30. Catching mighty North Sea winds

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DONG is the acronym for Danish Oil and Natural Gas, a company created in 1972 for managing oil and gas resources from the North Sea Danish sector, and for producing and distributing electricity as a utility owned by the Danish government. Incidentally, it developed and constructed in 1991 the first offshore wind farm in the world, near Vindeby, off the coast of Lolland Island, South Denmark. The turbines were devised and produced by Siemens (Germany). They were a major innovation at the time. Today, they look like dwarfs compared to the Siemens 10.0-193 turbines developed for the Hornsea Project (UK), planned for completion in 2022 off the Yorkshire coast: rotor diameter: 193 m vs 35 m; power capacity: 10 MW vs 0.45 MW. As recently as 2014, the UK government guaranteed £150 per MWh to get three more wind farms built off the British coast; at Hornsea, the cost per MWh of energy will be of the order of €70, and less for later stages of the project.

The march from Vindeby to Hornsea took a major turn in 2008, when Anders Eldrup (DONG CEO 2001–12) made a decisive push towards transforming DONG into the world leader in offshore wind farms. The metamorphosis was completed in 2017 with the sale of DONG's oil and gas business to INEOS, a UK chemical company. DONG was renamed Oersted, after the Danish scientist Hans Christian Oersted, who in 1820 discovered that an electric current through a wire could move a nearby magnet. In this way he started a new branch of physics, electromagnetism, which plays a crucial role in the functioning of wind turbines. The Danish government is no longer the sole owner of the company; however, it still owns 50.1 percent of the capital. In 2020, Oersted has a total power capacity of 7.5 GW (about a quarter of the world total), serving customers in Denmark, Germany, the Netherlands, the UK, Taiwan and on the US East Coast.

Oersted has actively contributed to spurring the technological advances that led to spectacular reductions in the costs of producing electricity from offshore wind farms, mainly by placing massive orders (up to 500 turbines at a time) with their two main providers, Siemens and Vestas (Denmark), sometimes in anticipation of their needs. Such policy strongly motivated Siemens and Vestas to massively invest in R&D, resulting in size and power increases, and also in improved reliability, as exemplified by Siemens "High Wind Ride Through"

system that precludes a sudden shutdown of a turbine when the speed of the wind passes a 25 m/s threshold, above which the integrity of the machine is under threat without this system. Oersted has also enhanced its own operations, in particular with regard to the ways the foundations of the turbines are laid out in the sea (even floating turbines are now seriously considered), and as regards management routines.

Although increasingly burning wood pellets and household refuse in its thermal power plants, Oersted will not completely phase out coal before 2023. Nevertheless, according to Harries and Annex (2018), from Bloomberg NEF: “Not only has Oersted gone green, it has also seen increased earnings”.

The University of Southern California (USC), in Los Angeles, is not next door to the headquarters Oersted has inherited from DONG in Fredericia, Denmark. However, a similar big idea is floating within both places. The late George Olah, founder of USC Loker Hydrocarbon Research Institute and one of the most famous twentieth-century chemists, along with two colleagues:

proposed and developed a feasible anthropogenic chemical recycling of carbon dioxide [that can] be converted by feasible chemical transformations into liquid fuels such as methanol, dimethyl ether... This concept of broad scope and framework is the basis of what we call the Methanol Economy. The required energy for the synthetic carbon cycle can come from any alternative energy source such as solar, wind, geothermal, and even hopefully safe nuclear energy. (Olah, Surya Prakash and Goeppert, 2011)

This way of storing CO₂ would not reduce the amount in the atmosphere, but it would at least close the open carbon cycle associated with the burning of gasoline made from fossil oil. Anders Eldrup had not heard of Olah et al. However, he came to concur with them. During winter 2009–10, the Danish wind farms produced such an excess of electricity, which had to be evacuated through the interconnectors to Norway and Sweden, that the price became negative. With the multiplication of offshore wind farms in Danish waters and elsewhere, it is anticipated that imbalances between production and consumption of electricity might result in negative prices for an increasing number of hours/year. Anders Eldrup came to the view that, rather than incur losses on excess electricity, it should be used to produce hydrogen. Similar conditions will prevail in the USA, in Texas and Midwestern states, as wind farms are multiplied. Then, with hydrogen and CO₂ at hand, it is not difficult to produce methanol, which would in this way also prove a means of recovering electricity in excess, hence dealing with the intermittency and volatility of renewables.

On October 19, 2019, in Copenhagen, Fatih Birol, International Energy Agency (IEA) Executive Director, launched an IEA special report on offshore wind (IEA, 2019a). While praising Denmark, and more generally Europe, for pioneering the technology's development, he also stressed the major role that

China and the US are “set to play in offshore wind’s long-term growth”. He concluded: “In the past decade, two major areas of technological innovation have been game-changers in the energy system by substantially driving down costs: the shale revolution and the rise of solar PV. And offshore wind has the potential to join their ranks in terms of steep cost reduction” (IEA, 2019b).

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