BUSINESS
RECORDER

Sunday 25 November 2018, 16 Rabi-ul-Awwal 1440

The power of wind

Khalid Faizi

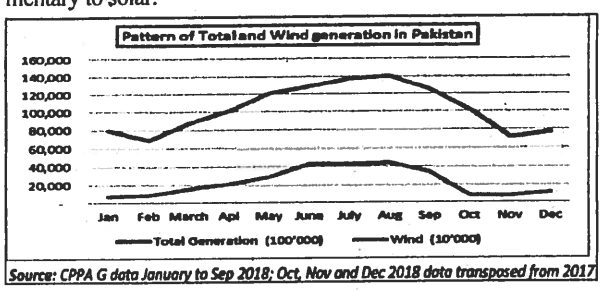
Pakistan's renewable energy portfolio (excluding hydropower) comprises 22 wind projects of 1,185MW, six solar projects of 388MW and four bagasse projects of 138MW totalling 1,711MW some 5.6% of the Country's total dependable capacity of 30,590MW; if 8,239MW of Wapda/IPPs hydropower capacity are added total renewables are 33% of total capacity https://www.nepra.org.pk/Admission%20Notices/2018/Nov/FPA%20Data%20for%20the%20month%20of%20October%202018.pdf.

The achievement to date is very credible as developing new power generation technologies, without much past experience of cost and performance is commendable; but now that we have a grip, the pace must be increased manifold to get maximum advantage from falling renewables costs to avoid expensive thermal generation, which is crippling Pakistan's power sector and putting an immense burden on foreign exchange reserves.

We are now in a period when clean, pollution free wind and solar generation is below USC 5 per kWh which is less than the cheapest gas or thermal generation. It must be remembered that traditionally, thermal generation is shown at monetary cost without imputing the real and significant environmental cost; if this cost was considered, it would increase the thermal cost significantly and further increase the benefit enjoyed by renewables over thermal generation. The development of renewables, including hydropower, is essential as it saves scarce foreign exchange, reduces dependence on imported fossil fuels and provides critical energy security.

Pakistan should generate as much wind, solar and hydropower as possible, to replace the highest cost thermal generation first, and reduce the basket price of electricity. Granted that hydropower is currently around 7-8 USC per kWh but we should accept that it can never, nor is it intended to, compete with wind and solar. Wind and Solar technology comprise 90-95% electrical/mechanical plant while hydropower has 80-85% civil works. As solar and wind demand has exploded worldwide the cost of manufacturing electrical/mechanical works has plummeted exponentially reducing wind/solar generation cost but the highly site specific, hydropower civil works is not subject to the same cost dynamics. However, notwithstanding this, the long-term lifecycle cost of hydropower is still the lowest due to a long life of 100 years compared with wind and solar which requires plant replacement every 25 years. Further, wind and solar cannot offer the ancillary services such as frequency control, spinning and operating reserves that hydropower can prqvide. Wind and solar generation are expected to increase volatility and uncertainty in the electric grid, and hydropower when added to the mix, has the potential to help manage these variable resources.

Solar generation is fairly constant throughout the year but peaks daily at the time of maximum demand; Wind on the other hand, peaks in the months of June, July and August which is the period of maximum annual demand, making it an excellent fit in the Country's generation and demand profile and complementary to solar.



Source: CPPA G data January to Sep 2018; Oct, Nov and Dec 2018 data transposed from 2017

Wind power is a function of (a) wind speed (varying with mast height); (b) rotor diameter (surface area of blades in contact with the wind) and; (c) turbine placement optimization. As land is finite and limited it is essential that the maximum potential is extracted through proper optimized wind turbine design, mast heights and blade surface area. If this is not done, there is a danger that we will not be able to extract the full potential from this gifted natural resource. It is essential for Government to spend well directed money on R&D to model and simulate and test different scenarios up to 150 meters height, with different rotor sizes so that an optimized design and standard emerges to exploit the full potential.

By the end of 2018, wind installed capacity worldwide is expected to be around 600,000MW while solar is projected to be 518,000MW; however, by 2020 solar is expected to match or exceed the wind installed capacity http://www.fi-powerweb.com/Renewable-Energy.html and thereafter solar will exceed wind for the foreseeable future.

India has installed wind capacity of some 34,000MW (5.7% of world) in contrast with Pakistan has around 1,200MW (one fifth of 1% of world). India's target is 60,000MW by 2022. https://www.indianwindpower.com/wind-energy-in-india.php#tab3. Pakistan must target a capacity of at least 3,000MW by 2022, which means we need to add additional 1,800MW over the next four years, i.e., some 450MW each year which is fully achievable, if we get our act together. Thereafter, the target should be to have a capacity of at least 10,000MW by 2030 requiring an addition of some 875MW per year over eight years. Adding some 8,800MW of new capacity with a plant factor of 50% this would give around 40 billion kWh of wind energy each year as shown below:

Variable	New Wind	Existing Wind	Total in 2030
Capacity (MW)	8,800	1,200	10,000
Plant factor	50%	30%	
Generation (GWh)	38,544	3,154	41,698

This generation of 40 billion kWh in 2030 would amount to some 20% of the projected 200 billion kWh potential demand in 2030. If solar is located on the same land it would be possible to harness an additional 15,000 MW of solar PV giving an output of additional 25 billion kWh

>P 9 Col 1

The power of wind

> from page 10

per annum. This would be very beneficial for Pakistan.

The technology for wind power generation is also undergoing rapid change; masts are going higher as it has been shown that higher capacities can be achieved at higher altitudes The wind potential ranges in India ranges from 49,130MW at 50 meters, 102,788MW at 80 meters to 302,000MW at 100 meters. http://niwe.res.in/department wra 100m%20agl.php "The fresh estimates are six-times the wind energy potential determined at a 50 meter hub height, and three-times the potential estimated at a hub height of 80 metres" https://cleantechnica.com/2015/09/07/indias-wind-energy-potential-upgraded-302-gw . The ratio of otor diameter (blade surface area) to mast height is also important as the energy generation is proportional to the surface area of blade contact with the wind flow. Annual energy production is more strongly correlated to increased rotor diameter than increased mast height by a margin of more than 1:4. Thus, mast height as a ratio of rotor diameter is expected to approach 0.5 to maximise wind potential. All these initiatives will mean plant factors approaching 50% https://deantechnica.com/2012/07/27/wind-turbme-net- capacity-factor-50-the-new-normal/ and rapidly falling levelized cost of energy.

https://scholarworks.uark.edu/cgi/viewcontent.cgi?referer=https://www.google.co.uk/&httpsredir=1&article=1070&context=meeguht

Wind Resource Assessment (WRA) is the most important aspect of wind power development. The evaluation and estimation of the wind potential depends to a great degree on the abovementioned technical factors. Pakistan's wind potential measured at 50 meters shows gross potential of 43,871MW with exploitable potential of about 11,000MW. http://www.pmd.gov.pk/wind/wind project files/Page767.html. AEDB has estimated a potential of "more than 50,000MW http://energyupdate.com.pk/download/aqeel-jafri-wind-energy.pdf. International Renewable Energy Agency (IRENA) also mentions a theoretical wind power potential of 50,000MW in Sindh and Balochistan. http://www.irena.org/events/2018/Apr/Renewables-Readiness-Assessment-Pakistan-Report. But it is acknowledged by the United States Department of Energy and National Renewable Energy Laboratory (NREL) that Pakistan has an approximately 346,000 MW potential at 50 meters height which was reassessed at 500,000 MW in 2016 https://www.mdpi.com/2071-1050/9/9/1611/htm . This is onshore potential and excludes significant offshore capacity. Such a potential can be achieved through dedicated wind farms and also encouraging farmers to install wind turbines on their land by only utilizing 2% of the land area with no adverse impact on farming activity but providing an additional revenue stream for the farmers. This is a model used in Germany. The wind capacity in Pakistan is grossly underestimated and requires a fresh look with new technical standards, current projections and new wind maps; the reassessed full potential could easily reach or exceed 1,000,000MW.

Hybrid generation is also need of the day as the hundreds of acres of land allotted for wind can generate significant quantities of solar generation. It has been seen that modern 300 W current technology solar PV panels can accommodate 1MW on four acres. Thus 300 acres allotted for a 50MW wind project can accommodate 75MW of solar on the same land. Such planning will ensure optimal utilization of the land for power production and would be the most appropriate combination as solar and wind complement each other with peak operating times for each occurring at a different- times of the day and year. The combination would have less volatility and better utility for the grid. Captive hybrid desalination should also be studied on Pakistan's long water deficient coastline as the intermittency of wind can be smoothened out through water production which can be produced and stored whenever the wind blows.

If, as proposed the implementation of wind generation goes into thousands of MW over the next decades then it would make sense to go for indigenous manufacture of turbines, blades and masts; small steps can be immediately taken to master the science, technology and develop a knowledge base.

India states that it wants to become a global manufacturing hub for wind turbines, just as China is for solar panels today. An Indian market potential for some 40,000 to 50,000 MW is anticipated over the next five years. They want to set up a supply chain vibrant enough to cater to a 10,000 MW per-year market which can also easily export. https://www.thehindubusinessline.com/companies/in-turbine-manufacturing-wind-blowing-the-india-way/article9681051.ece. Suzlon, an Indian company, has built almost one-third of India's installed wind capacity and it is the second largest operations and maintenance company with over 8,000 turbines in the Indian power sector. The Company, founded in 1995, really took off domestically and internationally after it acquired the German wind turbine manufacturer, REPower. Pakistan shares the same wind potential with the added advantage that we get it first and can harness the potential before it reaches India!

Adding wind and solar is the only route to cheaper electricity and a lower basket price of electricity; and is the strategy being adopted worldwide. The private sector would be capable of attracting investment and adding the capacity, but the public sector would need to invest to ascertain the Country's actual potential and in updating and expanding the T&D system to ensure that it is ready to receive renewables and deliver the electricity to the consumer; major reforms in T&D are required to reduce losses but these are not decision determinants for the proposed addition of renewable capacity. The private sector will build the capacity while the Government will deliver to the end user- a perfect public/private initiative. We need a clear vision, determination and hard work to achieve this goal; can we do it?

(The writer can be contacted on khalid.faizi@hotmail.com)