Wind isn’t just mysterious, destructive and exhilarating – capturing just 2% of it would solve the planet’s energy needs at a stroke. And as the windiest country in Europe, Britain is at the forefront of this green revolution.

The wind rips along the Humber estuary in Hull. It’s the kind that presses your coat to your back and pushes you on to your toes. “A bit too windy,” shouts Andy Sykes, before his words are swept away. He is the head of operational excellence at the Siemens Gamesa factory, which supplies blades – the bits that turn – to windfarms in the North Sea. At 75 metres long, they are hard to manoeuvre when it’s gusting.

Inside the vast factory hall, the blades lie in various states of undress. Several hundred layers of fibreglass and balsa wood are being tucked into giant moulds by hand. There are “naked” blades that require paint and whose bodies have the patina of polished tortoiseshell. Look through the hollow blades from the broadest part, and a pale green path, the tinge of fibreglass, snakes down the long tunnel, tapering to a small burst of daylight at its tip.

“Alice in Wonderland,” Sykes says. “That’s how I feel. That’s the emotion coming through. It’s 75 metres long. We know that. But stood here the perspective is just fantastic. It’s my favourite view.” Down this strange green rabbithole is a glimpse of a greener future, the possibility of a world powered by wind.

This is not as fanciful a vision as it once seemed. In the UK, the wind energy industry is celebrating. Last month, the cost of renewable energy dropped dramatically to undercut by almost half the government’s projections for 2025. At £57.50 per megawatt-hour, it is far cheaper than the state-backed price of £92.50 awarded in 2016 to Hinkley nuclear power station. The speed of wind’s progress is extreme and inarguable.

Emma Pinchbeck, executive director of RenewableUK, and a former climate change activist, can’t keep the happiness from her voice. But she is happy for new reasons. What’s really exciting, she says, is the fact that she “is not having to talk to officials about decarbonisation any more as a starting point. Windfarms are low carbon. But that’s not why we want to build them. We want to build them because they’re bloody cheap!”

Wind is in the news. And not just in terms of the energy it provides. One after another, Hurricanes Harvey, Irma, Maria and Nate have devastated the Caribbean and parts of the US mainland. In the UK, with a turbulent autumn looming, this month marks the 30th anniversary of 1987’s great storm, which felled 15 million trees in one night. A book exploring this event, Windblown: Landscape, Legacy and Loss, sold in a keenly contested auction last year and has just been published. Another new book, Where the Wild Winds Are, sees its author, Nick Hunt, walk the “invisible pathways” of Europe’s winds. In short,

wind is in the air. But why do lay people know so little about it – and can it really power the world?

The wind energy sector is certainly booming. Across the river from the Siemens Gamesa factory in Hull, in this long windy corridor of development on the east coast of the windiest country in Europe, there's the Dong Energy hub, the screens of its operation room flickering with the data of wind captured by blades turning in the North Sea. Next month, the company will change its name – short for Danish Oil and Natural Gas – to Ørsted, after the celebrated Danish scientist who discovered that electric currents create magnetic fields, to reflect its near complete shift from black energy to green.

Dong was among the companies that achieved the landmark price of £57.50, and Emma Toulson, who works in their Grimsby office, explains how they did it.

Since the government ruled out new onshore windfarms in England – a promise in its 2015 manifesto – energy companies have been forced offshore, making the UK the world's offshore leader. Allowed to develop beyond the vision of land-dwellers who see windfarms as a blot on the countryside, the turbines have grown steadily larger, as have the farms to which they belong. Dong's Hornsea Project Two will span 480 sq km, and Toulson's PowerPoint outlines a large jagged blue diamond for Project Three and an even larger blue rocket shape for Four.

Toulson has a slide that shows one very clear reason for the falling cost of wind energy. Over time, the diameter of the blades have enlarged. A turbine commissioned in 2002 swept 80 metres; in 2005, that figure rose to 90 metres; in 2011, it was 120 metres. By 2020, it will be 180 metres.

Of course, the supply chain has improved, and there have been engineering refinements. But put baldly, wind energy costs less, and will go on costing less, because the turbines are growing taller and the blades longer. The manufacturers of these machines are in a race to produce the largest.

Making something bigger in each incarnation seems a very basic idea of advancement. How much of a future is there in a pursuit of progress through perpetual excess?

Andrew Garrad co-founded Garrad Hassan, which has grown to become the world's largest wind consultancy. "When I started, in 1984, I could carry the biggest wind turbine blade on my back," he says. "I've made all sorts of embarrassing pronouncements about how big the blades can get … Never bigger than 50 metres or 70 metres or 90 metres, and I'm always wrong."

One limit is that if a blade can't support its own weight, it buckles. And the size at which this would happen? Garrad laughs. "About 1.5km in length."

To add to the sense of the fantastical, last week two scientists from the Carnegie Institution for Science at Stanford University, California, published a study that suggested a windfarm the size of India, in the North Atlantic, could power the world.

“A generation doesn’t last long in wind,” Garrad says. A new one is born every three to four years. Progress has been so fast that this year saw the first decommissioning of an offshore windfarm, Vindeby, in Denmark. At 25 years old, it is practically ancient, its entire output exceeded by that of a single 8MW Vestas turbine.

And yet despite the size of its gargantuan machines, the offshore wind industry is still in its infancy. Wind turbines may look alike, but as Garrad points out, “we are a long way from a design consensus”. There are fixed turbines and floating turbines, which can access deeper seas, turbines with gears and turbines without. The sight of three blades harmoniously turning has become commonplace. But there is no reason why offshore turbines should look like this. They could operate with a single blade (ruled out on land because one blade, whirring faster, is noisy), or with two blades (ruled out on land because an optical illusion makes them appear to pause as they pass the tower, flummoxing passersby). Offshore, there would be only the gulls to offend, and the people who will live, in four-weekly shifts, on the new accommodation vessels that are being deployed to manage the farms’ growing distance from shore.

The open ocean is a blank blue slate. “An engineer’s dream,” Garrad muses, who built his first windmill from old bicycle parts in his back garden when he was 17. When he was older, he climbed to the top of one of the first giant turbines and stuck his head out of the nacelle – the bit near the blades that houses the components – just to feel the wind in his hair.

“You poke your head through the trapdoor and you get the most fantastic feeling of the power of the wind,” he says, his voice growing faster, louder. “You can feel the torque on the rotor, feel the blades bending, and the whole machine taking the power out of the wind … That first primordial step from the wind itself into the rotating shaft.”

Wind has long had a transformative power in myths and legends. From Aeolus, the keeper of the winds in Greek mythology, to Vayu, the Hindu god of wind and Native American legends, humans have toyed with the idea of capturing it. (This preoccupation can be seen in object form at the Bora wind museum in Trieste, Italy: it has an exhibition of gusts trapped in bottles, sent in by wind lovers from around the world.)

Wind is a metaphor for change, the passage of time, the past and the future (“The answer, my friend …”). It blows through the art of Van Gogh, through Hokusai to the far western tip of Cornwall and Gill Watkiss, whose landscapes are peopled by figures permanently bent, snapped over by the wind, hair whipped. “I like to feel it playing havoc with me,” she says.

“You feel alive.”

Humans have a complex relationship with the wind. We have many names for rain, from mizzle to drizzle, torrents to downpours. But wind is different. “There are no borders to the wind. It blows across land, across oceans. It’s bigger than we can imagine,” says Tamsin Treverton Jones, who wrote Windblown. We know it by how it sounds or feels, which is severe enough in places for scientists to have explored the link between strong winds and suicide, and by the damage it leaves behind.

Poets aside, we have few words for the wind between a breeze and a gale. Even the Beaufort scale, which measures wind speed, categorises it specifically in relation to its impact on objects. Ted Hughes knew a “brunt wind”. Robert Macfarlane knows a “katrizper”, an Orcadian wind derived from the Norse for cat scratches. Watkiss, the Cornish artist, tells “exhilarating” wind by the way the telegraph wires hum. Debra Nicholson at the Wind Energy Museum in Great Yarmouth, with its bunting gently flapping over an assortment of 20th-century windmills, cites a 45-degree wind – one that gusts so hard, you have to walk into it at that angle. And a few miles away at E.ON’s Scroby Sands windfarm visitor centre, there’s talk of a “scowl”, a wind that whips around in all directions. Just along the promenade a kiosk sells children’s windmills and, at the dock, hulking Siemens Gamesa blades lie ready to be taken to sea.

But while most of us know what wind does and how it sounds, we don’t know what it is, or why it blows when air at the earth’s surface moves to equalise low and high pressure areas. There is much still to understand.

Ken Caldeira is one of the two Stanford climate scientists behind the idea of a North Atlantic windfarm the size of India. To understand the significance of his discovery, he says, it is important to know that when wind turbines are arrayed in rows, the extraction of wind by the first row reduces the amount of wind available for the second row, and so on. Row by row, the wind’s potential diminishes.

To counter this effect, turbines need to extract energy from the wind that’s above them. What Caldeira found was that that is exactly what can happen in parts of the North Atlantic, where heat “pours out of the ocean”, causing greater “cyclonic activity”. But could a farm the size of India really be built in open ocean? “You wouldn’t want to,” he says. Better to have many very large ones (China currently has the largest). A wind power station that size “would be a climate change in itself”. For one thing, “pulling that much energy out of the sky shifts the direction of wind”.

The challenges facing the wind energy industry remain immense. These include global political challenges: the presence of a climate-change sceptic in the White House, the UK

government’s dislike of onshore wind (cheaper and so far more productive than offshore) and the potential impact of Brexit.

There are technical challenges, too, such as the difficulty of storing the energy captured. Batteries for this purpose – such as the E.ON facility that opened in Sheffield last week – are still developing and are crucial to securing the supply, making it reliable. But still, the possibilities are immense.

“The total amount of power in winds globally is something like 50 times bigger than the total amount of power used by human civilisation,” Caldeira reckons. “If we were to power civilisation by winds, we would need to capture about 2% of winds today,” he says, sounding a little like Odysseus on his way home from Troy, bag of winds in hand.

And if the ocean is a blank blue state, there is another one above. The idea has been floated. Wind turbines on kites are in research and development. The jet stream, for Caldeira, is “the largest, most concentrated renewable energy source on the planet, 20 times as potent in every square metre as direct sunlight in the middle of the day”.

No one thinks that wind alone offers the answer to the world’s energy needs. But for now, at least, the possibilities are boundless.

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