DISCUSSION NOTE | NOVEMBER 2017 | 112017

Renewable Energy Forecasting in India – Not a simple case of 'more is better'

RAHUL TONGIA

BROOKINGS INDIA

QUALITY. INDEPENDENCE. IMPACT.

DISCUSSION NOTE

BROKINGS INDIA NOVEMBER 2017 | 112017

Renewable Energy Forecasting in India – Not a simple case of 'more is better'

RAHUL TONGIA

Growing Renewable Energy (RE) means a greater increase in variability of supply, a relatively newer phenomenon for grids where demand was the usual variable, and supply was tightly controlled, or 'despatchable'. One cannot control the wind or sun, but one at least needs to predict it well, so that the rest of the grid can plan its output accordingly. This is one of several key aspects of making RE grid integration cheaper and more scalable. Otherwise, as RE penetration grows, its challenges for the rest of the grid will increase.

History of RE forecasting in India

India has had a number of attempts for mandating output forecasting by RE sources – these were expectably resisted. Even despite Central Electricity Regulation Commission (CERC) draft notifications or frameworks as far back as 2015, no penalties were put in place for deviations beyond the 30 per cent norm post enactment. The dominant view was to first get predictions and data, and then worry about penalties later.

Let's leave aside whether the norms were right or not (why 30 per cent?), it could be argued that one needs a hybrid model for allowed deviation that factors in both the percentage and absolute scale. After all, even a 100 per cent error in prediction is easy to handle if RE is only 1 per cent of the state load. But at, say, 40 per cent of state load, even a 25 per cent deviation will mean a 10 per cent absolute deviation. Maybe we need a formula similar to the Duckworth-Lewis (formally, Duckworth-Lewis-Stern) formula for runs required in an interrupted cricket match, where it's not just the remaining overs but also the remaining wickets that matter.

Part of the government's efforts over a few years have been to enable Renewable Energy Management Centers (REMCs), specifically to improve forecasting. There have also been updates to scheduling norms to allow RE to flow inter-state, norms which were originally designed for conventional (despatchable) power plants.

Recommended citation:

Tongia, Rahul (2017). "Renewable Energy Forecasting in India – Not a simple case of 'more is better'," Brookings India Discussion Note, No. 112017, November 2017.

It's all about the risk

Forecasting is just one part of the puzzle – "what next" is the key issue. If you deviate from the forecast, should you be penalised, and by how much? These are key issues. There is inherently a limit to perfection in forecasting. On the other hand, tools are improving, so not only are average errors decreasing, the time-periods of confidence are improving as well. But at some point, policies will need to reflect a fundamental difference between solar and wind, where the time constants of change vary greatly. Solar is relatively predictable by time of day, but there can be very sharp and sudden changes due to a cloud cover. This is exacerbated in India due to the disproportional share of massive grid-scale solar parks instead of roof-top solar (as of now). This means in a minute, hundreds of MW of supply (there are 2000 MW-sized solar parks coming up) can be lost from just one location. In contrast, wind is often seasonal and more unpredictable, but has lesser changes per minute or even per five minutes, especially when aggregated over multiple wind zones.

Should all the risk for deviations from a schedule be borne by the RE provider? Can they be ameliorated by larger balancing areas and improved transmission? Just like the question "how much RE can the grid handle" cannot be answered either easily or even deterministically, these questions are a moving target in reality. As the grid evolves, storage matures, price signals improve (a big gap in India!), the ability to handle RE will improve. Thus, over time, RE prediction norms should become tighter and the penalties decreased per unit deviation (as the grid matures). This last point needs an incentives-based framework that encourages grid flexibility. If one is talking about an RPO (renewable purchase obligation, also called renewable portfolio obligation), perhaps one needs to recognise not just direct RE generation, but enabling solutions in things like storage. As an example, we have a few adjacent states in India rich in hydro or RE, but not both. Investments into each in silos may not be optimal compared to a system that rewards both in tandem.

Current status – steps taken, but need consistency

State Electricity Regulatory Commissions (SERCs) across India have begun notifying RE forecasting norms. These state-level efforts need to be compiled if not coordinated. RE developers used to complain that contracting in India was like dealing with 29 different countries. Luckily, there are now drafts for standardised bidding documents and even standardised RE PPAs (power purchase agreements). We need something similar for RE forecasting. It is a separate discussion whether the technical specifications of accuracy and penalties have to be identical. As an example, Karnataka has notified a band tighter than 30 per cent as tolerance. However, frameworks, assumptions, and methodologies need consistency.

Improved forecasting can even reduce pollution, as alternative generation can be best utilised, including from coal plants which have to flex their output. Such scheduling is not merely for generators in aggregate, but at a location-specific level.

DISCUSSION NOTE

Locational issues become paramount when we consider finite transmission capabilities and costs for the same. In fact, transmission costs for RE are a separate challenge, as RE has a low capacity utilisation factor, aka plant load factor (PLF). Thus, it inherently has higher transmission costs than the average.

There are several levels at which a state load despatch centre (SLDC) could ask for an output prediction. These could be at turbine, wind farm, pooling station, DisCom, state or country levels. It is obvious that asking for predictions at extreme granularity (per turbine) is expensive. On the other hand, aggregation across wider areas naturally leads to smoothening out, which obscures the inherent variability challenges at local and zonal levels.

What is the right balance of information and cost/complexity? Too much granularity isn't actually helpful as the grid doesn't know or care which turbine in a wind farm is producing the power being fed in. Most (transmission) grid operators want to know predictions of supply and demand at each grid node, i.e., the pooling station (sub-station) level. This is because transmission lines can often be congested, and are at the level of system control (in some ways they are the bridge between supply and demand). Unfortunately, one state in India has chosen to allow predictions aggregated at the state level.

If suddenly a state finds that its western areas see an increase of 500 MW wind, and its eastern area sees a simultaneous drop of 500 MW wind, then at the state level there is no new generation required on paper. BUT, this is only true in a theoretical world with infinite transmission capability. The grid is best helped by forecasts at the pooling station level. This is the norm followed by most states in India. It remains the choice of the wind farm how to operationalize that down to individual turbines, which may have multiple owners, technologies, vintages, expectations, etc.

Forecasting is just one part of the puzzle – "what next" is the key issue. If you deviate from the forecast, should you be penalised, and by how much? These are key issues.

This note only highlights some of the challenges and tradeoffs in forecasting – it has a cost, but one that should be worthwhile. Policy norms should be designed to be achievable, but with effort. Discussions with technologists indicate that pooling station level forecasts are doable – and state-level aggregations are inherently easier. If the latter also don't help the grid operator (transmission company), then maybe it's time to have a minimum granularity requirement for forecasting. A useful exercise would be for multiple stakeholders to share what different state norms are and also what works and what doesn't. With the right incentives, one would be surprised how quickly even "tight" RE prediction norms can be met.

Author

Rahul Tongia is a Fellow with Brookings India in New Delhi, and his work focuses on technology and policy, especially for sustainable development. He leads the energy and sustainability group at Brookings India, and also is active in broader issues of technology.

Tongia did his Ph.D. in Engineering and Public Policy from Carnegie Mellon University, USA.

QUALITY. INDEPENDENCE. IMPACT.

No. 6, Second Floor, Dr. Jose P Rizal Marg
Chanakyapuri, New Delhi - 110021
www.brookings.in