Forecasting and Scheduling of Renewable Energy in India: A demanding challenge for 2030.

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Socio-economic development has led to progressive increase in energy demand that cannot be met with traditional technology with local resources only. Renewable energy is seen as a transformative solution to this increasing energy demand and economic challenges like rising coal prices. Further, renewable and natural sources are available easily, are in abundance and are also environment friendly. Renewable energy has augmented exponentially in the past few years in India. With an average CAGR of about 14% in past 4 years, the renewable energy sector is expected to transform the power sector dynamics in upcoming years. The Government of India's ambitious target of 450 GW renewable power installed capacity by the year 2030 would prove to be a daunting task for the system operator in maintaining the balance between load and generation at any given point of time and would therefore pose a challenge in overall operation of the power system. With about 96 GW of grid interactive green power, India now ranks 5th in renewable energy installed capacity globally.

Power generation from Renewable energy plants is variable in nature as it depends on many factors such as weather, location, wind speed and other climatic conditions, etc. It is therefore pertinent to mention that integration of variable generation from solar and wind sources have become a real challenge for system operators in ensuring reliability and security of the power system network particularly with an exponentially increasing renewable energy share in our country's energy mix.

The Central Electricity Regulatory Commission (CERC) introduced the provisions for forecasting of solar and wind power under the Indian Electricity Grid Code (IEGC) in May 2010 for dealing with the difficulties in managing the infirm solar and wind power. IEGC 2010 envisaged plan for improved grid discipline and accountability by mandating Wind & Solar Forecasting & Scheduling. However, these provisions could not be operationalized due to inherent gaps in Forecasting and Scheduling technologies and likely financial impact on Wind and Solar power developers. These provisions are primarily voluntary in nature. The CERC Amendment to DSM Regulations 2016 incorporated regulations on capacity and frequency limitations of renewable energy sources. Further in March 2017, CERC came up with the procedure for Implementation of the Framework on Forecasting, Scheduling and Imbalance handling for Renewable Energy Generating Stations including power parks based on wind and solar at inter-state level.

The framework provided for incentive for generators to forecast and schedule accurately, enables centralized Forecasting and Scheduling at Regional Load Despatch Centre (RLDC) level. The provisions include Centralized (by RLDC) and Decentralized Forecasting (by wind/solar generators): flexibility in Revision of Schedule (every one and half hour in 4 time blocks); buyer obligations are limited to schedule; tolerance band of +/- 15% and socialization of the same; Deviation Charges linked to PPA rates; symmetrical Penalties for over-injection and under-injection; and any shortfall to be met through Renewable Energy Certificates (RECs). Meanwhile, the Forum of Regulators (FOR) circulated Model Regulations on forecasting, scheduling and deviation settlement for Solar and Wind Generating Stations at the State level to the State Electricity Regulatory Commissions (SERCs) which was adopted by several SERCs for designing the Forecasting and Scheduling frameworks for their States/ UTs.

The intense and delicate grid system in India experiences load shedding, low voltages, high frequency variation, flexible generation and high line losses. This makes demand forecasting even more challenging. Under Section 32 (1) of the Electricity Act, 2003, the State Load Dispatch Centre (SLDC) is responsible for ensuring the integrated operation of the power system in the respective state. For monitoring grid operations, visibility of the load and generation at the SLDC level is necessary. At present, real-time data from Solar and Wind Generators is not available in most of the existing SCADA systems at the SLDC, and forecasting and real-time data is not communicated to the SLDC. Further, with increasing share of renewables, energy accounting of actual energy generated on real-time basis would be necessary for developing forecasting model to overcome the issue of day ahead demand forecasting.

Amendments in state grid codes for facilitating forecasting and scheduling is also a crucial factor. As on date, the Electricity Regulatory Commissions (ERCs) of 19 states namely Andhra Pradesh, Assam, Bihar, Chhattisgarh, Gujarat, Haryana, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Punjab, Rajasthan, Sikkim, Tamil Nadu, Telangana, and Uttar Pradesh have issued final Forecasting and Scheduling Regulations. ERCs of 5 states namely Delhi, Odisha, Tripura, Uttarakhand and West Bengal have issued draft Forecasting and Scheduling Regulations. Together, these states account for about 85% of operational and under development renewable energy capacity.

Globally, renewable energy forecasting has been beneficial mainly due to reasons pertaining to deregulation of the electricity market. For example, in Germany the Transmission System Operators use forecasting at national level for trading as well as information on grid and security analysis. Similar trends have been observed in Denmark and Spain too where there has been higher renewable energy penetration. Moreover, the transition to bi-directional flow of electricity has further increased the need for better forecasting in European Union countries and it also assists in planning import and export of electricity among EU countries.

Although implementation of this framework is infused with roadblocks, there are ways to enable better grid discipline such as: a) placing interface meters at all required locations for imbalance accounting; b) SERCs preparing framework similar to CERCs roadmap to operationalize reserves in the country; c) SERCs coming up with regulations for Ancillary Service Operations at state level; d) Improving Frequency Response Characteristics (FRC) and enforcement through targets of FRC as per Grid Code with stringent provisions; e) System for compliance monitoring; f) Introduction of forward and futures contracts to enable higher liquidity in the market; and g) consideration of constraints from pooling stations and inter-regional and regional systems while evacuation of RE power.

The generation forecast should be based on a learning algorithm which would improve over time when the forecast is being fed with both real-time generation as well as weather data. Moreover, creating a Forecasting and Scheduling Fund for renewable power maintained by state utility could be one innovative way to address the present system gap. This fund may be collected from the proceeds of penalties under Forecasting and scheduling regime and may be utilized to assist older projects to come under the ambit of new Forecasting and scheduling regulations. Further, developing robust guidelines for forecasting service providers could help in realistic projections for renewable power generated.

The demand supply characteristic of the complex grid network is a crucial issue for power management. Achieving efficient power system operation requires an evolution of planned system operation by Load Despatch Centres maintaining a balance between current and future market scenario with proper transmission network and reliable communication in between the renewable power generator and load centres. The regulations and proposed methodologies including penalty/ incentive may be acknowledged as a pre-requisite for better grid management. The immediate solution is adoption of enhanced Forecasting and scheduling techniques that will enable better integration of growing renewable capacity while empowering the realization of Government of India’s goal for 2030.

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