# How close is too close? Mapping the impact area of renewable energy infrastructure on tourism

Edita Tverijonaite[1], Anna Dóra Sæþórsdóttir[1], Rannveig Ólafsdóttir[1] and C. Michael Hall[2,3,4]

[1] Faculty of Life and Environmental Sciences, University of Iceland, Sturlugata 7, 102 Reykjavik, Iceland; edt1@hi.is (E.T.); annadora@hi.is (A.D.S.); ranny@hi.is (R.Ó.)

[2] Department of Management, Marketing and Entrepreneurship, University of Canterbury, Christchurch 8140 2, New Zealand; michael.hall@canterbury.ac.nz

[3] Department of Service Management and Service Studies, Lund University, Campus Helsingborg, 25108 Helsingborg, Sweden

[4] Geography Research Unit, University of Oulu, 90014 Oulu, Finland

**Abstract**

Estimating the spatial extent of the impacts of renewable energy infrastructure on tourism is crucial for the identification of potential locations of resource use conflict. Such a task, however, is complicated and requires inclusion of social perceptions on the spatial extent of the impacts. This study investigates perceptions of the tourism industry in Iceland regarding the impact area of existing and proposed energy projects on tourism and analyses the factors affecting its size and shape. It is based on semi-structured interviews with tourism service providers, during which participants mapped their perceived impact areas using participatory mapping software. The results revealed that the reasoning affecting the perceived spatial extent of the impacts falls into three categories: visibility of renewable energy infrastructure and related environmental impacts; tourist mobility; and changes in tourism due to energy projects. Moreover, the impacts of the proposed energy projects were perceived as more negative compared to existing ones. Energy projects were considered less suitable in wilderness areas, which were defined by the tourism service providers as an important resource for nature-based tourism, but more acceptable in developed areas. Thus, the spatial extent of the impacts and the compatibility of renewable energy infrastructure with tourism highly depend on changes in place meanings and tourism processes brought by energy infrastructure as well as affected elements of tourism networks. This emphasizes the importance of including tourism stakeholder perceptions and knowledge into the early stages of energy planning to ensure sustainable development of both the tourism and energy industries.

**Keywords**: Renewable energy infrastructure, impact area, tourism service providers, spatial perception, stakeholder participation, Iceland.

# 1 Introduction

With a pressing need to mitigate the climate crisis, interest in the harnessing of renewable energy is increasing worldwide. In 2020, more than 260 GW of global renewable energy capacity was added, setting a new annual record [1]. Iceland is among the leading countries in renewable electricity production per capita. Almost 100% of electricity produced in the country in 2020 came from renewable sources with 68.8% from hydropower and 31.2% from geothermal power [2]. Over 80% of all energy used in Iceland is renewable [3]. The country's reliance on renewable energy sources is likely to increase further, since in Iceland's *Climate Action Plan* [4] the low share of renewables in the transport sector is being addressed by, among other measures, facilitating the purchase and the use of electric cars and other clean energy vehicles. Iceland has utilized hydro and geothermal power for several decades and numerous wind farm proposals are under consideration [5].

However, renewable energy infrastructure (REI) is characterized by limited spatial flexibility meaning that renewable energy resources have to be harnessed where they are available. In the case of Iceland such resources are, for the most part, available in relatively undeveloped natural areas which are of increasing value for tourism and recreation, potentially creating contestation over the resource use [6-8]. The tourism industry has been the largest contributor to the Icelandic economy in terms of export earnings [9] and to regional development since 2010 [8], with nature and scenery being the main attractions to tourists [10]. High quality natural areas are therefore a critical resource for the tourism industry. Thus, Iceland provides a valuable case for studying the impacts of REI on nature-based tourism.

An important factor in identifying the locations most suitable for REI with regard to tourism, is the spatial extent of potential impacts of REI on tourism. Estimating the impact area of REI on tourism is, however, a challenging task. Previous studies [11-13] have revealed that tourism stakeholder attitudes toward REI are highly heterogeneous along with the factors affecting the severity and extent of the impacts of REI on tourism. While visual impacts of REI have been shown to be a major concern among tourism stakeholders [14-17], numerous studies [18-22] have suggested that the visual impacts of REI are by far not the only factor affecting stakeholder attitudes toward REI. The meanings assigned to places where such infrastructure is proposed or constructed also play an important role given that they have been shown to shape the attitudes of tourism stakeholders toward specific REI projects [11, 19, 23].

In order to estimate the impact area of REI on tourism it is therefore essential to understand how changes brought by REI development affect tourist destinations as places containing multiple meanings to the people using them [24]. This study focuses on the views of tourism service providers on existing and proposed REI in Iceland. The beliefs and perceptions of tourism service providers regarding the impacts of REI on tourism and their spatial extent are likely to affect their decision-making on future investments and actions related to tourism planning and development in the areas that tourism service providers perceive as affected [8, 25]. Furthermore, tourism service providers play a major role in shaping tourist attitudes toward REI encountered during their travels [26]. Hence, knowledge of how tourism service providers perceive the impacts of REI on tourism and their spatial extent is an important contribution to understanding the complex relationships between REI and tourism.

The present study aims to: (I) map the impact area of REI on tourism as perceived by tourism service providers; and (II) investigate the factors affecting the size and shape of the perceived impact area. To achieve these aims interviews with tourism service providers in Iceland were conducted using participatory mapping software to estimate the perceived impact area.

# 2 Estimating the spatial extent of the impacts of REI on tourism

The spatial extent of the impacts of REI on tourism is a crucial factor for the selection of the most suitable sites for REI in regions relying on tourism and for reducing potential resource use conflicts, therefore several studies have investigated how the impacts of REI on tourism change with distance. Various studies [11, 27, 28] that examined how hypothetical offshore wind turbines would impact beachgoer attitudes and consequently visitation demand showed that with increasing distance between the wind turbines and the shore, the proportion of visitors reporting negative impacts on their experience and intention to avoid the beach decreased. In a study by Parsons et al. [11] the base trip-loss was estimated to be 29% if 100 wind turbines reaching the height of 175 m would be constructed at a distance of 2.5 miles (4 km) from shore and would drop to 5% at 20 miles (32.2 km). A study by Veidemane and Nikodemus [28] revealed that if 20 wind turbines with a 100 m high tower and 40 m long blades would be constructed at a distance of 8 km from shore 48,3% of tourists would be deterred from visiting the beach, while at a 20 km distance the proportion would drop to 18%. The distance between the wind farm and the shore was also positively correlated with the willingness to stay longer

in the area [28]. Similarly, the experienced visual disamenity costs among tourists decreased with increasing distance of offshore wind turbines from the shoreline [29].

Distance has also been found to play a role in shaping the attitudes of tourism service providers. Burns and Haraldsdóttir [30] indicated that tourism service providers located further away from a proposed hydropower plant or not directly relying on the area where it was proposed were less negative towards the proposed infrastructure. Ólafsdóttir and Sæþórsdóttir [14] showed that distance of a proposed wind farm from tourist activities and scenic areas used for tourism was an important factor shaping the attitudes of tourism service providers. While studies investigating how distance affects tourism stakeholder attitudes toward REI have emphasized the importance of the degree of visual impacts caused by REI [e.g. 11, 15, 28], the heterogeneity of these attitudes points to the need for research investigating other factors affecting the spatial extent of the impacts of REI on tourism. Such studies presently are relatively few. Sæþórsdóttir and Ólafsson [31, 32] described a method which was developed by one of the expert groups of *the Icelandic Master Plan for Nature Protection and Energy Utilization. The Master Plan* was implemented by the Icelandic Government with the aim to ensure sustainable energy utilization which would be compatible with other land uses such as tourism, as well as nature conservation goals and is responsible for the evaluation and ranking of the energy projects proposed by the energy companies [6, 33, 34]. The method developed by the expert group besides evaluating REI proposals simultaneously serves as a tool for estimating potential impact areas of the proposed REI on tourism and recreation. The impact areas include regions where the attributes falling into at least one of the five following categories would be affected: experience, recreation opportunities, use, infrastructure and future value [31]. While this method has been used in *the Master Plan*, some of the energy companies have criticised the large size of the identified impact areas [35]. Therefore, research investigating how tourism stakeholders perceive the impact area of REI on tourism and which factors they define as decisive for the size and shape of the impact area is greatly needed to ensure sustainable REI planning.

Several studies [18, 19, 36] emphasized that the technical and locational characteristics of REI do not fully explain stakeholder attitudes toward REI and pointed to the importance of place-based management of natural resources. As Devine-Wright [36] observed, “locations of renewable energy projects are not merely sites with topographical, ecological or archaeological features; they are also places replete with memories, experiences, stories and myths that are as much a feature of any locality as the soil type, height above sea level or average wind speed.”

This demonstrates the importance of also considering the sense of place [37-39] when assessing the impacts of REI on tourism [24]. According to Stedman [40], physical environment characteristics shape the symbolic place meanings which serve as a basis for people's place attachment and satisfaction with the place. While place meanings are socially constructed and might be kept even when changes to the physical environment occur [41, 42], various studies [40, 43] have pointed out that radical environmental changes are more likely to threaten the place meanings and lead to changes in the sense of place. Just how far these changes are likely to reach when REI is constructed in natural areas used for tourism may depend on how tourism stakeholders perceive the places where such infrastructure is constructed and their boundaries.

With respect to the concept of place, Massey [44] stated: "if space is rather a simultaneity of stories-so-far, then places are collections of those stories, articulations within the wider power-geometries of space". She further argued that places can be defined as "bundles of trajectories", "integrations of space and time" or "spatio-temporal events" [44], the character of which is defined by the intersections of the multiple relations to them. Places are not static, they are constantly changing and being co-produced by human mobilities and immobilities. While travelling, people also contribute to the construction and alteration of the spaces and places they move through. Thus, the concepts of mobility and place are not antagonistic, they are instead closely related and complement each other [24, 45].

Places are shaped by networks of social relationships which reach much further than the places themselves, with the multiple identities of places being created via complex internal and external linkages [46]. Therefore, while analyzing places and impacts of physical changes brought to them, it is important to take into consideration their interrelationships with other places and the wider surrounding environment [47]. This is highly relevant for tourism destinations which Hannam et al. [48] define as *mobility nodes*, a meeting point of multiple social connections. As a result, tourist places are "economically, politically and culturally produced through networked mobilities of capital, persons, objects, signs and information" [49]. All these mobilities contribute to shaping tourist places and create networks connecting tourist destinations, and therefore affect the spatial extent of the impacts of REI on tourism.

# 3 Research settings

## 3.1 Study context

Due to its location on the Mid-Atlantic Ridge in the northern periphery and consequent interplay of glaciers and volcanic activity, Iceland is recognized for its diverse landscapes and unique nature [50]. Around 25% of the country's area is currently under formal conservation protection (Figure 1) [51]. The country's protected areas include three national parks, 42 nature reserves, 48 natural monuments as well as numerous other protected areas [52]. Icelandic protected areas include sites of international importance. Vatnajökull National Park and a volcanic island of Surtsey are UNESCO natural World Heritage Sites, while Thingvellir National park is a UNESCO cultural World Heritage Site [53]. Six sites in Iceland have been designated as Wetlands of International Importance, or Ramsar sites [54]. At the time of writing, eight natural areas are protected from energy developments according to *the Icelandic Master Plan for Nature Protection and Energy Utilization* [55].

Generally, energy developments are not permitted in protected areas in Iceland, however, renewable energy resources are often available in scenic natural areas used for tourism which do not hold any formal protection status. Some of these areas are located in the interior of the country known as the Central Highlands, which the present study focuses on. The region consists of a 400-700 m high plateau covering around 40% of the country and is characterized by lava fields, glaciers, vast sand deserts, mountains, geothermal areas, vegetated oases, and wetlands. The Central Highlands are of high value for tourism and serve as a location for numerous tourism and outdoor recreation activities [7, 56, 57]. Water running from the glaciers and falling down the plateau and active geothermal areas provide numerous opportunities for harnessing energy [31, 32, 34]. Renewable energy resources within or at the edge of the Central Highlands provide for a significant proportion of current electricity production in Iceland [58]. Furthermore, various new energy projects have been proposed in the area and evaluated by *the Master Plan for Nature Protection and Energy Utilization* [5, 59, 60].

Most of the Icelandic population, which in January 2021 reached almost 370,000 [61], lives in the coastal lowlands of the country, with over 60% living in the greater capital area and the rest in small towns, villages, and farms [62]. The lowlands have numerous agricultural and other land uses, while the uninhabited Central Highlands are a venue for nature-based tourism, outdoor recreation, renewable energy harnessing, nature conservation, and sheep grazing.

For over two decades there has been discussed an idea of establishing a national park in the Central Highlands of Iceland [63], which resulted in creating Vatnajökull National Park in 2008 [64]. In December 2020 the Minister for the Environment and Natural Resources submitted a bill on establishing a Highlands National Park to the Icelandic Parliament. The park would cover an area of around 30,000 $km^2$ in the Central Highlands, corresponding to about 30% of the country [65]. After publishing the bill, however, opposition against establishing the park increased [66-69], which partly contributed to the bill's withdrawal from the Parliament as well as political disagreement. The establishment of the Highlands National Park would limit new energy developments in its territory [65]. Meanwhile, energy projects proposed in the Central Highlands are going through standard evaluation procedures, according to *the Master Plan* framework [70].

## 3.2 Study areas

For this research six study areas located within or at the boundaries of the Icelandic Central Highlands were selected due to the importance of the area for nature-based tourism and opportunities for energy utilization. Study locations include areas with existing as well as proposed renewable energy projects in order to see if there are any differences in the tourism industry's perceptions of their impacts on tourism (Figure 1; Table 1). Since previous research has shown that tourism stakeholders have different preferences regarding various types of REI [12, 71, 72], potential differences were investigated with respect to three types of REI, i.e. hydro-, geothermal and wind power, thereby also providing insights into the spatial extent of the impacts of various types of REI. The six selected renewable energy projects differ in their visibility and environmental impacts due to their type, size, and design (Table 1). The study areas are located at relatively high elevations, thus, their land cover is mostly desert-like with scarce vegetation [34]. While five study areas situated in the southern and in the northeastern parts of the Central Highlands are surrounded by diverse scenic landscape, the landscape around the study area containing the Blanda Hydropower Plant is rather uniform with no significant tourist attractions nearby.

*Table 1. Existing and proposed REI included in this study [73-82]*

| Existing REI* | Description | Installed capacity | Operation started |
|---|---|---|---|
| Blanda Hydropower Plant | Underground power station, reservoir (56 $km^2$), intake reservoir (5 $km^2$), 5 dams, several canals and tunnels | 150 MW | 1991 |
| Krafla Geothermal Power Plant | 2 steam turbines, 33 wells | 60 MW | 1977 |
| Seven hydropower plants in the Þjórsá and Tungnaá Catchment Area | 7 power stations, 3 main supply reservoirs (32 – 92 $km^2$), 7 smaller reservoirs (0.6 – 20 $km^2$), 24 dams, numerous canals and tunnels | 1035 MW | 1969 |
| **Proposed REI** | | **Estimated capacity** | |
| Hrafnabjörg Hydropower Plant | Underground power station, reservoir (27 $km^2$), 1-2 dams, several canals and tunnels | Three versions:<br>88.5 MW<br>50 MW<br>36.5 MW | - |
| Hágöngur Geothermal Power Plant | Directly disturbed area would reach around 0.3 $km^2$, infrastructure specifics not provided | 150 MW | - |
| Búrfellslundur Wind Farm | 30 wind turbines up to 150 m high | 120 MW | - |

**Since presently only two experimental wind turbines are operated in Iceland, located at the edge of the Central Highlands of Iceland [83], this study focused only on existing hydro- and geothermal power infrastructure.*

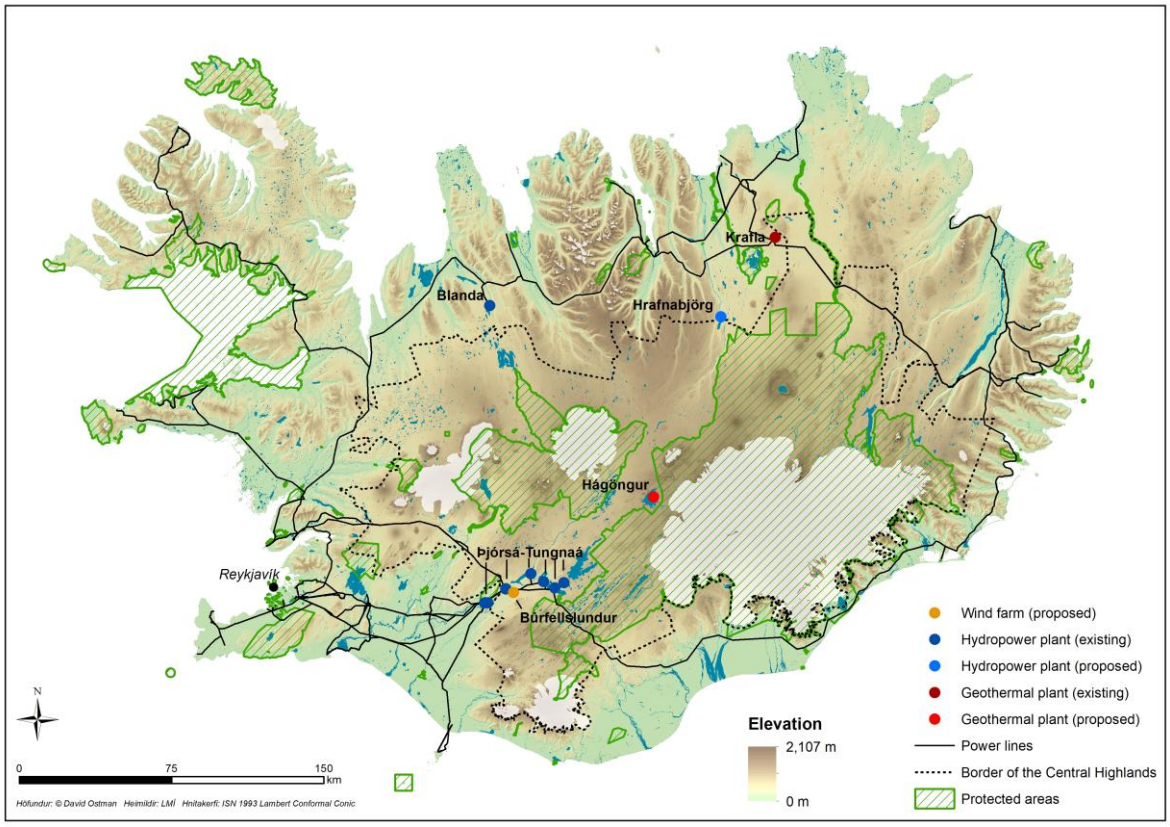


*Figure 1. Locations of the existing and proposed renewable energy projects included in this study.*

# 4 Methods

## 4.1 Data collection

This study adopted a phenomenological research design which aims to investigate how participants perceive and interpret the phenomena and what meanings they assign to them [84-86]. The tourism service providers' perceptions of the impacts of REI on tourism and their spatial extent were analyzed by employing qualitative research methods since they best suit the phenomenological exploratory nature of this study [87]. As pointed out by numerous researchers [88-90], semi-structured interviews enable investigation of participants' perceptions, attitudes and meanings assigned to certain places and phenomena. Asking pre-determined questions during semi-structured interviews also allows collection of data comparable between several study areas, while probe questions based on the participants' answers provide opportunities to receive information which could not be predicted in advance and space for the participants to discuss the issues that they perceive as the most important [88, 90]. Therefore, the data for this study was collected by conducting 49 semi-structured interviews in May–August 2020 with selected tourism service providers that use the natural areas located next to the existing or proposed energy projects discussed in this study for their business.

Purposive sampling [85] was used for the selection of the participants, and, in line with the aims of this study, the tourism service providers who are knowledgeable about tourism in at least one of the study areas were selected. In order to provide multiple perspectives of various types of tourism businesses, maximal variation sampling [91] was used for identification of the participants. Thus, companies that differ in the type of services that they provide, types of tourists they serve, size and length of operation, were included in the sample. The interviewed companies included accommodation and food service providers as well as travel agencies and day tour providers offering a wide range of tours, including hiking, sightseeing, jeep and super jeep, self-driving, horse riding, skiing, mountain biking, fishing, kayaking, photography, yoga and meditation, and flight tours. The size of the businesses ranged from one for self-employed participants to over 60 employees. While some companies included in the sample were active for less than 10 years, the oldest companies had been operating for over 40 years. Companies having their headquarters next to the study areas as well as those operating from the capital Reykjavik were included in the sample. Such sampling ensures the inclusion of a wide range

of views and perspectives and allows the identification of factors that affect the views of the tourism service providers regarding the impact area of REI on tourism.

Each interview was started by introducing the research team and the aims of the study to the participants. They were further informed that all data collected will be treated confidentially, that their participation is fully voluntary, and they can withdraw at any time. Once the participants gave their consent to participate in the study, they were asked whether the interview can be audio recorded, to which all of the participants agreed. In order to identify the perceived impacts of REI on tourism, their spatial extent and the factors affecting it, the following topics were covered during the interviews:

- The type of tourism business, customers and their preferences;
- The areas of Iceland and of the Icelandic Central Highlands used for the business;
- The main resources for tourism, main tourist attractions, and activities undertaken in the Central Highlands and in used study areas;
- The impacts of REI on the business of each participant and on tourism in Iceland in general, and factors affecting the character and the severity of these impacts;
- The estimated impact area of existing and proposed REI on tourism; and
- The reasoning behind each estimated impact area.

During the interviews the participatory mapping software *Maptionnaire* was used, allowing each participant to draw the estimated impact area of REI on tourism. For the estimation of the impact areas participants were asked to draw polygons to include the areas in which they considered tourism to be impacted by the energy infrastructure in question. The use of polygons during semi-structured interviews allows efficient mapping of the discussed place meanings, changes brought to them, and their spatial boundaries [92-94], and therefore is highly suitable for mapping the perceived impact areas of REI on tourism. However, the areas drawn by participants are often generalized, the boundaries of such areas tend to be 'fuzzy', and the level of precision varies according to each individual [92, 95]. Moreover, since the polygons were drawn by placing points which were connected by the software with straight lines, the areas tended to be less precise and to contain sharp angles when the participants placed relatively few points. In this study the impact areas were presented as drawn by the participants, and no changes were made to the drawings to account for the fuzzy boundaries of the mapped impact areas.

The maps prepared in *Maptionnaire* were presented to the participants on a portable computer screen. Participants could select between several base maps and could easily manipulate the map to choose their preferred scale. The maps included existing and proposed REI discussed in this study. Before mapping each participant was instructed about the use of *Maptionnaire* and was provided assistance during mapping if required. Few participants did not feel comfortable with using the software. They were offered a big, laminated map of Iceland with marked REI on it and were asked to draw their perceived impact areas with a marker. Later the drawings were copied into *Maptionnaire* and analyzed using the same procedure as impact areas mapped digitally.

While drawing their perceived impact areas participants were asked to provide their reasoning behind the estimated areas. Thus, they explained what impacts, landscapes, features, objects, routes, activities, and meanings they included in the mapped impact areas and what factors, according to them, shaped the boundaries of these impact areas. Participants were also asked about the character of the described impacts and of their estimated impact areas, which varied among the projects and was defined by the participants as positive, negative, mixed, or neutral. Participants were only asked to draw the perceived impact areas of the REI existing or proposed in the areas that they are familiar with, use, have used or are planning to use for their business and feel comfortable and knowledgeable enough to estimate impact areas of these energy projects on tourism. Additionally, to ensure that participants received sufficient information about the energy projects included in the study, detailed descriptions of the projects as well as various visual material, such as maps of the study areas, maps with visibility analysis of the energy infrastructure, and photographs were provided during the interviews. The interviews were conducted face-to-face, mostly by two interviewers, although several interviews were conducted by only one interviewer due to scheduling conflicts. Participants could choose either Icelandic or English as the interview language. The interviews lasted from 22 to 241 minutes depending on the number of study areas that each participant was familiar with and the number of estimated impact areas.

## 4.2 Data analysis

The interviews were transcribed verbatim and analyzed inductively based on the grounded theory method [96]. The data analysis started with open coding using Atlas.ti software. The data clusters for each study area were created and initial codes describing the value of each study area for the tourism industry, the impacts of each REI project on tourism, the factors

affecting their character and their spatial extent, as well as the main arguments for the estimated impact areas were identified. During the second round all codes related to the same energy project were revised and clustered into categories based on the reasoning used in the estimation of the impact areas. The GIS data drawn from the interviews containing perceived impact areas was imported into ArcGIS software and the analysis of each polygon as regards their localization, size and shape and the reasoning revealed in the interviews was conducted. Later, axial coding was used, and the reasoning categories were compared between the study areas to identify the factors affecting the spatial extent of the impacts of REI on tourism.

Based on the interviews and on the GIS data, an Excel sheet was prepared which contained the information about each estimated impact area, its size and character, the arguments for its size, the impacts of each energy project discussed, the factors affecting the character of these impacts, and the perceived need for further energy development in Iceland as well as information about each participant's business. Thus, the Excel sheet combined the information from the interviews with the information of the GIS data and served as a basis for writing up the results. Diagrams were also used to map the relationships between the various factors revealed in the interviews and the spatial extent of the impacts of REI on tourism [97]. Initial coding was done by one researcher, while the later steps of the analysis were conducted by the research team.

## 4.3 Overview of participants and their mapped impact areas

Some of the interviewees were not able or willing to map their perceived impact areas of REI on tourism. The reasons included not feeling knowledgeable enough or having never thought about the spatial extent of the impacts of REI on tourism before. Out of 49 participants 32 were willing to draw impact areas and to discuss the reasoning behind their drawings. Among the participants who estimated the impact areas, 15 tourism businesses were operating from Reykjavik, and 17 were located close to the areas with existing or proposed REI included in this study: five were in northwest Iceland, seven in northeast Iceland and other five in south Iceland (Table 2). All the tourism companies operating from Reykjavik were offering tours throughout the country, while companies located close to the areas with REI also included accommodation and food service providers, who estimated only the impact areas of REI located nearby. Thus, tourism businesses operating from Reykjavik constituted the highest proportion of participants who mapped impact areas of each energy project (Table 2).

*Table 2. Number of participants who estimated the impact areas of each energy project.*

| | **Interviews conducted** | **Participants who estimated impact areas** | **Existing power plants** | | | **Proposed power plants** | | |
|---|---|---|---|---|---|---|---|---|
| Location and type of tourism business | | | Blanda | Krafla | Þjórsá-Tungnaá | Hrafnabjörg | Hágöngur | Búrfellslundur |
| **Reykjavik** | **19** | **15** | **9** | **9** | **13** | **10** | **10** | **13** |
| (1) Travel agency/day tour provider/other | 19 | 15 | 9 | 9 | 13 | 10 | 10 | 13 |
| **Northwest Iceland** | **8** | **5** | **5** | | | | | |
| (1) Travel agency/day tour provider | 2 | 0 | | | | | | |
| (2) Travel agency/day tour provider and accommodation | 2 | 1 | 1 | | | | | |
| (3) Accommodation/food service provider | 4 | 4 | 4 | | | | | |
| **Northeast Iceland** | **13** | **7** | **3** | **4** | **1** | **7** | | **3** |
| (1) Travel agency/day tour provider | 7 | 4 | 2 | 2 | 1 | 4 | | 2 |
| (2) Travel agency/day tour provider and accommodation | 3 | 2 | 1 | 2 | | 2 | | 1 |
| (3) Accommodation/food service provider | 3 | 1 | | | | 1 | | |
| **South Iceland** | **9** | **5** | | | **4** | **1** | **5** | **5** |
| (1) Travel agency/day tour provider | 0 | 0 | | | | | | |
| (2) Travel agency/day tour provider and accommodation | 6 | 3 | | | 2 | 1 | 3 | 3 |
| (3) Accommodation/food service provider | 3 | 2 | | | 2 | | 2 | 2 |
| **Total** | **49** | **32** | **17** | **13** | **18** | **18** | **15** | **21** |

The data collected revealed differences regarding the character of the perceived impacts of REI on tourism. While some participants perceived the impacts of the REI on tourism as negative, others described them as positive or mixed/neutral. Therefore, the impact areas estimated in this study were categorized and the reasoning behind them was analyzed accordingly. Three participants preferred to draw two impact areas of different character for the same energy project. One drew separate impact areas for neutral and positive impacts of Blanda Hydropower Plant. Two participants estimated two impact areas each of the proposed Hrafnabjörg Hydropower Plant on tourism. One of them estimated separate positive and negative impact areas of the power plant, while the other estimated mixed and negative impact areas. In total, participants estimated 51 negative impact areas, 23 of the areas focused on positive impacts, and 31 were perceived as mixed/neutral impact areas.

# 5 Results

## 5.1 Perceived impact areas of REI on tourism

The participants were more negative toward the proposed energy projects compared to existing ones. Between 12 and 18 (80% and 86%) estimated impact areas of each proposed energy

project on tourism were perceived as negative compared to 1–3 (6%–17%) impact areas of the existing REI (Table 3, Figure 2). Besides discussing potential impacts of the proposed energy projects on tourism, most participants questioned the need for further energy development and the purpose of it.

The attitudes of participants toward the existing power plants were more positive than toward proposed energy projects. Participants stated that they have adapted their businesses to existing REI, since in most cases it was built before they started operating their businesses. In line with that, between 4 and 10 (28% and 56%) estimated impact areas of existing REI were perceived by the participants as positive, while the number of estimated positive impact areas of the proposed energy projects was relatively low, between 1 and 2 (5% and 13%) (Table 4, Figure 3).

Some participants perceived the impacts of REI on tourism as mixed or neutral. For each existing energy project between 7 and 10 mixed/neutral impact areas were estimated, which constituted between 39% and 62% of all estimated impact areas, while 1–3 mixed/neutral impact areas estimated for each proposed renewable energy project constituted 7%–15% (Table 5, Figure 4). Out of 31 mixed/neutral impact areas seven impact areas (23%) were defined as neutral. All of them focused on the impacts of the existing energy projects.

Table 3. Negative impact areas of all six energy projects on tourism.

| | Power plant | No. of impact areas | No. of all impact areas | % of all impact areas | Mean size ($km^2$) | Standard deviation | Median ($km^2$) |
|---|---|---|---|---|---|---|---|
| Existing | Blanda Hydropower Plant | 1 | 18 | 6 | 640 | - | - |
| | Krafla Geothermal Power Plant | 1 | 13 | 8 | 548 | - | - |
| | Þjórsá-Tungnaá Hydropower Plants | 3 | 18 | 17 | 5,423 | 3,160 | 6,336 |
| Proposed | Hrafnabjörg Hydropower Plant | 16 | 20 | 80 | 4,361 | 9,432 | 1,447 |
| | Hágöngur Geothermal Power Plant | 12 | 15 | 80 | 3,238 | 3,312 | 2,729 |
| | Búrfellslundur Wind Farm | 18 | 21 | 86 | 2,559 | 1,838 | 2,247 |

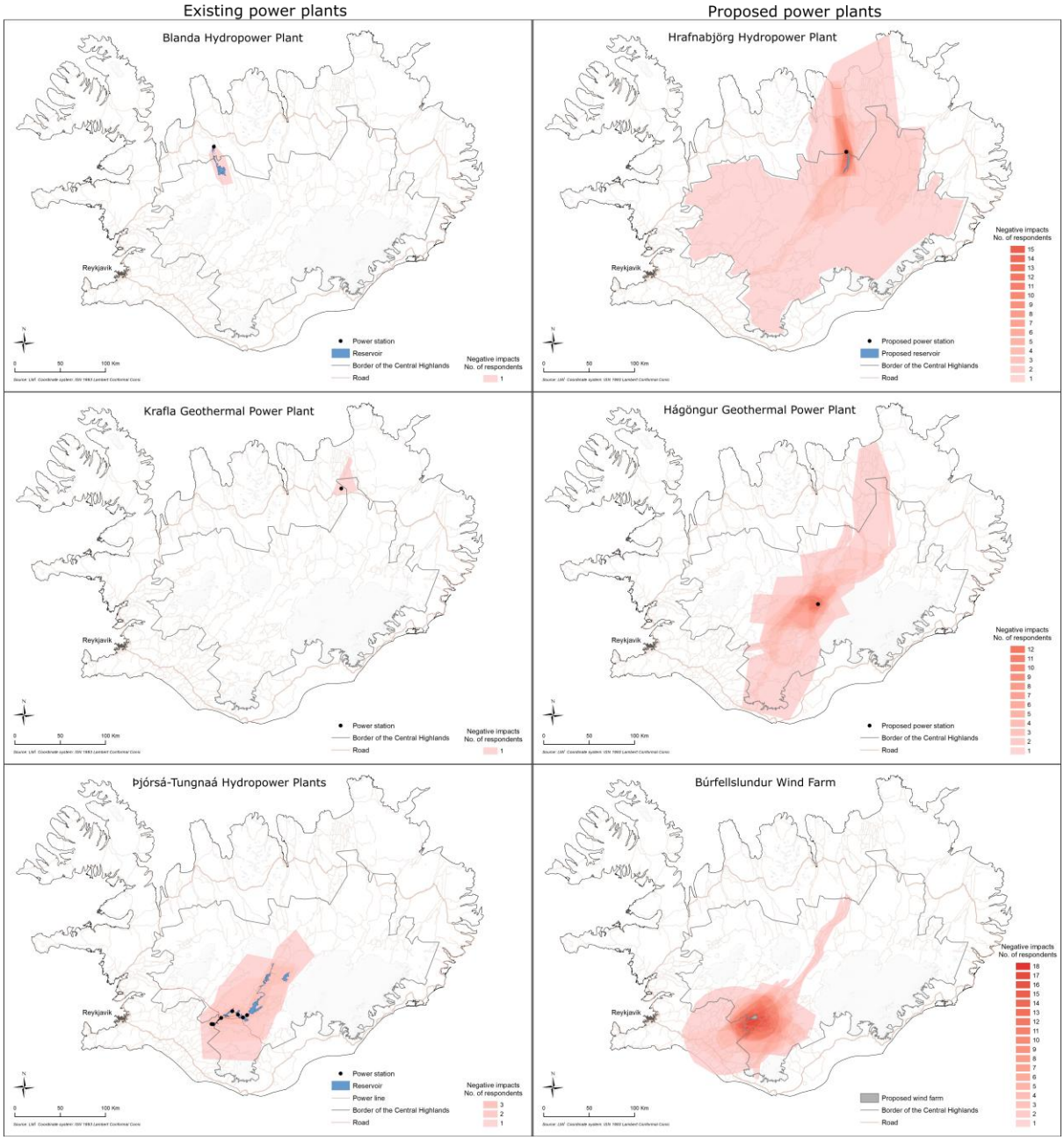


*Figure 2. Negative impact areas of all six energy projects on tourism.*

*Table 4. Positive impact areas of all six energy projects on tourism.*

| | Power plant | No. of impact areas | No. of all impact areas | % of all impact areas | Mean size ($km^2$) | Standard deviation | Median ($km^2$) |
|---|---|---|---|---|---|---|---|
| Existing | Blanda Hydropower Plant | 10 | 18 | 56 | 2,768 | 5,264 | 685 |
| | Krafla Geothermal Power Plant | 4 | 13 | 31 | 1,167 | 2,137 | 141 |
| | Þjórsá-Tungnaá Hydropower Plants | 5 | 18 | 28 | 10,284 | 12,020 | 5,356 |
| Proposed | Hrafnabjörg Hydropower Plant | 1 | 20 | 5 | 36 | - | - |
| | Hágöngur Geothermal Power Plant | 2 | 15 | 13 | 1,160 | 1,183 | 1,160 |
| | Búrfellslundur Wind Farm | 1 | 21 | 5 | 131 | - | - |

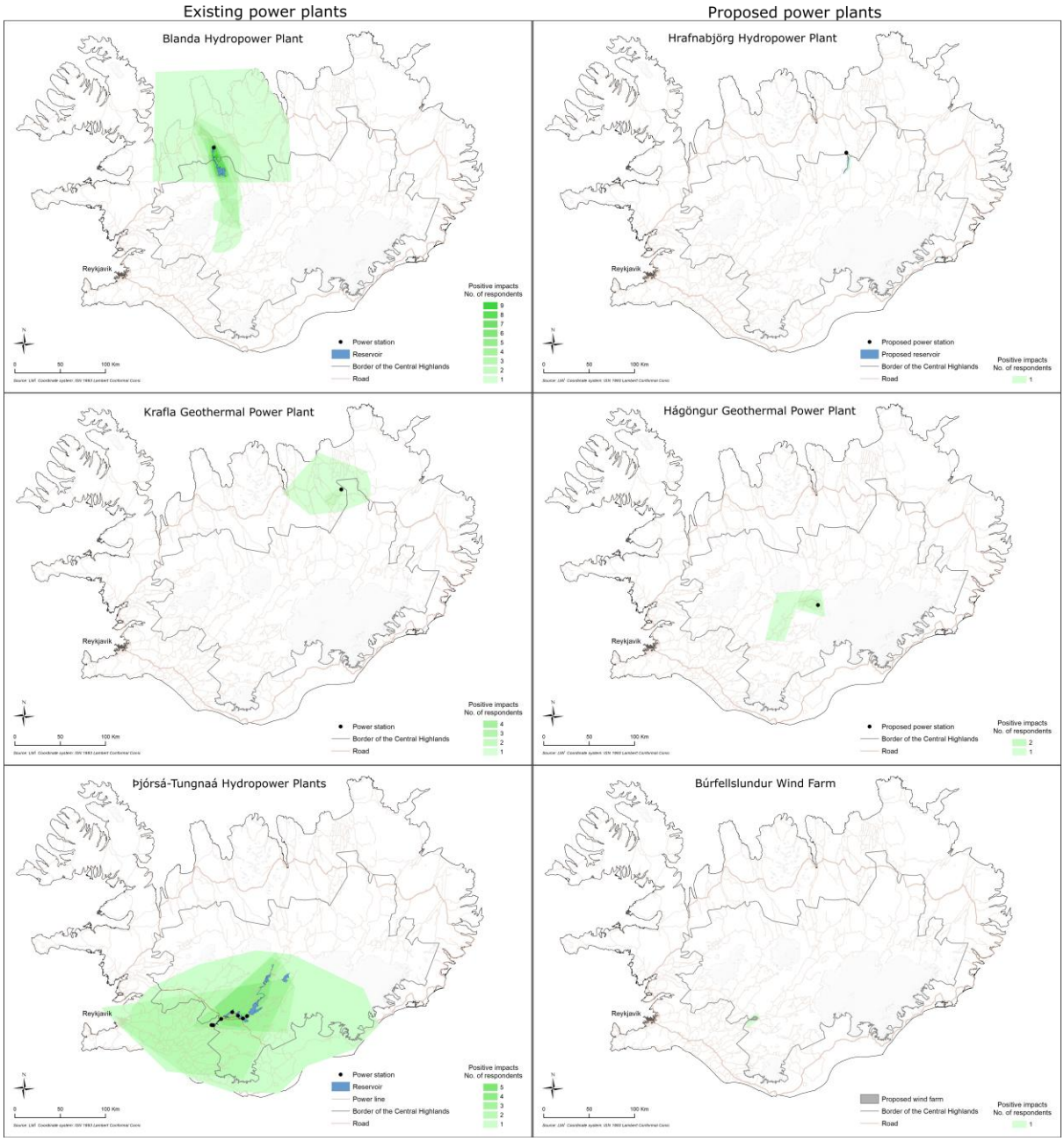


*Figure 3. Positive impact areas of all six energy projects on tourism.*

*Table 5. Mixed and neutral impact areas of all six energy projects on tourism.*

| | Power plant | No. of impact areas | No. of all impact areas | % of all impact areas | Mean size ($km^2$) | Standard deviation | Median ($km^2$) |
|---|---|---|---|---|---|---|---|
| Existing | Blanda Hydropower Plant | 7 | 18 | 39 | 1,012 | 967 | 531 |
| | Krafla Geothermal Power Plant | 8 | 13 | 62 | 765 | 764 | 482 |
| | Þjórsá-Tungnaá Hydropower Plants | 10 | 18 | 56 | 3,139 | 2,258 | 2,158 |
| Proposed | Hrafnabjörg Hydropower Plant | 3 | 20 | 15 | 7,244 | 327 | 7,419 |
| | Hágöngur Geothermal Power Plant | 1 | 15 | 7 | 6,983 | - | - |
| | Búrfellslundur Wind Farm | 2 | 21 | 10 | 310 | 9 | 310 |

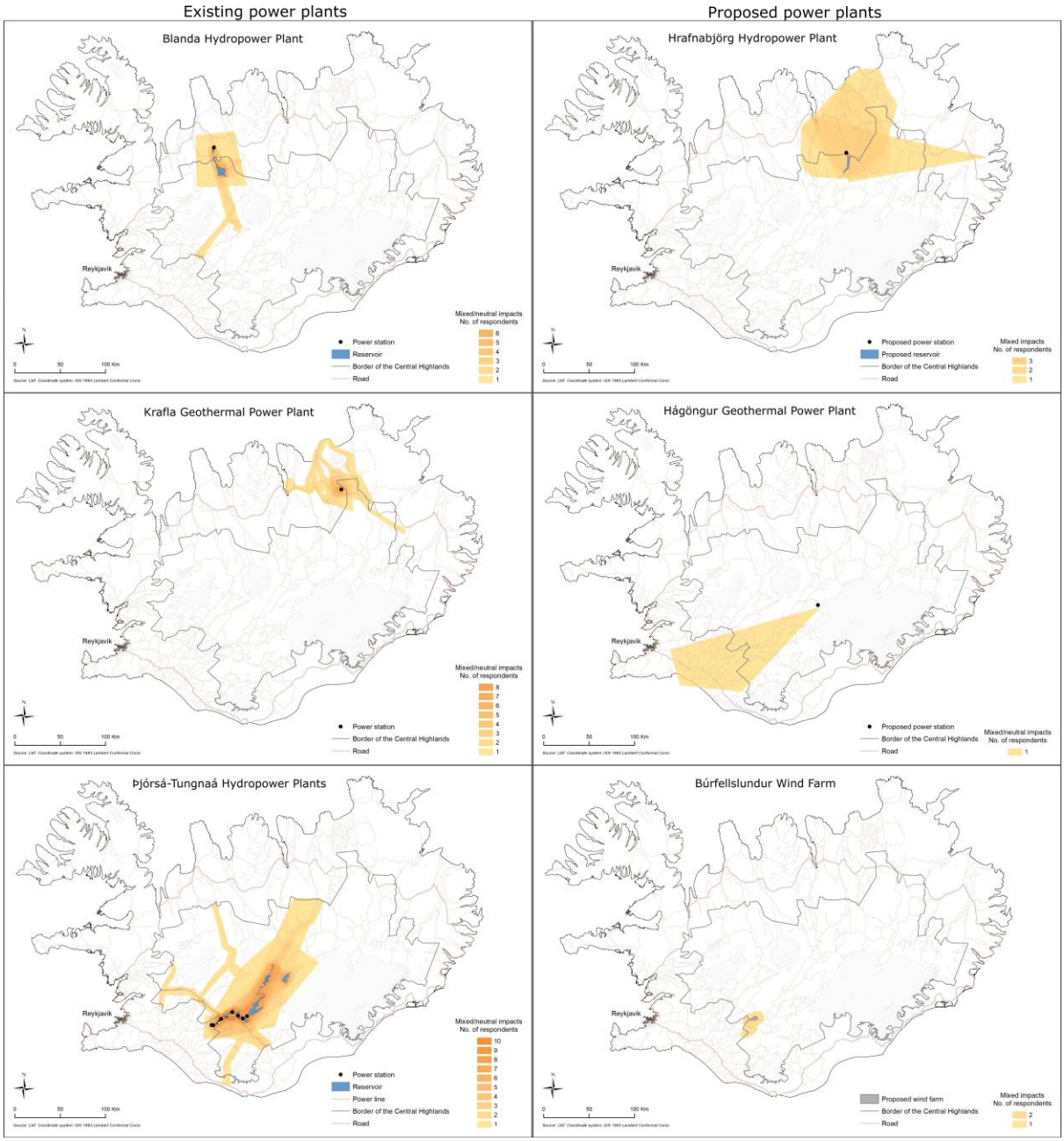


*Figure 4. Mixed and neutral impact areas of all six energy projects on tourism.*

## 5.2 Rationale behind the estimated impact areas

### 5.2.1 Negatively perceived impact areas of REI on tourism

The majority of the participants who perceived the impacts of REI as negative pointed to the environmental impacts of the energy projects in question. They emphasized that REI visually impacts the surrounding landscapes and transforms the image of the surrounding areas from natural into 'industrial'. Such changes, according to the participants, negatively impact visitor experience and reduce opportunities for the tourism industry in the areas around REI. Out of 51 estimated negative impact areas 26 (51%) were based on the visibility of the power plant infrastructure and associated environmental impacts and were relatively small (Table 6, Figure 5). Their size, among other factors, depended on the design of the power plant, as well as on the topography of the surrounding landscape which affects from how far the REI can be seen. The type of REI also affected the size of the perceived impact areas based on visibility. Participants pointed to the high visibility of the proposed wind turbines, which would be visible in the Icelandic landscape from tens of kilometers. In some cases, participants took into consideration the visibility of the power lines, thus, such estimated impact areas were larger in size. While discussing the impact areas of the geothermal plants, some participants considered the visibility of steam released by such power plants, which also led to estimating larger perceived impact areas of such power plants on tourism, compared to the impact areas the estimation of which was based on visibility of only power plant infrastructure.

Among the estimated negative impact areas extending beyond the visibility, 22 or 43% of all negative impact areas were mapped by taking into consideration tourist mobility (Table 6, Figure 5). Participants who used this reasoning emphasized that tourists travel to the Central Highlands for wilderness experience and tend to perceive power plants as not suitable in natural areas, therefore REI is likely to negatively impact their experience. Such impacts, according to the participants, might last for an entire day or during the entire trip. Thus, REI encountered on the way to a nature destination is likely to affect how tourists experience and perceive this destination. The participants who estimated the impact areas based on tourist mobility in such areas often included the main Central Highlands roads passing the REI, such as Sprengisandur and Kjölur roads as well as roads to and around Landmannalaugar, the most popular tourist destination in the Central Highlands (Figure 5). They included tourist destinations reached by travelling past the REI, the image and perception of which was/would be affected by the power plants. Several participants included into their estimated impact areas hiking routes that stretch

to the various parts of the Central Highlands and emphasized that hikers are especially sensitive to encounters with REI, therefore REI heavily impacts the value, image and future potential of hiking routes that it interferes with. Thus, the size of the perceived impact areas of REI on tourism based on the tourist mobility depended on the routes tourists are using, the destinations they are visiting, their travel mode, and the experiences they are seeking.

Some participants believed more REI in the Central Highlands is likely to negatively impact wilderness areas which the tourism industry relies on and, subsequently, damages the image of the whole Central Highlands and of the proposed Highlands National Park. The participants stressed the importance of keeping the size of the wilderness areas large in order to provide high quality experience to tourists and stated that building new power plants would cut into a large wilderness area. In those cases, participants defined the whole Central Highlands or large parts of them as the impact area of REI on tourism, since the experience of tourists travelling in these areas would be degraded. Participants emphasized that wilderness experience is an important attraction for tourists and a resource for tourism businesses and therefore stated that wilderness areas should be protected from energy developments. They perceived areas which are already developed, contain no tourist attractions and therefore are of low value for the tourism industry as being more suitable for REI development.

Three impact areas constituting 6% of all negative impact areas were estimated by considering the changes REI brings to tourism (Table 6, Figure 5). The participants who used this reasoning emphasized that REI alters tourist movement and their travel patterns and consequently affects other tourism processes in the estimated impact areas of REI on tourism. According to them, the construction of a power plant is likely to lead to avoidance of the surrounding areas due to decreased attractiveness of these areas and/or destruction of tourist attractions. For example, as pointed out by the participants, construction of the proposed Hrafnabjörg Hydropower Plant would destroy Aldeyjarfoss and Hrafnabjargafoss waterfalls, which are of increasing importance for the tourism industry. Such changes, according to the participants, might have negative impacts that stretch far out among the region. Tourists travelling in the region have less attractions to visit and therefore might spend less time there, which is likely to lead to reduced demand for tourism services and economic losses. The participants who estimated impact areas using these arguments often included the areas where tourism services are provided.

### 5.2.2 Positively perceived impact areas of REI on tourism

Most of the positive impact areas, or 17 out of 23 (74%) were estimated taking into consideration the changes in tourism that REI brought to the areas (Table 6, Figure 5). Numerous participants pointed to the improved access due to the road construction related to REI development. New roads and bridges opened up new areas for tourism and added new tourist destinations for visitors to the Central Highlands. Better roads enabled visitors to reach the destinations in the Central Highlands faster and safer. This allowed tourists to go on day tours to the Central Highlands while using the accommodation services in the lowlands. Moreover, they provided better opportunities for winter tourism in the Central Highlands.

According to the participants who estimated positive impact areas, improved access resulted in tourism industry using much wider areas of the Central Highlands for their businesses and including these areas into larger itineraries. For example, improved access due to construction of the Þjórsá and Tungnaá Hydropower Plants enabled the tourism industry to add Central Highlands destinations such as Landmannalaugar or other nearby areas into south Iceland itineraries and to diversify their tours. Improved access was also an important factor in estimating the positive impact areas of Blanda Hydropower Plant since, according to the participants, improvement of the Kjölur road, one of the main roads of the Central Highlands, positively impacted tourist destinations located along the road, such as Kerlingarfjöll and Hveravellir, by making them easier and safer to reach. The perceived positive impact area of Krafla Geothermal Power Plant based on improved access was relatively small, it included the tourist sites located nearby which became more accessible, such as Leirhnjúkur and Víti (Figure 5).

Some participants who perceived the impacts of REI as positive stated that although nature and, in particular, unspoiled nature is Iceland's main attraction, REI can become a tourist attraction to a certain type of tourist. According to the participants, tourists' attitudes toward renewable energy harnessing are generally positive, and some tourists are interested in visiting the power plants and learning about energy harnessing processes. Thus, power plants can become tourist attractions themselves and serve as a good addition to the itineraries organized in the region. Participants noted that geothermal power plants have a higher tourist attraction potential compared to hydropower plants and to wind farms due to their rarity and high educational value. The largest positive impact area of Krafla Geothermal Power Plant was estimated using these arguments. In some cases, construction of a power plant might have

unexpected positive impacts on tourism. After the construction of the Blanda Hydropower Plant and of its dams and reservoirs the water downstream became clear, which provided opportunities for recreational salmon fishing attracting foreign and Icelandic fishing enthusiasts to the area. Several participants considered it while estimating their perceived positive impact areas. In addition to improved fishing opportunities, the participant who estimated the largest positive impact area of the Blanda Hydropower Plant on tourism took into consideration the economic benefits of the power plant, via the creation of new jobs, which made the area a more competitive destination, and the future potential of the power plant as a tourist attraction if it would be better marketed. In their estimated impact area, they included a location in which tourists would have one more tourism attraction to visit during their trip.

Six positive impact areas (26%) were estimated based on visual impacts of the power plants. According to the participants, naturally looking reservoirs of the hydropower plants add diversity to uniform landscapes as, for example, around the Blanda Hydropower Plant, and provide guides opportunities to talk about renewable energy harnessing and sustainability in Iceland. The estimated impact areas based on these arguments were relatively small and ended with the visibility of REI.

### 5.2.3 Mixed and neutral impact areas of REI on tourism

Some of the participants who estimated mixed impact areas included both positive and negative impacts of REI on tourism, such as visual impacts on surrounding landscapes and on the environment as negative on one hand and the use of roads and bridges for their tours as positive on the other. Some participants also considered impacts that can be perceived both positively and negatively. For example, improved access allows faster and safer travel of tourists, but also leads to higher visitor numbers in natural areas, increased environmental pressure, crowding, and consequently degraded visitor experience and changes in the image and perception of tourist destinations that have become easier to access. Moreover, participants emphasized that while, in some areas, visitation increased due to improved access or investments into tourism infrastructure by the energy company, the areas located closest to the REI are often avoided due to their degraded attractiveness, especially by the businesses the customers of which are seeking wilderness experience. Thus, the perceived mixed impact areas varied largely in size. While the size of eight mixed impact areas was based on the visibility of REI, two impact areas were drawn by taking into consideration tourist mobility and 14 considered changes in tourist movement, their travel patterns and consequently in other tourism processes (Figure 5).

Some participants who estimated mixed impact areas stated that REI certainly changes the landscapes, however, how REI is perceived by tourists and how it consequently impacts tourism depends on various factors. They pointed to the importance of information that tourists receive about renewable energy harnessing in Iceland. According to the participants, if presented in a positive light by the guides as contributors to the sustainable development of the country and to climate change mitigation power plants are likely to be perceived positively. Tourists' perceptions of REI, as stated by the participants, are also likely to depend on their preferences and expectations, interest in renewable energy harnessing, and familiarity with REI.

Participants who perceived the impacts of the existing Blanda and Þjórsá and Tungnaá Hydropower Plants as neutral stated that the well-designed power stations fit well into the surrounding landscape and do not degrade visitor experience, while reservoirs have an appearance of natural lakes for those who are unfamiliar with the area. Impact areas estimated based on these arguments were generally relatively small and their size often depended on the estimated visibility of REI. According to the participant who estimated a neutral impact area of Krafla Geothermal Power Plant, the power plant is often visited on the way to Víti or Leirhnjúkur, but could not be defined as a tourist destination, thus, its impact on tourism is neutral.

*Table 6. The number of estimated impact areas based on visibility, tourist mobility and changes in tourism.*

| | Power plant | No. of negative impact areas | | | No. of positive impact areas | | | No. of mixed/neutral impact areas | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Visibility | Mobility | Changes | Visibility | Mobility | Changes | Visibility | Mobility | Changes | |
| Existing | Blanda Hydropower Plant | 1 | 0 | 0 | 4 | 0 | 6 | 4 | 0 | 3 | 18 |
| | Krafla Geothermal Power Plant | 0 | 1 | 0 | 1 | 0 | 3 | 2 | 0 | 6 | 13 |
| | Þjórsá-Tungnaá Hydropower Plants | 0 | 3 | 0 | 0 | 0 | 5 | 6 | 1 | 3 | 18 |
| Proposed | Hrafnabjörg Hydropower Plant | 10 | 4 | 2 | 0 | 0 | 1 | 0 | 1 | 2 | 20 |
| | Hágöngur Geothermal Power Plant | 7 | 5 | 0 | 0 | 0 | 2 | 0 | 0 | 1 | 15 |
| | Búrfellslundur Wind Farm | 8 | 9 | 1 | 1 | 0 | 0 | 2 | 0 | 0 | 21 |
| | Total: | 26 | 22 | 3 | 6 | 0 | 17 | 14 | 2 | 15 | 105 |

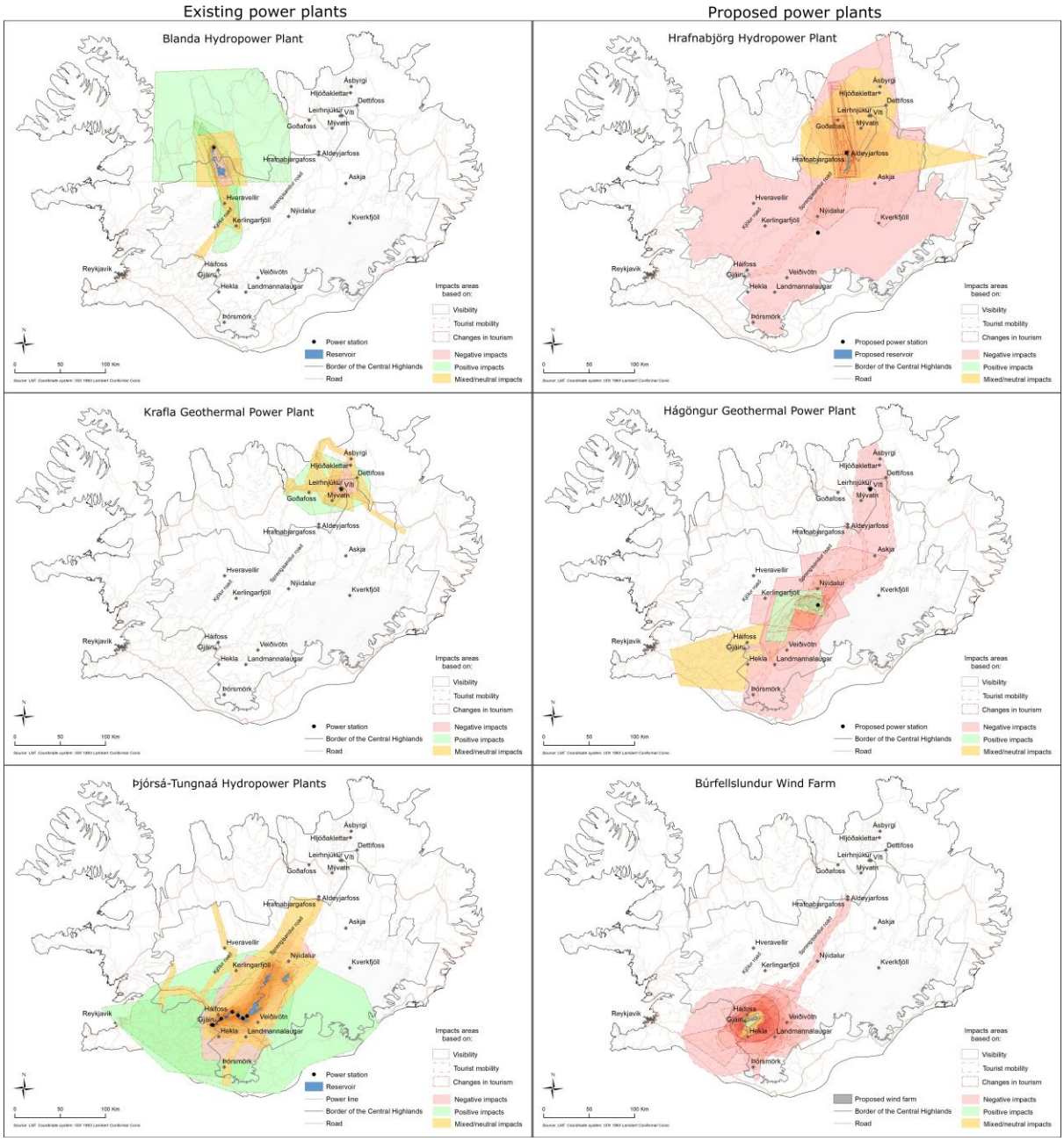


*Figure 5. Perceived impact areas of all six energy projects.*

## 5.3 Factors affecting the spatial extent of perceived impacts of REI on tourism

Much of the estimated negative, positive, mixed, and neutral impact areas are overlapping (Figure 5). This shows that the impacts of REI on tourism and their spatial extent are highly subjective and depend on numerous factors. These factors can be related to the landscape of the area surrounding the energy project, to the REI itself, as well as to the tourism stakeholders (Figure 6). Landscape characteristics together with the type, design, spatial distribution, and image of REI define the severity of the environmental, visual and aural impacts of REI. These impacts, as well as activities undertaken by the tourism stakeholders, their preferences, expectations, and place meanings assigned to the areas of REI, play an important role in shaping the impacts on the perception and image of the area and on the visitor experience. As the interviews revealed, the spatial extent of these impacts highly depends on the subjective perceptions of the tourism stakeholders. Participants who thought the impacts of REI on tourism end with visibility estimated the smallest impact areas. Participants who considered that the impact areas of REI on tourism stretched far beyond the visibility of REI and its environmental impacts, took into consideration tourist mobility. Thus, their mapped impact areas included routes and destinations where visitor experience, image and perception of the area as a whole would be affected if tourists would travel passed the REI (Figure 6). Participants who based their mapped impact areas on changes brought about by REI to tourist movement, travel patterns and other tourism processes included the areas which are/would be avoided due to decreased attractiveness or destroyed tourist attractions, where demand for tourism services would decrease due to lower tourist traffic and shorter stay and which, consequently, would experience economic losses. These impact areas also included areas where tourist flows increased due to improved access and which became part of larger itineraries, as well as areas in which visitors have another tourist attraction – a power plant – to visit.

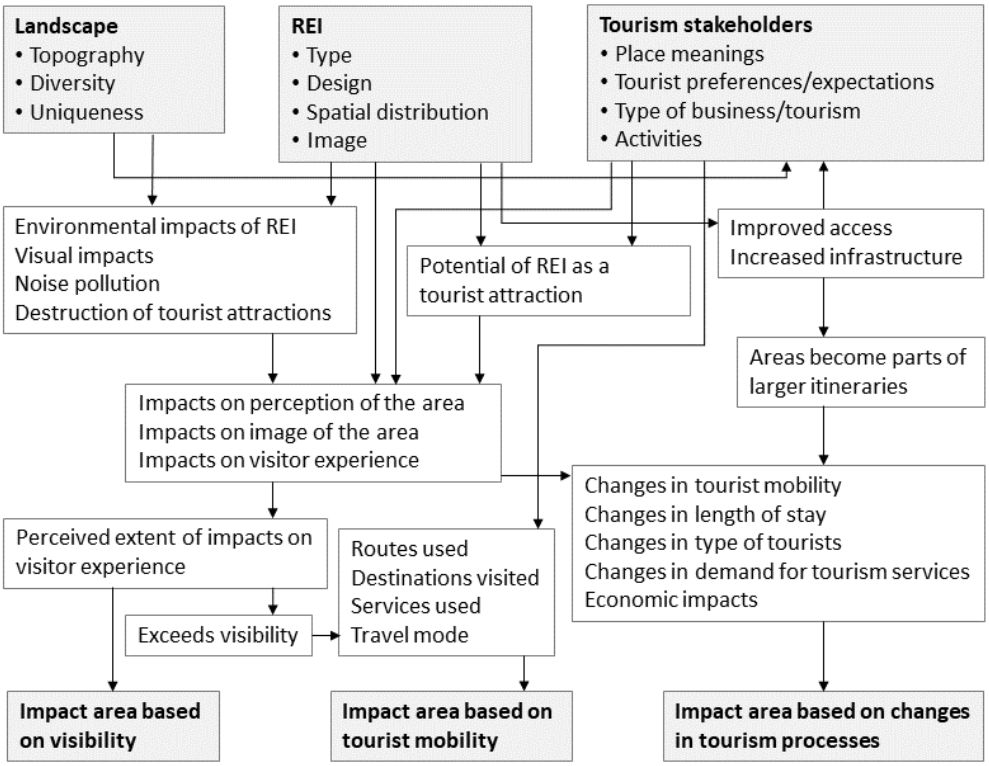


*Figure 6. Factors affecting the spatial extent of the impacts of REI on tourism as perceived by the tourism industry.*

# 6 Discussion

The results of this study revealed that the transformation of the physical environment due to the construction of REI leads to changes in place meanings assigned to the area by the tourism service providers, which supports the findings of Stedman [40]. REI proposed in natural areas was perceived by the tourism service providers as mostly incompatible with nature-based tourism, a finding in line with the majority of previous studies conducted in Iceland [8, 14, 26]. Most businesses perceived the areas surrounding the proposed REI as wilderness and emphasized that wilderness experience is an important attraction to tourists visiting the Central Highlands and therefore a valuable resource for the tourism industry. REI, according to the tourism service providers, changes the character of natural areas into 'industrial' thereby degrading the quality of visitor experience and reducing opportunities for tourism activities. Place meanings assigned to natural areas by the tourism service providers are threatened by REI developments, therefore such proposals in natural areas do not receive their support [98, 99]. Tourism service providers prefer to preserve wilderness areas instead of developing them for energy harnessing. They furthermore emphasized the importance of keeping the size of the

wilderness areas large to ensure high quality visitor experience and more opportunities for product development.

The spatial extent of the impacts of REI on tourism as perceived by the tourism service providers has been shown to depend on their perception of place and its boundaries. While some tourism service providers mapped the impact areas of REI on tourism ending with the visibility of REI and of its environmental impacts, others took into consideration the interrelationships of the areas surrounding the REI with other places and perceived these areas as parts of larger tourism networks. They estimated the impact areas covering the whole itineraries during which visitor experience would be affected. In some cases, the estimated impact areas included extensive areas where construction of REI is likely to lead to a chain of changes in tourist travel patterns, tourism demand and other tourism processes. This emphasizes that changes made to the physical environment in the areas of REI are likely to affect other tourist destinations, in places which are connected to these areas via tourism relationships. Previous studies have shown that when tourism demand in certain areas or regions declines due to the construction of REI, it is likely to increase in the neighboring areas or regions [11, 15]. Therefore, it is important to plan REI developments in coordination with multiple municipalities [100], which are also likely to experience changes in tourism demand. This study furthermore revealed that in smaller countries relying on nature-based tourism, such as Iceland, construction of a renewable energy project might affect a significant part of the country, pointing to the need for holistic approaches to planning renewable resources. Moreover, given that tourism processes and networks generally tend to stretch over the boundaries of administrative units, it is of crucial importance in planning REI developments to gather information on the spatial distribution of tourism processes connected to the area where the construction of REI is being considered.

Besides stressing the importance of preserving relatively undeveloped and wilderness areas as an important resource for the tourism industry, tourism service providers interviewed in this study also questioned the need for further renewable energy harnessing in the country and its purpose. In 2019 over 77% of electricity produced in Iceland was used by heavy industry [101]. In line with previous research [26], tourism service providers emphasized that new renewable energy projects should be constructed when they are needed for the local population. When such a need exists, various characteristics of the areas, including their value for current and potential future users and meanings assigned to these areas by stakeholders, should be examined in order to identify locations most suitable for REI development. Furthermore,

characteristics of REI itself and changes it is likely to bring to the meanings and perceptions of the areas should be taken into consideration [102, 103]. Tourism can be better facilitated by including tourism stakeholder perceptions of the places where REI is proposed as well as information on tourism in the areas and connectivity elsewhere. Numerous researchers [e.g. 104, 105] have pointed to the benefits of stakeholder inclusion at the early stages of planning of energy projects, when selecting the most suitable location for REI. One such benefit is higher support from stakeholders for developing REI [106-108]. As shown in this study, higher support of the tourism service providers for specific renewable energy projects would ensure that tourism businesses present energy projects to their customers in a positive light, which, according to the interviewed tourism service providers, plays an important role in shaping tourist attitudes towards renewable energy developments.

Numerous studies have emphasized the usefulness of participatory GIS for mapping the spatial distribution of the place meanings ascribed to the areas by the stakeholders and for identification of potential conflict areas [109-113], with research pointing to the need for a wider use of PGIS in natural resource planning to inform and facilitate decision-making [114]. This study showed that PGIS is an effective tool for mapping the perceived impact areas of REI on tourism. Such spatial information is essential for the selection of the most acceptable energy project proposals and for mapping the areas where conflicts between the energy and tourism industries are most likely to occur.

In this research the impacts of the proposed renewable energy projects on tourism were perceived by the tourism industry as being more negative compared to the impacts of existing REI. This is in line with the findings of previous studies showing that visitors' attitudes are more positive toward existing energy projects compared to planned but not yet built projects [16, 42, 115]. According to Brudermann et al. [16], such differences can be explained by *status quo bias* [116], a phenomenon describing people's preference for the current situation over change. According to Samuelson and Zeckhauser [116], such preference can be partly explained by the *loss aversion bias*, which means that people tend to prefer to avoid losing something they already have over gaining something new.

More positive attitudes toward existing renewable energy projects compared to the proposed ones suggest that tourism service providers over time are likely to adapt to the changes brought by REI and to adjust their activities to the new conditions. Thus, in some cases, construction of REI in natural areas might not lead to direct economic losses for tourism. However, as

emphasized by Ingólfsdóttir and Gunnarsdóttir [117], it is likely to result in lost opportunities for tourists "to experience the deep, transformative connection to nature that the raw, untouched wilderness has the capacity to elicit". REI developments in highly natural areas might lead to the displacement of visitors seeking wilderness experiences, who would be replaced by tourists that have different preferences and expectations and therefore are less sensitive to human alterations of natural landscapes [42, 118]. With wilderness areas decreasing worldwide it is essential to ensure that REI developments are planned appropriately by taking into consideration their impacts on nature-based tourism and its most valuable resource.

# 7 Conclusions

This study focuses on the spatial extent of the impacts of REI on tourism as perceived by the tourism service providers and on the factors affecting it. While the study was conducted in Iceland, a country highly suitable for such research due to the high importance of tourism for the local economy as well as abundance of renewable energy resources, its relevance extends beyond the Icelandic context. The study provided new insights into the spatial perceptions of the tourism service providers regarding the interrelationships between REI and tourism by employing PGIS. The results revealed that while some tourism service providers were of the opinion that the impacts of REI on tourism reach as far as REI and related environmental impacts are visible, 56% of the estimated impact areas exceeded visibility and included areas comprising of routes and destinations used by tourists where visitor experience is affected due to the previous encounter with REI as well as areas where tourism processes change due to construction of REI and other accompanying infrastructure, such as roads or power lines. This emphasizes that when planning energy development and selecting the most suitable REI locations it is of crucial importance to examine the areas used for tourism where REI has been proposed, given that elements of larger tourism networks would be impacted by the REI development.

Massey [44] emphasized that while attempting to draw boundaries it is impossible to consider everything, and relevant aspects must be selected. This study allowed identification of the issues related to REI and nature-based tourism that are perceived by the tourism service providers as the most important and therefore affecting the spatial extent of the impacts of REI on tourism. The present study revealed a high variety of shapes and sizes of the perceived impact areas, pointing to the importance of tourism stakeholder inclusion in REI planning.

Consideration of the resources, place meanings and values essential for the tourism industry, their spatial distribution, their perceived compatibility with REI as well as tourism service providers' knowledge of the tourism processes going on within and between places allow identification of the most likely areas of conflicts between REI and tourism and identification of the areas where tourism would be the least impacted.

While knowledge of the spatial extent of the impacts of REI on tourism is greatly needed for the planning of REI developments, this issue is currently largely under-researched. This study provided new knowledge on the spatial extent of the impacts of REI on tourism in areas which are used mostly for nature-based tourism. In line with previous studies [13, 14, 20, 115, 119], most participants of this study perceived REI as more suitable in already developed areas. Therefore, future research including renewable energy projects in landscapes comprising other types of place values, such as industrial or urban landscapes, would provide a needed contribution to the discussion regarding the factors affecting the spatial extent of the impacts of REI on tourism. Moreover, further research aimed at distinguishing personal landscape perceptions of the tourism service providers from commercial ones would provide deeper insights into the interrelationships of REI and tourism. Research investigating how other tourism stakeholders, for example tourists, perceive the impact areas of REI on tourism is also needed. A limitation of this study is that while it included three types of REI, hydro-, geothermal and wind power, and revealed differences in their perceptions by the tourism service providers, the qualitative character of this study did not allow the investigation of significant differences in the perceptions of the impacts of the three types of REI and of their spatial extent. A quantitative study investigating how tourism stakeholders perceive the impact area of various types of REI on tourism would allow such comparison.

This exploratory study has laid a groundwork for further research investigating the spatial extent of the impacts of REI on tourism by employing PGIS to map the impact areas of REI on tourism as perceived by tourism service providers and by providing the insights into the reasoning used by them. The findings of this study are expected to inform policy makers and to be of value while planning REI developments. This study points to the importance of gathering knowledge on the spatial distribution of the tourism processes going through the areas of proposed REI and of the inclusion of the tourism stakeholders into the early stages of planning.

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