

Pan-North-European wind power production and electricity transmission network From brainstorming to pinpointing

Wim Hegeman

At the Dogger Bank a 180 GW combined network is proposed which integrates the North-European transmission of electricity in a DC-network and the production from wind turbines at sea. With the present know-how and practical experience in wind energy technology a shallow area at the Dogger Bank can already be utilized for the first hundred wind farms of 300 MW each.

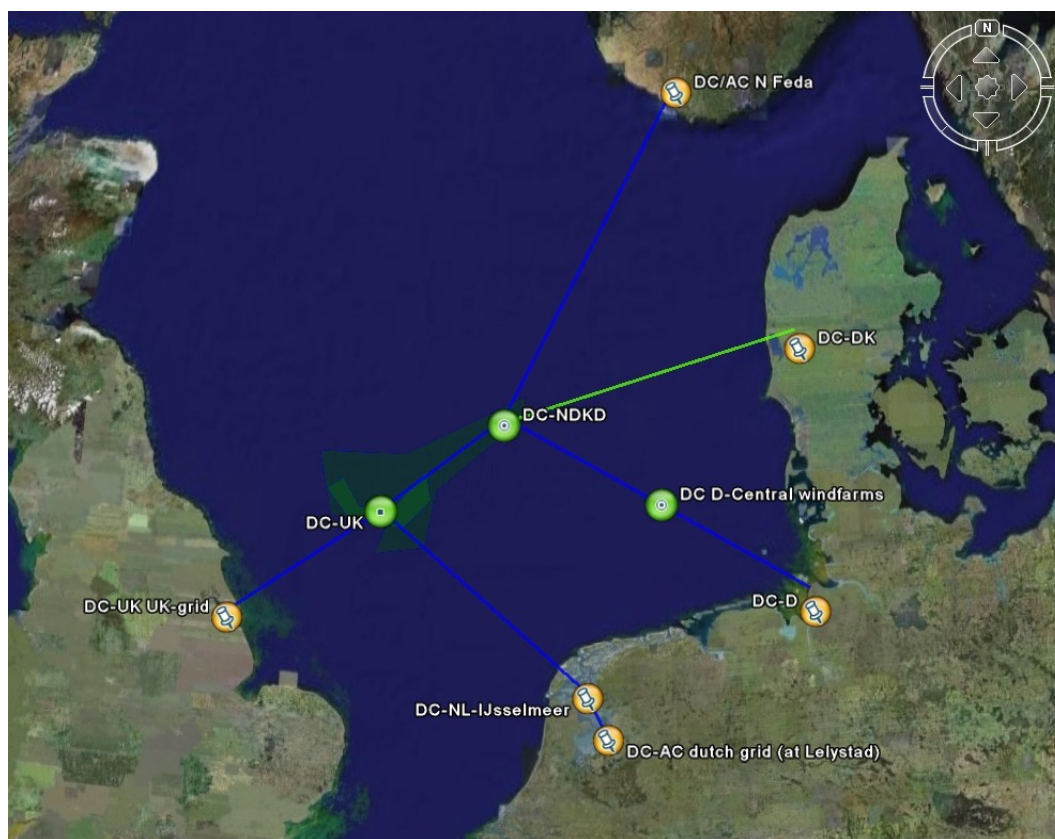


Figure. Wind energy production and transportation network between the national grids of the United Kingdom, Norway, Denmark, Germany and The Netherlands. The green area is the central area of the Dogger Bank. The light-green is the shallow Western Shoal area. German and Dutch wind parks can utilize the DC-cable capacity. The green pinpoints at sea are the DC-transformer stations, the yellow pinpoints onshore are DC-AC-transformer stations.

***No funding.** Connecting national electricity grids in Northern Europe in combination with large scale wind energy production will be cost effective in the future without national funding.

***Network.** In northern Europe the interconnection of electricity grids just started but an overall network is not established yet. In future the combination of grids with high power direct current cables will benefit to the electricity consumers and the environment.

***Dogger Bank electricity production area.** A shallow Dogger Bank is used as a central area where the central grid comes together (figure). In this area the production is concentrated in wind turbine parks in which each of 300 MW (50 turbines times 6 MW). In a closed package wind turbine park in which the distance between turbine is 500 m the total area of one park is around 16 square km. With the contemporary experience in offshore wind turbine parks the area of the Western Shoal can be used. The Western Shoal area has depth profiles of around 20 meter. See the light-green area in the figure.

The advantage is that the offshore wind energy techniques used around the UK coast and the Dutch coast will probably be the same. In the Western Shoal a total of 100 turbine parks (30 GW) can be build.

The outer contours of the Dogger Bank have depth profiles of around 30 meter (dark-green in figure). For this area building techniques in deeper water (30-40 m) are needed. At the Dogger Bank area an extra 500 turbine parks can be build. For the whole area a maximum of 180 GW wind energy capacity could be available. The total number of turbines is 30000 (6 MW each).

The network is developed in such a way that HVDC-electricity (HVDC: High Voltage Direct Current) can reach the high power lines of the national grids. Electric energy once on land can be transformed to AC (Alternating Current) and transported southward to the consumers and the industry.

***High winds at sea.** The wind velocity at the Dogger Bank area is much higher than at coastal regions. Compared to land-based wind turbines the same turbine at sea can generate 1.5 the amount of electricity. An area at land where so many turbines can be combined cannot be found in North-Western Europe.

***Storage of electricity.** The combined national grids once connected can adsorb a huge quantity of electricity which is consumed when produced. In fact the storage is in the network itself because the national networks can regulate the power production. Norway has also a huge potential of electricity hydro-storage. In the Netherlands at Lelystad gas-electric turbines can be started quickly when needed for the grid. For the latter the electricity storage is in the gas reservoirs at no extra costs.

***The direction of the electricity.** The market will determine where the electricity goes. The main direction will probably be southwards to the consumer or industry at daytime. The network combines the high power national grids which allows the electricity to access much more consumers and industry than the capacity shortage of the regional connecting points.

***New electricity market.** By the physical connection of the electricity there will also be an pan-North European electricity market. Electricity goes to the highest bidder.

***Who will have advantages of a combined network?** The consumer and the environment (and everybody between). A MWh produced by wind energy will not be produce by a carbon dioxide emission source. Also a huge wind turbine industry is generated or will be expanded. Offshore industry firms will benefit as the building process is a major part of the total cost of an offshore wind farm. A disadvantage will be for those electricity producers which make electricity at a higher price.

***Single line versus network.** A network is much more stable then a single line. If a cable is broken the production will continue along the other lines.

***Extension of the network.** The network can be used as extra connecting points. For example: wind energy productions parks in German sectors or at Lake IJsselmeer in the Netherlands can be added using the network.

***Combining the network.** There a several DC-cables from Norway to Denmark and The Netherlands. A DC-cable from the Dogger Bank network directly to Denmark is probably not needed because Norway has already DC-cables to Denmark. Combining and integrating the future DC-network with Dogger Bank DC-cables will have benefits to all without weakening the network concept.

***Risk assessment.** Biological and chemical effects will be at the 'de minimis' level (negligible). Many studies were performed for wind enenergy production. Utilizing wind energy has few disadvantages but many advantages. Building in nature protection areas will not harm marine live. It will not effect the marine food because the sea area occupied by a turbine is small. The real problem concerning marine life is a phenomenon called: "fishing down marine food webs".

***Political.** Executing the Dogger Bank energy plan will solve all nation commitments to renewable energy. Politicians of several countries must agree on a combined plan and will give a go to the private sector.

***Pinpointing and coordinates.** The area is pinpointed and the coordinates are available on request.

***Expertise.** For this proposal expertise is combined about wind energy, biological, chemical, physical assessment studies, national electricity grids, social acceptance and proposals for future regenerated energy.