Wind Power Development in India. G. M. Pillai (ed.). WISE Publication, Pune. 2006. 411 pp. Price: Rs 900.

This is the first comprehensive book on development of wind power in India. In spite of major wind power potential still remaining untapped, India has achieved the fourth largest wind power generation in the world in a span of less than 20 years: wind contributes almost 2% of total energy generation in the country. Also, one of the Indian manufacturing companies is the largest in Asia and fifth largest in the world. Presently, the focus is on onshore stand alone as well as grid interfaced systems. Rated capacities of wind power machines has increased gradually from 55 to 1250 kW for single machines as of now. Also the capacity utilization factors have increased from 8% in 1991 to 18% in 2006. To underpin the programme, extensive wind mapping of the country has been done. Present threshold annual average wind speeds are 13 kph and wind energy density of 200 w/sq. m at a hub height of 50 m.

There are twenty chapters in the book addressing all the relevant issues such as resource assessment; certification for safety and performance, indigenization efforts, research overviews, problems of integration with the grid requiring latest methods of generation forecasting and load dispatch. Need for effective operation and maintenance and for training and capacity building is emphasized so as to reduce down time of machines. Aspects such as socio-economic benefits, impact of electric tariffs, new streams of funding such as carbon credits and perception of investors and lenders are also covered. Issues of environmental impact along with niche areas for smaller hybrid systems of solar PV and wind are touched upon. The last chapter stresses the need for policy interventions apart from tariff regulation to avoid earlier boom and bust events and to canalize wind power into a steady part of the Integrated Energy Policy.

Jami Hossain's first person account of wind power development (chapter 2) during the last decade makes a thriller story reading and has been written lucidly with candour and passion. It outlines the birth of a new industry and one of the most successful renewable energy programmes on the Indian scene. At medium growth rate of 25%, it estimates wind potential of 32,000 MW by 2016. Initial onsite measurement programme has now been augmented by numerical models for complex terrain micro siting, with good record of success (R. V. Kharul, chapter 3). Certification procedures for India and their relation with international agencies have been brought into focus by M. P. Ramesh (chapter 4) with India-specific features such as lower air densities due to higher operating temperature, monsoon wind conditions, including cyclones and weakness as well as more frequent outages of grid power. Grid-interfaced machines may be requiring up to a week of standby energy storage for induction into the grid because of long and frequent outages.

Indigenization efforts have followed the Space programme model, but with much lesser detailing. Gradual indigenization for manufacture of wind machine parts, such as towers, blades and gear box has been undertaken. Complete autonomy for siting, installation, maintenance and monitoring has been aimed at and almost achieved. However, designs of all these components are still imported and consistency in quality is yet a question mark. Detailed interaction with the Space programme could be of help in ensuring consistent quality and initiating overall turbine research (B. Rathod, chapter 5). J. G. McGowan details international developments and laments that there is hardly any indigenous research (chapter 6). Offshore wind systems for India are still in future, but the world scene is covered by C. N. Elkinton and J. G. McGowan (chapter 7).

Apart from utility scale programme, we also need micro grids (5–50 kW) in low load areas of widely distributed villages. This has been handled by P. Ravindranath (chapter 8), who shows how hybrid systems of solar photovoltaics and wind energy complement each other in view of our wind characteristics and can bring about greater reliability and cost economies in capital as well as running costs as against solar PV systems alone. This option has not been tried in the scale it deserves, e.g. in village electrification programme. According to S. A. Khaparde (chapter 9), grid interfacing of wind components entails 10% of wind generation costs as extra for 30% wind power penetration. He outlines some mechanisms by which wind power induction can improve grid stability such as negative power control and low voltage ride being incorporated into wind machines.

Amongst the renewables, wind power sector was the first one to get private sector investments. Fiscal policies helped the induction but also created boom and bust cycles as economic benefits lowered from 90% to 30% (C. Shah and V. Sharma, chapter 12). Most states now provide wheeling and banking facilities, and price security has encouraged many industries, particularly in the textile sector, to invest in this option for captive use. As pointed out by A. Mathur *et al.* (chapter 13), wind power projects have a great potential for registering as CDM (Clean Development Mechanism) projects. For a wind farm size of 5 MW in Maharashtra, CDM benefits can be as high as Rs 0.17 per kWH generated, but with quite high transaction costs of 20–25% of benefits. The Electricity Act of 2003, providing for establishment of State Electricity Regulatory Commissions, has made it possible to mandate a minimum power percentage (3–10%) to be procured as green power from renewable sources and five states have done so (B. Joshi, chapter 19). Tax credits on the basis of power generated rather than capital costs help in the establishment of independent power producers in wind sector (D. Majumdar, chapter 15).

Location of wind farms in remote areas with poor infrastructure is difficult financially, but helpful in creating direct and indirect employment and also development of facilities for such areas. For example, in India 5.7 direct jobs and 23 indirect jobs per megawatt have been created in 2005–06. Maximum demand is for the operation, and maintenance skills and training facilities need to be created in this regard, which have to be constantly upgraded to match the growing sophistication in technology (R. V. Kharul and M. Reddy, chapter 16). Environmental impact studies of wind farms propose conjunctive land use (as actual machines and roads, etc. take only 2–4%), such as agricultural crops, grazing lands and energy plantations for biodiesel. These make wind farms suitable in terms of land use per megawatt over life cycle use and compatible to conventional sources. Use of forest lands is also permitted with certain restrictions. However, like all energy sources, wind farms do impact the environment (A. Gambhir, chapter 18). However, the fallacies can be corrected by proper studies and communication. Integrated Energy Policy drafted by the Planning Commission has

in the best scenario for renewables, put their contribution at 11% in AD 2032 as against projections of 20–30% by other countries and similar potentials in India according to studies elsewhere (G. M. Pillai, chapter 20). These have to be looked into as any dependence on fossil fuel, even piped natural gas, has security risks and climate change impacts.

The book under review is not only well-documented, but is also been well-produced. This hard bound volume of 411 pages is free from printing errors and is easy to read and maintain. It is a must for all renewable energy students, consultants and for policy planners in the energy field as well as development agencies. It should find a place on the shelves of libraries and documentation centres, as it is a valuable reference work having detailed index.

C. L. GUPTA

Solar Energy Unit,
Sri Aurobindo Ashram,
Puducherry 605 002, India
e-mail: solagni@auroville.org.in

Errata

Occurrence of monazite in the auriferous zones of Gadag gold field, Karnataka

A. G. Ugarkar, T. C. Devaraju, T. T. Alapieti and T. A. A. Halkoaho

[*Curr. Sci.*, 2007, **92**, 1763–1767]

Figure 1 on page 1764 was not printed properly. It is printed now in its enterity. We regret the error.

—Editors

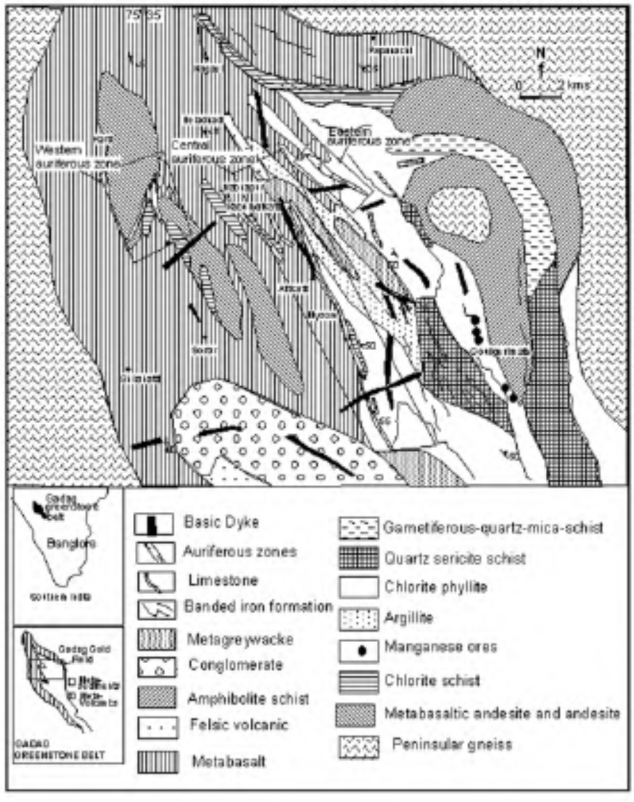

Figure 1. Geological map of Gadag gold field showing the western, central and eastern auriferous zones (modified after Ugarkar[27]).

Evidence for localization of *N*-methyltransferase (MMT) of caffeine biosynthetic pathway in vacuolar surface of *Coffea canephora* endosperm elucidated through localization of GUS reporter gene driven by NMT promoter

Vinod Kumar, K. V. Satyanarayana, A. Ramakrishna, A. Chandrashekar and G. A. Ravishankar

[*Curr. Sci.*, 2007, **93**, 383–386]

The title of the article 'Evidence for localization of *N*-methyltransferase (*MMT*) of caffeine .... NMT promoter' should be read as 'Evidence for localization of *N*-methyltransferase (*NMT*) of caffeine .... NMT promoter'. We regret the error.

—Editors

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