Exercise 1: To visualise wind power potential and aspects that relate to wind energy utilisation in a country of your choice.

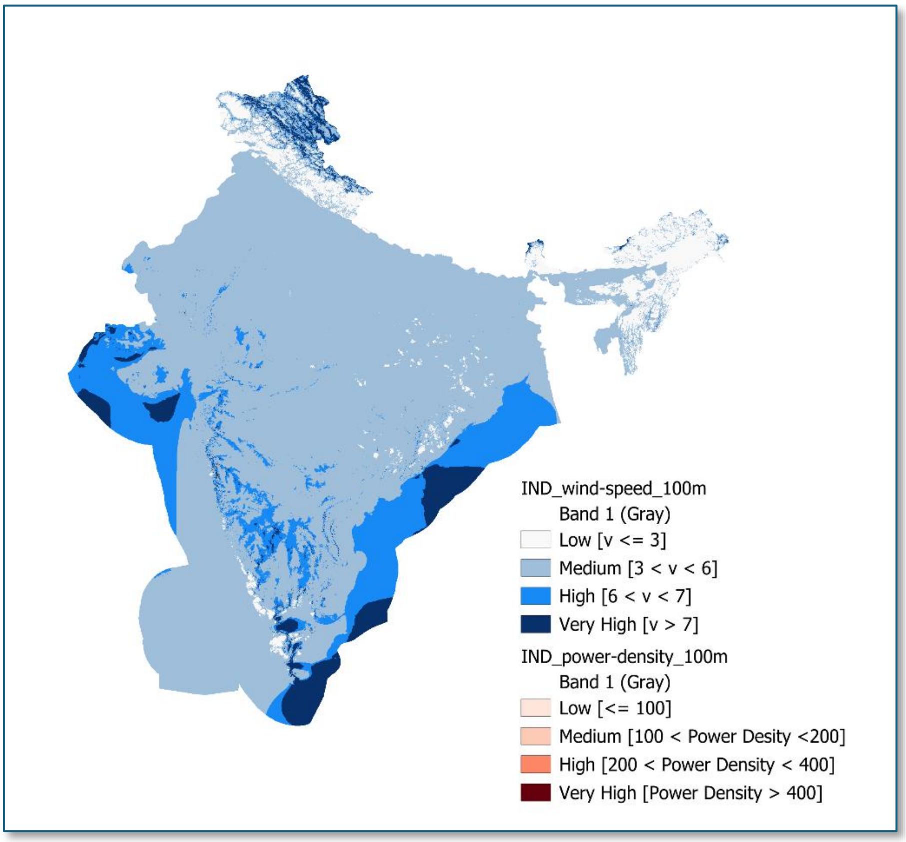

Figure 1.1: Average Wind Speed and Power density at a Hight of 100 m

Objective:

To visualize wind power potential and aspects that relate to wind energy utilization in India.

Data Source:

Download Wind Data: Energy Data Info

Content of Data: Wind Speed and Power Density

Method:

First step is to data Importing. Second step is data analysis by using histograms to categorize wind speed. Next step is to categories to Wind Speed and Power Density [See Fig 1.1].

Results:

The classification of wind speed and power density provided a clear representation of wind energy potential. The analysis successfully identified regions with varying suitability for wind energy projects, aiding in strategic planning and decision-making.

Exercise 2: Download and visualise the wind speed and power density map for Denmark.

Objective:

To download and visualize wind speed and power density maps for Denmark.

Method:

First step is to load data (.TIF) files for wind speed and power density.

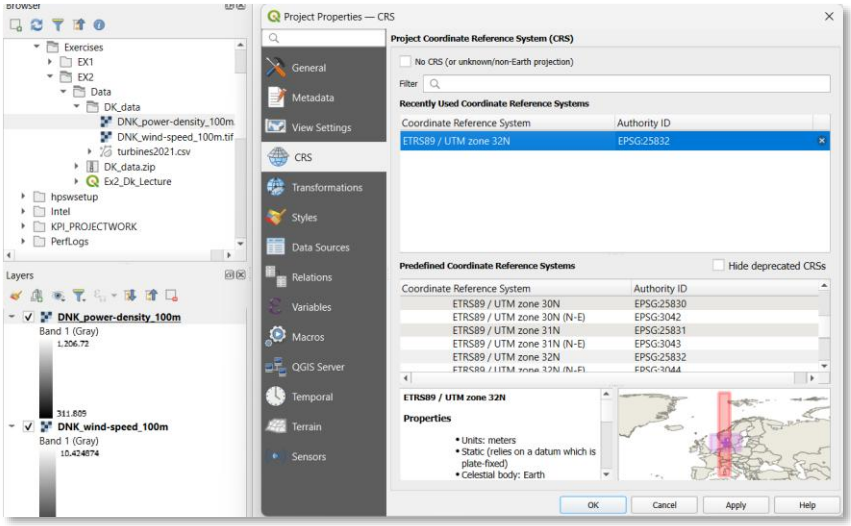

Figure 2.1

Second, set Coordinate System which is **ETRS89 / UTM zone 32N** (See Figure 2.1). Next step is to analyse Histogram and apply symbology for categorized wind speed and power density into classes.

Then next step is to add Wind Turbine Data, which is imported CSV file and reviewed its content (See Figure 2.2). Then next step is to visualize Wind Turbines to use Graduated Symbols and Unique Values to map for power capacity and manufacturers (See Figure 2.3 and 2.4).

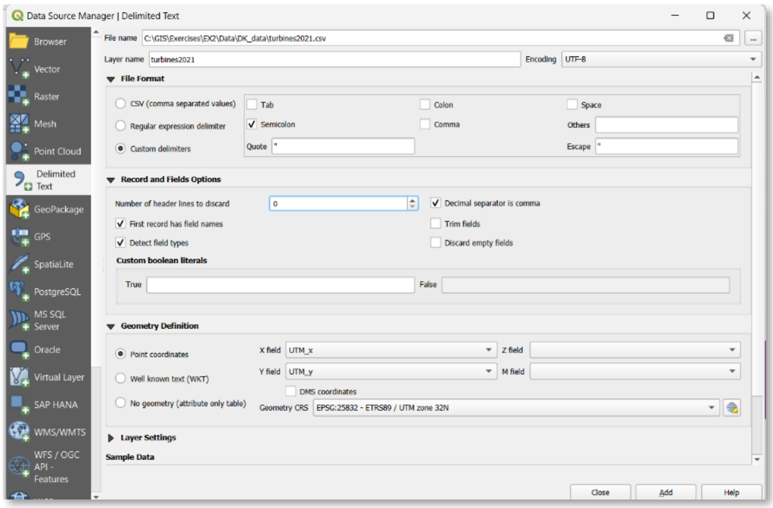

Figure 2.2

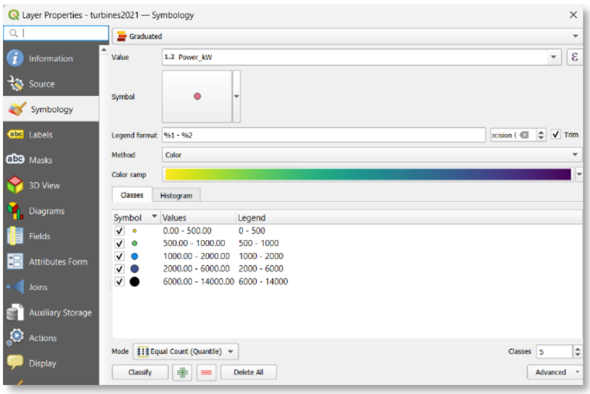

Figure 2.3

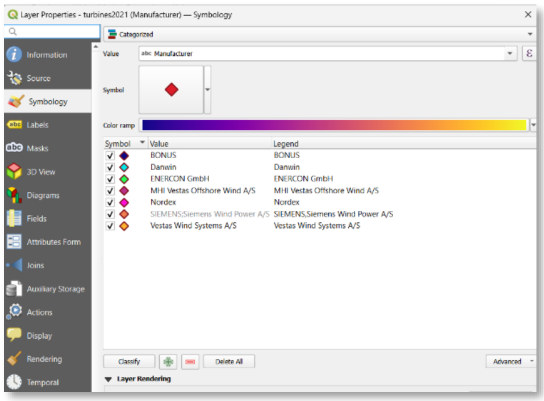

Figure 2.4

Last but not least, enhance Map Design to added grid, north arrow, and scale bar (See Figure 2.5).

Results:

The analysis effectively visualized wind speed and power classifications, as represented in the legend. Wind turbine capacity and manufacturer distributions were mapped to provide insights into spatial patterns of wind energy infrastructure. The final outputs highlight key areas for wind energy potential while ensuring clear and informative data representation.

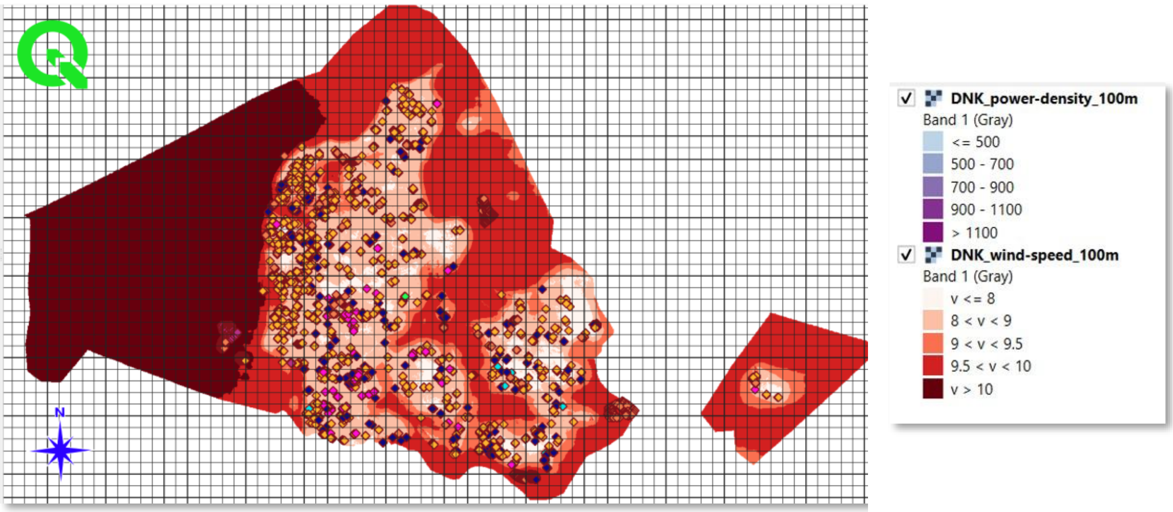

Figure 2.5

Exercise 3: Find potential wind energy locations in County Galway, Ireland)

Objective:

To find suitable locations for wind energy projects in County Galway, Ireland.

Method:

First, we imported ***County_Galway.shp*** and other relevant shapefiles into QGIS, ensuring consistency by borrowing the projection from ***County_Galway.shp*** and adjusting symbology for clear visualization. Next, we identified and saved specific land areas by selecting forests from ***OSM_Landuse*** using an attribute query **(*fclass = 'forest'*)**, exporting them as a new shapefile (*All_Forest*), and identifying regions with wind power density below 900 W/m² which is See fig 3.1. To assess wind turbine placement, we used the ***Select within Distance* tool** to find turbines within 5 km of natural heritage sites (See figure 3.2). For the final step, we created a “White Map” by conducting a buffer analysis: applying 1 km buffers to forests, heritage sites, and residential areas, a 0.5 km buffer to wind turbines, and a 0.2 km buffer to main roads. These buffered areas, along with ***OSM_Landuse*** and ***Power_Density_LessThan_900***, were merged into a single layer to define no-go areas (See

Figure 3.3). Finally, we applied the ***Difference* tool** to subtract restricted zones from ***County_Galway***, to find the suitable locations for wind energy projects (See Figure 3.4).

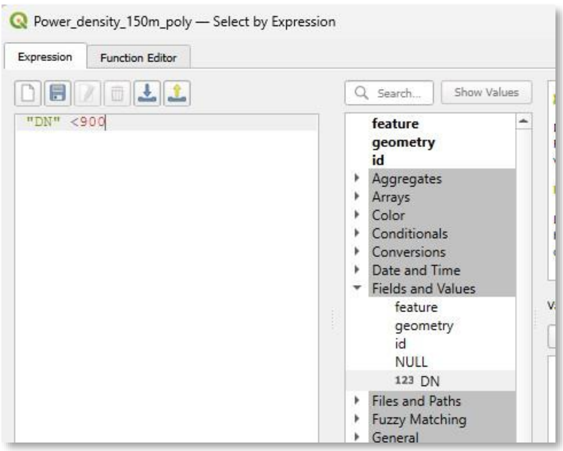

Figure 3.1

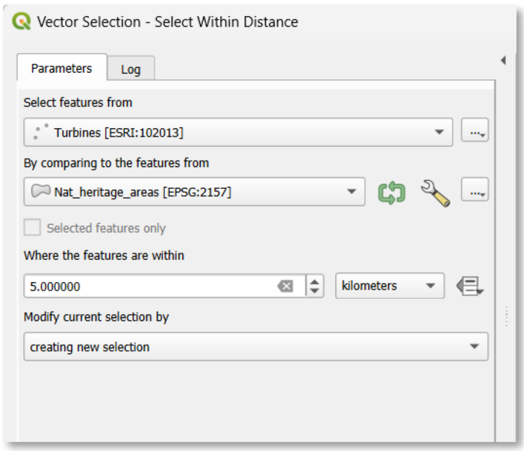

Figure 3.2

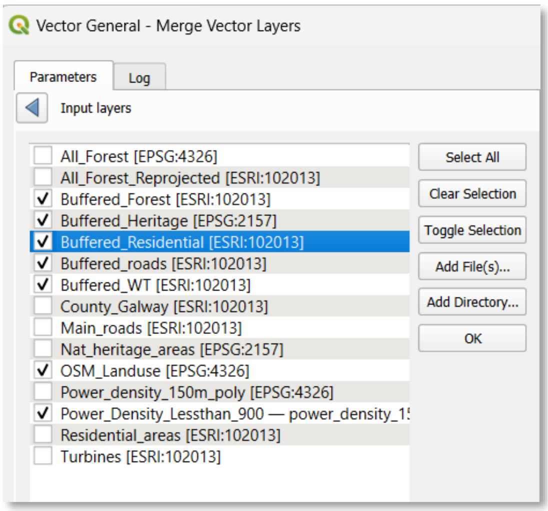

Figure 3.3

Results:

The analysis successfully identified suitable wind energy locations by applying spatial queries, buffering constraints, and geoprocessing techniques. The final map highlights optimal areas while excluding environmentally and spatially restricted zones, ensuring an efficient and sustainable site selection process.

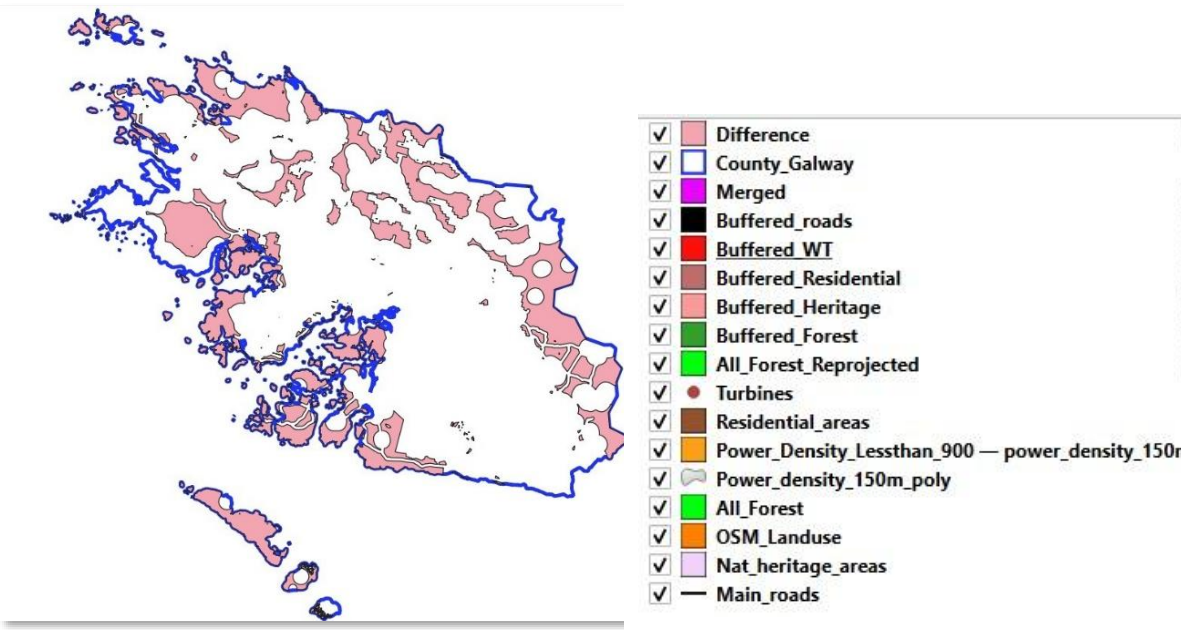

Figure 3.4

Exercise 4: Local Wind Farm Planning (Location: Lindewitt Municipality, Schleswig-Holstein).

Objective:

To analyse wind energy potential in Schleswig-Holstein by categorizing goals and principles, integrating wind turbine data, and creating a wind farm development map.

Method:

All relevant **.shp** files were imported into QGIS, and their colours and styles were adjusted for better visualization. The layers were categorized into two groups: Principles and Goals (See Figure 4.1).

Wind turbine data was downloaded from the official Schleswig-Holstein site (https://opendata.schleswig-holstein.de/dataset/windkraftanlagen-2023-07-13) and integrated into the project.

To identify suitable wind farm development areas, an **800 m** buffer was created around existing wind turbines. A Difference tool was attempted between the Potential Wind Areas layer and the buffered turbine layer, but an invalid geometry error occurred. This was resolved by using *Vector → Geometry Tools → Check Validity* to fix the geometry before reattempting the operation. The final Wind Farm Development Map successfully highlights areas suitable for future wind energy development (See Figure 4.2).

Results:

The categorized Principles and Goals provided a structured approach to wind energy planning. The wind farm development map highlights suitable areas free from existing wind turbines while maintaining regulatory constraints.

Exercise 5: Editing Points, Lines and Polygons

Exercise 6: Visualise the results with colours and transparency

Exercise 7.1: Convert (Rasterize Vector to Raster) the electric grid layer to an input raster for distance mapping. Calculate the distance from the grid in metres (r.grow.distance).

Exercise 7.2: Make a simple noise map for a planned wind farm in priority area „PR1_NFL_036“

Exercise 8: Offshore Wind Energy Planning in Sweden