Travelling large, the carbon footprint of Dutch business travel in 2016

An air-based affair

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A project of Breda University of Applied Sciences Centre for Sustainable Tourism and Transport in collaboration with NRIT Research, NBTC-NIPO Research and CBS

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1 Introduction

This is the first volume in the 'Travelling Large' series, on the carbon footprint (CF, the emissions of the greenhouse gas CO_2) of travel from or to the Netherlands, which focuses on Dutch business travel. This volume presents figures on the CF of Dutch business travellers in 2016. The 'Travelling Large' series started in 2009, with a report on the emissions of domestic and outbound holidaymakers for the years 2002, 2005 and 2008. This has become an annual subseries that has recently seen its 12th version published and shows developments from 2002 until 2018 (see Eijgelaar et al. 2020). The 'Travelling Large' series has also seen the publication of two reports on the CF of inbound tourists to the Netherlands, for the years 2009 (Pels et al. 2014) and 2014 (Neelis et al. 2020). The present report is written by the Centre for Sustainability, Tourism & Transport of Breda University of Applied Sciences and NRIT Research, in collaboration with NBTC-NIPO and CBS.

At the Paris climate conference (COP21) in December 2015, 195 countries adopted a universal, global climate deal and set out a global path to avoid dangerous climate change and a temperature rise of 2° C (UNFCCC 2015). It put the emissions of industrial sectors – including tourism and travel – high on the agenda again. They are discussed by tourism and travel stakeholders, for example as part of evolving Corporate Social Responsibility (CSR) strategies, COP21 itself (e.g. WTTC 2015), the Sustainable Development Goals (e.g. UNWTO 2016) and/or newly introduced climate policies (e.g. for aviation in ICAO 2016). The carbon footprint of business travel has received more and more attention over the past years. In the Netherlands, the coalition Anders Reizen ('Transforming Travel') for example, starting in 2015, now consists of 60 large businesses and organisations. It's target of halving business travel and mobility emissions in 2030 compared to 2016 has been incorporated in the National Climate Agreement (EZK 2019).

In 2008, the World Tourism Organisation (UNWTO) reported on the effects of climate change on tourism as well as the effects of tourism and travel on greenhouse gas emissions (UNWTO-UNEP-WMO 2008). The UNWTO report estimates the contribution of tourism and travel to carbon dioxide emissions at approximately 5% in 2005 (UNWTO-UNEP-WMO 2008). Gössling et al. (2015) found these emissions to double between 2010 and 2032. More recently, Peeters (2017) assessed the long term development of tourism and travel's carbon footprint and found this footprint to increase by a factor 4.6 between 2015 and 2100. Where currently 22% of tourism and travel trips is based on air transport, the share of air CO_2 emissions is 55%. By 2100 this will have risen to 75%. The strong growth of emissions is in stark contrast with the Paris 2015 Climate Agreement, that seeks to reduce emissions to almost zero by 2100. According to Peeters (2017), near zero-emissions is only achievable for tourism and travel when all mitigation opportunities are fully implemented. This also includes a physical barrier – cap on airport slots or global aircraft fleet – to unlimited growth of air transport. Information on the share of tourism and travel of the environmental impacts and eco-efficiency (kg CO_2 per Euro spent by tourists and travellers) of the Netherlands is important for the sector's continued implementation of CSR.

The aim of this research is to provide a first comprehensive overview of the effects of Dutch business travellers on climate and eco-efficiency in 2016. This understanding requires answers to the following questions:

- What is the total carbon footprint of Dutch business travellers?
- How does the business trip carbon footprint relate to the total carbon footprint of the Netherlands (and that of Dutch holidaymakers)?
- What factors determine the carbon footprint of Dutch business travel?
- What type of business trips and which parts of travel are the least/most damaging to the environment?
- What is the eco-efficiency of different types of business trips?

Chapter two of this report briefly describes the method used to calculate the carbon footprint and the eco-efficiency. Chapter 3 describes the results for 2016. Section 3.1 starts with a number of reference values for the CF in the Netherlands. Section 3.2 provides an overview of the calculated CF for business trips, split for several business trip types and a number of destinations. The chapter continues with a detailed breakdown of the CF by destination, duration, accommodation type, and transport mode, both for domestic business trips (section 3.3) and outbound business trips (section 3.4). Section 3.5 examines the distribution of emissions over the different components of business trips (accommodation, transport and activities). Section 3.6 looks at the eco-efficiency and compares the results with the eco-efficiency of the Dutch economy. Chapter 4 presents a brief comparison of CF values for business travel and holiday trips. Finally, in chapter 5, the research questions are answered, the results are reflected upon and some conclusions are drawn.

2 Methodology

Data on Dutch travel behaviour from the ContinuZakenreisOnderzoek (Continuous Business trip Survey, CZO), the annual business trip survey in the Netherlands, form the basis of this report. Specifically, for this analysis, as an indicator for the environmental effect of tourism, the carbon footprint (CF, expressed in kg CO_2 emissions) was used and added to the CZO. The CF has been accepted as a legitimate indicator for calculating the environmental impact by a continuously increasing group of stakeholders, both inside and outside the tourism industry. Carbon dioxide (CO_2) currently receives much societal and political attention, and policy is already developed for it. CO_2 is also one of the biggest environmental problems for tourism and travel (see e.g. Peeters et al. 2007a, UNWTO-UNEP-WMO 2008). The CF is calculated by multiplying emission factors for CO_2 (in kg CO_2 per night, per kilometre, etc.) by the number of nights, distance travelled, et cetera. These calculations are performed on data on the accommodation type, number of nights, transport mode, destination, and type of business trip, per trip featured in the CZO database. Note that for the CF, this report uses metric units throughout.

2.1 Carbon footprint

The carbon footprint is a measure of the contribution of an activity, country, industry, person, et cetera, to climate change (global warming). The CF is caused by the combustion of fossil fuels for generating electricity, heat, transport, and so on. CO_2 emissions cause a rise in the concentration of CO_2 in the atmosphere. Since the industrial revolution the CO_2 concentration has increased from 280 ppm to 410 ppm in 2019 (parts per million; see Dlugokencky et al. 2020), which causes the atmosphere to retain more heat. The atmosphere's ability to retain heat is called "radiative forcing", expressed in W/m2. However, besides CO2 emissions, other emissions also play a role in global warming. These include gases like nitrogen oxides, CFCs and methane. A common way to add the effects of these other greenhouse gases (GHG) to CO2 is by converting them into carbon dioxide equivalents (CO2-eq). To do this, the "global warming potential" (GWP) is often used as a conversion factor. These factors vary significantly per type of greenhouse gas. For instance, the GWP of methane is 25 (see IPCC 2007: 33). This means that in one hundred years the emission of 1 kg methane has the same effect on the temperature as the emission of 25 kg of CO2 over the same period. A conversion factor can also be determined for an industry or sector, which obviously depends on the exact mix of emissions. For nearly all tourism components this factor is relatively small (1.05, see Peeters et al. 2007a). However, for air travel this is not the case. Airplanes cause additional impacts on climate, as they not only produce additional GHGs like nitrogen oxides, but also because these substances appear 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". The non-CO2 effects of aviation are about twice as large as those of aviation CO2 emissions emitted since 1945 that are still in the atmosphere (Lee et al. 2020). However, the uncertainty is large: according to Lee et al. (2020) the total radiative forcing of aviation in 2018 varied between 70 and 229 with an average of 149 mW/m2. Unfortunately, as a result of various practical and theoretical objections, these percentages cannot be used as GWP (see Forster et al. 2006, Forster et al. 2007, Graßl et al. 2007, Peeters et al. 2007b). Thus, it is not possible to provide a CO2-equivalent for air travel. In this report, we therefore limit ourselves to the CF of CO2 emissions only (see also Wiedmann et al. 2007).

The CF consists of two parts: the direct and indirect CF. The direct CF consists of CO_2 emissions caused by the operation of cars, airplanes, hotels, etc. The indirect CF measures the CO_2 emissions caused by the production of cars, airplanes, kerosene, et cetera, and thus considers the entire lifecycle, in addition to the user phase (see Wiedmann et al. 2007). This report addresses all primary CO_2 emissions, plus the emissions caused by the production of fuel and/or electricity, but ignores all other indirect emissions.

2.2 Calculation model

The CZO data have been processed with SPSS 26.0, which required the development of a syntax (a piece of SPSS code) for the CF. A CF has been calculated for each single business trip in the CZO. Firstly, the CZO was supplemented with a variable that indicates the number of kilometres between origin and destination. This concerned the great circle distance, i.e. the shortest distance between origin and destination. Secondly, a diversion factor was added for each transport mode, which was used to multiply transport emissions with, in the end. Thirdly, a CF per day for each business trip component (transport, activities, accommodation) was calculated using an emission factor for CF and based on the number of nights, distance travelled and the emissions of an average person's diet. By multiplying these with the duration of the business trip, the CF for each complete business trip was found. Then, by increasing the individual carbon footprints with a weight factor and summation, the total carbon footprint of all business trips was calculated. As weight factors, those provided by the CZO for calculating totals for the entire Dutch population were used. For a detailed description of the calculation method and the emission factors, we refer to the internal BUas/CSTT-report 'Carbon footprint emission factors; version 2018 and trends 2002-2019' (Peeters 2019). Comparative 2016 figures on the CF of Dutch holidaymakers are taken from Eijgelaar et al. (2020).

2.3 Key figures business trips

Table 2.1 presents the key figures for business trips for 2016. The number of domestic business trips is similar to the number of outbound business trips. The majority of both domestic and outbound business trips is individual travel. MICE travel, on the other hand, makes up the remaining 35 per cent of trips. The most important international business travel markets are Germany, Belgium, and France. Due to a longer average length of stay (LOS) of international business trips, the total number of nights and expenditure of these trips are higher per trip? than those of domestic business trips.

Table 2.1: Key figures business trips 2016

	Unit	
Total business trips	Million trips	7.92
Of which:		
Domestic business trips	Million trips	3.92
Of which:		
MICE	Million trips	1.38
Individual business travel	Million trips	2.54
Outbound business trips	Million trips	4.00
Of which:		
MICE	Million trips	1.09
Individual business travel	Million trips	2.91
Of which:		
In Germany	Million trips	0.892
In Belgium	Million trips	0.609
In France	Million trips	0.269
In the United States	Million trips	0.234
In the United Kingdom	Million trips	0.182
In Spain	Million trips	0.179
In Italy	Million trips	0.160
Overnight stays by Dutch business travellers	Million nights	21.05
Categories:		
Domestic	Million nights	6.70
Abroad	Million nights	14.35
Expenditure on Dutch domestic business trips	Billion Euro	1.09
Expenditure on Dutch outbound business trips	Billion Euro	2.63
Total distance travelled on Dutch business trips	Billion km*	15.2

Source: CZO, 2016

**) These are not the actual distances, but the great circle return distance between home and destination; the real distances are between 5% and 15% longer*

3 Carbon footprint business travel 2016

3.1 Introduction

In this chapter, the results of the calculations and analyses of the survey year 2016 are presented (in kg CO_2). The values in table 3.1 are used for reference. The 166.7 Mt total Dutch emissions figure and the population size in 2016 were used to calculate the average CO_2 emissions per person and the CO_2 emissions per person per day in the Netherlands. Especially the last figure is used several times as a reference in this report, as emissions figure for 'staying at home'.

Table 3.1: Reference values carbon footprint, 2016

	2016
CO_2 emissions per average Dutch business trip	365 kg
CO_2 emissions per average Dutch business trip per day	85 kg
Total CO_2 emissions Dutch business travel	2.83 Mt
Average annual CO_2 emissions per person in the Netherlands	9.82 tonnes
Average CO_2 emissions per person per day in the Netherlands	26.9 kg
Total Dutch CO_2 emissions*)	166.7 Mt

Source: (CBS 2020); the business trip values have been calculated in this study

**) excluding LULUCF (forestry- and land use)*

3.2 Total carbon footprint

The total carbon footprint of all Dutch business travellers was around 2.83 Mt CO_2 in 2016. Tourism CO_2 emissions are not directly comparable with national CO_2 emissions, as transport and accommodation emissions were calculated using the nationality principle, thus including all tourism emissions of Dutch business travellers, i.e., also when they were produced abroad. However, measured as part of Dutch emissions (166.7 Mt CO_2 in total and just above 9.8 tonnes of CO_2 per person in 2016), the business travel emissions would amount to approximately 1.7% of the total Dutch carbon footprint. The carbon footprint per average business trip is 365 kg CO_2 and per day 85 kg CO_2.

Table 3.2 shows the (average) values of the carbon footprint of Dutch business travellers, divided in short (2 to 4 days) and long business trips (5 days and longer), and in domestic and outbound business trips. Domestic business trips produced a total carbon footprint of 0.38 Mt CO_2, which is 102 kg per business trip and 39 kg per day. An average outbound business trip has a much larger footprint of 612 kg or 128 kg per day. All outbound business trips produced 2.45 Mt CO_2. Thus, 13.5% of all business trip emissions were produced by domestic and 86.5% by outbound business trips (see figure 3.1), whereas the number of domestic business trips (3.92 million) is not that much lower than that of outbound business trips (4.00 million). The average carbon footprint for all business trips is 85 kg per day; 58 kg more than the Dutch average per day during the whole year (see table

3.1). This means that on average, the pressure on the environment is 215% higher during business trips than when staying at home. Moreover, this comparison does not take into account, for example, the emissions from people that leave their heating on in winter when taking a business trip, which would make their total footprint while on business trip a little larger still. The per day emissions of a domestic business trip are 11.9 kg above the average for staying at home, but only when there is no additional home energy-use.

Table 3.2: Carbon footprint per day, per business trip and in total, by destination and length of stay, 2016

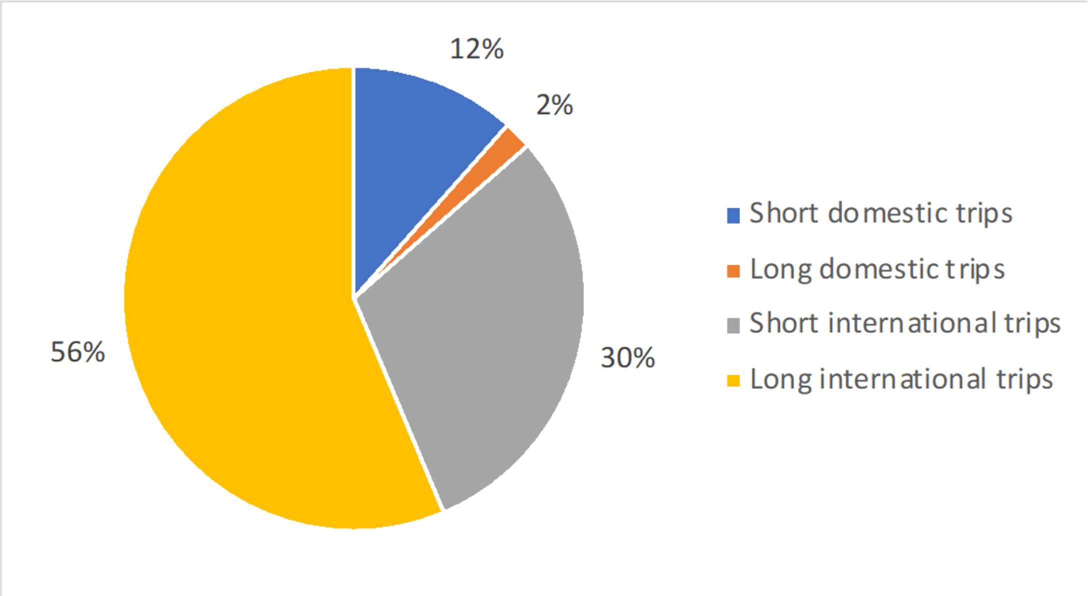
	Short business trip			Long business trip			All business trips		
Carbon footprint (*in kg CO_2*)	Per day	Per trip	Total (*Mt*)	Per day	Per trip	Total (*Mt*)	Per day	Per trip	Total (*Mt*)
In the Netherlands	39	94	0.328	34	205	0.056	39	102	0.384
Abroad	115	323	0.853	154	1,183	1.565	128	612	2.450
Belgium	48	117	0.064	36	212	0.010	47	126	0.077
France	90	238	0.050	60	419	0.024	83	276	0.074
Germany	86	223	0.165	51	297	0.042	80	235	0.210
Average	72	192	1.181	133	1,015	1.621	85	365	2.834

Source: CZO, 2016 (calculation CSTT/NRIT Research)

Per long business trip (5 days or longer) both the domestic and outbound carbon footprints are much higher than for short business trips (2-4 days). The differences are smaller on a per day basis. The carbon footprint per day of a long domestic business trip is actually smaller than for a short domestic business trip. The main reason for this is that the transport emissions are divided over a larger number of days. The same applies to outbound business trips to individual destinations. However, *on average*, the large number of long business trips to long-haul destinations pushes the carbon footprint per day of a long business trip towards the level of that of a short outbound business trip. The emissions of long outbound business trips produced 55.8% of all business trip emissions (see figure 3.1).

Per day and per business trip, the carbon footprint of a business trip in Belgium is at a similar level as that of domestic business trips. Figures for France and Germany are much higher. This is due to a larger share of transport emissions which is likely the result of larger average distances.

Figure 3.1: Distribution of all CO_2-emissions by domestic and outbound business trips and business trip length, 2016



Source: CZO, 2016 (calculation CSTT/NRIT Research)

3.3 Carbon footprint of domestic business trips

3.3.1 Length of domestic business trips

Table 3.3 shows that the carbon footprint per day of domestic business trips decreases with an increase of the length of stay. The transport component weighs less heavily on the carbon footprint of a longer business trip, because the distance between home and the destination does not differ much between longer and shorter business trips in the Netherlands. The average CO_2 emissions per day for domestic business trips are higher than for staying at home (39 vs. 27 kg/day).

Table 3.3: Carbon footprint per day, per business trip and in total, by length of stay for domestic business trips in 2016

	All domestic business trips		
Carbon footprint (*in kg CO_2*)	Per day	Per trip	Total (*Mt*)
2-4 days	39	94	0.33
5-8 days	34	188	0.05
9 days or more	28	440	0.01
Average	39	102	0.38

Source: CZO, 2016 (calculation CSTT/NRIT Research)

3.3.2 Accommodation type domestic business trips

Table 3.4 shows the carbon footprint of domestic business trips per day, per trip and in total, based on the accommodation type used. Please note that these are figures for the total business trip: besides the carbon footprint of the accommodation, those for transport and activities are also included.

The per day values of domestic business trips are mostly influenced by the accommodation type, since the travel distance, and consequently the choice of mode of transport, is more limited with domestic trips in the Netherlands. Hotel business trips show a higher per day footprint than trips to other accommodation types. These trips form the bulk of all domestic business trips, causing 80% of the total footprint. Staying in private homes or with friends and relatives, but also in congress centres and pensions, lowers the carbon footprint of a domestic trip.

Table 3.4: Carbon footprint per day, per business trip and in total, by accommodation type in the Netherlands for domestic business trips, 2016

Carbon footprint (*in kg CO_2*)	**All domestic business trips**		
	Per day	**Per trip**	**Total (*Mt*)**
Budget hotel	42	102	0.021
3-star hotel	42	105	0.116
4-star hotel	40	106	0.151
5-star hotel	40	114	0.021
Congress Centre	33	88	0.017
Pension/B&B	30	72	0.013
Apartment	37	100	0.003
Private homes (Airbnb, Wimdu etc.)	25	61	0.002
With friends, family, or relatives	24	57	0.009
Bungalow park	32	128	0.008
Other	35	119	0.018
Average	39	102	0.384

Source: CZO, 2016 (calculation CSTT/NRIT Research)

3.3.3 Transport mode domestic business trips

As in the previous section, values presented in table 3.5 are for the complete business trip, and not just the transport mode used. The privately owned car is the most popular transport mode which also shows in the total carbon footprint of domestic trips by car. These business trips also have one of the highest carbon footprints per business trip and per day, and therefore largely determine the average figures. The differences in emissions between privately owned cars, lease cars, and rental cars are small, apart from the per trip figure of rental cars, which is caused by a higher average length of stay. The difference in the carbon footprint per business trip between train on the one hand and the car on the other is large considering the short distances in the Netherlands.

Table 3.5: Carbon footprint per day, per business trip and in total, by transport mode for domestic business trips in 2016

	All domestic business trips		
Carbon footprint (*in kg CO_2*)	Per day	Per trip	Total (*Mt*)
Own car	40	106	0.244
Lease car	42	109	0.085
Rental car	37	126	0.009
Train/High speed train	29	74	0.042
Bus	32	98	0.005
Average	**39**	**102**	**0.384**

Source: CZO, 2016 (calculation CSTT/NRIT Research)

3.3.4 Organisation type domestic business trips

In terms of organisation type, business trips are only divided in individual and MICE trips. Since the travel distance and, consequently, travel emissions, cannot vary much for domestic business travel, the differences between domestic MICE and individual business travel are small. However, MICE travel, on top of having lower total emissions due to a smaller share of trips, shows lower per day and per trip emissions across almost all lengths of stay. Per day differences are small, but differences in per trip figures are more pronounced.

Table 3.6: Carbon footprint per day, per business trip and in total, by organisation type and length of stay in the Netherlands, 2016

	2-4 days			5-8 days			9 days or more			Total		
Carbon footprint (*in kg CO_2*)	Per day	Per trip	Total (*Mt*)	Per day	Per trip	Total (*Mt*)	Per day	Per trip	Total (*Mt*)	Per day	Per trip	Total (*Mt*)
MICE	38	89	0.113	33	182	0.015	34	304	0.000	37	95	0.128
Individual	40	96	0.215	35	191	0.033	28	449	0.008	40	106	0.256
Average	39	94	0.328	34	188	0.048	28	440	0.008	39	102	0.384

Source: CZO, 2016 (calculation CSTT/NRIT Research)

3.4 Carbon footprint of outbound business trips

3.4.1 Length of outbound business trips

Section 3.3.1 showed that for domestic business trips, the carbon footprint per day decreases as the length of stay increases. For outbound business trips, medium-length business trips (5-8 days) have the largest carbon footprint per day. An important factor here is the often considerably longer distance travelled on longer business trips, and the subsequent higher use of the airplane as transport mode, which increases the share of the transport component in the total carbon footprint. The far longer average length of business trips of over eight days (14 days) decreases the influence of this distance and transport mode factor.

Table 3.7: Carbon footprint per day, per business trip and in total, by length of stay for outbound business trips in 2016

	All outbound business trips		
Carbon footprint (*in kg CO_2*)	Per day	Per trip	Total (*Mt*)
2-4 days	115	323	0.853
5-8 days	164	1,011	0.988
9 days or more	124	1,669	0.577
Average	128	612	2.450

Source: CZO, 2016 (calculation CSTT/NRIT Research)

3.4.2 Outbound destination

The carbon footprint strongly relates to the destination, as well as the distance travelled, and transport mode used to get to each destination. Table 3.8 shows the carbon footprint of several outbound destinations, split in short and long business trips. It is obvious that more distant destinations have larger carbon footprints. In general, the carbon footprint per day is smaller with longer than with shorter outbound business trips for a given destination. However, a longer business trip is often one which is taken further away. The carbon footprint per day of, for instance, a business trip to the USA or Canada, does show that the transport component has a larger impact on the total footprint of a short business trip than a long business trip.

The United States has the largest total carbon footprint of all single country destinations (0.466 Mt, see table 3.8). Although it has a smaller number of business trips than Germany, Belgium, and France (see Table 2.1), the relatively long distance and the exclusive use of air transport produce a far higher carbon footprint. The apparent role of the airplane is even more visible in the carbon footprint per business trip for destinations on other continents that are further away than the United States. Table 3.8 shows that an average business trip to Australia or Oceania has a carbon footprint, per business trip, that exceeds that of a business trip to France by a factor 15. Per day the difference is ’only’ a factor seven, because business trips to Australia last much longer.

Table 3.8: Carbon footprint per day, per business trip and in total, by outbound destination, 2016

Carbon footprint (*in kg* CO_2)	Short Trip			Long Trip			Total		
	Per day	**Per trip**	**Total (*Mt*)**	**Per day**	**Per Trip**	**Total (*Mt*)**	**Per day**	**Per trip**	**Total (*Mt*)**
Europe									
Austria	131	397	0.250	71	474	0.017	109	426	0.042
Belgium	48	117	0.065	37	211	0.011	47	126	0.078
Czech Republic	120	355	0.012	64	432	0.007	102	380	0.020
Denmark	112	295	0.019	59	410	0.008	100	321	0.027
Finland	160	426	0.005	98	564	0.006	131	490	0.011
France	90	238	0.050	60	419	0.024	83	276	0.074
Germany	86	223	0.165	51	297	0.042	80	235	0.210
Greece	249	585	0.004	97	787	0.013	139	731	0.017
Hungary	191	531	0.005	106	603	0.008	141	572	0.015
Ireland	115	325	0.009	51	375	0.005	93	342	0.014
Italy	151	442	0.046	88	610	0.033	129	499	0.080
Norway	127	420	0.010	74	523	0.015	98	477	0.025
Poland	148	435	0.016	75	648	0.012	123	505	0.029
Portugal	192	596	0.012	123	649	0.008	166	616	0.020
Romania	162	508	0.010	106	601	0.012	133	556	0.022
Spain	174	492	0.055	98	604	0.040	145	534	0.095
Sweden	147	420	0.023	81	511	0.010	129	445	0.033
Switzerland	108	292	0.016	63	349	0.008	95	309	0.025
United Kingdom	95	265	0.039	52	414	0.014	87	293	0.053
Rest of Europe	115	322	0.077	75	490	0.045	104	368	0.123
Americas									
Canada	588	1,680	0.005	265	1,807	0.049	295	1,795	0.054
United States	512	1,819	0.043	264	2,008	0.424	288	1,989	0.466
Central and South America	601	2,125	0.026	292	2,387	0.131	352	2,332	0.161
Asia									
China	789	2,018	0.024	231	2,308	0.104	347	2,248	0.128
India	-	-	-	258	1,779	0.033	268	1,772	0.035
Japan	-	-	-	346	2,570	0.043	346	2,570	0.043
Rest of Asia	736	2,632	0.038	322	2,675	0.188	393	2,668	0.227
Oceania									
Australia	1981	3,963	0.005	419	4,221	0.059	611	4,168	0.079
Rest of Oceania	1298	3,108	0.010	334	3,508	0.017	713	3,351	0.026
Middle East									
UAE*	440	1,360	0.012	210	1,491	0.035	271	1,456	0.046
Middle East and Western Asia	270	856	0.016	163	1,279	0.044	200	1,132	0.060

Carbon footprint (*in kg CO_2*)	Short Trip Per day	Short Trip Per trip	Short Trip Total (*Mt*)	Long Trip Per day	Long Trip Per Trip	Long Trip Total (*Mt*)	Total Per day	Total Per trip	Total Total (*Mt*)
Africa									
Northern Africa	299	830	0.006	138	1,118	0.024	177	1,049	0.030
Southern Africa	586	1,982	0.006	222	2,212	0.073	253	2,193	0.079
Average/Total	72	192	1.181	133	1,015	1.621	85	365	2.834

*Source: CZO, 2016 (calculation CSTT/NRIT Research). *United Arab Emirates*

3.4.3 Accommodation type outbound business trips

For outbound business trips it is also possible to measure the carbon footprint related to the accommodation type used. Table 3.9 shows the values per day, trip and in total. Again, these figures are for the total business trip footprint, depending on the accommodation used, i.e., including transport and activities.

Table 3.9: Carbon footprint per day, per business trip and in total, by touristic accommodation type for outbound business trips in 2016

	All outbound business trips		
Carbon footprint (*in kg CO_2*)	Per day	Per trip	Total (*Mt*)
Budget hotel	105	417	0.098
3-star hotel	112	472	0.524
4-star hotel	140	620	0.971
5-star hotel	183	1031	0.461
Congress Centre	99	435	0.026
Pension/B&B	74	343	0.030
Apartment	127	913	0.121
Private homes (Airbnb, Wimdu etc.)	104	874	0.040
With friends, family, or relatives	77	418	0.041
Bungalow park	113	617	0.014
Other	90	599	0.101
Average	128	612	2.450

Source: CZO, 2016 (calculation CSTT/NRIT Research; note: due to missing values in accommodation data the totals differ from those given in other tables)

More so than with domestic business trips, the carbon footprint per day is relatively large for outbound business trips spent in a hotel (see table 3.9) compared to other accommodation types. Especially 5-star hotels have a high per day and per trip carbon footprint, but its absolute share is smaller than that of 3-star or 4-star hotels. The total share of emissions of the different types of hotels, as well as their share of the number of trips is approximately 84%. Apartments and private homes have an average per day carbon footprint, but a relatively high per trip carbon footprint, due to a higher average length of stay.

3.4.4 Transport mode outbound business trips

Based on transport mode choice, the largest carbon footprint per day was found for outbound business trips taken by airplane. The popularity of the airplane also gives these business trips the largest footprint per trip and in total. The average business trip by plane produces approximately four times more emissions than those by car. Business trips by train and touring car have a relatively low carbon footprint per day; only slightly higher than the average daily CO_2 emissions per person in the Netherlands. Their total emissions only produce a relatively small share of the total carbon footprint of outbound business trips.

Table 3.10: Carbon footprint per day, per business trip and in total, by transport mode for outbound business trips in 2016

	All outbound business trips		
Carbon footprint (*in kg CO_2*)	Per day	Per trip	Total (*Mt*)
Airplane	177	919	2.093
Own car	72	228	0.198
Lease car	75	233	0.087
Rental car	63	201	0.017
Train/High speed train	34	104	0.026
Boat/Ferry	61	364	0.005
Bus	32	127	0.011
Other	55	228	0.009
Average	128	612	2.450

Source: CZO, 2016 (calculation CSTT/NRIT Research)

3.4.5 Organisation type outbound business trips (longer than 4 days)

International MICE trips, just like domestic MICE trips, mostly show lower per day and per trip emission figures than individual business trips. Per day figures vary relatively less than per trip figures, since the average length-of-stay of international MICE trips (3.4 nights) is slightly lower than that of individual business trip (3.7 nights). Total emission figures are higher for individual business trips due to a higher number of trips.

Table 3.11: Carbon footprint per day, per business trip and in total, for outbound business trips (longer than 4 days) by organisation type in 2016

	Carbon footprint (*in kg* CO_2)	MICE	Individual		Average
2-4 days	Per day	101	120		115
	Per trip	298	331		323
	Total (*Mt*)	0.209	0.644		0.853
5-8 days	Per day	157	168		164
	Per trip	946	1044		1011
	Total (*Mt*)	0.318	0.67		0.988
9 days or more	Per day	139	121		124
	Per trip	1698	1664		1669
	Total (*Mt*)	0.096	0.481		0.577
Total	Per day	120	131		128
	Per trip	569	628		612
	Total (*Mt*)	**0.624**	**1.826**		**2.45**

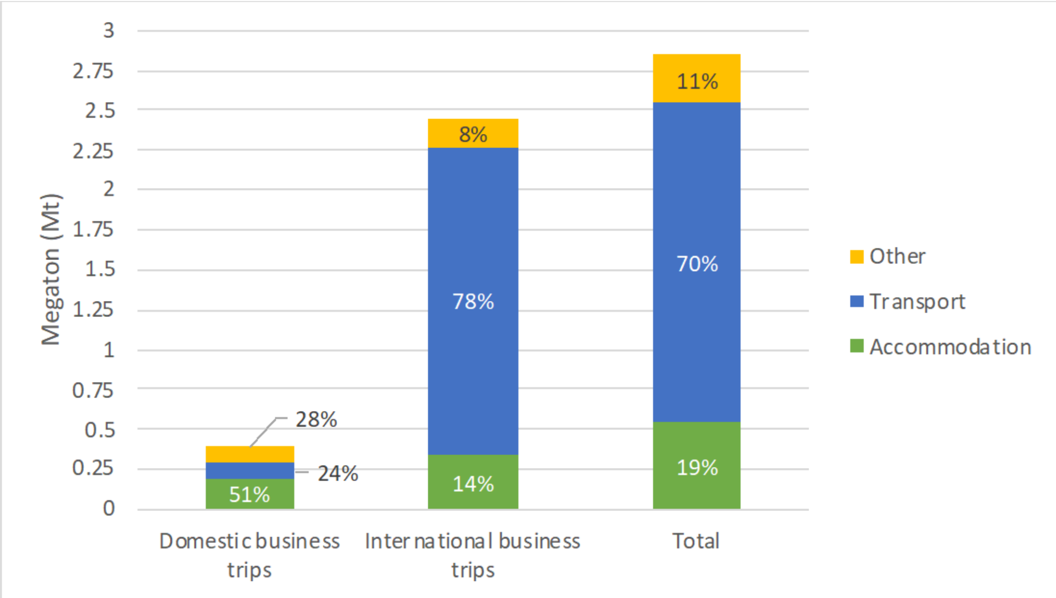
Source: CZO, 2016 (calculation CSTT/NRIT Research)

3.5 Carbon footprint per business trip component

The environmental impact of a business trip can be divided over the components transport, accommodation, and other aspects. These 'other aspects' are also called 'entertainment', and concern local activities (that also include local transport used for excursions et cetera). Figure 3.2 shows the division over these three categories. For all business trips, the transport used to and from the destination has the largest impact on the business trip carbon footprint (70.4%). Accommodation is responsible for just under a fifth of all business trip emissions (19.2%).

Figure 3.2 also shows large differences between domestic and outbound business trips. For the carbon footprint of domestic business trips, accommodation is particularly relevant (51.0%), whereas the accommodation share in international business trips is significantly smaller (14.2%). International business trip emissions are dominated by transport (78.3%). All three components have a much larger absolute environmental impact with outbound business trips than with domestic business trips.

Figure 3.2: Carbon footprint per business trip component in 2016



Source: CZO, 2016 (calculation CSTT/NRIT Research)

In table 3.12 the carbon footprint of the three components is shown for various destinations. One figure that stands out is the large share of transport in the business trip carbon footprint of more distant destinations. This is particularly valid for countries and regions that are mainly accessed by plane, where the transport share is typically at least around 70%, starting with for instance Greece, Italy, and Spain, and reaching up to 94% for overseas destinations. The share of other emissions is relatively small, which can be accounted for by the more functional character of business tourism, that leaves little room for activities such as theme park visits and road trips.

Table 3.12: Share of the components transport, accommodation and 'other' of the carbon footprint per destination, in kg per trip and in percentage of total, 2016

	Carbon footprint per business trip (*in kg CO_2*)			**Share of total carbon footprint (*in %*)***		
	Accommo-dation	**Trans-port**	**Other**	**Accommo-dation**	**Trans-port**	**Other**
Domestic						
The Netherlands	50	24	29	49%	23%	28%
Europe						
Austria	88	291	47	21%	68%	11%
Belgium	53	44	29	42%	35%	23%
Czech Republic	88	248	44	23%	65%	12%
Denmark	76	206	40	24%	64%	12%
Finland	84	365	41	17%	74%	8%
France	71	166	40	26%	60%	14%
Germany	63	139	34	27%	59%	14%

	Carbon footprint per business trip (*in kg CO_2*)			Share of total carbon footprint (*in %*)*		
	Accommo-dation	**Trans-port**	**Other**	**Accommo-dation**	**Trans-port**	**Other**
Greece	148	511	72	20%	70%	10%
Hungary	87	441	44	15%	77%	8%
Ireland	63	230	49	18%	67%	14%
Italy	89	365	46	18%	73%	9%
Norway	103	316	58	22%	66%	12%
Poland	88	363	55	17%	72%	11%
Portugal	81	495	40	13%	80%	6%
Romania	86	424	45	15%	76%	8%
Spain	84	406	44	16%	76%	8%
Sweden	78	327	40	18%	73%	9%
Switzerland	74	198	37	24%	64%	12%
United Kingdom	72	182	39	25%	62%	13%
Rest of Europe	78	249	41	21%	68%	11%
Americas						
Canada	139	1,588	68	8%	88%	4%
United States	162	1,743	84	8%	88%	4%
Central and South America	166	2,083	84	7%	89%	4%
Asia						
China	212	1,931	105	9%	86%	5%
India	146	1,556	70	8%	88%	4%
Japan	181	2,301	88	7%	90%	3%
Rest of Asia	177	2,404	87	7%	90%	3%
Oceania						
Australia	160	3,902	107	4%	94%	3%
Rest of Oceania	164	3,108	78	5%	93%	2%
Middle East						
United Arab Emirates	132	1,261	64	9%	87%	4%
Middle East and Western Asia	136	928	68	12%	82%	6%
Africa						
Northern Africa	119	855	74	11%	82%	7%
Southern Africa	218	1,857	117	10%	85%	5%
Average	69	254	38	19%	70%	11%

Source: CZO, 2016 (calculation CSTT/NRIT Research)

**total share not always 100% because component figures are rounded off*

Table 3.13 shows the shares of the components transport, accommodation and 'other' aspects per business trip based on the transport mode. Logically, the transport component of business trips taken by plane is the largest, whereas it is lowest for business trips taken by (high speed) train and bus.

Table 3.13: Share of the components transport, accommodation and 'other' of the carbon footprint per transport mode, in kg per trip and in percentage of total, 2016

	Carbon footprint per business trip (*in kg CO_2*)			**Share of total carbon footprint (*in %*)***		
	Accom-modation	Trans-port	Other	Accom-modation	Trans-port	Other
Airplane	105	761	53	11%	83%	6%
Own car	53	54	32	38%	39%	23%
Lease car	56	62	32	37%	41%	21%
Rental car	67	62	38	40%	37%	23%
Train/High speed train	50	12	21	60%	14%	25%
Boat/Ferry	106	178	80	29%	49%	22%
Bus	68	18	31	58%	15%	26%
Other	57	47	53	36%	30%	34%
Average	69	254	38	19%	70%	11%

Source: CZO, 2016 (calculation CSTT/NRIT Research)

**total share not always 100% because component figures are rounded off*

The next table (3.14) shows the shares of transport, accommodation and 'other' aspects of the business trip footprint and total footprint by accommodation type. Apartment business trips have the largest accommodation footprint. However, the share of accommodation of the total carbon footprint of apartment business trips is relatively low (16.3%), because they are often taken by plane, which weighs heavier on the total carbon footprint. With 5-star hotels the impact of high emission transport is even more pronounced.

Table 3.14: Share of the components transport, accommodation and 'other' of the carbon footprint per accommodation type, in kg per trip and in percentage of total, 2016

	Carbon footprint per business trip (*in kg CO_2*)			**Share of total carbon footprint (*in %*)***		
	Accom-modation	Trans-port	Other	Accom-modation	Trans-port	Other
Budget hotel	72	162	36	27%	60%	13%
3-star hotel	67	186	34	23%	65%	12%
4-star hotel	72	263	36	19%	71%	10%
5-star hotel	94	623	46	12%	82%	6%
Congress Centre	46	90	31	28%	54%	19%
Pension/B&B	25	102	34	16%	63%	21%
Apartment	126	580	66	16%	75%	9%
Private homes (Airbnb, Wimdu etc.)	22	435	56	4%	85%	11%
With friends, family, or relatives	15	139	37	8%	73%	19%
Bungalow park	68	136	49	27%	54%	19%
Other	78	215	54	22%	62%	16%
Average	69	254	38	19%	70%	11%

Source: CZO, 2016 (calculation CSTT/NRIT Research)

Finally, table 3.15 shows the division of the three components per organisation type. Average transport emissions are significantly higher for individual business travel than for MICE travel. Since the accommodation and other emissions are similar, the share of transport of the total carbon footprint is also larger for individual business trips.

Table 3.15: Share of the components transport, accommodation and 'other' of the carbon footprint per organisation type, in kg per trip and in percentage of total, 2018

	Carbon footprint per business trip (*in kg CO_2*)			**Share of total carbon footprint (*in %*)**		
	Accommodation	Transport	Other	Accommodation	Transport	Other
MICE	65	205	34	21%	67%	11%
Individual	70	276	39	18%	72%	10%
Average	69	254	38	19%	70%	11%

Source: CZO, 2016 (calculation CSTT/NRIT Research)

3.6 Eco-efficiency

The carbon footprint of a business trip (or per day) can be compared with business trip spending. This is called 'eco-efficiency', expressed in kg CO_2 per Euro. The lower the figure, i.e. the fewer emissions per Euro spent, the better the eco-efficiency. Table 3.16 gives an overview of eco-efficiency values for business trips made by the Dutch. Outbound short business trips generally score better eco-efficiency values than long ones, because spending is relatively high and transport emissions are low compared to long trips. Apparently spending does not increase equally or more with distance than emissions. The relatively low average eco-efficiency for out-bound business trips is mostly due to the use of airplanes with this type of travel.

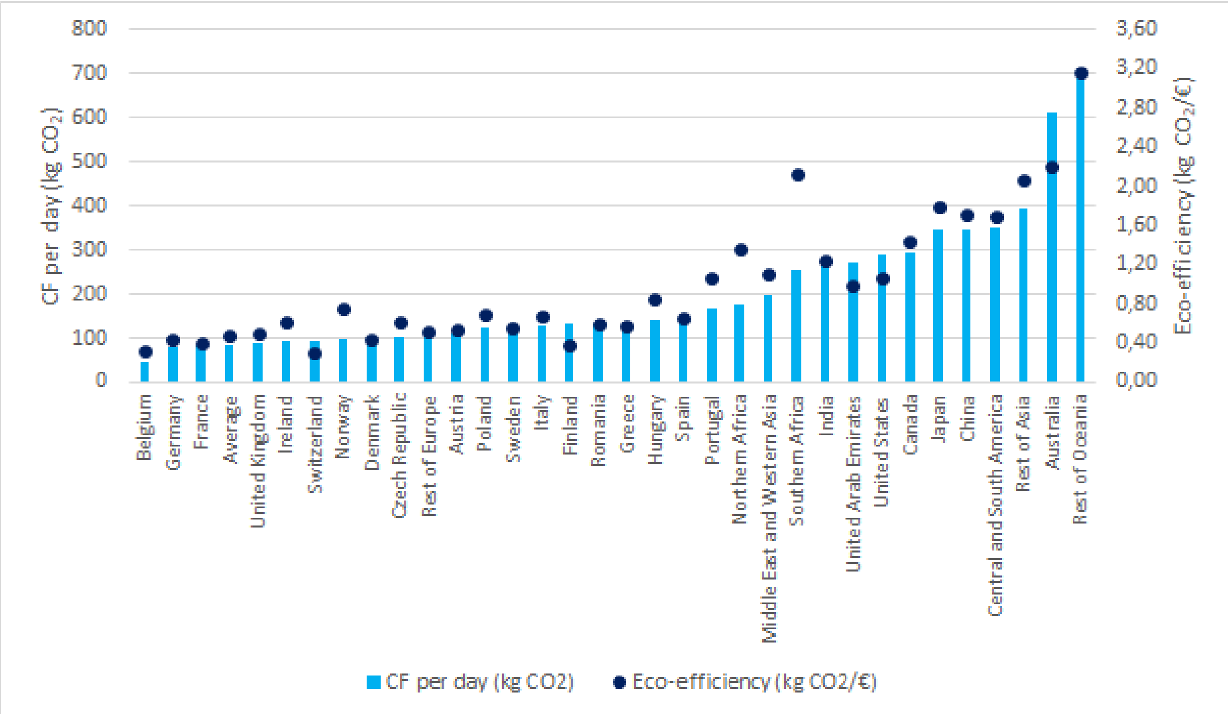
Table 3.16: Eco-efficiency, by destination and length of stay, 2016

Eco-efficiency (*in kg CO_2 per Euro*)	**Short business trip**	**Long business trip**	**Total business trips**
Domestic	0.31	0.27	0.31
Outbound	0.63	0.93	0.81
Average	0.38	0.80	0.48

Source: CZO, 2016 (calculation CSTT/NRIT Research)

However, between outbound destinations the eco-efficiency varies considerably (see figure 3.3). With 0.30 kg CO_2/€, Switzerland has the lowest, most favourable, eco-efficiency, whereas Australia, Oceania, and Southern Africa have the highest (respectively 2.21, 3.16, and 2.14 kg CO_2/€). With an eco-efficiency of around 1.07 kg CO_2/€, Portugal is the least favourable one within Europe. In 19 out of 20 European destination areas the spending in € is more than the emissions in kg.

Figure 3.3: Eco-efficiency and carbon footprint per day, by destination, 2016



Source: CZO, 2016 (calculation CSTT/NRIT Research)

The eco-efficiency of the whole Dutch economy was approximately 0.24 kg CO_2/€ in 2016 (Eijgelaar et al. 2017). Hence, basically all business trip types and destinations presented in this section are less eco-efficient. Based on transport mode choice, only business trips per train are more eco-efficient, as is shown in table 3.17. Travelling by airplane clearly produces the least eco-efficient business trip.

Table 3.17: Eco-efficiency of domestic and outbound business trips by mode of transport, 2016

Eco-efficiency (*in kg CO_2 per Euro*)	**Domestic business trips**	**Outbound business trips**
Airplane	-	0.97
Own car	0.30	0.37
Lease car	0.35	0.58
Rental car	0.38	0.42
Train/High speed train	0.21	0.19
Boat/Ferry	-	0.48
Bus	0.41	0.45
Other	-	0.52
Average	0.31	0.81

Source: CZO, 2016 (calculation CSTT/NRIT Research)

4 Comparisons between business and holiday trips

In this chapter we present some comparisons between carbon footprint results of business travellers and holidaymakers.

4.1 Key figures compared

Compared to the emissions produced by Dutch holidaymakers in 2016, business travel emissions are almost a factor 6 lower in total (see Table 4.1). Largely due to the lower number of business trips made (7.9 vs. 38.8 million). Per trip/holiday, whether domestic or abroad, there is not much difference, but per day business travel is roughly twice as emission-intensive. This is because business trips are much shorter than holidays in duration on average. Dutch business tourism shows a far higher average share of transport in the total carbon footprint (70.4%) than transport in Dutch holiday emissions in 2016 (48.0%) (Eijgelaar et al. 2017). This is largely the result of the higher share of aviation in business trips, and subsequently the higher share in the total distance travelled (see next section).

Table 4.1: Key figures Dutch business travel and holiday carbon footprint, 2016

	Holiday travel			Business travel		
	Domes-tic	Out-bound	Total/ Average	Domes-tic	Out-bound	Total/ Average
Number of trips (*million*)	18.1	20.6	38.8	3.92	4.00	7.92
CF per day (*in kg*)	24.5	61.0	49.3	39	128	85
CF per holiday (*in kg*)	146	676	428	102	612	365
Total CF (*in Mt*)	2.637	13.949	16.622	0.384	2.450	2.834

Source: Eijgelaar et al. (2020); CZO, 2016 (calculation CSTT/NRIT Research)

Even though per trip, the carbon footprint of business trips and holidays is not that much different, business trips are on average more eco-efficient than holiday trips. The average eco-efficiency for domestic holiday trips in 2016 was 0.88 kg CO_2 per Euro (business 0.31 kg CO_2 per Euro), for outbound holiday trips 0.94 (Eijgelaar et al. 2017), while for business 0.81 kg CO_2 per Euro. This is the result of higher expenditures.

4.2 Comparisons between shares of the number of trips and distance

Here we provide insight into the shares of different modes of transport of the total business trip market (number of business trips), and of the total return distance travelled on business trips, and compare these figures with those for holiday trips in 2016. For distance, the great circle distance between home and destination is used; the real distances are 5-15% longer.

Table 4.2 shows that trips made with privately owned cars make up the largest share of business trips (40.1%), while they represent only 6.6% of the total return distance travelled.

Trips by airplane make up more than a quarter of business trips but they account for more than 85% of the total distance travelled. This absolute figure (2.3 million trips), coupled with the high distance and the relatively high emissions of this transport mode, make that the environmental impact of airplane trips is high (73.8% of all business travel emissions). In holiday travel, the share of the airplane in trips is lower (21.6%), as is the share in distance (75.9%) and subsequently the share of holidays by airplane in total holiday emissions (59.0%) (Eijgelaar et al. 2020). The share of trips by car is higher for holiday travel (68.7%) than for business travel (56.5% aggregated). Next to the larger share of business trips by plane, this surplus is due to a larger share of business trips by train (10.3% of business trips versus 4.4% of holiday trips). The average return distance of a business trip is 1,921 km (domestic and outbound combined), or 3,634 km for the average outbound trip. By plane the average is 5,822 km. Dutch holidays show similar figures for 2016: 1,897 km average return distance for all trips and 6,631 km for holidays by plane (Eijgelaar et al. 2020).

Table 4.2: Business trips and distance per transport mode used

	Business travel	**Holiday travel**
	Unit	Unit
Share of total Dutch trips by transport mode used, per year	%	%
Airplane	28.7	21.6
Own car	40.1	68.7
Lease car	14.5	
Rental car	1.9	
Train	10.3	4.4
Boat/ferry	0.2	0.2
Bus	1.7	2.1
Other	2.2	2.2
Total	7.9 million trips	38.8 million trips
	Business travel	**Holiday travel**
Share of total return distance travelled*) per transport mode per year	%	%
Airplane	87.1	75.9
Own car	6.6	20.9
Lease car	2.7	
Rental car	0.5	
Train	1.9	1.1
Boat/ferry	0.1	0.0
Bus	0.6	1.3
Other	0.4	0.7
Total	15.2 billion km*	73.6 billion km*

Source: Eijgelaar et al. (2020); CZO, 2016 (calculation CSTT/NRIT Research)

**) not the actual distance travelled between home and destination, but the great circle return distance; the actual distance will be between 5 and 15% higher.*

Table 4.3 shows the shares of the number of trips and distance by accommodation type. The large majority of 7.9 million business trips is spent in hotels (80.2%). The other 19.8% is relatively equally distributed among a host of other accommodation types. The aggregated share of distance of hotels is similar to its number of trips (83.7% of distance and 80.2% of trips). However, within the hotel category it is clear that 5-star hotels have a disproportionate share of distance compared to the number of trips (20.5% of distance and 8.0% of trips). For 3-star hotels the share of trips is larger than the share of distance.

The share of business trips spent in hotels (80.2% aggregated) is significantly larger than that of holiday trips (35.2%). The share of holiday trips spent in bungalows (23.2%) is higher than that of business trips (1.1%). Since datasets of Dutch business travel and holiday travel make use of a different grouping of accommodation types and the purpose of the two types of travel differs a lot, it is not entirely sound to compare the distribution of trips and distance between the two types of travel. However, it can be seen that business trips, which are generally more functional, are mostly spent in more connected places (e.g. hotels, which are generally located around proper infrastructure).

The average return distance of business trips spent in 5-star hotels is the highest of all accommodations (4,942 km average or 6,911 km for international trips). Business trips spent in a pension or B&B have the lowest average distance, namely 655 km (or 1,683 km for international business trips).

Table 4.3: Business trips and distance by accommodation type

	Business travel	Holiday travel
	Unit	Unit
Share of trips (by the Dutch) of total trips by accommodation type	%	%
Budget hotel	5.6	35.2
3-star hotel	28.2	
4-star hotel	38.4	
5-star hotel	8.0	
Congress centre	3.3	
Pension/B&B	3.5	
Apartment	2.0	
Private rental (Airbnb/Wimdu)	1.0	
With family/friends/relatives	3.4	
Bungalow park	1.1	23.2
Other	5.5	41.6
Total	7.9 million trips	38.8 million trips

	Business travel	Holiday travel
	Unit	Unit
Share of total return distance travelled **) by accommodation type per year	%	%
Budget hotel	3.5	51.6
3-star hotel	20.1	
4-star hotel	39.6	
5-star hotel	20.5	
Congress centre	1.2	
Pension/B&B	1.2	
Apartment	4.8	
Private rental (Airbnb/Wimdu)	1.8	
With family/friends/relatives	1.8	
Bungalow park	0.6	12.0
Other	4.8	36.5
Total	15.2 billion km*	73.6 billion km*

Source: Eijgelaar et al. (2020); CZO, 2016 (calculation CSTT/NRIT Research)

**) not the actual distance travelled between home and destination, but the great circle return distance; the actual distance will be between 5 and 15% higher*

5 Conclusions and discussion

This is the first volume in the 'Travelling Large' series, on the carbon footprint (CF, the emissions of the greenhouse gas CO_2) of travel from or to the Netherlands, which focuses on Dutch business travel. This volume presented figures on the CF of Dutch business travellers on domestic and outbound trips in 2016. The 'Travelling Large' series started in 2009, with a report on the emissions of domestic and outbound holidaymakers. This has become an annual subseries that has recently seen its 12th version published and shows developments from 2002 until 2018 (see Eijgelaar et al. 2020). The 'Travelling Large' series has also seen the publication of two reports on the CF of inbound tourists to the Netherlands, for the years 2009 and 2014 (for the latest report, see Neelis et al. 2020). This new report is based on the Continuous Business trip Survey (CZO) of NBTC-NIPO Research. Additionally, information on the carbon footprint of various touristic activities and business trip components, collected by the Centre for Sustainability, Tourism & Transport of Breda University of Applied Sciences over the years, has been used (see also Peeters 2019). This is the first report using the CZO dataset and therefore no comparison can be made with other years.

In 2016, the total contribution of CO_2 emissions by Dutch business travellers was 2.83 Mt or 1.7% of all CO_2 emissions of the Dutch economy. It is not easy to define a sustainable level for CO_2, but it has become clear that substantial reductions are needed to prevent 'dangerous climate change'. The latter has been linked to more than 1.5-2 degrees warming in the 2015 Paris Agreement (UNFCCC 2015), which entered into force in November 2016 (UN 2016). For the moment, the EU has set the goal of a 20% reduction of GHG emissions by 2020 (and 40% in 2030) compared to 1990 levels (EC 2016). The new Dutch government has adopted a more ambitious target of 49% in 2030 in the national Climate Agreement (EZK 2019). Scientific publications have addressed the necessity of reducing CO_2 emissions by 3 to 6% per year and a total reduction of 80% by the end of this century (see e.g. Meinshausen et al. 2009, Parry et al. 2008, Scott et al. 2010, van Vuuren et al. 2010). However, more recent analyses show that regardless "of the carbon budget, emissions need to reach zero between 2050 in 2100 (as specified by the Paris Agreement). An earlier achievement of this goal will lead to lower temperature. And equity requires rich countries to reach zero before poor countries" (Peters 2018: 380). This implies ending our fossil fuel-based economy in the west within three-four decades. In terms of achieving this ambition, results of the Paris Agreement are more promising than those of previous COPs.

Travel emissions often cause a significant share of total business carbon footprints, next to regular mobility. Compliance with climate policies, CSR and cost reduction are some of the reasons businesses have an interest in reducing business travel emissions. Business travel and mobility emissions reduction have been integrated in the Dutch National Climate Agreement of 2019. Currently, the Transforming Travel (*Anders Reizen*) coalition, has over 60 major enterprises committed to halving carbon dioxide emissions for business mobility and commuter traffic in 2016 – 2030. In the National Climate Agreement, the parties have agreed to expand the coalition to 500 employers and that: "As many employers as possible, and at least 1,000, will commit to realising at least 50% in CO_2 reduction for business mobility by 2030, compared to 2016 levels. The parties will achieve this by communicating with employees on sustainable mobility, by putting in place reduction measures and by monitoring progress" (EZK 2019: 75). Current Transforming Travel measures related to business trips abroad are still rather limited. A main measure here is to switch to "rail travel instead of air travel for distances under 700 km, where travel time from door to door by train is <150% the travel time by aircraft". The Transforming Travel coalition did release a knowledge brief on how to fly less, smarter and/or greener (Anders Reizen et al. 2020).

Our report shows that the share of the airplane in the distance travelled and total busines travel emissions is very high – higher than for holidays – and herein lies the greatest challenge for reducing business travel emissions. A positive sign is the relatively high share of train trips in business travel. Increasing travel distances with this mode and replacing plane trips will be an effective start to reducing emissions, but does not solve the problem with long-haul trips. The differences in carbon footprint per business trip and per day are large: in 2018, 69.0% of all business trips had an individual carbon footprint per day that stayed below the average per day of 85.0 kg, whereas only 4.0% of all business trips' per day footprints were lower than the average per day emissions for everyday life of Dutch people (27.0 kg). This is a large contrast to holiday trips, of which almost 30% fell below that everyday average in 2016 (Eijgelaar et al. 2017).

The business trip types with the **highest average** environmental impact per day are the following (between brackets the deviation of the average footprint of Dutch business trips, 85.0 kg CO_2 per day):

- Intercontinental (long-haul) business trips (e.g. to Australia +618.8%)
- Business trips by airplane (+108.2%)
- European 'airplane' destinations (e.g. Portugal: +95.3%)
- Business trips in 5-star hotels (+67.1%)
- The average outbound business trip (+50.6%)

The business trip types with the **lowest** environmental impact per day are:

- Domestic train (-65.9%) and bus business trips (-62.4%)
- Outbound business trips by train (-60%) or bus (-62.4%)
- The average domestic business trip (-54.1%)
- All business trips spent at friends, family, or relatives (-48.2%) or at a pension/B&B (-47.1%)
- Nearby outbound business trips (e.g. in Belgium: -44.7%, and to a lesser degree in France: -2.4%, Germany: -5.9%)

Again, the large influence of the destination choice on the environmental impact of tourism is obvious, followed by the choice of transport mode, though the latter is closely related to the chosen destination as the airplane is the only realistic choice for long-haul destinations for most business travellers. However, the choice of accommodation can also play a considerable role, with 5-star hotels on the high end of the scale and private homes on the other.

The calculation of the eco-efficiency of business trips, expressed in business trip CO_2 emissions per Euros spent, primarily shows that the average Dutch business traveller produces twice as many emissions per Euro as the Dutch economy (0.48 kg CO_2/€ compared to 0.24 kg CO_2/€; see section 3.6). Here also, there are large differences between various business trip destinations and types. Long-haul destinations have the worst eco-efficiency (e.g. 2.21 kg/€ for Australia), while destinations like Switzerland have the best (0.30 kg/€). Only business trips by train (0.21 and 0.19 kg CO2/€ for domestic and international trips respectively) have a more favourable eco-efficiency than that of the Dutch economy (0.24 kg CO_2/€).

As this is the first carbon footprint report on business travel, we do not know whether emissions of this type of travel have grown over the years. We do know that the fast growth of the carbon footprint of Dutch holidaymakers (see Eijgelaar et al. 2020) contrasts starkly to the international climate crisis that demands significant reductions of the carbon footprint (by at least 3% per year) in order to prevent the worst impacts. That overall emissions growth is almost completely caused by the increase in the total distance travelled between 2002 and 2018, and this report shows that distance is also a major factor in business travel emissions. Here, the high share of business trips by plane in trips, total distance, and emissions, is not promising. Business trips do frequently show a somewhat better eco-efficiency than holiday trips, but as the carbon footprint per trip is not very different, there is no environmental gain here.

One-third of business trips can be classified as MICE travel. This puts a large responsibility on the Dutch MICE sector, also with respect to Corporate Social Responsibility (CSR). Dutch tour operators, the Dutch Association of Travel Agents and Tour Operators (ANVR), and other partners have recognised this responsibility, and have started to engage in carbon management. It is interesting to note that MICE trips show slightly lower domestic and outbound per trip and per day emissions than individual business trips, and have a lower transport share in emissions.

The authors hope that this report will provide the sector and the government with insight into the most important contributing factors of the environmental impact of business trips. This insight will hopefully contribute to the efficient execution of targets for emission reduction in business travel and mobility set in the National Climate Agreement (see above). The report provides indications on how the industry can reduce its environmental impact through carbon management, and how it can look for products that are less dependent on fossil fuels. The results of this research clearly show the importance of business travel, and general tourism, for climate policy, specifically regarding CO_2 reduction. The results can also further aid policymakers with the development of mitigation policy. For example, the impacts of impending emissions trading for aviation can be assessed using the data for carbon footprints. They could also be used to develop a tool for business consumers, helping them to take their business trip carbon footprint more into account (see Eijgelaar et al. 2016).

References

Anders Reizen, Natuur & Milieu & Climate Neutral Group (2020) *De Vliegwijzer. Voor minder en duurzamer zakelijk vliegen.* Anders Reizen, Natuur & Milieu, Climate Neutral Group.

CBS (2020) *Emissies van broeikasgassen berekend volgens IPCC-voorschriften*. Online documents at URL https://opendata.cbs.nl [27-10-2020].

Dlugokencky, E. & Tans, P. (2020) *Trends in Atmospheric Carbon Dioxide, Recent Global CO2*. Online documents at URL http://www.esrl.noaa.gov/gmd/ccgg/trends/global.html [27-10-2020].

EC (2016) *EU climate action*. Online documents at URL http://ec.europa.eu/clima/citizens/eu_en [19-12-2016].

Eijgelaar, E., Nawijn, J., Barten, C., Okuhn, L. & Dijkstra, L. (2016) Consumer attitudes and preferences on holiday carbon footprint information in the Netherlands. *Journal of Sustainable Tourism,* 24 (3)**,** 398-411.

Eijgelaar, E., Neelis, I., Peeters, P., de Bruijn, K. & Dirven, R. (2020) *Travelling large in 2018: The carbon footprint of Dutch holidaymakers in 2018 and the development since 2002.* Breda, The Netherlands: Breda University of Applied Sciences.

Eijgelaar, E., Peeters, P., de Bruijn, K. & Dirven, R. (2017) *Travelling large in 2016: The carbon footprint of Dutch holidaymakers in 2016 and the development since 2002.* Breda, The Netherlands: NHTV Breda University of Applied Sciences.

EZK (2019) *Climate Agreement.* The Hague, Netherlands: Ministry of Economic Affairs and Climate Policy, Directorate-General for Climate and Energy, Climate Department.

Forster, P. M. d. F., Shine, K. P. & Stuber, N. (2006) It is premature to include non-CO_2 effects of aviation in emission trading schemes. *Atmospheric Environment,* 40 (6)**,** 1117-1121.

Forster, P. M. d. F., Shine, K. P. & Stuber, N. (2007) Corrigendum to "It is premature to include non-CO_2 effects of aviation in emission trading schemes" [Atmos. Environ. 40(2006) 117-1121]. *Atmospheric Environment,* 41**,** 3941.

Gössling, S. & Peeters, P. (2015) Assessing tourism's global environmental impact 1900–2050. *Journal of Sustainable Tourism,* 23 (5)**,** 639-659.

Graßl, H. & Brockhagen, D. (2007) *Climate forcing of aviation emissions in high altitudes and comparison of metrics* Online documents at URL http://www.mpimet.mpg.de/fileadmin/download/Grassl_Brockhagen.pdf [10-11-2008].

ICAO (2016) *Resolution A39-3: Consolidated statement of continuing ICAO policies and practices related to environmental protection – Global Market-based Measure (MBM) scheme.* Montreal, Canada: International Civil Aviation Organization.

IPCC (2007) *Climate Change 2007: The physical science basis. Working Group I contribution to to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.* 978-0-52170596-7 Cambridge (UK): Cambridge University Press.

Lee, D. S., Fahey, D. W., Skowron, A., Allen, M. R., Burkhardt, U., Chen, Q., Doherty, S. J., Freeman, S., Forster, P. M., Fuglestvedt, J., Gettelman, A., De León, R. R., Lim, L. L., Lund, M. T., Millar, R. J., Owen, B., Penner, J. E., Pitari, G., Prather, M. J., Sausen, R. &

Wilcox, L. J. (2020) The contribution of global aviation to anthropogenic climate forcing for 2000 to 2018. *Atmospheric Environment*, 117834.
Meinshausen, M., Meinshausen, N., Hare, W., Raper, S. C. B., Frieler, K., Knutti, R., Frame, D. J. & Allen, M. R. (2009) Greenhouse-gas emission targets for limiting global warming to 2° C. *Nature,* 458 (7242), 1158-1162.
Neelis, I., Pels, J., Eijgelaar, E., Peeters, P. & Dirven, R. (2020) *Travelling Large in 2014 'Inbound tourism': The carbon footprint of inbound tourism to the Netherlands in 2014.* Breda, Netherlands: Breda University of Applied Sciences.
Parry, M., Palutikof, J., Hanson, C. & Lowe, J. (2008) Squaring up to reality. *Nature Reports Climate Change*, 68.
Peeters, P. (2017) *Tourism's impact on climate change and its mitigation challenges. How can tourism become 'climatically sustainable'?* Delft, Netherlands: TU Delft
Peeters, P. (2019) *Carbon Footprint Emissie Factoren; Versie 2017 en Trends 2002-2018*. Breda: Breda University of Applied Sciences.
Peeters, P., Szimba, E. & Duijnisveld, M. (2007a) Major environmental impacts of European tourist transport. *Journal of Transport Geography,* 15, 83-93.
Peeters, P. M., Williams, V. & Gössling, S. (2007b) Air transport greenhouse gas emissions. IN Peeters, P. M. (Ed.) *Tourism and climate change mitigation. Methods, greenhouse gas reductions and policies*, 29-50. Breda: NHTV.
Pels, J., Eijgelaar, E., Peeters, P. M., Landré, M., Nelemans, R. & Dirven, R. (2014) *Travelling Large in 2009 'Inbound tourism'. The carbon footprint of inbound tourism to the Netherlands in 2009.* Breda: NHTV Center for Sustainable tourism & transport.
Peters, G. P. (2018) Beyond carbon budgets. *Nature Geoscience,* 11, 378–380.
Scott, D., Peeters, P. M. & Gössling, S. (2010) Can tourism deliver its 'aspirational' greenhouse gas emission reduction targets? *Journal of Sustainable Tourism,* 18 (3), 393 - 408.
UN (2016) *Paris Agreement: Entry into force. C.N.735.2016.TREATIES-XXVII.7.d*. New York, USA: United Nations.
UNFCCC (2015) *Adoption of the Paris Agreement. Proposal by the president.* Geneva, Switzerland: UNFCCC.
UNWTO (2016) *Tourism and the SDGs*. Online documents at URL http://icr.unwto.org/content/tourism-and-sdgs [30-8-2016].
UNWTO-UNEP-WMO (2008) *Climate change and tourism: Responding to global challenges.* Madrid: UNWTO.
van Vuuren, D. P., Stehfest, E., den Elzen, M. G. J., van Vliet, J. & Isaac, M. (2010) Exploring IMAGE model scenarios that keep greenhouse gas radiative forcing below 3 W/m2 in 2100. *Energy Economics,* 32 (5), 1105-1120.
Wiedmann, T. & Minx, J. (2007) *A definition of 'Carbon Footprint'.* 07-01 Durham, UK: ISAUK Research & Consulting.
WTTC (2015) *Travel & tourism 2015. Connecting global climate action.* London, UK: World Travel and Tourism Council.

Appendix 1: List of terms and abbreviations

Term, abbreviation	Description
CF	Carbon footprint; expressed in kg CO_2 emissions
Combined trip	Business trips where transport and accommodation have been booked separately in advance
CSR	Corporate Social Responsibility
CSTT	Centre for Sustainability, Tourism & Transport (part of BUas Breda University of Applied Sciences)
CZO	Continuous Business trip Survey (ContinuZakenreisOnderzoek)
Great circle distance	Shortest route between two points measured along the earth's surface
LULUCF	Greenhouse gas emissions from forestry and land use
MICE	Organised business travel; abbreviation of 'Meetings, Incentives, Conferences, and Exhibitions'
Mitigation policy	Policy aimed at preventing or reducing climate change, like emissions trading or the stimulation of alternative energy forms
Mt	Megaton or 1 million tonnes, equivalent to 1 billion kg
Ppm	Part per million (one in a million parts)

Games

Media

Hotel

Facility

Built Environment

Logistics

Tourism

Leisure & Events

The impact of tourism on the environment, in general and specifically on the climate, is receiving plenty of attention. In 2008, the Centre for Sustainability, Tourism and Transport of Breda University of Applied Sciences and NRIT Research, in collaboration with NBTC-NIPO Research, published the (Dutch) pilot-report 'Travelling large in 2005'. In the present report the environmental impact of Dutch *business travel* behaviour was calculated for the first time. The carbon footprint was one tool used for this: the emissions of carbon dioxide are responsible for climate change. This report contains a complete overview of the impacts of Dutch business travellers on the climate in 2016.

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