Visualisation of nearshore and offshore windfarms - UK

1. Policy Objective & Theme

- SUSTAINABLE USE OF RESOURCES: Preserving coastal environment (its functioning and integrity) to share space

2. Key Approaches

- Knowledge-based
- Technical

3. Experiences that can be exchanged

The methodologies available for computer-aided alternatives, in the form of electronic drawings, graphics, and maps, to visualise developmental infrastructure at the coast.

4. Overview of the case

Different types of computer technology are being used to show the visual impact of placing windfarms in nearshore and offshore situations.

5. Context and Objectives

a) Context

There is growing interest worldwide in renewable energy sources. Wind energy is one of a number of renewables that is currently finding favour as a clean energy supply to either replace or supplement the current and future demand for energy. Whilst many windfarms have already been developed on the land, attention has increasingly turned to the nearshore and offshore environment as alternative locations. Numerous documents have been published in recent years about the criteria used for windfarm siting. The siting of wind turbines in the coastal and marine environment requires consideration of many factors, not least the impact of the wind turbine placement on the seabed and the marine benthic communities; on the marine life in the water and the migrant bird populations; use of the marine and coastal environment by shipping and leisure activities amongst many others; and the visual impact of the installations.

The latter has been one of the major objections frequently raised about windfarms with respect to potentially spoiling the landscape. Visual impact is most likely to be an issue in the nearshore environment where the turbines can potentially often be seen from the landward side, something which may or may not meet public acceptance or approval despite our desire to develop green energy supplies instead of the more traditional power stations. Issues that are often considered important in understanding the potential visual impacts of wind turbines in the landscape include: the height of the tower; the size of the turbine rotors; the colour of the structure and blades; the visual density of the wind turbines; the views from different angles; flicker effects of the rotor blades on the land e.g. on houses on land; the appearance of the tower and blades under different lighting and atmospheric conditions e.g. on clear and overcast days; different solar elevation and angles; and clear or foggy days.

b) Objectives

To develop a method of realistically visualising the placement of nearshore and offshore windfarms.

6. Implementation of the ICZM Approach (i.e. management, tools, resources)

a) Management

The University of Aberdeen has been pioneering the software methodology described.

b) ICZM tools

Public involvement in the planning process often necessitates being able to understand what form the proposed development will actually take when it is built. Traditionally this has involved looking at 2D plans and 3D drawings at various scales, different types of maps, and even solid models that depict a scaled down representation of the proposed development. Whilst paper plans, drawings and maps are still widely used, the potential of computer-aided alternatives in the form of electronic drawings, graphics, and maps has been widely recognised. With rapid developments in computer technology there are now many ways that proposed planning developments can be visualised in ways that are increasingly realistic and even interactive. These include 3D graphics, GIS maps and geo-visualisations (e.g. ESRI's ArcGIS), landscape design software (e.g. World Construction Kit /Nature View), visualisation tools such as CANVIS that uses a graphics toolbox to annotate a photograph, and more recently the use of Google Earth (GE). All can be used to develop different visual representations of the landscape with the potential to be able to engage an audience with the visual impact of a new development. More sophisticated and expensive examples of visualisation tools make use of a virtual reality immersion environment. These systems usually take the form of a combination of very powerful computer systems, graphics software, and multiple colour projection systems to generate a large projected image of the landscape of interest and the proposed development through which the viewer can then fly. They may be static or portable and usually use a curved theatre-style viewing environment. Some may utilise 3D viewing glasses to allow the user to see in 3D, and handheld communication keypad devices that allow a stakeholder group to vote interactively on each visual representation of the landscape.

In Scotland, several different visualisation approaches have been used to explore the impact of the proposed windfarm in Aberdeen Bay. The first is a simple and low-cost example used in an educational environment at the University of Aberdeen, and makes use of several different freely available software packages including: Google Earth (http://earth.google.co.uk/), MapWindow GIS (http://www.mapwindow.org/), Google Sketchup (http://sketchup.google.com/), and Shape2Earth (http://shape2earth.com/) to generate a simple 3D visualisation of the proposed windfarm development. A GIS dataset (ESRI shapefile (.shp)), showing the location of the proposed wind turbines, can be re-projected with the aid of the MapWindow GIS from an OS GB file to WGS84 and added as a layer to Google Earth. Graphic wind turbine objects from the Google Sketchup object library are then added to each of the proposed turbine locations previously added as a layer to the Google Earth view. The turbines can be scaled and 'skinned' in any desired colour shade. Using the 3D visualisation capabilities of Google Earth it is possible to generate a 3D view of the windfarm as well as to fly-through the proposed site with the potential to create a virtual field visit. The interactive nature of Google Earth also offers the possibility for individuals to explore the proposed development and to examine it from different viewpoints and to assess the impact on the visual landscape. Other contextual layers of information can also be added. The application can be saved and shared as a KML (Key Markup Language) file requiring only access to Google Earth software. The example can be used as a simple Public Participation GIS (PPGIS) exercise with the potential to involve stakeholders in the use of spatial datasets and visualisation tools for spatial planning.

The second example showcases the role of geo-spatial data and geo-visualisation tools used in public participation exercises by the Macaulay Institute in Aberdeen, Scotland, UK. This example uses a Landscape Visualisation Theatre (http://www.macaulay.ac.uk/landscapes/) to create a virtual environment for the public to engage in planning issues such as the siting of windfarms. It makes use of a powerful graphic toolbox which places the turbines in a landscape that can then be altered in a number of ways to allow the public to gain insight into what the proposed windfarm might look like over time e.g. midday, sunset, at night, summer and winter, in foggy conditions. It is also possible to fly through the landscape. Wireless handsets allow the participants to vote on, for example, how many turbines can be seen from the land in fog. To make the visualisation more realistic, additional objects can be placed and moved in the landscape, textures added to the graphic objects, and the turbine rotors animated. The end-result is a very effective way to present people with a more realistic idea of what the landscape might look like, with the option of creating different scenarios, providing the means for individuals to participate in a process, and as an educational tool.

Other visualisation examples are the customised off-the-shelf software packages that combine GIS-like tools and functionality with different visualisation tools, including animation, as well as models that can extend the realistic nature of the visualisation scenarios. A good example is the GH Windfarmer software produced by GL Garrad Hassan (http://www.gl-garradhassan.com/) that has widespread use for onshore and offshore windfarm siting exercises.

7. Cost and resources

Much of the software has been developed based on OpenSource software e.g. MapWindow, GE etc so, from the point of view of the University, has been free. Macaulay have made investments in their technology but these costs are not publically available.

8. Effectiveness (i.e. were the foreseen goals/objectives of the work reached?)

The capability to generate realistic visual landscapes with the aid of computer hardware and software offers new opportunities to explore what-if planning scenarios. Such tools can be a powerful and persuasive means to show people what impact a development may have on the environment. They can be used to raise awareness, educate, and influence. However, it must be recognised that such tools also have their inherent limitations, such as the computer environment, and the quality of the graphic representation displayed, which at best is still often very clearly computer- generated and only semi-realistic even to the less familiar eye. Fly-throughs may also be jumpy and the apparent screen flicker generated can be visually distracting. In this sense, these visualisations must be considered as only one of many tools in the toolbox that can be used to assist groups to participate in the planning process, one that offers considerable opportunities to become actively involved with the geospatial datasets and issues.

9. Success and Fail factors

Successful as a means of involving people as the tools are relatively easy to use and to work with – so very hands-on. For the Macaulay software, very successful as a means for engaging local people and interaction. Fail factors: probably the quality of the graphic visualisations; technophobes; and perceived degree of involvement.

10. Unforeseen outcomes

Whilst these tools are still not yet perfect, they nevertheless extend the capabilities at our disposal to examine the various different options, scenarios, and impacts upon the coastal and marine environment, in this case for nearshore and offshore windfarm siting.

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13. Sources

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