

Reaping the wind

THE NEGATIVES ASSOCIATED WITH DERIVING POWER FROM THIS SOURCE ARE USUALLY THE COST, THE NOISE FROM THE GENERATORS, THE FAST MOVING ARMS AND DANGERS TO BIRDS, WRITES **S ANANTHANARAYAN**. BUT THE OVERPOWERING BENEFITS OF CLEAN ENERGY AND A SAFE ENVIRONMENT ARE OVERPOWERING FACTORS

The windmill arm is an airplane wing that is fixed upright and this is the principle behind the industry of harnessing wind power, which now forms just 1.6 per cent of generation in India but is fast progressing. Denmark is the world leader in wind power and its share is over 30 per cent, with the target for 100 per cent by 2050.

Coming back to the airplane wing, it is its shape or profile that reacts with the stream of air to create an upward force, on each

wing, which lifts the load in between. This same force that arises when air moves over a curved surface acts similarly on the vanes of the windmill when the wind blows, turning them round in a vertical circle. The traditional windmills of Holland thus predate the invention of the airplane in making use of aerodynamics. And in the current concern to reduce the use of fossil fuels and pollution, wind power has become a compelling alternative. Denmark moved rapidly after the oil crisis of 1973 and developed expertise in building and installing wind-driven electric generators, both in the country and as an exporter.

The modern application of wind energy is no longer a machine to drive a grain mill but to drive the rotor of an electric dynamo, and the arrangement is called a wind turbine. The vanes are no longer made of wood and canvas but are giant structures of fiberglass-reinforced plastic, with struts and supports of sophisticated composite materials. And the arrangement has to bear a huge load, with the transmission and generator that work for weeks and months without a break. Denmark, in fact, had a head start in wind turbine research as it had got into the field as early as 1897, through the pioneering work of Poul la Cour.

In the same way as the airplane wing has been specialised for different loads and wind speeds, the vanes of the wind turbine are also specially designed, based on dimensions and wind conditions. As the outer ends of the vanes move faster than the inner part, the profile, which can be as much as 82 metres long, needs to be optimised along the length to present the best surface to the wind at each point and get the best conversion of energy. And the material and construction of the vanes needs to be good enough at all places and the connection to the central hub needs to be designed to stand a huge load.



Windmill pioneer Poul la Cour (1846-1908) and his wife Christine.



Poha Hummedshoj

Poha Hummedshoj of the Danish Technical University at Osterlid, just outside Copenhagen, during a presentation to journalists at the Euroscience Conference, said the force at the central hub was like that of a motor car pressing down through a lever that was seven kilometres long.

The research facility, which is housed near a now unused nuclear plant that had been set up under the legendary Niels Bohr, has separate departments that study the whole spectrum of the science of wind turbines — from material, structural design as well as support, mechanical transmission to the electric generator — using laser and Doppler-based study of air dynamics to best design the placement of turbines in a farm

and sophisticated micro and macro material science to arrive at the most suitable materials.

What wind turbines need to function is just the engineering and a reasonably continuous stream of air, at least four-five metres per second and not more than 25-30 metres. Most coastal areas and hilltops have an ample wind supply and are good places to set up several wind turbines, to act together as a wind farm. The usual wind turbines have been smaller and rated at 225 kilowatts, of which one would need four for a megawatt. But the present wind turbines have a span of 164 metres and a capacity of seven megawatts. A farm of these giants, each one larger than a football field, can generate power in the thousands of megawatts, larger than a nuclear plant. A farm known as the *East Anglia Array* is planned for 7,200 MW, using 1,028 of the 164-metre turbines. And wind turbines do it all without mining and transporting coal or causing any CO and CO₂ pollution, and without the need to dispose of ash or nuclear waste.

India now has wind turbines in many states and the capacity installed is approaching 20,000 MW, which is 8.5 per cent of the total, although the actual generation is only 1.6 per cent. This is far below the capacity installed in other countries, but India still ranks as the fifth worldwide. And the Union ministry of new and renewable energy has assessed the potential of wind resources at more than 100,000 MW.

The negatives associated with wind power are usually the cost, the noise from the generators and the fast moving arms — and dangers to birds. There are technical solutions to the noise from generators and locating the turbines far from cities could save people from the “whoosh” of the arms. There is also the trend now to locate farms out at the sea, as offshore facilities, either on steel and concrete stilts or even on floating platforms. These, of course, have higher costs for installation, maintenance and transmission of electricity.

As for the cost, the investment is generally being made by the state electricity authorities, with a growing market of private investment, mostly by pension funds, etc. “Inviting people in an area to invest in the wind farms that serve them would also help reduce resistance, as this would give the users the comfort of ownership,” said Poha. As for the danger to birds, he said there had been a number of studies and the risk from wind turbines was found to be not more than the usual dangers that the avian community faced. “But some birds, like the eagle, seem to get enraged and fly straight into the wind turbine,” he said.

The danger to some migratory birds does seem to be well founded, in many places, and would benefit from more study and effort to find a solution, but the overpowering benefits of clean power and saving the environment from pollution is a competing reason, and the number of wind turbines the world over is continuously rising.

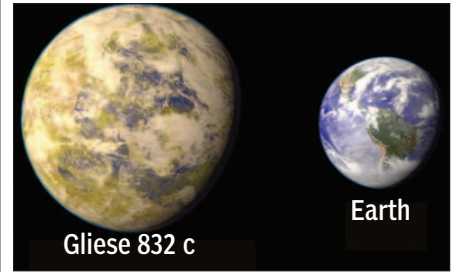
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PLUS POINTS

Most earth-like

Astronomers have discovered an alien planet that could offer some of the most earth-like conditions seen to date in the galaxy. Located just 16 light years away from our planet, Gliese 832c is a super-earth with a mass 5.4 times that of our own planet orbiting a red dwarf star every 36 days. This orbit means that Gliese 832c is much closer to its host star than we are to ours, but because its red dwarf star has only half the mass of our sun the planet receives around the same amount of stellar energy as we do.

This puts Gliese 832c in the habitable or “Goldilocks zone” in its solar system



This artist's illustration compares the size of potentially habitable exoplanet Gliese 832c to that of earth.

— a sweet spot where it is neither too hot nor too cold for liquid water to exist upon the planet's surface.

“With an outer giant planet and an interior potentially rocky planet, this planetary system can be thought of as a miniature version of our Solar System,” said Professor Chris Tinney of the University of New South Wales where the super-earth was discovered. “If the planet has a similar atmosphere to earth it may be possible for life to survive, although seasonal shifts would be extreme.”

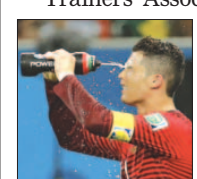
Gliese 832c is one of the most Earth-like planets yet discovered as ranked by the Earth Similarity Index. This measure incorporates a number of factors including surface temperature and planet density to rank extrasolar planets in a scale from 0 to 1. Gliese 832c was ranked 0.81 on the Index while the most earth-like planet yet confirmed (Gliese 581g) ranks at 0.89.

Unfortunately, this doesn't mean it's a given that Gliese 832c is similar to earth on the surface, as the large mass of the planet means that it probably has a thicker atmosphere than ours that has led to a runaway greenhouse effect and boiling temperatures. However, for astronomers the most exciting aspect of Gliese 832c is its relative proximity — 16 light years away in a galaxy that is 100,000 light years wide.

JAMES VINCENT/THE INDEPENDENT

Heat stroke tips

The first-ever World Cup water break (taken during the game between Portugal and the USA last week) served as a reminder that we all need to take extra precautions when playing in the heat. Sports-related heat injuries and deaths continue to rise nationally, according to estimates by the National Athletic Trainers' Association, the Centres for



Portugal's Cristiano Ronaldo takes a water break during a World Cup soccer match against the USA in Manaus, Brazil, on 22 June.

Disease Control and Prevention, which cites heat stroke as the leading cause of death and disability among high school students. But those deaths are preventable, both groups agree, if the right precautions are taken.

The athletic trainers' group announced updated guidelines that detailed exactly what

needed to change and the emphasis was on the importance of hydration, heat acclimatisation and body cooling.

And though the guidelines were written with athletes in mind, they could be applied by anyone who hoped to stay active during the summer months, the trainers said. “The biggest change is the concept of cool first, transport second,” said Douglas Casa of the University of Connecticut's Korey Stringer Institute.

The research institute was named for the former Minnesota Vikings player who died of heat stroke in 2001. Heat stroke strikes when a mixture of physical exertion and weather causes body temperatures to soar to 104° Fahrenheit or higher. Casa said that once body temperatures reached these extremes, irreversible cell damage could set in if the temperature wasn't brought down fast — within a 30-minute window.

This crucial interval could easily be eaten up by the time it took to call an ambulance and transport a patient to hospital. So the new guidelines say forget the ambulance and concentrate on cooling down the victim — a cold water bath works best.

The guidelines also said easing into a new sport during the summer months — to give the body time to adjust to the unfamiliar physical demands — could help prevent the condition. “Almost all heat stroke deaths happen within the first three to four days that people are out doing something new,” Casa said, and urged athletes not to lose sight of their overall health when training in hot weather. Dehydration, sleep deprivation and sickness could all force the body to work harder during exercise, increasing the chances that its internal temperature regulation would fail.

“Heat stroke occurs among young, healthy individuals who push themselves beyond the point of stopping because of peer pressure or organizational requirements,” said a professor of physiology at the University of Connecticut.

QUESTION OF RATIONALE

TAPAN KUMAR MAITRA LISTS SCREENING TECHNIQUES FOR EARLY DETECTION THAT PREVENT MANY CANCER DEATHS

When cancer is detected before it has spread, cure rates tend to be very high, even for cancers that would otherwise have a poor prognosis. Therefore, a great need exists for screening techniques that can routinely detect cancers at an early stage. One of the most successful screening procedures is the *Pap smear*, a technique for early detection of cervical cancer that was developed in the early 1930s by George Papanicolaou (for whom it is named).

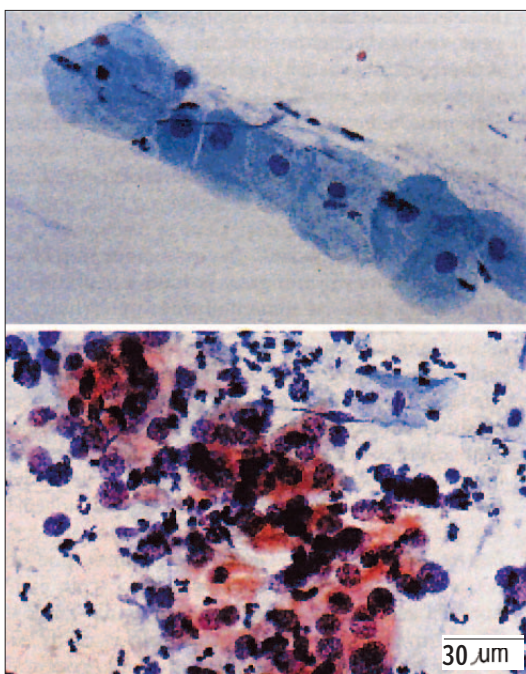
The rationale underlying this procedure is that the microscopic appearance of cancer cells is so distinctive that it is possible to detect the likely presence of the disease by simply examining a few isolated cells. A Pap smear is performed by taking a tiny sample of a woman's vaginal secretions and examining it with a microscope. If the cells in the fluid exhibit unusual features, such as large irregular nuclei or prominent variations in cell size and shape, it is a sign that cancer may be present and further tests need to be done. Because a Pap smear allows cervical cancer to be detected in its early stages before metastasis has occurred, this procedure has prevented hundreds of thousands of deaths.

The success of the Pap smear has led to the development of screening techniques for other cancers. For example, mammography utilises a special X-ray technique to look for early signs of breast cancer, and colonoscopy uses a slender fiber-optic instrument to examine the colon for early signs of colon cancer. The ideal screening test would allow doctors to detect cancers anywhere in the body with one simple procedure, such as a blood test.

Prostate cancer is an example of a disease that can sometimes be detected this way. Men over the age of 50 are often advised to get a *PSA test*, which measures how much Prostate-Specific Antigen is present in the bloodstream. PSA, which is a protein produced by cells of the prostate gland, normally appears in only tiny concentrations in the blood. If a PSA test reveals a high concentration of this protein, it indicates the existence of a prostate problem and further tests are performed to determine whether or not cancer is actually present.

Other cancers also release small amounts of specific proteins into the bloodstream, where their presence might be used to signal the existence of early disease. To investigate such tiny changes in blood proteins, scientists are experimenting with a general approach called *proteomic analysis* to analyse proteins present in the blood. The term “proteome” refers to the complete set of proteins produced by an organism's genome.

The key to most proteomic techniques is mass spectrometry, a high-speed, extremely sensitive method for identifying proteins based on differences in mass and electrical charge. Because a blood sample contains thousands of different proteins, the data generated by proteomic analysis can be extremely complex. To deal with this problem, artificial intelligence software programmes are used to compare the complex protein patterns seen in blood samples from individuals with or without cancer.



Normal and Abnormal Pap Smears. (Top) In a normal Pap smear, the cells are relatively uniform in size and contain small spherical nuclei. (Bottom) In this abnormal Pap smear, marked variations in cell size and shape are evident, and the nuclei are larger relative to the size of the cells. The abnormalities exhibited by these isolated cells suggest that they may be derived from a cervical cancer, and further examination of the uterus is therefore required.

One of the first cancers to be investigated in this way was ovarian cancer. When this disease is detected before it spreads, the five-year survival rate exceeds 95 per cent. However, early disease has few symptoms and relatively few cases are detected early, so less than 50 per cent of women with the disease survive more than five years. Obviously, better detection techniques are needed. Using proteomic analysis, scientists recently identified a pattern of five proteins in the blood of women with ovarian cancer that is not seen in the blood of other women. Initial studies indicated that the test had a specificity of about 95 per cent, which means that 95 out of 100 women exhibiting the abnormal pattern of five proteins will have ovarian cancer. Subsequent reports suggest that it may be possible to improve the sensitivity of the test even further.

Proteomic screening tests are also under development for a number of other common cancers. Although such approaches are still in their infancy and numerous obstacles remain to be overcome, it is hoped that many cancers will eventually be detected in their early stages using proteomic techniques to identify small changes in blood protein composition.

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Targeting specific toxins

STEVE CONNOR REPORTS ON HOW FUTURE SOLDIERS COULD BE PROTECTED AGAINST GERM WARFARE BY GENETICALLY MODIFIED BLOOD CELLS

Soldiers on future battlefields could be protected against germ warfare agents by having blood transfusions with genetically modified cells that can neutralise deadly biological toxins, scientists have found. Human red blood cells have been genetically engineered to produce protein antibodies and other antibody-based medicines that can be safely delivered to any part of the body, researchers said.

A study has shown that the technique works well when carried out on laboratory mice, and that modified human red blood cells stay circulating in the body for up to four months, giving transfusion patients long-term protection, they said.

Red blood cells normally carry oxygen from the lungs to the living tissues and are the most numerous of all the cells, accounting for about a quarter of the 100 trillion cells of the human body. They are deliberately small and flexible to allow them to flow through narrow capillaries. They also lack their own chromosomes because the red cell nucleus is lost during development, making any genetic modification inherently safer as they cannot replicate to produce a cancerous tumour and are naturally removed from the bloodstream after four months.

“We wanted to create high-value red cells that do more than simply carry oxygen. Here we've laid out the technology to make mouse and human red blood cells in culture that can express what we want and potentially be used for therapeutic or diagnostic purposes,” said Harvey Lodish of the Whitehead Institute for Biomedical Research in Massachusetts.

The study published in the journal

THE INDEPENDENT



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