

## Offshore wind resource measurements in the Dutch North Sea including observed wind farm wake effects beyond 20km

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Offshore wind energy in the North Sea is growing rapidly. With the increasing amount of wind farms in the North Sea, it is to be expected that wake effects will have substantial influence on the energy yield. Understanding the wind conditions play an essential role.

Wind Energy plays an essential role in the Energy Transition. To achieve its renewable energy goals, the Netherlands is working on more offshore wind energy. The energy agreement outlines the route for the implementation of offshore wind energy. This is part of the objectives for 2030 as an intermediate point towards the development of a CO<sub>2</sub> neutral energy system in 2050.

With the increasing amount of wind farms, there is a growing concern about environmental aspects and the influence of wake effects on neighbouring wind farms. Meteorological measurements play an important role to better understand this effect.

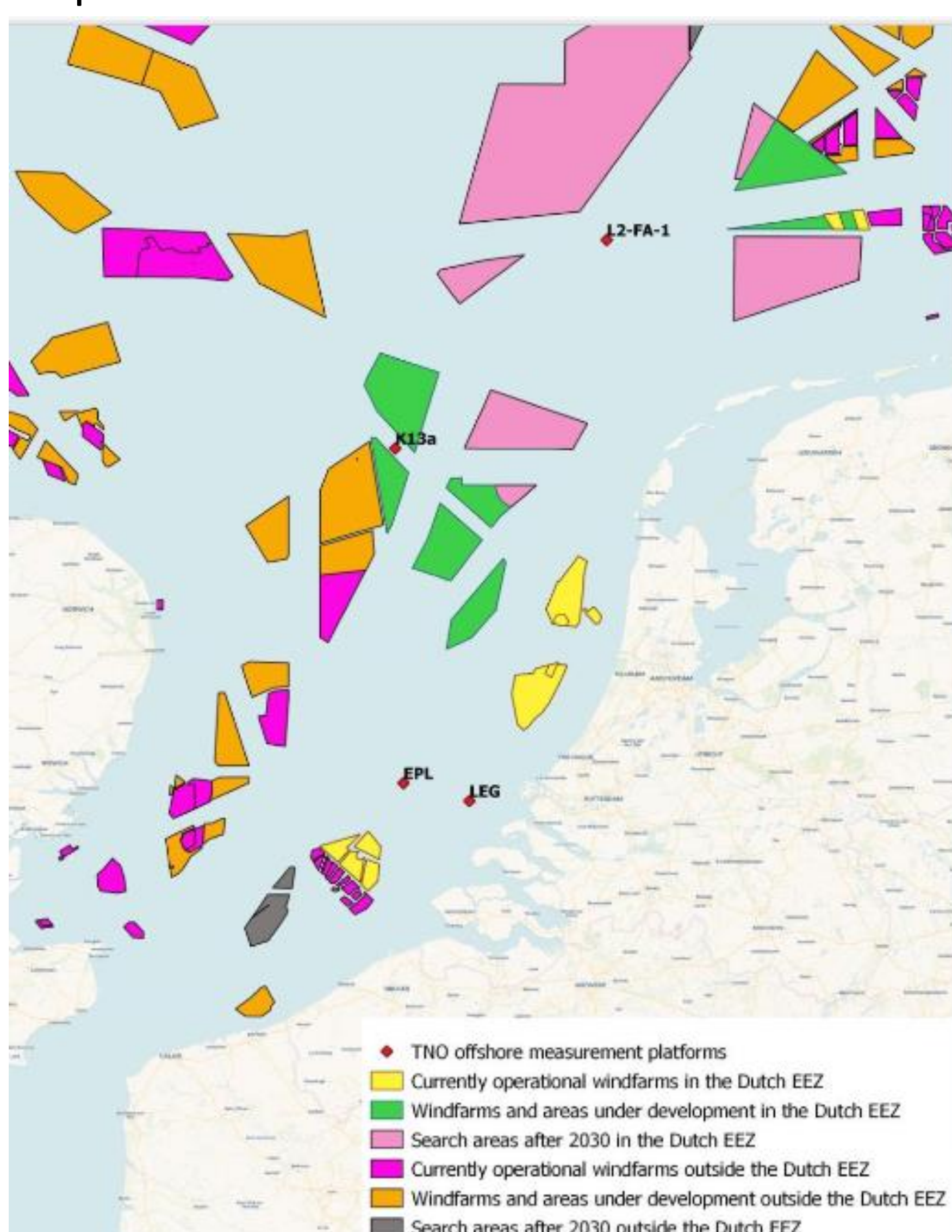


Figure 1: Wind farms in the North Sea. In yellow the existing wind farms in the Dutch part of the North Sea, the green areas indicate the current wind farms under development and developments after 2030 are marked in pink. It is clear that enormous activities will take place in the North Sea in the context of the energy transition.

### TNO Measurement campaigns

TNO performs for The Dutch Ministry of Economic Affairs and Climate Policy measurement campaigns in the North Sea since 2014 at different strategically chosen locations. Currently, the locations of the measurements are Lichteiland Goeree platform (LEG), Europlatform (EPL), platform K13-A and platform L2-FA-1 under the program “Wind op Zee”.

Besides measurements TNO also uses this data for determining wind resource assessments and wake studies.

The data collected during these campaigns can be obtained via the website

<https://offshorewind-measurements.tno.nl/>

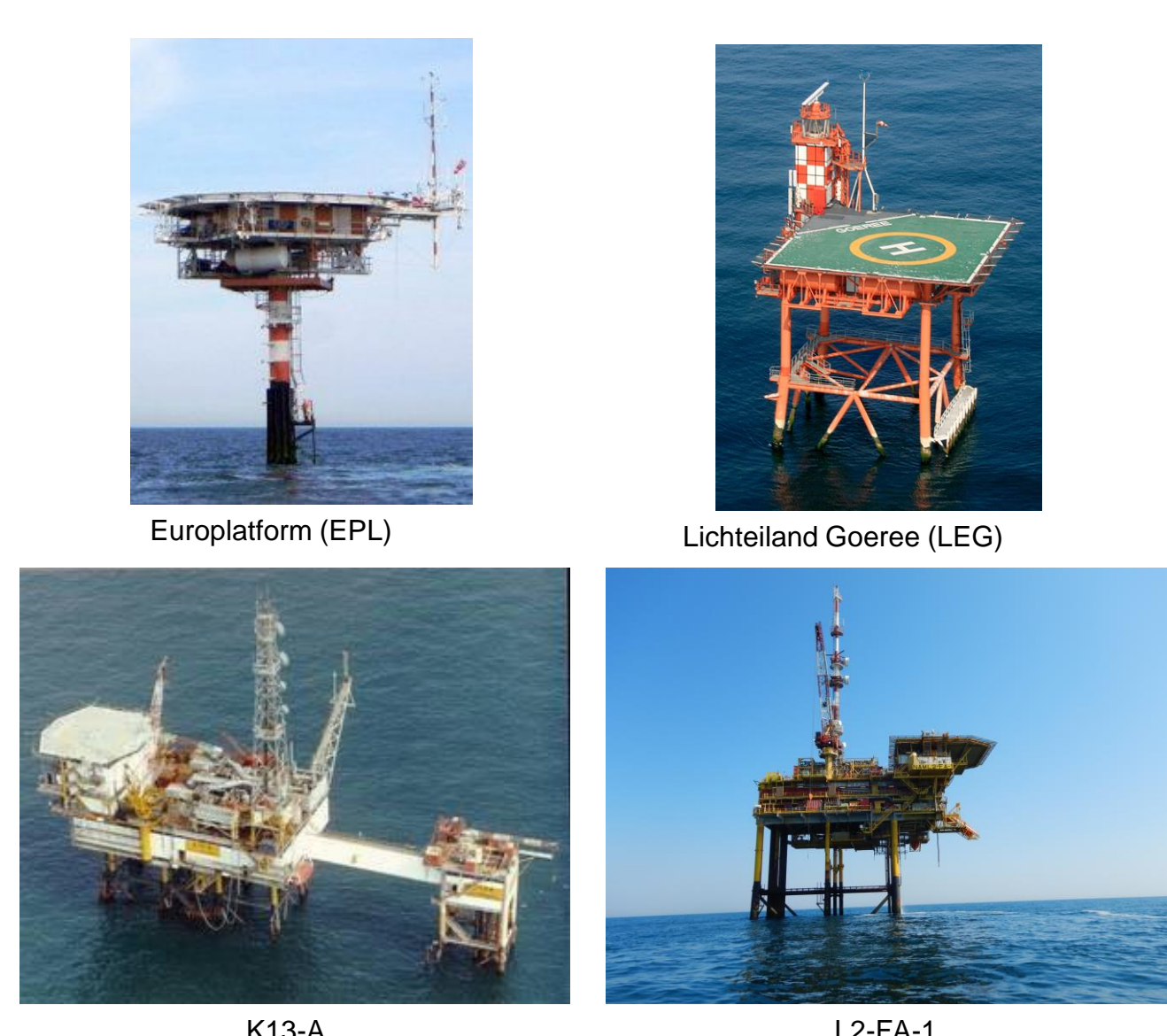


Figure 2: Measurement platforms

### Investigation of wake effects of Borssele wind farm (BWFZ)

The wakes from offshore wind farm Borssele (BWFZ) can be observed in the measurement data at the platforms EPL and LEG, see Figure 3. The data is separated into two periods: before (blue) and after (orange) construction. In green the wake simulation is given for comparison.

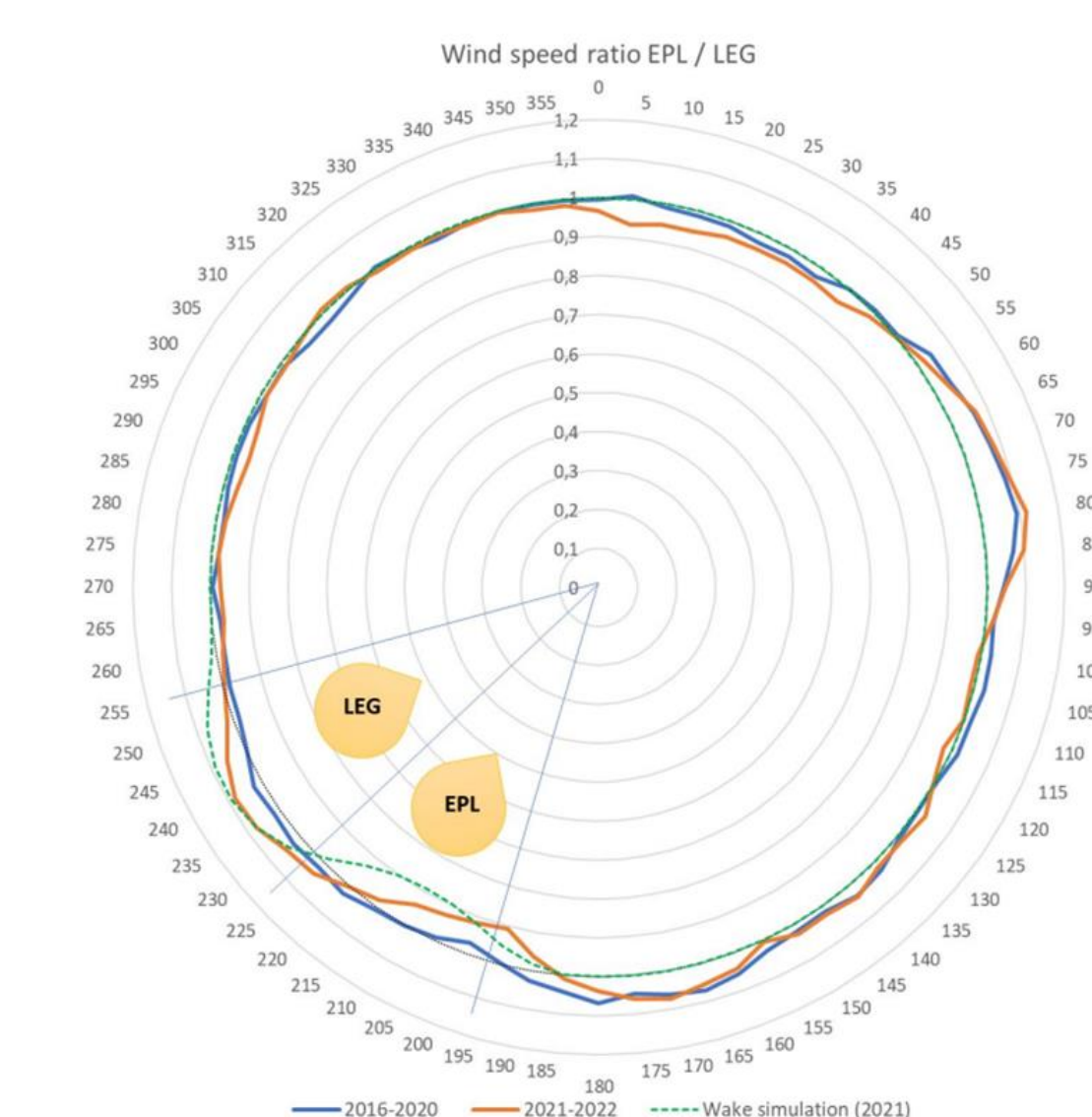


Figure 3: wind speed ratio of LEG and EPL directional for wind speeds between 5.5 and 12.5 m/s

The maximum impact of Borssele was found to be 9.0% for LEG at 240° wind direction, and 11% for EPL at 210° wind direction. The estimated total impact on the average wind speed for all sectors is estimated as 0.30% or 0.029 m/s for both platforms.

Figure 4 shows the location of these platforms with respect to the Borssele wind farm zone, which are located at a distance of 26km (EPL) and 43km (LEG).

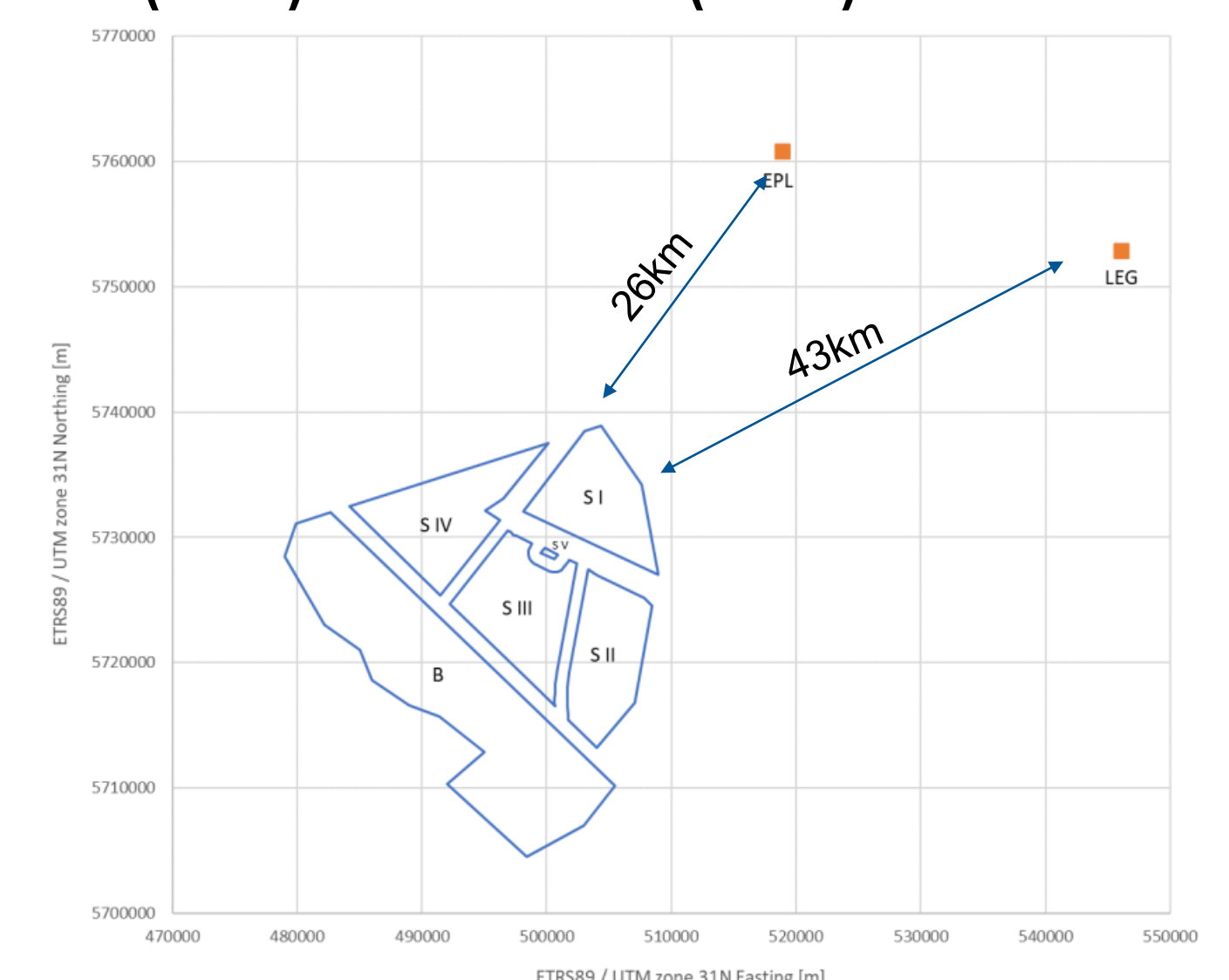


Figure 4: Borssele wind farm and platforms LEG and EPL

### References

- [1] Government of the Netherlands, “Offshore wind energy”, 2023. [Online]. <https://www.government.nl/topics/renewable-energy/offshore-wind-energy>.
- [2] TNO report wind conditions at Sea 2022. [online] <https://offshorewind-measurements.tno.nl/>

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