PEG Comments on CEA's draft Guidelines on Resource Adequacy

CEA's guidelines on resource adequacy (RA), along with resource adequacy planning procedures specified in the IEGC can provide a framework for states and DISCOMs to plan their investments as well as power procurement in a cost-optimal manner taking cognizance of available technologies as well as changes in demand. Hence, this is a welcome step in the right direction. In the face of demand uncertainty and increasing viability of various low-cost technology options, it is critical that RA frameworks also aid flexibility in decision making and allow for state-specific innovation. In addition, RA studies are extremely complex and there needs to be an initial period during which the methods are fine-tuned and capacity building of the various institutions involved is undertaken.

In this context, it is imperative that there be a trial period of a few years for the RA framework specified by CEA, and that RA targets are not binding during this trial period[1]. Specifically, penalties should not be imposed for non-compliance with specified targets during this period. Without such a cautious approach, RA requirements may not result in cost-optimal investments, and instead result in long term, base-load contracting with associated inefficient resource lock-ins.

With this larger context in mind, Prayas (Energy Group)'s comments on the guidelines focus on process related aspects and lack of clarity regarding specific proposals, as detailed below.

1. Transparency in resource adequacy studies

The proposed IRP process will have far reaching impacts on decision making in the power sector. Thus, all steps in the process (initiated by CEA, LDCs, DISCOMs) should be open to public scrutiny, so that interested stakeholders can participate through comments and suggestions. Greater participation strengthens the IRP and increases stakeholder buy-in of the process. This has also been demonstrated in international experience where rigorous IRP[2] and RA approaches have been adopted. Transparency is a pre-requisite for greater participation, and this applies to the input/output data as well as the tools used.

- The modelling studies are only as good as the input data and assumptions. Hence, it is important that these inputs be vetted carefully by all stakeholders. Input data used for all the studies involved should be made public by the respective agencies (CEA, NLDC and DISCOMs), and comments should be sought regarding these inputs. The studies should be conducted only after considering the comments received, along with a statement of reasons. The CEA's RA guidelines should clearly make provisions to make such data public.

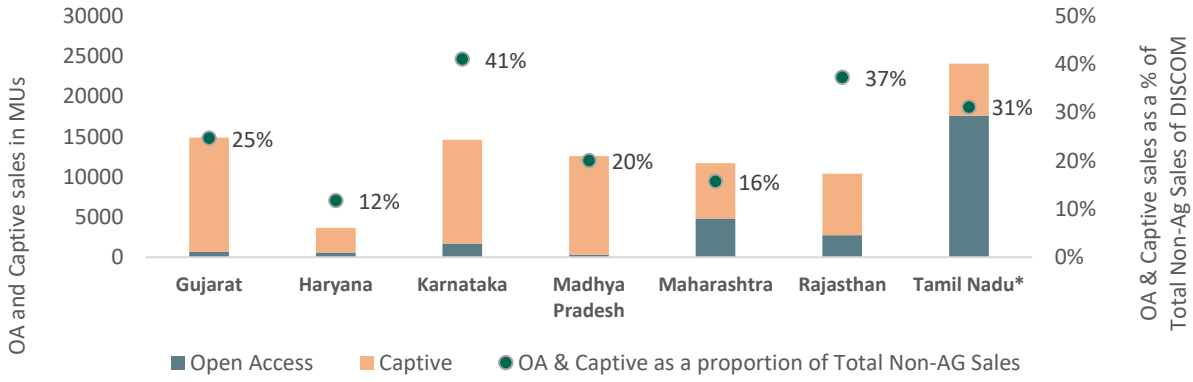
[1] This is also highlighted in a 2021 paper assessing IRP processes and RA frameworks in the North Western Power Pool of the United States. The paper titled, "Implications of a regional resource adequacy program for utility integrated resource planning" states that:
"Ultimately, interviewees from public utility commission staff from SPP states indicated that LSEs have an incentive to develop IRP assumptions that are consistent with SPP's in order to fulfill their membership duties. IRP guidelines in these states are generally much broader and more flexible than the IRP rules in Western U.S. states. This flexibility makes it easier for LSEs to adapt their IRP analyses to align with SPP requirements. LSEs should be able to develop NWPP-aligned forecasts as part of their IRP processes and benefit from the public stakeholder engagement as long as IRP regulations in the NWPP states are based on a broad and flexible set of principles." More details here: https://www.sciencedirect.com/science/article/pii/S1040619021000518

[2] Hirst's assessment and review of 50 resource plans in 1994 highlights the importance of participation and transparency in IRP: https://www.sciencedirect.com/science/article/abs/pii/0957178794900086

- The choice of modelling tools used for RA studies is also equally important. Black box models should be avoided as the use of such models affect the credibility of the studies. Only tools that have public documentation on how the models are formulated, and the methods and algorithms used in these models should be used for these studies. In addition, it is preferable that open-source tools are used for the studies since stakeholders can review the implementation and point out to any issues with the same, which can then be addressed in a transparent manner. A couple of open source tools that have been used for RA studies include GridPath developed by Blue Marble Analytics and Probabilistic Resource Adequacy Suite (PRAS) developed by NREL. Both GridPath and PRAS have been used for RA and IRP studies in the United States[3]. In addition, a capacity expansion model has been developed using GridPath for India, and a couple of production cost simulation models have been developed for the states of Maharashtra and Gujarat.

2. Demand uncertainty and incompatibility with ongoing sector changes

Several DISCOMs are seeing increasing sales migration through the open access and captive routes. Figure 1 has compiled information from seven states in India accounting for about 50% of the sales which clearly shows that open access and captive consumption in 2018-19 was as high as 26% of non-agricultural sales in the state.



Source: PEG compilation from various tariff orders, additional surcharge petitions and CEA general review.
Note: The OA numbers for Tamil Nadu are for the year 2019-20, as 2018-19 numbers are unavailable.

In addition, there is a strong policy push to increase retail competition and to provide consumers the option of choosing their electricity supplier. These are reflected in recent policy proposals such as the green open access rules (which has effectively reduced the eligibility limit for open access from 1 MW to 100 kW, thus providing competitive choice to a wider ambit of consumers) and various provisions of the Electricity Act (Amendment) Bill 2022.

Sales migration makes it extremely challenging to estimate DISCOM demand especially over a 5-10 year timeframe. This challenge will compound if retail competition is introduced, and it is unclear how

[3] The GridPath RA Toolkit is explained in detail in the report titled 'Advancing resource adequacy with the GridPath RA Toolkit – A Case Study of the Western US' available at https://gridlab.org/gridpathratoolkit/. The PRAS suite of tools are described at https://www.nrel.gov/analysis/pras.html along with several RA studies for the United States.

the multiple/parallel distribution licensees will be able to conduct reliable RA studies in the context of shifting consumers.

There are also proposals to introduce time-of-day (ToD) tariffs to more consumers with the increasing penetration of smart meters, which could result in changes to demand profile that are difficult to predict for the long term.

Simultaneously, there is a push towards centralised dispatch (CERC's MBED proposal) as well as increasing market penetration and the proposed introduction of various products are intended to widen the reach of the market resulting in an increasing role for the market in providing grid services, including instruments such as capacity markets that promote resource adequacy.

It appears that the proposed RA framework is incompatible with these changes and it will be difficult, if not impossible, to account for these changes in the studies. In the worst case, the exercise could lead to inefficient investments and lock-ins leading to higher tariffs, stranded assets and increased stress on DISCOM finances, without any significant improvement in reliability.

Given this risk, it is perhaps prudent to trial the RA studies in a sandbox environment over a period of two years or so. This period can be utilised for learning what works and what does not, adapt to the changing environment and build institutional capacity, without significant downside risks. Thus, RA studies should be used only as one input in a menu of inputs while making investment decisions in the states. It should not be the only guiding factor in determining capacity addition given the uncertainty and risks involved. Specifically, it is premature to levy RA non-compliance charges currently. All other processes such as doing the RA studies, making the data public and submitting to ERC/NLDC/CEA could proceed as planned, but without penalties for non-compliance for the first few years.

3. Incompatibility with the Indian Electricity Grid Code (IEGC)

The proposed guidelines appear to be incompatible with the RA methodology proposed in the draft CERC (IEGC) Regulations, 2022. Following are the specific areas of incompatibility:

- CERC proposes a bottom-up planning approach which includes demand forecasting at the state level, followed by generation and transmission RA planning at the state level based on the national-level Planning Reserve Margin (PRM) published by CEA. These studies then feed into a national level simulation of generation resource adequacy for the states by NLDC. This approach is described in Section 3.6 of the explanatory memorandum to the draft IEGC. However, the RA guidelines proposed by CEA also specify that CEA would publish the results of an optimal generation mix study along with the national-level PRM, which "shall guide capacity buildout investments in the country" (Clause 5.1 (b)).
- It is desirable that a bottom-up approach is adopted instead of prescribing the capacity addition that the LT-DRAP studies must consider for two reasons:
    a) DISCOM would contract the generation that is optimal given the demand it needs to serve and the existing contracted generation, and
    b) the Monte Carlo simulation over the range of uncertainty in demand and RE generation needs to be conducted as part of the LT-DRAP and it would be premature to specify the capacity to be added before this process.

  Instead, once all the LT-DRAP studies are done, these could be aggregated at the regional/national level, and further optimisation of the capacity addition could be done.

- The draft IEGC specifies that the annual RA planning shall be done on a rolling basis for the next five years. However, the proposed RA guidelines specify a 10-year horizon (Section 5.5). While it is understood that 5 years may not be sufficient to add certain technologies, uncertainty also increases non-linearly as the horizon period increases, reducing the reliability of the RA studies. Hence, a horizon of 5 years may be a better choice.

4. There isn't one optimal solution

The output of the LT-DRAP is the "quantum and type of resources required in the portfolio of a utility to meet the demand in an optimal (least cost and secure) manner" (Section 4.9). However, there can be multiple combinations of different types of resources that can meet reliability requirements at relatively similar costs. Picking one (least cost) optimal solution could ignore other equally good solutions that may have other benefits such as being more compatible with the rest of the national demand or can provide wider socio-economic and developmental benefits not accounted for fully within the electricity domain. Thus, it is critical that scenario based analysis and presentation of results with multiple options is part of the framework to enable informed decision making in the state. This is also why having state level flexibility and not mandating RA targets/ frameworks is important.

5. Capacity value depends on other capacity additions

The optimisation exercise described in Section 4.8 of the proposed RA guidelines appears to indicate that the capacity credits for different generation sources are static. In reality, capacity value of a generation source could be affected by addition of other generation sources. For example, in a solar heavy system, additional solar capacity will have a low capacity value since its generation will not be coincident with the net load peak. However, addition of storage resources can result in a higher capacity value for solar. Thus, capacity values need to be calculated with different combinations of capacities of different technologies being added in an iterative process. This does not seem to be the case with the proposed methodology.

6. Need for a bottom-up, deliberative and inclusive process

- As mentioned earlier, a bottom-up approach is desirable in order to align the interests and compulsions at the state level with those at the national level. Another advantage of a bottom-up approach is more accurate characterisation of uncertainty with respect to demand and RE generation in the state level studies. It is mentioned in a footnote in Section 3 that the RA guidelines may be amended in the future such that utilities can conduct their own optimum reserve margin studies. However, in the meantime, capacity addition decisions may be made based on a sub-optimal methodology which could result in inefficient resource lock ins.
- As per the proposed guidelines, the role of the SERCs is limited to setting a PRM that is stricter than that prescribed by the CEA. This makes the process overly prescriptive, and there is no scope to improve the process based on the specific considerations in the state with respect to the methods followed, uncertainty ranges and probabilities used in Monte Carlo simulations, etc. Instead, the SERCs should have wider latitude in formulating RA practices. With increasing penetration of intermittent renewable energy sources and the increasing viability of energy storage, the methods employed to measure and ensure resource adequacy are also evolving. Thus, there is a need for SERCs to innovate based on international best practices and discover RA methods and processes that work best for their jurisdictions. These experiences can then inform other DISCOMs/jurisdictions as well.

- Most DISCOMs presently do not have the capacity to perform RA studies. Especially given the various uncertainties involved, choosing the right assumptions requires a lot of practice and experience. Hence, capacity building is an important component of this exercise, one that is likely to take some time to bear fruit.
- Given these uncertainties and constraints, it is imperative that the process is more deliberative and bottom-up in nature. As suggested earlier, sandboxing is a good way to try out what works and what does not, and build capacity along the way. Transparency and involvement of the wider stakeholder community in this exercise can also help expedite the learning process.

7. Miscellaneous comments

- **Lack of clarity in methodology for incorporating uncertainty:** Section 4 of the guidelines describes the steps to be followed for the RA studies to be undertaken by the DISCOMs. In addition, Annexure A refers to stochastic modelling and multiple scenarios to account for uncertainty. One important input to this process is the probability distribution of different future occurrences, and this can have a significant impact on the optimal capacity addition. However, the methodology for ascertaining these probabilities is not described in the guidelines. In addition, stochastic programming is an evolving discipline and there aren't many tools available which can do this efficiently. It is desirable that the guidelines clarify these aspects in detail.
- **Retirements vs Life extension:** Incorporating retirement schedules is mentioned in Section 4.4, but life extension could also be an economical choice in some cases. In such cases, life extension should also be included in the candidate capacities wherein the decision is made based on the R&M costs and resulting generation capacity benefit.
- **Resolution of the RA studies:** The resolution of the RA studies is specified as hourly, e.g., in Clause 4.5(b). While hourly resolution is sufficient for long term studies such as capacity expansion, it is not be sufficient to capture the impact on the system due to variability in demand and intermittent RE generation. For example, a coal generator with a ramp rate of 1%/min can ramp up or down by up to 60% of its installed capacity in an hour which is its entire capacity above technical minimum. Thus, an hourly simulation cannot capture the ramp constraints that are seen in a real system. A resolution of 15 min or higher should be considered in studies where operational constraints such as ramp rates are being considered, such as dispatch simulations.
- **Calculation of capacity credit:** It is mentioned (in 4.8(a) and B5) that capacity credit for different generation sources should be calculated based on nationwide coincident peaks. However, this could be at odds with what is beneficial for the DISCOM area. Perhaps, state coincident peaks could be considered for LT-DRAP, and subsequent RA studies for a larger area can identify the DISCOM capacity additions that are incompatible with the needs of a larger geographical area, and corrective measures could be taken. This is also in sync with the bottom-up approach mentioned earlier.
- **Forecast errors:** It is mentioned that forecast errors are used to construct future scenarios (Clause A4). However, forecast errors are likely not relevant for an IRP exercise which covers a longer time period. Ideally, different demand and generation patterns need to be used based on past data and possible changes in weather and demand growth.
- **Weather synchronised scenarios:** Scenarios for VRE generation (Clause A5(c)) need to be in sync with demand variations to the extent that they are both weather dependent. Thus, it is important to understand the extent to which weather simultaneously impacts both demand

and VRE generation, and these should be incorporated to the extent possible in the Monte Carlo simulations.