**Resource adequacy issues in Pakistan s power grid II**

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In the first part, we observed that NTDC’s IGCEP2047 envisages addition of 50 GW of new capacity in the grid by 2030, with investments to top over USD 70 billion. For a country already sinking under foreign loans and where electricity prices have risen beyond the affordability of most consumers, this should be a cause for serious concern. We must explore every option and avail every opportunity to minimize future capacity needs without compromising country’s aspirations for development and consumers’ capacity to pay. With this objective, we re-examine below, the rationale behind the existing reliability criteria and explore a few options which could help the country reduce its future investment requirements in the power sector.

The discussion, admittedly illustrative and non-exhaustive, essentially focuses on three aspects. First, we examine the suitability of the capacity-based reliability criteria as the primary basis for resource adequacy planning in the local context to see if some other criteria, alone or combined with the present, can serve our needs better. Second, we explore how objectively the present criteria or the proposed one can reflect the costs and benefits of reliability to consumers. Finally, we offer a few suggestions that our policy- and decision-makers and regulator can use to assess the full range of technical and financial implications of resource adequacy plans and take informed decisions that best serve our country’s socioeconomic interests.

Capacity-based reliability criteria, either “loss of load” events or “reserve margin”, are a legacy of the past when economy of scale ruled the monopolistic electricity business. Most demand was served by central-station generation via a complex inter-tied T&amp;D grid. Utility managers actually had a propensity to go for capital-intensive larger plants since that meant lower costs in generation and higher return on their asset bases.

Reserve capacity was the only economic choice to deal with uncertainties in demand, weather and generation availability. Storage of electricity was either not possible or very expensive and technologies for controlling power flows in the grid or for consumer demand were non-existent.

With the advent of competitive small generators, smart grid technologies, and electronic sensors and control devices, multiple options have emerged and are being used successfully around the world to deal with the possibility and actual events of supply failure quite effectively and at a fraction of the cost of maintaining reserve generation upstream which is called upon only a few hours in the year to deal with peak demands.

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In this changed world, capacity-based reliability criteria have lost the charm and utility they once enjoyed. Energy-based criteria such as “loss of energy expectation (LOEE) or its equivalent “loss of energy probability (LOEP)” or “expected un-served energy (EUE)” offer a much better and more realistic criteria to explore the chances of not serving consumers energy demand and plan and configure power supply and delivery networks and facilities to prevent such losses from exceeding beyond specified limits. Consumers’ energy demand is also easier to forecast more accurately than their peak demand and is less affected by unexpected economic and weather changes. It may be wise, therefore, for our planners to switch from capacity-based reliability criteria for future capacity expansion planning to energy-based or a composite capacity cum energy based criteria.

Considering physical reliability criteria, either capacity- or energy-based, exclusively and ignoring the costs of maintaining generation reserves and its value to consumers is another area that requires a serious re-visit. It might have been difficult in the past to assess its scope or serve electricity at different reliability levels to consumers distinguished by their preferences, but not anymore. Technologies now exist to enable suppliers to discriminate among consumers categories in accordance with their reliability preferences to match its cost with their willing to pay. Barring a few industrial processes in which excessive and un-notified interruptions can result in heavy losses, for most other consumers, local solutions can be easily used to match their reliability needs at only at a fraction of the cost of maintaining unnecessary generation reserves upstream in the grid.

Pakistan is all set to move to a competitive wholesale electricity market in about 18 months. It is all the more important to gain deep insights into how the costs of providing reliability in supply are linked with dynamics of generation, demand patterns and uncertainties, and adverse weather. It is also critical to have a realistic knowledge about the value consumers place on the reliability of their supply. As we progress to more competition in generation, we will need to separate capacity provision issues from energy trade and their respective pricing. In the absence of a clear understanding and a fair compensation scheme, investors will be reluctant to build and keep idle plant capacity as reserve which could easily lead the country to a crisis similar to one that California faced during 2000-2001.

Three emerging developments will further convolute the resource adequacy issues.

Cost-competitive renewable technologies are making rapid inroads into the power grids of most countries. EVs are also quickly replacing conventional means of transportation.

Spurred by high demand in EVs, battery storage technologies are also experiencing rapid progress in their capacity, performance, and costs. Collectively, all three pose new challenges to the traditional ways of supplying electricity to consumers, but are opening up new opportunities also.

Renewables hold a great promise in serving electricity demands of society economically and sustainably, but do not contribute to firm system capacity as conventional plants
do. The same is true for EVs which while pose new challenges to the grid also hold great promise in improving utilization of generation capacity in the grid and alleviating stress on them. Utility-scale storage at reasonable costs opens up new and unprecedented opportunities for us to obviate the need for building and keeping peaking plants at substantial and unaffordable carrying costs.

Resource adequacy issues have thus acquired a new and unprecedented importance.

The basic concept of reliability which is at the core of resource adequacy issues requires critical review. How the costs of building this reliability in the power grid can be balanced with the economic value that consumers derive from it makes it imperative that we understand the complexities of demand and supply. The generation planning tools at present take a somewhat simplified view of the issue and focus on generation availabilities only while overlooking the uncertainties is demand and weather forecasts.

There is a serious need to separate reliability evaluation from the current optimization exercises to model the full range of uncertainties in all the variables that affect the reliability of service to consumers and how is it linked with the value they place on it.

NEPRA generally holds public hearings to understand and address stakeholders’ concerns on the proposed long-term plans by NTDC. This is a good exercise but is meaningless if the stakeholders and the most important among them, the consumers, are not technically trained to understand the complexities of such plans which ultimately reflect in their tariffs. Therefore, it’s important for NEPRA to commission, either directly or through NTDC, independent reliability evaluation studies to understand the costs of building the requisite reliability in the grid, how these costs fare against its value to consumers, and what is the most economically-efficient and equitable means of building and providing reliability to them?. The results of these studies will help the Authority a great deal in taking informed decisions on such technically complex issues and strike a balance between the interests of suppliers of electricity and its consumers.

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