Artistic wind turbines along greenways: The concept

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Introduction

The contemporary built and industrial landscape - we can see every day - is filled with many industrial parks, logistic areas, power plants and other enormous structures and objects which ensure a living environment for humans. Actually, these structures cause many gaps and blind spots in an otherwise green network. Furthermore, in some cases there are abandoned industrial parks consuming enormous pieces of land. The reason for this is pretty clear in this case: there is no responsible owner who should take care of it or there is no budget to cover the costs for its demolition. So what we now see are huge industrial parks in the landscapes with no purpose, perpetuating a division and creating very unattractive scenic object. This paper proposes a concept for how to repurpose such forlorn industrial areas and how they can even become part of a greenway. The industrial function will be replaced by new one: the wind energy utilizing alternative design concepts.

Background/Literature Review

The current generation of renewable energy production based on traditional wind turbines has witnessed a high degree of public opposition, often resulting in unsuccessful projects never to become constructed. Specifically, the visual impact has become a crucial concern to the general public (Betakova et al., 2015; Vries et al., 2012; Wolsink, 2007) next to other environmental impacts, such as noise (Pederson, 2008) and danger to flying animals (Drewitt and Langstone, 2006). Traditional wind turbines are sometimes considered to be unsuitable structures and their opposition is often connected with a NIMBY syndrome. The NIMBY effect which can lead towards a negative response to the construction of WTs has not been demonstrated (Petrova, 2013; Wolsink, 2007, 2012). However, the NIMBY effect has become an implicit phenomenon when planning for a large investment proposal such as a wind park. It sometimes appears in research today that respondents are concerned about being labelled as exhibiting NIMBY behaviour (Horst, 2007). The literature has thus established more acceptable explanations of opposition to WT construction, namely place attachment (Devine-Wright and Howes, 2010; Haggett, 2011; Hall et al., 2013), sense of identity (Horst, 2007), and confidence in the construction itself and in its benefits (Aitken, 2010). Place attachment is very important in forming a positive environment for local inhabitants (Lewicka, 2011; Rollero and de Piccolo, 2010). Landscape is not merely perceived as scenery, but also as a dwelling space (Soini et al., 2012).

As such, this reserach explores the following question: could a fundamental redesign of the wind turbine result in a change in public acceptance for them? And, how would such a change affect the impact upon landscape scenery? There have already been some new design techniques and approaches that entirely change the way that a wind turbine functions, its visual appearance, and overall performance in generating electrical energy (Manwell et al., 2009). What is typically found today are two distinct "families" of wind turbines: horizontal axis wind turbines (HAWT) and vertical axis wind turbines (VAWT). Specifically, it is the placement of the rotor – the driving force for how electrical energy is generated – that separate the two styles of wind turbines. The most commonly used device is the three-bladed turbine from HAWT family. It is important to mention that large number of other types of devices have been proposed, and in some cases successfully built (Manwell et al., 2009). In some types of designs, the idea is to channel wind to increase the productivity of the rotor. The literature explains that to build such effective rotor which could withstand very strong occasional winds is very expensive and therefore the turbine is not cost efficient (van Bussel, 2007). However, there are several types of wind turbines using such technology, e.g. FloDesign, Invelox, Next-Gen Wind or WindTamer turbine. This paper does not calculate the efficiency of this alternative wind energy system. Efficienty data is often only declared by the producers and inventors, and not typically mentioned in literature (Allaei et al., 2015).

Goals and objectives

The goal of this paper is to show alternative wind turbine design with channel-based technology in different landscape scenes: 1) as a part of conversion project; 2) as a historical cultural dominant; and 3) as a modern sculptural monument. The connecting principle of each design is the alignment with its environment and visual attractiveness.

Method(s)

This work discusses the possibilities in design variability of combining channel-based wind turbines with artistic sculptures and other aesthetic structures. The design and appearance of traditional wind turbines are very strict and cannot be modified in a sophisticated architectural way. Hence, another type of wind turbine had to be chosen (Manwell et al., 2009) with new conceptual architectural designs and practices. The channel-based wind turbine has been used for the architectural experiment, sometimes also labelled as wind concentrator. Generally, such wind turbines have a rotor placed in a shroud creating the air inlet. As the turbine works inside its shroud (channel), the exterior can be designed and modified according to needs of selected

places. There are available such wind turbine types in current market, e.g. FloDesign, Invelox, Next-Gen Wind or WindTamer turbine. To author´s knowledge, there are installed Invelox wind turbines in Palmyra Atoll in Hawaii and in Fort Custer in Michigan. The first WindTamer turbine, for example, was installed in 2011 in Kunkiai, Lithuania. FloDesign´s test turbine was installed in Boston Harbor, near Logan Airport, as company´s first full-seze prototype. Summarized, such wind turbine types are at the their beginning of installation, so only few yet can be found in the field. Furthermore, these installed devices do not deal with the aesthetics, but rather the function. This paper is then one of the first focused on aesthetic of wind turbines and its possibilities.

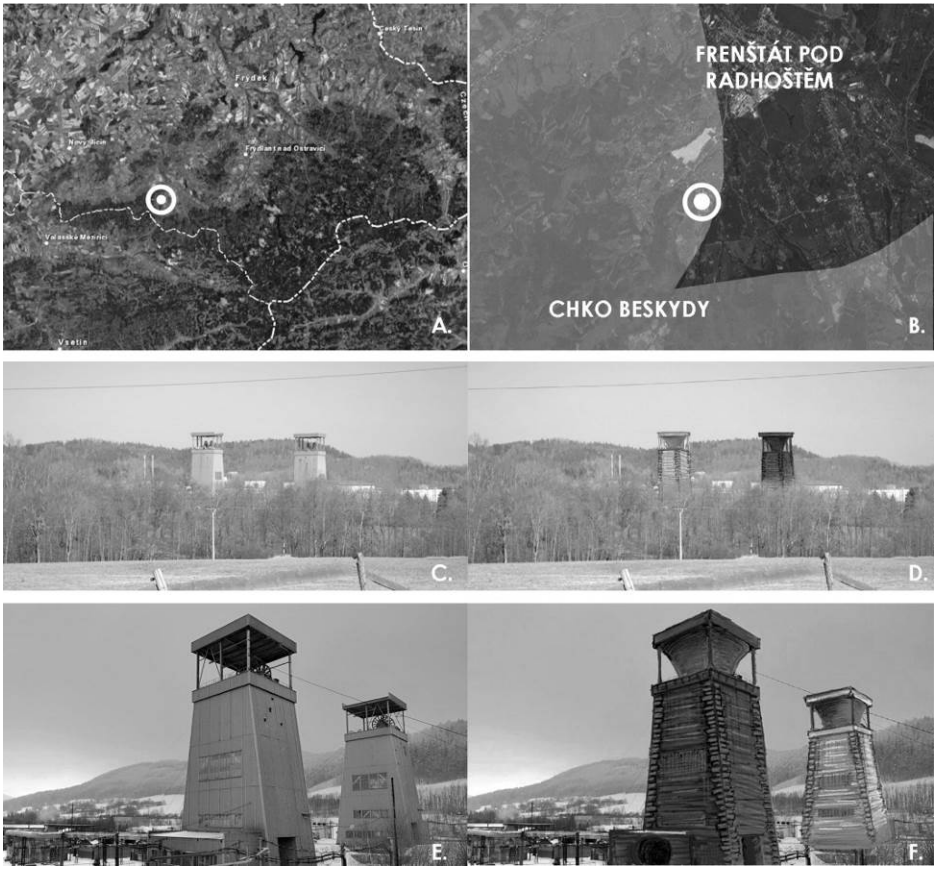

Figure 1. Frenstat conversion project: A, B: location – Czech Republic (south Moravia); C, D: further view before and after redesign; E, F: close view before and after redesign

The method or principal described in this paper shows how to integrate artistic wind turbine designs into a variety of different types of landscape. The design is based on conversion, using an existing abandoned industrial park as a test scenario. Industrial parks offer many structures and objects which might be used for the conversion into the channel-based wind turbine device. The profile which concentrates the wind can be applied to variable structures. This is, of course, the task for structural engineers; however, the principal will be always similar. The tower construction would serve best for such usage due to its height and proportion. The height can assure sufficient wind speed and the size in general would allow installing a turbine device of greater size and capacity. The wind turbine device is mounted inside the existing structure, leaving just the top part with air intakes are visible. This exterior part – or air intake – is can be highly very variable in its design. It can allow the use of any suitable material as a "cover shell", thus resulting in a structure that is more attractive (e.g. basic colours, natural materials such as stone, wood and bricks, or other modern materials such as glass, mirrors, or metal).

In addition, this principal can be applied on virtually any new project and not simply a retrofit of a former industrial site. In this case, the design does not need to conform to an existing structure, thus the artistic and functional design options are much more opened-ended and can be tailored to the local vernacular character of any given landscape or cultural influence. On the other hand, more materials and load-bearing structures may be needed to create such device.

The approach described above minimizes the visual impact, or can even create an iconic symbol or landmark of the place, and also provide artistic and aesthetic amenities. The selected proposals reviewed herein distinctly show how the wind turbine can be in harmony and in accordance with the surrounding landscape features.

Results

The design principals resulted in several proposals. The first proposal shows conversion of an old industrial park used for coal mining, which has been closed for several years (see Figure 1). The park is located in the Czech Republic, 10 kilometres south from town Frenštát pod Radhoštěm. What is worthy to mention is the location of this project; the complex is actually located in the large protected area known as Beskydy (see Figure 1a, 1b), surrounded by large forested hills towards the southwest and by a river to the east, which can be incorporated as part of a valuable greenway. This area is prime example of a visually disruptive and unattractive large industrial complex remaining in the landscape today.

Local people often complain about this current situation such that an enormous industrial park stands abandoned in what they perceive to be a natural landscape. The mining activity ceased yet the objects of this activity have remained, abandoned. The design proposes to develop two channel-based wind turbines inside the towers and also to restore the rest of the park for recreation (greenway development). The artistic concept is based on a variety of designed towers from the exterior – summer and winter tower where a summer tower would have shell form dark wood and dark stone as granite and the winter tower would utilize light coloured wood as birch and light coloured stones as sandstone. Using natural materials on both towers would make the structures more compatible with the surrounding landscape features (see Figure 1d, 1f).

Figure 2 illustrates a proposed design for natural mountainous landscapes and based on transformation into a historical view tower, using natural materials for the structure. Such device may help to highlight the identity of the landscape.

A third option symbolises a free-form idea, presenting it as artistic sculpture. The beautify of the new alternative wind turbine design is that it allows a designer to incorporate a broad variety of ideas and form them into artistic and aesthetically pleasing sculptures. The artistic performance presenting the design of goblet of fire is shown in Figure 3, using circular openings as air intakes and also exhausts.

Figure 2. Example of wind turbine as historical view tower in natural mountainous landscape

Figure 3. Example of wind turbine as sculptural monument designed for cityscape

Discussion

All described designs in this paper can become a characteristic part of selected restoration project where greenways are used to provide linkages to key recreational, cultural or scenic amenities. It will support the visual character of landscape by symbolism or iconic appearance, and also enhance the recreational and educational features for people living in or visiting such places. Together with clean energy production and new image of the place, the abandoned industrial parks might connect centres and welcome visitors. One could say that such artistic designs would be enough to create places and spaces that are aesthetically more attractive functionally more useful. However, adding the wind turbine production would somehow ensure the payback costs for renovation and economically making such an investment project more realistic. Wind energy could ensure the energy self-sufficiency of the project, minimizing the impact on nature and wildlife and increasing the recreational and educational potential of the locality. The Table 1 shows the summarization of advantages and disadvantages of artistic wind turbines types, compared with traditional wind turbines – horizontal axis three-bladed wind turbines; proposed by author.

Table 1. Summarization of advantages and disadvantages of artistic wind turbines types, compared with traditional wind turbines

Artistic wind turbines	Traditional wind turbines
Advantages	
• Attractive design and therefore higher public acceptance • Alignment with surroundings • Possible design for cityscape and public spaces • Retrofitting to existing structures • Possible lower impact on wildlife and people • Possible noise reduction • Variable design applied to specific situation	• Tested and known efficiency • Developed technology during decades • Tested and known durability and productivity • Simple design • Accompanying studies
Disadvantages	
• New alternative method without long-term testing • Each situation may require specific design solution to its conditions • Unknown behaviour in strong weather conditions (storm, hurricane, etc.) • Unknown noise data and other • Costs dependent on conditions of each place	• Visual impact – public opposition • Impact on wildlife – bird and bat populations • Noise annoyance and light flickers • Danger risk to human – not possible to build up in cityscape • Very high costs

Conclusion

The channel-based wind turbine is applicable to a variety of landscapes and surroundings, historical and cultural development of differnt areas, providing sustainability and other demands due to its elimination of environmental impacts. Specifically, channel-based turbine designs reduce the danger and risk to human beings and birds/bats (the turbines is located at the ground level, inside the channel). The uniqueness of the design should be considered based on the possible accommodation and adjustment to any environment where it might be built, i.e. mountainous landscapes and seascapes, urbanized areas, industrial settings, and public spaces. This wind energy turbine can be sensitive to places with respect to natural and cultural attributes, can be retrofit to former industrial structures, and can create aesthetically pleasing pieces of art.

Renewable energy production does not have to be just the existing system of "build and produce" without specific consideration for the consequences on

the visual character of landscape and physical environment for all beings (Vorel et al., 2006). The technology of channel-based turbines has many advantages, in particular variability and accommodation to many different settings, and to create aesthetically attractive systems with strong possibilitie on future landscape aesthetics (Nohl, 2001). Such devices, if designed in accordance with the surrounding landscape, can supply the area by 'clean energy' without causing negative impacts on adjacent landscape features and wildlife.

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