Travelling large in 2009 'Inbound tourism'

The carbon footprint of inbound tourism to the Netherlands in 2009

NHTV Breda University of Applied Sciences

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A project of NHTV Centre for Sustainable Tourism and Transport in collaboration with NBTC Onderzoek and CBS.

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Contents

1 Introduction

This report is a special edition within the series of Travelling Large reports, on the carbon footprint (CF, the emissions of the greenhouse gas CO_2) of Dutch holidaymakers (see de Bruijn et al. 2008, de Bruijn et al. 2009a, de Bruijn et al. 2009b, de Bruijn et al. 2010, de Bruijn et al. 2012, de Bruijn et al. 2013a, de Bruijn et al. 2013b). All reports have been written by the Centre for Sustainable Tourism & Transport of NHTV Breda University of Applied Sciences and NRIT Research, in collaboration with NBTC Onderzoek and CBS. In contrast to the regular reports in this series the current volume presents the carbon footprint of inbound tourism to the Netherlands. The data have been gathered for 2009 and show the carbon footprint of all international tourists visiting the Netherlands.

Despite a shift of media attention from issues like climate change towards the (volatile) global economy, the impact of industrial sectors – including tourism – on the environment is still discussed by these respective industries, for example as part of evolving Corporate Social Responsibility (CSR) strategies and/or newly introduced climate policies. For tourism, the 2008 World Tourism Organisation (UNWTO) report on the effects of climate change on tourism as well as the effects of tourism on greenhouse gas emissions (UNWTO-UNEP-WMO 2008) is still a work of reference. Other industry associations have also started to handle the theme more seriously (e.g. WTTC 2009). The UNWTO report estimates the contribution of tourism to carbon dioxide emissions at approximately 5% in 2005 (UNWTO-UNEP-WMO 2008). Moreover, UNWTO expects these emissions to increase by a factor 2.6 (or 160%) between 2005 and 2035. Information about the eco-efficiency (kg CO_2 per Euro spent by inbound tourists to the Netherlands) can be one of the aspects to include in strategically developing different markets.

The aim of this research consists of two parts. Firstly, it provides a complete overview of the emissions of inbound (international) tourists to the Netherlands and eco-efficiency in 2009. Secondly, it compares the results with the carbon footprint and eco-efficiency of outbound tourism. This understanding requires answers to the following questions:

- What is the total carbon footprint of inbound tourists?
- How does the inbound tourist carbon footprint relate to the total carbon footprint of the Netherlands and the footprint of Dutch holidaymakers?
- What factors determine the carbon footprint of inbound tourists?
- What type of inbound tourists and tourist markets are the least/most damaging to the environment?
- What is the eco-efficiency of different tourist markets?

Chapter two of this report briefly describes the method used to calculate the carbon footprint and the eco-efficiency. Chapter 3 gives an overview of the general characteristics of tourist trips to the Netherlands. Chapter 4 describes the carbon footprint of inbound tourism in 2009. Section 4.1 starts with a number of reference values for the CF in the Netherlands. Section 4.2 provides an overview of the calculated CF for holidays, split for several holiday types and a number of destinations. The chapter continues with a detailed breakdown of the CF by duration (4.3), country of origin (4.4), accommodation type (4.5), transport mode (4.6), and form of organisation (4.7). Section 4.8 examines the distribution of emissions over the different components of holidays (accommodation, transport and activities). Chapter 5 looks at the eco-efficiency and compares the results with the eco-efficiency of the Dutch economy. Finally, in chapter 6, the research questions are answered, the results are reflected upon and some conclusions are drawn.

2 Methodology

Data on the characteristics of incoming tourists from the research conducted by the Netherlands Board of Tourism and Conventions (NBTC) form the basis of this report. NBTC conducts this research, titled 'Focus on the incoming tourist: Inbound Tourism Research' (ITR2009; see NBTC 2009), once every three years. 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 ITR2009 data. The CF is a legitimate indicator for calculating the environmental impact of the tourism industry. Carbon dioxide (CO_2) currently receives much societal and political attention, and policy has already been developed for it. CO_2 is also one of the biggest environmental problems for tourism (see e.g. Peeters et al. 2007a, Scott et al. 2012, 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, etcetera. These calculations are performed on data on the accommodation type, number of nights, transport mode, country of origin, and type of trip, per trip featured in the ITR2009 database.

2.1 Carbon footprint

The carbon footprint is a measure of the contribution of an activity, product, country, industry, person, etcetera, to climate change (global warming). The CF is caused by the combustion of fossil fuels for generating electricity, heat, transport, and so on. Anthropogenic CO_2 emissions are causing 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 395 ppm (parts per million; see Conway et al. 2012), which causes the atmosphere to retain more heat. The atmosphere's ability to retain heat is called "radiative forcing", expressed in W/m^2. However, besides CO_2 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 CO_2 is by converting them into carbon dioxide equivalents (CO_2-eq). For tourism, the most important non-carbon greenhouse effect is not caused so much by the concentration of certain gases in the atmosphere, but by the effects these gases have on for instance contrails and cirrus clouds. Unfortunately, as a result of various practical and theoretical objections, these effects are difficult to assess (Forster et al. 2006, Forster et al. 2007, Graßl et al. 2007, Peeters et al. 2007b). Thus we have chosen not to include the non-carbon effects of and thus limit ourselves to the CF of CO_2 emissions

only (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, etcetera, and thus considers the entire lifecycle, in addition to the user phase (Wiedmann et al. 2007). This report addresses all direct CO_2 emissions, plus the emissions caused by the production of fuel and/or electricity, but ignores all other indirect emissions. Most of these are relatively low compared to the direct emissions and require an effort to calculate beyond the scope of this report and its underlying data.

2.2 Calculation model

The NBTC ITR2009 data have been processed with IBM SPSS Statistics 20.0, for which a syntax (a series of SPSS commands) has been developed to calculate the CF. For each single trip in the NBTC ITR2009 data, a CF has been calculated. Firstly, the NBTC ITR data was supplemented with 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 tourist trip component (transport, activities, accommodation) was calculated through the use of an emission factor for transport modes, accommodation types, type of trip and specific activities. By multiplying these factors with distance covered and the duration of the trip, the CF for each complete trip was found. Then, by increasing the individual carbon footprints with a weight factor and summation, the total carbon footprint of all trips was calculated. We calculated weight factors per country of origin in such a way that they matched the official Statistics Netherlands (CBS) number of inbound guest-nights per country of origin. The CBS data were retrieved from CBS Statline (CBS 2013). For a detailed description of the calculation method and the emission factors, generally the method used for the Dutch holidaymaker CF has been applied (Peeters 2013). Some additional calculations and assumptions are discussed in the following sections.

2.2.1 Weighing number of nights

The distribution of trips and nights per country of origin as measured by ITR2009 is not truly representative due to the method used. As CBS (2013) also measures number of nights per country of origin and type of accommodation, we have designed a weighting method to make ITR2009 representing the number of nights as given by CBS. We have done so in two main ways. First we corrected the ITR2009 for the sampling bias caused by subjects that visited more than one accommodation during their trip. Clearly such subjects have a much higher chance to be found in the survey at the accommodations (so we did not correct the entries collected at Schiphol Airport). The second step was to find weight factors in such a way that the ITR2009 gives the same number of nights per area region of origin as CBS (2013). The resulting totals are within 1% (in most cases even within 0.1%) of the CBS data. A full description is given in Annex II.

2.2.2 Data corrections

There was a discrepancy between the detailed and compound country of origin variables (respectively designated V2A and hv2a). We found 18 records (trips) where the condensed variable coded a certain country that was not specified in V2A. Furthermore, we found 18 instances where V2A was coded with 'other country', where a specific country had been given in hv2a. As we have weighted the whole dataset for V2A and found the issues only in 36 records (~1%), we decided to stick to the data given by the original V2A indicator, and replaced all the hv2a values to the category 'other intercontinental countries'. This action caused all totals and individual country values for both detailed markets as well as compound markets to be equal. Disadvantage is that the 'other intercontinental countries' in compound markets are inflated in numbers and deflated in carbon footprint, so we will report 'other countries' and not specific 'intercontinental other countries'. Countries affected are Germany (4 records), Belgium (2), France(9), Italy (3) and Spain (1).

2.2.3 Compound markets

Some countries with a low number of respondents were combined into compound markets as follows:

- Luxembourg, grouped with Belgium
- New Zealand, grouped with Australia as Oceania
- Finland, Hungary and Czech Republic, added to 'Rest of Europe'
- Brazil, added to 'Rest of Americas'
- Indonesia, Taiwan and South Korea, added to 'Rest of Asia'

2.2.4 Other assumptions

Following assumptions were made:

- Regarding transport mode there was an issue where intercontinental subjects (apparently) submitted the transport mode with which they entered the Netherlands while on a tour through Europe. However, for the carbon footprint it is important to use the transport mode to travel to Europe. Therefore we assumed all trips from outside Europe to have been by air.
- The accommodation emission factors have been corrected for the typical Dutch values based on data from CBS. The values are shown in Table 2.1.
- The emissions for local activities emissions were based on emission factors for different types of holidays. ITR2009 does not provide these holiday types but we defined these using the most important activity reported by the subjects in the survey. In this way, the emission factors per tourist-day for inbound travel could be coupled to the outbound holiday types.

Table 2.1 Accommodation emission factors

Accommodation type	kg CO_2 per night
Hotel / pension	22.33
Campsite	10.77
Holiday homes	15.08
Group accommodation / youth hostel	8.73
Other	16.91

Source: Data based on an analysis of energy use and accommodation databases by CBS (2011)

2.3 Trip duration and length of stay in the Netherlands

Inbound tourists may spend part of their trip outside the Netherlands, for instance travelling to Germany, staying there a couple of days, than visiting the Netherlands for a number of days and after that several other countries. Visits to more than one country pose a problem for calculating the emissions per day. What to do with the emissions of the travel from home to the first destination (Germany in this example)? To solve this we have defined two forms of emissions per day: one taking all travel emissions into account and one that only takes emissions that can be attributed to the stay in the Netherlands into account. In general, this problem only occurs with intercontinental trips, where tourists may come to visit 'Europe' rather than the Netherlands, for instance on a two-week trip that includes a one-day visit to Amsterdam. We dealt with this in the following way:

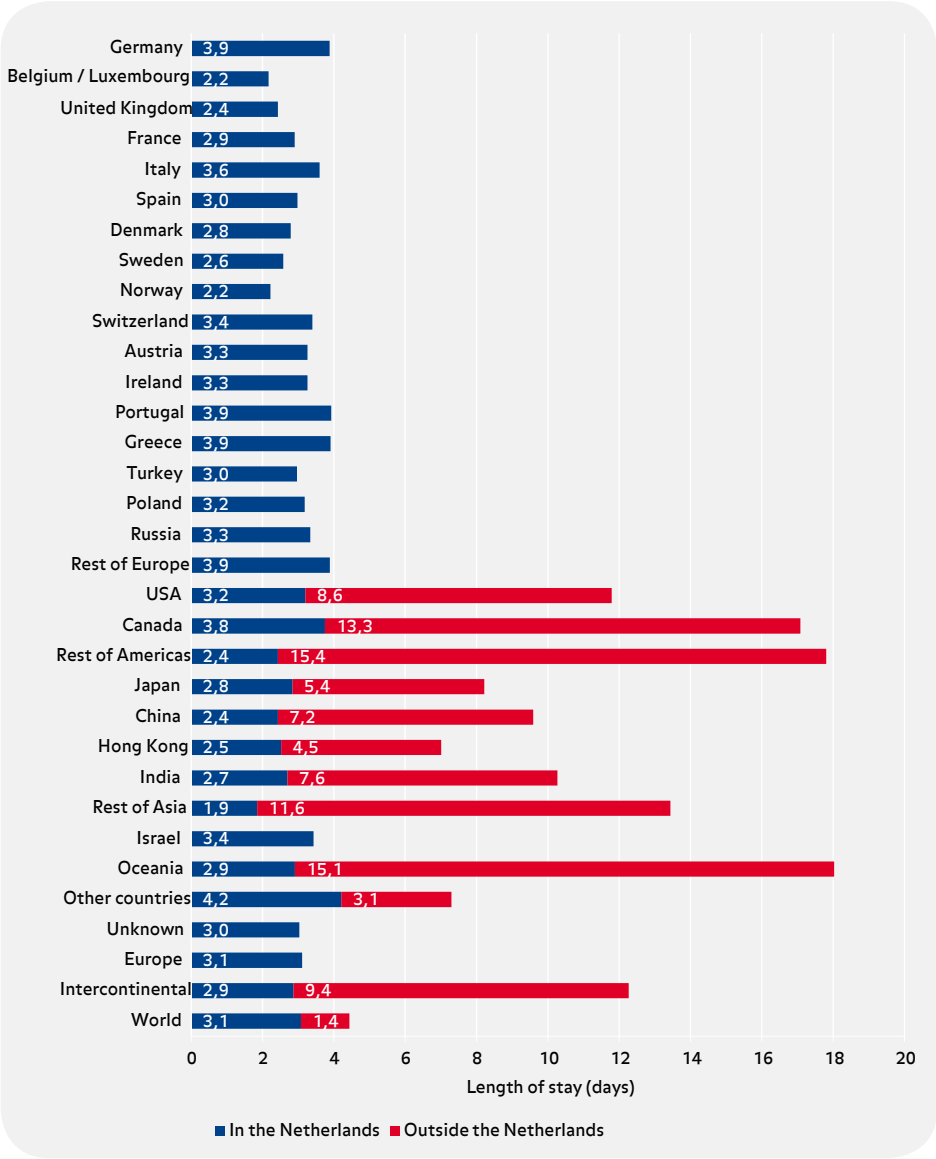
$$\text{CF per day} = \frac{\text{distance travelled} * \text{emission factor}}{\text{length of entire trip}} + \text{CF}_{acco} \text{ per day} + \text{CF}_{other} \text{ per day}$$

$$\text{CF of entire trip} = \text{CF per day} * \text{length of entire trip}$$

$$\text{CF of stay in the Netherlands} = \text{CF per day} * \text{length of stay in the Netherlands}$$

Both values are relevant depending on the situation. The CF of the entire trip is more relevant to specific characteristics of inbound trips and overall tourism emissions, while the CF over the length of stay in the Netherlands is more relevant to the CF of inbound tourism to the Netherlands as a whole and for example for comparing with outbound tourism emissions. Figure 2.1 shows the average length of stay of inbound trips by country of origin. The majority of the length of stay of inbound intercontinental trips is spent outside the Netherlands. We will use the term 'entire trip' for emissions of the whole trip and 'attributable to NL' for emissions weighted to the share of the trip stayed in the Netherlands.

Figure 2.1 Average length of stay, by country of origin, 2009



source: Analyses of NBTC ITR2009

2.4 Method-related deviations from earlier published data

NBTC (2009) published figures about the total number of international inbound tourists and their spending within the Netherlands. Though these numbers are mainly based on the same data as we have used for our carbon footprint assessment, we come up with different numbers. We would therefore like to stress that our calculations are tentative at this moment. The ITR2009 was not designed to accommodate the kind of analyses we present in this report. Therefore the officially published data (NBTC 2009) for numbers of trips, nights and spending should be used when citing inbound data. The differences are caused by a couple of factors. First, the NBTC published data include an estimate for the visitors that stayed at other accommodations than measured. We have ignored visitors to those unregistered accommodations (like private addresses, VFR, B&B, stays on private boats). Therefore, our method causes the number of trips per country to be lower than published by NBTC (2009). Second, the database is known to give an overestimate due to the collection method at accommodations in stead of country borders. In our analyses we have corrected for that using a method that reduces the bias caused by respondents staying in more than one accommodation during their stay in the Netherlands. Third, we weighted based on the measured CBS number of nights per country, so the total number of nights is the same as published by CBS. This causes a (small) deviation in the distribution of trips over countries from those published by NBTC (2009). We intend to solve these issues in the next ITR version, to be published in 2014.

3 Overview inbound tourism 2009

The majority of inbound tourists that visit the Netherlands originate from Europe. Most visitors (approx. one-third) come from Germany. Other important countries of origin within Europe are Great Britain and Belgium. The majority of intercontinental tourists come from the United States. Overall, incoming tourists to the Netherlands are 70% leisure, 26% business and 5% 'other' (NBTC 2009).

In Table 3.1 the key figures for inbound tourism are presented for the year 2009*

	Unit	Entire trip	Attributable to NL**
Total number of tourists to the Netherlands	million trips	8.22	8.22
By length of stay			
1-3 nights	million trips	5.21	5.21
4-7 nights	million trips	1.95	1.95
more than 8 nights	million trips	1.06	1.06
By transport mode			
airplane	million trips	3.37	3.37
car	million trips	3.96	3.96
other	million trips	0.89	0.89
By accommodation type			
hotel / pension	million trips	6.14	6.14
bungalowpark	million trips	1.31	1.31
camping	million trips	0.54	0.54
group accommodation	million trips	0.22	0.22
European tourists of which:	million trips	7.03	7.03
from Germany	million trips	2.68	2.68
from the United Kingdom	million trips	1.13	1.13
from Belgium and Luxembourg	million trips	1.46	1.46
from other European countries	million trips	1.75	1.75
Intercontinental tourists of which	million trips	1.19	1.19
from America	million trips	0.60	0.60
from Asia	million trips	0.40	0.40
from Oceania	million trips	0.07	0.07
from other countries	million trips	0.12	0.12
Expenditure by inbound tourists	billion Euro		3.54
European	billion Euro		2.59
Intercontinental	billion Euro		0.95

Overnight stays by inbound tourists	million nights	36.4	25.3
European	million nights	21.9	21.9
Intercontinental	million nights	14.6	3.4
Total distance travelled on holidays by inbound tourists ***	billion km	26.0	13.9
European	billion km	6.9	6.9
Intercontinental	billion km	19.1	7.0

Source: analyses of NBTC ITR2009

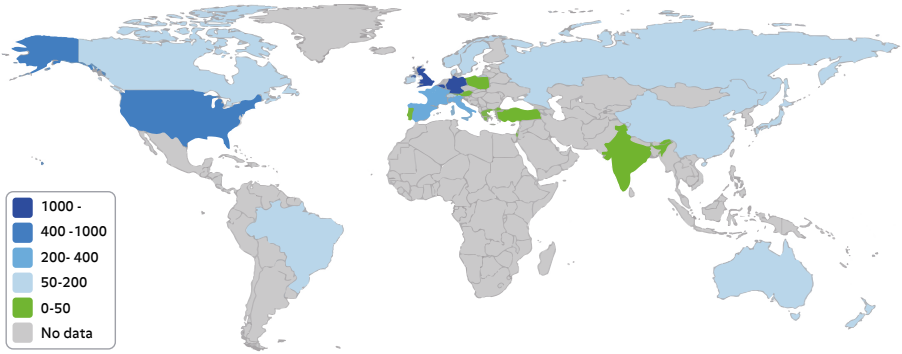
**)Some of the data for arrivals, nights and spending in this table differ from those published by NBTC (NBTC 2009). Total number of arrivals is down in this report from 9.9 million to 8.2 million and total expenses by tourists from Euro 4.0 billion to Euro 3.54 billion. The causes for these differences are described in section 2.3.*

***) The carbon footprint in the Netherlands is calculated by allocation of emissions from transport for the length of stay in the Netherlands only.*

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

Figure 3.1 shows the number of arrivals from various countries (or regions) of origin on a geostatistical map. Figure 3.2 shows a geostatistical map of the average distance travelled from each origin to the Netherlands and back.

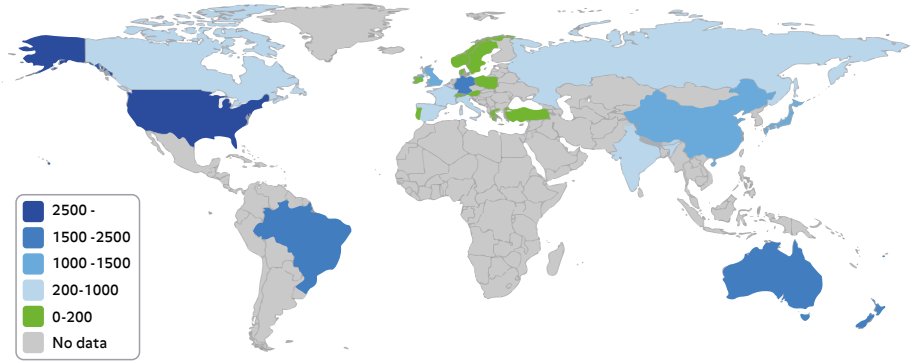
Figure 3.1 Number or arrivals (*1000) by country of origin, 2009



Source: analyses of NBTC ITR2009

[1] grey represents areas without data.

Figure 3.2 Total distance (*10^6 pkm) by country of origin, 2009



4 Carbonfootprint 2009

4.1 Introduction

In this chapter, the results of the calculations and analyses of the year 2009 are presented (in kg CO_2). The values in Table 4.1 are used for reference and offer perspective on the numbers found for inbound tourist trips. Overall Dutch CO_2 emissions are taken from the Dutch Emission Register (or Pollutant Release and Transfer Register) website (Emissieregistratie 2013), which covers the process of collecting, processing and reporting emission data in the Netherlands. The 170.2 Mt figure and the population size in 2009 were used to calculate the average CO_2 emissions per person and the CO_2 emissions per person per day in the Netherlands.

Table 4.1 Reference values carbon footprint, 2009

	2009
CO_2 emissions per average Dutch outbound holiday	663 kg
CO_2 emissions per average Dutch outbound holiday per day	60.6 kg
Total CO_2 emissions Dutch outbound holidays	12.2 Mt
Average annual CO_2 emissions per person in the Netherlands	10.33 ton
Average CO_2 emissions per person per day in the Netherlands	28.3 kg
Total Dutch CO_2 emissions*	170.2 Mt

Sources: data generated for de Bruijn et al. (2013a) and Emissieregistratie (2013).

*) excluding LULUCF (forestry- and land use)

4.2 Total carbon footprint

Table 4.2 shows the (average) values of the carbon footprint of inbound tourists. The total carbon footprint of all inbound tourists to the Netherlands was around 2.6 Mt CO_2 in 2009 (or 4.6 Mt if we include the emissions attributed to time spent outside the Netherlands). Tourism CO_2 emissions are not directly comparable with national CO_2 emissions, as part of the transport emissions occur in other countries, whereas the national emissions are only caused within the Netherlands. However, measured as part of Dutch emissions (170.2 Mt CO_2 in total and just over 10 ton CO_2 per person in 2009), inbound tourism emissions attributable to NL would amount to 1.5% of the total Dutch carbon footprint. The carbon footprint attributable to NL per average trip is 319 kg CO_2 and 104 kg CO_2 per day.

Table 4.2 Carbon footprint per day, per trip and in total, 2009

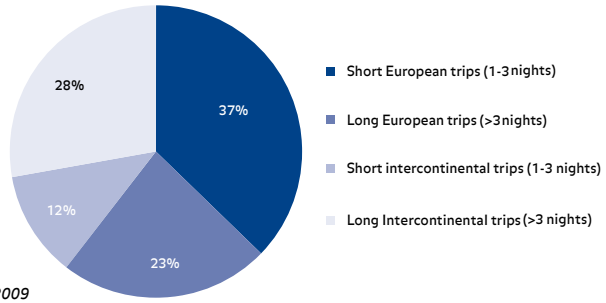
Carbon footprint in kg CO_2	Per day	Per trip	Total (Mt)
Inbound trips of European origin*)	72	225	1.58
Inbound trips of intercontinental origin	206	2,523	3.00
of which attributable to NL*)	304	872	1.04
Inbound trips (total)	126	557	4.58
of which attributable to NL*)	104	319	2.62

Source: analyses of NBTC ITR2009

**) The carbon footprint in the Netherlands is calculated by allocation of emissions from transport for the length of stay in the Netherlands only. For inbound trips with a European origin the difference between the average overall trip length of stay and the length of stay within the Netherlands is negligible.*

European tourism trips to the Netherlands produced a total carbon footprint of 1.6 Mt CO_2, and averages of 225 kg per trip and 72 kg per day. An average intercontinental trip has a much larger footprint of 2,523 kg or 206 kg per day. Taking the entire length of the trip, all intercontinental trips to the Netherlands produced 3.0 Mt CO_2. 1.0 Mt CO_2 of this can be attributed to the Netherlands. Thus, 60% of inbound tourism emissions were produced by European and 40% by intercontinental trips (see Figure 4.1), whereas the number of European trips (7.0 million, 86%) is much larger than the number of intercontinental trips (1.2 million, 14%). The average carbon footprint attributable to NL is 104 kg per day, which is 56 kg more than the average Dutch outbound holiday (see Table 4.1).
When looking at the length of the entire trip, there is a large number of short inbound trips of 3 nights or less (5.2 million, 63%) compared to long trips of more than 3 nights (3.0 million, 37%). However, long trips have a larger carbon footprint per trip. If we include only CO_2 emissions attributed to the length of stay in the Netherlands, long trips are responsible for 51% of all inbound tourism emissions (see Figure 4.1).

Figure 4.1 Distribution of CO_2-emissions by inbound tourists attributed to their stay in the Netherlands by origin and trip, 2009



Source: analyses of NBTC ITR2009

4.3 Length of stay

The carbon footprint for long trips is much higher than for short trips (see Table 4.3). However, the differences are not very large on a per day basis. The carbon footprint per day of a long trip is actually smaller than for a short trip. The main reason for this is that the transport emissions are divided over a larger number of days. Short trips (1-3 nights) have a relatively large carbon footprint per day. However, a long trip (8 nights or more) does have a larger carbon footprint per day than a medium-length trip (4-7 nights). This may seem contradictory, as one would expect a higher transport footprint per day for shorter trips for a given distance travelled. However, it appears that longer trips also show considerably longer distances travelled, and the concomitant higher use of the airplane as transport mode increases the share of the transport component in the total carbon footprint. This is illustrated by a geostatistical map of the average length of stay of the entire trip to the Netherlands by country or region of origin (Figure 4.2), where far away countries show higher average lengths of stay than countries or regions situated nearer to the Netherlands.

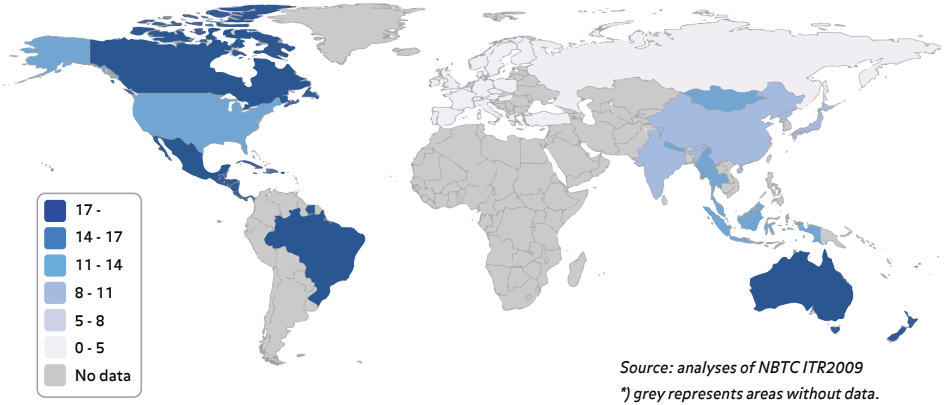
Table 4.3 Carbon footprint per day, per trip and in total, by length of stay, 2009

	Entire trip			Attributable to NL *)		
Length of stay (entire trip)	Per day	Per trip	Total (Mt)	Per day	Per trip	Total (Mt)
1 - 3 nights	129	248	1.292	128	246	1.283
4 - 7 nights	99	506	0.987	84	409	0.796
8 nights or more	140	2,172	2.302	94	511	0.541
Average	126	557	4.580	104	319	2.620

Source: analyses of NBTC ITR2009

**) The carbon footprint in the Netherlands is calculated by allocation of emissions from transport for the length of stay in the Netherlands only.*

Figure 4.2 Average length of stay (number of nights for entire trip) by origin, 2009



Source: analyses of NBTC ITR2009

**) grey represents areas without data.*

4.4 Country of origin

The carbon footprint strongly relates to the distance travelled and transport mode used, and thus the country of origin. Table 4.4 shows the carbon footprint per day, per trip and in total, for both the entire trip and for the length of stay in the Netherlands by country of origin, and in Table 4.5 by total distance travelled from the country of origin to the Netherlands and back (return distance). It is obvious that more distant countries have larger carbon footprints per day and per trip. The majority of total CO_2 emissions are from trips with over 2,000 km travel distance, though the amount of trips with less than 2,000 km travelled is actually higher (76%). The average carbon footprint of short distance inbound trips (< 500 km, i.e. from Germany, Belgium and Luxembourg) is only slightly higher per day than the average CO_2 emissions per person per day in the Netherlands. Germany's large total carbon footprint is due to a high number of inbound trips from this country (2.68 million out of 8.22 million). The USA has the largest total carbon footprint of intercontinental countries. The long distance and use of air transport are the main reasons for this, in addition to large number of trips from the USA (0.60 million). The apparent role of the airplane is also visible in the carbon footprint per trip from longer distance European countries like Spain, Greece, Turkey and Russia. An average trip from Oceania has a carbon footprint, per entire trip, that exceeds the average European trip by a factor 21.5. Per day the difference is only a factor four, because trips from Oceania have a much longer average length of stay.

Table 4.4 Carbon footprint (kg CO_2/day), per trip and in total, by country of origin, 2009

	Entire trip			Attributable to NL *)		
Country	kg/day	kg/trip	Total (Mt)	kg/day	kg/trip	Total (Mt)
Germany	44	172	0.461	44	172	0.461
Belgium and Luxembourg	43	92	0.134	43	92	0.134
United Kingdom	106	257	0.292	106	257	0.292
France	86	250	0.099	86	250	0.099
Italy	127	459	0.094	127	459	0.094
Spain	165	493	0.121	165	493	0.121
Denmark	108	301	0.031	108	301	0.031
Sweden	155	399	0.028	155	399	0.028
Norway	177	393	0.032	177	393	0.032
Switzerland	83	283	0.028	83	283	0.028
Austria	129	421	0.021	129	421	0.021
Ireland	110	357	0.026	110	357	0.026
Portugal	160	629	0.019	160	629	0.019
Greece	141	551	0.016	141	551	0.016
Turkey	171	507	0.015	171	507	0.015
Poland	111	351	0.016	111	351	0.016
Russia	194	649	0.040	194	649	0.040
Rest of Europe	121	469	0.094	121	469	0.094
USA	196	2,306	0.986	285	913	0.390
Canada	133	2,280	0.117	167	627	0.032
Rest of Americas	156	2,774	0.333	193	470	0.056
Japan	334	2,745	0.160	393	1,115	0.065
China	251	2,411	0.206	373	906	0.077
Hong Kong	381	2,669	0.044	557	1,404	0.023
India	195	2,008	0.073	318	858	0.031
Rest of Asia	211	2,835	0.587	441	816	0.169
Israel	283	969	0.035	283	969	0.035
Oceania	268	4,841	0.330	321	933	0.064
Other Countries	212	1,551	0.123	274	1,154	0.092
Unknown	166	503	0.018	166	503	0.018
Europe	72	225	1.585	72	225	1.585
Intercontinental	206	2,523	2.995	304	872	1.035
World	126	557	4.580	104	319	2.620

*Source: analyses of NBTC ITR2009 *) The carbon footprint in the Netherlands is calculated by allocation of emissions from transport for the length of stay in the Netherlands only.*

Table 4.5 Carbon footprint (kg/day), per trip and in total, by return distance, 2009

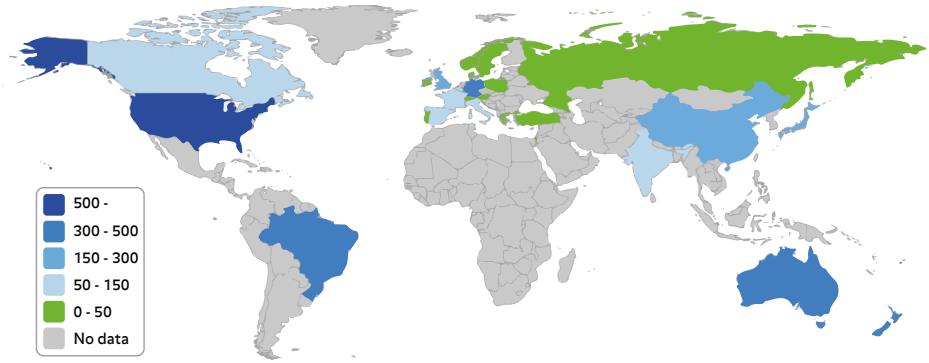
Return distance (km)	Entire trip			Attributable to NL *)		
	Per day	Per trip	Total (Mt)	Per day	Per trip	Total (Mt)
< 500 km	40	118	0.366	40	118	0.366
500 - 1000 km	67	222	0.226	67	222	0.226
1000 - 1500 km	81	256	0.455	81	256	0.455
1500 - 2000 km	129	399	0.131	129	399	0.131
> 2000 km	196	1,697	3.403	234	720	1.443
Average	126	557	4.580	104	319	2.620

Source: analyses of NBTC ITR2009

**) The carbon footprint in the Netherlands is calculated by allocation of emissions from transport for the length of stay in the Netherlands only.*

Figure 4.3 and Figure 4.4 show the total carbon footprint on geostatistical maps for the entire trip and the stay in the Netherlands respectively. Geostatistical maps in Figure 4.5 and Figure 4.6 display the carbon footprint per day for the entire trip and the stay in the Netherlands respectively.

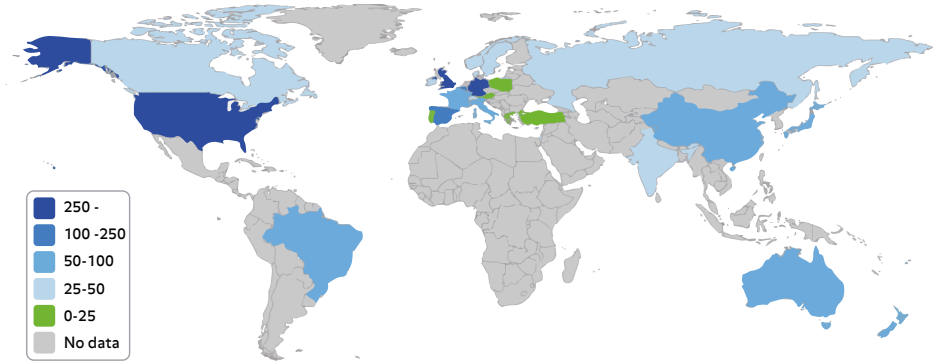
Figure 4.3 Total carbon footprint (kton) of the entire trip by origin, 2009



Source: analyses of NBTC ITR2009

**) grey represents areas without data.*

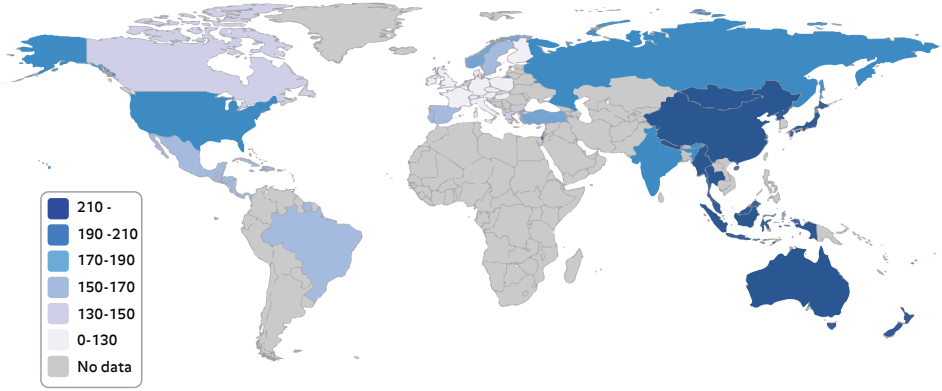
Figure 4.4 Total carbon footprint (kton) attributable to NL by origin, 2009



Source: analyses of NBTC ITR2009

**) grey represents areas without data.*

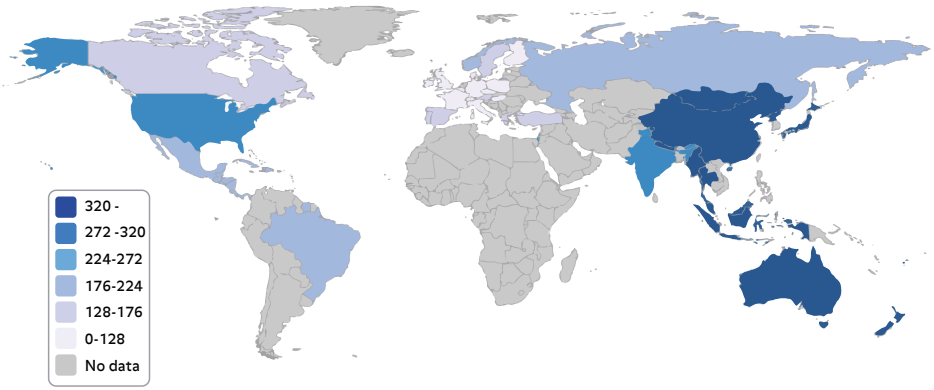
Figure 4.5 Carbon footprint (kg CO_2/day) of the entire trip by origin, 2009



Source: analyses of NBTC ITR2009

**) grey represents areas without data.*

Figure 4.6 Carbon footprint attributable to NL (kg CO_2/day) by origin, 2009



Source: analyses of NBTC ITR2009

**) grey represents areas without data.*

4.5 Accommodation type

Table 4.6 shows the influence of accommodations on the carbon footprint per day, per trip and in total. Please note that these are figures for the total trip, based on the accommodation type used: the carbon footprint for transport and activities is also included besides that of the accommodation.

The carbon footprint per day is largest for inbound tourists staying in a hotel (see Table 4.6). Users of this accommodation type also cause the largest total carbon footprint and it is by far the most popular form of accommodation (6.1 million trips). Tourists staying in bungalow parks (1.3 million) or on a camping (0.54 million) produce less CO_2 per day and per trip, and much less in total. Group accommodations have the lowest total carbon footprint, but a high CF per day and the highest CF per entire trip. The low total carbon footprint can be explained by the relatively small amount of inbound tourists staying in group accommodations (0.22 million). The large CF per day originates from a high share of long distance holidays by airplane. The CF per trip is further increased by a significantly higher average length of stay in group accommodations.

Table 4.6 Carbon footprint per day, per trip and in total, by touristic accommodation type, 2009

	Entire trip			Attributable to NL*)		
Carbon foot-print in kg CO_2	Per day	Per trip	Total (Mt)	Per day	Per trip	Total (Mt)
Hotel / pension	155	641	3.939	141	356	2.185
Bungalowpark	39	207	0.271	38	196	0.257
Camping	52	239	0.130	52	234	0.128
Group accommodation	137	1,073	0.240	101	231	0.052
Average	126	557	4.580	104	319	2.620

Source: analyses of NBTC ITR2009

*) The carbon footprint in the Netherlands is calculated by allocation of emissions from transport for the length of stay in the Netherlands only.

4.6 Transport mode

Based on transport mode, the largest carbon footprint per day and per trip was found for inbound tourists travelling by airplane. The popularity of the airplane (3.4 million trips) and the long distances associated with this type of fast transport also gives these trips the largest footprint in total. The average trip by plane produces over three times more emissions than that by car. Also, the total emissions by air more than double those by car, even though the number of inbound tourists travelling by car (4.0 million) is higher than those by air. Inbound holidays based on all other transport modes have a very low total footprint compared to those by air and car.

Table 4.7 Carbon footprint per day, per trip and in total, by transport mode, 2009

	Entire trip			Attributable to NL*)		
Carbon foot-print in kg CO_2	Per day	Per trip	Total (Mt)	Per day	Per trip	Total (Mt)
Airplane	187	1,134	3.817	200	552	1.857
Boat / ferry	92	246	0.028	92	246	0.028
Train	38	94	0.033	38	94	0.033
Car	47	167	0.661	47	167	0.661
Coach / bus	41	81	0.025	41	81	0.025
Bicycle / moped	30	139	0.002	30	139	0.002
Other	84	151	0.014	84	151	0.014
Average	126	557	4.580	104	319	2.620

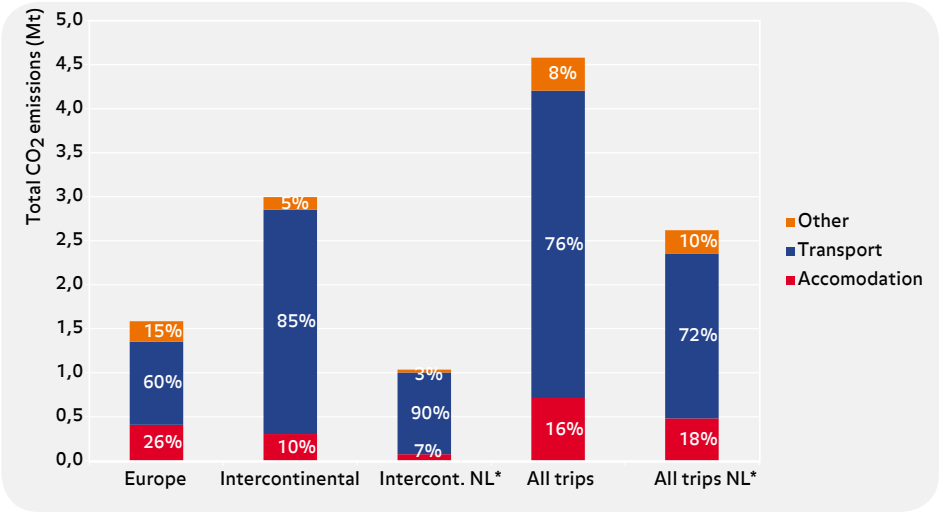
Source: analyses of NBTC ITR2009

*) The carbon footprint in the Netherlands is calculated by allocation of emissions from transport for the length of stay in the Netherlands only.

4.7 Carbon footprint per tourist trip component

The carbon footprint of a tourist trip can be divided over the components transport, accommodation, and other aspects. These 'other aspects' are also called 'leisure activities', and concern local activities (that also include local transport used for excursions, business activities, etc.). Figure 4.7 shows the division over these three categories for European and intercontinental inbound trips, and all inbound trips in total. Transport used from and to the country of origin has the largest impact on the tourist carbon footprint for all inbound trips (76%). Accommodation is responsible for less than a sixth of all inbound tourist trip emissions (16%).

Figure 4.7 Carbon footprint per tourist trip component for both entire trip and attribute to NL in 2009



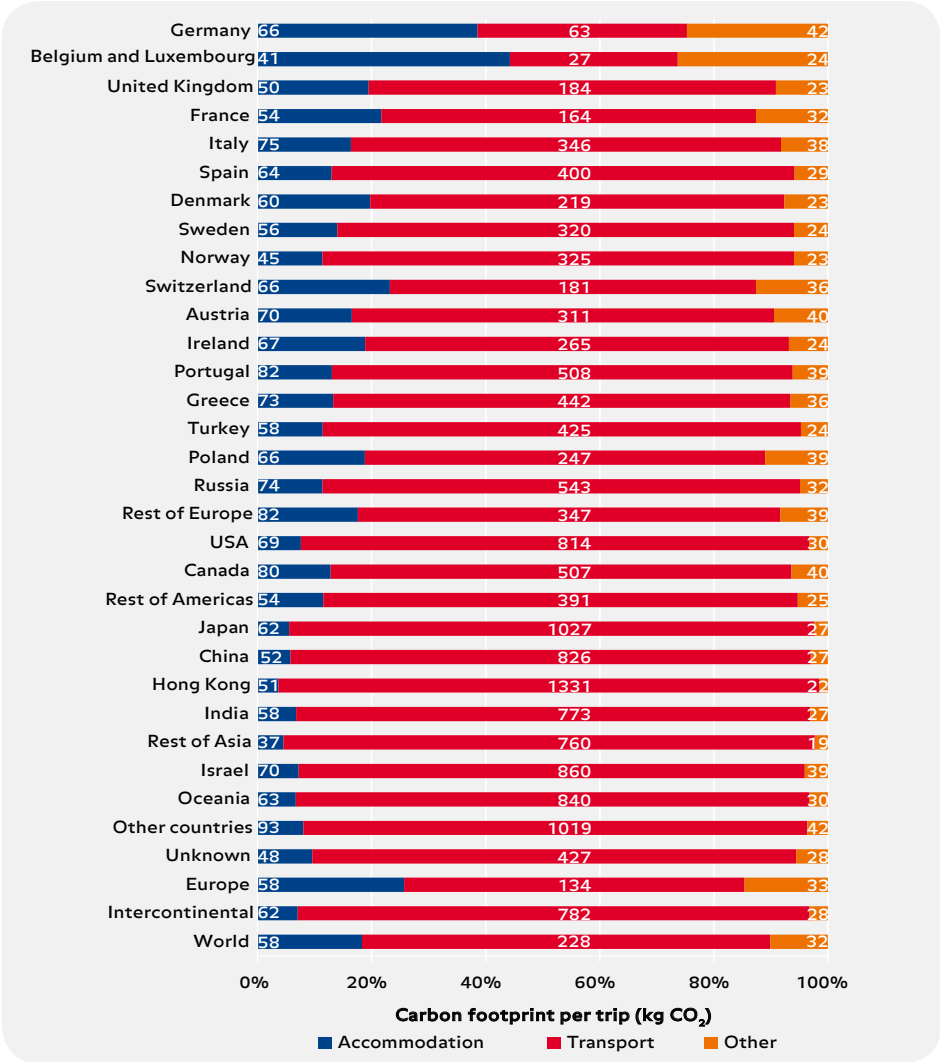
Source: analyses of NBTC ITR2009

*) The carbon footprint in the Netherlands is calculated by allocation of emissions from transport for the length of stay in the Netherlands only. When emissions are only attributed to the length of stay in the Netherlands, the shares of CF of intercontinental trips for accommodation, transport and other vary for the total emissions and the emissions attributable to NL only. Per specific trip the shares are equal, but due to averaging and weighing the overall average shares differ.

Figure 4.7 also shows large differences between European and intercontinental inbound holidays. Transport contributes significantly more to intercontinental holiday emissions (85%) than to those of European holidays (60%). As a result, accommodation and other aspects contribute significantly more to European holidays, but this does not mean that accommodation contributes more per day or per trip compared to intercontinental holidays. In Figure 4.8 the carbon footprint attributable to NL of the three components is shown for various countries or origin. One figure that stands out is the large share of transport in the tourist carbon footprint of more distant countries. This is particularly valid for countries

and regions that are mainly accessed by plane, where the transport share is typically at least around 65%, starting with e.g. the UK and France, and reaching up to around 95% for faraway intercontinental trips.

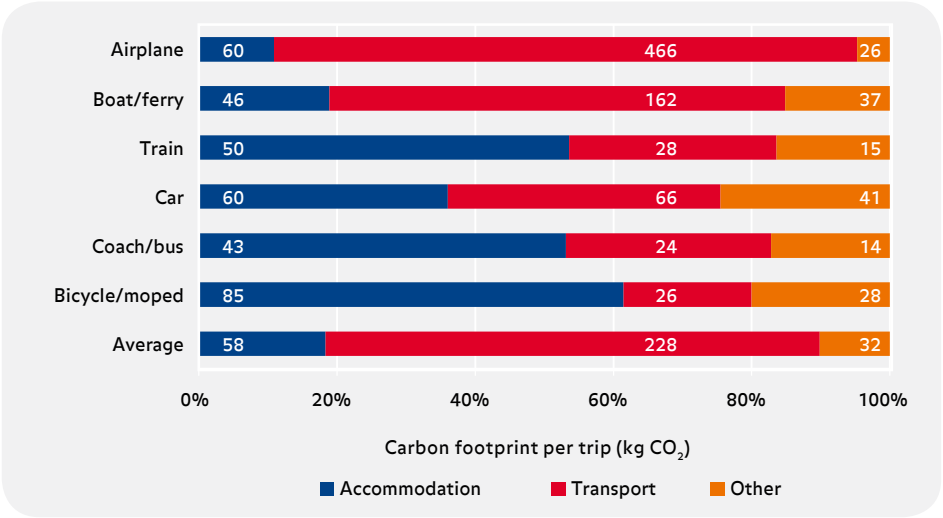
Figure 4.8 Share of the components transport, accommodation and 'other' of the carbon footprint attributable to NL per country of origin, in kg CO_2 per trip, 2009



Source: analyses of NBTC ITR2009

Figure 4.9 shows the shares of the components transport, accommodation and 'other' per inbound trip based on the transport mode used. Unsurprisingly, the transport component of trips by plane is the largest, whereas it is low for trips by bicycle/moped.

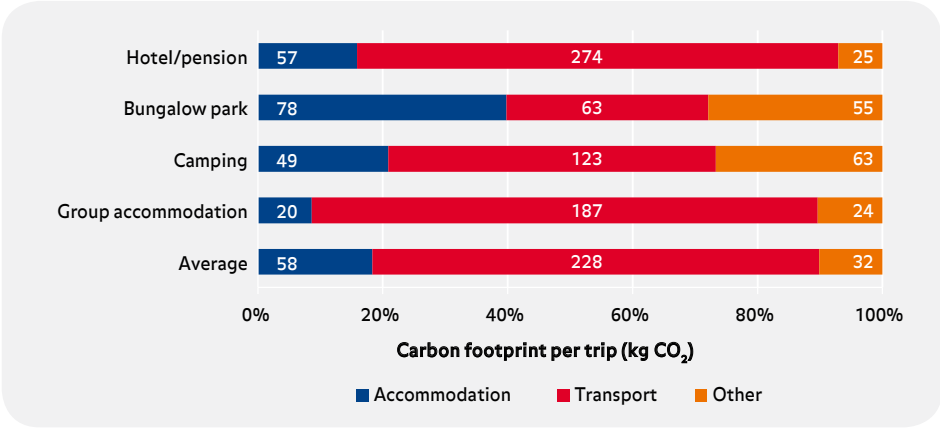
Figure 4.9 Share of the components transport, accommodation and 'other' of the carbon footprint attributable to NL per transport mode, in kg CO_2 per trip, 2009



Source: analyses of NBTC ITR2009

Finally, Figure 4.10 shows the shares of transport, accommodation and 'other' aspects of the carbon footprint per trip and the total footprint based on the accommodation type used. Inbound trips spent in hotels have the largest impact on the environment. The share of accommodation of the total carbon footprint of hotel stays is relatively low (16%), because they are more frequently combined with air transport, which weighs heavier on the total carbon footprint. Because of a shorter average travel distance and higher than average length of stay in bungalow parks, the CF of accommodation is the largest (both absolute and percentage), while the CF of transport is the lowest.

Figure 4.10 Share of the components transport, accommodation and 'other' of the carbon footprint attributable to NL per accommodation type, in kg CO_2 per trip, 2009



5 Eco-efficiency attributable to NL

The carbon footprint attributable to NL of a trip (or per day) can be compared with tourist spending attributable to the Netherlands. 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 5.1 gives an overview of eco-efficiency values for trips to the Netherlands. The average eco-efficiency of inbound trips is 0.74 kg CO_2 per Euro. Despite the lower average amount of spending per trip, European trips have a much better eco-efficiency than intercontinental trips because of a significant difference in carbon footprint.

Table 5.1 Eco-efficiency, carbon footprint and spending per trip attributable to the stay in the Netherlands, 2009

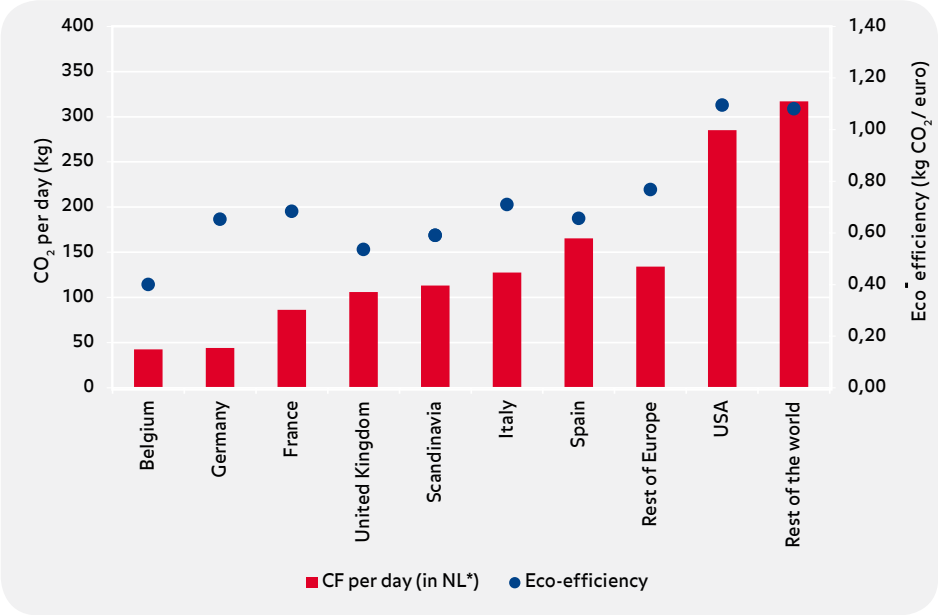
	CF per trip* (kg CO_2)	Spending per trip (euro)	Eco-efficiency (kg CO_2/euro)
Europe	225	367	0.61
Intercontinental	872	804	1.08
Average	319	430	0.74

Source: analyses of NBTC ITR2009

**) The carbon footprint in the Netherlands is calculated by allocation of emissions from transport for the length of stay in the Netherlands only.*

The eco-efficiency attributable to the stay in the Netherlands varies considerably between countries of origin (see Figure 5.1 and Figure 5.2). Belgium has the most favourable eco-efficiency with around 0.40 kg CO_2 per Euro. Trips from Germany have a lower carbon footprint per trip compared to France, UK and Scandinavia, but the eco-efficiency is similar due to the difference in average spending per trip. Intercontinental trips generally have a worse eco-efficiency than European trips because of significantly higher carbon emissions. Trips from the United States have an eco-efficiency of 1.09 kg CO_2 per Euro, close the average for intercontinental trips. In general, the differences between destinations are smaller in eco-efficiency than in the carbon footprint per trip or per day. Apparently, tourist spending increases along with their emissions.

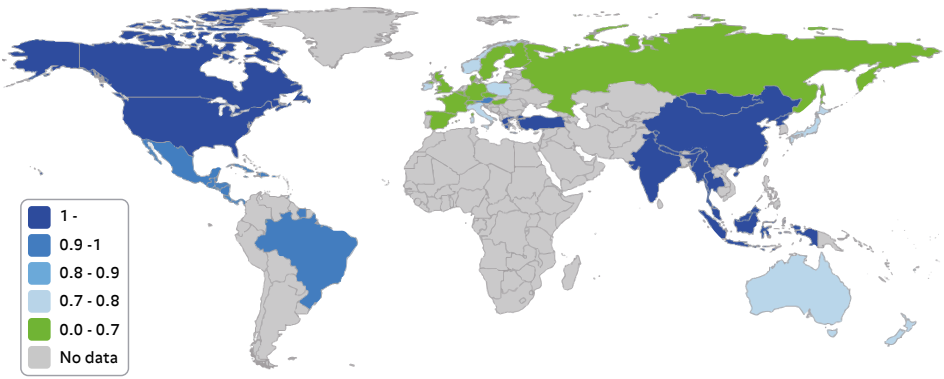
Figure 5.1 Eco-efficiency per trip and carbon footprint per day attributable to the stay in the Netherlands, by country of origin, 2009



Source: analyses of NBTC ITR2009

*) The carbon footprint in the Netherlands is calculated by allocation of emissions from transport for the length of stay in the Netherlands only.

Figure 5.2 Eco-efficiency (kg CO_2 / euro) attributable to NL by origin, 2009



Source: analyses of NBTC ITR2009

) purple represents areas without data.

The eco-efficiency of the whole Dutch economy is approximately 0.30 kg CO_2/euro derived by dividing the total CO_2 emissions of 170.2 Mt (see Table 4.1) by the 2009 GDP of euro 571 billion (CBS 2011). Hence, most trip types and destinations presented in this section are less eco-efficient, as is shown in Table 5.2 and Table 5.3. The average inbound trip per coach/bus or by train, the most eco-efficient trip types based on the transport mode used, are similar to the amount of emissions per Euro of the Dutch economy. Camping trips have the worst eco-efficiency by far because of the low amount of spending associated with the accommodation type. Trips by airplane have the worst eco-efficiency compared to other transport modes. The large amount of spending per trip by airplane is not enough to fully compensate for the large carbon footprint associated with this transport mode.

Table 5.2 Eco-efficiency, carbon footprint and spending per trip, based on accommodation type used, 2009

Accommodation type	CF attributable to NL per trip * (kg CO_2)	Spending attributable to NL per trip (euro)	Eco-efficiency (kg CO_2 / euro)
Hotel / pension	356	504	0.71
Bungalowpark	196	222	0.88
Camping	234	167	1.40
Group accommodation	231	289	0.80
Average	319	430	0.74

Source: analyses of NBTC ITR2009

**) The carbon footprint in the Netherlands is calculated by allocation of emissions from transport for the length of stay in the Netherlands only.*

Table 5.3 Eco-efficiency, carbon footprint and spending per trip, based on mode of transport used, 2009

Main transport mode	CF attributable to NL per trip * (kg CO_2)	Spending attributable to NL per trip (euro)	Eco-efficiency (kg CO_2 / euro)
Airplane	552	676	0.82
Boat / ferry	246	459	0.53
Train	94	326	0.29
Car	167	240	0.69
Coach / bus	81	370	0.22
Bicycle / moped	139	295	0.47
Average	319	430	0.74

Source: analyses of NBTC ITR2009

**) The carbon footprint in the Netherlands is calculated by allocation of emissions from transport for the length of stay in the Netherlands only.*

6 Conclusions and recommendations

This report was based on the Inbound Tourism Research (ITR2009) of the Netherlands Board of Tourism & Conventions (NBTC). Additionally, information on the carbon footprint of various touristic activities and tourist trip components, collected and calculated by the Centre for Sustainable Tourism & Transport of NHTV Breda University of Applied Sciences over the years, has been used (Peeters 2013).
The inbound tourist trip types with the highest average environmental impact per day are the following (between brackets the deviation of the average footprint (attributable to NL) of inbound tourism to the Netherlands, 104 kg CO_2 per day):

- short intercontinental trips (+766%)
- trips from extreme long-haul countries, e.g. Japan (+278%) and Oceania (+208%)
- the average trip of intercontinental origin (+192%), e.g. from the USA (+174%)
- trips by airplane (+92%)
- trips spent in hotels/pensions (+35%)

The inbound tourist trip types with the lowest carbon footprint attributable to NL per day are:

- trips by train (-71%)
- trips by bicycle or moped (-64%)
- trips from nearby countries, e.g. from Belgium/Luxembourg (-59%) and Germany (-57%)
- trips by car (-54%) or coach (-61%)
- trips spent in a bungalow park (-64%) or camping (-50%)
- the average trip of European origin (-30%).

The large influence of the country of origin on the environmental impact of tourism is obvious, followed by the choice of transport mode, though the latter is closely related to the country of origin, as the airplane is the only realistic choice for long-haul trips. The choice of accommodation also has an impact, but it is likely that the type of accommodation is also associated with the distance tourists travel and the transport mode used. For instance, camp sites and bungalow parks are often associated with short-distance holidays, whereas hotels and group accommodations are more commonly associated with long-haul trips by air transport.

The calculation of the eco-efficiency of holidays, expressed in holiday CO_2 emissions per Euros spent, primarily shows that the average inbound tourist to the Netherlands produces two and a half times as much emissions per Euro as the Dutch economy (0.74 kg CO_2/ Euro compared to 0.30 kg CO_2/ Euro; see chapter 5). Here also, there are large differences be-

tween various tourist origins and trip types. Intercontinental trips have the least favourable eco-efficiency (e.g. around 1.09 kg/ Euro for trips from the USA), while countries such as Belgium have the most favourable (around 0.40 kg/ Euro). Still, these differences are smaller than for instance the holiday carbon footprint per day, because most high impact holidays are taken by high spenders. Only inbound trips from tourists by coach/bus and train are lower than the eco-efficiency of the Dutch economy (0.22 respectively 0.29 kg CO_2/ Euro compared to 0.30 kg CO_2/ Euro).

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 inbound tourism and the Netherlands as international destination. This insight may help to develop policies towards more sustainable inbound tourism. Decision makers will not only have to assess the total economic and environmental impacts, but also the eco-efficiency and for instance the future market potential. All these variables may give contradicting signals to the policymaker. Such insights might be taken in consideration when developing the strategy for Dutch inbound tourism promotion.

The results can aid policymakers with the development of mitigation policy. For example, the consequences of emissions trading for aviation, for the commercial viability of certain markets can be assessed using the data on carbon footprints.

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Annex I: List of terms and abbreviations

Term, abbreviation	Description
B&B	Bed and breakfast
CF	Carbon footprint; expressed in kg CO_2 emissions
CO_2	Chemical formula of carbon dioxide
CSR	Corporate Social Responsibility
CSTT	Centre for Sustainable Tourism & Transport (part of NHTV Breda University of Applied Sciences)
Eco-efficiency	The ratio of the carbon footprint to tourist spending; expressed in kg CO_2 per Euro spent
GDP	Gross domestic product
Great circle distance	Shortest route between two points measured along the earth's surface
ITR	Inbound Tourism Research
LULUCF	Greenhouse gas emissions from forestry and land use
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 ton, equivalent to 1 billion kg
NBTC	Netherlands Board of Tourism & Conventions
NL	the Netherlands
Ppm	Part per million (one in a million parts)
VFR	Visiting friends and relatives

Annex II: Extended methodology

Number of accommodations bias

A large part of the IT2009 survey has been measured at check-in at accommodations. This means that guests using more than one accommodation during their stay (as measured with variable V5), have a higher chance to appear in the survey. This bias needs correction, which has been performed by creating a weight factor that is 100/'nr of accommodation visited in NL' (variable V5). V5 has first been corrected as in some cases it exceeded the length of stay in the Netherlands (V4). In those cases it has been reduced to the value of V4. The effect of this bias correction is that the total length of stay slightly reduces because tourists visiting a large number of accommodations also by definition stay long, but are now weighted less in the database.

Weight factor for nights

The weight factor given in the data file was based on weighing number of guests as recorded per accommodation by CBS for the condensed country distribution. However, this caused rather strong differences in the totals for many of the detailed countries as given by CBS Statline (CBS 2013) for guests from hotels, pensions and youth accommodations for 2009. The second problem with weighing on number of guests given by CBS is that the carbon footprint analysis should be based on number of tourists entering the Netherlands and that ITR2009 should give this number (each respondent is a tourist at the border not a tourist at an accommodation). With the original guest in accommodation weighing too many nights are measured from the length of stay of the whole trip within the Netherlands (variable V4) as compared with CBS published data. As CBS actually measures number of nights and number of guests at accommodations, but not number of tourists entering the Netherlands we have now weighted the ITR2009 data based on the number of nights given by CBS.

The following procedure has been followed:

1. First the values of number of accommodations visited that are larger than the number of nights are cut-off at this number of nights.
2. CBS (2013) gives the number of nights in hotels, pensions and youth hostels for 40 countries, but the totals (including campsites, B&B, etc.) for only ten countries plus some compounds. This has been corrected by using a conversion factor between the extended and compound classification for all compounded countries and applying this to certain countries of the extended country classification. Table 4 gives the number of nights as given by CBS (2013) and Table 5 gives the final use of conversion factors to all accommodations per extended country classification (as given by variable V2A) and the weight factors applied per detailed country with data (some countries without any entry in the IT2009 file have been omitted).

3. As we have now weighted as if each respondent was representing a night, we need to divide the weight factor for each respondent by the length of stay within the Netherlands (V4) to arrive at the total number of night as given by the weighted sum of V4.

Table 4 Accommodation factors for the compound country classification.

Country	Nights all accommodation types	Nights Hotel -Pension-YH	Accommodation correction factor
Germany	10,172,700	2,752,100	3.696
Belgium	3,039,200	1,176,500	2.583
Great-Britain	2,771,300	2,399,900	1.155
France	1,137,200	875,400	1.299
Switzerland	340,800	266,400	1.279
Italy	741,200	678,500	1.092
Spain	726,300	678,500	1.070
Denmark	289,400	215,000	1.346
Sweden	181,500	163,300	1.111
Other countries Eurozone	892,100	727,600	1.226
Other Europe	1,452,200	1,314,200	1.105
USA	1,861,200	1,825,900	1.019
Asia	1,022,800	990,700	1.032
Australia and Oceania	214,500	204,100	1.051
Africa	171,200	160,400	1.067
Total	25,013,600	14,428,500	1.734

Table 5 The accommodation factors and weight factors used for the extended country classification.

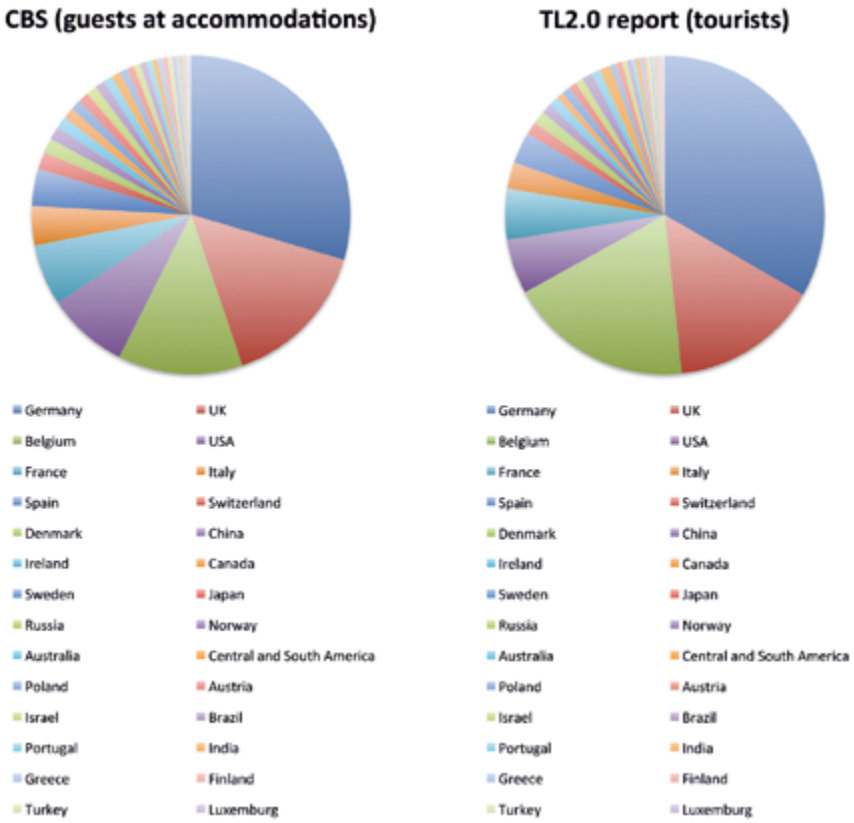
Country	Accommodation correction factor base	Accommodation correction factor	Weight factor
Canada	USA	1.019	127
USA	USA	1.019	105
Brazil	USA	1.019	579
Central and South-America	USA	1.019	235
Australia	Australia and Oceania	1.051	79
New-Zealand	Australia and Oceania	1.051	586
Japan	Asia	1.032	36

Country	Accommodation correction factor base	Accommodation correction factor	Weight factor
Indonesia	Asia	1.032	2087
Israel	Asia	1.032	183
Taiwan	Asia	1.032	197
China	Asia	1.032	134
Hong Kong	Asia	1.032	61
South-Korea	Asia	1.032	131
India	Asia	1.032	32
Asia	Asia	1.032	224
Belgium	Belgium	2.583	162
Denmark	Denmark	1.346	79
Germany	Germany	3.696	155
France	France	1.299	102
UK	UK	1.155	96
Italy	Italy	1.092	65
Norway	Other Europe	1.105	247
Turkey	Other Europe	1.105	77
Poland	Other Europe	1.105	193
Czech Republic	Other Europe	1.105	99
Hungary	Other Europe	1.105	369
Russia	Other Europe	1.105	39
Other Europe	Other Europe	1.105	215
Luxemburg	Other countries Eurozone	1.226	198
Ireland	Other countries Eurozone	1.226	259
Portugal	Other countries Eurozone	1.226	225
Austria	Other countries Eurozone	1.226	129
Finland	Other countries Eurozone	1.226	417
Greece	Other countries Eurozone	1.226	74
Spain	Spain	1.070	48
Sweden	Sweden	1.112	24
Switzerland	Switzerland	1.279	149

The resulting totals are within 1% (in most cases even within 0.1%) to the ones published by CBS for the extended country classification. The total number of tourists now amounts to 8.2 million, which is 19% lower than the number of guests published by NBTC (2009). The difference can be attributed to several causes. See section 2.4.

The number of tourists per country has inevitably shifted compared to those published by CBS (2013) and NBTC (2009). Figure 3 shows the shares per country, sorted for the guests at accommodations as published by CBS. The largest three are still Germany, UK and Belgium, but UK and Belgium swap places in the new tourist arrivals calculated in our analysis. 80% of arrivals at accommodations are reached with 7 countries (Germany, UK, Belgium, USA, France, Italy and Spain) in the CBS data, and with 6 countries in our analysis (Germany, Belgium, UK, USA, France and Spain).

Figure 3 Comparison of distribution per country (only those with valid numbers for both datasets)



The average length of stay in the Netherlands is now 3.16, the average length of stay per accommodation is 2.8 and the average number of accommodations visited during the stay in the Netherlands is 1.18. Figure 2.1 shows the length of stay within the Netherlands and for the total trip.

The impact of tourism on the environment, in general and specifically on the climate, is receiving plenty of attention. In 2008, the Centre for Sustainable Tourism and Transport of NHTV Breda University of Applied Sciences and NRIT Research, in collaboration with NBTC-NIPO Research, published the (Dutch) pilot report 'Travelling large in 2005'. In this report the environmental impact of Dutch holiday behaviour was calculated. The carbon footprint was one tool used for this: the emissions of carbon dioxide are largely responsible for climate change. For the first time we now present a detailed report on the carbon footprint of inbound tourism in 2009 and roughly compare the results with the carbon footprint of outbound tourism in the same year.

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