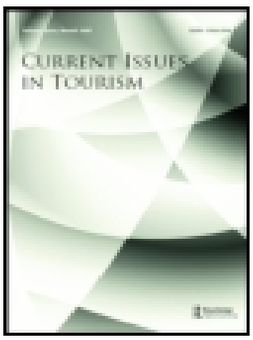

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Renewable energy sources as an attractive element of industrial tourism

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This paper deals with the overview of the interaction of tourism and renewable energy sources, and evaluates their potential regarding tourism industry as well as in terms of increasing of tourism attractiveness in the selected area. Renewable energy sources can be considered an attractive element within the industrial tourism and, in some cases, can increase the number of visitors to the area, mainly due to its modern design, proportions, eco-image and, in certain regions, due to its uniqueness. In analysis, interactions of renewable energy and tourism were classified into four categories. The analysis showed that the touristic subjects connected to the sensitively selected and located type of renewable energy source could have significant numbers of visitors in tens of thousands. According to results of the analysis, the highest number of visitors reached the visitor centres next to geothermal power plants and wind parks, which can be explained by their unique visual aspects. The paper also analysed the possible impact of the renewable energy infrastructure on tourists, when available studies indicate the minimal impact of installation if the power plants are sensibly placed in the country regarding location or distance from considered subject.

Keywords: industrial tourism; sustainable tourism; renewable energy sources; tourism potential

Introduction

The current growth of the economy and standard of living in different parts of the world causes an increase in qualitative and quantitative demands of the energy sector, generally provided products and services. These higher demands create specific conditions and new interactions in various fields of human activities, including tourism industry. The best expression of global growth is by using the Human Development Index (HDI), which is the accepted statistic summarizing life expectancy, education level and income per capita of defined geographical area (usually the country). In the last decades, it was possible to characterize its development by an increase from a value 0.597 from 1990 to 0.711 from 2014. This growth is mainly driven by the strong economies of the Eastern and Southern Asian countries, where an annual increase was 1.34%, compared to the global growth of 0.7%, in 2014 (UNDP, 2015).

The growth of HDI and its reflection in the growth of the tourism most accurately demonstrate an increase in international tourist arrivals. In 1990, it was 0.457 billion (UNWTO, 2001), while in 2014, the total number of international arrivals increased to

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1.135 billion (UNWTO, 2014). For the last five years, tourism industry has grown to 3.3% (UNWTO, 2015), but the currently forecasted growth, according to UNWTO for the period up to 2030, assumes a slowdown to 2.5%, with the target number of international tourist arrivals of 1.8 billion (UNWTO, 2011). From an economic perspective, the significance of tourism is characterized by 9% share of a global GDP; tourism provides every eleventh job and creates 1.5 trillion USD in export, which represents 6% of world export (UNWTO, 2015).

However, the above-mentioned extensive development of tourism is closely associated with a rise in the energy demand and with a rise in the negative environmental impact of each sub-activities of tourism (Gössling & Peeters, 2015). The environmental impact of tourism was analysed in a large number of studies from private sectors and in studies published in scientific journals, which mostly analysed production of greenhouse gases associated with the various segments of tourism (Bode, Hapke, & Zisler, 2003; Hoogendoorn & Fitchett, 2016; Katircioglu, 2014; Munday, Turner, & Jones, 2013; Robaina-Alves, Moutinho, & Costa, 2016; Shi et al., 2013). In scientific journals, there are less often published studies dealing with the structure or increase of energy demand in the sector of tourism (Dogan, Seker, & Bulbul, 2015; Liu, Feng, & Yang, 2011; Zhang & Gao, 2016).

The global energy demands are currently mostly covered by fossil fuels, the usage of which is associated with the significant production of CO_2, which is considered a major greenhouse gas. The same situation prevails in tourism, where fossil fuels cover most of the energy demands. The tourism industry contributes to the global production of CO_2 with 5% (UNWTO, 2012), while 75% of this comes from transport, 21% from accommodation and 4% from other activities (IRENA, 2014). But, if we evaluate the combined impact of tourism on a global climate change (or global warming), the impact is in the range from 5.2% to 12.5% (uncertainty is addressed to ambiguous role of cirrus clouds that are induced by aviation) (UNWTO, 2012).

The most recent value of direct energy consumption in tourism published in the reputed scientific journal is 16,700 PJ (for 2010) (Gössling & Peeters, 2015). Globally, tourism, therefore, consumed 3.3% of the total world consumption of primary energy sources, which was in 2010 approximately 502,000 PJ (British Petroleum, 2011). In the analysis of current energy consumption, the Global Tourism Transport Model by Peeters (2013) can be used, which forecasts selected indicator of the tourism industry (including energy consumption) for the horizon of 2050. According to this model, Gössling and Peeters (2015) evaluated the energy consumption of tourism for the year 2015 at a value of 18,400 PJ, that is, 3.4% of global energy production, which was, according to BP, 541,000 PJ (British Petroleum, 2016). At the currently predicted growth, according to the Global Tourism Transport Model, energy consumption for business-as-usual scenario is forecasted to be 44,100 PJ in 2050 and the number of international tourist arrivals to be 13.6 billion (Gössling & Peeters, 2015).

The structure of energy consumption in the tourism industry is composed of three main components. Transport has a dominant position (94%), followed by an accommodation (3.5%) and an energy consumption of other activities (2.5%) (Eneida & Zayra, 2009). A fundamental parameter in the energy demand of transport is distance, which increases with globalization (UNEP and UNWTO, 2008), and thus overall quantitative requirements for fuels grow. Transport needs of tourism are covered by air transport (54%), road transport (39%), ship transport (5%) and rail transport (2%) (UNWTO, 2015). According to the ICAO, air transport, as a marginal factor of energy consumption in tourism, has reported a growth of 6.5% (ICAO, 2013) which is predicted up to 2030. The predicted growth of fuel consumption in air transport is in the range of 3.0–3.5% (ICAO, 2016).

This discrepancy between an increase in traffic and increase in fuel consumption is caused by a more efficient use of fuel, which is based on the technology of modern jet engines and aerodynamics.

Energy demand of accommodation services is in the second place. Accommodation includes activities that are related to heating, cooling, lighting, cooking, cleaning, operating spa facilities and so on. (UNEP and UNWTO, 2012). The energy demands of these activities are directly related to the range and level of providing services for accommodation. A wide variety of authors have previously published scientific papers that evaluated and classified energy demand for accommodation. Becken and Simmons (2002) defined energy demand of accommodation of tourism in New Zealand in the range from 32 to 110 MJ/person/night. Beccali, La Gennusa, Lo Coco, and Rizzo (2009) set energy intensity for Sicily accommodations between 32 and 112 MJ/person/night. Bohdanowicz and Martinac (2007) determined the required energy of accommodation in the range from 51 to 256 MJ/person/night, but for some types of accommodation in luxury categories, this range shifted up to 322 MJ/person/night. Gössling (2002) divided energy consumption, according to the type of accommodation into six categories, from 25 to 130 MJ/person/night, with an average value of 98 MJ/person/night. Taking into account the total number of international tourist arrivals, the final energy consumption of accommodation represents considerable part of the total energy consumption in the tourism industry with great potential for savings.

The above-presented energy summary showed that the energy demand and environmental impacts of the tourism industry have a notable share from a global point of view and it has to be addressed. Predicted growth, decreasing reserves of fossil fuels and efforts in the elimination of negative environmental impacts are bringing new challenges in meeting energy demands, which will require the application of new technologies and procedures within the connection of the energy sector and tourism industry in terms of sustainable tourism (Farmaki, Altinay, Botterill, & Hilke, 2015).

The output of mentioned efforts, technologies and procedures should be, according to the authors, in the form of maximum implementation of renewable energy sources (hereinafter RES) to the energy mix of each country, on a global level as well as direct in tourism destinations, which will cause and in some cases have already caused a strong interaction of RES and tourism. RES can be applied in meeting energy needs in accommodation services and also in some forms of transport. Numerous authors have dealt with the implementation of RES (Chaoqun, 2011; Michalena, Hills, & Amat, 2009; Shi et al., 2013) and with energy savings opportunities in the tourism industry (Gravouniotis, Bauen, & Pearson, 2012; Irsag, Puksec, & Duic, 2012; Yang, Li, Zheng, & Zhang, 2008). However, these authors evaluated only direct economic (i.e. energy cost savings) or the environmental benefits of this implementation.

This paper, in contrast to the above-mentioned works, deals with the other benefits of RES in the field of the tourism industry, since the basic benefits are obvious. In relation to tourism, RES infrastructure can be considered a significant landscape element that is unique to its technical nature, dimensions, design and movement. The positive aspects of appropriately chosen RES are therefore reflected not only in increased energy independence or improvements in environmental quality, but according to the authors, also in an increased number of visitors in selected areas.

The connection of RES and tourism creates an attractive element of industrial tourism, or rather energy tourism. This specific area of tourism is characterized by the tourism attractiveness of industrial sites in the country, new technologies or power plants (Otgaar, 2012). Industrial, respectively energy tourism is the subcategory of special interest tourism. The

concept of special interest tourism was introduced at the turn of the 1980s and 1990s (Weiler & Hall, 1992) and characterize touristic activities that form counterpart to the mass model of the common tourism industry. The inclusion of industrial, respectively energy tourism within the category of the special interest tourism is evident because of its ecological and technical nature. The term energy tourism is widely discussed in the paper by Frantál and Urbánková (2014), and the authors not only defined the terminology background but also provided analysis of energy tourism in conditions for tourism in the Czech Republic; they evaluated three types of tourist attractions related to energy sector. However, the authors dealt with RES only on the marginal level (in the form of Dragon Kite Festival under wind turbine), and the paper in detail dealt with traditional energy sources – nuclear power plant and surface coal mine. Potential tourist attractiveness of the wind park in the conditions of Portugal is analysed in Sousa and Kastenholz (2015). They suggest integrating tourism with wind energy production, including tourism research-related guidelines for wind farm planners and efforts to include wind farms in tourist experience planning such as guided tours and event creation. However, they also concluded that more research is needed to promote wind farms as green destinations, capable of attracting a growing number of environmentally concerned visitors. Jirická, Salak, Eder, Arnberger, and Pröbstl (2010) present innovative strategies involving the use of RES within tourism in the Central European region. Some other examples of evaluation of touristic attractiveness of RES are in the category of "grey literature" outside of academic publishing, and in most cases, describes particular RES power plant and its touristic utilization in general terms.

Analysis of the tourism potential of RES is thus within the academic literature largely unexplored. The above-mentioned publications dealt with RES on a marginal level, or assessed RES in particular and narrow geographical area. This paper, on the contrary, provides a comprehensive view of the possible use of RES power plant for tourism, which does not focus only on the particular type of power plant or geographical area. The presented data and introduced logic structure of various tourism activities related to RES should form the basis of the following deeper analysis of this interesting sector of industrial tourism.

Methodology

In the first part of the paper, which shows high energy demand and environmental impacts of tourism industry, data were sourced from official yearbooks, outlooks and studies of major influential organizations operating in the field of tourism (e.g. UNWTO) and energy (BP Energy Outlook). A significant portion of used data also comes from published papers in scientific journals. In the second part, which deals with the evaluation of numbers of visitors in the selected area with interaction between RES and tourism, categorization has been established defining the interaction according to levels and forms of providing services, from the lowest to the highest form.

First, the lowest form of interaction of RES and tourism industry is characterized by the existence of RES power plant in the selected area, which is not connected to any other direct tourism infrastructure. These technologies usually increase interest in the area that has not yet been popular, but non-existent tourism infrastructure prevents further economic benefits. Visitors' interest is mainly caused by curiosity and in some countries by the rarity of similar types of technologies. The middle form of interaction between RES and tourism industry, the second category, is based on simple tourism elements in the form of info points and educational (hiking) trails that facilitate access and provide basic information about power plants, area and used technology. This form not only increases

awareness, but also builds a positive image of the RES as a whole. The result is the higher number of visitors and also positive motivations for local municipalities or energy companies to build other tourism infrastructure. The third category, higher interaction, includes the visitor centres built near various RES power plants. These visitor centres not only offer interactive education about technologies and principles of RES but also point to the importance of sustainable development and using of greener forms of energy sources. In most cases, visitor centres are linked to other tourism services such as restaurants and souvenir shops. The highest, fourth, form of interaction between RES and tourism are educational tourist centres, which are based on direct use of renewable and alternative energy sources with emphasis on educative function. Technologies using RES are built directly in centres in a way that the visitors are confronted not only with the technology, but also with a final form of energy output (e.g. restaurant kitchen using biogas from a nearby biogas power plant). The primary purpose of these centres is increasing social awareness of RES, green technologies and sustainable way of living. Educational centres often provide long-term courses and internships focusing on different technologies and ways of using RES. The graduates from developing countries can implement different principles of RES in their domestic energy mixes. A summary of possible interactions is given in Table 1.

The aim of this paper is to bring an overview of the most common interactions of tourism and RES, and evaluate their tourism potential and tourism attractiveness in the selected areas. Tourism attractiveness and potential were assessed by using a parameter of the number of visitors for each object of analysis representing the specific interaction of RES and tourism. Areas, particularly tourism subjects, were selected with an attempt to cover the most common forms of interaction and different geographical entities. For the final list, only tourism subjects were chosen with proper online presentation (an important factor due to current communication behaviour) and location without other near human-built tourist attractions. Data related to the number of visitors were obtained via electronic communication (email, social media) with the employees of centres, through publicly available publications and sources of selected institutions.

Results and discussion

Current implementation and expansion of RES to the world and local energy mixes most accurately demonstrate following numbers. In 2015, RES covered 19.1% of global primary energy consumption (REN21, 2015), in the EU countries 16% (Eurostat, 2015), separately for Germany 30% (Morris, 2016), in the USA 13% (US EIA, 2015) and in China about 15% (IRENA, 2015). RES are therefore a stable part of the energy mixes of many countries with expected extensive development in the future (European Commission, 2015).

Table 1. Categorization of the common interaction of RES and tourism.

Level of interaction	Form of interaction
Lowest	RES are the attraction in the area, but without the other tourism infrastructure
Middle	Simple info points and nature educational (hiking) trails are built close to RES
Higher	Near RES are built simple visitor centres
Highest	RES are directly linked to the educational centres

Impact of renewable energy sources on tourism

The power plants based on RES, which are built in areas with tourism based on the landscape and aesthetic value of the country, are often seen by the owners of tourism infrastructure as a negative element with a possible threat to future income. An overwhelming majority of available studies dealing with mentioned concerns point to the fact that the presence of power plants using RES (in the form of wind farms, photovoltaic, geothermal, hydropower plants, etc.) does not constitute an increased risk for the tourism development in the area.

The study by Michel, Buchecker, and Backhaus (2015) deals with the impact of installation of photovoltaic panels in the ski resort in the Gomms valley (Switzerland). The authors highlight the fact that a sensitive placing of panels results in positive feedback from visitors. In the paper, authors also considered another way of photovoltaic installation and evaluated their impact on the local population and incoming tourists. The final analysis confirmed that with a suitable location outside the protected areas and historical buildings, RES are fully accepted.

A survey of the perception of RES within the territory of Cornwall is brought in the study by The South West Research Company (2013), where the authors evaluated the impact of wind and photovoltaic power plants on visitors, as well as the perception of the RES as a whole sector. From the total number of respondents (1007), 80% were strongly for RES, 14% had an ambivalent relation to RES and only 6% had a negative attitude towards RES.

The study of German Offshore Wind Energy Foundation (2013) assessed the impact of offshore wind farms in the Baltic Sea region. According to the authors, reduction in the number of visitors in the evaluated area after construction of the wind farm does not represent a significant risk, since most offshore wind farms are visible from seashore only under specific weather conditions. A Scottish study by Caledonian University, Moffat Centre and Cogentsi (2008) of wind farms' impact on the local tourism industry shows that construction of wind farms in Scotland will affect 30% of visitors, but negative impact on the economy of the area is estimated to be only 0.18%. The study by Regeneris Consulting and The Tourism Company (2014) evaluated the possible consequences of the wind farm installation on the Wales tourism. The results of the study indicate only minimal impact on the local level. The possible interaction of offshore wind farms and tourism in French Mediterranean was analysed in Westerberg, Jacobsen, and Lifran (2013). According to published studies, the distance of offshore wind farm from coast is a critical parameter. If the wind farm is located further than 12 km, there is no impact on tourism; if the wind farm is located from 5 to 12 km, it has to be accompanied by a coherent environmental policy and wind farm-associated recreational activities. The study by Frantál and Kunc (2011) assessed the wind turbine installation on the landscape image and tourism potential of affected areas, as perceived by tourists and local entrepreneurs.

The impacts of hydropower plants in the Pyrenees are evaluated by Rodriguez (2012), where the author highlights the positive effects of built infrastructure on tourism in the affected area. Roads and other infrastructure allowed access to previously inaccessible areas for visitors, which increased the number of visitors in the region. Prinsloo (2013) evaluates the positive impact of RES on tourism, and he also points to the fact that, from the visitor's point of view, an existence of RES in the visited area does not affect feelings of their vacation or their will to return.

Interaction of renewable energy sources and tourism

For the lowest and middle category of interaction, the evaluation of the tourism attractiveness is a difficult task, because there is no comprehensive tourism infrastructure through which it would be possible to determine the real numbers of visitors. A typical example of the interaction in the first category is the change of driving routes with the purpose to travel through the area with the existence of wind farms. The result is an increase in traffic in the area, creation of illegal parking spots in places with a good view, but also higher revenue from sales at gas stations or restaurants. Such behaviour can be observed, for example, in the areas of wind farms in Alberta (Canada) or Burgenland (east Austria).

The second category of interaction is mainly characterized by educational (hiking) trails and cycling paths, simple info points nearby RES power plants (mostly wind and geothermal plants). These forms of interactions are particularly popular in Germany and Denmark (cycling paths in areas of wind farms) or Iceland (hiking trails nearby geothermal power plants).

More popular, but an economically more costly form of interaction between RES and tourism, are visitor centres that allow better propagation of RES in terms of their image and knowledge of used technologies. These centres are mostly located near offshore, onshore wind farms, geothermal or hydropower plants. A higher number of visitor centres near wind farms is caused not only due to their overall expansion, but also due to efforts of energy companies to build a positive relationship towards the wind farms, which are often rejected by the locals and tourists (infamous NIMBY attitude). The higher number of centres is also related to the attractiveness of wind energy regarding their design, proportions and movement of visible parts. Category of visitor centres represents seven selected centres in Canada, USA, United Kingdom and Iceland.

Visitor Centre Hellisheiði (Iceland) nearby geothermal power plant provides guided tours, interactive learning and hiking trails with a total length of 100 km. According to the visitor centre staff, the number of visitors in 2015 was 90,000[1] (which account for approximately 8% of all visitors to Iceland). A unique combination of RES power plant and tourist attraction are Icelandic thermal baths Blue Lagoon, which use wastewater from the Svartsengi geothermal power plant. Blue Lagoon yearly receives 31.5% (or almost 350,000) of total number of visitors to Iceland (Icelandic Tourist Board, 2015). Although in this case it is not possible to declare an interest of visitors on RES, it is clear that the building of geothermal power plant and its subsequent utilization increased the attractiveness of the area.

The Whitelee Wind Farm Visitor Centre (Whitelee, Scotland, UK) offers a permanent multimedia exhibition about wind energy utilization and more than 130 km of marked trails in the countryside of Scottish Highlands intended for hikers, cyclist or horse riders. In 2015, this centre, according to the staff, was visited by 75,000[2] people. The other selected visitor centre in Scotland is the Cruachan Power Station Visitor Centre (Oban, Scotland, UK), which is built near pumped-storage hydropower plant from 1959. Apart from the visitor centre, infrastructure built for upper reservoir accessed the higher part of the Cruachan Horseshoe mountain range. According to the available official documents, about 60,000 tourists visit yearly (Scottish Power, 2016).

Another visitor centre near the wind farm is the Canadian North Cape Wind Energy Interpretive Centre (Prince Edward Island, Canada). This centre offers a wide range of activities such as a thematic hiking trail, restaurant, souvenir shop and interactive educational panels. According to the general manager, yearly visit to this visitor centre is close to 40,000.[3] The next successful visitor centre is the

Scrooby Sands Visitor Centre (Great Yarmount, Norfolk, UK). This centre near an offshore wind farm is operated only in summer mode and the number of visits is around 35,000 (E-on, 2016).

The Visitor Centre Racoon Mountain Pumped-Storage Hydropower Plant (Chattanooga, Tennessee, USA) combines educational function and relaxation near the reservoir. Besides the video and photo presentation in the visitor centre, hiking trails of varying difficulty are also available, supplemented with the primary object of tourism infrastructure (view points, shelters, etc.). The number of visitors fell in 2015 from 16,500 to 10,000[4]. This decrease must be attributed to the general reconstruction of the hydropower plant and the visitor centre. Despite this, the visitor centre staff continue to offer services within limited operation at the outdoor recreation centre.

Smaller visitor centres are often associated with other elements of tourism infrastructure, as it is in the case of Sheringham Shoal Wind Farm Visitor Centre (Sheringham, Norfolk, UK), which is a part of Sheringham Museum. The centre offers not only interactive presentation, but visitors can observe a distant wind farm using a powerful telescope. Annually, this centre is visited by, according to Sheringham Museum, about 13,000 visitors (Sheringham Society, 2016).

The fourth category of interactions, that is, educational centres, is represented by the Nordic Folkcentre for Renewable Energy (Ydby, Nordjylland region, Denmark), the Centre for Alternative Technology (Machynlleth, Wales, UK) and the Wild Horse Renewable Energy Centre (Ellensburg, Washington, USA). The Nordic Folkcentre for Renewable Energy is a gold standard within educational centres related to energy and sustainable development. The centre itself was established in 1970 and creates a unique combination of renewable energy power plant and visitor centre. In self-sufficient energy centre, technologies of RES are presented as well as technologies for the sustainable way of living. The centre also offers training courses of varying lengths and levels. According to the employees, each year, the visit centre approximately receives 6000[5] people (5800 in 2014, and 6100 in 2015).

An educational centre with a similar aim was founded in 1973 in Machynlleth. The Centre for Alternative Technology serves as a place for the presentation of sustainable living and RES in almost all its forms. Visitors may attend one-day tour, or be participants in long-term courses. The centre, which annually welcomes nearly 20,000[6] visitors, is currently operated by 120 employees.

A different form of presentation of RES technologies is represented by the Wild Horse Renewable Energy Centre. This centre offers a combination of the visitor centre with accommodation services of higher standards. Visitors may attend guided tours during which they are informed about specific wind and photovoltaic farms. Built tourism infrastructure in the form of walkways and hiking trails enables safe movement and view of the nearby RES power plants and famous tourist attraction, the Cascade Mountains. The centre is open around eight months of the year. In 2015, the centre was visited by 14,859[7] people and according to the staff, since the centre was opened in 2008, it was visited by 145,000 tourists. A summary of the numbers of visitors is given in Table 2.

Unconventional forms of interaction between RES and tourism industry, which are difficult to categorize to the above-mentioned classes are, for example, represented by an observation point in the Canadian Grouse Mountain Park (Vancouver, Canada) which is located in the nacelle of the wind turbine at a height of 58 m. This tourist attraction offers a unique view of the surrounding countryside and the opportunity to explore using wind energy from the unusual point of view. Even though the number of visitors related

Table 2. Summary of the number of visitors of the selected tourism subject in 2015.

Name and location of the tourism subjects	Number of visitors
Educational centres:	
Centre for Alternative Technology (Machynlleth, Wales, UK)	20,000
Wild Horse Renewable Energy Centre (Ellensburg, Washington, USA)	14,859
Nordic Folkecentre for Renewable Energy (Ydby, Nordjylland region Denmark)	6000
Visitor centres:	
Hellisheiði Geothermal Plant Visitor Centre (west Iceland)	90,000
Whitelee Windfarm Visitor Centre (Whitelee, Scotland, UK)	75,000
Cruachan Power Station Visitor Centre (Oban, Scotland, UK)	65,000
North Cape Wind Energy Interpretive Centre (Prince Edward Island, Canada)	40,000
Scrooby Sands Visitor Centre (Great Yarmouth, Norfolk, UK)	35,000
Sheringham Shoal Wind Farm Visitor Centre (Sheringham, Norfolk, UK)	13,000
Raccoon Mountain visitor centre (Chattanooga, Tennessee, USA)	10,000

to this specific attraction is unknown, according to the official statement of the park, " … wind turbine inspire and educate 1.2 million visitors in Grouse Mountain Park" (Grouse Mountain Ski Resort, 2010).

An attractive way of promoting RES and sustainable lifestyle is followed by the Greenwood Forrest Amusement Park (Snowdonia, UK). The park covers its energy demands using photovoltaic panels and as the first park in the UK introduced so-called "people-power" roller coaster, where cars are driven back to the top with gravity and the mass of the passengers. This park is visited by almost 150,000 people a year (Wales Online, 2015).

Another suitable form of interaction between RES and tourism is the construction of architecturally valuable buildings, which attract the attention of the media as well as tourists and therefore promote the area. A typical, and has to be said beautiful, illustration is the international award-winning architecture of several small hydropower plants in Nordland county (Norway). The best example is the hydropower plant, Øvre Forsland, which represents the top of the Scandinavian industrial design and annually attracts to the mountains of northern Norway many tourists.

An interesting and architecturally unusual building is the observation point, the Mabelthorpe Wind Tower (Mabelthorpe, Lincolnshire, UK). This is an elevated observation point, which provides a 180 degree view on the nearby offshore wind farm also amplifying the characteristic sound of distant wind turbine blades, which gives visitors the opportunity to perceive the nearby offshore wind farm in an unusual way. The amplification of sound is caused by a specific architecture of the tower and its interior, which creates simplified wooden speaker box.

The above-presented examples reflect the current state of connection between RES and tourism industry in the most common forms. From the mentioned examples, it is obvious that tourism subjects connected to the infrastructure of RES offer unusual tourism experience, interactive and modern education combined with additional services such as restaurants, gift shops and sometimes accommodation, which represent an additional economic opportunity for local business. The overview of numbers of visits shows significant values for each of selected visitor centres. Visits in tens of thousands indicate significant potential of this field of industrial tourism in the future. Building the infrastructure of RES thus should be considered an opportunity for the future growth of the region and not vice versa as it is often happening today.

Conclusion

The increasing worldwide energy demands and energy needs of tourism create suitable conditions for wider use of RES in the energy mixes of every country on a global level as well as direct in-tourism destinations, which will cause and in some cases have already caused strong interaction between RES and tourism. Evaluation of this interaction is, therefore, a current topic, which may result not only in improving the environmental quality and economic savings, but in some cases also in increasing the tourism attractiveness of the area, since RES can create an attractive element within the industrial tourism.

This paper summarizes common interactions and evaluates their potential in terms of tourism industry through the analysis of the parameter of the number of visitors for selected tourism subjects. In this paper, it was also analysed the possible impact of the RES infrastructure on tourists. Available studies indicate the minimal impact of installation if the power plants are sensibly placed in the country in terms of their location or distance from the other tourism subjects. Possible interactions of RES and tourism were divided into four categories, from the lowest level with almost no interaction, through building educational (hiking) trails and info points, over interactive visitor centres near RES power plants and to the highest level with educational centres, which are closely linked to the specific technology of RES. Areas, particularly tourism subjects, were selected with an attempt to cover the most common forms of interaction and different geographical entities. For the final list, we chose only tourism subjects with proper online presentation (an important factor due to current communication behaviour) and location without other near human-built tourist attractions. The final evaluation consists of 10 subjects situated in the USA, Canada, United Kingdom, Iceland and Denmark. Selected subjects represent the category of visitor centres and educational centres that provide interaction between RES and tourism in higher forms. Data related to the number of visitors were obtained via electronic communication (email, social media) with the employees of centres, through publicly available publications and sources of selected institutions.

Given the summary of the number of visitors for wind farms, geothermal and hydropower plants show significant values for each of selected visitor centres, which indicates considerable tourism potential for this area of industrial tourism. The results of the analysis showed that the RES infrastructure offers plenty of additional tourism services, which represent an additional economic opportunity for local business. The high popularity of the mentioned technologies of RES can be attributed to their design, proportion and in certain areas to their rarity, which contribute to increasing the overall attractiveness of the area if conditions of proper and sensitive installation are met.

Disclosure statement

No potential conflict of interest was reported by the authors.

Notes

1. Information from Sigurður Jón Björgvinsson, Orkanáttúrunnar.
2. Information provided via unknown employee through contact e-form on website.
3. Information from Anne Arsenault, Tignish Initiatives Corp.
4. Information from Laura Smith, TVA Communications.
5. Information provided from director Jane Kruse, Nordic Folkcentre for Renewable Energy.
6. Information provided from an unknown employee via social media communication.
7. Information from Andrea Nesbitt, Wild Horse Renewable Energy Centre.

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