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A Kite-surfboard Design Targets Generating Electricity by Visitors

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Abstract: In the context of the world energy crisis, how to achieve sustainable energy transition for everyone is a heated topic. According to research, kitesurfing is now a popular extreme sport, compared to traditional surfing, kitesurfing has a greater potential to generate electricity due to its greater speed. This paper takes the Isles of Scilly in the UK as a case study, based on the energy dilemma caused by the many visitors in the Isles of Scilly. Through various methodologies such as design research, user interviews and business models, this paper explores a way to make use of the visitors in Isles of Scilly, by combining the fun activity of kitesurfing with electricity generation, so that visitors can help with the local renewable energy transition. This paper concludes with the design of a surfboard that generates electricity from the hydro-turbines of kitesurfing and envisages a future business model and new energy development approach for the community.

1. Introduction

At the 2015 United Nations General Assembly (UNGA), 17 Sustainable Development Goals (SDGs) were issued along with 169 targets to achieve a sustainable future for the planet [1]. Among these, SDG 7, the global energy goal, is one of the most central parts. It is expressed as: Ensure access to affordable, reliable, sustainable and modern energy for everyone, and calls for us to reduce our dependence on fossil fuels, increase the use of sustainable energy sources globally and improve energy efficiency. These initiatives will effectively improve multidimensional world challenges such as climate change, energy crisis and air quality [2], which has recently become an increasingly debated issue in research.

Renewable energy is defined as environmentally friendly and clean energy, with solar, wind, biomass, geothermal and hydro energy etc. [3]. In the current energy consumption structure, fossil energy sources still dominate, with oil resources accounting for 33.6%, followed by coal resources at 27.2% and natural gas at 23.9%, according to 2020 data. Renewable energy sources account for only 10.8%, with hydropower accounting for 6.8% [4]. Solar, hydro and wind power have been widely researched and used due to their low cost and high efficiency [5].

The transition to sustainable energy will remain an urgent need for the next three decades. Many factors are at stake in the successful implementation of the sustainable energy transition, and current research has found that the main factors are: climatic [6], policy [7], economic [8] and technological influences [9]. Therefore, the approach to sustainable transition needs to be tailored to each region.

In this context, Europe has been working on various aspects of the energy transition[10]. In this context, Europe has been working on various aspects of the energy transition. For the UK in particular, with its long-standing dependence on fossil energy, more effort is needed to achieve energy security, equity and sustainability [11]. In the 2019 European Clean Energy Plan, which proposes a community-based governance model for the future of energy [12]. The community-based energy transition project has proven to be a successful event in Europe, and the same methodology could be put into practice more often in the UK in the future.

Tourism is now the backbone of the service sector in many countries and, according to surveys, accounted for 10.4% of the world's GDP in 2020, creating 319 million jobs worldwide. Almost all sectors of the tourism industry consume energy and are particularly energy intensive [13]. In past studies, tourism has been blamed for being a driver of global warming, with a significant negative impact on the global environment [14]. Therefore, there is a research gap for better integration of tourism with local new energy policies and plans in the process of globalizing the energy transition [15].

According to Figure 1, energy consumption from tourism is high and is most severe in developed countries.

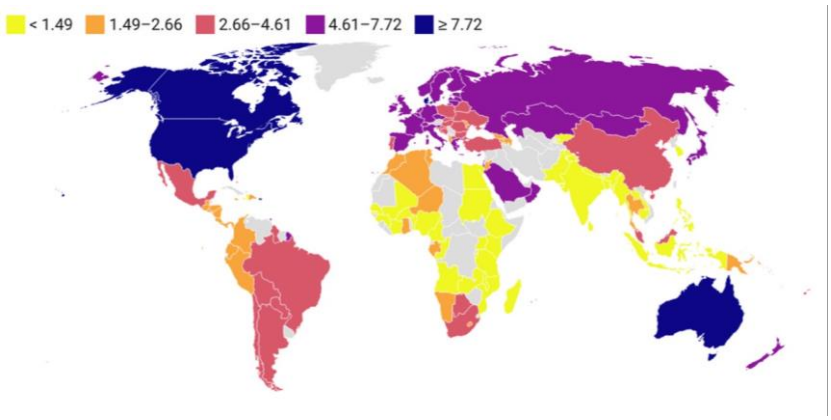

Figure 1 Energy consumption per visitors in 2019 [16]

In addition, the Global Tourism Report 2020 shows that as most tourists choose to stay in hotels, they will tend to use more energy as hotels do not charge extra for electricity usage [13]. In the survey, many visitors expressed a willingness to get involved in local energy initiatives, but most lacked motivation and there is still a large design gap in the UK as there are still relatively few initiatives targeting the energy transition [17-18].

Among the main requirements of sustainable tourism as proposed by the United Nations are: energy saving, locally appropriate development strategies and waste reduction [19].

In summary, this paper will be based on the urgent need for energy transition in the context of the global energy crisis, and will adopt a community-based research approach to explore ways in which tourists can be engaged in the local energy transition process in the UK, using tourism as the main research target.

One of the UK's most famous natural attractions and coastal heritage, the Isles of Scilly have five major islands. Of these, 2,200 are long-term residents, but each year Scilly attracts over 100,000 visitors from all over the world [20-22]. The energy transition in the Isles of Scilly continues to face serious challenges due to the distance of 28 kilometers from the British mainland and the particularly high number of tourists it receives.

The Scilly Isles are still highly dependent on fossil energy and need to import it from outside. It is currently the eighth highest in England for fuel poverty. It is worth noting that HITACHI company [20, 23-26] has already carried out some activities in Scilly to help with the energy transition, such

as helping to install solar panels, hot water systems and batteries in the homes of local residents, but the activities are still limited to the homes of local residents and there is still a research gap for activities aimed at tourists

According to research, kitesurfing is now a popular extreme sport with a very large number of enthusiasts worldwide, and Scilly is a great place for kitesurfing. Compared to traditional surfing, kitesurfing has a greater potential to generate electricity due to its greater speed. The official website of Scilly states that currently Scilly allows visitors to kitesurf on their own and there are no official facilities yet, but there are plans to develop this activity in the coming years.

2. Design Opportunity

In conjunction with the above analysis, the design of this paper will be based on the UK's Scilly Islands' 2025 energy targets and will help the local energy transition by combining the fun activity of kitesurfing with electricity generation.

By using a large community of 100,000 local visitors per year to help a small community of 2,200 inhabitants, it will have a better effect and educate the tourists about energy conservation.

3. Design Process

Through the definition of design opportunities, analysis using a variety of design research methods, stakeholder mapping, user persona, and value proposition canvas, insight into user needs and definition of design direction.

3.1 Stakeholder Mapping

There are three main stakeholders in the kitesurfing power project: tourists, local residents and the local government, as shown in figure 2. The three stakeholders influence each other, with the government managing the local residents and visitors and setting policies accordingly. Local people can help tourists and tourists can bring more jobs and development opportunities to the area.

Through the analysis of the stakeholders, the most important part of this project is the tourists and the local residents, it is an important aspect to ensure that the quality of life of the local residents is not reduced while ensuring the tourist experience. It is important that the electricity used for tourism and the electricity generated by this project form an internal self-sufficient system.

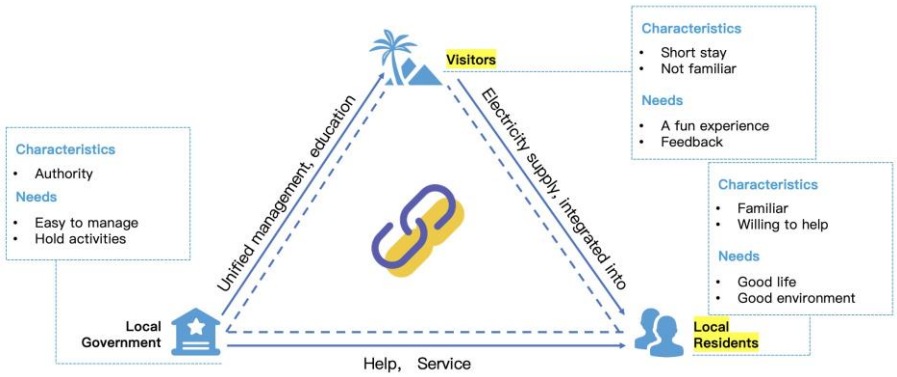

Figure 2 Stakeholder Mapping

3.2 User Persona

The user persona is shown in Figure 3. The user's name is Robin, and she is a 21 year old university student. She loves adventure, extreme sports, travelling and have a passion for public service.

Figure 3 User Persona

The user's name is Robin and she is a 21 year old university student. She loves adventure, extreme sports, travelling and have a passion for public service events. She wants to have a great and unique travel experience in the Isles of Scilly and due to her short stay, she wants to get up to speed with the activities and get feedback to share with her friends.

She was concerned about the need for professional guidance, the safety of the activities and wanted a good system of support facilities and services.

3.3 Value Proposition Canvas

As shown in Figure 4, the project is analyzed in six areas in the Value Proposition Canvas.

Visitors can have a great experience, learn to kitesurf, experience the process of generating electricity, show off to friends and give something back by helping to protect the local environment. This table analyses how to create a possible product and service system by weighing up the gains and the pains of the visitor.

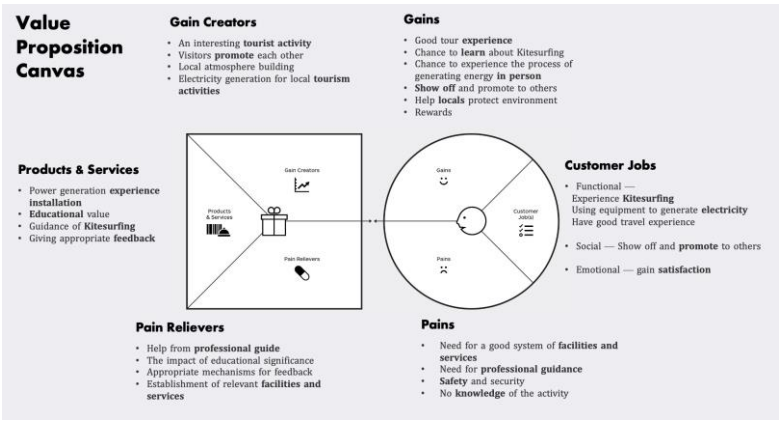

Figure 4 Value Proposition Canvas

3.4 Design Brief

A visitor engagement power generation activity under the goal of sustainable tourism based on the kitesurfing activity, in the context of isles of Scilly, UK.

4. Results

The final surfboard design is shown in Figure 5.

Figure 5 Final Product

The board is a more popular and easier to use longboard style. The overall colour scheme of the large ocean and a small part of the beach is used to better blend in with the sea during surfing. The surfboard is emblazoned with the E-surfer logo.

The surfboard structure is divided into two parts: upper and lower. The upper part is mainly the visitor standing area and the battery mounting area. The board's visitor standing area has been designed with a black raised material to increase friction and safety when standing, in accordance with the positioning of the visitor standing area on conventional surfboards. The battery mounting is slotted for stability and security and reduces the need for additional attachment to the board. The handle above the battery is designed for easy removal of the battery.

The lower part of the surfboard consists mainly of the power generating turbine and the board fins. A traditional three-fin design is used, with a longer fin in the centre to keep the board stable and flexible fins on either side to facilitate steering in the surfing. The design of the power generation turbine is similar in principle to the small hydraulic turbine and the internal structure is shown in Figure 6.

Figure 6 Turbine Internal Structure

The rotating blades take the form of the commonly used hydro turbine, with angled blades that are more conducive to high-speed rotation in the water. The outer rim has been designed with a protective compartment to prevent injuries when holding the board or during surfing. The protective compartment is also designed to allow for the rapid passage of water.

The board generates electricity by rotating a turbine that drives an internal spindle, which generates electricity through the control box and built-in motor, and then stores the electricity inside the board's battery via a cable.

Visitors use the storyboard as shown in Figure 7.

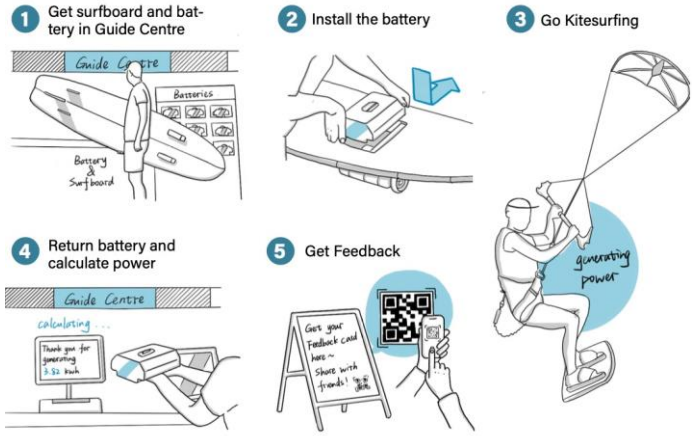

Figure 7 Story Boarding

There are five main stages of use. Firstly, visitors go to the Guidance and Service Centre to register for the event and collect their power surfboards, kites and batteries, where they are informed about the regulations and instructions. Secondly, visitors place the collected batteries into the battery slots on the board as instructed and secure them well. Next, visitors can head to the kitesurfing and generate electricity through the board at the same time. After finishing kitesurfing, visitors return to the Instruction and Service Centre to hand back their boards and batteries. The staff at the Guidance and Service Centre will guide visitors through the power detection equipment to calculate the amount of power generated during the visitor's surfing session. Depending on the amount of electricity generated, visitors receive a voucher to be used on the Isles of Scilly as a reward. Finally, visitors can scan their mobile phones to receive personalized rewards and electronic thank you cards that they can share with friends or upload to social media, and by doing so, they can also provide some publicity for the project.

5. Conclusion

This paper focuses on the current energy transition dilemma of the remote British islands of Scilly due to too many visitors, and proposes a creative combination of power generation and fun kitesurfing activities to help the local energy transition through the power of visitors.

Through the design and business model of a surfboard that can generate electricity, the Scilly Islands' multiple stakeholders are considered in a holistic manner, with visitors bringing money and electricity to the islands while also receiving something back and being able to educate visitors about energy conservation.

Where this paper falls short is in the lack of practice and testing on the ground, there could be opportunities to travel to the field for testing and feasibility analysis in future designs.

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