

Project Proposal:

Impact of a new minimum distance between wind turbines and settlements -

GIS Analysis with free geodata

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Background:

Germany works on the shift from fossil energies to renewable energies. This is even enshrined in German laws. The state of Baden-Württemberg in southern Germany aims to get 10% of the needed energy out of wind energies produced within the state until 2020 (Windenergieerlass Baden-Württemberg 2012). In 2019 the German Government suggested a new Law for Wind turbines. The proposal commands a new minimum distance of wind turbines from settlements. How big will the area affected by these new requirements be? Will the new minimum distance have an impact in impeding the goals for 2020 for Baden-Württemberg? Even though the proposal is not yet implemented, it is still an important topic.

The most important criteria to find a suitable location for a wind turbine park are the wind speed and the profitability considering the energy the park can produce and the cost of building and operation services. Criteria are divided in two groups: knock-out criteria and trade-off criteria. Knock-out criteria consider any form of settlement, traffic areas, energy pipelines/cables, radio stations, military stations, airports (no matter which size), nature and landscape aspects, waterbodies, some sorts of forest (protected, to use for relaxation or soil protection) and areas where natural resources are exploited. Trade-off criteria consider also nature and landscape aspects, regional important relaxation areas and cultural and soil landmarks (Gesellschaft für Landmanagement und Umwelt mbh 2013). For many of these criteria a certain distance to wind turbine parks is necessary as proposed in Bergmann and Höfle (2013).

Location:

The research area should be near the City of Heidelberg, in the north of Baden-Württemberg. It is assumed that both the region of Mannheim and the region of Heidelberg are too small and the population density is too high, to be suitable for a wind turbine park. Because of that, the project work to analysis possible locations for wind turbines is performed within the regions of Rhein-Neckar-Kreis and Neckar-Odenwald-Kreis.

Literature Research:

The potential of free geodata in comparison with official geodata was investigated by Bergmann & Höfle (2013). They conclude that the free geodata are not as exact as official data, but the spatial location is nearly identical. In their conclusion free geodata can be used, to detect areas with potential locations for wind turbines.

To determine potential location, different parameters must be considered. This is the optical impact of wind turbines, which was analysed in a GIS-based approach by Taeger & Ulferts (2017). A different parameter is noise, but with the distance of 1000m noise surveys are no longer necessary (Lechleitner & Bohm 2016).

Data Research:

In this project free geodata, like OpenStreetMap will be used. The reasons for using free Geodata is, that it is free, easier to access and has already been used in analysis of potential wind turbines location (Bergmann & Höfle 2013). Within that study several tags are used to get the useful data, which will be adapted to our study and used in this analysis too. The following tags should be used for the analysis: `landuse=residential/ farmyards/ industrial/ commercial`, `railway`, `aeroway=runway/ taxiway/ terminal`, `power=line/ minor_line`, `boundary=protected_area`, `leisure=nature_reserve`, `highway=motorway/ motorway_link/ trunk/ trunk_link/ primary/ primary_link/ secondary/ tertiary` (Bergmann & Höfle 2013, adapted).

For the regions either OSM data (`boundary=administrative (admin_level=8)`) or other data sources (e.g. https://gadm.org/download_country_v3.html) can be used.

To get the best results both datasets should be downloaded and compared to find out which one is suited best for the analysis and to get an impression of the OSM data.

For the analysis an elevation model is necessary, free data is provided by several sources. The main difference is the spatial resolution. Because of the pretty small regions that are considered in this project, a high spatial resolution is necessary. This can be found at https://www.opendem.info/download_srtm.html.

Tools:

The analysis will mostly be done within QGIS. Depending on the datasets a preprocessing can be done with help of GDAL. The data can either be downloaded by hand or can be downloaded by an automated script containing the OSM tags.

Every dataset must be buffered with the distance that is required according to German law. To see the difference that results from the new proposed distance to settlements, that layer must be buffered twice: With a buffer distance of 1000 m and a buffer distance of 700 m. All buffer layers must be merged and clipped with the administrative areas of the two regions to see possible areas for wind turbine parks and if the areas change depending on the new distance to settlements. For the possible areas an elevation analysis is needed to see if the areas are flat enough to build a wind turbine park on them. Dolinski et al. (2012) propose an analysis with commercial programmes, but most of the analysis can also be done with QGIS. But also, a script for GRASS GIS can be used to analyse the parameters for the potential wind turbine location (Bergmann & Höfle 2013). Using free software and data allows the repetition of this analysis in different areas.

To work together on the project a GitHub repository will be used.

Target/Achievements:

To achieve the goal of more renewable energies it is necessary to find suitable places for new wind turbine parks. The target of this project is to calculate the total area, which is lost as potential locations for wind turbine parks by the new required distance to settlements. Is the new distance creating a big (significant) impact?

Sources:

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