

Article # 28

Contribution of wind power to the Indian electricity generation mix today and in the future 2035

A. Kaupp, December 2005

The Directory of Indian Wind Power 2005 (www.windpowerindia.com) is a very comprehensive and interesting reading for all interested in wind power in India. It shows how an industry despite all odds, grows fast and is competitive. There is no question that it will further grow from 115 MW installed in 1994 to 1870 MW installed in 2003 and 3595 MW installed in 2005. The official gross potential cited by MNES is 45,195 MW assuming 1% of land availability for wind power generation in potential areas. The technical potential is assumed to be 14,775 MW based on 20% grid penetration as of March 2005.

Analyse the published data in detail in terms of GWh contribution, compare it with a reasonable Indian power mix and growth scenario and the following picture will emerge:

1. Based on the more important figure of GWh of electricity generated the sector shows the following plant load factor (PLF) meaning percentage of GWh generated as compared to the ideal "MW * 8760 hours" utilization.

Table 1: PLF of wind power in India (source of data, MNES)

Fiscal year	93/94	94/95	95/96	96/97	97/98	98/99	99/00	00/01	01/02	02/03
Installed capacity MW	114	349.5	731.6	900.7	967.5	1023.4	1166.3	1338.8	1627.2	1868.4
Generation following year, MWh	191,276	496,440	878,376	988,455	1,073,359	1,445,810	1,577,030	1,970,728	2,446,814	2,811,151
PLF	19.1%	16.2%	13.7%	12.5%	12.7%	16.1%	15.4%	16.8%	17.2%	17.2%

This low utilisation is not really surprising because it is technology specific. It is also well in line with the average PLF of 18.2% of all wind power stations in Germany.

2. The Indian 2005 per capita electricity consumption is given as 606.2 kWh by CEA. Assuming that in the year 2005, about 1.078 Billion people live in India, this amounts to 653,628 GWh of electricity consumed. In other words the present contribution of wind power to the national electricity consumption is about 3,595 MW * 0.172 * 8.760 = 5,417 GWh or 0.83%.
3. Let us examine a 2035 scenario where the Indian population reaches a conservative $1.028 * 1.012^{34} = 1.542$ Billion people. Hopefully per capita electricity consumption is then at 2500 kWh similarly to a middle income country. Consequently 3,855,000 GWh of electricity will be consumed. Furthermore, assume that 30,000 MW of wind power are installed and operating at an average plant load factor of 18%. In other words $30,000 * 0.18 * 8760 = 47,304$ GWh is the wind power contribution or 1.2%. The percentage contribution of wind power to the overall electricity consumption in India will therefore remain more or less the same over the next 30 years under best circumstances. The scenario of 30,000 MW wind power will only happen if the presently installed capacity of 3,595 MW will grow by $30,000 / 3,595 = (8.345)^{0.033} = 1.073$ or 7.3% per year. This is roughly in line with the annual growth of electricity consumption in India which has been stated as 7%. Note that if we assume that the Indian electricity consumption grows 7.3% annually over 30 years, the demand reaches a staggering $653,628 * 1.073^{30} = 5,411,558$ GWh resulting in a per capita consumption of 3509 kWh in 2035.

The issue for the next 50 years in the Indian power sector is not how and when India switches to renewable energy. The Indian power sector needs to be color blind. All sources of energy are needed to generate electricity. "Black, blue, green, yellow, red" kWhs are the need of the hour and not a fixation on unrealistic renewable energy contributions to the future power mix. Per capita electricity consumption in the range of 600 kWh to 5000 kWh is a very strong indicator of the degree a country has urbanized, industrialized and mitigated poverty. It is perhaps a better indicator than per capita income. The indicator reflects well to what extent sufficient and income generating rural electrification and therefore electrical appliances, which are a sign of affluence such as radios, TV, refrigerators, fans and air conditioners have reached the low and middle income level households in India.