Low Carbon Green Growth Roadmap for Asia and the Pacific

FACT SHEET

Wind energy

Wind energy explained

Wind energy is the kinetic energy of air in motion.

How it works

Differences in air temperature caused by energy from the sun's rays create air flows, and kinetic energy from this wind can be captured by wind turbines. Wind turbines essentially function like a fan in reverse: blades are propelled by natural wind flow and the energy is consolidated through a series of gears to turn a generator and produce electrical energy. Turbines range widely in physical size and energy production capacity. Smaller turbines can function efficiently at lower wind speeds; however, they cannot produce electricity at the utility-scale. Large wind farms can be located on land or offshore.

Opportunities in Asia and the Pacific

Best wind speeds for utility-scale development in Eastern Asia: The greatest potential for large-scale wind energy development lies along the coast in East Asia including China, Japan, Republic of Korea and Taiwan Province of China, in coastal Oceania and parts of the Pacific.[1] Wind speeds in northern China and Mongolia as well as parts of western China and India are high. But these areas are often far from load centres, unlike the coastal resources.

Offshore wind potential along Eastern seaboard: Some of the best wind speeds are offshore. Unfortunately, offshore installations cost as much as double the onshore wind farms due to the added cost of building foundations and transmission lines in water.[2] Better wind speeds and higher production capabilities of offshore turbines may absorb the cost difference over time.

Trends in development

As of 2010, there were 60.7 GW of installed wind power capacity in Asia and the Pacific.[3] This represents only a small share of the electricity generation mix in most markets – in 2009, wind power accounted for 0.7 percent of total electricity generation across the region.[4]

Asia leading the world in growth: Growth in wind energy development is increasing more steadily in Asia than in any other continent. Installed capacity in Asia grew by more than 50 per cent each year from 2008 to 2010. Indeed, nearly 55 per cent of the worldwide wind capacity installed in 2010 was installed in Asia, elevating the continent to second place for total installed capacity, at 31 per cent.[5] The Global Wind Energy Council projects that Asia will overtake Europe for most installed capacity by 2015, when the continent is projected to have more than 180 GW of installed capacity.[6]

[1] C. L. Archer and M. Z. Jacobsen, "Evaluation of global wind power", *Journal of Geophysical Research* (2005) vol.110, D12110.

[2] Soren Krohn, ed., *The Economics of Wind Energy* (Brussels, European Wind Energy Association, 2009).

[3] Global Wind Energy Council, *Global Wind Report: Annual Market Update 2010* (Brussels, 2011).

[4] Aggregation of 2009 wind energy generation data from International Energy Agency for Asia excluding China, China, and OECD Asia and Oceania. *Statistics and Balances* (Paris, IEA, 2009).Available from www.iea.org/stats/index.asp (accessed 15 February 2012).

[5] World Wind Energy Association, *World Wind Energy Report 2011* (Bonn, 2011).

[6] Global Wind Energy Council, *Global Wind Report: Annual Market Update 2010* (Brussels, 2011).

China leading the way: Growth in Asia is in large part due to extensive wind farm development in China in recent years. At the end of 2010, total (cumulative) installed wind energy capacity in Asia was 61.2 GW, of which 44.7 GW, or 73 per cent, was in China.[7]

Strengths with wind energy

- **Scalability:** There is no technical barrier to build wind power at various scales. Countries can choose the size of wind power according to their needs as well as climatic and geographic contexts.
- **Wider potential for small-scale wind:** Wind energy production at smaller scales (with smaller turbines) has lower required wind speeds and thus more potential across the region.
- **Compatibility with existing grids powered by diesel:** Small-scale production could feed into hybrid mini-grids for rural electrification, with the potential to offset diesel- or biomass-burning generators when the wind is blowing. Feeding local wind energy into the mini-grid not only reduces environmental impact of a rural electrification scheme but also cuts long-term costs and increases reliability by reducing dependence on diesel.[8]

Challenges to using wind energy

- **High upfront planning and capital costs:** Investment costs for feasibility planning, turbine equipment and interconnection remain a large barrier for both large- and small-scale wind developments.
- **Site-specific modelling and assessments needed:** Ecologically sound and economically efficient locations for wind farms require extensive environmental assessments and wind resource modelling, adding to the time and cost of development.
- **Intermittent power generation and seasonal fluctuations:** Electricity production from wind energy is not easily dispatched. Currently available battery storage technologies are not cheap or efficient enough for utility-scale deployment. The variability of generation currently inhibits the amount of wind energy that can be fed into the grid.
- **Land-use decisions:** The best onshore wind resource is often along mountain ridge tops. In Asia and the Pacific, these areas tend to be heavily forested. Some forest would need to be cleared for access roads and construction; but the remaining tree cover surrounding turbines would decrease the wind power plant's efficiency.[9] In some communities, proposed wind power plants have been met with local resistance due to concerns about aesthetic and low-frequency noise issues.

Implementing strategies

Focus on small-scale and mini-grids: Feed-in tariffs, mandatory interconnections for small wind instalments and financial support mechanisms for off-grid and mini-grid-connected wind projects can help promote efficient wind energy development while also expanding rural electrification in a low-carbon way.

Pair wind with other renewable energies: Technological development to couple wind energy production facilities with pumped-storage hydroelectric plants could provide a means of storing intermittent energy production from wind.[10]

[7] World Wind Energy Association, *World Wind Energy Report 2011* (Bonn, 2011).

[8] Alliance for Rural Electrification, *Hybrid Mini-Grids for Rural Electrification* (Brussels, 2011).

[9] True Wind Solutions, LLC, *Wind Energy Resource Atlas of Southeast Asia*, Paper for World Bank Asia Alternative Energy Program (Albany, New York, 2001). Available from http://siteresources.worldbank.org/EXTEAPASTAE/Resources/wind_atlas_complete.pdf (accessed 26 September 2011).

[10] C. Bueno and J.A. Carta, "Wind powered pumped hydro storage systems, a means of increasing the penetration of renewable energy in the Canary Islands", *Renewable and Sustainable Energy Reviews* (2006) 10, pp. 312–340.

Consider a regional super-grid: Regional cooperation and investment in a super-grid of high-voltage direct current (HVDC) cables can help integrate more wind energy into the electricity market. Seasonal fluctuations can be minimized by connecting wind power plants in both the northern and southern hemisphere into a regional super-grid.[11] Installation of a super-grid with new HVDC cables would also minimize transmission losses.

Create interconnection requirements: Requiring grid operators to off-take electricity produced by wind power and standardizing the requirements (technical and financial) for interconnection to the grid are important regulatory moves to create incentives.

[11] Mikiyasua Nakayama, "Transboundary super grid as a long-term solution for energy security and general security", Powerpoint Presentation at the USJI Seminar on the Great East Japan Earthquake: Lessons for Japan's Energy Policy, Infrastructure Development, and Media Coverage, Washington D.C., 21 July 2011. Available from www.us-jpri.org/en/reports/seminar/nakayama20110721.pdf (accessed 18 November 2011).