*voice over text* ***2050–An Energetic Odyssey***
*Dirk Sijmons / IABR*

In Paris on 12 December 2015, at the end of the United Nations Climate Change Conference, a historic agreement was signed in which 195 countries solemnly promised to keep the global rise in temperature *"well below 2°C"*. The Paris agreement constitutes a stunning challenge. We need to reduce our carbon emissions by a staggering 80 to 95% to reach that goal. We are long well aware of the risks of belching out $CO_2$, but we seem petrified as rabbits caught in the headlights. Risks alone will not get us into action. We have to reframe. We have to exchange the frame of risk for the frame of opportunity. And for this we need new 'imaginaries', images of a future that can work, that gives us perspective and hope.

## 2050 - an Energetic Odyssey

Reaching the EU target requires nothing less then a complete transition from fossil fuels to carbon neutral energy sources, a transition that will not be easy and that will have repercussions at every level of our society. Overcoming the fossil fuel habit is going to be even tougher because reserves have not yet been depleted. In other words, the problem is not a shortage of hydrocarbons in the ground, but rather an excess of carbon dioxide in the atmosphere.

You are looking out across the North Sea, an area where wind can be harvested on a grand scale. The North Sea is one of the crucial areas in Europe where we will win or lose the battle for renewable energy. But the North Sea is not empty. Our story is set in the most intensively used coastal waters in the world. With fishery and shipping routes cutting right across, it contains designated nature reserves and military zones, oil rigs the size of skyscrapers, countless oil and gas pipelines and there are already several wind farms. Moreover, the North Sea, is used as a sink for pollutants and residual heat from our industries.

In*'2050 an Energetic Odyssey',* the North Sea will bring the region together. Through regional cooperation we will, step by step develop a new regional energy system that has the North Sea as its heart. And by doing so, show how we can move from a polluting fossil energy system to a regional system based on renewables, within a timespan of 35 years. And all of it based on a regional cooperation.

Let us introduce the main physical components:
Of course, the wind farms, with the cables within these farms through which electricity is transported.

The connectors at sea where the cables from the wind farms converge, the landing cable that leads to the coast, ending at a landing point where electricity can be tapped.

There are pipeline corridors that currently transport gas and will subsequently take carbon dioxide to underground storage facilities.

In addition, the ports and industrial estates where wind turbine components are manufactured assembled and shipped out to sea.

In order to situate the assembly point sufficiently close to the building site, an additional construction island is planned in the vicinity of the Doggersbank.

In the animation, we are already rolling out and projecting the wind projects planned for 2020, while we set out the bigger energy picture for you.

Together, the North Sea countries – the UK, Norway, Denmark, Germany, Belgium and the Netherlands – annually consume approximately 5,500 TWh of energy.

This represents their collective use of electricity, heat and fuel, for the sake of convenience expressed as units of electricity. In the context of substantial greenhouse gas reduction by 2050, renewables play a pivotal role and would need to supply at least 75% of all the energy that we consume. This is a very ambitious goal that requires a quantum leap in clean energy production and the maximum effort in terms of energy saving.

Let's unravel this enormous challenge bit by bit:
Currently, 8-9% or approximately 500 TWh per year of the energy consumed by North Sea countries already comes from renewable sources.

First of all, energy saving needs to be high on the European agenda. Every MW we save means a whopping 3 MW less production due to inevitable losses during production, conversion and transport. So saving energy is by far the most cost-effective reduction strategy because its effect is tripled.

That's why we're setting the bar as high as possible and stating that a 30% reduction relative to 2015 has to be attainable. A saving of no less than 1,500 TWh

At the other end of the spectrum we have to take account of various sectors for which there will still be no alternative to fossil fuels by 2050, like mining, heavy transport, steel production, *et cetera*. We estimate that some 900 TWh per year will suffice for the North Sea region.

Our research indicates that it is feasible, with the right ambition, to generate 1,200 TWh of electricity per year by offshore wind. This will provide a dazzling 90% of the total electricity demand of the North Sea countries and roughly one third of the total energy demand. Through regional cooperation the North Sea could become Europe's energy transition's biggest asset.

Even taking into account the high population density, procedural hurdles and compensating for NIMBY type setbacks, it should be possible to accomplish the remaining renewable objective of 1,400 TWh with a patchwork of large and small, centralised and decentralised initiatives in these six countries. Projects with the potential to produce the rest of the renewable energy, heat and fuel from solar, water, wind, geothermal, biomass and tidal sources.

Numbers like these remain abstract until one realizes that this means that by 2050 we will need to have installed some 25,000 wind turbines of an average capacity of 10MW that will have a net coverage of some 57.000 km2.

This is an average of installing 15 turbines a week. It's clear that we need to start thinking on a different scale. A huge undertaking that demands the utmost in terms of planning, funding, design and implementation.

This grand operation offers major opportunities for the European economy. All the manufacturing and building of specialized vessels will dramatically increase demand on existing port facilities around the North Sea and may even necessitate port expansions.

Let's focus on the network characteristics for a moment. In this cooperative model the wind energy system in the North Sea will quickly move to a tipping point where regional cooporation boosts the efficiency by changing from linear interconnections to a meshed grid.

The positive impact on employment is significant. At all levels and stages of the supply chain there will be jobs for workers of all skills: *blue growth* for the economy.

Above all, the 310,000 jobs are expected to be generated by this North Sea energy harvesting, even outnumbering the 280,000 jobs that will be lost in the offshore fossil fuel industry.
Due to its scale and timeline, this European mega-project will be a breeding ground for innovation; development of new materials, ever increasing wind turbines size, technology required to facilitate maintenance of turbines at sea and floating wind turbines in order to utilise deeper sections of the North Sea too. The mission drives the innovation. Sooner than we imagine, fundamentally new technologies will emerge for harvesting wind energy. Not only deeper water but also higher atmospheric levels involving giant kites. All these innovations and economies of scale will drastically reduce the levelled cost of wind energy. This price will be the tipping point between the observation that things always take longer to happen than you think and then they happen much faster then you think they could.

Other essential ground breaking technology is needed to store superfluous energy for times of scarcity. Currently, conversion to hydrogen seems a promising option. As a fuel, hydrogen can also serve as an alternative for diesel.

2050. The interim objective has been accomplished.

Good planning and design of the operation can ensure optimal alignment with the marine ecology of the North Sea. The odd 25,000 towers and submerged stone structures adds welcoming artificial reefs onto which all kinds of underwater plants and animals can attach themselves. Using state-of-the-art pile-driving technologies or gravity-based solutions can largely mitigate negative effects of the construction process, ensuring that sea mammal navigation remains undisturbed.
Combining the construction of wind farms with the establishment of fishery-free zones and marine reserves forms a promising synergy.

Last but not least, spatial planning is taking bird migration routes into account when selecting wind farm locations. The zone closest to the coast, which birds use for orientation, should be left untouched where possible. In addition, farms can be temporarily taken out of operation if the radar detects a flock of migratory birds approaching.

A positive effect of this careful planning is that the view from the coast for tourists is not affected. Placed outside the twelve miles zone, the curvature of the earth reduces the visibility on a clear day to a white haze at the horizon produced by the tops of the turbine blades.

When we wake up, will this scenario survive the pressure of the day-to-day policy dilemmas?
We have good reasons to think it can. The interactive production of this installation, in the cultural domain, forged a coalition of key actors. It is the result of intense collaboration between designers and scientists, and a consortium with expert input from builders, offshore specialists, ministries, energy firms, a transmission system operator, port authorities and nature NGO's. It can be done but only when a tailwind can be organized in the shape of realistic pricing or taxation of carbon dioxide that would provide the invisible hand of the market with green gloves. An energetic society needs an entrepreneurial state guided by an unwavering political course.

This imaginary of the North Sea as foundation of a green Next Economy can very well become a reality. Regional cooperation allows us to harvest green energy on a massive scale and can be aligned with actual ecosystem improvement. We have now overcome the crisis of the imagination.

The North Sea, which has been so prominent in our history, will become a pivot in the deep de-carbonisation of our society and a source of prosperity for all.