

Measuring the Sustainability of Tourism in Germany

Report on the 2nd project phase: Updating of the Tourism Sustainability Satellite Account & Development of complementary indicators

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Abstract

The project presented here has pursued two main goals. First, the so-called *Tourism Sustainability Satellite Account* (TSSA), an accounting system for measuring the sustainability of tourism in Germany, which was initially developed and applied in the previous project phase¹, was repopulated with the currently available data. The TSSA is an extended tourism satellite account (TSA) and indicator system respectively that is essentially based on the statistical frameworks of national accounts (NA) and environmental economic accounts (EEA). In addition, the TSSA includes social indicators that measure the sustainability of labour relations in tourism. The TSSA thus enables a systematic attribution of the economic, environmental and social impacts of tourism to tourism-related economic sectors at the national level.

The results of the TSSA update show that tourism in Germany continues to make a significant contribution to value added and job creation. Around 3.6 % of total gross value added and 6.1 % of employment were attributable to tourism in Germany in 2019. However, labour productivity in the tourism sector remains relatively low.

In terms of environmental impact, energy consumption in the tourism sector has slightly increased compared to the last measurement (based on data from 2015 or 2016). However, energy intensity has decreased over the same period. Energy intensity in tourism is about as high as for the average of the German economy. Regarding tourism-induced greenhouse gas (GHG) emissions, and particularly emissions intensity, the situation has also improved, even though the GHG emissions intensity of tourism is still well above the average of the German economy. Within the tourism sector, transportation (in particular aviation and shipping) contribute the most to energy use and GHG emissions. By contrast, tourism-induced water consumption appears to be less of a problem in Germany. The water intensity of tourism is significantly lower than the average of the German economy. Within the tourism sector it is the highest in accommodation and gastronomy.

In terms of the social sustainability dimension, the relatively low and decreasing income gap between men and women (known as the Gender Pay Gap) in the tourism sector over time is worth mentioning. By contrast, all other indicators regarding the working conditions in tourism

¹ The first project phase was completed in June 2020. The results were published as an interim report (in German, with an extensive summary in English) under the title “Messung der Nachhaltigkeit des Tourismus in Deutschland – Entwicklung eines Tourismus-Nachhaltigkeits-Satellitenkontos” (Umweltbundesamt, Texte 61/2021).

continue to perform less favourably. Consequently, employees in the tourism sector still assess the working conditions as worse compared to the average of the overall economy.

It has already been shown in the previous project phase that for some sustainability indicators, especially from the ecological dimension, a consideration within the framework of the TSSA approach is not possible without restrictions. This is due, among other things, to the insufficient data available from official statistics and the complexity of causally attributing certain ecological effects to tourism activities. In the second part of the project presented here, a detailed research of existing data bases was therefore conducted for the environmental indicators "biodiversity", "water quality", "noise pollution", "land use", "air emissions" and "waste generation" as well as for the social indicator "tourism acceptance". Based on this, it was evaluated to what extent alternative accounting approaches - as a supplement to the TSSA measurement system - can indicate the tourism effect. The data screening initially confirmed the insufficient data availability at national level.

The subsequent feasibility analysis yielded that a spatial differentiation according to the degree of tourism relevance (based on tourism density and intensity) and an ensuing analysis of the change in environmental conditions in regions strongly influenced by tourism in comparison to the overall German average represents an opportunity to quantify the contribution of tourism e.g. to land use. On the one hand, existing official regional data could be used here. On the other hand, additional data collections at the local level would also be essential for certain environmental indicators in the future. In other cases, in particular for biodiversity impacts and solid waste generation, the preconditions for suitable data availability must be created first. By contrast, the acceptance of tourism by residents can easily be measured through standardised surveys.

Summary

PROJECT PART A

In Part A of the present report, the so-called Tourism Sustainability Satellite Account (TSSA), developed in the previous project phase, was again filled with data (Balaš et al. 2021). The TSSA is an indicator measurement system that can be used to quantify the economic, environmental and social impacts of tourism at the national level. The TSSA approach is based on the methodology of the Tourism Satellite Account (TSA) and thus follows a production- or supply-side allocation of tourism activities according to the classification of economic activities (NACE Rev. 2 and WZ 2008, respectively) in the national accounts. The following economic sectors are classified as "relevant for tourism":

- ▶ WZ 55: Accommodation
- ▶ WZ 56: Gastronomy
- ▶ WZ 49: Land transport and transport via pipelines
- ▶ WZ 50: Water transport
- ▶ WZ 51: Air transport
- ▶ WZ 77: Rental and leasing activities
- ▶ WZ 79: Travel agency, tour operator and other reservation service
- ▶ WZ 90-93: Arts, entertainment and recreation

All other economic sectors that are considered particularly relevant to tourism according to the definition described above are grouped and defined as "remaining" economic sectors. This includes, for example, retail trade.

Within the framework of the TSA, so-called tourism quotas are determined for all relevant economic sectors, which indicate the level of sector-specific gross value added that is caused by tourism demand. In this way, classic economic indicators such as total gross value added and job creation by tourism can be calculated. In the framework of the TSSA approach, the economic assessment of the tourism economy is extended by an ecological and social sustainability component. In order to quantify the ecological impact, e.g. the resource consumption and greenhouse gas emissions of the German tourism industry, data from the Environmental Economic Accounts are used in particular. In the case of social sustainability, official statistics consistent with the NACE Rev. 2/WZ 2008 classification are primarily used as well.

TSSA results can be used in many ways: For example, they provide orientation for the development and review of tourism policy strategies and measures. Through the regular collection of the corresponding data, important information on the status of the implementation of sustainability-related goals (as formulated, for example, in the German Sustainability Strategy) in tourism can be generated, so that policy instruments in the field of tourism could be evaluated with regard to their sustainability impact. The TSSA indicators can also be used to identify sector trends with regard to sustainable development and key negative impacts of the tourism industry due to the economic sector-specific differentiation. In addition, TSSA indicators can also be used in the context of future benchmarking systems to compare the sustainability

performance of certified tourism actors/businesses with non-certified ones. For example, for accommodation businesses, ecological factors such as energy consumption, greenhouse gas emissions and water use per gross value added or per overnight stay could be collected and compared with national (TSSA) values as a reference.

By refilling the already existing TSSA measurement system with current data, it has been possible to check how key sustainability indicators of German tourism have developed over time for the first time. The data for the first TSSA calculation referred to the years 2014 to 2016, depending on the sustainability dimension (Balaš et al. 2021). The current calculation presented here is based on data from 2018 or 2019, which means that the partly massive distortions in tourism resulting from the Corona pandemic have not yet been taken into account. In order to establish comparability, it was necessary to apply the same methodology and use the same data basis. This was largely successful; but regular data revisions and changes in the calculation bases of the national accounts and the national accounts make consistent comparison over time difficult.

As in the first project phase, the very broad definition of tourism by the World Tourism Organization is used, which is also the basis for the internationally accepted calculation of tourism satellite accounts. This covers all travel motives, including business trips, as well as overnight and day trips, provided the latter take place outside the usual environment. Tourism is understood as an economic activity in which companies offer tourism products and services. In the case of the economic and social sustainability dimension, the reference area of the study is Germany, both as a destination for domestic and foreign tourists and as a location for tourism companies that may also be active in outbound tourism, such as tour operators or airlines. In the case of the ecological sustainability dimension, the German tourism industry is taken as the frame of reference in accordance with the so-called national principle. The sustainability dimensions examined were selected, in addition to practicality reasons such as data availability, on the basis of international and national target systems such as the Sustainable Development Goals of the United Nations or the German Sustainability Strategy, as well as on the basis of sustainability aspects that are of particular importance for tourism.

The results of the second filling of the TSSA with the currently available data presented here can be summarised as follows:

a) Economic sustainability

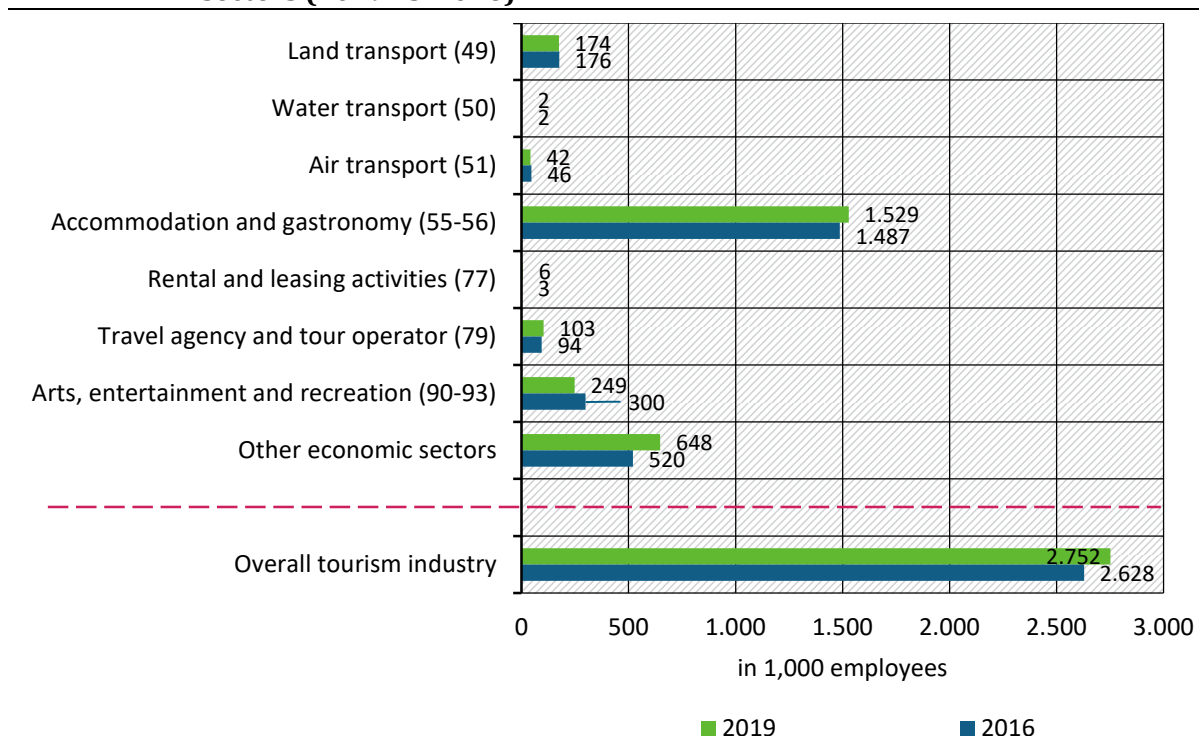
In economic terms, the German tourism industry experienced a positive development between 2016 and 2019. Tourism-related **gross value-added** rose nominally by around 10.6 %. However, tourism caused an increase in value added especially in those economic sectors that are only marginally related to the tourism industry. In addition, the hospitality industry also recorded a positive development. The share of tourism in the German economy as a whole remains at 3.9 %.

In 2019, 6.1 % of the German **labour force** worked in the tourism industry, with more than half being employed in the hospitality industry. This figure has increased since 2016, but only by 4.7 %, i.e. significantly less than tourism-induced value added, and again primarily less than in the rest of the economy (see Figure 1). The lower growth in the number of employees compared to value added is possibly already an indication of the shortage of skilled workers, from which the tourism industry suffers in particular.

Another problem related to employment in tourism are the low **gross salaries of** employees. Although these have increased significantly from 2015 to 2019, they are still far below the average in the German economy. The situation is particularly problematic in the hospitality industry with an average gross annual salary of around 18,000 euros (the average salary in Germany is about twice as high), partly due to numerous part-time and seasonal employment work contracts. In contrast, salaries are significantly higher in shipping, but especially in aviation.

Labour productivity (gross value added per person employed) in tourism is also significantly (about one third) below the cross-sector average in Germany. It also increased only slightly between 2016 and 2019. These figures confirm that tourism is essentially a labour-intensive service industry with comparatively low value added per employee employed.

Figure 1: Employed persons considering the respective tourism quotas of the economic sectors (2019 vs. 2016)



Info: Figures in 1,000 employed persons.

Source: Own calculations and illustration based on Balaš et al. (2021); Statistisches Bundesamt (2021a).

b) Ecological sustainability

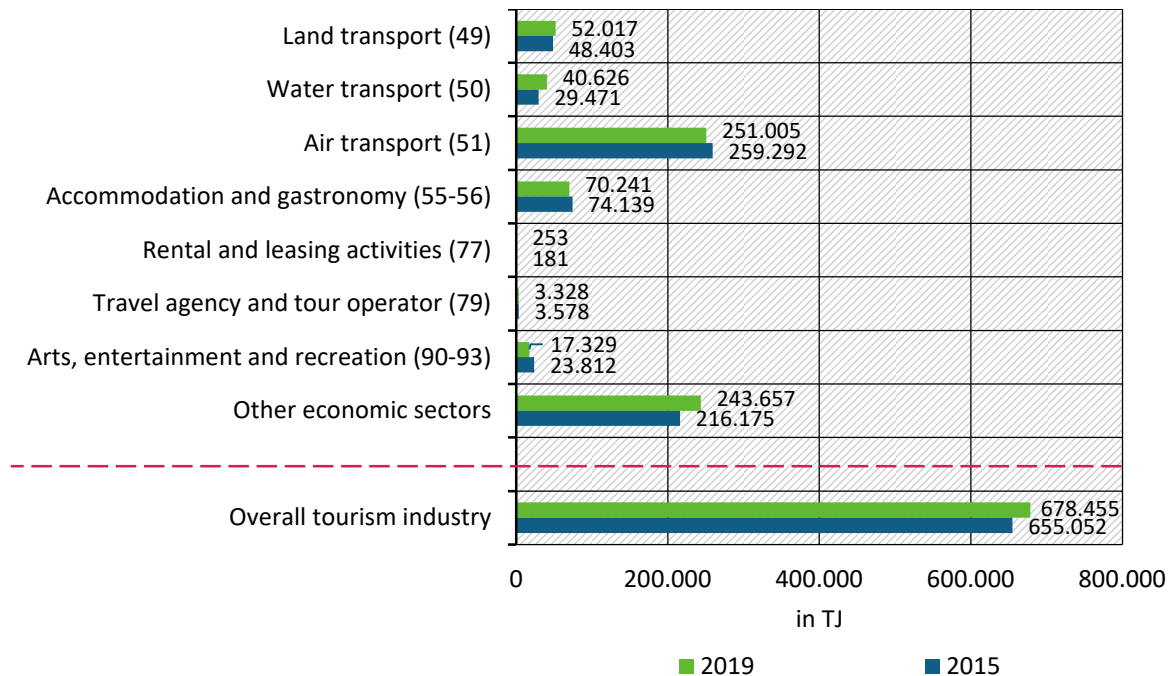
In the environmental field, the TSSA maps the areas of energy use, greenhouse gas emissions (GHG emissions), air pollutants and water use. A comparison with the previous study is only possible regarding to the first two sustainability dimensions. The generation of air pollutants was not previously surveyed, and different parameters had to be used for water use.

The absolute **energy consumption**² of the German tourism industry increased slightly from 2016 to 2019. The share of tourism-related energy consumption in the German economy as a whole also increased, from 3.7 % to 4.0 %. The "lion's share" of total energy consumption

² Specifically: "energy use". For reasons of more widespread use, the term "energy consumption" is usually used here.

continues to be accounted for by air transport (despite a slight decline in energy consumption) and the remaining, rather tourism-unspecific economic sectors, each with more than one third. In tourism-induced land and water transport, energy use has increased, whereas in the "stationary" sub-sectors it has slightly decreased (cf. Figure 2).

Figure 2: Tourism-induced energy consumption by economic sector (2019 vs. 2015)

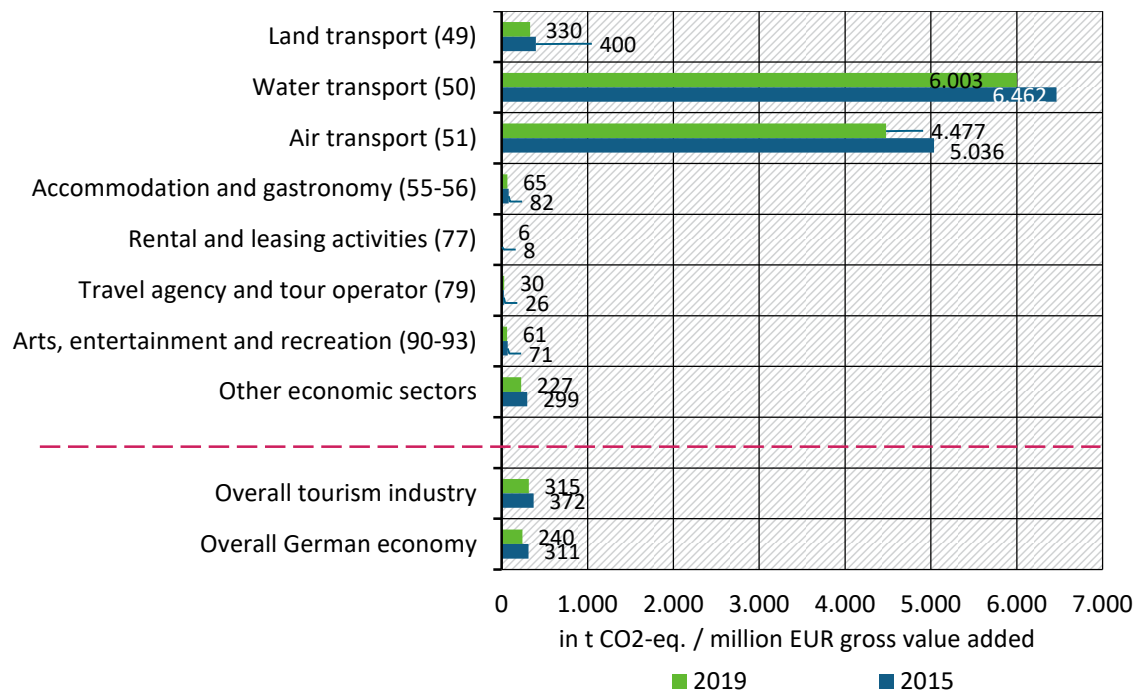


Source: Own calculation and illustration based on Statistisches Bundesamt (2012b).

The energy intensity of the tourism industry has decreased between 2015 and 2019 and currently corresponds on average to the energy intensity of the German economy as a whole. It is still the case that aviation and shipping have an extremely high energy intensity, although declines can be observed in both economic sectors over time. The stationary sub-sectors of tourism can also be assessed positively in terms of the ratio between energy consumption and value added over time.

In contrast to energy consumption, **GHG emissions** fell marginally in the period between 2015 and 2019. Their tourism-induced share in the German economy is now at 5.2 %. Like energy intensity, the GHG intensity of the tourism industry has decreased significantly. However, it is still significantly higher than the average value of the German economy, where the decline has been even more pronounced (cf. Figure 3). A look at the tourism sub-sectors shows that in terms of GHG intensity, the discrepancy between stationary service providers on the one hand and air and water transport on the other is even greater than for energy intensity. This is presumably due to the fact that renewable energies are increasingly used in the former, whereas it is much less the case in the transport sector. For the transport sector, however, greenhouse gas and energy intensity figures also show the differences between land transport with significantly lower values than for air and water transport.

Figure 3: GHG emission intensity of tourism-relevant economic sectors, the tourism industry and the German economy as a whole (2019 vs. 2015)



Source: Own calculations and illustration based on Statistisches Bundesamt (2021a, c).

As in the first project phase, GHG emissions of tourism were not only considered on the production side, but also on the **consumption side** with regard to GHG emissions contained in tourism **products**. The analysis refers to domestic tourism consumption and includes not only direct emissions resulting from consumption, but also indirect emissions resulting from the production and transport of products and fuels. However, only CO₂ emissions are considered. Due to a limited data availability, it was only possible to make a comparison between 2015 and 2017, which should be interpreted with great caution, as the underlying statistics contain different data allocations, especially in the transport sector. The central result is that tourism consumption, including the upstream value chains, causes 15.7 % of the CO₂ emissions of total consumption in Germany. Of these, about 70 % are transport-related, but the share of restaurant and accommodation services is also significant.

For the first time, the tourism-induced, locally effective **air pollutants** nitrogen oxides and particulate matter were surveyed within the second run of TSSA. In tourism, these are almost exclusively generated in the transport sector. The intensity of these emissions compared to gross value added is almost three times or twice as high in tourism as in the German economy as a whole, which in turn is due to the high transport intensity in tourism. In the case of nitrogen oxide emissions, aviation and shipping are particularly problematic, and in the case of particulate matter, land transport as well as shipping.

Finally, in the ecological sustainability dimension, the tourism-induced **water consumption**³ was calculated. The most recent data, however, are from 2016. A comparison with the results of the previous study is not possible due to the use of different parameters. Tourism-induced water consumption is for the most part attributable to the non-tourism-specific "remaining" economic

³ Specifically: "water use". For reasons of more widespread use, the term "water consumption" is usually used here.

sectors. Within the core tourism sectors, the hospitality industry stands out above all. While tourism in Germany is to be regarded as problematic above average in terms of energy use and GHG emissions, its water consumption can be assessed as much more favourable compared to other sectors. Tourism-induced water consumption amounts to only 1.7 % of the entire German economy. The tourism water intensity is less than 50 % of the average of the German economy.

c) Social sustainability

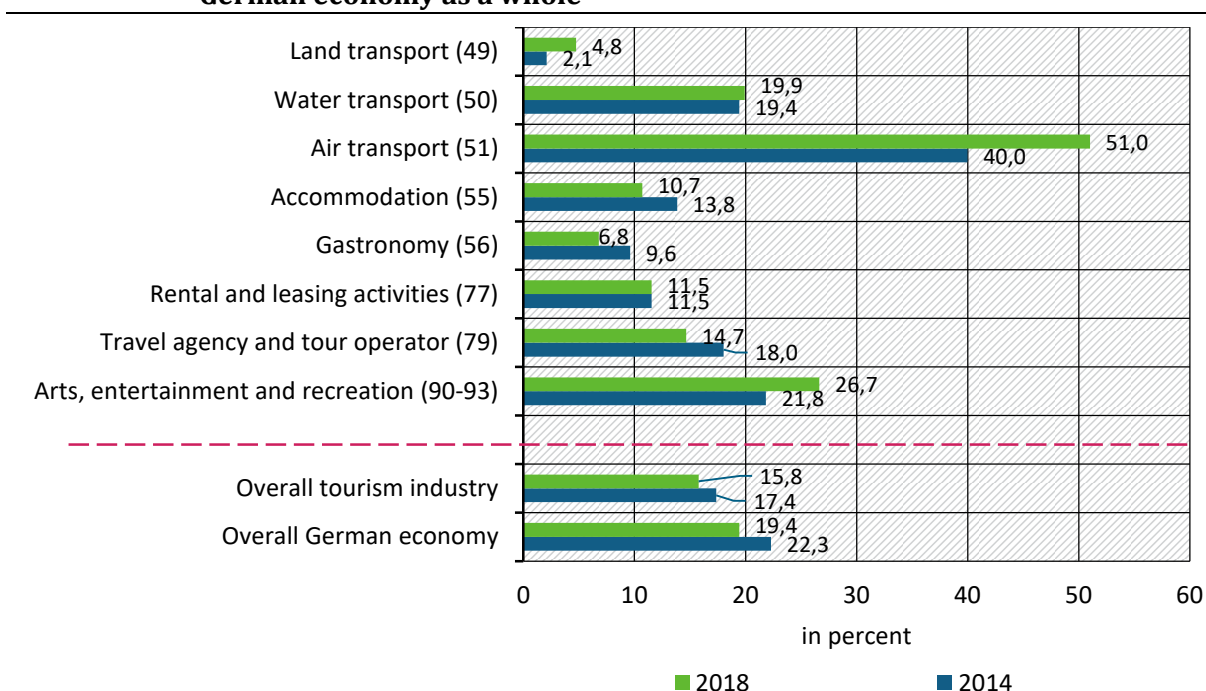
As in the previous study, various regularly collected data of the Federal Statistical Office as well as the TSSA-compatible index "**Good Work**" of the German Labour Union Federation (DGB) were related to tourism. The DGB survey is representative (although with very low case numbers in some sub-sectors), but is based on subjective assessments of the respondents. According to the survey, the job satisfaction of tourism employees in 2019 was in the middle range, only slightly below the average value for all sectors. The value is practically unchanged since 2018. Within the tourism industry, air transport stands out as having an above-average positive rating, while shipping is the least well rated.

The difference in pay between women and men is less predominant in tourism than in the German economy as a whole. The so-called **gender pay gap**⁴ was 15.8 % in tourism in 2018. In Germany as a whole, by contrast, it was 19.4 %. The value has fallen both in tourism and in Germany as a whole since 2014. It is particularly pronounced in aviation, alongside culture and entertainment. In contrast, it is only 6.8 % in the hospitality industry (see Figure 4).

In line with low gross salaries, the **low-wage rate** in the German tourism industry is also high. It was 40.7 % in 2018 compared to 21 % in the German economy as a whole. Low wages are most prevalent in the hospitality industry. Here they even dominate with a share of over 70 %. Comparatively, travel agencies and tour operators fare best with a low-wage rate of just over 20 %. The values have hardly changed since 2014.

⁴ Defined as the percentage difference in the average gross hourly earnings of women compared to those of men. The value is "unadjusted", i.e. all occupations in tourism are compared. The value does not refer to the same activity.

Figure 4: Gender pay gap in tourism-relevant sectors, the tourism industry and the German economy as a whole



Source: Own calculations and illustration based on Balaš et al. (2021), Statistisches Bundesamt (2018a).

Excessive working hours are relatively uncommon in tourism, with a share of 6.9 % (2019). However, the value is slightly above the cross-sector average of 5.4 %. The only sector with an above-average frequency of very long working hours is shipping (22.9 %), which is presumably due to the fact that the crews on cruises stay on board for the entire trip. A comparison with the previous survey is not possible as the basis of calculation has changed.

Involuntary **fixed-term employment** was widespread in the German tourism industry in 2019 with a share of 36 %. However, the value is not significantly higher than the average in the German economy as a whole (31.1 %). The situation is roughly the same in all tourism sub-sectors and has declined slightly since the last survey with figures from 2018.

In order to cover the aspect of social sustainability, also on the part of consumers, the indicator "**poverty-related denied participation**" in tourism⁵, which is surveyed annually by the European statistics authority Eurostat, was used again. Between 2010 and 2019, this indicator fell continuously from 23.7 % to 12.8 %. This puts Germany in a very good position as a source market compared to the European Union average (27.4 %).

d) Interpretation and changes at a glance

Looking at the development of the tourism sustainability indicators as a whole, a mixed picture emerges. In the economic sector, the trend was positive until 2019, but labour productivity remained considerably below the average of the German economy.

⁵ Defined as the impossibility of being able to afford a one-week holiday trip per year.

Table 1: Overview and changes in sustainability indicators of the German tourism industry

Indicator	Share in the German economy ⁶	Intensity or comparison to the overall economy ⁷	Development of the indicator
Economic sustainability			
Gross value added	3.9 %	n.a.	↑
Employment	6.1 %	n.a.	↗
Labour productivity	n.a.	☹☹	↗
Ecological sustainability			
Energy use	4.0 %	n.a.	↘
Energy intensity	n.a.	☹	↗
GHG emissions	5.2 %	n.a.	↗
GHG emission intensity	n.a.	☹	↗
CO ₂ in tourism products	15.7 %	n.a.	-
NO _x emissions	10.7 %	☹☹	-
Particulate matter emissions (PM ₁₀)	7.6 %	☹☹	-
Particulate matter emissions (PM _{2.5})	7.8 %	☹☹	
Water use	1.7 % ⁸	☺☺	-
Social sustainability			
Job satisfaction	n.a.	☹	→
Gross salaries	n.a.	☹☹	↑ ⁹
Low-wage rate	n.a.	☹☹	→
Gender Pay Gap	n.a.	☹	↗ ¹⁰
Excessive working hours	n.a.	☹	-
Involuntary fixed term	n.a.	☹	↗ ¹¹
Participation barred due to poverty	n.a.	n.a.	↑

⁶ Figures refer to 2019 unless otherwise stated. The ecological indicators refer to the share in the German economy excluding private households.

⁷ Figures refer to 2019 unless otherwise stated.

⁸ Reference year 2016.

⁹ 2015 - 2019.

¹⁰ 2014 - 2018.

¹¹ 2018 - 2019.

Legend: n.a. = not applicable

☺☺ = significantly better; ☺ = better, ☹ = comparable, ☹ = worse, ☹☹ = significantly worse

Arrows pointing upwards indicate a desirable development: Arrows pointing downwards indicate an undesirable development. Arrows pointing sideways indicate an unchanged situation. Depending on the respective indicator, this may mean that the indicator value increases or decreases. The reference period is from 2016 to 2019, unless noted otherwise. A hyphen (-) means that a comparison is not possible due to lacking data.

Source: Own compilation.

In the ecological dimension, energy consumption in particular has remained problematic until 2019. Although energy intensity has developed positively, absolute consumption has continued to increase instead of decreasing. However, these challenges are largely due to tourism-induced transport, which is also responsible for an above-average share of tourism in air pollutant emissions. Tourism consumption, including the upstream emissions contained in products and services, also leads to high CO₂ emissions.

Only in terms of water use, German tourism is considered to be significantly more resource-efficient than the German economy on average.

The social sustainability dimension of German tourism cannot be described as satisfactory either. Almost all indicators, especially gross salaries, are below the respective averages of the German economy. Only the gender pay gap is lower in tourism than in most other sectors. However, all social indicators have developed positively or at least have not deteriorated. Gross salaries in particular have risen significantly on average, but this has not led to a reduction in the high average low-wage rate. There is a need for action above all in the hospitality sector and here especially in gastronomy. Finally, it is positive to note that on the demand side, the trend towards a broader participation in tourism has continued until 2019.

PROJECT PART B

In Part B of this report, the possibility of considering further sustainability indicators within the framework of the TSSA system was analysed. During the initial development of the TSSA measurement system for Germany in the first project phase, it was established that some relevant environmental indicators could not be measured in this way. These are in the areas of **impacts on biodiversity, noise pollution, land use and solid waste generation**.

Furthermore, the social aspect of **tourism acceptance** by the resident population in the destination areas, which is currently very much part of the public discussion, could not be mapped with the help of the TSSA. Some environmental impacts that are also relevant had not yet been the subject of the first project phase, namely **air pollutant emissions** and **impacts on water bodies and groundwater**.

The aim of Part B of the project was therefore to look for alternative methods to measure the impacts and to integrate suitable approaches, if necessary, into a national sustainability indicator system for German tourism. In a first step, an extensive screening of existing measurement methods and data bases was carried out for each thematic complex. In a second step, they were evaluated and checked for the feasibility of developing a suitable indicator. The main question here was whether a causal relationship could be established between the observed or measured environmental and social impacts and tourism.

At the same time, care had to be taken to ensure that the collection or processing of existing data could be accomplished with a reasonable amount of effort. The following ranking of desirable initial situations was established:

1. Usability of data from official statistics, ideally compatible with the TSSA system, i.e. assignability of impacts to specific economic sectors and, via tourism quotas, to the tourism industry.
1. Usability of data from official statistics, but without compatibility with in TSSA systematics.
2. Other regularly available data or accounting approaches that can be used in any form.
3. Conducting special surveys (e.g. interviews, mapping, surveys). Special surveys may provide accurate information, but are usually associated with a high level of effort and costs.

As a result of the screening, it can be stated that extensive data material and accounting approaches are available for all environmental impacts. However, a number of problems arise with regard to their usability:

- ▶ Data are not available across the board or there are only irregular observation periods and generally a low data frequency. This is particularly the case for the topics of noise and water bodies/groundwater.
- ▶ Officially recorded economic sector data are not available at a deeper level (example: solid waste generation) and therefore cannot be assigned to tourism.
- ▶ The data collections are tourism-specific, but not representative (e.g. surveys of the German Hotel and Restaurant Association Dehoga on resource consumption and waste generation in the hospitality industry).
- ▶ Only partial components of the tourism system are mapped (e.g. only golf courses/ski resorts; only officially recorded overnight stays, no day trips).

In addition, certain sustainability aspects are primarily regionally/locally or seasonally relevant. This applies, for example, to the issues of tourism acceptance, effects on biodiversity or waste generation. A central challenge, however, is that a causal relationship between tourism and environmental impacts is generally not possible to establish based on the available data outside the TSSA.

Therefore, an alternative approach is proposed in which areas in which tourism plays a particularly important role (in the following referred to as "tourism-relevant") are compared with the national average or with areas in which tourism is significantly less developed regarding certain sustainability indicators. If these areas differ significantly from the average with regard to a certain indicator, it can be assumed that this may be related to intensive tourism use. Even if a causal relationship cannot be clearly proven, the development of indicators in regions with intensive tourism use could provide indications of specific management needs for sustainable tourism. The approach could be relevant e.g. for the topics of biodiversity, land use and tourism acceptance.

The municipality was chosen as the spatial resolution for areas particularly relevant to tourism. On the one hand, this considers the fact that tourism impacts are often highly localised; on the other hand, the municipality is a spatial reference level at which uniform statistics still exist nationwide. Tourism density and tourism intensity (in relation to overnight stays) were used as

central reference values for determining tourism-relevant municipalities. Municipalities were defined as particularly relevant for tourism if their tourism density and tourism intensity were above the national average by at least a factor of 10. As a result, there are 89 municipalities which together account for about 17 percent of all overnight stays in Germany (outside of large cities with more than 100,000 inhabitants) and cover 0.4 % of Germany's surface area. The municipalities that are particularly relevant for tourism are mainly located on the coasts and on the islands, but also in the area of the Alps and in the low mountain ranges (including a number of health resorts). Whether the choice of factor 10 (related to the national average of municipal tourism intensity and density) is optimal could not be conclusively clarified. This also depends on what a national tourism indicator system is ultimately to be used for. A lower factor would of course result in a larger number of municipalities that are particularly relevant for tourism, but which differ less from the average.

It should be noted that the accounting approach proposed here does not consider the informal accommodation market or day tourism for statistical reasons. A separate accounting for months with high and low visitor numbers in tourist destinations was also dispensed with. All these differentiations would involve an unjustifiably high accounting effort, since data from completely different sources would have to be combined or even specifically collected for this purpose. Effects of day tourism are mapped via TSSA in those sustainability fields where it is possible. For other ecological and social impacts of day tourism, it makes sense to examine them via a thematically expanded day trip monitor.

The feasibility analysis for measuring the investigated impact areas has led to the following **results:**

- ▶ **Tourism acceptance among the resident population** is strongly subjective and is therefore difficult to measure with the help of objective indicators such as tourism intensity or tourism density. At best, these can only provide indications of possible acceptance problems among the local population. It is therefore considered essential to measure tourism acceptance by means of targeted, representative surveys. A methodology for this has already been developed and implemented by two research institutes in Germany, the so-called Tourism Acceptance Balance. It is recommended to conduct this survey nationwide as well as differentiated according to tourism-relevant and less tourism-relevant municipalities in order to better capture the influence of tourism density and intensity. A differentiation according to seasons at the time of the survey would also be useful.
- ▶ **Noise pollution** can be measured objectively, but its individual assessment by the people affected is also subjective. Both aspects are regularly measured or surveyed in Germany, but it is very difficult to assign them to tourism as a source of noise. Two possibilities were investigated to establish this assignability. Firstly, one could fall back on an already existing indicator, namely the exposure to aircraft noise. Passenger air traffic is by definition almost exclusively of a tourist nature but cannot always be clearly separated from freight traffic. Moreover, this would only capture a small section of tourism-induced noise, which is why the use of this indicator is not recommended. The second approach involves special surveys on noise pollution in tourism-relevant communities. In order to reduce the survey effort, it is recommended to integrate questions on noise perception into the above-mentioned tourism acceptance balance.

- ▶ The effects of tourism on **biodiversity** in Germany were assessed as significant and predominantly problematic in the literature and also in a stakeholder workshop during the first project phase. The data on biodiversity is extensive, multi-layered and difficult to fathom. Another problem is the difficulty of attributing impacts on biodiversity to tourism, especially since individual leisure activities play a major role in this context, which are not necessarily of a touristic nature. Two potential solutions are discussed, which aim to measure the development of biodiversity only in those areas that are of particular importance for tourism and nature conservation:
 - Identification of protected areas with high tourism use, in which other uses are restricted at the same time (national parks and biosphere reserves). For these two types of conservation areas, there is on the one hand the so-called Integrative Monitoring Programme (IMP), and on the other hand, central tourism parameters have been measured in all national parks and biosphere reserves within the framework of a Socio-Economic Monitoring (SÖM). With the help of selected data from the IMP as well as the SÖM, an index value could be formed to measure the (development of) biodiversity in these "tourism-relevant" protected areas, which could at least be approximately related to intensive tourism use.
 - In the monitoring report on the German Sustainability Strategy, there is an indicator on "biodiversity and landscape quality". This is based on the nationwide measurement of the populations of representative bird species, which allow conclusions to be drawn about the ecological quality in different landscape types. An index value is formed (for Germany as a whole and for each landscape type). In order to at least approximately establish a connection with tourism as a possible trigger for positive or negative bird population developments, a special index could be formed from data from sample areas in municipalities particularly relevant for tourism.

The two approaches presented here address the causality problem, but do not solve it. Moreover, both are limited to certain areas, although it can be argued that for the measurement of the effects of tourism on biodiversity, it is precisely these areas that are of particular relevance. The second approach allows for a comparison with the national average, which is why it is favoured. However, a first test showed that the number of sample areas in tourism-relevant municipalities would have to be increased for this. Further analyses are therefore necessary to come to a final assessment of the feasibility of one or both of the investigated accounting approaches.

- ▶ Regarding the **impacts on water bodies** and **groundwater**, the situation is similar to that for biodiversity. Systematic and nationwide aggregated data are available on the ecological and chemical quality of surface waters and on the quantitative availability and chemical quality of groundwater. However, no impacts attributable to tourism can be derived from this data. Since tourism is not a relevant factor for the status of groundwater, but it is for the status of surface waters, a possible accounting method was sought for the latter. Ultimately, the only possible approach is to differentiate between municipalities that are particularly relevant to tourism and those that are less relevant. A sub-index could be formed for water bodies whose monitoring sites are located in tourism-relevant municipalities. The comparison with the national average would then provide indications of the possible role of tourism as an important cause of negative impacts on water bodies, although without being able to clearly prove causality.

- ▶ For the quantification of **land use** by tourism, the feasibility of two approaches was investigated. Direct data is available for golf courses, ski resorts and passenger ports. However, these only represent a small section of tourism-relevant infrastructure or facilities, which is why this approach was classified as unsuitable. The second approach uses the Monitor of Settlement and Open Space Development of the Institute for Ecological Spatial Development (IÖR). With the help of satellite data, it is possible to regularly determine at the municipal level how much land is taken up by buildings as well as sealed and partially sealed transport and other surfaces. This data can in turn be differentiated according to municipalities that are particularly relevant for tourism and other municipalities. The degree of causality in the case of significant differences can be substantiated in this case by additionally using data from the Federal and State Statistical Offices on "land area by type of actual use", which shows the land use by sports, leisure and recreation facilities. It is therefore recommended to measure the land consumption by tourism via the IÖR indicator in municipalities that are particularly relevant for tourism.









- ▶ In the area of **air pollutant emissions**, three possible balancing approaches were examined. Air pollutants are mainly emitted by (tourist) traffic. Similar to greenhouse gas emissions, air pollutants are accounted for within the framework of the national accounts and can be assigned to specific economic sectors. Therefore, tourism-specific accounting can take place within the framework of the TSSA, but only on the supply side. This has already been implemented in the TSSA update in the context of project part A. In order to also record the emissions of motorised individual transport, an additional demand-side recording would have to be carried out. In Germany, there is a dense network of measuring stations whose data can be used. In addition, it would be possible to survey emissions from motorized individual transport with reference to tourism as part of the studies on "Mobility in Germany" already carried out at regular intervals. However, this would also require the tourism share of traffic to be measured, which would increase the overall effort. In summary, both demand-side approaches are possible, but supply-side accounting is preferred because it is easier to collect data and can be differentiated according to tourism sub-sectors. In this way, tourism-induced air pollutant emissions could be determined together with greenhouse gas emissions. Against this background and in view of the associated methodological problems, an alternative measurement specifically for tourism-relevant municipalities does not appear to be expedient.

- ▶ In the literature, **solid waste generation** due to tourism in Germany is not considered a serious problem, neither in terms of waste volume nor in terms of hazardousness. However, it is assumed that there is a seasonally increased waste load in tourism-relevant communities. Data on the volume of solid waste are available in Germany at the municipal level, but not sufficiently detailed to be able to make statements about tourism via the economic sectors. Alternatively, two approaches could be considered: On the one hand, surveys of tourism enterprises could be conducted, as already practised by the German Hotel and Restaurant Association Dehoga. However, participation in these surveys is voluntary and therefore not representative. A representative survey would be possible, but would be time-consuming and costly. This would not be appropriate given the rather low relevance of the topic. The second approach would compare the waste generation of tourism-relevant municipalities with the national average. However, this would still have to be seasonally differentiated in order to filter out the share of tourism, because averaged over the year, the values would probably hardly differ. Therefore, a special indicator for tourism-induced waste generation is not proposed for the time being.

However, it would be desirable to collect the commercial waste volume in a more detailed way in the future. In this way, integration into the TSSA would be possible.

The feasibility analysis has thus shown that for most of the impact areas analysed here, there are indeed possibilities for accounting (cf. Table 2). This is especially the case for tourism-induced air pollutant emissions, which can easily be integrated into the already existing TSSA system and calculated together with greenhouse gas emissions. However, both types of emissions should also be accounted for on the demand side in order to be able to consider motorised private transport, which is so important for tourism.

Table 2: Overview of possible indicators for measuring the effects of tourism

Impact area	Recommended accounting approach	Feasibility
Tourism acceptance by the resident population	Tourism acceptance balance: nationally representative survey, differentiated among other things according to municipalities that are particularly relevant to tourism and those that are less relevant.	
Noise pollution	Special survey in municipalities that are particularly relevant for tourism, can be integrated into surveys on tourism acceptance balance	
Effects on biodiversity	1. Special accounting in protected areas with intensive tourism use	
	2. Integration into the national indicator "Biodiversity and landscape quality" and creation of a sub-indicator for municipalities particularly relevant for tourism	
Effects on water bodies	Integration into the national index on the "Ecological Status of Surface Water Bodies" and creation of a sub-indicator for municipalities particularly relevant to tourism	
Land use	Use of the monitor of settlement and open space development and creation of a sub-indicator for municipalities particularly relevant to tourism	
Air pollutant emissions	Supply-side balancing based on the Environmental Economic Accounts (UGR), integration into the TSSA	
Solid waste generation	Currently not an indicator that can be implemented with reasonable effort. A more in-depth official data collection with regard to economic sector classification would be recommended.	

Source: Own compilation.

The indicators identified in the other areas examined, i.e. in the areas of tourism acceptance, noise pollution, biodiversity, water pollution, land use (and waste generation), would be classified in the area of the so-called "complementary indicators", which would be added to the core indicators of the TSSA. Regarding the currently important topic of tourism acceptance by

the resident population, a special survey (possibly supplemented by the topic of noise pollution and differentiated according to municipalities that are particularly relevant for tourism and other municipalities) is recommended, especially because such a survey has already been designed and carried out.

For the impact areas of biodiversity, water bodies and land use, only an approximate causal allocation to tourism is currently feasible via the creation of a sub-indicator for municipalities particularly relevant to tourism (or for protected areas heavily frequented by tourists in the case of biodiversity). Even if a direct causal connection with tourism cannot be established in these cases, it seems more sensible to work with this methodology and, if necessary, to develop it further than to leave out these ecological impact areas that are extremely relevant for tourism. In addition, the development of the area-specific indicators can be used to derive indications for the (destination) management of municipalities that are particularly relevant to tourism, if they are interested in sustainable development, irrespective of the question of who is responsible for the corresponding impacts. The data could also be used for a possible certification as a sustainable tourism destination.

However, the actual significance of indicators for municipalities that are particularly relevant to tourism would still have to be reviewed in concrete cases. While the reference value for the processing of data on land use is also the municipality level, in the case of impacts on water bodies and biodiversity, it is not easy to determine in how many tourism-relevant municipalities there are actually survey areas for bird monitoring or the analysis of water quality in order to collect enough data. In the case of surveys on tourism acceptance, it would also have to be ensured that these take place to a sufficient extent in tourism-relevant municipalities. Depending on the results, it could make sense to increase the number of tourism-relevant municipalities in order to obtain more valid data or to cover a larger share of the total tourism volume in Germany.