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

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Step 1: Open QGIS🡪 Open .Tif file form browser Step 2: Right Click on Layer 🡪 Properties Step 3: Properties 🡪 Histogram

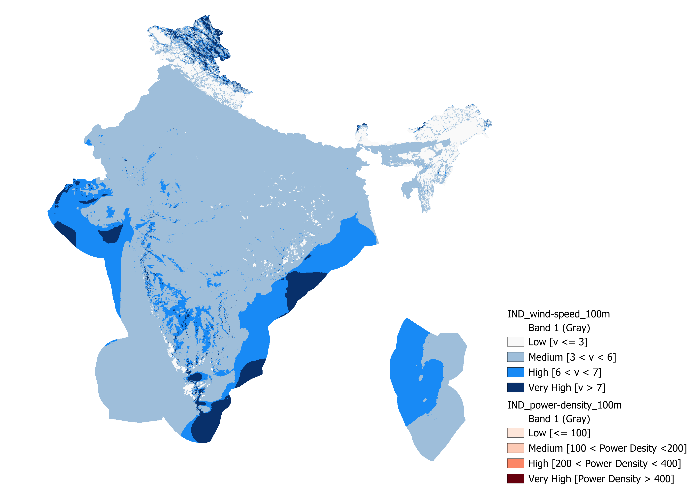
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Step 4: Properties 🡪 Symbology Step 5: Properties 🡪 Histrogram Step 6: Symbology Windowmenu



|  |  |
| --- | --- |
| Country | India |
| Download Wind Data | Energy data info |
| Content of Data | Wind Speed and Power Density |

In a Figure 1.1, you can see the approach used to find the solution for average wind speed at a height of 100 meters. Specifically, in Step 3, my first approach involved analysing the data using a histogram and dividing it into four categories: Low, Medium, High, and Very High. The categories are based on wind speed values as follows:

Low: Less than 3 m/s

Medium: Between 3 and 6 m/s

High: Between 6 and 7 m/s

Very High: Greater than 7 m/s

In Step 4, I applied this classification in the Symbology menu, as you can see in the image.

In a Figure 1.2, you can see the approach used to find the solution for average power density at a height of 100 meters. I followed same approach of Figure 1.1, see in step 5 and step 6.

Low: Less than 100 W/

Medium: Between 100 and 200 W/

High: Between 200 and 400 W/

Very High: Greater than 400 W/

(Figure 1.1: Average Wind Speed at a Hight of 100 m)

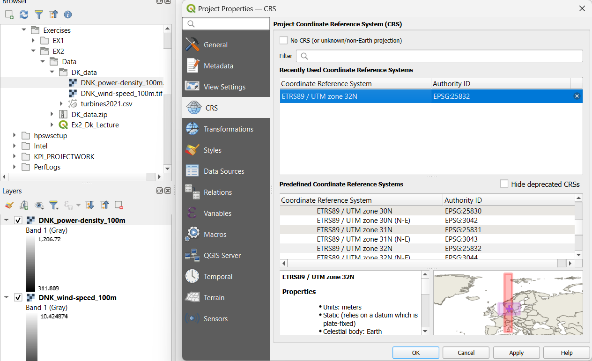
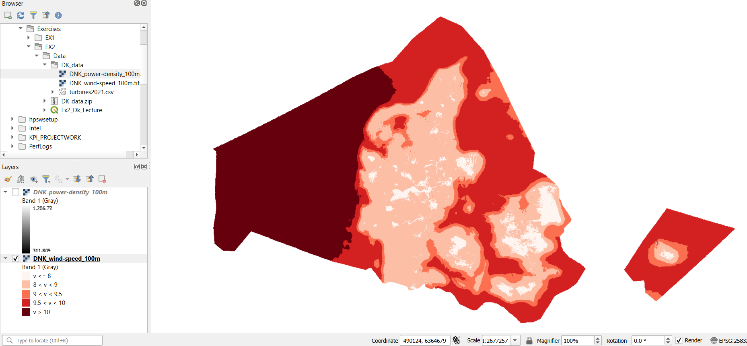
A map of india with different colored areas

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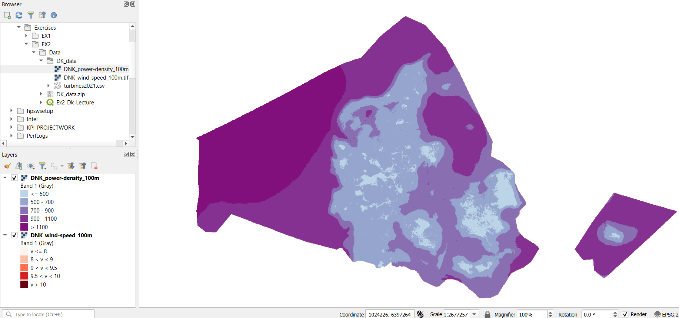
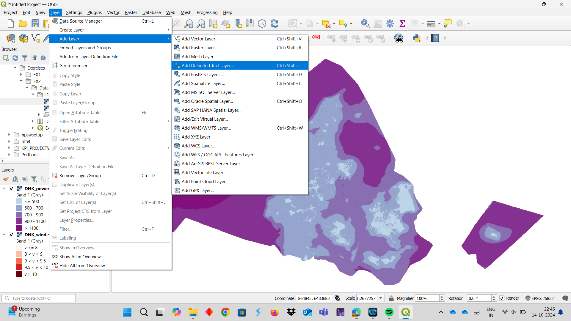
(Figure 1.2: Average Power Density at a Hight of 100 m)

# Exercise 2: Download and visualise the wind speed and power density map for Denmark. Consider type of symbology and choice of colours. Add the csv-file containing wind turbines. Visualise the wind turbines in Denmark by: Installed Capacity and Manufacturer. Use the methods Unique Values, Graduated Symbols, Graduated Colours etc. Add a grid, North arrow etc to your map.

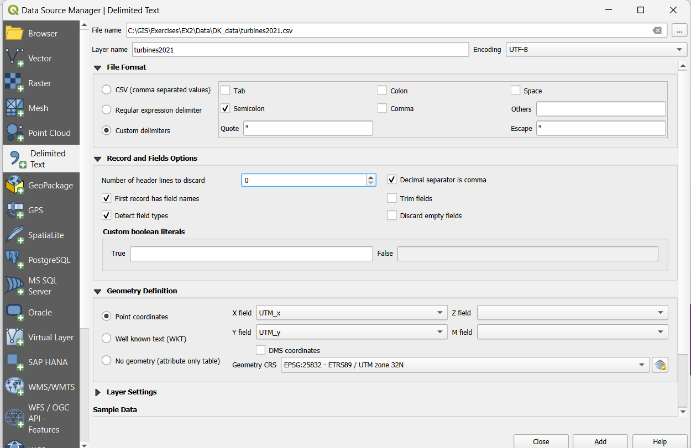
**Step 1:** Open QGIS 🡪 Open (.Tif) files of Wind speed and Power density map for Denmark, **Step 2**: Project 🡪 Properties [See Fig. 2.1, Change coordinates reference system, Used **ETRS89 / UTM zone 32N**], **Step 3:** Right click on Layer 🡪 Properties 🡪 Histogram [my first approach involved analysing the data using a histogram] 🡪 Symbology [dividing it into categories, names and different colours]. I didn’t include photos of step 2 and 3 because it has already explained in Exercise 1. I added only final look photos, see in Fig 2.2 [Wind speed] and 2.3 [Power density].

(Figure 2.1) (Figure 2.2)

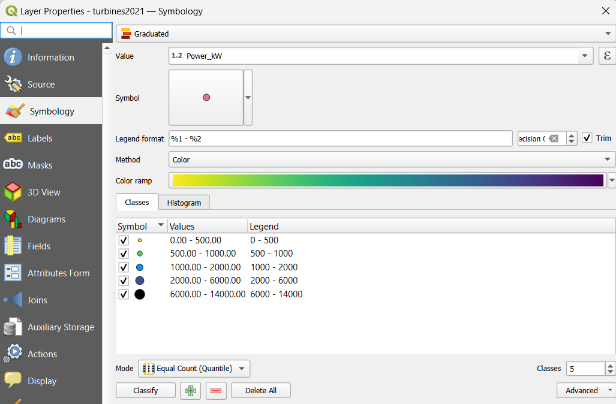
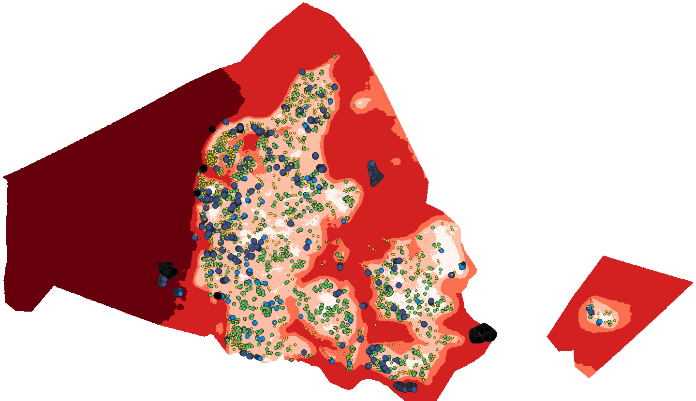
(Figure 2.3) (Figure 2.4)



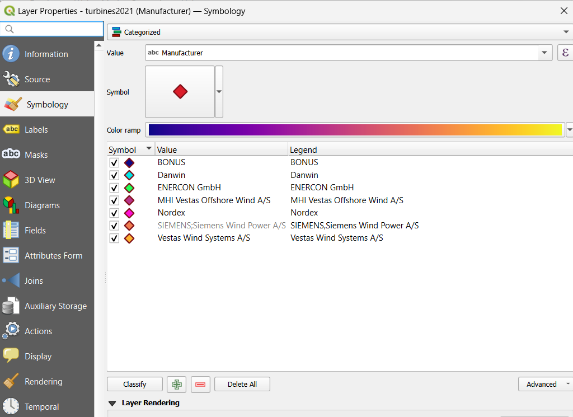
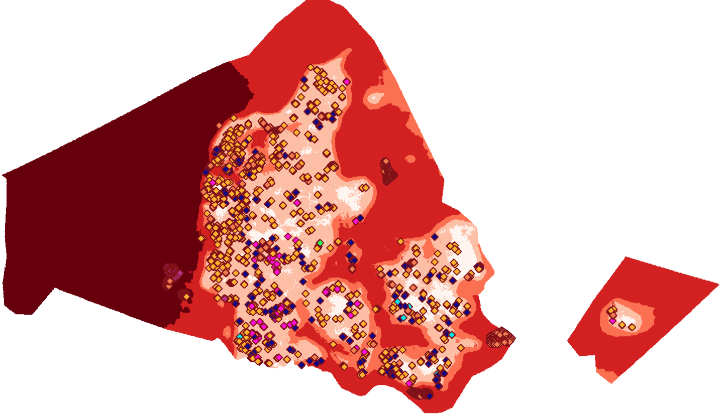
**Step 4**: Layer 🡪 Add Layer 🡪 Add Delimited Test Layer [See fig. 2.4 and 2.5], Here basically added (.csv) file of containing of Wind turbine. Before added in QGIS, Opened in Notepad (App) and understood given data.

(Figure 2.5)

**Step 5**: Right click on Layer 🡪 Properties 🡪 Symbology [See Fig. 2.6], Here, the task is to visualize the installed capacity of the wind turbines. In the selection menu, choose the **Graduated** category and set the value to **Power**. The output is shown in Fig. 2.7. **Step 6:** I followed the same steps to visualize the **manufacturer** of the wind turbines, but I changed the category type. I selected specific companies and removed other companies for visualization [See Fig. 2.8]. The result is shown in Fig. 2.9. **Step 7:** Go toView 🡪 Decorations, I added a Grid, a North arrow using this option [See Fig. 2.10]**.**

(Figure 2.6) (Figure 2.7)

(Figure 2.8) (Figure 2.9)

A map of a red triangle with black dots

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(Figure 2.10)

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

**Step 1**: Import “County\_Galway.shp” and other “.shp” files, adjust their Colours. **Step 2**: Right click in OSM\_Landuse 🡪 Open attribute table 🡪 Select by expression. For future selections, set “fclass” to the condition “fclass” = “forest” [See Fig 3.1]. **Step 3**: Right click in OSM\_Landuse 🡪 Export 🡪 Save selected Features As. Save file under the new name “All\_Forest”[See Fig 3.2]. The result is shown in Fig. 3.3.

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(Figure 3.1) (Figure 3.2) (Figure 3.3)

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**Step 4:** I followed the same steps as above to find areas with wind power densities less than .[see Fig. 3.4 and 3.5].

**Step 5**: In the Processing Toolbox 🡪 Search Vector Selection-select within distance. [See Fig 3.6]. This provides the results for all wind turbines located less than 5 km away from natural heritage sites. [See Fig. 3.7].

(Figure 3.4) (Figure 3.5)

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(Figure 3.6) (Figure 3.7)

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(Figure 3.8) (Figure 3.9) (Figure 3.10)

**Step 6:** Vector 🡪 Geoprocessing tools 🡪 Buffer. I Created buffer of 1 km for (Forest, Natural Heritage and Residential areas), 0.5 km (Wind turbine) and 0.2 km (Main roads), resulting in a total of five buffered areas. [See Fig. 3.9 and 3.10].

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(Figure 3.11) (Figure 3.12)

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**Step 7:** Vector General 🡪 Merge Vector Layers. Select five buffered area, “OSM\_Landuse” and “Power\_Density\_Lessthan\_900” to merge them together [See Fig. 3.11]. The result is shown in Fig. 3.12. [No go area]

**Step 8:** Vector 🡪 Geoprocessing tools 🡪 Difference. Here, subtract the merged area from “County\_Galway” to find the difference area [See fig. 3.13], also referred to as potential wind areas [See fig.3.14].

(Figure 3.13)

A map of the united states

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(Figure 3.14)

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