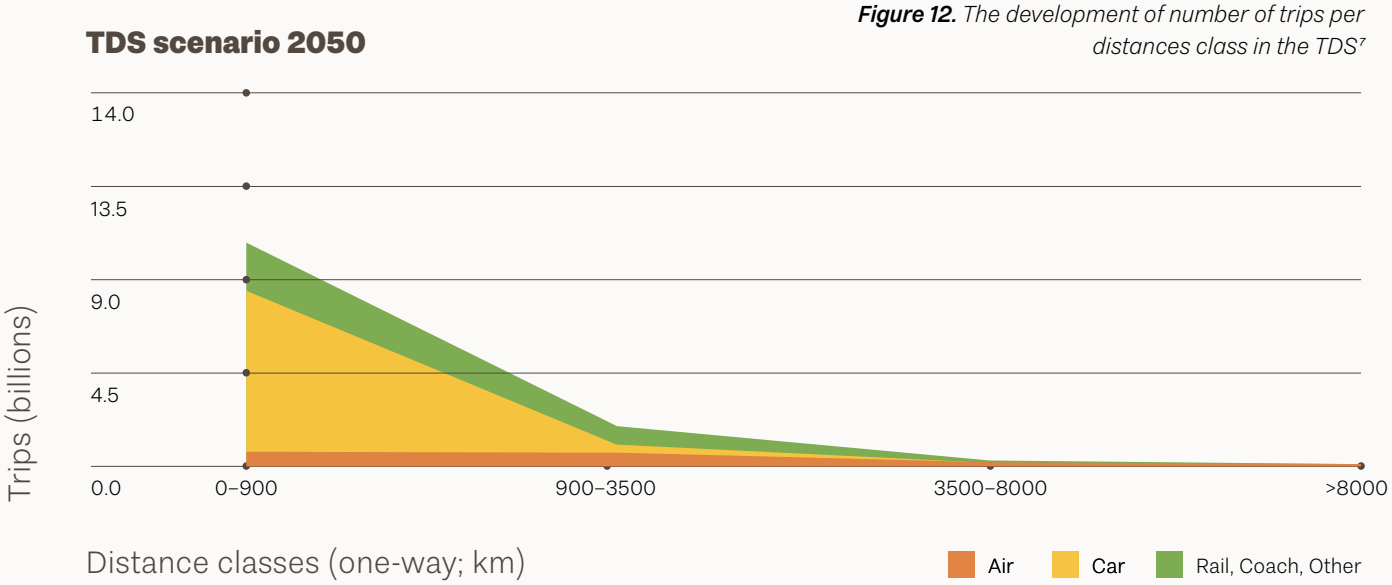


Figure 12. *The development of number of trips per distances class in the TDS*[7]



[7] *Particularly due to the introduction of electric fuel cell long-haul zero-emissions aircraft after 2050 allows for a regrowth of long-haul travel. But also in 2050, some growth is still available compared to 2019.*

What interventions shape the TDS scenario?

To reach the TDS scenario, a mix of interventions has been applied:

1 **Alternative fuels & energy sources:** For accommodation, car and other transport modes, the assumption is a transition to full electric transport and a shift towards 100% renewable electricity. All these transitions will happen mainly outside of the tourism domain and will happen anyway under the Paris Agreement. The only exception is air transport. However, the production of bio-fuels is starting up and there have been experiments with e-fuels. The latter are produced directly from atmospheric CO_2 using a power-to-liquids – PtL – production process. Though initially, the focus was only on bio-fuels, these pose too many, very serious, sustainability risks - e.g. displacing land use for food and nature - to become available in significant quantities. Therefore, in TDS, bio-fuels before 2035 are replaced by e-fuels, because of their superior environmental performance. Fossil fuels are fully phased out within the limitation of the availability of renewable energy to power the PtL-processes required. This means that balance is required regarding the fair share of all renewables and the growth of aviation. To introduce synthetic e-fuels, which were about four times as expensive as fossil fuels in 2019, a policy is required to provide a global mixing mandate to enforce the share increase of SAFs to 100% by 2050 in the aviation fuel mix.

2 **Technology:** The policies for technologies assume that air, car, train/others and accommodation will become more efficient each year than they are now (we set these at the model limits of 3.5%/year for cars, 0.25%/year for aviation, 2.5%/year for trains/other and 2.5%/year for the accommodation industry). The additional efficiency for aviation is much lower because fuel efficiency is a major design parameter for aircraft, making the remaining margins very small. We also assume that electric aircraft, using fuel cells powered by hydrogen, will be developed at large scale, but realistic assumptions about the development and fleet replacement times causes the impacts of electric aircrafts to take place only after 2050.

3 **Infrastructure policies:** The policy for infrastructure is to substantially increase the annual investments into (high-speed) rail networks for the coming 40-50 years (200 billion USD per year) starting this immediately. At the same time, there will be a policy to put a maximum capacity on the growth of airport slots and therewith on the number of flights up to 2050. The model keeps the overall demand for aviation fuel at about the level of 2019 to ensure zero-emissions is reached by 2050 by increasing the share of e-fuels to 100% (without violating the renewable energy share limitation for aviation). After 2050, this airport slot restriction can be removed relatively quickly as the electric fleet comes onto the market, relaxing the shortage of renewables for producing e-fuels.

4 **Travel speed developments:** Changing the speed limit of different modes of transportation could lead to a small reduction in emissions. However, slowing speed for flying with current aircraft will even increase emissions because the aircraft performs much worse at such an off-design point. The speed increase caused by rail investments is more effective but automatically assigned other areas in the model. Therefore, no additional speed policy was set here.

5 **Taxes and Subsidies:** Taxes and subsidies can be an effective way to allow the price mechanism to influence the travel choices people make and, for instance, to reduce average distances travelled and to cause a modal shift. Indirectly, higher transport prices will most likely counter the trend of decreasing the length of stay.

In the model, several taxes and subsidies can be applied. One interesting property of the very complex interaction between all transport modes and distance classes that tourists travel, is that for example a tax on cars would slightly increase the total emissions. This has to do with part of the shift from the car moving towards not only air travel but also higher distance classes leading to even longer distances and higher emissions. Also, for aviation, the emission reductions are enforced by the e-fuel mandate, which will very much increase the ticket prices (about double them) and will thus not only internalise the environmental cost, which a tax may do, but at the same time provide a direct emission reduction towards zero. The global cost of other modes of transport such as trains was decreased by 40% by adding subsidies. Finally, on top of the assumed increase of carbon cost, abatement costs and all other measures, we explored adding a ticket tax for aviation. But we found that such an additional tax does not add much to the reduction efforts, but a lot to the cost of tourism, deeming it unnecessary. As energy-efficiency and renewable investments in the accommodation sector already have a quick return on investment and are overall increasingly cost-effective, we do not believe the carbon tax would be a useful measure in the accommodation industry.

6 **Travel behaviour:** The role of marketing to change travellers' behaviour can be important in this scenario. Therefore we reduced the intrinsic psychological 'value of distance' and increased the willingness to stay longer at about the same trip frequency, by assuming a marketing paradigm shift by the sector. The value of distance reduction is slowly relaxed after 2050, because of the introduction of electric aircrafts into the fleet.

7 **Offsetting:** The CORSIA offsetting system requires only emissions to be offset that rise above the 2019 level and allows for a range of exemptions for certain markets related to developing countries, causing the overall tourism emissions still to rise. Moreover, domestic aviation is not included in CORSIA, as domestic flights fall within the Paris Agreement and Nationally Determined Contributions (NDCs). In the model, we assumed CORSIA offsetting with 20% effectiveness, but as other measures in the scenario already prevent emissions rising above the 2019 level, CORSIA has no effect regardless of the effectiveness assumption.

Perspective:

Intrepid Travel

For the first time, the Envisioning Tourism in 2030 report provides a vision for how global travel and tourism could reach a net zero future. It also tells us how the shape of tourism needs to change, for a climate-safe future. Importantly, the research shows that there is only one plausible way for tourism to maintain growth, and simultaneously decarbonise.

This report is exceptionally timely. On one hand, the world faces a critical environmental tipping point – "we are in the fight of our lives," said the UN secretary general Antonio Guterres at COP27. On the other hand, global tourism is rapidly recovering from the impacts of the COVID-19 pandemic, and once again returning value to communities who rely on it for their livelihoods.

The report's decarbonization scenario challenges all tour operators to think carefully and move faster on decarbonizing our businesses. In many cases that will mean reimagining business models and approaches entirely. But now is not the time to be complacent or sit on the sidelines. This is a crisis and what is needed is real collective action from every organisation and on every level. Business as usual is not an option.

Intrepid is already the first global tour operator with science-based carbon emissions targets and we're working to reduce the impact of transport in the trip emission profile; strengthen our domestic and regional travel offering; and promote longer trips in destinations that require long-haul flights.

For businesses like Intrepid, which is asset light, working with our supply chain on decarbonization is critical. Our supply chain represents more than 80 per cent of our overall Scope 3 emissions, with a large portion accounted for in transportation. Decarbonizing our supply chain – specifically transportation – relies on availability of electrical vehicles and high-speed ground transport. That, in turn depends on different players, including governments, prioritising the phasing out of fossil fuels in favour of clean technologies.

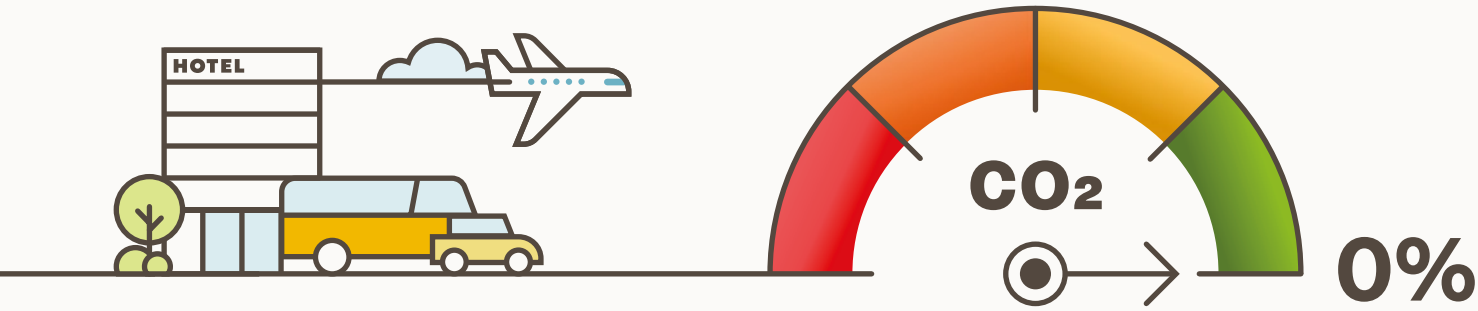
This is not going to be easy and no business can act alone, or simply ignore what needs to be done. Change requires all of us to work together and climate action has to happen at all levels.

Dr Susanne Etti,
Global Environmental Impact Manager

4

The implications of the TDS scenario

The TDS scenario outlines a range of soft and hard policy measures that are crucial for achieving the net zero target in 2050. The measures however require adaptive behaviour from members of the global tourism system which in some instances may be seen as sacrifices made for the common good.



While the emission pathway outlined above allows for growth (tourism revenue, number of guest nights and number of trips), this growth deviates from the traditional paradigm leading to modal shifts and the reallocation of revenue. The accommodation, train and car sectors are likely to benefit while growth in aviation will stabilise until electric flights or other alternatives allow for the decarbonisation of the sector. In this section the anticipated sub-sector level implications of the TDS will be introduced followed by the implications of the changed conditions for tour operators, destinations and accommodations. Moreover, the social, political and institutional acceptance of the scenario is reviewed. Last but not least, questions around global equity and fairness, a key component in the TDS scenario, are addressed.

Aviation industry

Implications

The aviation industry reaches net-zero by 2050

The growth of aviation is stabilised at 2019 levels until its decarbonization, reducing the number of flights by 25% in 2030 and by 48% in 2050 compared to the BAU scenario

Despite the reduction, the number of flights will still grow by 6% in 2030 and 19% by 2050 compared to 2019

Flights become 13.3% of all trips in 2050 (down from 22.6% in 2019)

The cost of flying will increase from 0.06 $/pkm (2019) to 0.10 $/pkm (2030) and will further increase to 0.18 $/pkm (2050). After that prices will decrease with the introduction of the fuel cell electric aircraft.

By 2030 4% of aviation fuel will be e-fuel, by 2050 this is 99%

By 2050 65% of all aircraft being ordered is fuel cell electric

Distance travelled, the number of trips and global revenue will increase, but remain behind the BAU scenario

There is a modal shift to low-carbon transport alternatives to ensure that the global tourism and travel sector grows as in BAU

There is a need for government subsidies for rail and bus transport

Large-scale investments are required to speed up electrification and the uptake of SAFs

Actions

Providing airlines with a mandate to increase the share of SAFs to nearly 100% by 2050

Capping global airport capacity temporarily at the 2019 level, applying an equitable allocation system

Increasing ticket prices to compensate the costs (SAFs, limited growth etc.)

Shifting from awarding frequent flying to potentially rewarding more sustainable choices

Renegotiating air services agreements

Providing government subsidies to support the uptake of SAFs

Re-investing tax revenue in aviation instead of transferring it into a central government budget

Setting the existing CO_2-standard for aircraft such that development of zero-emissions aircraft becomes obligatory

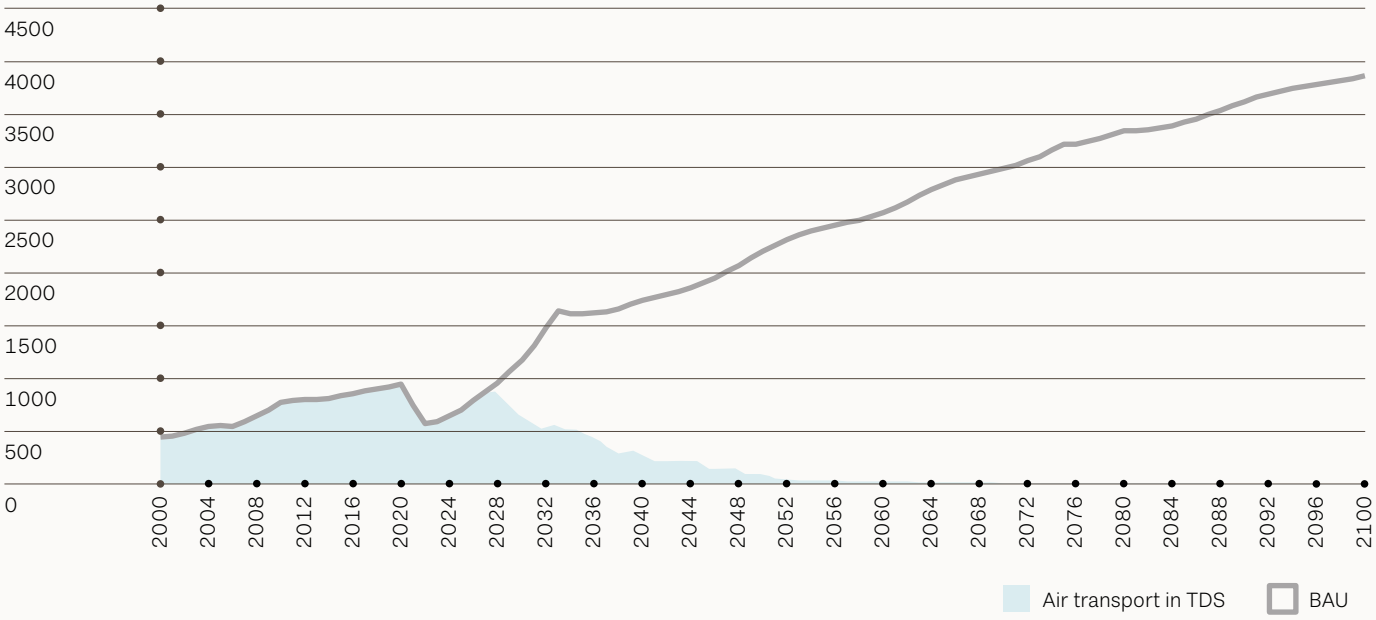
Skills training and skills transfer to avoid job loss

Aviation is not likely to halve emissions by 2030. Not even immediate, hard measures would allow the aviation industry to achieve the 2030 goal. However, the 2050 goal is within reach (see Figure 13). Nevertheless, as aviation is the biggest contributor to tourism-related emissions, the decarbonisation scenario requires the industry to take unprecedented measures.

The aviation industry needs to be mandated to increase the share of SAFs to nearly 100% by 2050. To speed the uptake of SAFs, immediate investments are needed. This represents higher costs in the initial phase which will lead to increased ticket prices. The cost of flying will increase from 0.06 $/pkm (2019) to 0.10 $/pkm (2030) and will further increase to 0.18 $/pkm (2050). This is caused primarily by the e-fuel mixing mandates passing the additional cost of this type of fuel on to passengers. It is crucial that taxes resulting from air travel are re-invested in the aviation industry instead of being transferred to a central government budget.

Air global emissions (Mton)

Figure 13. *Aviation related CO_2 emissions*

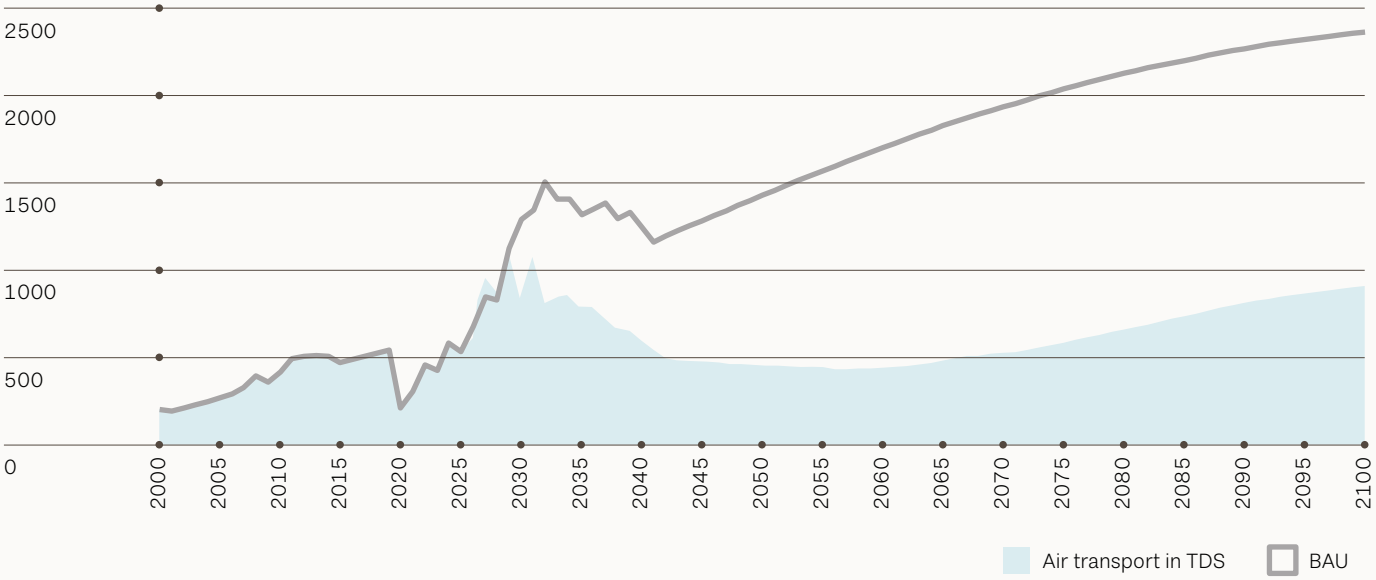


While mandating the use of SAF is crucial, there is a limit to available SAFs (particularly the share of renewable energy which can be allocated to aviation only). In order to keep this share at a reasonable level, we assumed - at any moment in the future - a maximum of 7% of all renewable energy to be reserved for e-fuel production. Without a volume restriction, mandating 100% of e-fuel by 2050 would mean aviation to consume 20-50% of all renewable energy available. Therefore, we assumed in the simulation model for TDS the supply to be limited to about the 2019 level, shifting demand to other transport modes and distance classes.

To allow the aviation industry to prepare for the changes, this measure would only be applied from 2027, leading to a gradual decline in total revenue to around 500 billion USD per year by 2042 (see Figure 14). The global revenue will start to increase again in the second half of the century.

Total pure revenues (billion 1990USD)

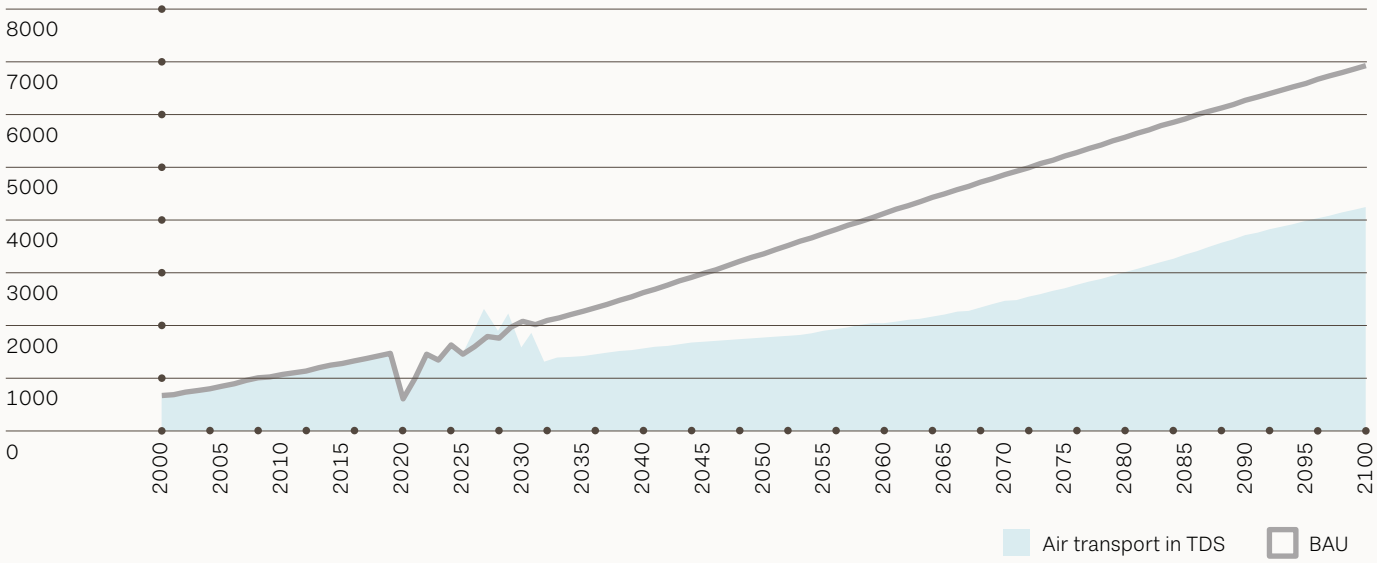
Figure 14. *Air global revenues per year*



Likewise, the number of trips will drop from 1.8 billion (2027, start of the measure) to 1.27 billion (2032) and from this point will slowly grow again towards the end of the century reaching 4.1 billion in 2100 (see Figure 15.).

Trips (million)

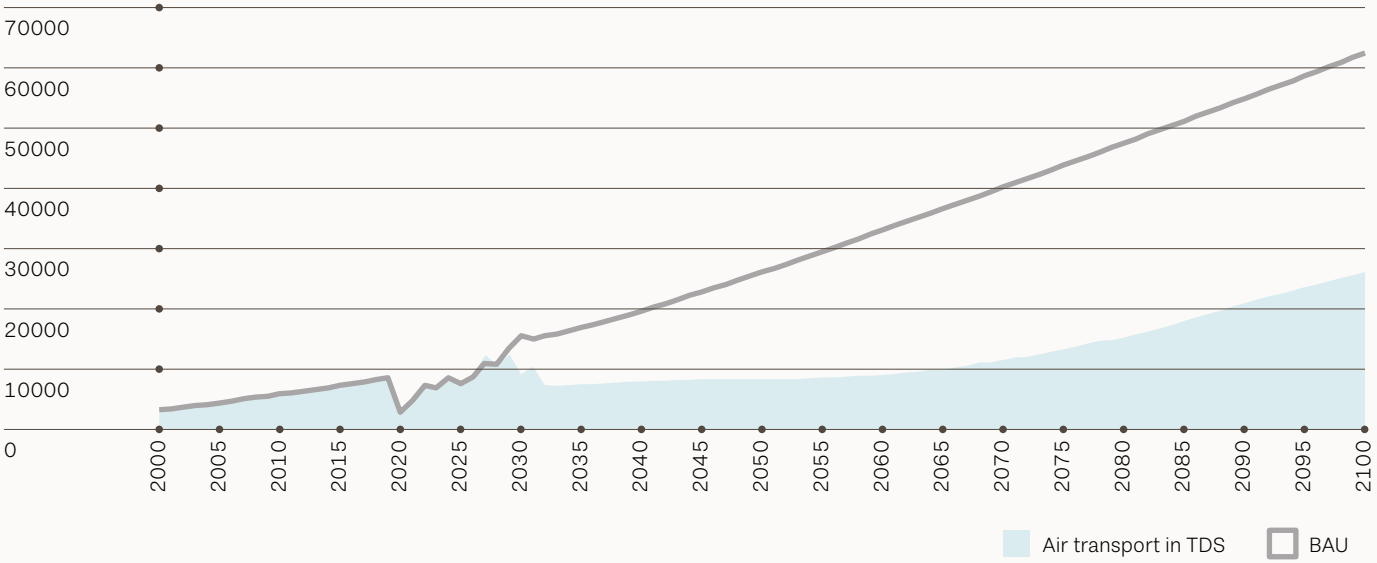
Figure 15. *Air global number of trips*



In the TDS scenario, distance travelled by air will decrease from around 11 trillion pkm in 2027 to 7.3 trillion (2032) and will gradually increase again from around 2060 (see Figure 16.).

Distance (10^9 pkm)

Figure 16. *Air global distance travelled*



Therefore, the aviation industry will be able to continue to serve current demand while growth would remain behind the business-as-usual scenario. Since voluntary behaviour change has its limitations (European Travel Commission, 2022), it is time to shift towards stronger industry and government intervention. Limiting growth is necessary until electric flights or other alternatives are deployed globally allowing the sector to grow again after 2060. The longer timeline enables airlines to plan ahead and to ensure a successful transition of their fleet to low-carbon alternatives.

Furthermore, increased ticket prices and the restrictions on airport capacities will have an impact on passenger demand. Depending on demand elasticity, higher ticket prices will lead to reduced demand. Short-haul flights have higher elasticity than long-haul given the potential to shift to other transport modes while long-haul passengers tend to be less price sensitive (European Commission, 2019). While demand for short-haul will shift to low-carbon transport alternatives (where possible), the medium to long-haul routes, the main drivers of tourism related emission growth (Peeters & Eijgelaar, 2014), will need to be reconsidered as well. In the TDS scenario the number of long-haul trips (return journey over 7000km) will go from being 6.0% of all trips in 2019, to 3.45% by 2050.

The limits on airport capacity will impact upon connectivity and force passengers to search for alternatives. Especially in case of destinations highly dependent on aviation, decisions will need to be made carefully as part of a collective action. In this way, detrimental impacts on national economies (income flow, employment, commercial and trade benefits, income multiplier effect etc.) (IATA, 2015) can be avoided. As such, wealthy countries will reduce their emissions slightly faster to give room for growth by those small, aviation-dependent countries. Existing air services agreements, especially in case of island nations, may need to be renegotiated. Furthermore, frequent flyer programs that promote growth will need to be reconsidered with a shift from rewarding frequent flying to rewarding more sustainable choices. This would place the responsibility even more on passengers that are currently responsible for most air travel and therefore for much of tourism's carbon footprint (Figure 17.).

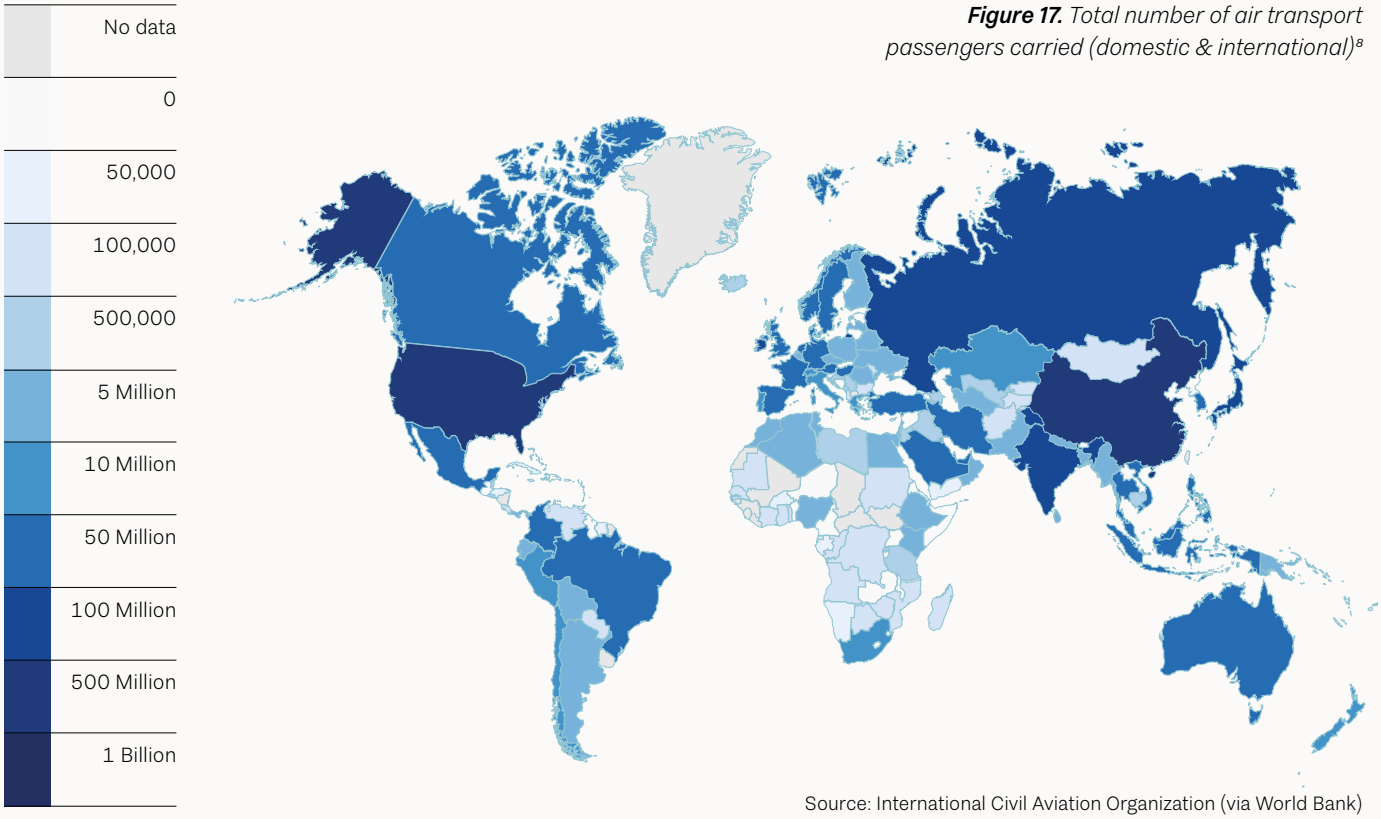


Figure 17. *Total number of air transport passengers carried (domestic & international)*[8]

Source: International Civil Aviation Organization (via World Bank)

Reduced demand for aviation will have consequences for the labour market as well. However, while direct and indirect jobs linked to the aviation industry will be affected (European Commission, 2019), the impact on overall employment and on GDP may be kept to a minimum with a focus on re-skilling, up-skilling and cross-training. Furthermore, education needs to adapt to the new TDS-requirements so that higher shares of the graduates are able to enrol in non-aviation transport and accommodation courses. Climate action combined with a just transition in the labour market is possible, and necessary, to avoid even larger human costs resulting from climate crash. The labour shifts will take place over a period of 25 years and more, so, if anticipated, can happen relatively smoothly and without damage.

[8] *Based on the registration country of the airline, 1970 to 2020. Source: (Roser, 2020)*

Ground transportation – **Car industry**

Implications

The car industry reaches net-zero by 2050 (it has the potential to fully decarbonise by 2035)

Cars are assumed to be 69% more energy efficient by 2050, compared to 2019

Global revenues will increase sharply, outpacing the BAU scenario in the period 2026 and 2050, reaching 141 billion USD per year at its peak

The growth of the number of trips by car and distance travelled outpaces the BAU scenario reaching 8.1 billion trips and 5.8 trillion passenger kilometres (pkm) respectively by 2050

In 2050, trips by car will account for 62% of all trips

Market opportunity: the car industry can absorb parts of travel demand no longer supplied by aviation

Higher initial costs for society as a whole

Large investments required (deployment of electric cars, charging infrastructure etc.)

Government intervention will remain key to support the shift towards battery-electric vehicles (BEVs) and fuel cell electric vehicles (FCEVs)

Actions

Investing in the manufacturing and deployment of electric cars

Developing the public charging infrastructure, particularly at tourism accommodation and attractions

Greening of energy sources

Intensifying government intervention to support the shift towards BEVs and FCEVs

Developing new products and services for electric car tourism

Focusing on micro-mobility at destinations (e-bikes, e-scooters)

Promoting (electric) car-sharing services

Skills training and skills transfer for employee retention

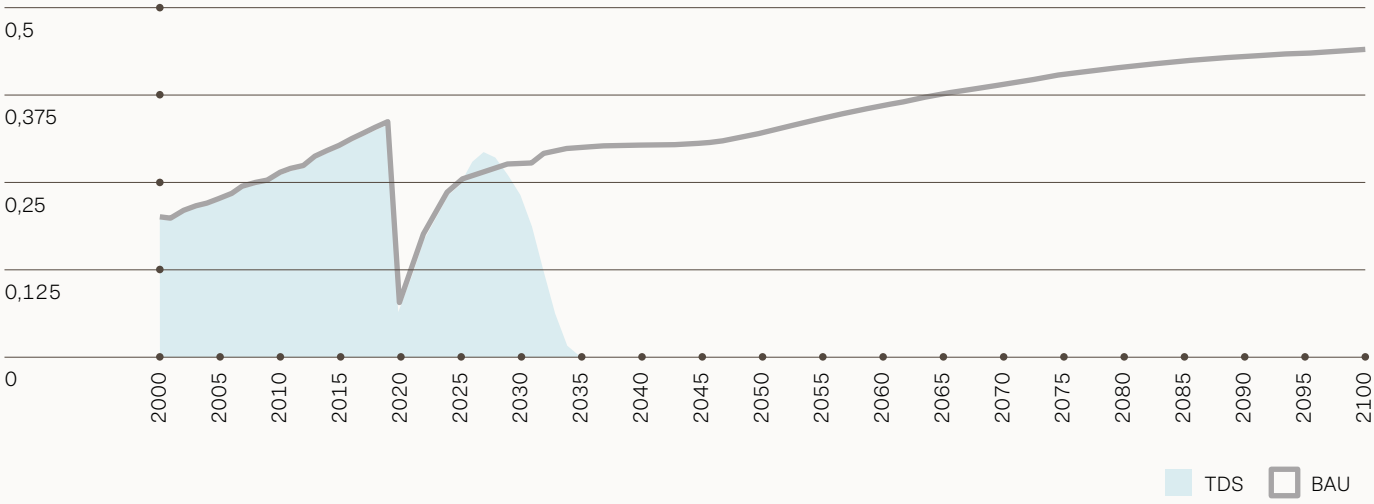
While the growth of the aviation industry will be capped in the first phase of the transition process, the car industry has the potential to benefit from the decarbonisation scenario. Given the higher speed of advancement in technology and the deployment of electric cars (the car industry has the potential to fully decarbonise by 2035 – see Figure 18.), the car industry can lead the decarbonisation of mobility and absorb much of the demand from, for instance, aviation (on short-haul routes). However, the rapid growth presents challenges for car manufacturers and poses higher initial costs for society as a whole. The cost of battery-electric vehicles (BEVs) is currently 30 to 90% higher than the cost of internal combustion engine vehicles (ICEs) although this gap is expected to get smaller in the future (McKinsey and Company, 2022b). In 2021, BEVs accounted for nearly 10% of global sales, 85% of that is concentrated in China and Europe, followed by North America (10%) (International Energy Agency (IEA), 2022). While the share of BEVs in global sales is still relatively low, we have seen a rapid growth in the past years, which is likely to continue.

In the TDS scenario, global revenues will increase sharply outpacing the BAU scenario in the period 2026 and 2050, reaching 141 billion USD per year at its peak (see Figure 19.).

Nevertheless, the public charging infrastructure is still in its infancy and requires rather large investments as well as cooperation amongst stakeholders to create charging stations thereby enabling the uptake of low or zero-emission transport alternatives.

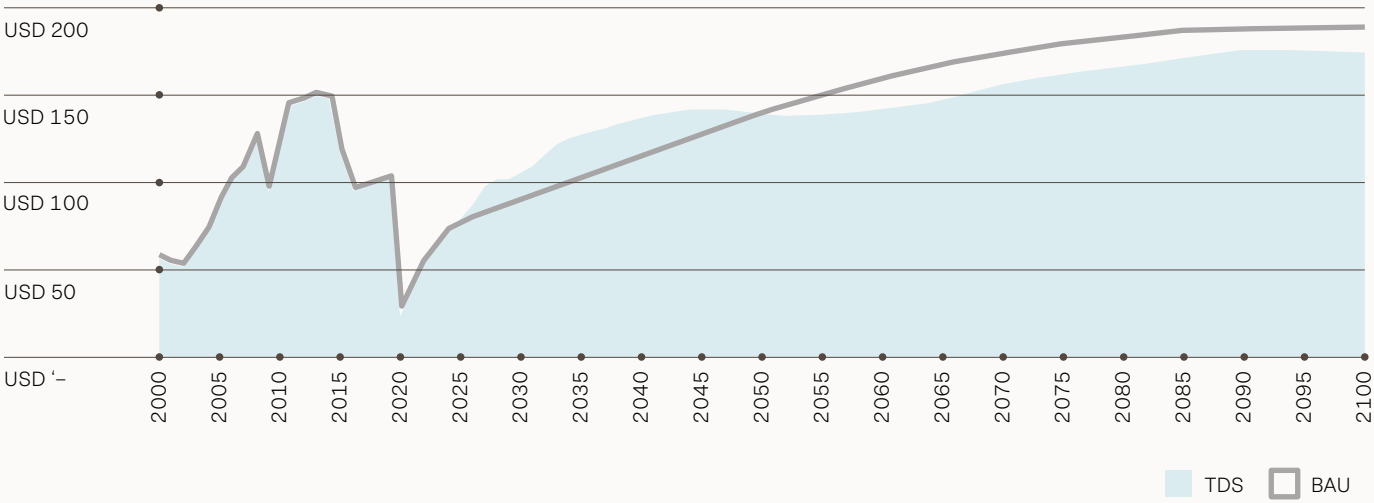
Car global emissions (Gton)

Figure 18. *Car related CO_2 emissions*



Car global revenues per year (billion 1990USD)

Figure 19. *Car global revenues per year*



However, it must be recognised that BEVs will not provide the ultimate solution to curbing transport-related emissions unless the environmental impacts caused by the extraction of raw materials, the manufacturing process, the electricity source for charging and the disposal of used batteries are addressed. BEVs can only become a good alternative to conventional cars if the cost of manufacturing and recycling is offset by running the charging infrastructure on green energy. While, in 2019, the share of global primary energy from low-carbon sources was only 16%, there are countries such as Sweden, Norway, France or Brazil, with high energy use, that have advanced significantly in decarbonising their energy sources (Ritchie et al., 2020a).

Governments have made their contribution towards the decarbonisation of mobility by regulations (e.g. low-emission zones, pedestrian zones, capping CO_2 emissions from new vehicles, setting targets on the ratio of zero-emission vehicles, banning new cars with ICEs etc.) as well as incentives (e.g. subsidies for low-emission vehicles) (McKinsey and Company, 2022b). These interventions will need to intensify in the coming decades to support the shift towards BEVs and fuel cell electric vehicles (FCEVs).

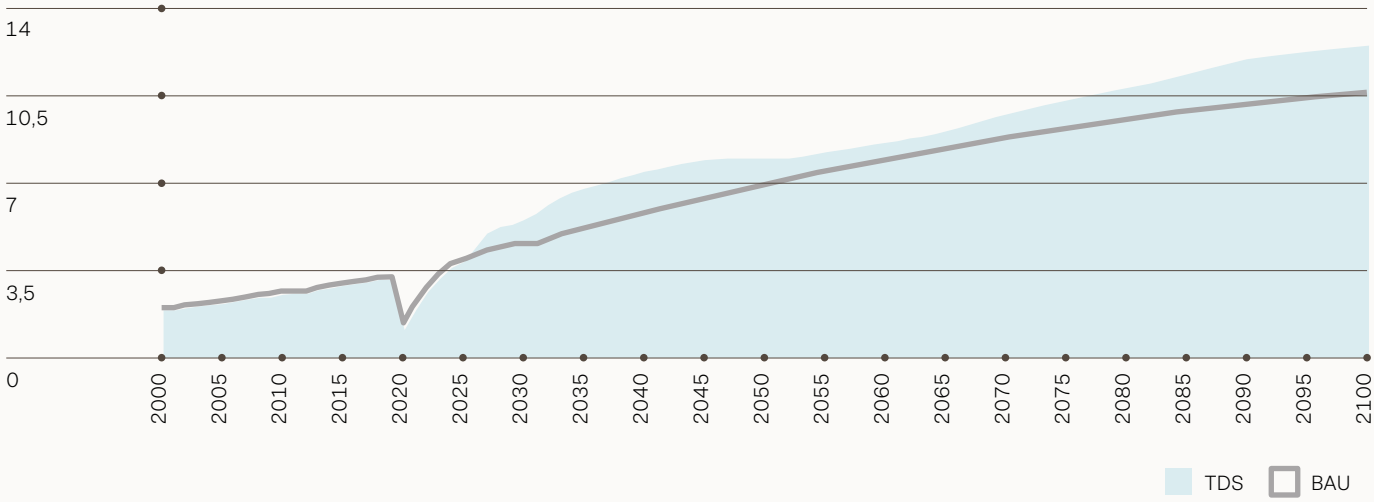
As with the aviation industry, there are transition risks related to the wider economy and the job market as well. The manufacturing of BEVs and FCEVs require new and different skills which will presumptively demand the re-skilling or up-skilling of employees. But again, these changes take many years, so with the right efforts it is certainly possible to do this, and an increasing number of car manufacturers have already made steps in this direction.

However, by tapping into the market of electric vehicles, automotive companies have great opportunities to thrive in the net zero-emission scenario. While certain jobs may be lost, new positions will emerge as well as new products and services. For instance, the potential of the car industry in the travel and tourism sector is currently under-utilised. As the range of electric cars on a single charge is increasing, people become more inclined and able to travel by car, contributing to domestic or regional tourism.

In the TDS, growth of the number of trips by car and distance travelled outpaces the BAU scenario reaching 8.1 billion trips (see Figure 20.) and 5.8 trillion pkm (see Figure 21.) by 2050. In terms of new products, camping provides a great niche. While electric cars can technically tow caravans, the problem is that most electric car manufacturers failed so far to request an approval permit for towing. Those manufacturers who did, got one without any issues. Towing reduces the range the car can travel due to the extra weight. Until now, electric cars were mainly seen as alternative options for urban driving. However, as the driving range is getting bigger, more and more manufacturers can consider getting their models certified to tow. This may accelerate change and contribute to the growth of the electric car-based tourism market. High-tech solutions may also contribute to marketing efforts by providing anonymised vehicle data (McKinsey and Company, 2022a) and information about visitor journeys and other behavioural factors for electric car-based tourism. Furthermore, e-bikes and e-scooters can play a great role in tourism products and can also solve first and last-mile problems in destinations. These potentials need to be recognised and exploited.

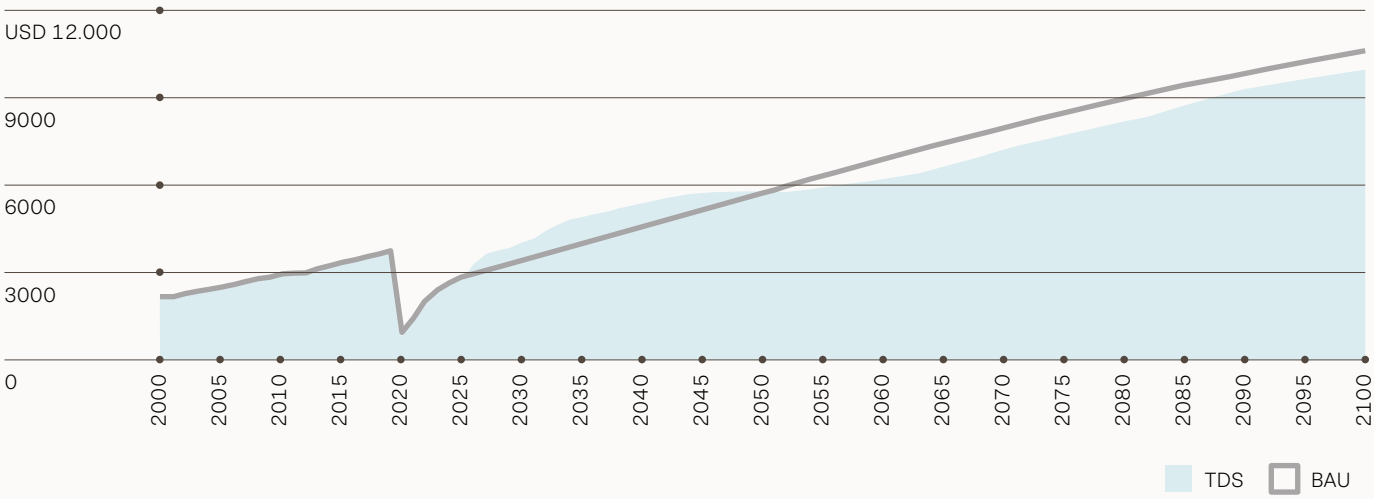
Car global number of trips (billion)

Figure 20. *Car global number of trips*

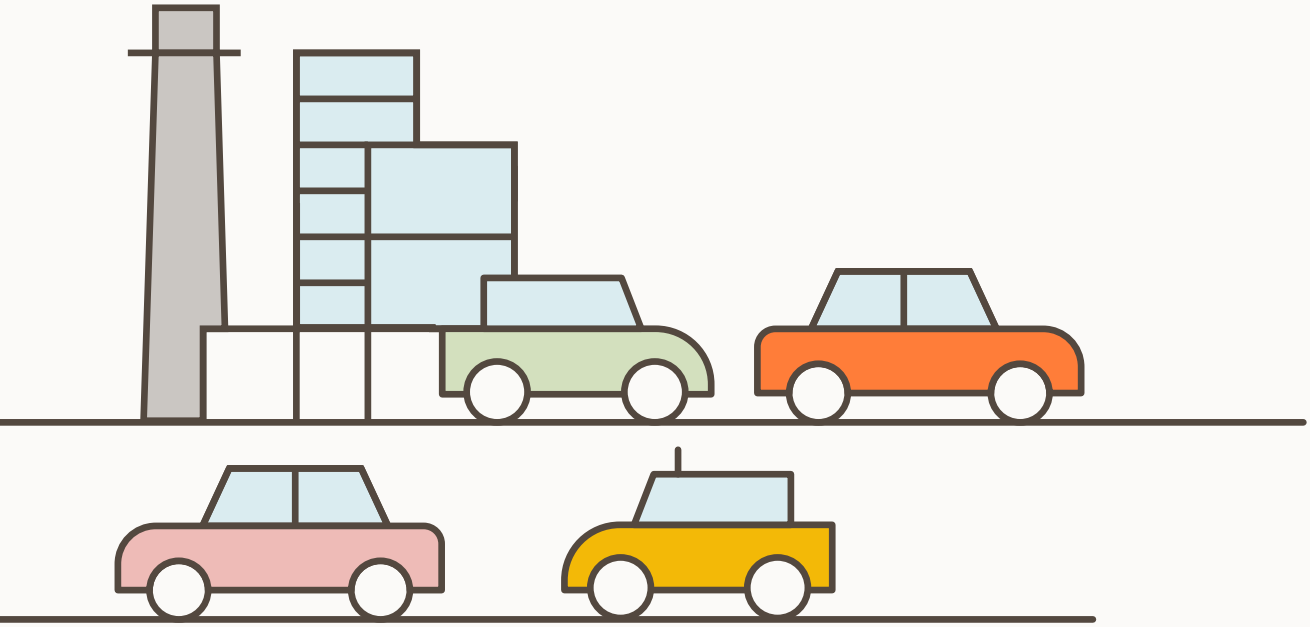


Car global distances travelled (billion pkm)

Figure 21. *Car global distances travelled*



The developments outlined above will likely lead to further behaviour change. Despite the fact that the range of electric-vehicles on a single charge is increasing, people may be more inclined to reduce the distances travelled, opt for public transportation (public transportation tends to reduce emissions compared to private vehicles), use car-sharing services or choose non-motorised vehicles. Such a behavioural shift has a great impact on the success of the decarbonisation scenario as it boosts the tourism economy while reducing carbon emissions and energy use.



Ground transportation – **Other: rail, bus, ferry**

Implications

'Other' transport modes will reach net-zero by 2050

'Other' transport accounts for 19% (2030) and 26% (2050) of all kilometres travelled as compared to the 2019 share of 15%

The number of trips travelled by 'other' transport mode will increase from 1.9 billion (2019) to 3.3 billion (2050)

The increase in revenue will outpace the BAU scenario reaching 438 billion USD in the year 2050

Large investments are required in the initial phase to develop the necessary infrastructure

The global cost of other modes of transport such as trains is decreased by 40% by adding some subsidies

New ecosystem dynamics, investment and business development models are required to facilitate growth

Improved facilities and services will lead to enhanced passenger experience

Actions

Investing in high-speed rail network to improve connectivity (200 billion USD/year from 2025 until well after 2050)

Lowering taxes on rail tickets to generate demand

Increasing government subsidies

A well-functioning, international rail network requires political will for collaboration to accommodate the same ease of booking as is the standard in aviation

Re-investing tax revenue into the rail industry

Standardization of tracks and rolling-stock

Aligning rules and language, similar to the aviation industry

Improving facilities and services to enhance the passenger experience

Developing more flexible routes

The temporary reduction in air transport will stimulate a modal shift which will benefit the car industry as well as the bus/coach, ferry and rail service providers.

Globally, the rail industry carries approximately 8% of all passengers while it accounts for only 2% of the energy demand of the transport sector (International Energy Agency, 2019). In Europe, in 2018, the share of rail transport amongst all transport modes for leisure travel was 2% and within land transportation approximately 5% (European Travel Commission (ETC) & Eurail B.V., 2020). The rail industry has the potential to fully decarbonise earlier than 2050 (see Figure 22.). Currently, the most extensive electric rail networks can be found in Europe, Japan, China, India and Russia (they together account for 90% of worldwide rail passenger transport) (International Energy Agency, 2019).

The ferry sector already has the technology to introduce electric shipping. Norway has pioneered much work in this field. The world's first electric car ferry was launched in Norway in 2015 carrying up to 260 passengers and 160 cars on a 20-minute fjord

crossing and by 2022 Norway had launched the first fully-electric fast ferry. By 2026, western Norway's fjords will only allow zero-emission electric ferries, cruise ships, and tourist boats. Electric ferries are also being launched worldwide. For example, in New Zealand the Ika Rere became the first fully electric ferry to launch in the Southern Hemisphere in Wellington. Spain's first fully electric ferry, the Cap de Barbarià, will operate between Ibiza and Formentera next summer. An innovative new electric "flying ferry" will be tested in the UK next year.

While air transport will remain crucial for long-haul travel and for providing access to remote areas in the world, 'other' transport, particularly rail, has great potential. In the TDS scenario, 'other' transport accounts for 19% (2030) and 26% (2050) of all kilometres travelled, compared to the 2019 share of 15%. Rail transport can provide a viable alternative to many short-haul routes thereby fostering behavioural change, increasing its market share and contributing largely to halting greenhouse gas emissions. It is anticipated that in the TDS scenario the number of trips will increase significantly from 1.9 billion (2019) to 3.3 billion (2050) (see Figure 24.) while distance travelled by 'other' transport will increase to 3.1 trillion passenger kilometres (2030) and 5.1 trillion pkm (2050) from 2.2 trillion pkm (2019) (see Figure 25.). This increase is partly due to the fact that, in the TDS scenario, the cost of train travel will decrease by approximately 40% due to introducing subsidies. As a result of increased demand, global revenues will outpace the BAU scenario reaching 438 billion USD in the year 2050 (see Figure 23.).

Figure 22. *"Other" transport mode including rail, bus and ferry - CO_2 emissions*

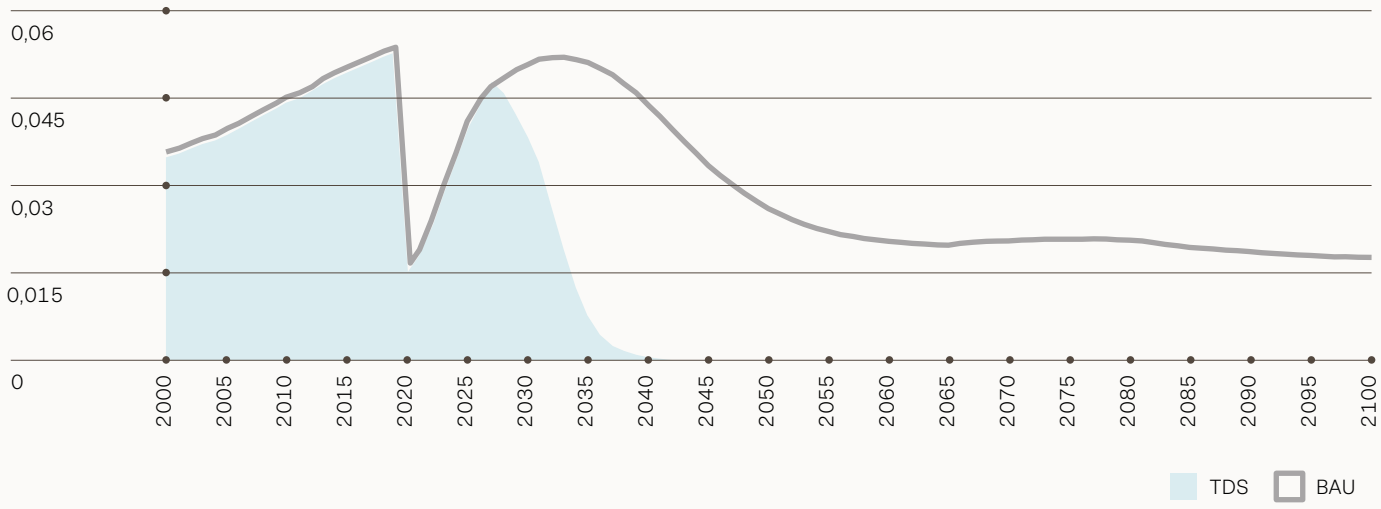
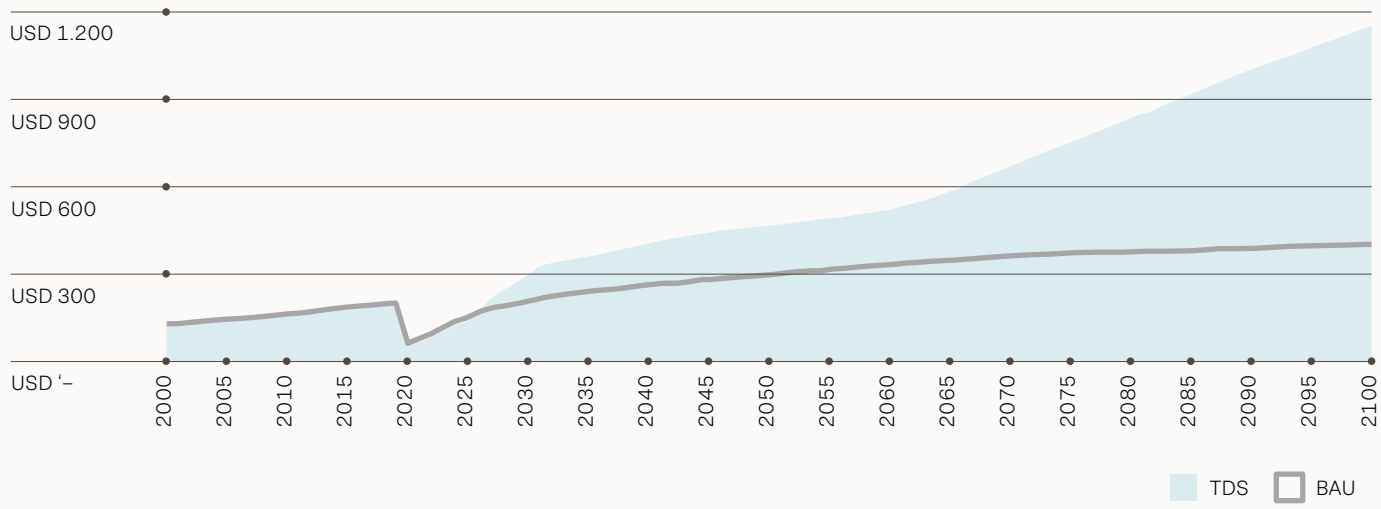
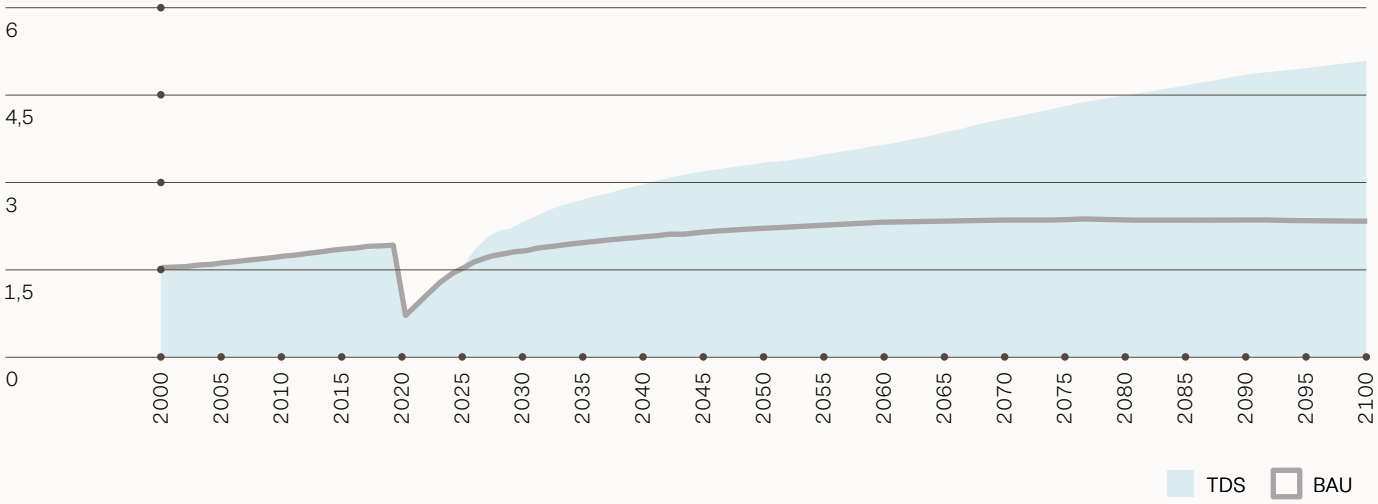


Figure 23. *'Other" transport mode including rail, bus and ferry - global revenues per year*



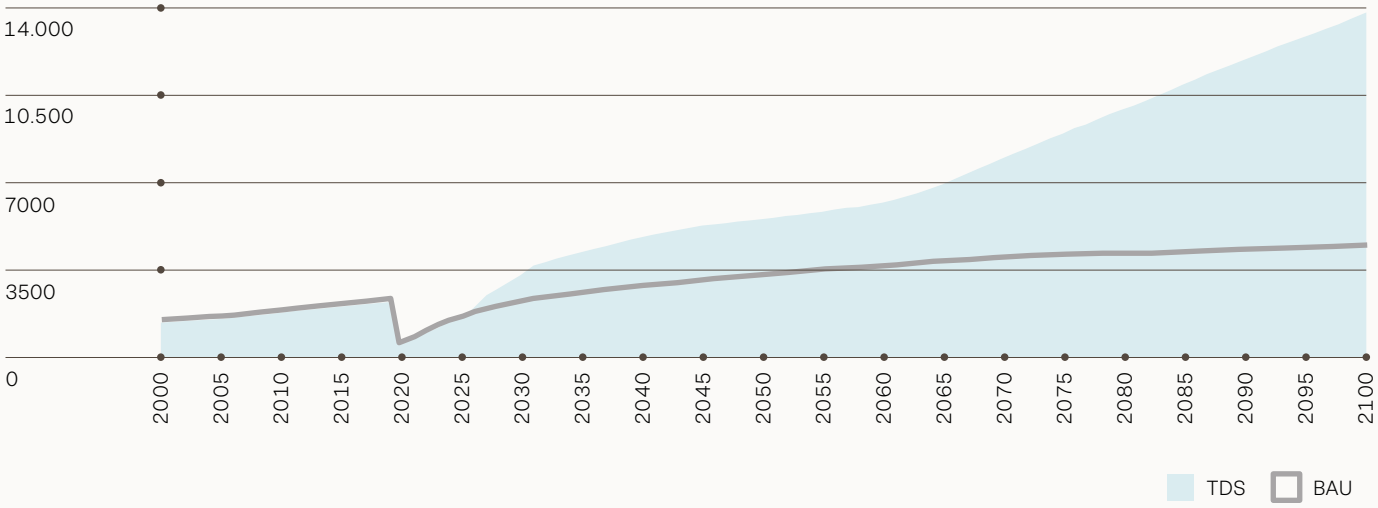
Other global number of trips (billion)

Figure 24. *Number of trips by "other" transport mode including rail, car and ferry*



Other global distances travelled (billion pkm)

Figure 25. *Distance travelled by "other" transport mode including rail, car and ferry*



As the train will become a better alternative, alongside other alternatives (car, bus/coach, ferry etc.) cooperation amongst stakeholders will need to strengthen to cope with increased demand. This could result in new ecosystem dynamics, investment and business development models that ensure flexibility and speed. It is certainly good news for the travel and tourism sector that, in the global rail network, high-speed rail represents the largest growth in terms of infrastructure (International Energy Agency, 2019). This growth is led by developments in China, whereas the extension of the network is somewhat slower in Europe and Japan, with the rest of the world lagging behind (Figure 26.). While a high-speed rail network is of great importance for cross-border travel, especially amongst EU member states, and a pre-condition to promote low-carbon mobility for tourism purposes (amongst others), there are numerous challenges. Besides large amounts of investments, a well-functioning, international rail network requires political will for collaboration, standardization of tracks and rolling-stock so that trains can run across borders, and the alignment of rules and language similar to the aviation industry (Future Rail, n.d.). This is also necessary for creating global ticket booking systems matching the quality of such systems in aviation.

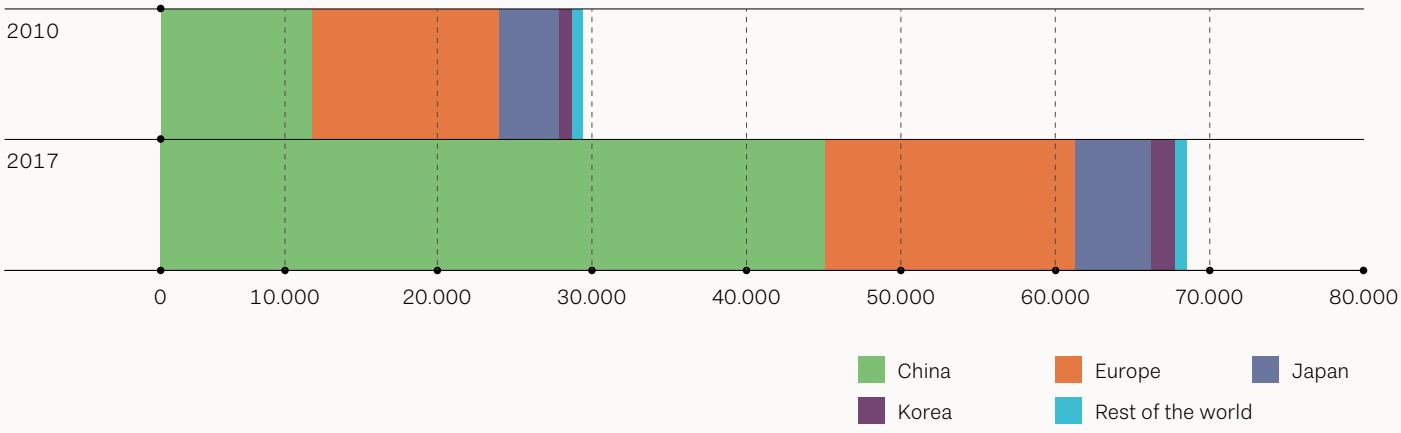
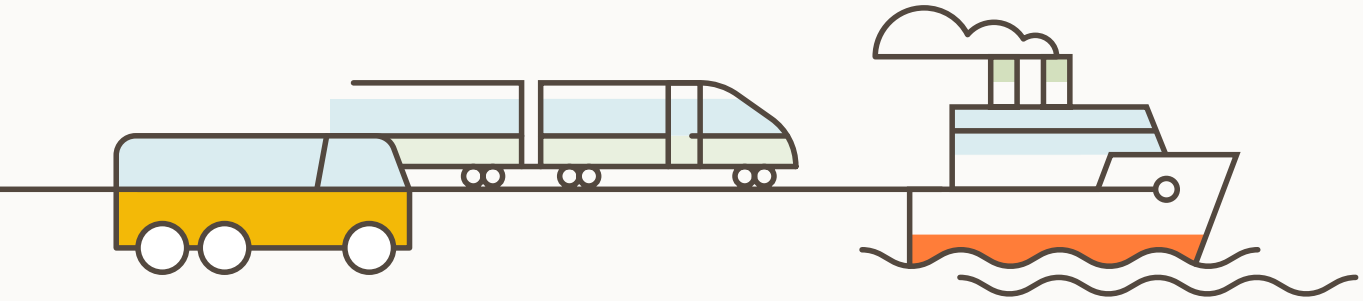


Figure 26. *High-speed rail track length by key region, 2010 and 2017*[9]

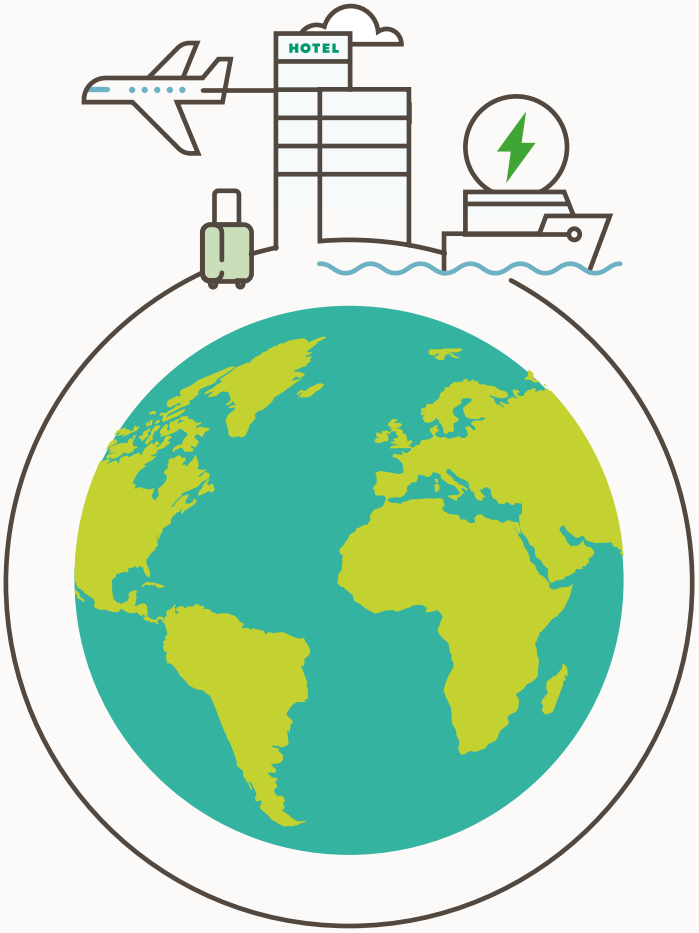
It must be acknowledged that the shift to train transport will be easier and faster in the regions where the current infrastructure (conventional and high-speed rail) is relatively well developed, while it will require more time in regions where the infrastructure is currently under developed (e.g. North and South America and Africa, even though extensive rail-infrastructure is available, but mainly used for freights transport). In these regions, (electric) car, bus/coach or other public transport options may be a better alternative on the short-term. Furthermore, China is now heavily investing in the African rail industry.

It may be anticipated however, that higher demand caused by the restricted growth of aviation will lead to increased investments in rail infrastructure despite the high initial costs and the long payback periods. Increased ticket sales will lead to revenue growth that can offset some or all of the investment costs and which can be re-invested into the greening of energy sources, improving of safety standards, harmonising of ICT systems and the enhancement of the passenger experience. Mobile ticketing, dynamic pricing, integrated booking systems and real-time information provision need to become the norm (European Travel Commission (ETC) & Eurail B.V., 2020) making rail travel a viable alternative. Tour operators may further stimulate demand for low-carbon transport alternatives e.g. tour operators replacing flights with rail options in holiday packages.



[9] *Source: (Based on UIC, 2018, International Energy Agency, 2019)*

How should the tourism sector respond to the TDS?



The changes in the transport sector outlined above will have significant implications for the way tourism businesses and destinations plan to develop. While the TDS scenario allows for growth (revenue, number of trips and guest nights), growth will be more directed at car, rail, coach and other transport modes. reducing the dominant role of aviation by capping airport capacities to keep aviation distances travelled at 2019 levels. Therefore, the TDS scenario is characterised by a modal shift, with electric cars and 'other' transport modes such as rail, bus or ferry being a popular alternative. To enable this shift, large scale investments are needed into infrastructure, technology, electrification and the greening of energy sources while marketing efforts should target short or medium-haul markets.

Accommodation Industry

Implications

The accommodation industry reaches net-zero by 2045

By 2030 83% of the accommodation sector is assumed to be electric (from 50% in 2019) and 12% more energy efficient than in 2019

By 2050 99% of accommodation is electric and 47% more energy efficient than in 2019

Revenue generated by the accommodation industry will increase from 1.2 trillion USD (2019) to 2.5 trillion USD (2050), outpacing the BAU scenario

The number of guest nights will increase from 26 billion (2019) to 49 billion (2050), outpacing the BAU scenario

Short-term big investments are required

Investments will likely yield long-term revenue gain

Travellers' needs and wants are likely to change as a result of shifting travel patterns (e.g. extended stay)

Actions

Strengthening net-zero commitments

Strengthening the regulatory environment e.g. purchase of renewable energy sources

Understanding emission sources (scope 1, 2 & 3)

Optimizing resource management

Clear division of responsibilities amongst parties (in the operational model)

Improving the transparency of emission data and standardisation of energy certification

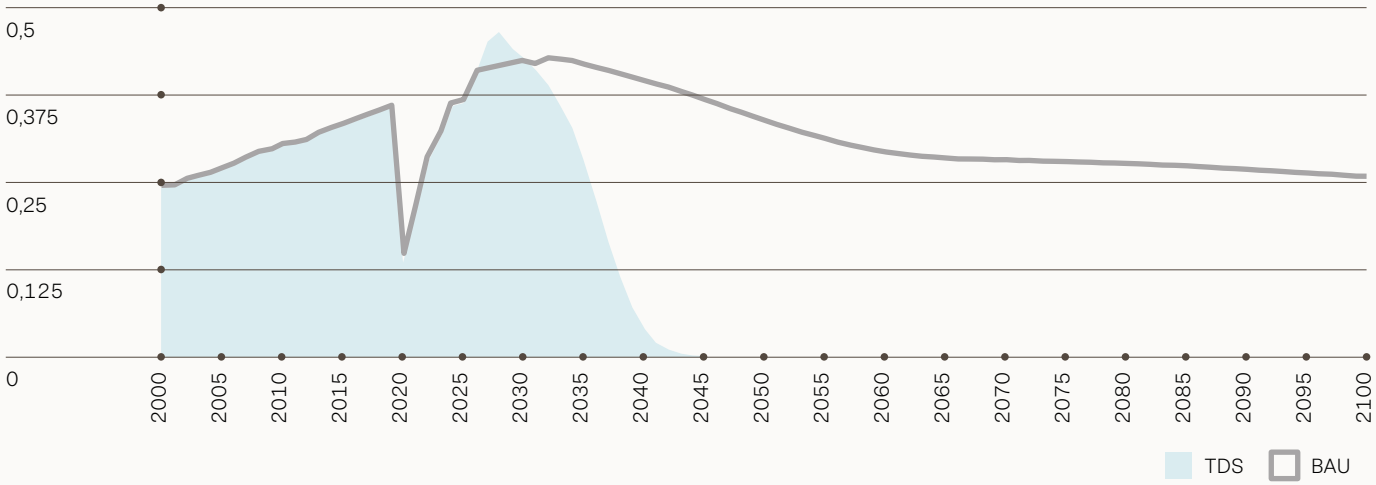
Incentivizing longer stays

Adapting the services and facilities in line with changing travel behaviour

In the TDS scenario, revenue generated by the accommodation industry will increase from 1.2 trillion USD (2019) to 2.5 trillion USD (2050) (see Figure 28.), while the number of guest nights will increase from 26 billion (2019) to 49 billion (2050) (see Figure 29.) and will continue to increase towards the end of the century. This is due to the fact that the scenario allows for the total number of trips and guest nights to grow (it even outpaces the BAU scenario) while the distance travelled will also increase, albeit at a lower pace and will remain behind the BAU scenario. Distance travelled will be redistributed amongst travel modes motivating people to take less trips but extending the length of stay. Extended length of stay will benefit the accommodation industry leading to increased revenue and optimised operations (potentially reducing costs). The accommodation industry has the potential to be 83% electric by 2030 and fully decarbonise by 2045 (see Figure 27.).

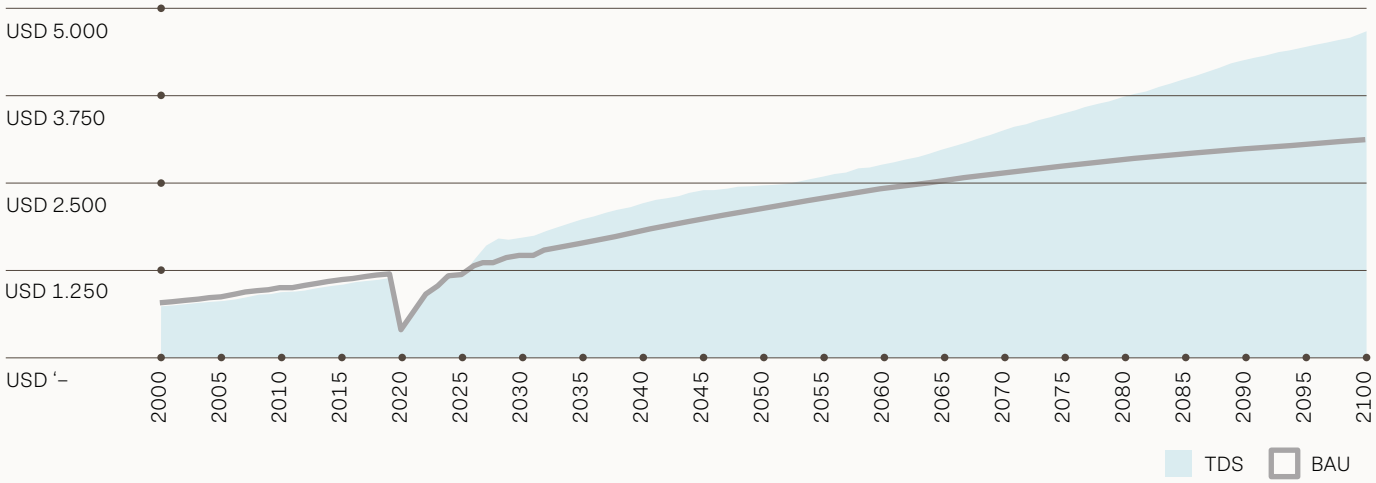
Accommodation global emissions (Gton)

Figure 27. Accommodation related CO_2 emissions



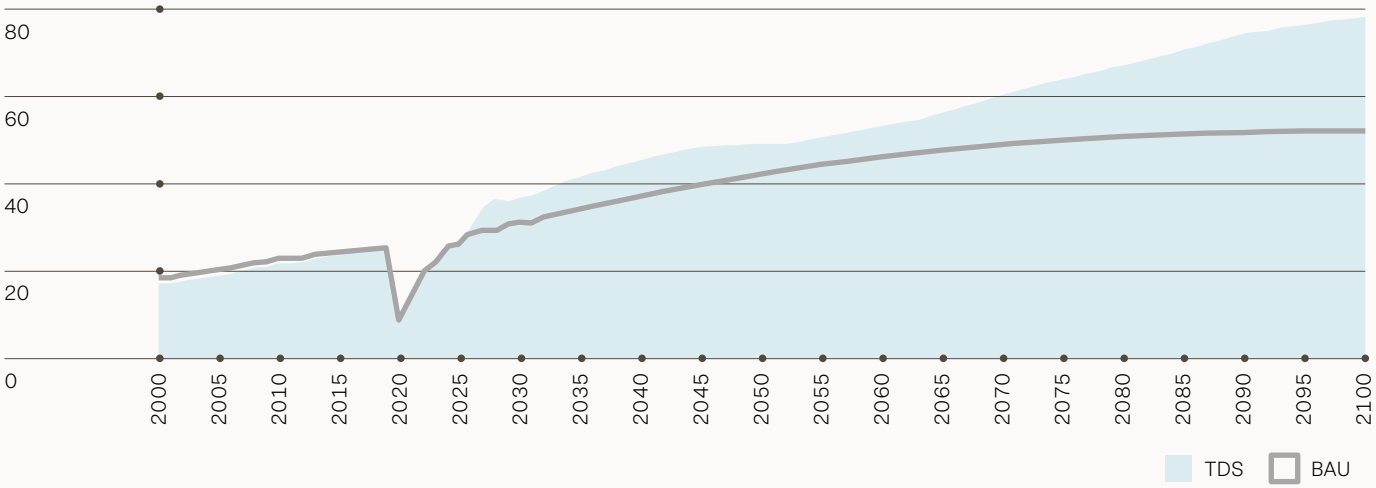
Accommodation global revenues per year (billion USD1990)

Figure 28. Accommodation related global revenues per year



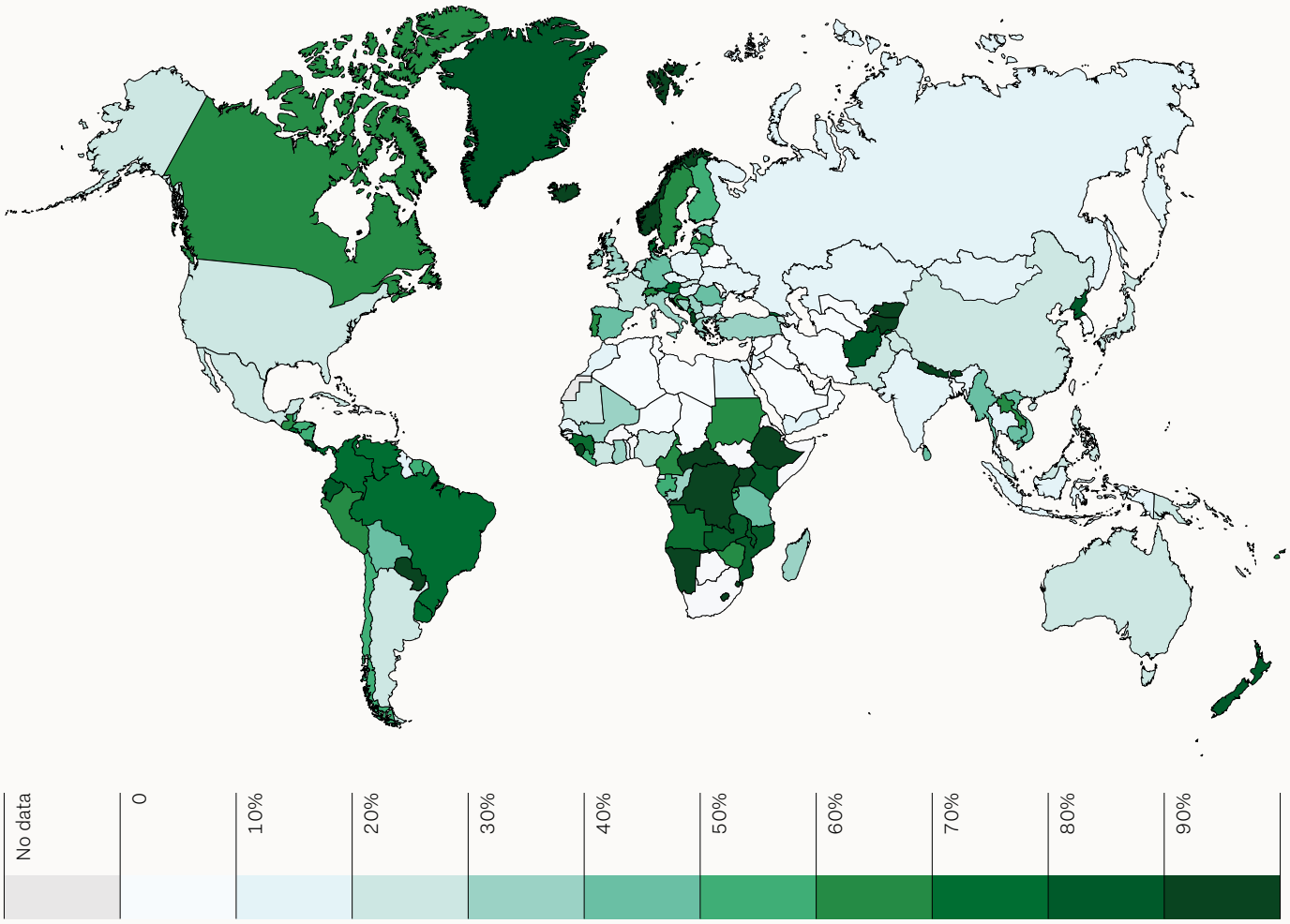
Accommodation nights (billion)

Figure 29. Accommodation guest nights



As stated earlier, the technology to fully decarbonise the accommodation sector already exists. Therefore, net zero-emission commitments in the following years are expected to intensify. While short-term big investments are required, such investments will presumably yield long-term revenue gain. Optimizing energy efficiency and reducing energy usage are the most common measures hotels take to reduce their carbon footprint. Energy costs usually represent the second largest costs after labour, therefore investing in energy efficiency and the use of renewable energy sources has great potential for cutting costs and gaining return on investment (see e.g. Greenview (2021)). A pre-condition for such measures is the understanding of emission sources (scope 1, 2 & 3) as well as the clear division of responsibilities amongst parties within the different accommodation industry operational models. It is crucial that not only scope 1 & 2 emissions (direct and indirect emissions from controlled or owned assets) but also indirect scope 3 emissions resulting from operations (purchase of products and services, such as food and beverages or laundry, waste management, employee travel etc.) are mitigated as much as possible. According to WTTC (2021a), scope 3 emissions account for approximately 55% of all emissions of accommodation service providers. Additionally, we must recognise that the share of electricity production from renewables differ significantly per continents and countries (see Figures 30. and 31). The share of renewables is higher in parts of Africa and South America. Both are amongst the ones that receive the most international funds for clean energy production, research and development while their annual CO_2 emissions per capita is amongst the lowest.

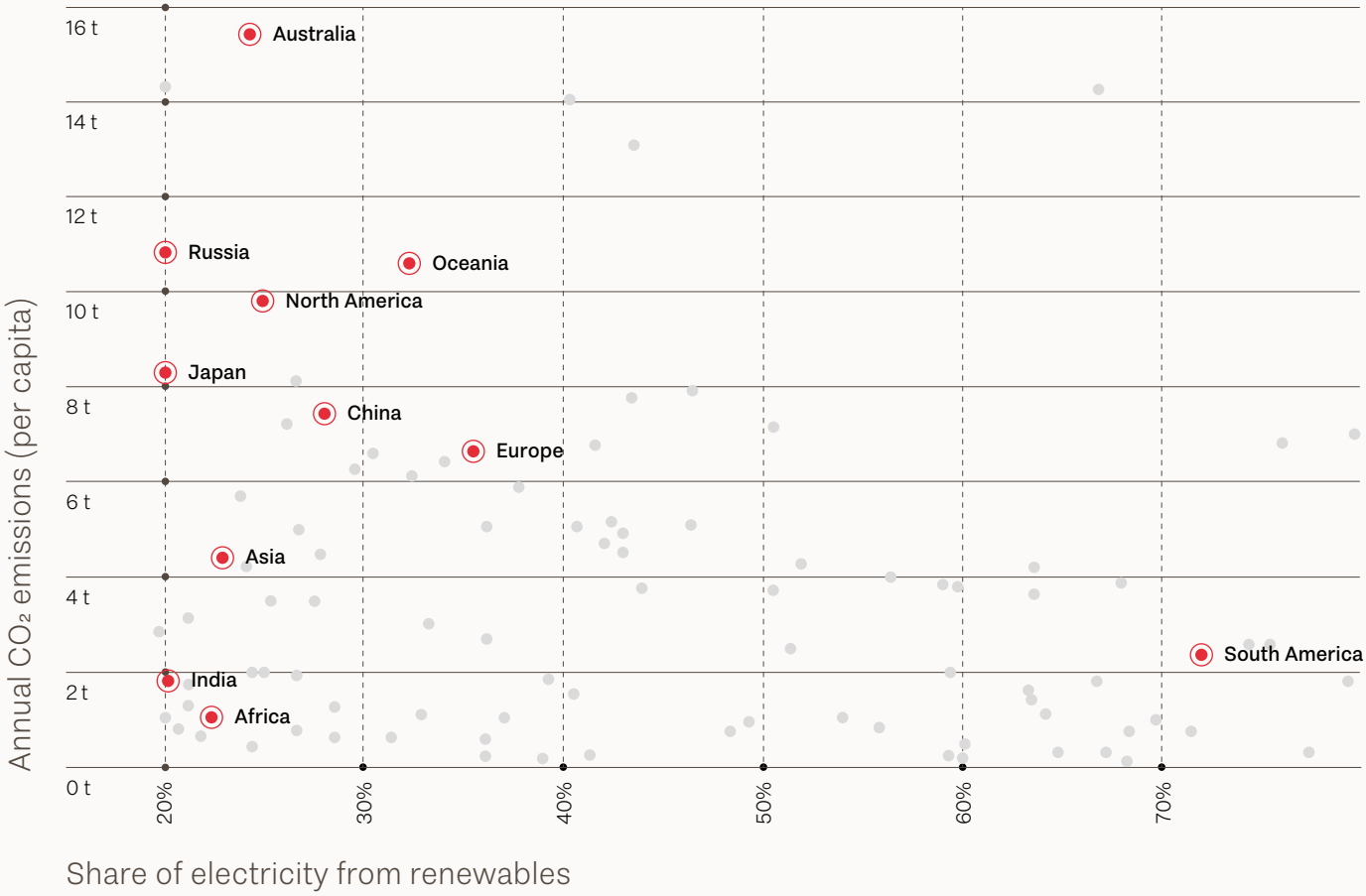
Figure 30. *Share of electricity production from renewables (2021)*[10]



Source: Our World in Data based on BP Statistical Review of World Energy (2022); Our World in Data based on Ember's Global Electricity Review (2022); Our World in Data based on Ember's European Electricity Review (2022) OurWorldInData.org/energy

[10] *Source: (Ritchie et al., 2020b). Renewables include electricity production from hydropower, solar, wind, biomass & waste, geothermal, wave and tidal sources.*

Figure 31. *CO_2 emissions per capita vs. share of electricity from renewables (2020)*[11]



Source: Our World in Data based on the Global Carbon Project, BP Statistical Review of World Energy and Ember (2021)

The regulatory framework surrounding the process of renewable energy purchase, the reporting of emissions data and the standardization of energy certification is a pre-condition for the decarbonisation of the accommodation industry (see e.g. Greenview (2021)). Consequently, if the net zero goal is to be achieved, the regulatory environment needs to be strengthened in the future.

The optimisation of all facets of accommodation operations is likely to impact upon the labour market. The deployment of technology and smart solutions (e.g., self-check in) will require a smaller labour force. While numerous accommodation service providers are still suffering from the impacts of the COVID-19 pandemic and dealing with large-scale labour shortages, automation and cutting-edge technology may be a way to tackle the lack of employees and at the same time improve planning and resource management.

The increasing popularity of longer-stays indicate a change when it comes to travellers' needs and wants. Hotels and other accommodation service providers will need to analyse demand, identify emerging trends and adapt the service and facilities accordingly. Additionally, to foster behaviour change, incentives for longer stays should be considered and offered in collaboration with other members of the tourism value chain. Given the increasing market-share of rail and car, accommodation providers will need to consider first and last-mile issues (for rail, e.g. car sharing, shuttle services or public transport) and will need to install charging stations for electric vehicles. Additionally, energy for the charging infrastructure will need to come from clean energy sources.

[11] *Source: (Ritchie et al., 2020b). Carbon dioxide (CO_2) emissions per capita, measured in tonnes per year versus the share of total electricity output from renewables.*

Tour operators

Implications

The role of TOs as specialists will strengthen, particularly for rail travel

Travellers' needs and wants are likely to change as a result of shifting travel behaviour

A change of narrative is required (storytelling, awareness, education, inspiration etc.)

Monitoring of state of transport infrastructure will be necessary for product development

Focus needs to shift to domestic and regional tourism

Focus needs to shift from aviation to alternative modes like rail, coach and electric car travel

Renewed business management and cooperation models will emerge

Potential to reduce export and import leakage

Actions

Shaping demand instead of following it

Renewing the product portfolios to facilitate change

Shifting towards more domestic and regional tourism

Focusing on new source markets

Product development in line with the TDS

Prioritizing destinations less fragile to environmental impacts

Incentivising longer stays

Monitoring of state of transport infrastructure for the development of low-carbon tour packages

Strengthening collaboration with local businesses and service providers

Helping the fight against greenwashing by phasing out businesses with harmful practices

The TDS scenario strengthens the view that continued growth of travel distances is not a precondition for the well-being of tour operators and that moderate but equitable growth can result in fewer environmental impacts, fair distribution of wealth across the globe and improved living standards overall. Shifting growth away from high-emission to lower-emission products and segments can help mitigate the issues related to excessive visitation and climate change and foster growth in parts of the world where it is still possible.

As the number of trips taken will continue to grow, tour operators have the potential to influence visitor flows by creating offers that shape travellers customer journeys in line with the net zero target. As a consequence of the modal shift (from air to car/bus/train) TOs will need to adapt their product portfolios by building packages around alternative transport modes. TOs will lead and shape demand, instead of following it (European Travel Commission, 2022), given that the necessary infrastructure is in place. To ensure that low-carbon tour packages are feasible and to guarantee seamless travel experiences, the analysis and continuous monitoring of the state of infrastructure and transport services in specific destinations will be necessary.

Besides alternative forms of transportation, in response to less supply of air travel, TOs should focus more on domestic and regional tourism. In the TDS scenario travel distance stays below the reference (approximately 50% less distance travelled than in the 2050 BAU scenario), while the number of trips and guest-nights will grow. This practice is expected to lead to inclusion of new destinations, new product offers and the strengthened role of TOs as specialists. The need for an extensive range of activities and services (to satisfy long staying guests) opens up new possibilities for the inclusion of locally owned businesses and service providers thereby potentially reducing export and import leakage at the destination. Furthermore, alternative offers can help with tackling overtourism related issues and

seasonality by spreading visitors spatially and time wise. Those TOs that focus primarily on long-haul travel may face additional challenges as the shift to domestic and regional tourism may require significant changes in their profile and operational models. One main advantage will be the fact that growing demand and restricted supply will shift this type of travel to higher-spending customers and better profit rates.

TOs can further aid the decarbonisation efforts by only collaborating with accommodation service providers, excursion organisers, attractions and other players that meet the net zero emission criteria. The new partnerships, within and between countries, will require renewed business management and cooperation models amongst members of the global tourism system.

TOs will need to keep up with the latest technological advancements in order to successfully intervene. For instance, advertising algorithms could nudge people to go to certain destinations (e.g. people living in the vicinity of a place). TOs could also aid the fight against greenwashing by helping to phase businesses with harmful practices out of the market.

The shift from long-haul to short-haul travel and potentially to train, (electric) car or other low-carbon transport alternative could result in revenue loss from the sales of airline tickets. However, this loss will be offset by the increase in the sales of train tickets, commission from longer hotel stays and cooperation with other members of the value chain. Furthermore, people are expected to make fewer long-haul trips but with longer stays thereby opening up opportunities for a range of incentives and loyalty programs.

National Tourism Organisations (NTOs)/ Destination Management Organisations (DMOs)

Implications

Dynamics of the global tourism system will change

Need for new destination development, management and marketing strategies

Attention needs to shift to domestic and regional source markets

Destinations depending on aviation will find additional growth challenging

Joint efforts are needed to compensate destinations that are suffering in the TDS

Integrated and holistic cooperation models (cross-sector, cross-level and cross-border) will be needed

New understandings of the holiday experience, change of mindset is required

Actions

Coordinating sector-wide efforts

Rethinking of the image, brand and positioning of the destination

All emissions from travel to/from the destination must be accounted for in national, destination and business strategies and climate action plans

Prioritizing tourism products and market segments with high-value and low-carbon footprint

Incentivizing longer stays at the destination

Strengthening cooperation with the public sector to increase taxes and environmental charges to compensate for revenue loss from aviation

Strengthening local as well as regional cooperation to develop multi-destination offers

Sharing data, knowledge and best practices

In the decarbonisation scenario, national tourism and destination management organisations can and should take the lead in shifting the focus from purely economic growth towards a balanced view on economic, social and ecological value. NTOs and DMOs can stimulate the sector to think about the factors they can change and benefit from, and not about the sacrifices they need to make. The TDS scenario presents a range of new opportunities while it also requires the rethinking of the global tourism system. The redistribution of visitor flows across transport modes and geographies requires new destination development, management and marketing strategies.

NTOs and DMOs may face new challenges as their marketing efforts may need to be limited to nearby countries (as it is already the case in The Netherlands, or in Norway where the primary focus is on Scandinavian countries and other European countries) and/or be focused on and to fully optimising the most valuable long-haul markets. The attention will need to shift more and more to domestic and regional source markets which may require the revision of the image, brand and positioning of the destination. This shift, however, holds possibilities. While reliable global statistics about domestic tourism are not available, in 2018, approximately 9 billion domestic trips were made worldwide for tourism purposes, six times more than international trips (1.4 billion). In the OECD countries, 75% of the total tourism expenditure comes from domestic tourism, while in the European Union revenue from domestic tourism exceeds inbound tourism expenditure (World Tourism Organization (UNWTO), 2020). Countries such as the USA, Mexico, Japan, Germany and the UK have the strongest domestic markets in terms of revenue.

Destinations that depend heavily on long-haul markets and

therefore on aviation, given their unique/remote geographical location, will face additional challenges to grow. Where possible, marketing efforts should shift to domestic or regional markets. In the case of regional tourism, the destination should be accessible via rail, road or boat/ferry connections. Where the domestic market does not hold much potential as the destination depends heavily on foreign visitors (e.g., small island destinations) restrictions on airport capacity growth should be considered carefully and flights that contribute significantly to inbound tourism should continue to operate while cutting other, less utilised routes. Additionally, efforts should be made to lengthen visitor stays by only offering products/packages of extended duration (e.g., set minimum nights), and strategically scheduling flights to and from the destination thereby optimising revenue. Increasing taxes and environmental charges in aviation (and potentially in other parts of the tourism value chain) to further compensate the incurred revenue loss can be an option. Reinvesting the revenue from tax and other charges in a transparent manner can prevent loss of demand as a result of increased costs. Raising awareness is crucial to increase social acceptance. Furthermore, global joint efforts are needed to compensate destinations that may be hit by the restrictions on aviation growth.

Destinations relying heavily on the meetings, incentives, conferences, and exhibitions (MICE) sector will need to review current practices too (as conferences and events can be significant sources of emissions while technology allows for fewer in-person meetings) and make changes in accordance with the net zero target. NTOs and DMOs will need to lead this change by creating awareness, sharing knowledge and best practices, coordinating sector-wide efforts and reporting on progress in a transparent manner. NTOs and DMOs should play the same role across the destination's entire product portfolio by prioritizing tourism products with a low carbon footprint and using demarketing practices to discourage market segments that do not comply with the destination's decarbonisation efforts.

Cross-sector (car, train, accommodation, etc.) and cross-border collaboration is crucial which will require NTOs and DMOs to establish new, or strengthen existing, cooperation models by taking a holistic, integrated approach towards destination management. Vertical, horizontal and sectoral integration is a precondition that will increase the responsibilities and duties of these organizations, in collaboration with the private sector.

How can we secure buy-in for the TDS scenario?

The commitment of travellers as well as political and institutional support are vital for the successful implementation of the TDS scenario. This section provides an overview of some of the key challenges and opportunities that can help secure buy-in for the TDS scenario and ultimately lead to a more equitable future for travel and tourism.

Social acceptance

Implications

The change of travel behaviour is inevitable in the TDS, however, this change is restricted to a minority of travellers

Voluntary behaviour change has its limitations, change needs to be supply and regulation-driven

Understanding of the importance of the sector's decarbonization and the consequences of a climate crash is central for increasing support from society

A change of mindset is required for the transition (e.g. the value of travel distance, quality of the experience, slow tourism etc.)

Labour conditions and holiday schemes may need to be adjusted to facilitate travel behaviour change (e.g. longer stays)

Fears may arise regarding the impacts of the TDS on the labour market

Actions

Offsetting travel restrictions by providing plausible alternatives

Increasing social acceptance by formulating clear messages

Reframing the holiday experience

Educating travellers about their eco-footprint

Reviewing holiday schemes to facilitate the change of travel behaviour

Improving the transparency of the investments of revenue from taxes and environmental charges to create trust

Standardizing the measurement of carbon footprint to aid travel decisions

Developing a new labour market agenda (cross-training, up-skilling, re-skilling)

Enforcing measures to make travellers behave in a pro-environmental manner

Behaviour change is a core requirement for the decarbonisation scenario. However, while travellers will face certain restrictions (e.g. capped airport capacity) plausible alternatives will be provided that will allow them to continue to travel. Moreover, 85-90% of trips from the BAU scenario in terms of distance travelled, will be offered in the TDS scenario. Social acceptance of the scenario largely depends on the awareness and knowledge of the public related to the importance of the decarbonisation of the sector, the consequences of a potential climate crash and the range of green alternatives available to avoid such an outcome. It must be understood that the faster the transition is completed the quicker restrictions can be lifted and the costs reduced. Social acceptance can be increased by formulating clear messages.

However, the change of travel patterns maybe difficult for many. The shift towards proximity tourism, less flying and a transition towards low-emission/zero-emission transport modes require discipline, understanding and investment (e.g. personal vehicles) and essentially the reframing of the holiday experience. Awareness of the consequences of actions is key as it may lead to the feeling of moral obligation to act in a pro-environmental manner (European Travel Commission, 2022). Given that currently attitudes towards sustainability does not always align with behaviour, social acceptance of the decarbonisation scenario is crucial to induce behaviour change. Considering that there are limits to voluntary behaviour change, a shift in travel patterns is only possible if the necessary infrastructure and services are in place and policies aiming at pro-environmental behaviour are enforced. The myth that sustainable options are ultimately more expensive need to be demolished as well. Furthermore, transparency is key when it comes to the investment of revenue from higher ticket prices or environmental charges.

We also need to accept that certain destinations are more environmentally fragile. Places that can still host or develop tourism in an environmentally sustainable way should be prioritised by NTOs, DMOs and tour operators, thereby directing the public's attention to destinations less at risk, redistributing the benefits of tourism, contributing to improved living standards and potentially to a more equitable future.

The increased cost of flying raises questions about social inequality. While some may fear that the TDS scenario will make flying the privilege of the wealthy, they fail to recognise that it already is. A study by Gossling and Humpe (2020) suggests that in 2018 only 11% of the world's population travelled by air, while only 4% took international flights. Therefore, increasing the costs associated with aviation will hit mostly the wealthy. With time, the cost of aviation will drop in the TDS scenario, as demonstrated earlier, making it possible for a wider segment to fly.

Issues around the impacts on the labour market may lead to some backlash from society. While jobs may be lost in the aviation industry, other sectors will experience increased labour force needs. It is inevitable that employees will need to transfer to other segments, participate in cross-training, up-skilling or re-skilling to exploit the newly presented employment opportunities. This can be a great labour market agenda for the coming decades (Anderson, 2022).

Political and institutional support

Implications

Growth is possible while reaching the net-zero target of 2050

The emphasis lies on the redistribution of resources, revenue and growth

Government subsidies are essential for offsetting the transition costs

The transition to green energy will be cheaper on the long-term than relying on fossil-fuel based systems

A faster transition will speed up technological developments, economic growth and job creation

Political and institutional support is key and in our common interest (to avoid climate crash)

Cross-border collaboration is critical for an equitable future

Actions

Providing government subsidies to offset the transition costs

Supporting the deployment of new technology via funding programs and other means and incentives

Supporting the development of necessary infrastructure via large-scale collaborations and investment schemes (e.g. high speed and common railways)

Bringing the emissions caused by jet fuel tanked in a country into the NDC

ICAO's existing CO_2-standard for new aircraft needs to be strengthened in a way that zero-emissions will be the only kind of aircraft that can be certified for operational use after 2040 (short-haul), 2045 (medium-haul) and 2050 (long-haul)

Temporarily prioritizing sub-sectors that can transition faster (e.g. modal shift)

Developing carbon standards and harmonizing the measurement of carbon footprint both on the demand and supply side

Compensating destinations that may suffer in the TDS (e.g. tourism equity funds, redistribution of available SAFs etc.)

The common perception that the shift to green energy is expensive and the decarbonisation scenario is only possible by degrowth that leads to negative economic impacts and loss of revenue has been hindering the transition process. The TDS scenario shows that growth in the global tourism system can still be achieved while reaching the net zero target of 2050. The number of trips and guest nights, distance travelled, and global tourism revenue can still grow, albeit at a more moderate pace and in some instances staying behind the BAU scenario (distance travelled), while in other cases exceeding it (number of trips, guest nights and revenue). The emphasis however lies on the redistribution of resources, revenue and growth across sectors and geographical regions temporarily prioritising sectors where transition can be achieved faster and limiting those where the shift requires a longer timespan.

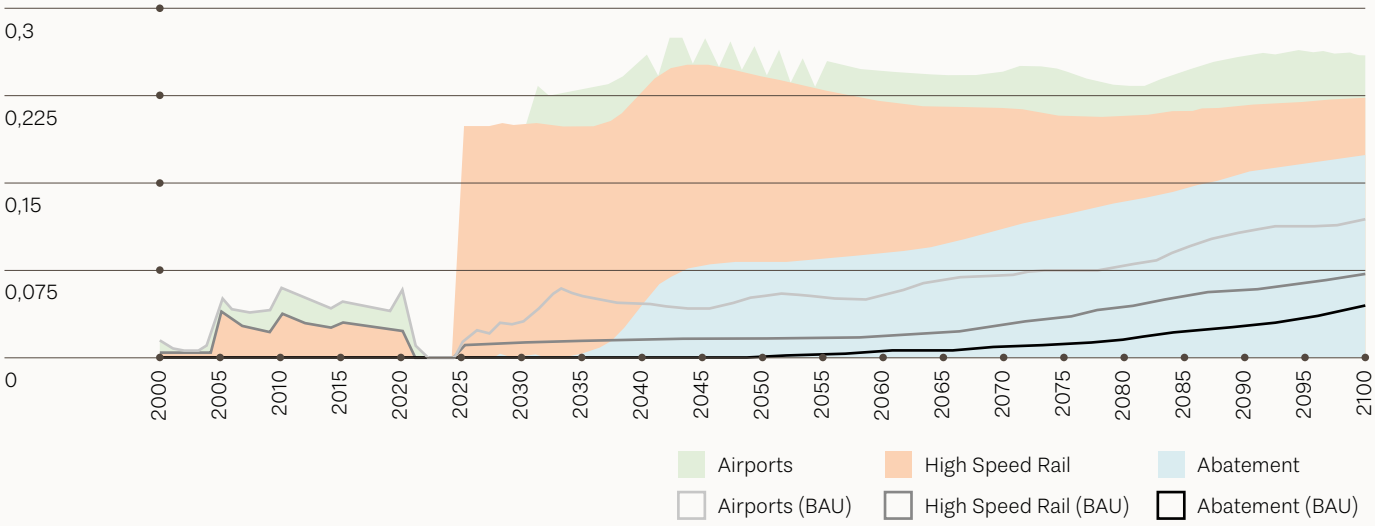


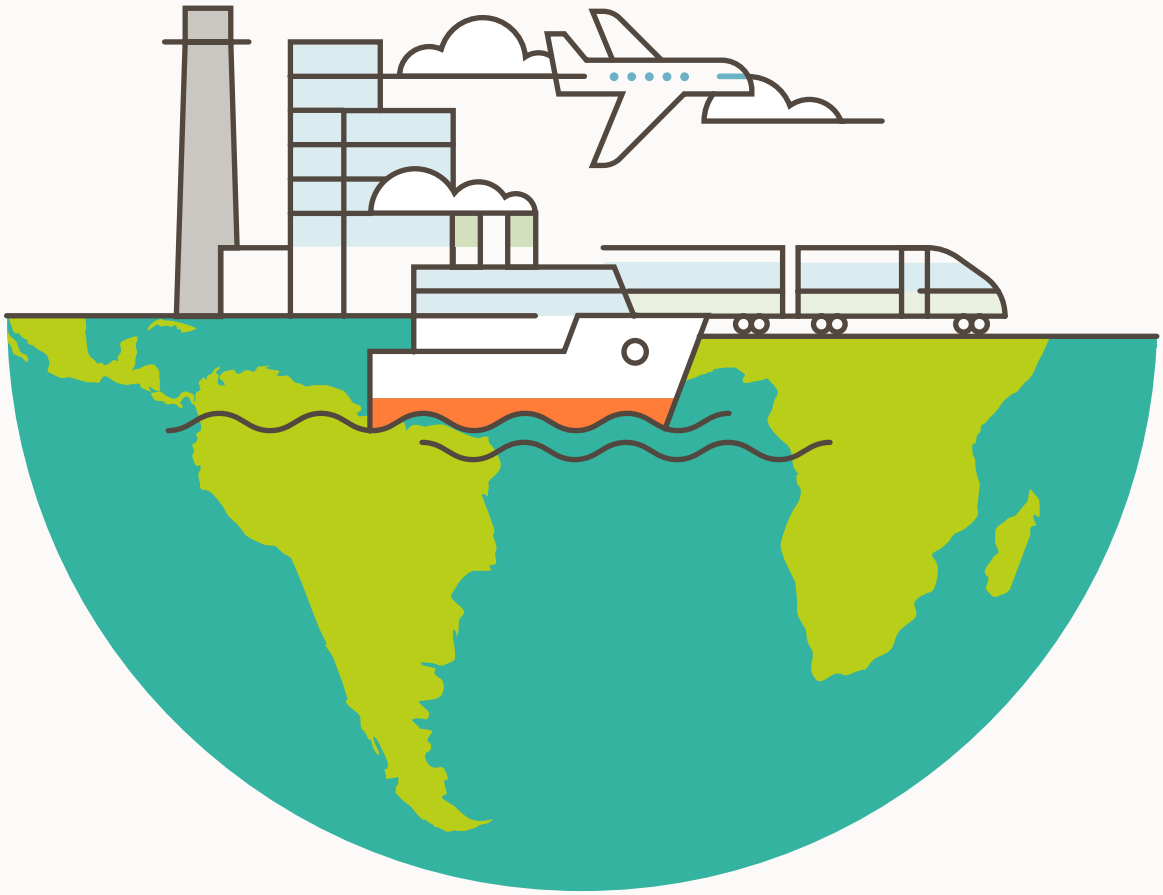
Figure 32. *Investments in technology, high-speed rail and airports in the TDS*

The higher initial investment costs (see Figure 32.) are likely to be offset by lower energy costs in the long-term. A recent study (Energy and Climate Intelligence Unit (ECIU) & Oxford Net Zero, 2021) advocates for fast transition to green energy systems and claims that the shift would lead to net economic benefits contributing positively to GDP. The findings of this study are confirmed by Deloitte (2022) as well. Transitioning to green energy is assumed to be cheaper then continuing with a fossil-fuel based system. A faster transition will assumably speed up technological developments, economic growth and job creation leading to even larger cost savings. Furthermore, failing to transition will result in significant human costs (e.g., liveability of places, health and well-being etc.). These claims coupled with the continued growth of the tourism sector suggests that political and institutional support is in our common interest. The question however is where the unprecedented amount of investments will come from. As Figure 32. shows, the total investments needed will be around 300 billion USD/year. The largest part of this money, approximately 200 billion USD/year will need to go into the development of the high-speed rail network so that rail can become a viable alternative to air travel.

Institutional support is crucial for the deployment of new technology, the development of infrastructure (rail, public charging infrastructure for electric vehicles, etc.), skills training and the offsetting of transition costs via large-scale subsidies and funding programs. Public sector engagement is key to enforce the measures outlined in this report and to speed up green technologies in sectors such as aviation so that restrictions can be lifted as soon as possible. The involvement of policy makers is even more pressing when considering that aviation, a major contributor to emissions, is not directly included in the Paris Agreement.

Furthermore, cross-border collaboration via international agreements is crucial when it comes to the distribution of e.g., available SAFs and other resources, the fair compensation of destinations that may suffer from the newly introduced measures and the enforcement of policies at the global tourism system level.

To further align global initiatives, the standardization of measurement of tourism carbon footprint (supply and demand side) is crucial as well as the alignment of carbon standards. Furthermore, to support the transition across the entire tourism supply chain, the sharing of data is of high importance.



Global implications – **equity and fairness**

Implications

The TDS will alter the direction of visitor flows but so will climate change

The TDS has its challenges but the human costs of climate change will be even bigger

50% of all countries (amongst them large developing nations) will likely benefit from the reduction of distance travelled and the redistribution of visitor flows

The contribution of travel and tourism to GDP tend to be the highest in remote LDCs (least developed countries) and SIDS (small island developing states) that are expected to suffer the most in the TDS

Compensation of destinations hardest hit in the TDS is key

A united travel and tourism industry is crucial to ensure a fair transition to net-zero

Actions

Increasing capacities to implement mitigation policies

Rethinking destination management/development strategies

Improving intergovernmental cooperation to increase investments into infrastructure and to tackle resource scarcity

Creating new market opportunities via regional collaborations

Creating joint tourism equity funds or other international development funds to compensate LDCs and SIDS

Increasing the uptake of low-carbon energy in developed countries in order to reduce the costs for developing nations

Negotiating the distribution of SAFs, airport slots etc. in aid of destinations

Diversification of the local economy to reduce dependence on tourism

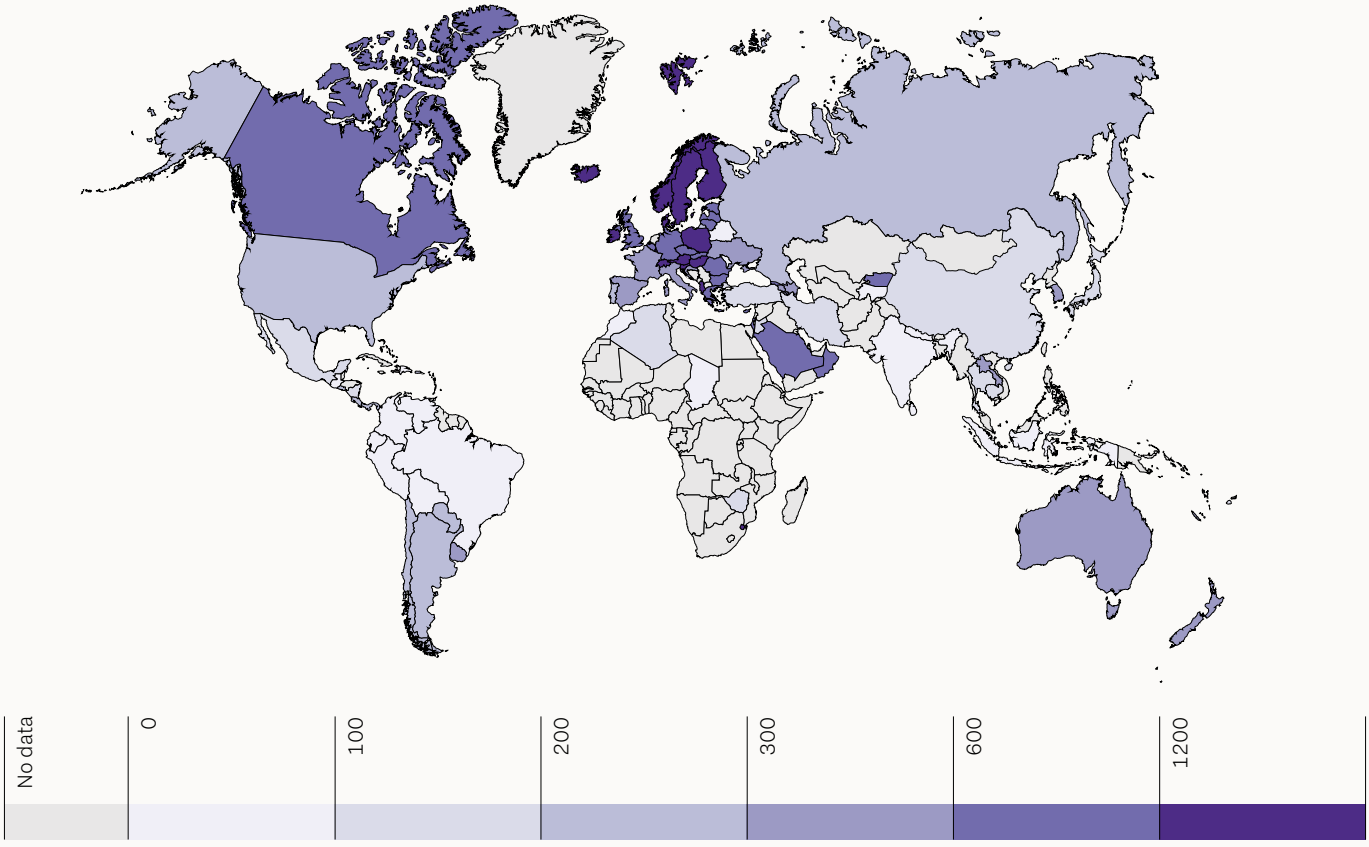
The TDS scenario has both cross-sectoral and geographical implications at the global scale. The transition to net zero is only possible through system-wide changes. While the scenario indicates the growth of the tourism sector, this growth deviates from the usual paradigm as it signals a modal shift, a change in travel patterns (distance and frequency) and the redistribution of resources and revenue across sub-sectors and geographies. Such an approach is likely to change the dynamics of the global tourism system. While it is often argued that such a change may strengthen global inequality, the current tourism system is based on a skewed distribution of benefits as well as opportunities, therefore a system-change may potentially lead to a more just and equitable future.

Tourism and climate change vulnerability - inequalities

The highest number of international outbound tourist departures are registered in Europe and North America (see Figure 33.). Likewise, the highest number of air transport passengers come from high and upper middle income countries (see Figure 17.) that are predominantly located in developed regions. These passengers reside in countries with the highest overall carbon footprint (see Figure 34.) and are responsible for most of the transport related CO_2 emissions. However, the countries that will suffer the most from the impacts of climate change are the low and lower middle income countries, the ones that have the smallest carbon footprint. Most of these countries tend to be heavily dependent on tourism revenue. Predominantly small island developing states (SIDS) where the contribution of travel and tourism to national GDP is the highest (more than 15%), are the most vulnerable to climate change. Amongst these countries are the Maldives, Seychelles, Mauritius, Antigua and Barbuda, Bahamas, Saint Lucia, Grenada, Barbados, Jamaica, Vanuatu, Fiji, and Kiribati. Non-SIDS include Costa Rica, Belize, Honduras, Laos, Thailand, Cambodia, Vietnam, Mexico, Namibia, and Gambia (European Travel Commission, 2018).

This represents a paradox. While tourism is a key driver of socioeconomic development in these destinations, the dependence on long-haul travel and aviation contributes significantly to climate change that can destroy these destinations in the long-term. Being the most vulnerable, the capacity of these destinations to implement mitigation policies, to adapt to the changing circumstances caused by climate change and to exploit the newly emerging opportunities is the most limited, compared to developed countries. While SIDS (Caribbean, Indian and Pacific Ocean) are most exposed to sectoral risks, such risks are also dominant in Africa, the Middle East and South Asia (see Figure 35.).

Figure 33. *Number of international outbound tourist departures per 1000 people, 2017*[12]



Source: World Bank

[12] *Source: (Roser, 2017)*

Figure 34. *National average carbon footprints for 116 countries*[13]

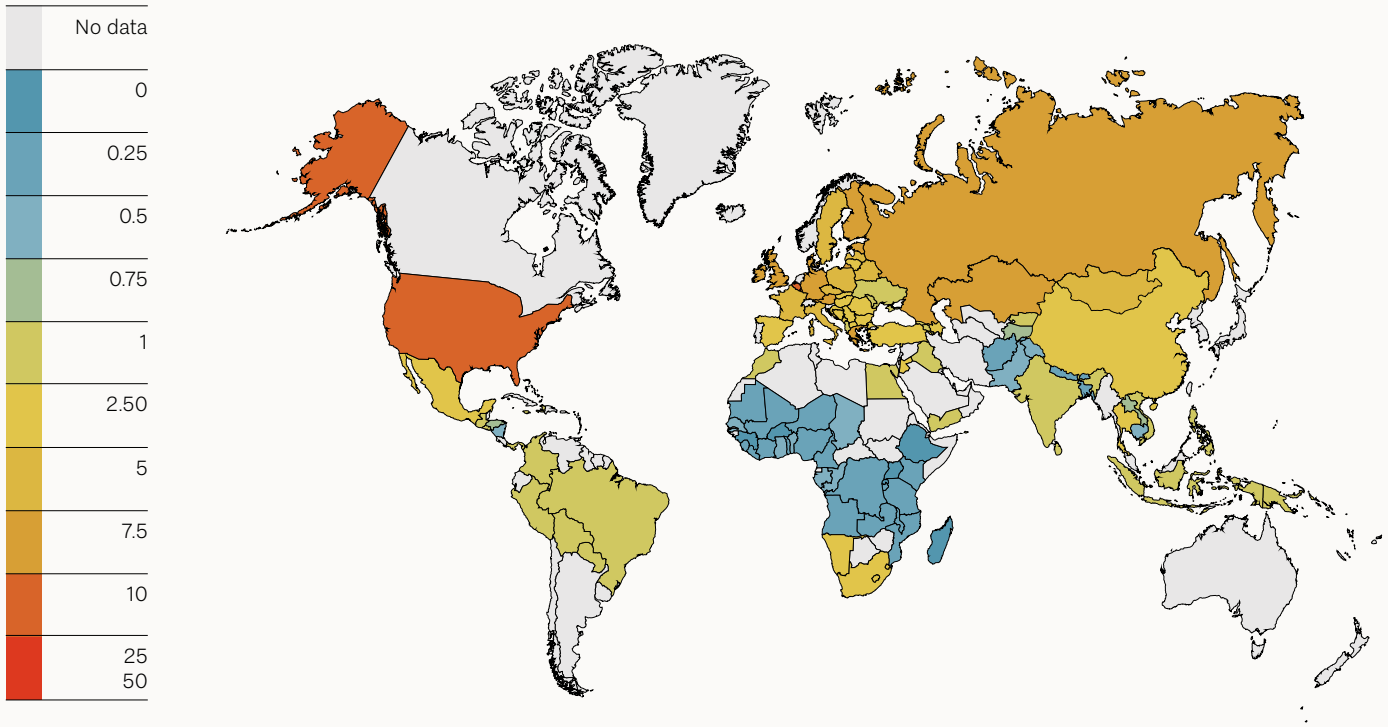
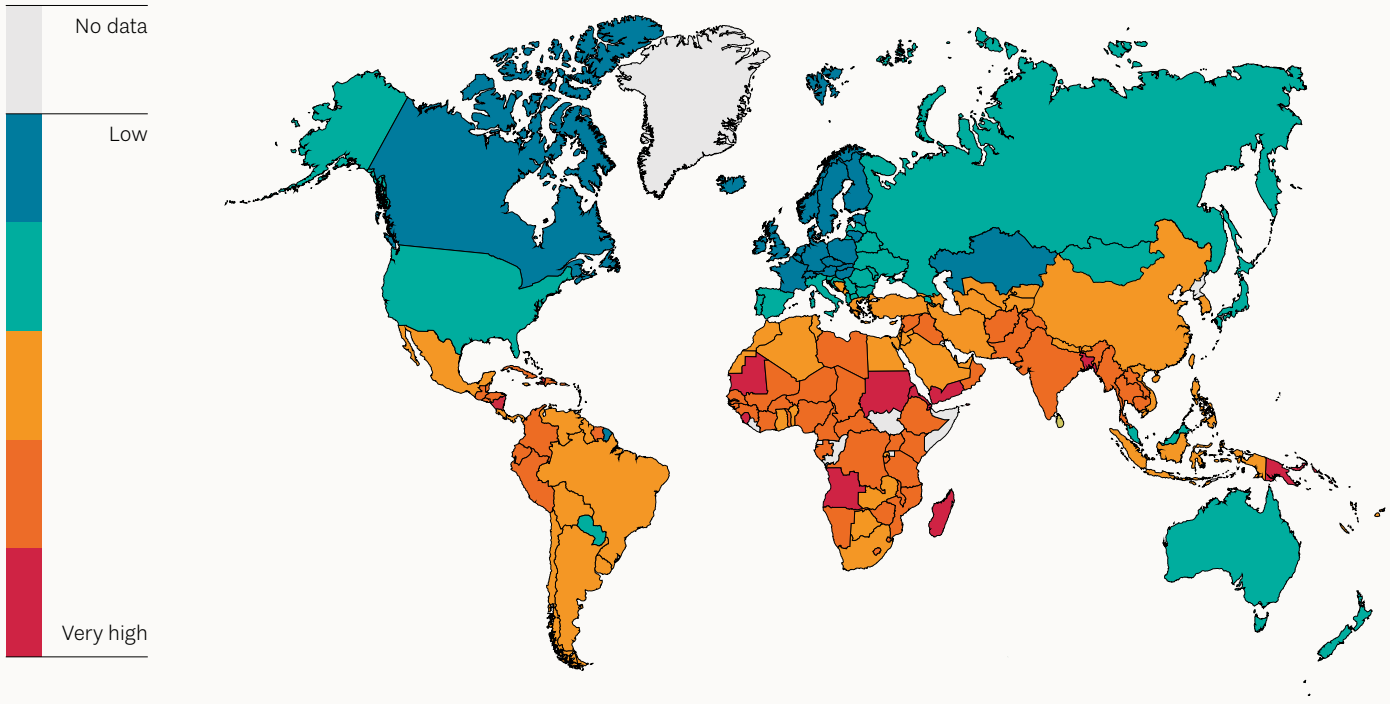


Figure 35. *Global climate risk for tourism*[14]



[13] *Source: (Bruckner, 2022) - (as represented in the World Bank Consumption, grey countries are missing from the database)*

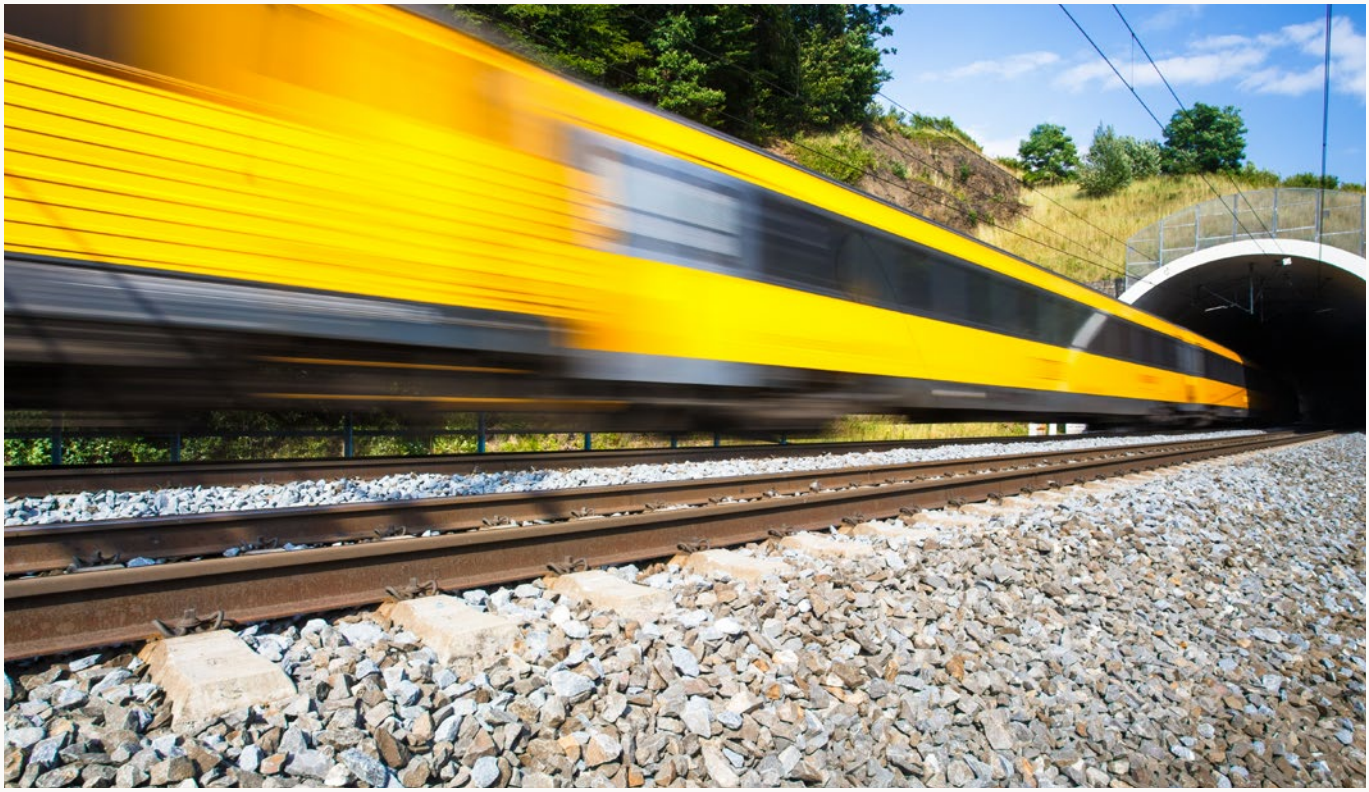
[14] *Source: (European Travel Commission, 2018)*

Availability of investments and other resources

A pre-condition to implement the policies outlined in the scenario is the availability of investments. Infrastructure and technological developments are key for tourism to shift to zero-emission practices. Considering global inequality, investments may not be readily available in all parts of the world, existing infrastructure may be lacking, and resources may be scarce, therefore intergovernmental cooperation and potentially private investments will be key to provide support where needed. While fiscal policies, tools and instruments to increase the available funds are likely to be determined at the national or lower scales, dialogues should be held across countries to share resources and knowledge and to provide development aid.

In case of destinations in emerging countries heavily dependent on tourism (e.g. SIDS) support from the international community will be crucial. Tourism in these destinations can be a major driver of much-needed economic development, however tourism and the local economy have to be developed in-line with the net zero target, posing further challenges. While certain measures can be implemented more easily, such as shifting to domestic or regional source markets (where possible), others necessary for reaching net zero are costly. For instance, to make clean energy affordable, wealthy countries can play a key role by increasing the uptake of low-carbon energy which will likely reduce the costs, as it was the case for solar energy (Ritchie et al., 2020a).

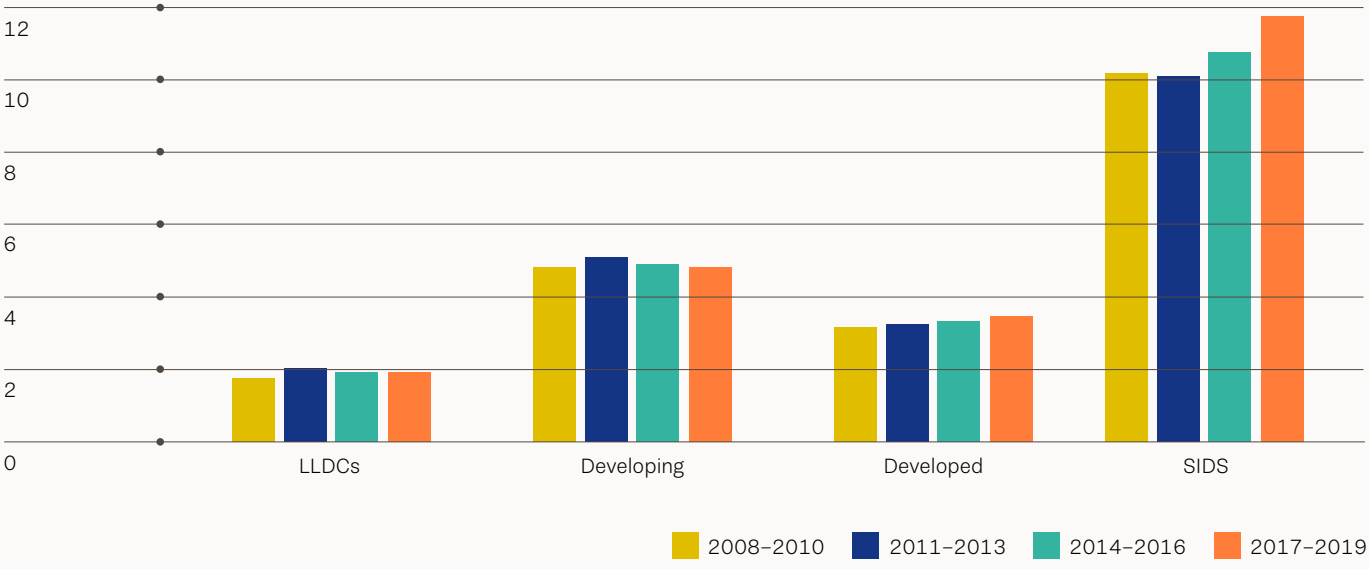
Furthermore, it is crucial that tourism is developed as part of a diversified economy, to avoid overdependence on foreign visitor spending. The COVID-19 pandemic demonstrated the detrimental impacts of overdependence on tourist dollars across the entire tourism supply chain. Furthermore, by rethinking the tourism system in the TDS scenario, import and export leakage, a major problem in these destinations, can also be mitigated. The tourism leakage in developing countries is estimated to be between 40% (India) to 80% (Caribbean) (UNEP-GPA et al., 2016). The import leakage in these nations is thought to be around 50% of gross tourism revenue and up to 20% in developed countries with diversified economies. The gap clearly shows the importance of diversification. Export leakage is a problem predominantly in developing nations. Up to around 70% of visitor expenditure can leave the country (UNEP-GPA et al., 2016). This is due to the heavy presence of international companies (hotel chains, excursion organisers, tour operators, airlines etc.). By supporting locally owned businesses through, for instance, joint tourism equity funds and other means, sustainable economic development resulting from tourism practices can be enhanced. However, cooperation and the necessary support infrastructure is only possible if we recognise the need for and potential of a more just and fair tourism industry that allows for the redistribution of resources, wealth and growth.



The impact of travel distance reductions on least developed countries

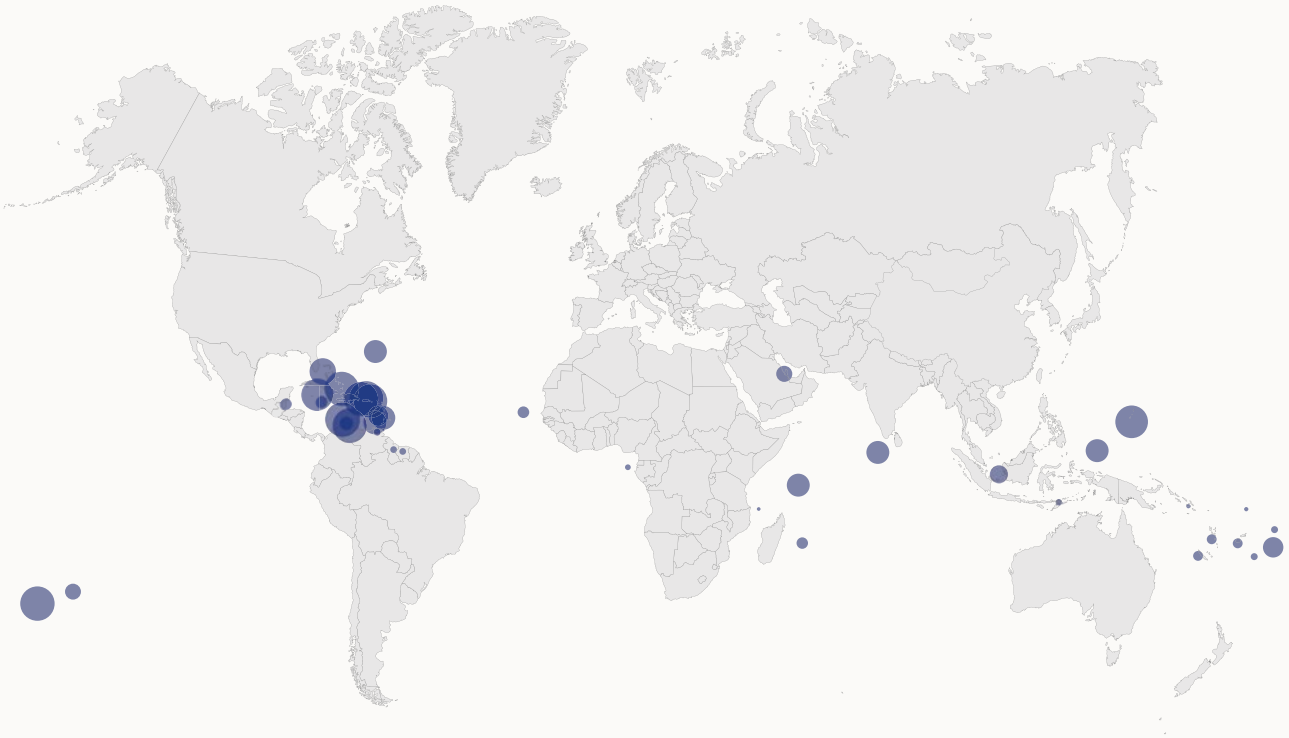
There is a common fear that restrictions on air travel will hinder poverty reduction efforts in the least developed countries (LDCs). A study by Peeters and Eijgelaar (2014) however proved that the restrictions will not lead to devastating impacts on LDCs and most revenue loss can be compensated by other means e.g. a shift in source markets, extension of length of stay, higher cost of flying will likely attract high spending tourists, new tour package combinations, multi-destination packages, international development aids, increased environmental charges, redistribution of SAFs, collective tourism equity funds or poverty reduction funds to aid LDCs, etc. The study showed that changes in distance travelled (reduction - such as in the TDS scenario) will lead to increase in arrival numbers in 50% of all countries globally (amongst them are some of the larger developing nations), while the other half would experience a loss. However, the total number of worldwide arrivals would remain nearly the same. This also means that non-remote emerging countries where a large proportion of the earth's poor people live would benefit as outbound tourism will likely decrease while domestic and inbound regional tourism increase (Eijgelaar et al., 2017). Furthermore, as Figure 36. shows, the contribution of tourism to GDP in landlocked least developed countries (LLDCs) is the smallest further reducing the risk of devastating impacts resulting from changed travel patterns. Nations in which inbound tourism expenditure represents more than 20% of the GDP are Small Island Developing States (SIDS). However, SIDS rely heavily on long-haul travel (see Figure 37). The main source market for SIDS in the Caribbean is the USA while SIDS in the Pacific rely mostly on tourists from Australia, New Zealand and to some extent China, USA and Europe (UNCTAD, 2021). It is evident that the concentration of arrivals from a small number of markets, a local economy highly dependent on tourism, underdeveloped domestic and regional tourism, and reliance on air travel increase the risks (UNCTAD, 2021). To manage sectoral risks in SIDS and other vulnerable destinations, joint efforts are needed from members of the global travel and tourism system.

Figure 36. *Direct contribution of tourism to GDP by economy group, % average*[15]



[15] *Source: (UNCTAD, 2021)*

Figure 37. *Tourism inbound expenditure per capita*[16]



This graph shows tourism inbound expenditure per capita, with larger circles representing higher expenditure.

Furthermore, it must be recognised that the lack of mitigation efforts will lead to devastating impacts from climate change in these destinations, as they tend to be the most vulnerable.

Consequently, these impacts (e.g. floods, heat waves, droughts, severe storms, famine etc.) will affect tourism flows.

[16] *Source: (UNCTAD, 2021)*

Perspective:

Iberostar

Iberostar Hotels and Resorts has nearly 80% of its all-inclusive resorts beachfront over 100 locations mostly in the Caribbean and Mediterranean. Iberostar has identified exposure to climate change as its primary business risk, seen through damages from hurricanes, beach loss and degradation of coastal ecosystems. In 2020, Iberostar announced it would reach Carbon Neutrality by 2030 and in 2022, Iberostar presented its SBTi validated plan to decarbonize its Scope 1 & 2 relative to a 2019 baseline by 85% by 2030 and reduce its Scope 3 by 50% in the same timeframe. In this roadmap, Iberostar detailed its 11 decarbonization pathways as well as best practices for other accommodations to accelerate their own decarbonization actions. To reach carbon neutrality, Iberostar committed to producing up to 500,000 metric tonnes of high quality nature-based carbon offsets by 2030, representing roughly 22,000 hectares of land protection. For the company's roughly 1 million metric ton footprint in 2019, this represents a substantial business case to first decarbonize (~$32 million in savings per year by 2030) which is necessary to unlock the unprecedented investments that will be required early on for electrification, energy efficiency and energy generation. Finally, its commitment to carbon neutrality produces a $17 million per year business case that can direct unprecedented investment in developing long-term nature-based carbon mitigation programs that also boost adaptation in its destinations while the business and its supply chain continues on its journey to Net Zero by or before 2050.

Iberostar acknowledges its ambition requires unprecedented public-private partnerships and industry collaboration. For example, to decarbonize 85% of its Scope 1 & 2 by 2030, Iberostar will need to work with local governments and energy providers to add up to 220 MW of new renewable energy in its destinations. Or to halve emissions from its purchased goods and services, it requires aggregated purchasing power to influence its supply chain in hard-to-abate sectors.

In the context of Envisioning Tourism 2030, Iberostar showcases an example of accommodation that has a strategy core to its business model that will halve emissions by 2030 and reach Net Zero by 2050, if not well before. This study models 83% of accommodation must be electric by 2030. Iberostar will be on average 90% electric. Accommodation is assumed to be 12% more efficient. Iberostar aims to be 35%.

Envisioning Tourism 2030 further emphasizes the need to consider travel more holistically, requiring more dialogue between the sub-sectors that make up the traveler journey. In order to increase stays or alter modes of transportation to destinations, businesses will need to collaborate in platforms that either don't exist or are currently limited in fostering cross-sector dialogue. In order to ensure equity can translate to business decisions, there must be a platform for the sector and its destinations to speak and be heard.

Envisioning Tourism 2030 provides further urgency for Iberostar to ensure that its strategy can not only be executed but converted into best practices and adjusted relative to the needs of other industries.

Megan Morikawa,
Global Director of Sustainability Office,
Iberostar Group

5

Conclusion and recommendations

With travel and tourism set to continue growing apace amidst a deepening climate emergency, we are at a fork in the road, with two distinct options ahead: decouple tourism from emissions, by doing all that is possible to bring about net zero trips and prioritise these over the most polluting trips, or accept the need to curb the global tourism system as a whole. The second option is not just worse for individuals who wish to see the world, but for the destinations and businesses that are currently dependent on international visitation and wish to use it as a tool for sustainable development.

A third scenario, to continue with business as usual and fall far short of emissions targets, is not an option to be seriously entertained. As various IPCC reports have consistently shown, climate change is already causing dangerous and widespread disruption and is harming the lives of millions of people around the world, despite efforts to reduce the risks. Even with global warming limited to 1.5 degrees centigrade, as aligned with our decarbonisation scenario, we face unavoidable multiple climate-related hazards now and over the coming decades. The costs of mitigation and adaptation are already on the balance sheets for businesses and governments, but they will be much greater in a world that heats by 2 degrees or more. If temperatures reach the limits of human survivability, as predicted under high emissions scenarios, tourism in many places will effectively become impossible and an irrelevance.

Tourism is particularly exposed to climate risks, often sited in locations such as coastlines and mountains most vulnerable to climate change. Highest vulnerability exists in regions where tourism growth is expected to be the strongest (Source: Scott et al, 2019) with risk hotspots for tourism found in Africa, the Middle East, South Asia and island nations in the Caribbean as well as Indian and Pacific Oceans. However, damage is already being felt everywhere - with worsening droughts and heatwaves, floods and wildfires, snow melt and changes in seasonality, and biodiversity loss.

The fact that this report found only one growth scenario compatible with current climate targets should help focus minds on taking the actions necessary. We know what is technically possible, but until now we have lacked the will to make it a reality. We estimate that the investment required for this scenario is several trillion US dollars, but that's no more than 2 or 3 percent of total tourism revenue over the same period. And note this is an investment - with an expected return - not simply a cost to be absorbed. Those who invest now will help to reshape tourism and reap the benefits in the future.

The scientific community has made it clear, and the world has signed on through mechanisms like the Paris Agreement, that we must at least come close to halving emissions by the end of this decade, and reach net zero as soon as possible before 2050. For the Tourism Decarbonisation Scenario (TDS) we used the following levers:

- **Mandated use of e-fuels for aviation.**
- **Investment in electrification of transport and accommodation, alongside massively acquiring/developing renewable energy.**
- **Investment in technology and infrastructure (e.g. more efficient aircraft, high speed rail).**
- **Subsidies on ticket prices for sustainable travel modes.**
- **Some limits on aviation growth including capping long-haul flights to 2019 levels.**

We also recognise the omission of cruise and scope 3 supply chain emissions in our modelling. Cruises are currently a small part of the tourism system, but in general (with some river and sailing cruises providing notable exceptions) they have an extremely high individual footprint which is not at all compatible with the Tourism Decarbonisation Scenario. Similarly, scope 3 supply chain emissions are certainly significant for many tour operators and accommodation providers. However, most of these emissions will be captured within the UNFCCC policy framework, through Nationally Determined Contributions (NDCs), and will benefit from the same developments towards renewables and electrification required for the TDS.

Our intention is not to prescribe the specific detail of the future scenario, but to indicate the direction that travel and tourism needs to take. There are many detailed policy or technical recommendations that are needed to bring about the interventions within the decarbonisation scenario, and we recognise that others are better placed to begin or continue those discussions, from within the corresponding sectors such as transport, construction and energy. To secure its future, the Travel & Tourism sector should strongly advocate for all the above measures to be put in place. Tourism needs to bring different industry sectors together as one voice and to be better represented in global initiatives such as climate finance discussions.

This entire effort also comes with a warning - particularly for those managing destinations and planning for the future. That future is increasingly uncertain and typical economic growth patterns are just as likely to face disruption as the increasingly destabilised weather patterns. The single scenario we've outlined represents unprecedented mobilisation of resources and action, at a time when increasingly challenging geopolitical, economic, humanitarian and environmental pressures may unfortunately frustrate such efforts. Suffice to say, the need for adaptation and significantly increased resilience should not be overshadowed.

We conclude here that, even maximised as they must be, we cannot simply rely on technology, SAF and offsetting schemes, then continue along with business as usual. Technology arrives far too late, SAF has serious resource constraints, and offsetting is inadequate and unreliable. Therefore, the following recommendations focus on the role of global and national policymakers (for instance: ICAO, UNFCCC, UNWTO, World Bank, national governments), destination-level (for instance: Destination Management Organisations, local authorities and equivalent governance units), and private sector businesses in destinations (for instance: accommodations, local transport, attractions) and tour operators/online travel agents (OTAs) to reshape the travel and tourism system.

Ensure greenhouse gases from travel to/from destinations are fully accounted for, to provide the right incentives to reduce emissions.

1/ Global / National policymakers
2/ Destination level governance
3/ Private sector

Incentivising international transport emissions reductions	1	2	3
Ensure those significant travel and tourism emissions currently excluded from national carbon budgets (specifically international cruise and aviation) are brought under decarbonisation legislation. A suitable framework for this already exists, based on the Nationally Determined Contributions (NDCs) reporting mechanism under the Paris Agreement.	✓		
Consideration should be made as to whether destination countries should receive the additional carbon budget from international transport emissions currently excluded. This would allow destinations to set their own priorities, e.g. prioritising tourism over other industries if they wish. But cooperation and agreements with source markets would be necessary to ensure fair responsibility and action is placed on those nations "consuming" the tourism product.	✓		
Ensure mechanisms, such as carbon pricing or regulation, are in place to recognise the cost of greenhouse gas pollution and enable better decision making on carbon budget trade-offs and investments in decarbonised products and mitigation efforts.	✓		
Ensure incentives for frequent flying are removed, such as frequent flyer loyalty schemes.	✓		✓

Measurement, reporting and transparency	1	2	3
Agree an approach to consistently measure, share and report on all travel and tourism's direct emissions data at global, national, destination and business levels	✓	✓	✓
Tourism is defined by travel away from home. Therefore all emissions from travel to/from the destination must be accounted for in national, destination and business strategies and climate action plans. Consideration should be made for "advertised emissions", where promotional activity creates a driver for increased CO_2.	✓	✓	✓
Use the framework of the Glasgow Declaration on Climate Action in Tourism as a platform for transparency and to ensure a coordinated and consistent approach.	✓	✓	✓

Formulate a coordinated climate action "masterplan" (long term planning & investment) for travel and tourism

1/ Global / National policymakers
2/ Destination level governance
3/ Private sector

Independent global taskforce & masterplan	1	2	3
Create an independent, globally representative taskforce to set international policy around tourism and climate action.	✓		
Develop a coordinated international plan for optimising tourism's growth and distribution flows in a way that is compatible with climate targets.	✓		
Give due consideration to destinations that are most dependent on tourism, particularly long haul, and give priority for tourism growth to least developed visitor economies.	✓		
Ensure capacity growth of transport infrastructure (particularly airport and cruise port construction/ expansion) is compatible with climate targets and destination capacity limits and equitably distributed. A global airport capacity distribution scheme is needed in conjunction with bringing international aviation within the NDCs process.	✓		
Enforce the development of zero-emission aircraft through ICAO's existing CO_2 standard.	✓		

Aligned international, national, business and destination plans	1	2	3
Ensure place-based master plans are developed and urgently implemented within national frameworks, and destination management plans align with (or are part of) these.	✓	✓	
Ensure climate targets are always included in business and destination plans, which complement existing climate goals/commitments outside of tourism, and broader national and international targets.		✓	✓
Develop plans which acknowledge the future shape of tourism in a destination is likely to differ from the present, building resilience by diversifying with changes in source markets, type of visitor, length of stay etc. and planning for a potential increase in local/domestic visitation, including for the pressures this may bring to vulnerable spaces and the need to manage shifting visitor flows.		✓	✓
Pay particular attention to reducing destination dependency on high volumes of long-haul markets, by shifting towards medium and short haul ones and towards more sustainable modes of transport.		✓	✓
Use the framework of the Glasgow Declaration on Climate Action in Tourism to facilitate alignment and collaboration.	✓	✓	✓

1/ Global / National policymakers
2/ Destination level governance
3/ Private sector

Influencing other sectors	1	2	3
Travel & Tourism should strongly advocate to the relevant sectors (transport, energy, construction and city planning etc) for all the measures outlined in the decarbonisation scenario to be put in place urgently and at scale.	✓	✓	✓
Tourism needs to bring disparate industry players together as one voice and to be better represented in global initiatives such as climate finance discussions.	✓	✓	✓
Strengthen the governance of destination management, with oversight and influence on anticipated changes in transport and energy infrastructures, accommodation development, and the capacities of routes to/from the destination (airports, cruise ports, road and rail networks etc).		✓	

Investment and enabling environment	1	2	3
Refer to the Tourism Decarbonisation Scenario, including tourism forecasting information, when developing and applying green taxonomy frameworks for sustainable investments.	✓		
Prioritise international transport routes and national transport and energy infrastructure needs which will have the greatest decarbonisation impact and return on investment for tourism.	✓		
Shift development funds and investment programmes to support growth in green infrastructure and decarbonised tourism. Make climate finance easy to access and equitable and facilitate collaborative business investments.	✓	✓	✓
Coordinate and participate in precompetitive collaboration on shared infrastructure and supply chain decarbonisation initiatives. Such initiatives will benefit a wide range of businesses and stakeholders, and yet require coordination and the right enabling environment to be initiated.		✓	✓
Ensure a long-term plan is in place for recruiting, training and upskilling the workforce of the future.	✓	✓	✓

Start identifying and providing low and net-zero tourism options

1/ Global / National policymakers
2/ Destination level governance
3/ Private sector

Product development	1	2	3
Bring integrated carbon management into product development, factoring-in the carbon footprints of customers/markets and products, and optimising carbon in terms of CO_2 budget spent against revenues received.		✓	✓
Bring to market, as soon as possible and certainly within this decade, close-to-zero carbon experiences, accommodation and package holiday options.		✓	✓
Review existing product portfolios and itineraries to facilitate change. Focus on increasing the value (economic or otherwise) of tourism rather than increasing volume. New product and itinerary development should incorporate regenerative and adaptation solutions and investment in local businesses and communities.		✓	✓
Incentivise longer stays to grow value without growing emissions to/from the destination, and reduce economic leakage (e.g. from imported goods to service visitor demand).		✓	✓
Encourage innovation to facilitate tourism's transition. For instance, new booking platforms which support multi-stop, multi-modal trips and solutions to last mile challenges, or package holidays which charter trains or book whole carriages.			✓
Stimulate demand for decarbonised solutions through coordinated purchasing power (for instance, hotels providing demand for district heating networks) and communication out to supply chain businesses.			✓

Marketing and communication	1	2	3
Factor in carbon when identifying the most valuable/desirable source markets. Target customers that can reach the destination through lower carbon routes, and develop the destination product offering accordingly.		✓	✓
Develop carbon labelling for products based on a standard methodology, allowing fair comparisons both for B2B buyers and end consumers.	✓	✓	✓
Use choice editing and behaviour economics "nudges" to match customers with the lowest carbon products that meet their requirement.			✓
Stimulate consumer demand for more sustainable and green options.			✓

Better understand and plan for how tourism will operate in a decarbonised, 1.5 degree world

Surprisingly little is known about the current and future global impact of climate change on tourism. With tourism set to double in size by 2050, with an associated increase in coastal development and land use, the failure to account for climate-related risk leaves many tourism businesses, investors and local workforces around the world vulnerable. For instance, in the Caribbean, 29% of tourism's facilities are at risk of inundation with 1 metre of sea level rise. But estimates do not exist on the total global, or even regional, values of tourism resort infrastructure at risk due to climate change - crucial missing figures (Epler Wood et al., 2019). So, we can only tell part of the story in this report, describing the necessary changes to transform tourism into a zero-carbon economy. Businesses and destinations also need to plan for the future impacts of sea level rise, high intensity storms, coastal erosion, changes in seasonality and other impacts within their development strategies. There will be significant challenges and opportunities ahead.

Sign and implement the Glasgow Declaration

All of the above recommendations require collaboration and alignment at the global, national, regional and business levels, with ever-increasing action and ambition.

All stakeholders in the tourism sector are therefore urged to sign and implement the Glasgow Declaration for Climate Action, as the global framework for climate action under the pathways of measure, decarbonize, collaborate, regenerate and finance. All travel stakeholders are urged to review their sector and individual climate action plans in light of the new recommendations above. Those parts of the industry which can decarbonize fastest are encouraged to accelerate their plans to address the barriers and opportunities presented in this report.

Perspective:

Visit Barbados

Barbados fully supports and embraces the "Envisioning Tourism 2030" report and stresses the importance of the vital document for the travel and tourism industry to have a roadmap for a path toward a sustainable and net zero future. Decarbonization is critical, especially for small island developing states, as our Prime Minister, the Hon. Mia Mottley has articulated on the world stage.

Tourism destination management has significant importance in controlling many impacts of tourism, as well as ensuring the sector's success, thus ensuring its sustainability. Sustainable tourism destination management emerged from the need to develop tourism destinations sustainably, as the impact of a well-managed tourism destination can provide essential benefits. Conversely, poor management can have a severe impact on ecosystems, economic stability, and overconsumption of resources and can contribute to the loss of cultural integrity and identity of the destination.

The Barbados Tourism Marketing Inc. (BTMI) is undertaking a series of initiatives to develop a more sustainable and responsible tourism industry in Barbados. Understanding that Barbados remains on the frontline of the climate crisis and as a tourism-dependent economy premised heavily on its natural assets, ensuring that efforts are prioritized to build resilience is paramount. As such, the BTMI is working hard to accelerate the decarbonization of the island's tourism operations as we work towards the national goal of becoming carbon neutral by 2030. In this regard, Barbados was featured as one of the select destinations in the documentary series "Sustainable Travel: Where Next," produced by Sustainable Travel International (STI), highlighting eco-friendly practices on the island, and was one of only three destinations in Central & Latin America (and the only destination in the Caribbean) to be part of the Top 100 Green Destination list for 2022.

Dr. Jens Thraenhart,
Chief Executive Officer,
Barbados Tourism Marketing Inc. (BTMI)

Perspective:

Destination Vancouver

In 2021 right in the middle of all the disruption from the global pandemic, Destination Vancouver went through a process to review purpose and mandate. From that work we embraced our role as a destination management organization, that seeks to transform our communities and our visitors through the power of travel. To date our focus has been on working alongside our communities' climate action in Vancouver, which recently accelerated the timeline with the Climate Emergency Action Plan passed in November 2020 to keep Vancouver on track to reduce our community carbon emissions by 50% by 2030. This so far has been limited to looking at our own corporate emissions as well as understanding the emissions related to the visitor journey within the destination.

The Envisioning Tourism in 2030 report is challenging destinations to consider their role, as part of the broader tourism and travel system and the emissions associated with travel to the destination.

The decarbonization scenario challenges destinations to connect much more closely with their neighbours. For Vancouver this means our neighbouring US cities of Seattle, Portland, and Spokane, precisely the destinations that would be connected to Vancouver if a planned future high-speed rail project is built. Destinations will need to collaborate and become champions of enabling developments like these and advocating for timelines that match the 2030 and 2050 climate goals.

The future of carbon accounting for destinations will have to come to terms with the concept of advertised emissions. This is defined as the uplift in greenhouse gas (GHG) emissions that are attributed to the increase in sales generated by advertising. In June 2022 the concept was adopted as Leadership Practice by the UNFCCC Race to Zero. What the findings in this Envisioning Tourism in 2030 report challenge us to do is develop a methodology to systematically identify and incorporate the carbon emissions into our marketing and development business plans as destinations.

Gwendal Castellan,
Sustainable Destination Development

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