

Zero-emission tourism mobility

A research and policy agenda

PIB Connecting success formulas: sustainable mobility and energy in Austria and the Netherlands - K2K Consortium development zero-emission tourism mobility



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Executive summary

The Knowledge-To-Knowledge (K2K) project "Consortium development zero-emission tourism mobility" is part of the private-public Partners for International Business (PIB) programme 'Erfolgsformeln Verbinden: Nachhaltige Mobilität und Energie in Österreich und in den Niederlanden'¹. The K2K project was executed by the Centre for Sustainability, Tourism and Transport (CSTT), the research institute of the Academy for Tourism of Breda University of Applied Sciences. Partners in this project were Camptoo, NKC, Emodz, and TUI Netherlands. The goal of the K2K project was to develop a joint research and policy agenda for stimulating zero-emissions tourism mobility under Dutch-Austrian cooperation. The results, derived from an extensive literature study and a number of interviews and meetings with both tourism and transport experts, and tourism (business) professionals, are found in this report.

Electric vehicle tourism has the potential to strongly contribute to the reduction of local air and noise pollution at destinations, and contribute increasingly strongly to reducing CO₂ emissions. However, a sole switch from ICEs to EVs does not solve congestion issues, so at least a partial modal shift towards other near-zero emission modes is required. Currently, limited Battery Electric vehicle (BEV) choice and a number of other barriers limit consumer interest in BEVs in general, so also in tourism. The barriers towards EVs in tourism have not been studied specifically yet, but it is likely that range anxiety and charging issues, like roaming, are the main issues. These are likely exaggerated by the often international character of tourism and a consumer lack of knowledge of systems abroad.

All these barriers can technically be overcome in the short term, with the advent of more EVs with a longer range (and more traction and larger luggage spaces), the roll-out of fast charging infrastructure along corridors and regular stations at destinations, and the efforts directed at harmonising roaming, although much depends upon political and other stakeholders' actions. Austria lags far behind the Netherlands in terms of charging infrastructure and roaming, while charging along the German corridors has recently improved a lot. The e-tourism sector is in its infancy. Charging infrastructure is available at a small share of hotels and restaurants, EVs can be rented occasionally and pilot e-tour products exist, but knowledge levels and speed of adaptation vary among tourism stakeholders.

Long-distance rail connections between the Netherlands and Austria are gradually improving, and already offer a near zero emission alternative to air and car trips. But as airplanes and cars are 'top of mind', the perception about the cost and duration of train travel is negative, and the planning and booking of international rail tickets is difficult and more costly than air, the rail potential is used insufficiently. A more level (financial) playing field between different transport modes is needed, as well as improved interoperability of international rail.

Research agenda

The research agenda consists of five themes:

- Theme 1 studies the presence, marketing, communication, use and user experience of charging infrastructure at tourism destinations, including integration of EV relevant information in all route planners and integrated with touristic information.
- Theme 2 researches the perceptions of the use of different transport modes.
- Theme 3 investigates the role of advanced technology and (online) travel product integrators in developing near zero emission tourism (both road and rail).
- Theme 4 investigates how to stimulate rail travel in tourism through improved interoperability and easier ticketing as a quick improvement, and high-speed rail investments for the longer term.
- Theme 5 researches how to ensure a level playing field with respect to tax differences between the operations of air transport, specifically international, and zero-emission mobility.

¹ Connecting success formulas: sustainable mobility and energy in Austria and the Netherlands

Policy agenda

The main policy recommendations are:

- Develop a clear EU commitment to a long-term strategy for the expansion of charging infrastructure as this would send a strong signal to all involved stakeholders.
- Develop a destination policy for catering for the e-mobility needs of tourists, which differ from those of residents.
- Policies to develop charging infrastructure should be accompanied by measures that improve tourists' understanding of the overall cost of driving an EV.
- Ensure that rail policies at the EU level include priority planning of international schedules, harmonized ticketing and scheduling, and further development of HSR infrastructure.
- Creating a level playing field with respect to air and other transport regarding fuel taxes, VAT or substitutional taxes.
- A policy that requires all rail companies to provide up-to-date real time databases at no or very low cost, which allows app-makers to provide real time information about all forms of electric mobility, from train timetables and ticketing, to free capacity at charging points and payment systems for charging.

Potential projects/initiatives

The following projects and initiatives are suggested:

- We first suggest a large development project to improve the ticketing process in international rail travel. The aim would be to make the booking of international rail tickets as easy as booking plane tickets. It should also investigate the impact of a simple, free and fully flexible ticketing system.
- A number of quick knowledge projects (e.g. max. 6 months), followed-up by both simulation tests, practical tests and practical implementation through 'learning-by-doing' for topics like a travel-simulator, destination electric mobility guidelines and optimum route finding for EVs.
- Develop an *electric tourism transport laboratory* in cooperation with Dutch and Austrian innovation institutes and universities. The goal is to develop and test markets for electric road and rail transport solutions at destinations, accommodation and corridors.

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Abbreviations

AC	Alternating current
AFID	Alternative Fuels Infrastructure Directive
BEB	Battery Electric Bus
BEC	Battery Electric Coach
BEV	Battery Electric Vehicle
CO	Carbon monoxide
CO ₂	Carbon dioxide
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
CSTT	Centre for Sustainability, Tourism and Transport
dB	decibel
DC	Direct current
EC	European Commission
EEA	European Environmental Agency
EV	Electric Vehicle
FCEV	Fuel-Cell Electric Vehicle
GHG	Greenhouse Gases
Gt	Gigatonne
HEB	Hybrid Electric Bus
HEV	Hybrid Electric Vehicle
HSR	High-speed rail
ICE	Internal Combustion Engine
IPCC	Intergovernmental Panel on Climate Change
K2K	Knowledge-To-Knowledge (project)
kW	kilowatt
kWh	kilowatt hour
LCA	Life-cycle analysis

Lden	day-evening-night level
Mton	Million ton
NDC	Nationally Determined Contribution
NEDC	New European Driving Cycle
NOx	Nitrogen oxides
NGO	Non-governmental organisation
NKC	Dutch campervan club
OCHP	Open Clearing House Protocol
OCPI	Open Charge Point Interface
OCPP	Open Charge Point Protocol
PHEV	Plug-in Hybrid Electric Vehicle
PIB	Partners for International Business
pkm	person-kilometre / per passenger-kilometre
PM	Particulate matter
REEV	Range-extended electric vehicle (also E-REV)
RFID	Radio-Frequency Identification
SOx	Sulphur oxides
TCO	Total Cost of Ownership
TEN-T	Trans-European Transport Network
UNWTO	United Nations World Tourism Organization
Whr/kg	Watt-hour per kilogram
WLTP	Worldwide harmonized Light vehicles Test Procedure
ZEV	Zero-Emission Vehicle

1 Introduction

1.1 Background

The impact of tourism, and particularly tourism transport, on climate change, is a relatively new study area. In 2008, the United Nations World Tourism Organization (UNWTO) published the first report that attempted to quantify global tourism carbon dioxide (CO₂) emissions (UNWTO-UNEP-WMO, 2008). It found that tourism produces 5% of all anthropogenic CO₂ emissions, and that tourism transport was responsible for 75% of this amount. Strikingly, half of all tourism emissions are produced through aviation, whereas this is only used as transport mode for 20% of all tourism trips. More than half of all trips is made by car. On top of that, aviation has a high non-CO₂ related impact on climate change (Peeters & Williams, 2009). For the EU25, Peeters, Szimba, and Duijnsveld (2007) calculated that outbound tourism transport made up around 10% of EU25 total CO₂-eq emissions (excluding both international sea and air transport emissions and land use changes) in 2000.

Under the Paris agreement, emissions pathways have been agreed for keeping global temperature rise below 2 degrees by 2100. Tourism is currently not on these pathways, jeopardising the globally agreed target. Neither are aviation industry plans to lead to 'carbon neutral growth' sufficient (Peeters, 2017). Fossil fuel based transport, notably aviation, is the main factor hampering a more sustainable development in tourism. A mix of technological innovation, operational measures, and behavioural changes is needed to achieve absolute reduction in tourism emissions, with (near) zero emission tourism being the ideal scenario.

A possible solution lies in the combination of a shift from airplanes and (fossil) cars to train, bus and efficient cars/e-mobility, and a worldwide reduction of transport volume (Peeters & Dubois, 2010). This appears the only way to enable tourism trip and economic growth as well as substantial emission reduction. Particularly for short to medium-length holiday distances, which include most intra-European holidays, (near) zero emission tourism could be achieved through the use of electric trains, buses and cars, replacing air travel and fossil fuel-based land transport (Peeters & Dubois, 2010). Where free aviation volume growth cannot be reconciled with the goals of the Paris agreement (UNFCCC, 2015), all other transport modes – private car, coach, rail, shipping – need to grow to fill-in the aviation gap, but climate-neutral tourism only develops if these modes are fully electrified (Peeters, 2017). Yet there are many technological, political, operational, juridical, fiscal, and last but not least, behavioural barriers to increased implementation and/or use of them.

1.2 Netherlands-Austria tourism

Austria is a typical short-to-medium-length holiday destination for the Dutch market. It has been an important destination for Dutch holidaymakers for decades. In the 1990s the Austria share in all Dutch outbound holidays was a little above 10%. This share has since dropped to 6.2%, but mainly because the number of Dutch holidays has increased overall. According to Statistics Netherlands (CBS), the number of Dutch holidays to Austria has remained rather stable, between 1.1 and 1.3 million per year (CBS, 2017). Austria Tourism mentions 1.93 million Dutch arrivals in 2017, with a 60/40 division over winter/summer in terms of nights stayed (Österreich Werbung, 2018). The transport choice for Dutch citizens to Austria has changed over the 1990-2016 period: in 1990, 61% travelled by car, 20% by coach or train, 17% by plane, and 3% by other means (including campervans). Now, 54% travel by car, 6% by coach/train, 38% by plane, and 2% by other means (CBS, 2017).

The transport changes noted above have an impact on the CO₂ emissions of holidaymakers. The Centre for Sustainability, Tourism and Transport (CSTT) of Breda University of Applied Sciences has been measuring the Dutch holiday carbon footprint since 2002 (latest report: Eijgelaar, Peeters, de Bruijn, & Dirven, 2017). In 2016, the average carbon footprint of a holiday to Austria was 409 kg per person. For comparison, the average outbound holiday produced 661 kg. Total CO₂ emissions of Dutch holidaymakers to Austria were 0.451 Mton (million ton) CO₂, which was 3.8% of all outbound tourism emissions (Eijgelaar et al., 2017). These figures include emissions for transport, accommodation and activities during the holiday. Of the 409 kg of an Austria holiday, 44% are produced by origin-destination transport, 40% by accommodations, and 16% mainly by local transport, and by activities.

The share of campervans to Austria is unknown, because the Continuous Holiday Survey of NBTC-NIPO, on which the carbon footprint figures are based, reports the campervan as part of the cluster 'caravan-tent trailer-campervan' (CTC). A rough estimate finds 5,000-10,000 campervan trips. The holiday carbon footprint of this CTC cluster is higher than average, with 737 kg as opposed to 661 kg (Eijgelaar et al., 2017). The main cause for this is the greater length of these trips. Research amongst members of the Dutch campervan club (NKC) revealed that Austria is not a key destination for NKC members: France is visited 8 times more often, the Netherlands four times, and Germany three times (Barten, 2015).

1.3 K2K project

The Knowledge-To-Knowledge (K2K) project is part of the private-public Partners for International Business (PIB) programme 'Erfolgsformeln Verbinden: Nachhaltige Mobilität und Energie in Österreich und in den Niederlanden'². The goal of the K2K project "Consortium development zero-emission tourism mobility" is to develop a joint research and policy agenda for stimulating zero-emissions tourism mobility under Dutch-Austrian cooperation. Questions that this project seeks to answer are: What are promising initiatives and alliances? What kind of research needs (government) funding for taking decisions on zero-emission tourism mobility projects, further support of already implemented initiatives, etc.? What can be done in terms of local, regional and national policies to stimulate zero-emission tourism mobility? The aforementioned PIB programme³ develops and shares knowledge on three themes: smart charging, heavy transport, and tourism.

1.4 Network

The K2K project is executed by the Centre for Sustainability, Tourism and Transport (CSTT), the research institute of the Academy for Tourism of Breda University of Applied Sciences⁴. Over the past 15 years, the CSTT has become a centre of worldwide expertise on tourism emissions and mitigation, contributing numerous academic articles and reports for organisations like UNWTO, the European Parliament and the OECD on this topic (see www.cstt.nl). Partners in this project are Camptoo (campervan sharing platform, e-campervans, www.camptoo.nl), NKC (Dutch Campervan Club, www.nkc.nl), Emodz (co-creator in new mobility, www.emodz.com), and TUI Netherlands (near zero emission tourism product development).

1.5 Methodology

The research and policy agenda developed for this report is the result of an extensive literature study and a number of interviews and meetings with both tourism and transport experts, and tourism (business) professionals. The meetings included a PIB meeting in Innsbruck (27.9.2017; protocol in Appendix 1), a professionals event at the Dutch Tourism Expo in Utrecht (10.1.2018; Appendix 2), and the e-mobility day in Melk, Austria (26.5.2018). The work in Melk has been done by a group of students from Wageningen University (WUR), as part of a group assignment on zero emission tourism.

² Connecting success formulas: sustainable mobility and energy in Austria and the Netherlands

³ See www.mobilitaetundenergieausholland.nl/

⁴ Former NHTV Breda University of Applied Sciences

2 Climate change, transport and tourism emissions

2.1 Introduction

Transport has been described as a potential “roadblock to climate change mitigation” (Creutzig et al., 2015, p. 911), with more people travelling more often, faster, and for shorter periods. Worldwide, transport is still largely fossil fuel dependent, and the sector contributes a large share (23%) of anthropogenic CO₂ emissions (Sims et al., 2014). Transport emissions are expected to double by 2050 (Creutzig et al., 2015). In the EU28, the transport sector contributed 25.8% of total greenhouse gas (GHG) emissions in 2015. Transport emissions (including aviation but excluding international shipping) were 23% above 1990 levels in 2015 (EEA, 2018b), and more than 25% if provisional data for 2016 are considered (EEA, 2017b). The transport sector is the only major European economic sector in which GHG emissions have increased, compared with 1990 levels. With 72.9%, road transport has the highest share of transport emissions, with aviation in second place (13.3%).⁵ Cars produced 44.4% of all transport emissions in the EU in 2015 (EEA, 2018b). GHG emissions from international aviation have more than doubled since 1990 and were almost 25 % higher in 2016 than in 2000 (EEA, 2017b).

2.2 Tourism emissions

Tourism transport’s contribution to climate change is largely through CO₂ emissions, as most tourism transport is fossil fuel based. In 2008, the World Tourism Organisation (UNWTO) reported on the effects of climate change on tourism as well as the effects of tourism on greenhouse gas emissions (UNWTO-UNEP-WMO, 2008). The UNWTO report estimates the contribution of tourism to CO₂ emissions at approximately 5% in 2005 (UNWTO-UNEP-WMO, 2008). Airplanes cause additional impacts on climate, as they not only produce additional GHGs like nitrogen oxides, but also because these substances are emitted in the upper atmosphere, where they cause chemical reactions, and in some cases contrails (condensation trails) and sometimes even high altitude ‘contrail-induced’ cirrus clouds. This produces a significant net contribution to “radiative forcing”. In 2005, the total contribution of aviation to radiative forcing accumulated since 1940 was 2.0 (excluding cirrus clouds) to 2.8 times (including cirrus) as large as the effect of all airplane CO₂ emissions (best estimates from Lee et al., 2009). However, the uncertainty is large: the total contribution of aviation to climate change lies somewhere between 2% and 14%. Unfortunately, as a result of various practical and theoretical objections, these percentages cannot be used as Global Warming Potential (see Forster, Shine, & Stuber, 2006, 2007; Graßl & Brockhagen, 2007; Peeters, Williams, & Gössling, 2007). Thus it is not possible to provide a CO₂-equivalent for air travel.

Gössling and Peeters (2015) found the emission to double between 2010 and 2032. More recently, Peeters (2017) assessed the long term development of tourism’s carbon footprint and found this to increase by a factor 4.6 between 2015 and 2100. Where currently 22% of tourism trips is based on air transport, the share of air CO₂ emissions is 55%. By 2100, the air travel share increases to 32%, causing its CO₂ emissions to take 75% of total tourism CO₂ emissions. The strong growth of emissions is in stark contrast with the Paris Agreement, that seeks to reduce emissions to almost zero by 2100, but according to the Intergovernmental Panel on Climate Change (IPCC) should reach zero emission in 2050 (IPCC, 2018). According to Peeters (2017), almost zero-emissions is only achievable for tourism when all mitigation opportunities are fully implemented. This also includes a physical barrier to unlimited growth of air transport, for example a cap on airport slots or global aircraft fleet.

2.3 Transport emissions

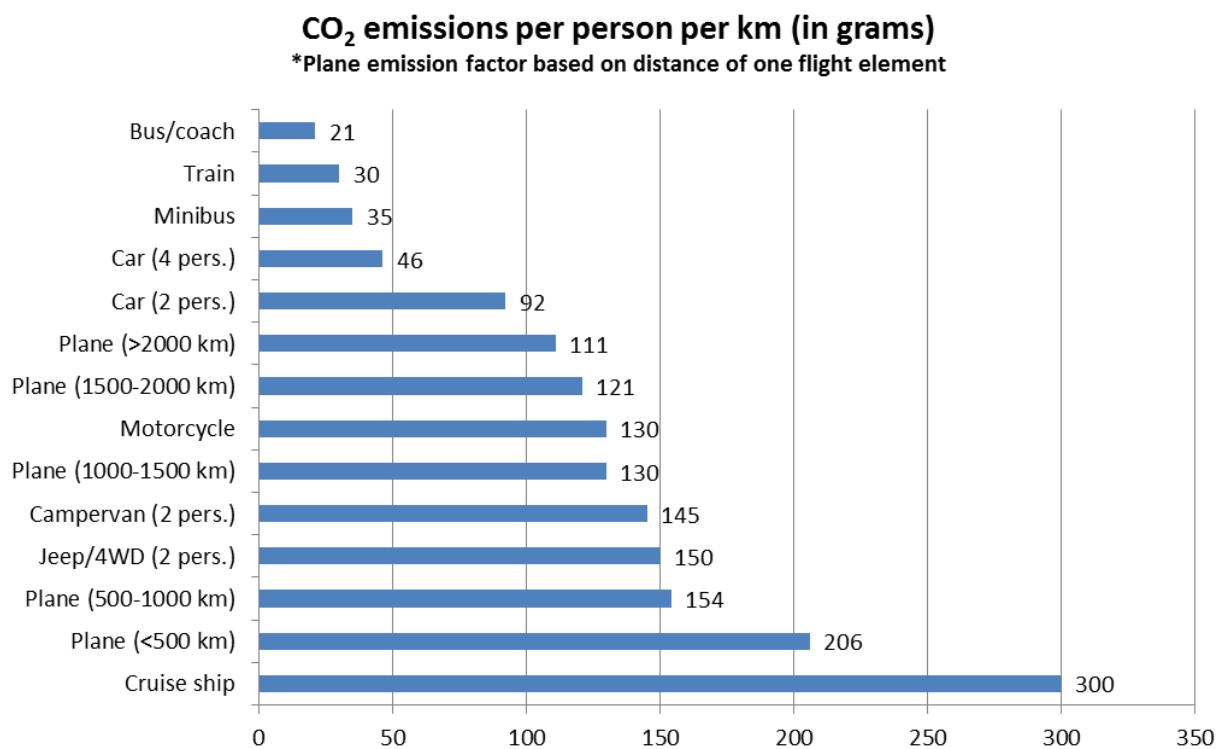
The annual average specific NEDC type-approved CO₂ emissions from newly registered passenger cars has decreased by almost 19% in 2016 compared to 2009. The EU’s 2015 target of 130 g CO₂/km was met in 2013. In 2016, average emissions decreased by 1.5 g CO₂/km (EEA, 2017a). Monitoring of CO₂ emissions from new vans started in 2012. Since then, average specific emissions have decreased by 6.6%. In 2016, average emissions

⁵ Only national emissions reported to the UNFCCC and the EU Greenhouse Gas Monitoring Mechanism

decreased by a further 4.7 g CO₂/km, a 9.2% decrease from 2012 levels. Emissions from newly registered passenger cars and vans need to further decrease by almost 20 % for new passenger cars and by more than 11 % for vans in order to meet the targets of 95 g CO₂/km by 2021 and 147 g CO₂/km by 2020 respectively (EEA, 2017b). CO₂ emissions from passenger cars and vans are officially reported by Member States and vehicle manufacturers. While these emission values are based on measurements performed in the laboratory using the standard European vehicle test cycle, it is nowadays widely accepted that such measurements may not reflect real-world driving performance. Therefore, a new emissions test procedure, the Worldwide Harmonised Light Vehicle Test Procedure (WLTP) has been introduced.

Currently, tourism transport modes show a wide range in per passenger-km (pkm) emissions, with coaches and trains at the lower end of the spectrum (see Figure 1). As these are averages, electric trains powered by renewable energy and producing near-zero transport emissions, are not featured. Current average CO₂ emissions pkm for Netherlands-Germany-Austria passenger train travel are 1.0 gr for the Netherlands⁶ (NS, 2018), less than 1 gr pkm for long-distance train in Germany (DB, 2018), and 14.2 gr pkm for Austria (ÖBB-Holding, 2017). Some Dutch-Austria train travel runs via Switzerland, where pkm emissions are also near zero (Tuchschnid, 2011).

Figure 1: Average CO₂ emission pkm factors of tourism transport modes



Source: CSTT

2.4 Climate policy

2.4.1 Global, EU and national climate policies

The Paris Agreement (UNFCCC, 2015), having entered into force on 4 November 2016 and currently signed by 195 parties, aims at keeping the global average temperature rise below 2 °C, pursuing a maximum 1.5 °C rise. These goals have a chance of being reached by implementing a finite global carbon budget, with global

⁶ Dutch Railways (NS) uses only renewable energy from wind since 2017. Effectively, rail passenger emissions are therefore zero, but incidental bus replacement transport puts average pkm emissions at 1 gram.

emissions peaking no later than 2020, at around 40 Gt (gigaton) CO₂, and declining towards 5 Gt by 2050 (Rogelj et al., 2015). The contributions that each individual country needs to make in order to achieve the Paris goal are determined individually by each party, and called Nationally Determined Contributions (NDCs).

The EU's 2030 climate & energy framework contains a binding target to cut emissions in the EU by at least 40% below 1990 levels by 2030 (EC, 2014a). The EU low-carbon roadmap aims for its emissions to reach 80% below 1990 levels, through domestic reductions alone (EC, 2011a). In order to adhere to the binding obligations of the Paris Agreement (UNFCCC, 2015), the upcoming Dutch Climate Law will set the goal of reducing GHG emissions by 95% in 2050 compared to 1990 levels. Furthermore, it strives for 49% reduction in 2030 (Klaver et al., 2018).

2.4.2 Transport policy

The EU's overall long-term goal on transport is to reduce this sector's greenhouse gas emissions (including international aviation but excluding international shipping) by 2050 to a level that is 60% below that of 1990 (EC, 2011b).

In 2017, the European Commission (EC) proposed setting new CO₂ emission standards for cars and vans for the period after 2020. The proposed framework foresaw a 30 % reduction of average emissions by 2030 compared to 2021 (EEA, 2017b). These upcoming emission standards will be based on the new emissions test procedure, the WLTP. In September 2018, the European Parliament's environmental committee voted for stricter standards, whereby carmakers would have to reduce CO₂ emissions by 45% by 2030 compared to 2021, and an interim target of 20% instead of 15% in 2025. The committee also voted to increase sales targets for low and zero emission vehicles to 20% for 2025 and 40% for 2030. Finally, in October 2018, the European Council agreed its position: Average CO₂ emissions of new passenger cars registered in the EU will have to be 15% lower in 2025 and 35% lower in 2030, compared to the emission limits valid in 2021. The Council also agreed to adjust the Commission proposal on an incentive mechanism for zero- and low-emission vehicles such as fully electric cars or plug-in hybrid vehicles as regards passenger cars. The benchmark for cars for 2030 was raised to 35% (Council of the EU, 2018).

To achieve its obligations to the Paris Agreement, the Netherlands is setting goals for six major sectors in so-called Climate Agreements, determined by governmental, business and societal parties. The target for the Mobility sector is to reduce annual emissions by 7.3 Mt CO₂ in 2030. The key tool to achieve this is electrification of transport (EZK, 2018). The Agreement follows the Dutch government's earlier target of striving to only allow zero-emission new car registrations from 2030 onwards (VVD, CDA, D66, & ChristenUnie, 2017). Amongst others, the Climate Agreement on Mobility aims for better public transport infrastructure, including for international train travel within 700 km. As the agreement is for national purposes, references to international transport are not made. Only domestic aviation is included (EZK, 2018).

2.5 Key environmental factors in tourism transport

2.5.1 Climate change

The UN Secretary General recently called climate change "the most systemic threat to humankind" (Guterres, 2018). Climate change is a relatively slow process that affects almost every major element of the earth's biosphere and human socioeconomic processes (IPCC, 2014a). Natural hazards for the Netherlands include sea-level rise, increased flows through rivers and the risk of flooding from both. Furthermore flooding risks occur due to increased peak rain-showers. Also, long-lasting droughts are posing risks to both biodiversity and nature as well as agriculture. Furthermore, heat-waves cause health risks and premature deaths. Also Alpine regions like in Austria suffer from increased risk of flooding and damage to ecosystems from droughts. Furthermore, specifically winter-tourism in Austria is under pressure due to the impact of climate change on snow-cover and glaciers. This may cause all expected growth of winter-tourism overnight stays of almost 100% in 2100, to disappear completely (Damm, Greuell, Landgren, & Prettenhaler, 2017).

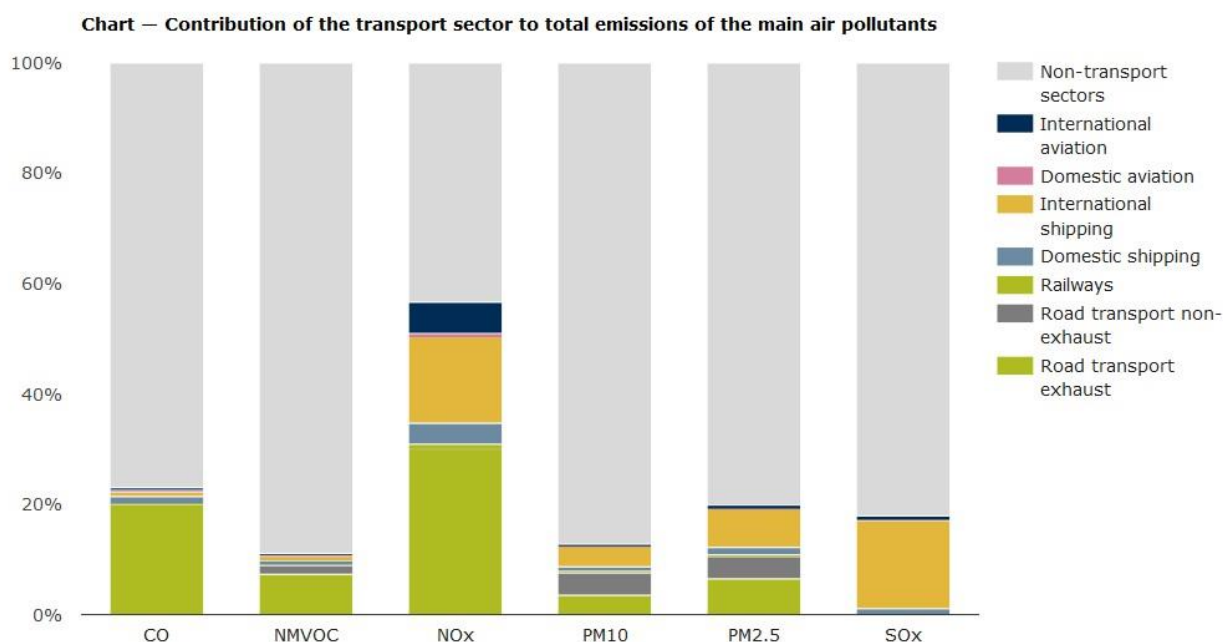
Tourism's contribution to climate change is considerable, as discussed in section 2.2. In global tourism, transport is responsible for 75% of all CO₂ emissions. The emissions of Dutch tourism trips to Austria have been presented in section 1.2. Here, transport and accommodation produce similar shares (around 40%) of holiday

CO₂ emissions, but it is likely that the transport share will grow with the increased use of airplanes for these holidays.

2.5.2 Air pollution

Transport's contribution to all aspects of air pollution in Europe is considerable (EEA-33), see Figure 2. Road transport has large shares of carbon monoxide (CO), nitrogen oxides (NO_x), and particulate matter (PM) emissions, while cruise ships are a part of international shipping (NO_x, PM and sulphur oxides (SO_x)). Aviation is mainly visible through NO_x, whereas rail travel plays a negligible role compared to these other modes. In Alpine destinations, the topography multiplies air pollution (and other) impacts locally along valleys or passes (Permanent Secretariat of the Alpine Convention, 2013).

Figure 2: Contribution of the transport sector to total emissions of the main air pollutants (EEA-33)



Source: EEA (2017c)

2.5.3 Noise

The World Health Organisation (WHO) handles noise as the second largest environmental cause of health problems, just after the impact of air quality (particulate matter) (WHO, 2011). The health of our ecosystems is also at risk. The noise maps of Europe reveal graphically how even relatively moderate levels of noise such as 55 dB (decibel) Lden (day-evening-night level) are extending over more and more territorial area outside of urban areas, directly threatening valuable habitats and species that are particularly susceptible to noise (EEA, 2014). Common causes of environmental noise pollution are road, rail and airport traffic, industry, and construction.

Houthuijs, van Beek, Swart, and van Kempen (2014) estimate that at least about 19.8 million adults in Europe suffer from noise nuisance from road traffic, railways, aircrafts or industry; 9.1 million of them suffer severely. They also estimate that 7.9 million adults suffer from sleep disturbance due to night time noise, with 3.7 million of them being severely sleep disturbed. This exposure to noise contributes to about 910 thousand additional prevalent cases of hypertension and to 43 thousand hospital admissions per year and about 10 thousand premature deaths per year related to coronary heart disease and stroke. About 90% of the disease burden is related to road traffic noise.

Both END data and citizen ratings show that noise from road traffic is the most dominant threat, both due to its geographical extent and the numbers of people it affects. In addition, while airports do not affect a wide geographical area, the effects of aircraft noise extend beyond the damage to health of people living nearby airports. It also directly impacts on the ability of younger generations to concentrate and learn in schools located near aircraft flight paths. Although railway noise does not have the same high numbers of exposure that road traffic reaches, the numbers of people affected remain significant (EEA, 2014).

The studies mentioned above usually link health problems to noise levels in excess of 55 dB Lden (Long-term average indicator designed to assess annoyance and defined by the Environmental Noise Directive (END)). It refers to an annual average day, evening and night period of exposure. The WHO recommends that for a good night's sleep, continuous background noise should stay below 30 dB and individual noises should not exceed 45 dB.

In Alpine destinations, noise from (tourism) transport is amplified by the mountain landscape. E-mobility would result in a reduction of noise pollution from car traffic.

2.5.4 Landscape pollution

Aesthetic or landscape pollution by tourism (transport) infrastructure has been noticed for decades, particularly in Alpine destinations (Krippendorf, 1975; Langer, 1995; Opaschowski, 1999). It relates to tourism urbanisation and the construction of roads, railways, parking lots and airports disturbing or destroying the Alpine natural and cultural landscape. In many Alpine destinations, this largely car-based infrastructure serves a tourism purpose for a very considerable share of its traffic. It is concentrated in the valleys, increasing its visibility. At the same time, the same landscape has an essential function for tourism and needs to be sustained (Unger, Abegg, Mailer, & Stampfl, 2016, p. 475) and productive land and soil is a rare resource in the Alps (Permanent Secretariat of the Alpine Convention, 2013). The Alpine landscape thus presents difficulties for using e-mobility as a sole solution for reaching zero emissions tourism.

3 Options for (near) zero-emission tourism mobility

3.1 Introduction

Aviation is not included as a possible near-future, near-zero emission tourism transport mode. The quickest – and only - way to ‘decarbonise’ flying in time for the Paris emission reduction goals currently are alternative fuels. Biofuels have been assumed to take this role, but their capacity will be limited because of its large area use, competition with food production and other users of biofuels and because of damage to nature and the fact that biofuel’s still have a significant climate impact (Jong et al., 2018). Another approach could be to produce kerosene from captured CO₂ through a power-to-liquid process (Schmidt, Batteiger, Roth, Weindorf, & Raksha, 2018; Schmidt, Weindorf, Roth, Batteiger, & Riegel, 2016). A Dutch initiative proposes a large-scale demonstration plant to be built and tested before 2020 (Terwel & Kerkhoven, 2018). This test plant would use CO₂ captured from a blast furnace, thus reducing CO₂ emissions by almost 50%. In future, technologies are needed to use CO₂ captured directly from the atmosphere to close the carbon cycle. So far, some plants have demonstrated atmospheric carbon capture to be possible, but that is still at the cost of significant CO₂ emissions during that process (Keith, Holmes, St. Angelo, & Heidel, 2018).

3.2 Cars

Cars are the backbone of tourism transport, both domestic and international. The expectation is that this will remain so for the coming decades. Electric vehicles (EVs) are embraced as a key solution in mitigating GHG emissions in transport, and have already been embedded in policies at various geographical and governmental levels (see 2.4.2).

3.2.1 Types and emissions

The advent of hybrid and electric vehicles has led to a variety of types available today. A 2016 EEA report describes the different types of hybrid and electric vehicles available in Europe, including their (dis)advantages. These are summed up in Table 1. We note that some of the disadvantages, notably that of few recharging stations, are of temporary nature, and some may be a matter of perception.

Table 1: Vehicle types, engines and (dis)advantages

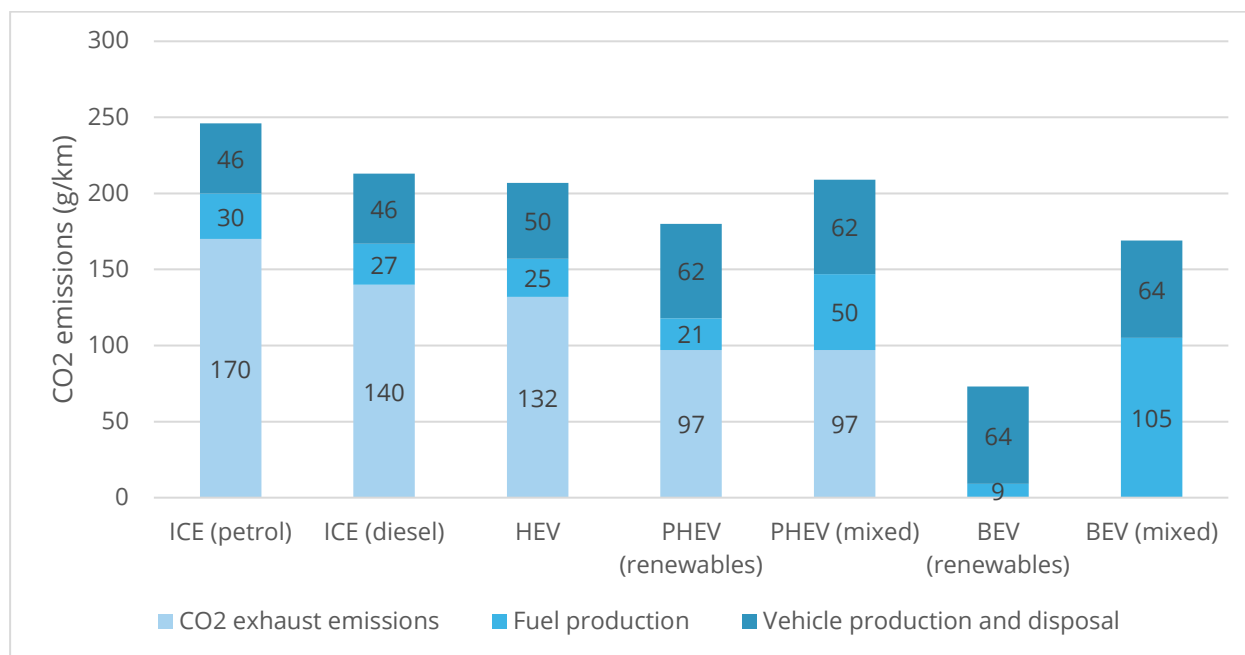
Type	Engine	Advantages	Disadvantages	Electric km range
Conventional vehicle	Internal combustion engine (ICE) using fossil fuels	Choice of many different models Many fuel stations Low purchase price	Exhaust emissions Fossil fuel dependency Higher engine noise Low energy efficiency	-
Battery electric vehicles (BEVs)	Electric motor and battery with plug-in charging	Higher efficiency Home/workplace charging No engine noise Zero exhaust emissions	Few charging stations Charging takes long Short driving range	80-400
Hybrid electric vehicles (HEVs)	Combined ICE and small electric motor/ battery charged via regenerative braking or engine	Higher efficiency Many fuel stations	Exhaust emissions Fossil fuel dependency Higher engine noise than e.g. BEVs Technological complexity	0-10

Type	Engine	Advantages	Disadvantages	Electric km range
Plug-in hybrid electric vehicles (PHEVs)	ICE complemented with an electric motor with plug-in charging	Higher efficiency Home/workplace recharging Many fuel stations	Exhaust emissions Medium to large fossil fuel dependency Technological complexity	20-85
Range-extended electric vehicles (REEVs/E-REVs)	Electric motor and plug-in battery, with auxiliary ICE only for supplementary battery charging	Higher efficiency Home/workplace recharging Many fuel stations	Technological complexity	70-145
Fuel cell electric vehicles (FCEVs)	Fuel cell for on-board electricity, generally using compressed hydrogen and oxygen	Higher efficiency (but less than BEVs) No engine noise Zero exhaust emissions (except water)	Limited commercial availability Few fuel stations Technological complexity	160-500

Source: adapted and updated from Hacker et al. (2016)

How near zero emission these vehicles are depends on the electricity used during their production and operational phase. Over their life-cycle, electric vehicles (EVs) are not zero emission, as their production is (even) more energy-intensive than that of ICEs. However, seen from a life-cycle analysis (LCA) perspective, the lower emissions during an EV's lifetime outweigh other environmental effects. The advantage over ICE vehicles depends very much on the electricity (mix) used, as is shown by a TNO study that compared relative CO₂ emissions across the lifetime of different middle-class (C-segment) ICE, BEV and PHEV vehicles for the Dutch situation with 2013 as reference year (see Figure 3). For the average vehicle in this class, a BEV on renewable energy thus produces 70% less CO₂ pkm than a conventional vehicle on petrol. On a largely 'grey' electricity mix, the BEV advantage is 30% less CO₂. PHEVs show a more modest gain. Decarbonisation of electricity generation – "a key component of cost-effective mitigation strategies" (IPCC, 2014b) – will lower fuel production emissions of EVs in the (near) future, whilst in the long term ICE emissions may increase due to increasingly more complex fossil fuel extraction methods. The German situation is exemplary for the effects of the electricity mix on BEV advantages. With the current German mix, an ifeu analysis shows BEV CO₂ emissions are 'only' 16 to 27% lower than those of ICEs (Helms et al., 2016; NPE, 2018), but it also concludes "that the benefits of electric vehicles will continue to increase during the next years, mainly due to a growing percentage of renewable energy in the electricity system" (Helms et al., 2016, p. 5). The current German electricity mix is a relative disadvantage for Netherlands-Austria tourism trips per EV.

Figure 3: LCA CO₂ emissions for different passenger vehicles and fuel types



Source: Verbeek, Bolech, van Gijlswijk, and Spreen (2015)

BEVs also offer local air quality benefits due to their zero exhaust emissions, such as NO_x and PM, but the latter is still emitted locally from road, tyre and brake wear.⁷

3.2.2 Batteries

The revolution of the electric car, coach and camper all hinge upon the efficiency of batteries. Current Li-ion batteries support energy densities of up to 400 Watt-hour per kilogram (Whr/kg) (McCloskey, 2015). Theoretically, these batteries could be improved to levels of about 800 Whr/kg. But there are resource issues that may limit the global battery capacity available: within ten years the reserves of the rare metals now used to produce high-density Lithium-ion batteries will be depleted causing the batteries to become less efficient. Several technological breakthroughs are therefore needed to secure the future of (affordable) battery-powered transport (Turcheniuk, Bondarev, Singhal, & Yushin, 2018).

3.2.3 Sales

After continuous strong growth, electric vehicle registrations in Europe reached 1 million halfway 2018. However, whilst plug-in sales are growing, they still account for only 2% of all new car and van registrations across Europe (Norway is an exception with 37% of new registrations). In Austria, this share is approx. 1.6% (BEÖ, 2018b; EV-Volumes.com, 2018). In the Netherlands, the share of EVs of all new passenger car registrations was 4.6% for the January-September 2018 period (see Table 2). While the share of PHEVs and E-REVs of new registrations has decreased, the share of BEVs has grown. Per October 2018, there were 132,449 passenger EVs registered in the Netherlands, of which 34,251 BEVs (NEA, 2018).

The ambition is to have 10% of all new passenger cars sold to have an electric powertrain and a plug in 2020, and 50% in 2025, with 15% of all new cars being fully electric in 2025 (EZ, 2016). It is the current government's aim for all new cars to be zero emission by 2030 at the latest (VVD et al., 2017).

⁷ For the most recent European, full-scale LCA analysis of EVs, we refer to the EEA's latest Transport and Environment Reporting Mechanism (TERM) report (EEA, 2018a).

Table 2: EV share of new passenger car registrations in the Netherlands

Year	BEV	PHEV	BEV + PHEV
2014	0.8%	3.2%	4.0%
2015	0.8%	9.1%	9.9%
2016	1.1%	5.6%	6.7%
2017	2.1%	0.6%	2.6%
Jan – Sept 2018	3.8%	0.8%	4.6%

Source: NEA (2018)

3.2.4 Charging infrastructure

The majority of BEVs and PHEVs charge through plug-in charging. Battery swapping is not widespread, and wireless charging is still in a pilot phase. Important for users are charging mode and type. The charging mode dictates the charging speed, and other technical requirements (required voltage, current and speed that charging cables have to provide, plus the level of communication between the vehicle and the power outlet). There are four modes available for plug-in charging (Hacker et al., 2016; Spöttle et al., 2018):

- **Mode 1 (slow charging):** Common household sockets and cables. Domestic or office buildings. Alternating current (AC), 3.7-11kilowatt (kW).
- **Mode 2 (slow or semi-fast charging):** Non-dedicated socket with special charging cable provided by manufacturer. AC current, 7.4-22 kW.
- **Mode 3 (slow, semi-fast or fast charging):** special plug socket and dedicated circuit allowing charging at higher power levels. Via wall box (home) or stand-alone pole (public). Dedicated charging equipment. AC current, 14.5-43.5 kW.
- **Mode 4 (fast charging):** also called 'off-board charging'. Delivers direct current (DC) to the vehicle. An AC/DC converter is located in the charging equipment (instead of vehicle), 38-170 kW

The charging type describes the plug which connects the vehicle and the charging point. Six types are distinguished (see Table 3). Each type supports specific plugs and adapters and is used by one or more OEM (Original Equipment Maker). In Europe, Type 2 (Mennekes) is the standard for slow charging and Combo2 for fast charging. While this would theoretically would ensure physical interoperability, some slow charging stations in Europe are Type 3 only, as they were installed for Italian and French cars until 2012. Fast charging stations often offer Type 4 (CHAdeMO) plus CCS Combo. Tesla operates its own chargers. Spöttle et al. (2018) note that it does not appear that carmakers will coalesce around a single connector standard.

Table 3: Charging types Europe

Type	Charging standard	Geographic distribution	Carmakers
Type 2 (Mennekes)	EU standard for slow charging	EU	Mandatory for EU sales
Type 3 (EV Plug Alliance)	Slow charging	Italy and France	Not produced since 2012
Type 4 (CHAdeMO)	Slow and fast charging	Europe (until 2019, but CHAdeMO-equipped EVs on road for longer)	Nissan, Mitsubishi, Kia, Citroën, Peugeot
CCS COMBO2 (Combined Charging System, Type 2)	EU plug standard for Type 2 slow charging and Combo 2 fast charging	Europe	BMW, Daimler, Ford, Fiat Chrysler, General Motors, Honda, Hyundai, Volkswagen
Tesla Supercharger	Fast charging	Europe	Tesla

Source: Spöttle et al. (2018)

Charging points vary from private/domestic, to semi-public and public. Semi-public and public points are important for tourism, as their availability enables charging on routes other than to work, increasing flexibility and decreasing range anxiety (Dimitropoulos, Rietveld, & van Ommeren, 2011). The former are frequently located at commercial car parks, shopping centres or leisure facilities, with access often restricted to clients or customers, and the latter at roadsides and public car parks.

The charging network in the Netherlands is comparably extensive, and still expanding, with growth of regular charging points slowing down a bit in 2018 compared to the previous three years, and growth of fast charging points increasing (see Table 4). As of October 2018, the Netherlands has 3 publicly accessible hydrogen refuelling locations (in Rhoon, Helmond and Arnhem).

Table 4: Number of charging points in the Netherlands

Number installed at	31-12-2015	31-12-2016	31-12-2017	30-09-2018
Regular charging points				
Public (24/7 publicly accessible)	7,395	11,768	15,288	18,760
Semi-public (limited publicly accessible)	10,391	14,320	17,587	17,250
Regular Public + Semi-public	17,786	26,088	32,875	36,010
Fast charging				
Fast charging points - Public and semi-public	465	612	755	952
Fast charging locations			178	203
Private charging points	55,000	72,000	80,000	93,000

Source: NEA (2018)

Numbers and statistics on charging points and locations vary in online registers. Some only list public charging stations, which usually only includes those of energy companies and parking lots. The number of publicly accessible (semi-public) stations, for example those at accommodations, may be a lot higher though, as is shown above for the Netherlands. In Germany and Austria, charging networks are lagging behind that of the Netherlands. As of November 2018, Germany counted some 13,700 public charging points, divided over 6,600 locations. 750 of these locations (some 1500 points) are fast charging (Bundesnetzagentur, 2018). The overall numbers are much higher (see Table 5). Germany is said to have its highways covered with fast charging points (400+ locations) country-wide in the course of 2018 though – an apparent world-first (NPE, 2018) – and an advantage for Netherlands-Austria EV tourism. Austria counts some 2,600 public charging points, at 1,100 locations (BEÖ, 2018a). Table 5 shows statistics for public and semi-public charging infrastructure in Germany and Austria. The figures on semi-public/all may not necessarily be comparable with those for the Netherlands in Table 4, due to different sources and methods. The table offers some perspective on accessibility, in terms of socket types available. It also shows that many charging locations can be found at or near hotels and restaurants (but note that locations at restaurants and hotels can overlap). For comparison, Austria counts around 13,500 accommodations that classify as hotel (includes Pension, Gasthof, Youth Hostel, etc.) (Fachverband Hotellerie, 2018), and around 65,000 accommodations in total (about two thirds of these are privately owned apartments and holiday homes) (Statistik Austria, 2018). Accessibility and roaming are further discussed in section 4.4.1.

Table 5: Charging infrastructure statistics Germany and Austria

	Germany	Austria
Public charging infrastructure*		
- Charging locations	6,605	1,102
- Charging points	13,147	2,582
All charging infrastructure**		
- Charging locations	13,720	3,741
- Charging points	39,339	11,733
- Charging speed**		
o % <11 kW	31%	41%
o % 11-22 kW	51%	51%
o % > 22 kW	19%	8%
- Socket type**		
o Type 2	58%	49%
o Schuko	26%	32%
o CHAdeMO	4%	2%
o Combined Charging	4%	3%
o CEE/Tesla/Other	8%	14%
- Charging locations at or near hotels	2,802	1,357
- Charging locations at or near restaurants	4,726	1,875

*Sources: BEÖ (2018a), Bundesnetzagentur (2018). **Source: GoingElectric (2018)

3.2.5 Payment systems and communication protocols

This section discusses the payment systems and communication protocols of charging infrastructure, as there are important interoperability issues linked to both, which are of influence on particularly international EV drivers.

Paying for public charging is currently on the basis of either energy use, charging time, flat rate tariffs, or a combination of the three. Due to a lack of regulation in the early years of charging infrastructure rollout, different payment systems were developed, with the result that there is no uniform payment mechanism at charging stations. Options include cash, Radio-Frequency Identification (RFID) cards specific to charging network operators, mobile phone, or direct communication between car and charger, SMS payment, and payment with credit cards. Customers of one charging station operator cannot always charge conveniently at a station from a different operator, causing drivers to sign up with multiple charging networks, carry the respective access cards and/or use a variety of mobile apps for access to the operator (Spöttle et al., 2018).

This issue was addressed by Directive 2014/94/EU on the deployment of alternative fuels infrastructure (AFID). It allows charging operators to provide recharging services to customers on a contractual basis, including in the name and on behalf of other service providers, and by obliging operators to offer charging services on an ad hoc basis with no prior contract. Charging at one charging station on behalf of a different operator requires that roaming between the operators works, which means that the two operators need to have a contractual agreement. Roaming requires that the charging stations have an internet connection, that their protocols are compatible, and that the station has either a RFID card reader or a function for remote activation. Currently, most EU Member States have a minimum of two different billing systems in place and most allow for ad hoc

charging. There are national and local attempts to develop roaming solutions. For example Hubject, an industry joint venture, aims at harmonising roaming. The current situation is not always convenient for customers, in particular when travelling internationally (Spöttle et al., 2018).

Charging infrastructure operators are confident that the payment systems will be interoperable within the coming years as the market is moving quickly to find solutions. Still, further regulation (in particular with regard to smart charging applications) will be needed to ensure an EU charging network that takes into account future needs (Spöttle et al., 2018).

Then there are the protocols that carry out the communication between car, charging stations, grid, and roaming platforms. Communication functions include identification, authorisation, battery status, etc. As with payment systems, there is a large variety of different protocols in place globally, and these are not always interoperable. Not all protocols encompass services like roaming for payment and smart charging. To make charging stations operated by different providers accessible for a broad range of clients, many national providers of charging infrastructure have agreed to use the Open Clearing House Protocol (OCHP), including ElaadNL in the Netherlands, Ladenetz.de in Germany, and Vlotte in Austria. Another protocol supported by a broad range of actors is the Open Charge Point Protocol (OCPP), which was initiated by ElaadNL (Spöttle et al., 2018). OCPP is the global open communication protocol between the charging station and the central system of the charging station operator. It handles the charging transaction and in addition can exchange information between the vehicle and the electricity grid. Then there is OCPI (Open Charge Point Interface), an open protocol between operators and service providers that supports affordability and availability of charging infrastructure. OCPI supplies correct charge station information such as location, availability and pricing, manages bilateral roaming, and allows for real-time billing and mobile access to charge stations (ElaadNL, 2018). Other protocols are not discussed here. See ElaadNL (2018) for an overview.

3.3 Trains

3.3.1 Electric trains

Based on transport (not LCA) emissions, electric passenger trains are the only transport mode that currently fits the description near zero emissions when looking at Netherlands-Austria transport (assuming that the German electricity mix makes it difficult to cross the country zero emissions with a BEV). Current average CO₂ emissions pkm for Netherlands-Germany-Austria passenger train travel are 1.0 gr for the Netherlands (NS, 2018), less than 1 gr pkm for long-distance train in Germany (DB, 2018), and 14.2 gr pkm for Austria (ÖBB-Holding, 2017). Some Dutch-Austria train travel runs via Switzerland, where pkm emissions are also near zero (Tuchschnid, 2011).

There are several attractive ways for Dutch holidaymakers to visit Austria by train: (1) using high-speed rail (ICE) connections by Deutsche Bahn through Germany during day-time, (2) ÖBB Nightjet overnight connections between Düsseldorf or Hannover and Innsbruck or Vienna (and several stops in-between), and (3) special, seasonal winter sport day and overnight trains, partly run by Treinreiswinkel. For consumers the main advantage of overnight trains as opposed to cars is that they win one day at the destination, besides not having to make an overnight stopover along the highway and arriving more relaxed.

Austria has a relatively large train transport system, 5000 km in length, very suitable for local holiday transport. The train system is run by different TOCs, train operating companies, of which ÖBB-Personenverkehr is the biggest. Long-distance (high-speed) lines connect the capital to other major cities in Austria, as well as to other European cities.



Photo: ÖBB Nightjet on the Düsseldorf-Innsbruck line

3.3.2 Hydrogen and battery-electric trains

Hydrogen as well as battery-electric trains are an option in some tourism destinations for replacing regional diesel trains, possibly tapping into local resource strengths, such as the presence of hydrogen power plants. The world's first hydrogen-powered passenger train service has just begun operating in the north of Lower Saxony, Germany (16 September 2018). This train, Alstom's Coradia iLint, is powered solely by hydrogen fuel cells, which convert hydrogen and oxygen into electricity (and water), offering speeds of 140 kilometres per hour. Technically, hydrogen could be near zero emissions, though the production of hydrogen is not emissions-free (level depends on resource used). Alstom is contracted to supply 14 fuel cell trains in total. In Austria, a hydrogen train is planned in the Zillertal (start operation in 2022), and in the Netherlands in the province of Groningen (test phase in 2019). The Dutch province of Friesland intends to have all of its (diesel) trains replaced by battery electric ones by 2025, rather than extending overhead lines (van Gompel, 2018). First trains may already be operating by 2021 (Kruidhof, 2018).

3.4 Other modes

3.4.1 Electric campervans

Fully electric campervans are currently in study or pilot phases, with only a handful of these vehicles on the road. The Nissan e-NV200 base, already serving as electric taxi or business van, is expected to be on the market as e-Campervan (40 kilowatt hour (kWh), range around 250 km) in 2019. A custom-built campervan based on a 24 kWh e-NV200 is already used within this K2K project as a pilot model, rented out by partner Camptoo (Camptoo, 2018). A test report is available through ANWB (2018b). Meanwhile, Volkswagen is planning an electric remake of its classic campervan in 2022, the I.D. Buzz. Other studies include the e.home by Dethleffs.

3.4.2 Electric bicycles

Over the last decade, electric bicycles (e-bikes) have shown massive growth throughout Europe. As rental vehicles for tourists, they can contribute in lowering emissions at the destination, by replacing car trips. E-bikes are already included in the tourism offer in many destinations throughout Europe.

3.4.3 Electric busses

Zero-emission busses are a key element in the transition to a more sustainable public transport system (Bakker & Konings, 2018), replacing conventional (diesel) buses in both cities and rural areas. Local governments primarily introduce them to fight air pollution (ibid.). As with cars, there are different types of electric buses, the most important ones being battery electric buses (BEBs) and hybrid electric buses (HEBs). BEBs drive purely on electricity and HEBs also on conventional fuel. For tourism, these vehicles offer opportunities for lowering transport emissions and congestion at the destination. But where the Netherlands ranks first in terms of BEB fleet and orders, Austria is at the bottom end of the scale in Europe (T&E, 2018c).

Battery electric coaches (BEC), for origin-destination transport, are slowly moving out of the test phase. Long-distance bus operator Flixbus has tested two BECs on the Paris-Amiens service in 2018 (Flixbus, 2018). Chinese company BYD, well-known for its public transport BEBs, offers one BEC model on the European market (BYD Europe, 2018). Their BECs already operate outside Europe.



Photo: the first full-size BEBs in the Netherlands operated on the touristic island of Schiermonnikoog, in 2013.

3.5 Tourism examples

EVs are already used in Austria in tourism. Amongst others within the Alpine Pearls network. This is a sustainable tourism mobility network of 25 communities in all six Alpine countries, promoting train and bus arrivals, offering pick-up services and sustainable mobility alternatives for local transport (Alpine Pearls, 2018). Werfenweng in Salzburgerland is a best-practice example among these communities. It provides tourists who hand-in their car keys with plenty of sustainable transport options such as e-bikes, e-mountain bikes, e-cars and other zero emission vehicles (ZEVs), without charge, to transport them to activities in and around the destination. More general, EVs are increasingly being offered as rental vehicles, also with a strong tourism focus in specific destinations, like on a number of Wadden Sea islands.

Charging infrastructure is gradually appearing at accommodations, but in a fragmented way, and many accommodations do not openly communicate having them. Chargemap.com shows around 7.4% of public charging stations in Germany to be located at hotels and 2.3% at restaurants (Reintjes, 2018). Online platforms

such as ChargeHotels⁸ present a range of hotels offering charging, also in Austria (Tesla chargers are in the majority at these hotels).

Tourism products specifically for EVs are still at a very early stage. Dutch car tour operator Pharos Reizen has started offering specific EV itineraries in Germany, Norway and Scotland. Pharos is actively preparing for a larger demand for such tours, even though demand is limited at the moment (Borsboom (pers. comm.), 2018). Another example is the Black Forest region in Germany, offering the 'Schwarzwald e-drive Experience', a one or three-day high-end package deal including a Tesla (Schwarzwald Tourismus, 2018). Popular media articles have started publishing accounts of BEV longer distance holiday trips, for example from Amsterdam to South Tyrol (van Rijkevorse, 2018).

⁸ <http://www.chargehotels.com>

4 Barriers and solutions

4.1 Barriers for EV use in tourism

Even though EV sales are increasing (see 3.2.3), their share is still minimal compared to conventional vehicles. A range of studies have identified a number of common barriers against EV uptake. These have not been done in a tourism context, but do provide valuable insight into what could stimulate tourists to drive electrically on holiday. According to a representative survey of the Dutch adult population, the six main reasons for the Dutch not to buy an EV are: too expensive (65% of respondents), range too low (31%), waiting for more common types (26%), insufficient charging infrastructure (24%), no charging option (16%), not suitable for holidays (15%) (ANWB, 2018a). Other studies also found price, range anxiety and various issues and anxieties related to charging to be the main barriers for the average Dutch consumer (see e.g. Nijland, Uitbeijerse, & van Meerkerk, 2017). These barriers, be it sometimes in a different order, reflect those found in the wider (international) literature (e.g. Biresselioglu, Demirbag Kaplan, & Yilmaz, 2018; Egbue & Long, 2012).

A general major barrier to a relatively new technology such as EVs, is that consumers show the tendency to resist those. They need to prove themselves first (Egbue & Long, 2012). Due to a lack of knowledge and a perceived lack of information, for example on charging (points), potential consumers expect more problems with EVs than experienced users encounter (Vogt & Bongard, 2015). Gender, age and educational levels influence attitudes, knowledge and perceptions related to EVs (Egbue & Long, 2012). Early adopters of EVs, for example, are mostly above average income earners, have a high education level, display environmentally friendly behaviour and are open to new technologies (Nijland et al., 2017). In general, environmental benefits are important for EV adoption, but still less so than cost and performance (Egbue & Long, 2012), though some (national) studies find environmental performance of EVs to be a stronger predictor than price value and range confidence (Degirmenci & Breitner, 2017).

The largest barrier for not buying an EV in most studies are the higher costs associated with EVs (Hacker et al., 2016). Without incentives or subsidies, the purchase of an EV can indeed be up to €10,000 more expensive than a comparable ICE vehicle (Hacker, Waldenfels, & Mottschall, 2015)⁹, and private users appear to focus more on this purchase price than on energy prices and other running costs (Nijland et al., 2017; Vogt & Bongard, 2015). The latter, and also the total cost of ownership (TCO), are already cheaper for EVs than ICEs in a number of countries (Palmer, Tate, Wadud, & Nellthorp, 2018). Battery costs are (currently) the main reason for the higher purchase costs of EVs in comparison with ICEs (Bunsen et al., 2018).

Other main reasons relate to differences of EVs compared to the conventional (ICE) vehicles people are used to: limited range, limited charging options, and limited choice of models. The range of many BEVs is actually already longer than most consumers need for an average trip, but perceived as a barrier (Vogt & Bongard, 2015). Spöttle et al. (2018, p. 79) conclude that “range anxiety continues to be an issue for potential PEV drivers as they want chargers to be as visible as petrol stations appear today. Depending on where the potential driver is located, range anxiety could either be due to an actual lack of infrastructure or a lack of awareness thereof”.

PHEV buyers are not anxious about range (Lane et al., 2018), but as shown before their environmental advantage is very limited. There is some speculation that private owners may be more sensitive to the financial advantages of charging over fuelling, especially at home or at the ‘normal’ publicly accessible chargers, where electricity – at least in the Netherlands - is significantly cheaper per kilometre than fuel. This advantage diminishes when the number of annual kilometres driven is high and the electric km share is comparatively low (Hoen & Hilbers, 2016). The number of public charging points is also seen as limiting, even though most of the charging is done at home or at work (Hacker et al., 2016). These are both barriers that apply in a tourism

⁹ For example, in the Netherlands (as of 7.11.2018), the starting price for a Volkswagen Golf is €23,620 while that for a Volkswagen e-Golf is € 39,680. A Renault Zoe (BEV) starts at € 32.890; a larger ICE model such as the Renault Mégane starts at € 22,690. Nissan Leaf (BEV) € 36,890 vs. the Nissan Pulsar (ICE) €26,490.

context. Tourism professionals agree with there not being enough charging infrastructure available yet (Appendix 2). A limited number of charging stations and points also leads to anxieties about having to wait a long time at public charging stations (Nijland et al., 2017), or simply not having the same refuelling experience as ICE users (Burnham et al., 2017). Multiple charging stops and repeated long waiting times – either due to an occupied station or slow charging speed – could potentially create a (perceived) obstacle for consumers to use EVs for travelling long distances to holiday destinations. Finally, although the number of EV models available is increasing, choice of models and configurations is much smaller than of ICE vehicles.

Besides good charging infrastructure coverage itself, there are other barriers in charging infrastructure. Because whereas the “standards for PEV charging modes and types in place in the EU are sufficient to guarantee uniform quality, safety of charging and investor security for market actors”, “the harmonisation of payment systems and protocols (software), is further behind than for the technical hardware” (Spöttle et al., 2018, p. 79f.). This is due to the fragmented, non-systematic way of (early) charging infrastructure planning, where government and private-sector parties implemented various types of infrastructure. It has resulted in less-standardised development of back-end communications, payment, and power supply standards, forcing EV drivers to use a variety of memberships, accounts, and cards to access all of the nominally publicly available infrastructure in many European countries (Hall & Lutsey, 2017, see also 3.2.5). This can be both confusing and inconvenient. Spöttle et al. (2018, p. 80) on this topic: “Subscription services lock-in customers, deterring them from using other networks, and unsubscribed drivers may be deterred by paying higher rates or subscription requirements and instead opt to charge at home. The communication between the charging station and the vehicle works despite a high number of different protocols, but payment systems are not always compatible with different protocols. The diversity of payment systems is mirrored in the large range of consumer prices for charging, which varies hugely from region to region.” This might become an increasingly difficult issue as the market grows (Hall & Lutsey, 2017), and it is particularly problematic for (international) tourists. The issue is described as interoperability or e-roaming, meaning that “drivers can charge at any station with a single identification or payment method, and that all charging stations can communicate equally with vehicles” (Hall & Lutsey, 2017, p. 23). In the Netherlands, price differences are smaller than in other countries, and Dutch inhabitants do not have roaming issues in their country (for tourists in the Netherlands this may not necessarily be so).

In a small Dutch focus group research, participants briefly mentioned limitations for EVs on holidays: short range, insufficient charging infrastructure abroad, insufficient luggage room, and a possible lack of sufficient traction in more challenging circumstances. Their proposed solution of solving this with a temporary switch to an ICE model for holidays (Schothorst, 2017 in Nijland et al., 2017) would be a blow to near zero emission tourism mobility. EV users interviewed at the e-mobility day in Melk viewed more frequent stopping for charging during holidays both as a disadvantage and an advantage. While the total journey time probably increases, there is more time for relaxation and enjoying places along the way. Attractive route planning allows for interesting stops making the journey part of the holiday.

The barriers for battery electric campervans are the same as for all BEVs, except that current campervan models available show a shorter range than the average car counterpart, making charging infrastructure and interoperability even more important.

4.2 Barriers for train use in tourism

Key barriers in rail travel, as opposed to air travel, are the difficulties in finding travel information, tickets, and attractive tariffs (availability heuristics). Differences in time perception – with rail it is the whole journey, while with air it is airport-to-airport – lead to the perceived idea that air travel is (always) faster. In comparison with cars, trains are frequently seen as unreliable and not punctual, and these points seem to be weighed more heavily than dealing with traffic jams in cars. Rail travel is also simply not top of mind, whereas (habitual) air and car travel are (Donners, 2018), and rail travel is often perceived as more costly than air. An analysis by Steer Davies Gleave (2016) for the European Commission shows that the costs of travelling by air are actually higher than rail, on a fare per kilometre basis, on all shorter interurban routes except in Germany and Spain. Even on most routes where rail travel was faster than air it was still less expensive. However, rail was more expensive

than air for international journeys than domestic interurban ones. On the basis of their sample, Steer Davies Gleave (2016) suggest that on longer domestic and international journeys (over 300 kilometres), rail operators should probably charge less than airlines, unless they can offer a faster city centre to city centre journey time. Railways cannot compete with airlines in terms of the booking process. For example, airlines can offer extremely low fares up to one year ahead, which railways cannot due to the slow development of timetables.

Dutch tourism professionals see (electric) rail travel only as a small part of the solution, as it is limited by consumer unawareness and perceived disadvantages, available connections and destinations, and last-mile options. They see the need for an all-EU high-speed rail (HSR) network, with more destinations and capacity, and a level playing field regarding other transport modes.

4.3 Barriers in tourism offer and demand

Dutch tourism professionals insist that most (European) countries are not ready for supporting zero-emission tourism mobility yet, particularly in terms of infrastructure, but often extending to the whole chain. With the Netherlands as main exception. They acknowledge that tourism is not leading in near zero emissions mobility or in fact, that the management of Dutch tourism businesses does not see the need for investment in zero-carbon tourism (yet). This may be due to anxiety for what the competition does (wait-and-see attitude). Some remarks lead to the perception that part of the sector is not very aware of the possibilities and technologies available. For example, air travel is still top-of-mind for many and some of the solutions suggested are not up-to-date anymore. Yet they do see a shared responsibility for tourism businesses (in establishing zero emission mobility). In the near future, they see tourism businesses at least providing a facilitating role for taking away anxieties for electric holidays, for example through providing information. Creating demand is required, because it is thought that the average Dutch customer is simply not ready for zero-carbon tourism yet, unaware of the possibilities, and/or does not ask for it. However, the new NBTC Holland Marketing tourism plan (NBTC, 2018) focuses more on nearby markets, which increases the potential for e-mobility. Also there is interest by NBTC in specific e-mobility tourism products.

4.4 Solutions for EV uptake

4.4.1 Charging infrastructure

Insufficient charging infrastructure has been identified as a considerable barrier against EV adoption. Though what should come first – EVs or charging infrastructure – is frequently termed as a chicken and egg dilemma. For achieving EV uptake, it is recommended to focus (partly) on citizens with access to a home charger, as a range of studies have shown this type of access to be the most important factor in encouraging EV purchase. In fact, only 5% of vehicle charging occurs at public charging locations (incl. on-street city charging, car parks and fast charging along road corridors). The bulk (95%) of EV charging is done at home and at work (see review by Hardman et al., 2018). Hence consumer focus on public charging infrastructure appears to be rather a psychological barrier (T&E, 2018e). Moreover, an analysis by the Platform for Electromobility (2017) shows that on average there is one public charging point available for every six EVs in the EU, be it with considerable fluctuations per Member State. Directive 2014/94/EU, the Alternative Fuels Infrastructure Directive (AFID), recommends that EU Member States ensure a ratio of a maximum of 10 EVs per charging point (EC, 2014b). According to the Platform for Electromobility (2017) this ratio for the EU will still be guaranteed in 2020. In their European Parliament study, Spöttle et al. (2018) note that the build-up of charging infrastructure is progressing at varying rates relative to electric vehicle sales in a given country (and has largely been funded by government efforts). The density of charging infrastructure generally correlates positively with PEV adoption, but the influence of charging infrastructure as a variable differs depending on the national context (see also Hall & Lutsey, 2017).

For tourism purposes, public charging locations are far more important than for everyday trips, for obvious reasons. In particular, fast charging options along highways for origin-destination travel (e.g. Netherlands to Austria) and charging infrastructure at accommodations and touristic sites. Fast charging stations along highways enable journeys beyond the range of EV. Standard chargers are impractical for this purpose. A good network of fast chargers along main tourism corridors and highways could also reduce perceived and actual

range barriers, offering a similar refuelling experience as ICE users (Burnham et al., 2017; Neaimeh et al., 2017), as noted by ANWB (2018a). Fast charging is a driver for EV uptake, and increases electric distances travelled (Neaimeh et al., 2017). T&E (2018e) shows that most EU countries have a good fast charging coverage. Dividing all (2,550) rapid charging locations on main roads over the length of all EU motorways, the average coverage is currently at least one charging location, with two charging points each, per 60 km motorway, which is along the EC's guidelines for the TEN-T core network. In practice, this average is not upheld in every Member State, and even if, these fast charging stations do not always feature multiple charging points (risking single point of failure), nor do they feature every charging type/outlet. Hence international long-distance EV travel is not straightforward yet.

Spöttle et al. (2018) stress that instead of the current demand-driven approach to rolling out charging infrastructure, a shift towards a coverage-oriented approach is needed. Offering a safety net for emergency situations, this would have a positive impact on range anxiety. Currently, around 1,000 ultra-fast (150-350 kW) charging locations are planned for 2020, i.e. one site every 34 km on the strategic EU road network. These allow for 400km driving after a 15 minutes break (provided the car is capable of charging so fast). By 2020 there may be almost 5000 medium-fast chargers and 220,000 regular chargers across Europe (T&E, 2018d). Besides fast charging, consumers – and tourists will perceive this more particularly – have difficulties in charging their vehicle at different locations because the charging infrastructure may or may not be compatible or roaming may not be possible. So increasing interoperability of charging points will be perceived positively particularly from a tourist perspective, but also in general (Hardman et al., 2018). Whilst offering free charging at accommodations and touristic sites might be beneficial in diminishing some barriers to EV uptake for tourism purposes, eventually free charging may not be the way to go as it can lead to unnecessary charging behaviour and consequentially congestion at such charging points (Hardman et al., 2018).

Coverage is currently best in Northern and Western Member States. T&E (2018e) have identified groups of Member States where e-mobility uptake will happen in successive waves, based on differences in GDP per capita, the renewal rate of national vehicle markets and geographic location:

- Front-runners are most Western and Nordic countries: Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Luxembourg, Netherlands, Sweden and the UK
- Followers: Italy, Portugal and Spain
- Slow starters composed of EU13 and Greece: Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Greece, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, and Slovenia.

The front-runners and followers are also those countries that are most likely to be visited by Dutch tourists by car. In the current (early) phase of charging infrastructure roll-out, investments are expected to be paid through both public sector financing and private investors. Once the EV fleet increases to a certain level and matures, charging businesses will be (or are already) self-sustaining, business-driven and profitable (and no longer require subsidy). For fast charging along motorways to be profitable – important for tourism – T&E (2018e) assumes EVs should take up 2% of the vehicle fleet. They estimate that the Front-runners' group will reach this share around 2024/5, Followers in 2028 and Slow starters in 2030/32.

Many efforts are directed at tackling the problems around roaming (see 3.2.5 and 4.1). Harmonising roaming requires the establishment and adoption of common (open) standards for charging network operators, notably the Open Charge Point Protocol (OCPP) and Open Clearing House Protocol (OCHP). These enable efficient communication between charging stations, the grid, and back-end offices to ensure interoperability in operation and payment. The Netherlands is mentioned as leading here: "Through careful planning and regulation, every public charging station (and many private stations) in the country can now be operated and paid for using a single radio-frequency identification card or key fob. This has made traveling with an electric vehicle in the Netherlands much easier and more affordable while also promoting competition in the electric vehicle charging industry" (Hall & Lutsey, 2017, p. 23). The protocols mentioned above are enforced through all public tenders in the Netherlands. Other countries are also trying to promote interoperability. For example Ladenetz, a government-sponsored collaboration among municipal utilities, universities, and private electric vehicle service equipment (EVSE) operators in Germany and the Netherlands, intends to create a Europe-wide network of interoperable and user-friendly charging stations. And Hubeject, an industry joint venture, has

launched a service known as “intercharge” that incorporates e-roaming into more than 40,000 stations (Hall & Lutsey, 2017). Still, there is little agreement on how future communication between charging stations and the grid will be managed. Market actors are also divided on whether the diversity of protocols is an issue at all (Spöttle et al., 2018).

4.4.2 Taxes and incentives

German, Pridmore, Ahlgren, Williamson, and Nijland (2018) assessed taxes and incentives encouraging CO₂ emission reduction in all passenger cars available across Europe in 2016 (ICEs and EVs), as well as key taxes and incentives over the years 2010 to 2016. Their main conclusion was that several case studies “provide evidence that taxes and incentives – if sufficiently large and targeted – can have a strong impact on the composition of new car sales, although other factors such as improving technology and reducing economic hardship can also be important. Careful design of policy is required to avoid rebound effects and unintended adverse impacts such as increased emissions of other pollutants” (German et al., 2018, p. 10). US studies shows that federal and state incentives were and are in fact necessary for BEVs to be cost competitive (Breetz & Salon, 2018; Jenn, Springel, & Gopal, 2018). Breetz and Salon (2018) conclude that future BEV cost competitiveness could improve if innovation and scaling leads to significantly reduced BEV purchase prices, but that it will still be challenging for BEVs to achieve unsubsidized cost competitiveness. Dutch Touring Club ANWB advocates (temporary) incentives for both private and business drivers in order to make EVs affordable for all (ANWB, 2018a).

Low running costs of EVs could take away much of the high cost barrier. Without subsidies, the TCO of EVs is still greater than that of ICEs, but with schemes in place, EV TCO is already cost-competitive to the TCO of petrol cars in some countries (e.g. Norway, UK, USA, Japan) (Lévay, Drossinos, & Thiel, 2017; Palmer et al., 2018), or will be around 2024 compared to petrol, and by 2030 compared to diesel cars (Stewart & Dodson, 2016). Low running costs would imply charging costs to be lower than refuelling an ICE vehicle, amongst others (Hardman et al., 2018).

4.4.3 Production and marketing

There is evidence that more than the (perceived) lack of charging infrastructure, it may be the limited availability of EVs on the market and the marketing budget spent on it that contribute to low EV sales (T&E, 2018a), as well as dealers being simply dismissive or misinforming about EVs (Zarazua de Rubens, Noel, & Sovacool, 2018). Besides leading to more models with a higher range, a larger amount of models may also remove other anxieties, such as EVs not having enough luggage space or traction for holiday purposes (see 4.1).

4.4.4 EV tourism as catalyst

Recent evidence from Sweden shows that while EV adoption has mainly occurred in metropolitan areas, with personal norms as most important factor for adoption, there are also non-metropolitan hotspots. The latter are municipalities with high tourism numbers, particularly from Norway, where EV numbers are large. Westin, Jansson, and Nordlund (2018) therefore hypothesise that exposure to EVs could affect local residents' beliefs. They link this to a neighbour effect of EV adopters clustering together, which was found in earlier research in Sweden (Jansson, Pettersson, Mannberg, Brännlund, & Lindgren, 2017). Westin et al. (2018) suggest that making EVs more visible, for example through EV tourism, could facilitate a norm change towards EVs. Various regions around the world are investigating or promoting this link, for example by introducing charging infrastructure and e-rental vehicles in tourism destination, often for use by both residents and visitors. Examples vary from the 2020 CIVITAS Destinations Project, with six EU tourism island destinations as partner (CIVITAS Initiative, 2018), to tourism regions in China, New Zealand, or the USA.

4.5 Solutions for train uptake in tourism

4.5.1 Taxes and incentives

Currently, flying often out-competes other transport modes on convenience, time efficiency and costs (Casey, 2010). These advantages undermine the competitiveness of alternative, more sustainable transport modes like

the train (Higham, Cohen, & Cavaliere, 2014). Fuel taxes are almost non-existent in international aviation, and the aviation industry strongly opposes any kind of taxes on the sale of international aviation transport, or environmental charges. For Europe, NGO Transport & Environment estimates the lack of fuel and VAT taxes to be worth €40billion (T&E, 2018b). Taxes are also not included in the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), which aims at carbon neutral growth from 2020. The different handling of aviation has resulted in the absence of a level playing field for other transport modes, notably trains. A better competitive position of rail travel requires more equal taxes in international aviation, carbon taxes for all modes, and infrastructure charges, specifically for night-trains, at a level that covers the real costs.

4.5.2 Increase or improvement of offer

One key solution lies in the breaking of habitual air travel and bridging the knowledge gap on rail travel. Holidaymakers are simply unaware of rail options, as they do not appear as fast as air travel options. Travel time can be much improved by solving operational and technical barriers and developing a European HSR network. In its 4th Railway Package, the European Council aims to remove these barriers and create a single European rail area. Donners (2018) investigated 31 connections within a 750 km radius from Amsterdam and found this combination of measures could increase the number of connections where rail would be faster than air from two now to 25 (of 31), and the share of rail travel on these connections would increase from 27 to 63%. It does appear that HSR investments have reduced the viability of night trains, as some (former) night train journeys can now be made by relatively short day train trips. The ÖBB Nightjet is a positive exception, due to limited competition (Austria has no HSR network), a highly regulated coach market, limited or poorly-timed air services to the places along Nightjet lines, and the Nightjet network coinciding with the densest part of the TEN-T network (Bird et al., 2017).

A number of examples in EU Member States have shown that more competition in railways can lead to improvements in the attractiveness of rail services by providing consumers with a greater choice of services, and even to the availability of lower fares. However, competition can also have all kinds of operational and financial effects, such as timetable planning issues and (more) complex fare structures, that need to be resolved. Besides competition, it is important for EU travellers to be able to access good quality information on various ticket options in order to make reliable and confident choices (Steer Davies Gleave, 2016).

Tourism professionals deemed the combination of train and eRental car very interesting for many holiday purposes.

But also a large gap between real travel times and costs and perceived ones in the very large advantage of air over rail, should be further investigated and might be reduced by improved marketing (training courses for railway marketing managers?), cooperation between railway companies (on timetable and ticket cost data which now is not the case), etc.

4.6 Expert opinions

The following expert opinions reflect the discussion, and often consensus, at several K2K meetings (see Appendices 1 and 2, amongst others).

4.6.1 Cars

Experts echo the literature in viewing limited range as a barrier to EV adoption. In respect to barriers in charging infrastructure, they mention the fact that chargers cannot be reserved currently, and that interoperability and affordable roaming are essential prerequisites for the transition to electric mobility. They are of the opinion that adequate infrastructure should be realised (just) before adoption of electric vehicles, but are unsure of the exact way to do this. They see differences in needs between residents and tourists in regards to electric mobility, though the requirements of the latter are not well known. At Alpine destinations, many hoteliers seem willing to install charging infrastructure, but are uncertain which type of chargers to install and when to start, as they do not know what will work in future. Knowledge levels and speed of adaptation vary among destination stakeholders. Besides these barriers, experts are of the opinion that EV uptake, also in tourism, will not solve the congestion problem on corridor motorways and, particularly, at Alpine destinations.

4.6.2 Trains, busses and public transport

A modal shift from aviation and cars towards trains and public transport is the only way to ease pressure on the available road network in many Alpine regions. There is simply no surface available to increase the road network, for example. Tourism professionals acknowledge that this modal shift is currently the fastest way to reduce carbon emissions from tourism transport, but only for a limited number of trips. But stimulating modal shift towards the train would require a better train connection between The Netherlands and Austria, and also more awareness of currently internationally well-connected destinations. The fact that not all train travel in Germany is (near) zero emission due to the electricity mix was not seen as an impediment, but rather as a stimulant (for Deutsche Bahn and German politics). Long distance trains are already near zero emission (see 2.3). Train travel could possibly be stimulated by offering discounts at the destination, and perhaps by cooperation between destinations and train companies (instead of airlines). Tourism professionals also suggested to start sorting travel offers by experience, instead of by the usual destination-transport-accommodation, allowing for easier take-up of more sustainable products.

4.6.3 Aviation

There is acknowledgement that zero emission tourism will be impossible as long as people fly to their destinations since the electric plane is still far in the future and it is still uncertain it can be developed (see also 3.1).

4.6.4 Policy, planning and perception

The pressure of mobility and transport in Alpine regions is very high on Saturdays, as this is the day of arrivals and departures. A better spread of arrivals and departures is desirable, but necessitates large changes in tourism stakeholders' thinking. It would require direct cooperation with transport companies and governmental bodies responsible for transport planning. In addition, there are developments that make the stays shorter, which means that in total more arrival and departure traffic arises. On the other hand, an arrival during the week collides in the worst case with high workday traffic (so there seems to be realisation that capacity limits have been reached or are exceeded).

Tourists seem to perceive an advantage in plane and car travel, underestimating the total time needed for air travel, and the cost of the first and last miles. Also, people tend to be irritated by delays in public transport, while they accept sitting in a traffic jam. Perceptions about ease, time and cost of the various transport modes need to be changed, if a meaningful modal shift is to be realised.

5 Research and policy agenda

5.1 Main conclusions

- Electric vehicle tourism can strongly contribute to the reduction of local air and noise pollution at destinations, and contribute increasingly strongly to reducing CO₂ emissions. However, a sole switch from ICEs to EVs does not solve congestion issues, so at least a partial modal shift towards other near-zero emission modes is required. Currently, limited BEV choice and a number of other barriers limit consumer interest in BEVs in general, so also in tourism.
- The barriers towards EVs in tourism have not been studied specifically yet, but it is likely that range anxiety and charging issues, like roaming, are the main issues. All of these issues can technically be overcome in the short term, with the advent of more EVs with a longer range (and more traction and larger luggage spaces), the roll-out of fast charging infrastructure along corridors and regular stations at destinations, and the efforts directed at harmonising roaming, but do partly depend on political and other stakeholders' actions. Austria lags far behind the Netherlands in terms of charging infrastructure and roaming, while charging along the German corridors has strongly improved.
- Long-distance rail connections between the Netherlands and Austria are gradually improving, and already offer a near zero emission alternative to air and car trips. But as airplanes and cars are top-of-mind, the perception about the cost and duration of train travel is negative, and the planning and booking of international rail tickets is difficult and more costly than air, the rail potential is used insufficiently. A more level (financial) playing field between different transport modes is needed, as well as improved interoperability of international rail.
- The tourism sector has only just started in e-tourism. Charging infrastructure is available at a small share of hotels and restaurants, EVs can be rented occasionally and pilot e-tour products exist, but knowledge levels and speed of adaptation vary among tourism stakeholders.

5.2 Research agenda

Theme 1a: EVs in tourism - Tourist requirements

Very little research on EVs applies to a tourism perspective. Some evidence shows that consumers see the limitations of EVs on holiday as a barrier to purchase such a vehicle at all (ANWB, 2018a). It would be valuable to examine what these (perceived) limitations are from a tourism perspective, and how they can be overcome. It is quite possible that anxiety about sufficient range and charging infrastructure are the main issues here, and as this report has shown these are barriers that can be overcome, amongst others through heightening awareness on these topics. Most literature on BEV adoption, charging, etcetera, is still based on BEVs with shorter driving ranges of around 150 km (Hardman et al., 2018). Arguably, such vehicles are genuinely less suitable for holidays over middle to long distances such as those from the Netherlands to Austria. The needs of vehicles with a longer range and their users might differ, and their usefulness for holiday purposes may also be perceived otherwise (perhaps more positively). Future studies should investigate the infrastructure needs, specific consumer barriers, demographics, and so on, for these longer range vehicles, and particularly also from a tourist perspective. How many (fast) charging points are needed along tourism corridors and how interoperable should they be (Hardman et al., 2018)? Do needs about these topics differ for tourists compared to everyday users, both along corridors and at (Austrian) destinations? Where are they aligned and how can providers efficiently adapt to those needs?

Theme 1b: EVs in tourism - Destination adaptation

Following theme 1a, this theme looks at EV requirements from a destination perspective. Research into the presence, marketing, use and user experience of charging infrastructure at tourism destinations may help in finding ideal circumstances for EV-friendly tourism destinations (and remove uncertainty about charging point availability/payment). Similar questions arise as with corridors: Where should charging locations be built and how interoperable should they be, but also who is to finance and exploit them? What is required from

destination management organisations (DMOs), accommodations, attractions on the one hand, and local or regional governments and charging providers on the other? How to embed zero emission mobility thinking in tourism businesses, not only in Austria but also in the Netherlands? What are the information deficits among professionals, and what information do tourists need from tourism businesses? How can accommodation managers be assisted with installing charging infrastructure, communication to the clients about their facilities, reserve capacity offered by third parties near to the accommodation and how in turn they can assist their e-mobility clients in an efficient way? What role can or should the government play in his respect? When is it the right time for a hotel or destination to invest in (semi-public) charging stations? How much will they be used? When will clients avoid hotels or destinations due to a lack of EV facilities, and how and when should marketing include EV communication? Which destinations could be particularly suitable for EVs, and which for rail, in terms of routes and infrastructure?

Theme 1c: EVs in tourism – Corridor infrastructure

International tourism travel per EV requires a good and reliable network of fast chargers along main travel corridors (mainly highways), featuring multiple charging points per station (to avoid failure), and multiple charging types (to allow every EV a reliable network). At present, the exact coverage of fast chargers along EU highways, and whether charging stations and charging types are offered in acceptable, regular distances, is not well-investigated. Research and develop better integration between route planners and charging infrastructure in order to enable tourists to plan their (touristic) route and immediately get easy-to-use information on places to charge, eat or do something. Can offering seamless door-to-door holidays contribute to a meaningful uptake of trains and EVs (cars, campervans), and thus to modal shift? This links to theme 1a, i.e. what are specific tourist needs here?

Theme 2: Perceptions of tourism transport modes and zero-emission tourism

Research that addresses the perceptions towards different transport modes. Why are travel costs and times (too low for air travel and too high for trains) as well as reliability perceived so differently for the different transport modes and how to modify this to the advantage of low carbon emissions transport? How can the train re-enter the mind-set of holidaymakers? How to let zero-emission tourism enter the perception of consumers? Could improving awareness of consumers on zero-emission offers lead to behavioural change towards electric mobility?

Theme 3: The role of advanced technology in near zero emission tourism

Research in how advanced technology and/or travel integrators¹⁰ may help customers to overcome the (planning and booking) practicalities of e-mobility (both e-cars and trains), improve the effectiveness of marketing of public transport, reduce the perceived versus real travel cost and time, add value by adding relevant information, finding suitable routes and planning of trips, reduce uncertainty, built-in guarantees the travel will be problem-free and offer assistance when things go wrong. Can this improve interoperability and ease of planning for long-distance e-mobility-based tourist travel between The Netherlands and Tirol (including Germany) and within Tirol/Austria? This topic includes the development of a free rail database for timetables/ticketing for all of Europe, as well as development of a free database system for finding/reserving charging points (to feed commercial apps and platforms) and pay-systems.

Theme 4: Stimulating rail travel in tourism

Improved interoperability and easier ticketing may provide a relatively quick start for mode shift towards rail in tourism. A more extensive, joint European HSR network is needed to compete at a much larger scale with air travel on longer routes. Which routes, stops and capacities are ideal and feasible for tourism (see also Donners, 2018)? Alliances in rail need to be all-EU to avoid competition. More specifically for Netherlands-Austria tourism: How to improve the rail connection between these countries, and how does this fit into a broader policy for rail transport to Austria from the North? From a tour operator and DMO perspective: what do they need to make rail tourists more welcome (advantages)? When is zero-emission tourism more profitable for them?

¹⁰ In essence, travel integrators are tour operators packaging air tickets with hotel and/or other travel services.

Theme 5: Ensuring a level playing field

Aviation prices are currently far too low due all kinds of tax exemptions, causing demand to be artificially high. There is no level playing field for other, more environmentally-friendly modes. What is the current and potential role of the governments in developing zero-emission mobility exactly? A more level playing field should be facilitated by taxing aviation fuel, include VAT on air tickets, and account for external costs of aviation (climate change, noise, etc.) in ticket prices. More solid evidence on the effects of these measures on transport prices and consequent consumer behaviour could stimulate their implementation.

We note that a rapid turnaround of many research projects will be required because of the rapid developments in the various fields (EVs, charging infrastructure and protocols, advances (travel) technology). These are mentioned as such in the potential projects section (5.4).

5.3 Policy agenda

Fast charging corridors

We echo Spöttle et al. (2018), who recommend that a clear EU commitment to a long-term strategy for the expansion of charging infrastructure would send a strong signal to all involved stakeholders. Using public and private partnerships to expand the fast charging corridors beyond the initial projects to enable e-mobility across any of the major motorways that connect Europe will provide assurance to PEV drivers, notably international tourists, that they can roam freely and will increase adoption. Particularly the Netherlands, but also Austria and Germany, are all considered front-runners in terms of EV-infrastructure roll-out. This implies they would need public sector financing for building fast charging infrastructure along motorways until max. 2024/5, very likely phasing out earlier, when their markets become mature (T&E, 2018e). Hence, it is recommended to keep up subsidy programmes for (fast) charging infra until maturity is reached, after which rebound effects could arise. This will be achieved later in some more peripheral tourism destinations. To enable zero emission tourism trips to Southern and Eastern European states, the majority of funding should gradually shift to these countries from 2020 onwards.

Destination support

An increased offer of e-mobility can contribute strongly to a more sustainable development of inland travel (NBTC, 2018). Charging infrastructure at destinations will need to be a mix of slow charging at accommodations and fast charging at tourism sites, city centres etcetera. Tourism destinations will need to realise that tourists' demands of charging infrastructure differ from those of residents. Just like with regular charging infrastructure, free charging should probably be avoided so as not to get congestion issues, putting off tourists. Tourism professionals have a lot of information deficits in zero-emission tourism. They need (political) leadership, guidance and assistance as to what to install and when. Governments should assist in improving interoperability (passes, apps, price differences).

EV costs and awareness

The development of charging infrastructure is a key part of policy towards the promotion of EVs, but it will not be sufficient for large uptake. Policies need to include incentives to improve the understanding with tourists of the overall cost of driving an EV consisting of both the purchase costs and the energy and maintenance cost and heighten the awareness of consumers about EVs (Hardman et al., 2018). The latter also requires a higher share of car advertising being spent on EVs.

Rail commitment

Policymakers should assist in improving rail tourism by supporting and assisting in the optimisation of international interoperability through removing technical barriers (differences in electricity supply and security systems), as well as regulatory and operational barriers, to ease international journeys. Rail schedules need to be planned and harmonised at a European level, whereby high-speed and long-distance trains are prioritised (Donners, 2018). National (awareness) campaigns could stress the positive factors of rail travel, prioritised

amongst holidaymakers, such as comfort, ease and costs. National tourism initiatives could include combinations with other zero-emission modes, presenting seamless offers, with various modules for consumers to choose from, as proposed by the NBTC (2018). This would maximise sustainable tourism transport in and into the Netherlands, through HSR replacements of air connections, better connectivity between modes and last mile solutions. "Seamless journeys" also require the facilitation of a seamless digital journey, where all modes and payment systems are connected digitally (NBTC, 2018). A strong commitment to a joint EU HSR network is essential to establish an attractive and competitive offer in the long-term. Current initiatives/campaigns of various stakeholders (including airports) to stimulate rail travel on short distances, replacing flights, need government backing, requires support of first- and last-mile solutions, and zero-emission destination transport.

A specific topic is the formation of a policy to develop free and public up-to-date real time databases that allow app-makers to provide real time information about all forms of electric mobility from train timetables and ticketing to free capacity at charging points and payment systems for charging.

Creating a level playing field

A better competitive position of rail travel requires more equal taxes in international aviation, carbon taxes for all modes, and infrastructure charges, specifically for night-trains, at a level that covers the real costs. Or as it is phrased by NBTC (2018): taxing of non-sustainable modes and investing these funds in the strengthening and faster development of sustainable transport options. Investment in new, faster and more frequent train connections between the Netherlands and neighbouring countries, plus a more realistic pricing of aviation, would make rail travel an attractive alternative.

5.4 Potential projects/initiatives

We suggest a large R&D project to improve the ticketing process in international rail travel. Aim would be to make the booking of international rail tickets as easy as those for plane tickets. This will require a more international (instead of national) focus, and opening up schedule information to large ICT partners (third parties) that are more experienced in providing such services to a large international public (see also Donners, 2018). Also, it should investigate whether copying the aviation ticketing system, specifically yield management that extensively varies ticket prices for the same product, is really working for rail transport, because it has literally reduced the flexibility of rail use (i.e. allowing 'hop-on-hop-off' travel). Furthermore, there is scope to create an international ticketing and marketing system where learning-by-doing is applied as it is in major tourism booking platforms such as booking.com. This means that the webpages vary subtly per visitor, in such a way that it can continuously try ways to improve the actual booking rates. This could result in the development of a laboratory to experiment with the development of electric mobility tourist products between Netherlands and Austria.

We have already mentioned the rapid development in some of the fields discussed in this report. We therefore suggest a number of 'short sprint' R&D projects, where quick knowledge projects (e.g. max. 6 months) are followed-up by both simulation tests, practical tests and practical implementation through 'learning-by-doing'. Simulation tests would involve the use of car or travel simulators dedicated to EV and in an accelerated form show the test-driver in the simulator the difficulties experienced along the way. And this would help to find solutions for experienced issues with planning routes. Both simulations and practical tests may lead to new research approaches:

- In cooperation with for instance the Technical University of Delft and the Royal Dutch Touring Club ANWB, a special long-distance EV simulator could be made that lets people try to reach Austria in a compressed timeframe. It could include real time charging infrastructure availability, etc.
- Develop destination policies for sustainable transport development in cooperation with NBTC, who prioritises electric transport and rail travel in their plans for 2030 NBTC (2018). These plans are for instance 'investing in electric mobility', 'give wings to rail', and 'prioritise sustainable transport'.

- Develop guidelines for destinations and accommodation and attractions at destinations on electric mobility, including charging infrastructure, roaming, and information needs.
- Investigating EV corridor tourist behaviour specifically the extent to which the 'highways' are followed, or whether tourists make use of more scenic secondary ways.
- Investigating tourist EV corridors by searching optimal routes with fast charging infra, followed up by practical user tests on the main Netherlands-Germany-Austria routes, and finally defining additional policy and infrastructure needs.
- Investigating tourist perceptions of travel time, travel cost, comfort, experience and willingness to travel about car, rail and air modes, with the objective of how to change perceptions in a way that sustainable transport modes are promoted.
- Develop an *electric tourism transport laboratory* in cooperation with Dutch and Austrian innovation institutes and universities. The goal is to develop and test markets for electric transport solutions at destinations, accommodation and corridors. Products could range from marketing strategies, to guidelines for destinations, tour operators and railway companies, and apps for tourists that assist in finding the best routes and planning for trips (both by EV and rail).

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Appendix 1: Brief report 27.9.2017, K2K Tourism meeting, Innsbruck

Participants:

H.E. Marco Hennis (Netherlands' ambassador)
Harold Gohm (Netherlands' honorary consul)
Nicole van der Pauw (Netherlands' embassy)
Maarten ten Wolde (Netherlands' embassy)
Paul Peeters (BUas)
Eke Eijgelaar (BUas)
Martijn Bohncke (Camptoo)
René Herder (Province of Groningen)
Frans Hoofwijk (NKC)
Alexandra Medwedeff (Land Tirol)
Leo Satzinger (Land Tirol)
Alexander Jug (VVT)
Markus Mailer (Universität Innsbruck)
Möltner Lukas (Management Center Innsbruck)
Verena Schallhart (Management Center Innsbruck)
Katleen Johne (Tirol Werbung)
Julia Williams (PIB manager)
Anja Obererlacher (Standortagentur)
Julia Scharting (Standortagentur)

The evening started with a welcome by Anja Obererlacher (Standortagentur), followed by brief presentations:

1. Introduction PIB by Julia Williams-Jacobse. The PIB is a three-year public-private program of cooperation between parties in The Netherlands and Austria in the field of electro-mobility. The program started in 2017 and runs till the end of 2019. It has three levels: government-to-government (G2G), knowledge-to-knowledge (K2K) and business-to-business (B2B). It focuses on zero-emission tourism, heavy transport and distribution, and smart charging.
2. Introduction Province of Groningen by René Herder. The Province of Groningen aims at serving as a living lab for future mobility, focusing on:
 - Autonomous Transport (air, water, rail and road)
 - Electric mobility (battery change bikes)
 - Hydrogen buses and trains (2018/19)
 - Energy island

3. Introduction VVT by Dr. Alexander Jug. The VVT aims at doubling the percentage arrivals by train (from 5 to 10%). The VVT wants to include sustainable drivetrains (battery-electric and fuel-cell electric) and aims at incorporating 5 electric buses in the regular service by 2020, and integrating e-car sharing in their services. The challenges are driving in the mountains, long-distance services and charging infrastructure.
4. Presentation „easy travel“ by Prof. Markus Mailer of the Universität Innsbruck. Aiming at increasing arrivals by train, Easy travel is a research project with 5 scientific partners and 4 local partners, that runs from September 2016 till June 2018. Motivated by the domination of car usage for holiday trips in Tyrol, limited road network in the Austrian Alps, and luggage transport, on-site mobility and booking being main reasons not to use the train, the project aims to develop a **completely carefree package** for tourist arrival without a car focusing on:
 - Comfortable luggage transport
 - Flexible on-site mobility
 - “One-Stop-Shop” - integrated booking of all holiday trip components
5. Presentation „PIB K2K“ by Prof. Paul Peeters (NHTV) on the K2K tourism. Main research question is ‘How to create (near) zero-carbon tourism transport between The Netherlands and Austria and at the destination?’
Goals:
 - a. Develop a research and policy agenda
 - b. Develop policies, and demonstration projects.
 - c. Work at all government levels (local to international)
 - d. Create strategic alliances
 - e. Identify potential projects/initiatives

After that, starting from a set of propositions developed by the NHTV in cooperation with the Standortagentur and the PIB manager, a discussion was held on the possibilities to make tourism (more) sustainable. This discussion was part of the Knowledge-to-Knowledge project ‘Zero-emission Tourism’.

Propositions:

1. Electric plug-in vehicles are the best solution to reach zero-carbon tourism transport
2. Replacing flights and cars by electric trains is the most effective way to reduce carbon emissions
3. Electric transport providers very well anticipate on tourist’s desires, choices and behaviour
4. The focus in this project should be entirely zero-carbon tourism transport within Austria
5. The tourism sector is very well prepared for the zero carbon transport revolution

The discussion yielded the following ‘nuggets’.

Space and modal shift.

In Tirol, only 14% of the land surface is useable. Modal shift (to train and public transport and in any case away from air transport, which has no proven options to reach zero emissions within a reasonable timeframe) in transport choices for tourism will ease the pressure on the limited space, whereas a shift to e-vehicles does not. According to some participants, autonomous driving is not going to contribute to solving this, because of the ‘rebound effect’. However, using trains in Germany still leads to significant emissions, because of the electricity mix. This, however, was not seen as a reason not to switch, but as a good cause for accelerating the ‘Energiewende’ within the railways. (In the Netherlands, the NS - the train company - has a ‘green electricity’ contract.) Also, stimulating modal shift towards the train necessitates a better train connection between The Netherlands and Tirol.

A suggestion was made to give tourists arriving by train a discount on their stay, and spread the cost thereof over all tourists visiting Tirol. At the moment, there is cooperation with airlines which makes traveling by airplane attractive. There were differing views among the participants as to whether this cooperation should be called into question in favour of rail travel.

Perceptions.

Tourists seem to underestimate the total time needed for air travel, and the cost of the first and last miles. Also, people tend to be irritated by delays in public transport, while they accept sitting in a traffic jam.

Perceptions about ease, time and cost of the various transport modes need to be changed, if a meaningful modal shift is to be realised.

Lessening the mobility pressure on the Saturdays.

Currently, the pressure of mobility and transport on the Saturdays is very high, as this is the day of arrivals and departures. A better spread of arrivals and departures is desirable, but necessitates a lot of 'Umdenken' in many people within the tourism sector but in direct cooperation with the transport companies and governmental bodies responsible for transport planning. In addition, there are developments that make the stays shorter, which means that in total more arrival and departure traffic arises. An arrival during the week collides in the worst case with high workday traffic.

EV in tourism.

Many hoteliers seem willing to install charging infrastructure, but are uncertain which type of chargers to install, as they do not know what will work in future. Also, they are uncertain about the best moment to do so. In the destinations there are different knowledge levels and different speeds with regard to adaptation to the EV market.

Zero emission tourism seems impossible as long as people fly to their destinations since the electric plane is still far in the future.

Impediments to the change to EV.

For many people, presently the limited range of the vehicle and the fact that chargers cannot be reserved, are important reasons not to change to electric vehicles.

It is very important that adequate infrastructure is realised (just) before adoption of electric vehicles, but how to get this right?

Interoperability and affordable roaming are essential prerequisites for the transition to electric mobility.

With regard to the transition to electric mobility, the needs of the tourist, and the needs of the inhabitants differ. What does the tourist need for a zero-emission holiday?

From the above the following research questions may be derived;

1. How to improve the rail connection between The Netherlands and Tirol and how does this fit into a broader policy for rail transport to Tirol from the North.
2. How to improve the carbon footprint of German railways?
3. Why are travel costs, times and reliability perceived so differently for the different transport modes and how to modify this to the advantage of low carbon emissions transport?
4. How to better spread the tourist's arrival and departure dates without compromising the ease of booking and the accommodation occupation rates, and without overburdening the workday traffic?
5. How can accommodation managers be assisted with installing charging infrastructure, communication to the clients about their facilities and how in turn they can assist their e-mobility clients in an efficient way? What role can or should the government play in his respect?

6. How to improve interoperability and ease of planning for long-distance e-mobility-based tourist travel between The Netherlands and Tirol (including Germany) and within Tirol/Austria?
7. What are the psychological roadblocks for tourists to use electric cars and campers for their holidays and tourism trips?
8. How to break through the issue of the market unable to develop; without a proper infrastructure for charging, while investments in this infrastructure wait for the market to develop.
9. How do the needs for tourists to use e-mobility from the needs of the inhabitants of Tirol in their daily travel differ, where are they aligned and how can providers efficiently adapt to those needs?

Appendix 2: Brainstorm 10.1.2018, Changes in Tourism, Dutch Tourism Expo, Utrecht

Title presentation: Zero-emissie toeristische mobiliteit: wat is daar voor nodig? [Zero-emission tourism mobility: what are the requirements?]

Presenters: Eke Eijgelaar & Paul Peeters

Participants: Monique van Agthoven (Fox, tour operator), Martine Bakker (NYU School of Professional Studies), Isabel Boekel (Corendon, tour operator), Miranda van Dam (Inholland, university), Corne Dijkmans (NHTV, university), Akke Folmer (Stenden, university), E. Graaf (HZ, university), Loes Knoop (Buro Scanbrit, tour operator/travel agency), Jeranne Koekoek (TravelBird, travel agency), M. Pinckaers (ANWB, transport branch org/tour operator), Berend Simons (Sawadee, tour operator), Ton Vermeulen (NRIT, tourism media), Tom Sutherland (tuifly, airline), 8 others (professionals and tourism students)

Presentation started with a brief introduction of the PIB programme and the K2K project. The context for zero-emission tourism mobility was explained, and illustrated with some examples from Austria and the Netherlands. The brainstorm session used a number of propositions, as well as two questions (see below). Input on the propositions was gathered through discussion, and participants were asked to use post-its for ideas and thoughts about the two questions. Participant response on the propositions often exceeded the topic discussed.

In the following, the **propositions** are presented, followed by the main comments recorded:

1. The Dutch tourism sector is very well prepared for the zero carbon transport revolution
 - Not in aviation. Biofuels too expensive for airlines + this is not zero emission.
 - Currently not, as shortage in charging infra, accommodations are unprepared. In short: the whole chain is practically missing. Particularly outside the Netherlands.
 - Much depends on technological developments and tourism is not leading in those.
 - Facilitating role for tourism to take away anxieties for electric holidays? Within its role, tourism should at least provide relevant information on (near) zero-emission holidays.
 - It is the chicken & egg story: who takes the first step?
2. Replacing flights and cars by electric trains is the most effective way to reduce carbon emissions
 - This is regarded the fastest way for now. But only so for a limited number of trips, because of the distances. Also not regarded suitable for multiple-destination trips.
 - Here too, tourism has an informative role, i.e. on train travel. Because there is a lack of awareness of currently internationally well-connected destinations (by train).
 - A problem with perceptions is noted, about the perceived advantages of planes and cars ('they're faster').
 -
3. Management of Dutch tourism businesses does not see the need for investment in zero-carbon tourism yet
 - Acknowledged, with the remark that there is probably anxiety for what the competition does, does not, or will do (wait-and-see attitude).
4. The average Dutch customer is not ready for zero-carbon tourism yet (and/or does not ask for it)

- Acknowledged that demand is required, but that you need an offer to create demand as well. Another chicken-egg story.
- Under this proposition, responsibility was also discussed. Participants definitely saw a shared responsibility for tourism businesses here.

5. Infrastructure for zero-carbon holidays in Europe is currently insufficient

- Acknowledged, with an individual remark that there is enough infrastructure to travel through Spain and France for example. But in general, “there can never be enough charging infrastructure”. Any insecurity about must be avoided/removed.
- The combination train-eRentalcar was deemed very interesting for holiday purposes.
- The suggestion was made to start sorting travel offers by experience, instead of by the usual destination-transport-accommodation, allowing for easier take-up of more sustainable products.

Questions:

1. What research is required to take zero-emission tourism mobility decisions?
2. Which strategic alliances are necessary for stimulating and implementing zero-emission tourism mobility?

The input on these questions, gathered through post-its, has been filed under various themes below.

Consumer awareness/attitude

- Why is the train not in the mind-set of holidaymakers?
- What is the experience of the consumer? What do they want?
- Consumer perception excludes zero-emissions.
- Need to raise awareness of consumers on zero-emission offer.
- What is the willingness of consumers to pay for CO2 (compensation).

Policy/Government

- What is the role of the government in zero-emission mobility? Lobby for solutions/funds together with businesses.
- Which government policies are required?
- Need willingness for intergovernmental decision-making and investments.
- Need quota for air miles.
- What is the effect of a local tax on flying from abroad?

Technology

- Which sources for zero-emission tourism are there?
- How can the latest technological developments be used in the transport sector?
- How can air travel turn zero-emission? Which steps? How much time?

Tourism/transport offer

- When is zero-emission tourism affordable/cheap(er)?
- Direct flights should be made cheaper than indirect ones. How?
- Need HSR routes, stops and capacity. Joint European HSR infra.
- Need free PT to decrease car use at destination.
- Alliances: needs to be all-EU to avoid competition. Level playing field. The minimum is neighbouring countries.
- Alliances: between transport, traveller and technology orgs/businesses

Session conclusions

There is general consensus that most (European) countries are not ready for supporting zero-emission tourism mobility yet, particularly in terms of infrastructure, but often extending to the whole chain. With the Netherlands as main exception.

Participants do not see much demand for zero-emission tourism offers yet. Consumers are thought to be either largely unaware of possible offers, or having too many anxieties about a lack of infrastructure. The tourism sector needs to take an informative role here, at the least.

There is reasonable consensus that the tourism sector has a shared responsibility in taking zero-emission tourism mobility further, but that there also needs to be demand. Hence a chicken & egg story, with much wait-and-see what the competition does.

Electric train travel is only seen as a small part of the solution, limited by consumer unawareness and perceived disadvantages, available connections and destinations, and last-mile options. There is a need for an all-EU HSR network, with more destinations and capacity, and a level playing field regarding other transport modes.

Some remarks lead to the perception that part of the sector is not very aware of the possibilities and technologies available. E.g. air travel is still top-of-mind for many and some of the solutions suggested are not up-to-date anymore. Interestingly, solutions were largely sought in the tourism and transport sectors; government solutions were practically not addressed.



Games



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