Task 25 Fact Sheet

STORAGE NEEDS AND WIND POWER

Wind power will increase balancing needs in the power system. Today system operators balance by adjusting output levels of some of the power plants. In the future, storage options can also help with the balancing task; however, their use will depend on whether or not they are cost effective compared with other options.

What are the benefits of storage?

Storage provides a flexible element in the balancing task of power sys- tem operation. Storage can act as either generation or demand, helping with the task of maintaining the balance between demand and genera- tion at different time scales. Storage also has value in power systems without wind. About 100 GW of pumped hydro storage has already been built worldwide.

Example of using storage is given in Figure 1 (in blue).

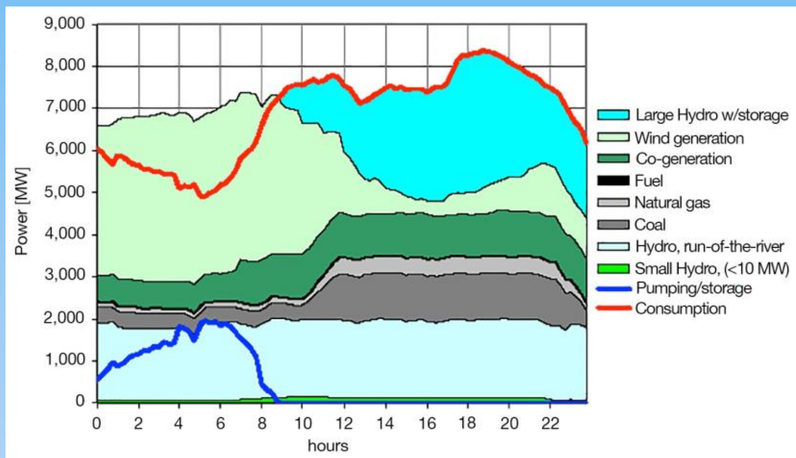

Figure 1. Example of pumped hydro usage in Portugal, during one night of high wind generation and low load (Source Estanquero et al. 2012).

Why is storage not used more in power systems?

The benefit of storage must be weighed against its cost. Building storage means investing to something that does not generate new energy, but actually wastes part of the energy when storing it. This is why generators that change their output levels as needed will usually provide flexibility more cost efficiently. Storing fuels, or water in reservoirs, is the most cost effective form of storage today. Thermal storage is also more cost effective than electrical storage. Storage technologies are still developing and costs are decreasing. Storages may have several revenue streams, from electricity markets (storing energy for hours or days) to grid support markets (providing quick responses to manage the frequency).

Is storage needed in power systems with wind power?

The fact that “the wind doesn’t always blow” is often used to suggest the need for dedicated energy storage to handle fluctuations in wind power. Dedicated energy storage to handle fluctuations ignores the realities of both grid operation and the performance of a large, spatially diverse wind-generation resource. Because power systems are balanced at the system level, no dedicated back-up with storage is needed for any single technology.

Storage is most economic when operated to maximize the economic benefit to an entire system. So far there has been more challenge in power system operation when “wind blows too much at low demand” than “no wind at high demand”.

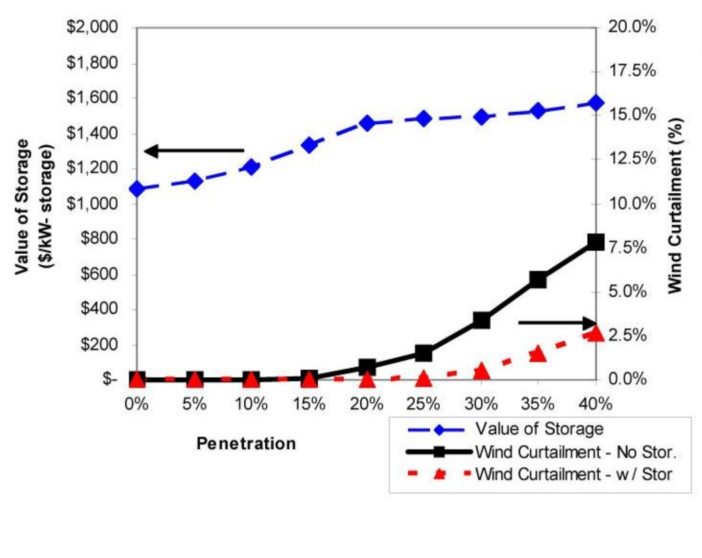

Figure 2. Value of storage will increase when share of wind increases. At higher shares of wind power, storage capacity will also reduce curtailments needed for wind power in situations where wind is high and demand is low. (Source: LBNL, US)

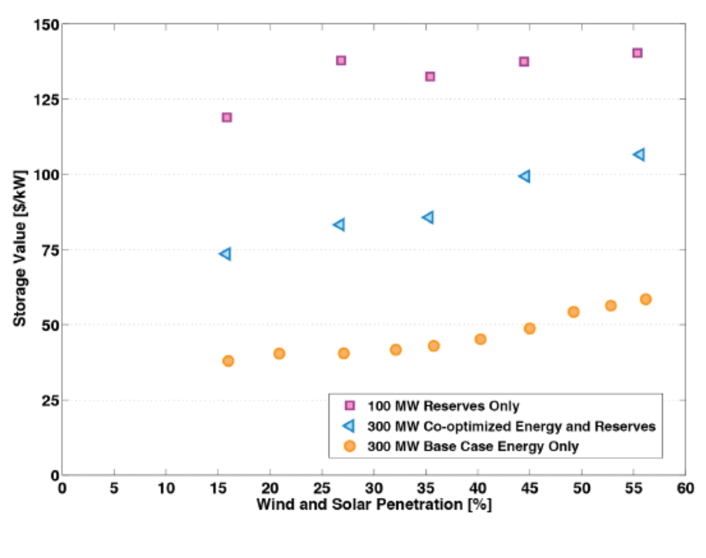

Figure 3. Example from western United States on cost effectiveness of storage – using storage for Reserves Only would be more cost effective than using it for energy and reduction of curtailed renewable energy. (Source Denholm et al, 2013)

There is already experience of surplus energy that is curtailed (wasted) in times of low demand. New storage could reduce curtailed energy (Figure 2) and can also have value in grid support (Figure3). Additional wind could increase the value of energy storage in the grid as a whole.

How much storage is needed in the future is a competition among more flexible generators and demand side options. Demand side can consume more when surplus of electricity is available and less when there is scarcity of electricity.

Also transmission lines can enable larger areas to be balanced (surplus energy may not occur simultaneously with neighbouring areas). Research work suggests that the share of wind needs to be more than 50 % of yearly demand before storage options become cost efficient – unless there is no possibility to use transmission with neighbouring areas. For solar PV storage is an enabler in lower shares than for wind (IEA, 2014).

Associated publications

Easac (2017) Valuing dedicated storage in electricity grids. Available at www.easac.eu

Milligan, M.; Porter, K.; DeMeo, E.; Denholm, P.; Holttinen, Hannele; Kirby, B.; Miller, N.; Mills, A.; O'Malley, M.; Schuerger, M.; Soder, L. (2009). **Wind power myths debunked**. IEEE Power & Energy Magazine, vol. 7, 6, ss. 89 – 99

Denholm P. et al (2013) **Impact of Wind and Solar on the Value of Energy Storage**. NREL report available at http://www.nrel. gov/docs/fy14osti/60568.pdf

Nyamdash, B., Denny, E., O'Malley, M.J. (2010) **The viability of balancing wind power with large scale energy storage**. Energy Policy, Vol 38 pp 7200-7208

Estanqueiro, A.I. (2012). Wind Integration in Portugal. In: Wind Power in Power Systems. Chapter 25. T. Ackermann (Ed.). 2nd Edition. John Wiley and Sons, Chichester . pp 569-593.

International Energy Agency (2014) **The power of transformation: Wind, Sun and the Economics of Flexible Power Systems**. IEA, Paris, ISBN PRINT 978-92-64-20802-5 / WEB 978-92-64-20803-2

More information

This Fact Sheet draws from the work of IEA Wind Task 25, a research collaboration among 18 countries. The vision is to provide information to facilitate the highest economically feasible wind energy share within electricity power systems worldwide. IEA Wind Task 25 works on analysing and further developing the methodology to assess the impact of wind power on power systems.

See our website at
https://community.ieawind.org/task25

See also other fact sheets

Wind Integration Issues Fact Sheet
Capacity Value of Wind Power Fact Sheet
Balancing Power Systems with Wind Power Fact Sheet
Variability and Predictability of Large-Scale Wind Power Fact Sheet