Impact of high RE addition on thermal plants

By M Rajagopalan

When a substantial amount of renewable energy (RE) based installation is being planned, a pertinent question to ask is: "What capacity (MW) of conventional power plants will the additional RE installation help avoid investments in or, perhaps even, help in retiring some of the existing coal MW?

To explain, Tamil Nadu has an installed capacity of over 8000 MW of wind turbines. What is the capacity credit or comfort that this installed capacity offers? Investments in how many MW of coal plant capacity could be avoided? The honest answer is: "Zero MW". That's because there are many 15-minute time blocks in the year in which wind doesn't blow at all. Despatchable capacity from conventional plants such as coal must not only be available in the form of installed capacity, but must be kept running ("spinning"), to back up the shortfall.

There are many who offer a comforting explanation that wider geographic distribution of RE and improved transmission through green corridor, etc. will smoothen out the variability of RE, taking advantage of varying demands in different parts of the country. This is not backed by any evidence, as models show that peak demand across different regions tend to overlap and excess RE is rarely available. Other solutions such as "Energy storage" etc, are yet to pass the tests of scalability and affordability.

So, if India is planning an RE addition of 175 GW, it practically means that an equivalent capacity of despatchable generation must be kept available in hot readiness. Solar PV will not contribute a single MW during night time when the demand peaks, and coal plants must be kept running on low load during daytime to allow absorption of solar generation and to be ready for evening ramp-up.

So, in a situation where 200 GW of RE capacity and 230 GW of thermal capacity together need to meet a peak demand of 180 GW, (and an average demand of 150 GW), and if it is mandated that entire RE generation must be absorbed preferentially, the only way to do this is by cycling down coal plants to a low PLF- sometimes even bringing the load down to a technical minimum. If technical minimum is reached, the grid operator will have no option but to curtail RE.

So, the option available is to run coal plants at low PLF with consequences of a) Higher fuel consumption per kWH, due to lower efficiency, and higher CO2 emission per kWh b) Higher fixed cost per kWh due to poorer amortisation and c) Higher maintenance costs due to frequent cycling of the plants and using liquid fuel at low loads. It can be shown that when a coal plant operates at 55% load instead of normative 85%, the add-on costs can be nearly Rs 1/kWh on account of these three factors. The other option is to curtail RE generation, defeating the purpose of adding them in the first place. This is exactly what's happening in China, where 21% of wind generation was curtailed last year, to protect thermal plants.

A way out of the situation is to introduce suitable, anytime-despatchable solutions that need not be kept spinning, but which can, nevertheless, come online in quick time to restore power lost due to RE shortfall. Hydro plants must be promoted in states where resources exist. In the US, markets in California and Texas are witnessing adoption of IC-engine technology that have the flexibility to start and ramp-up to full load in 2-5 minutes if wind fails and to withdraw instantly when wind comes back. Modular design of these plants also enable despatches in smaller chunks at best efficiency.

India should make a course-correction in its capacity addition, so as to have a proper, efficient and flexible grid with the right mix. At least 20% of planned coal-plants addition can be replaced with flexible generation.

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