Incentives and regulatory loopholes

India may be the fifth largest player in the world in terms of installed wind capacity but there's a lot between the lines that begs attention, writes aritra bhattacharya

In Jaisalmer

THE story of wind energy in India is complex and layered — populated by claims and counter-claims, green promises and red power generation sheets; violations of laws and gaps in regulation have stalked the sector for years. Nevertheless, the installed capacity of wind energy in the country touched 18,551 MW this year, making India the fifth largest player in terms of installed capacity in the world.

A large part of this capacity addition was thanks to incentives provided by the Union ministry of new and renewable energy, chief among these being the 80 per cent Accelerated Depreciation benefit available to all grid-connected wind farms since the 1990s. "It was the main driving force for the wind energy sector in the country," says a source in the ministry who did not wish to disclose his name as he was not authorised to speak to the media.

Benefit under Accelerated Depreciation was dependent on the volume of investment and many large corporations invested in wind energy — not because they were serious about producing green energy but because they wanted to avail of Accelerated Depreciation. "The scheme was largely availed by big profit-making companies who set up projects through balance-sheet financing," says the ministry source.

This had two effects, say sources in the government and research institutions, who spoke on condition of anonymity: first, many projects were set up in areas where the potential for wind power generation was low, thereby producing a deep lag between installed capacity and actual generation figures; and, second, corporate entities often over-stated the amount they invested in wind farms to claim higher depreciation benefits, thereby keeping the prices of wind turbines artificially high.

But not everybody agrees entirely with the second proposition. For instance, K Venkatachalam, chief advisor, Tamil Nadu Spinning Mills Association, says, "For any capital good, no rationality can be provided over the price pattern. It all depends on the supply-demand theory." Yet, when asked whether there was any merit in the claim that big wind energy companies worked in collusion to keep prices turbine high, he said, "To some extent it may be true."

Kanchan Kumar Agarwal, a member of the Renewable Energy Team at the Centre for Science and Environment, notes that wind turbine prices in India don't seem to be falling, whereas globally, prices have dipped considerably over the last few years; a report from the International Renewable Energy Agency also corroborates Agarwal's views. The ministry source, however, says that the fact that prices have remained stagnant in India is an achievement. "Indian prices are low compared to international prices. Prices of cement and steel — the two main raw materials in the manufacture of turbines — have escalated 60-70 per cent in the last few years, but turbine prices have not increased," he notes.

In Sangareni

However, government sources say there may be some merit in the claim of a cartel operating in the wind energy sector. Some people, like a source in Luminous Renewable Energy — one of the smaller players in the industry that focuses on small and medium-sized turbines — are emphatic about the presence of a cartel. The source, who has spent over three decades in the renewable energy sector, says, "There is no doubt that there is a cartel that keeps prices high."

The extremely secretive nature of the operation of the wind energy sector does not help matters. The typical route of investing in wind energy in India has been thus: big suppliers like Suzlon and Vestas would purchase land in parts of the country for a pittance; they would then set up wind turbines with capacities of around one MW and above in the acquired holding and invite large corporations with deep pockets to buy a certain number of wind turbines. The companies who would invest through this route would avail of 80 per cent Accelerated Depreciation on the invested amount, while the supplier would get a handsome price for the deal — a win-win situation for both parties (a number of shady deals were entered into through this route, and will be explored later in the series). Suppliers and corporations would keep the figures involved under wraps and nobody would know the exact cost of wind turbines.

Did the policy environment and modus operandi of the industry favour large suppliers like Suzlon and skew the market in their favour? In response, Tasma's Venkatachalam says, "There is no policy announced by any government with regard to wind farms. Affluent suppliers book the lands in advance and accordingly, by assuring turn key projects, they are able to dominate in the market because of their close nexus with the department/ministries."

The Accelerated Depreciation benefit was withdrawn with effect from 31 March 2012. The ministry source says, "The scheme was supposed to be withdrawn in any case whenever the direct tax regime came into effect. But since that was taking time, and given the fact that only profit-making corporations were being able to avail of the benefit, it was discontinued in March 2012."

Yet, it is unclear how long the government will be able to hold out against the industry on this. The wind power industry in India functions around three key associations: the Indian Wind Energy Association, comprising mainly vendors and investors in the sector; the Indian Wind Power Association, comprising mainly investors; and the Indian Wind Turbine Manufacturers' Association, comprising manufacturers of windmills.

These associations, dominated by the big players in the industry, have immense lobbying power. Sources say that they play a big role in determining government policy. In fact, news reports before the Union Budget highlighted their parleys with the finance ministry to reintroduce depreciation benefit. The extent to which the incentive played a role in pumping in investments into the sector is clear in the figures: while in 2011-12, when Accelerated Depreciation was available, the wind energy sector added 3,196 MW in installed capacity; in 2012-13, after Accelerated Depreciation was discontinued, only 1,282 MW has been added as installed capacity. This difference clearly shows that many corporations invested in wind energy not because they were serious about "green energy" but because of the incentives on offer.

Though the Budget did not reintroduce the depreciation benefit, it decided to restart the Generation-Based Incentive, which was started in December 2009 and continued till the end of the 11th Plan in March 2012. GBI signals a move away from an installation-based discourse to a generation-based discourse, crucial in India given the huge difference in installation and generation figures.

Next week: Between installed capacity and generation figures

The writer in on the staff of *The Statesman*, Kolkata, and this article has been written under the aegis of a CSE Media Fellowship

Central government incentives for promoting wind power projects in the country include:

- Concessional import duty on certain components of wind electric generators.
- Excise duty exemption to manufacturers.
- 10 years' tax holiday on income generated from wind power projects.
- Loans for installing windmills are available from the Indian Renewable Energy Development Agency and other financial institutions.
- Technical support, including wind resource assessment, is provided by the Centre for Wind Energy Technology, Chennai.
- Preferential tariff in potential states; this is the tariff at which respective State Electricity Regulatory Commissions buy power from grid-connected wind farms in the state.

Source: Farooq Abdullah's statement in the Rajya Sabha on 11 March 2013

Tariffs notified by State Electricity Regulatory Commissions for wind energy

State	Buy back rate (Rs/Kwh)
Andhra Pradesh	4.70
Karnataka	3.70
Madhya Pradesh	4.35
Maharashtra	3.78-5.67 (depending upon wind zone)
Rajasthan	5.18 ~ for Jaisalmer area 5.44 ~ for rest of the state
Tamil Nadu	3.51
Gujarat	4.15
Kerala	4.77
Odisha	4.48

Source: Farooq Abdullah's statement in the Rajya Sabha on 18 March 2013

Peeping into the living cell

Another step has been taken to understand the goings-on within, says s ananthanarayan

THE last two centuries have seen great strides in understanding the process of life. It was nearly 200 years after the first glimpse of cells through the microscope, in 1665, that living things were seen to be made up of cells, within which the vital functions of life take place and which arise as copies of other cells. With advances in technology, in molecular biology and genetics, many of the components of cells and their interactions are now largely known.

But there is a long way to go, as the work of a team at the Max Planck Institute for Biology of Ageing, Cologne, with associates from Italy, Sweden, the UK and Korea, have found. In their paper just published in the journal, *Cell Biology*, Mugen Terzioglu, Benedetta Ruzzenente, Julia Harmel, Arnaud Mourier, Elisabeth Jemt, Marcela Davila Lopez, Christian Kukat, James B Stewart, Rolf Wibom, Caroline Meharg, Bianca Habermann, Maria Falkenberg, Claes M Gustafsson, Chan Bae Park and Nils-Goran Larsson have shown by a real life trial that a firm conclusion reached after laboratory tests is not true.

Mugen Terzioglu and Nils-Goran Larsson

Animal and plant cells consist of a membrane envelope that contains compartments that have different functions. The most important is the *nucleus*, which contains the *DNA*, which is the code molecule that spells out the action and functions of the cell. The actions of the cell are actuated by different proteins, each of which brings about a specific action because of its special chemical profile or shape. And it is the DNA which tells the cell what proteins to make and, hence, what actions to carry out.

The DNA molecule is sequence of groups of three chemical units. There are only four of these units and so there can be 4x4x4=64 different groups of three. But many groups are treated as standbys or start and end markers and, finally, the sequence, which can be millions of units long, consists of choices from only 20 different groups. Each group helps synthesise a chemical unit called an *amino acid* and each segment of the DNA chain then specifies a sequence of amino acids, which makes up the protein. And then there is the process by which the cell picks up the information from the DNA and transfers it to cell components that join amino acids and assemble proteins.

The segments of DNA that specify proteins are first copied on to messenger units called *mRNA*, which resemble the bit of DNA that they represent. mRNA carry the information to the next important component of the cell, the *ribosomes*, where proteins are assembled. This assembly uses other DNA-like units called transfer or *tRNA* and ribosomal or *rRNA* to collect and link amino acids to form the protein.

The other important component of the animal cell is the *mitochondrion*. Mitochondria are bodies within the cell that, among other functions, generate the chemical units used for transfer of energy within the cell. For this role, they are called the *powerhouse of the cell*. Cells need huge energy, the pancreas cell to create insulin, or the brain cell to fire an electrical signal to start an action, or a thought, and so on.

This energy is made available by the mitochondria and some cells have thousands of these "energy converters". But mitochondria have other important functions, too, like creating the proteins that help the cell convey and receive signals, to develop the cell as a particular kind of cell, regulating its growth and also its death and, hence, the ageing process. They are also involved in the production of substances like cholesterol and components of haemoglobin in the blood.

The sperm cell, which only needs to move, has only one mitochondrion, while the ovum, which has to grow into the embryo, has thousands. The result, incidentally, is that at fertilisation, the single mitochondrion of the sperm cell is lost and when the fertilised egg multiplies, the mitochondria are all from the mother.

Mitochondria also have their own nucleus and DNA, called *mtDNA*, which is in addition to the DNA within the nucleus of the cell.

The mitochondrion DNA is similar in many ways to the DNA of bacteria and it is thought that mitochondria may have arisen through a capture of a bacterium by the cell, some time in the course of its evolution. The mtDNA is contained in several copies, in the form of a circle, as found in bacteria. The proteins that arise from the code in the mtDNA are for the action of using oxygen and glucose for generating energy transfer units, and also to create some of the RNA of ribosomes, including the 22 tRNA that are required for converting the information from mRNA into protein. How the mtDNA function or any defects in the function, which are associated with a number of diseases and ageing, are thus areas of great interest. One gene in the DNA, and the associated protein, *Mitochondrial transcription termination factor 1* (*MTERF1*), has been identified as an important agent in the process of decoding DNA information on mRNA and the generation of proteins in ribosomes. "MTERF1 has been reported to couple rRNA gene transcription initiation with termination and is therefore thought to be a key regulator of mammalian mitochondrial ribosome biogenesis," say the authors in the abstract of their paper in *Cell Biology*.

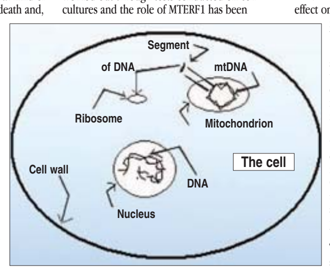
Details of the action of MTERF1 have been worked out through tests conducted on cell cultures and the role of MTERF1 has been considered as known and understood for 20 years. But the team at the Max Planck Institute made an assay of the role of the protein in a living model and arrived at surprising results.

The group

In vivo trial

The mitochondrial DNA is known to have two strands, the heavy (H) and the light (L). The copying of the sequence of the strands has been proposed to be regulated by the MTERF1 protein, strongly promoting a correct copy of segments of the H strand. But studies *in vitro*, or using cell cultures in the lab, have yielded different results and have not answered many questions, perhaps because all real conditions cannot be created outside a living organism.

Post-doc researcher Mugen Terzioglu and colleagues used genetic engineering methods to modify mtDNA in living mice so that the MTERF1 gene was not expressed. "Knocking out" the gene and, hence, the protein should have blocked the strong effect that was attributed to the protein and resulted in mice with several deficiencies. Surprisingly, all functions of the gene-depleted mitochondria were intact and the gene-depleted mice were thriving. Analysis of different organs and cell components of the "knock-out" mice resulted in all parameters, particularly of generation of energy transfer units, being found unaffected. Studies of the action at the places in the mtDNA sequence, where MTERF1 was known to bind, again showed no changes despite there being no MTERF1 proteins. It appears the protein has no effect on the H strand of the DNA, but serves, instead, to block the L strand, which became active in "knock-out" mice.



The cell

The finding will change the way scientists have looked at proteins and their role within cells. In particular, they open a new perspective into the mechanism of translation of DNA information.

"The findings also illustrate the fact that *in vitro* systems like cell culture can only, to a certain extent, represent a natural physiological condition. Consequently, the insights gained *in vitro* must always be verified *in vivo*," says Mügen Terzioglu, lead author of the paper.

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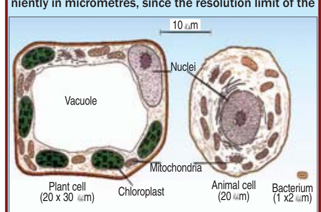
Problem of size

tapan kumar maitra **explains the units of measurement in cell biology**

THE challenge of understanding cellular structure and organisation is complicated by the problem of size. Most cells and their organelles are so small that they cannot be seen by the unaided eye. In addition, the units used to measure them are unfamiliar to many students and, therefore, often difficult to appreciate. The problem can be approached in two ways: by realising that there are really only two units necessary to express the dimensions of most structures of interest to us; and by illustrating a variety of structures that can be appropriately measured with each of these units.

The micrometre (mm) is the most useful unit for expressing the size of cells and larger organelles. A micrometre (sometimes also called a micron) corresponds to one-millionth of a metre (10^{-6}m). In general, bacterial cells are a few micrometres in diameter, and the cells of plants and animals are 10- to 20-fold larger in any single dimension. Organelles such as mitochondria and chloroplasts tend to have diameters or lengths of a few micrometres and are therefore comparable in size to whole bacterial cells. Smaller organelles are usually in the range of 0.2-1.0 mm. As a rule of thumb, if you can see it with a light microscope, you can probably express its dimensions conveniently in micrometres, since the resolution limit of the



light microscope is about 0.20-0.35 mm.

The nanometer (nm), on the other hand, is the unit of choice for molecules and subcellular structures that are too small or too dim to be seen with the light microscope. A nanometer is one-billionth of a metre (10^{-9} m). It takes 1,000 nanometers to equal one micrometre. (An alternative to the term nanometer is therefore millimicron, mm.)

As a benchmark on the nanometer scale, a ribosome has a diameter of about 25-30 nm. Other structures that can be measured conveniently in nanometers are microtubules, microfilaments, membranes and DNA molecules.

Another unit frequently used in cell biology is *die angstrom* (Å) which corresponds to 10^{-10} m or 0.1 nm. Molecular dimensions, in particular, are often expressed in angstroms. However, because the angstrom differs from the nanometer by only a factor it often adds little flexibility to the expression of dimensions at the cellular level and will therefore not be used in this text.

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