Not as free as air

It is important to regulate optimum positions for wind farms so that the best possible power is extracted, and in the most economical way

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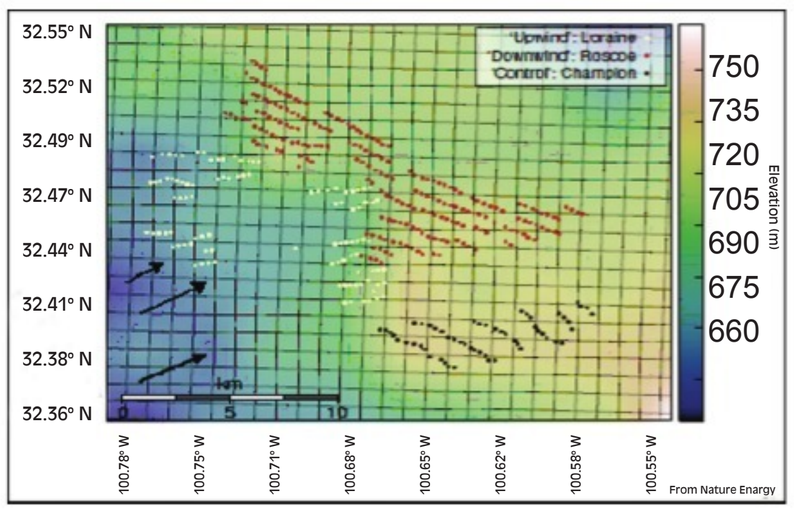
The costs of conventional sources of electric power have been the cost of the inputs and the penalty of pollution. The main cash cost to the producer has been the cost of inputs, usually coal and oil.

In the case of hydroelectric, solar or wind powered plants, on the other hand, the sources are nature given and the costs have been only the cost of the installation and maintenance. While hydroelectric plants are restricted to just a few locations, the use of solar and wind powered plants has been increasing. As wind farms grow more in number, however, farms that are upwind of other farms have started affecting the working of the downwind farms.

JK Lundquist, KK DuVivier, D Kaffine and JM Tomaszewski from the University of Colorado, the National Renewable Energy Lab, Colorado and the Denver Sturm College of Law, in a paper in the journal, Nature, examine the practical effects of crowding of wind farms, as well as the economic and legal consequences, in the case of wind farms in the State of Texas. Texas happens to be the state in the US with the greatest number of wind farms - 12,077 turbines, over 121 farms, with capacity of 21 GW. In comparison, India has an installed capacity of 34 GW. India has a surface area of 3.3 million square km, compared the 0.7 million square km of Texas. The coverage in India is hence about a third of the coverage in Texas, but this is comparable and the study is relevant to India.

The principle is that when wind strikes the vanes of a collection of turbines, energy is transferred to the vanes, which are set rotating, and energy is lost by the wind. The wind field on the lee side of the turbines is thus less energetic than on the windward side. If another set of turbines is located close behind the first lot, there would be less energy to be transferred and the second set would work less efficiently. A similar effect is found when a flock of birds are flying. When birds move through the air, they face air resistance, which amounts to a wind. Now, it is found that the conical space behind the leading bird is at a lower pressure and the birds that follow face less air resistance. Birds are thus adapted to fly in formation, so that they use the least energy. The space behind the leading bird, or a set of turbines, is called the "wake" and in the case of the turbine, the turbines that lie in the "wake" of turbines that are upwind are starved of strong winds to set their vanes in motion.

The study considers a group of three wind farms, Roscoe, Loraine and Champion, in the state of Texas, to see how exactly they affect each other. Roscoe was set up in March 2008 and the Loraine farm was set up in November 2009, at a nearby location, within 10 km, and upwind of Roscoe. Champion is a similar wind farm, set up in March 2008, the same time as Roscoe, but outside the influence of Loraine. The study examined the available data of production efficiency and the time of the year, of the three farms, between 2008 and 2015, from the time Roscoe and Champion started working, and through the time when Loraine was set up and could be expected to affect the working of Roscoe.



The method of study was to consider the daily or available record of production during the year and a half that Roscoe and Champion were in operation before Loraine was set up and then the production at Champion for the whole period, as well as the production at Loraine. The data of Champion and Loraine, as well as national, hourly wind speed data bases and other sources of information indicated the actual wind conditions, under the seasonal and other conditions, during 2009-15. From this, as well as simulations, the production at Roscoe that should have been, during 2009-15, had Loraine not been set up, was calculated.

The actual production at Roscoe during 2009-15 showed that there was a reduction by five per cent, on the average, ever since Loraine came up. The output graphs of Roscoe and Champion are seen to keep pace till November 2009, when Loraine started operation. From that point on, the graphs of Roscoe and Champion diverge, showing graphically the effect that Loraine has on Roscoe. The highest losses in the downwind farm were seen to occur during specific conditions, rising as high as 15 per cent (production of 270 MW against potential 315 MW) and wind speeds could drop by two meters per second, in the short range, and by 0.5 meters per second as far as 50 km away.

The paper then analyses the economic costs of this drop in the efficiency of downwind farms. The wind farm occupies a large area and the sites are carefully selected after a wind survey that lasts at least a year. Apart from optimum wind conditions, it is also important that the farm be well located to get connected to the electric grid and also approachable for maintenance. The wind conditions, in fact are studied in great detail, using lasers and the Doppler Effect to detect air movement, so that the dimensions and the section of the wanes are optimally designed. The care and attention is important, for getting the best return on the large investment made and because every extra milliwatt generated amounts to huge savings, over time, in coal burned and CO2 released by conventional electricity generation.

With all this care, for a working wind farm to find that its output is hit to the extent of five per cent because another farm is set up at an upwind location, is tragic twice over. As the first plant was surely installed at the best place the terrain has to offer, the site for the second farm has been chosen with some compromise. And then, the output of the first farm is reduced. No doubt, the total power produced by the two farms is more that what could come from either of them, but when both farms are working below capacity, it shows that regulation and planning could have allowed both farms to stay optimal.

The study observes that the regulation of new wind farms is mostly the zoning and architectural restrictions that are relevant to civil constructions in general. There appears to be no regulation, specific to wind farms, by the State, nor alternate means for owners of wind farms to prevent other farms from coming up and affecting the working of the earlier farms. The study notes the legal position with respect to a land owner's rights to the benefits of what lies beneath his land. If it were a source of oil, the same source could be tapped by wells sunk in a neighbouring tract of land, and this could deplete the oil in the source. There is now legislation to protect the interests of the first oil well, and also water sources, the paper says. Regulation of wind farm spacing, however, is still to start.

The paper also notes that the effect that wind farms have on each other, indicates that there is limit to the power that can be extracted, the world over, from the wind. It is hence important that optimum positions for wind farms be regulated so that the best possible wind power is extracted, and in the most economical way.

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Need to act right now

Naturalist David Attenborough has warned that civilisations are going to collapse if humanity fails to tackle the threats of climate change

ANDREW GRIFFIN

Civilisations are going to collapse and much of nature will be wiped out to extinction if humanity doesn't take urgent action on climate change, Sir David Attenborough has warned.

The naturalist gave a terrifying picture of the future of humanity during climate talks being held in Poland. He said that humanity was facing a major threat and that leaders had to drive down harmful emissions if they wanted to preserve the natural world.

The warning came as Attenborough took the "People's Seat" at the opening of the conference held recently, as part of a UN initiative that aims to give normal people a voice at the international climate talks. He said the world was facing its greatest threat in thousands of years: climate change.

"If we don't take action, the collapse of our civilisations and the extinction of much of the natural world is on the horizon," he said. "The world's people have spoken, their message is clear - time is running out. They want you, the decision-makers, to act now.

"They're supporting you in making tough decisions but they're also willing to make sacrifices in their daily lives."

The UN has launched an Act-Now.bot which helps people discover simple everyday actions they can take to tackle climate change.

Attenborough said, "The people have spoken: leaders of the world, you must lead, the continuation of our civilisations and the natural world upon which we depend are in your hands."

United Nations Secretary-General Antonio Guterres warned negotiators at the meeting that the world was in deep trouble with climate change.

"Climate change is running faster than we are and we must catch up sooner rather than later, before it's too late," he said.

"For many people, regions and even countries, this is already a matter of life and death."

He also said that climate action was not just the right thing to do, it made social and economic sense - pointing to how action to cut emissions would curb air pollution deaths and generate millions of jobs and trillions of dollars.

The speeches come after four former presidents of the annual UN climate talks warned that the world was at a crossroads, and decisive action in the next two years would be crucial to tackle the threat of climate change.

In a joint statement, France's Laurent Fabius, Frank Bainimarama, from Fiji, Salaheddine Mezouar, from Morocco, and Peru's Manuel Pulgar Vidal said, "The challenges are there, as are the solutions.

"We require deep transformations of our economies and societies to build a better world for all. This must be powered by multilateral co-operation."

They called for ambitious decisions that were sufficiently detailed and comprehensive to enable the effective operation of the Paris Agreement, secured three years ago in the French capital to curb global warming.

A process to enable countries to announce efforts by 2020 to ramp up their domestic ambition on cutting greenhouse gas emissions must be launched, they said, as current efforts were not enough to prevent dangerous temperature rises.

And there needed to be progress on the goal of mobilising $100bn (£78bn) a year for poorer countries to drive clean growth, they urged.

The World Bank has announced that it is doubling investments in climate action with $200bn for 2021-2025, including $50bn towards helping countries adapt to the impacts of global warming.

Negotiators at the talks will hear details of a global review on efforts to tackle climate change, and the pressure is on to work towards increasing commitments from countries by 2020.

The talks also aim to draw up the rulebook for making the Paris deal operational, and poorer countries will be looking for a boost to the finance being made available to help them develop cleanly.

The independent

PLUS POINTS

Better eye care

A "contact lens" patch for a more effective alternative to treating common eye diseases has been developed by a team from Nanyang Technological University (NTU).

With this patch, common debilitating eye diseases such as glaucoma and macular degeneration could be treated in a more painless and efficient way.

The two millimeter by two millimeter patch is covered with nine biodegradable microneedles loaded with drugs that are delivered into the eye in a controlled release.

Shaped like a pyramid for optimal tissue penetration, each needle is thinner than a strand of hair and is made of hyaluronic acid, a substance found in the eye that is used often in eye drops.

After pressing the patch onto the eye surface gently — much like putting on contact lenses, the drug containing microneedles detach by themselves and stay in the cornea, releasing the drug over time as they dissolve.

Current treatment methods are hindered by the eye's natural reactions, such as blinking and tearing.Unlike topical applications and eye drops, which can be washed away easily, the eye patch works around the body's defences and the microneedles are not affected by blinking and tearing.

This way of treating eye diseases was developed by a team led by Professor Chen Peng from NTU's School of Chemical and Biomedical Engineering (SCBE), with clinical insights from the Singapore National Eye Centre's Associate Professor Gemmy Cheung.

Prof Chen, who took the lead on the project, said the contact lens patch could realise the medical need for localised, long-lasting and efficient eye drug delivery.

Topical drugs such as eye drops and ointments require repetitive applications with a high dosage, as less than five per cent of the drug is absorbed by the eye each time and the eye naturally clears out much of the drug.

The research team has filed a patent and is working on further improving the technology that goes into the eye patch. It is also looking to partner clinician scientists to study the feasibility of conducting clinical trials.

The straits times/ann

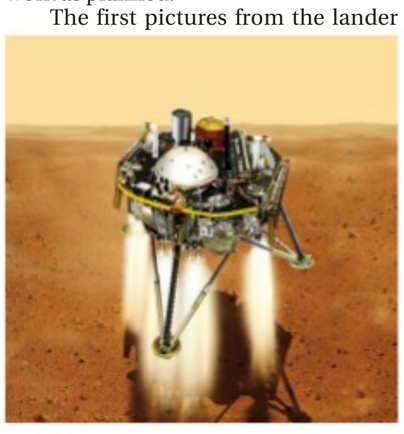
Slightly tilted

Nasa's unmanned Martian quake sensor, InSight, has landed at a slight angle on the Red Planet. The $993 million lander arrived on Monday at its target, a lava plain named Elysium Planitia, for a two-year mission aimed at better understanding how Earth's neighbouring planet has formed.

"The vehicle sits slightly tilted in a shallow dust and sand-filled impact crater known as a 'hollow'," Nasa said in a statement.

InSight was engineered to operate on a surface with an inclination up to 15 degrees. Therefore, experts are hopeful that its two main instruments - a quake sensor and self-hammering mole to measure heat below the surface - will work as planned.

The first pictures from the lander



show just a few rocks in the vicinity, more good news since touching down right near a rocky area would have made deployment of the solar arrays and instruments tricky. Better images are expected in the coming days once InSight sheds the dust covers on its two cameras.

"We are looking forward to higher-definition pictures to confirm this preliminary assessment," said Bruce Banerdt, principal investigator of InSight at Nasa.

Dawn/ann