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# ADVANCING CLEAN ENERGY DEPLOYMENT WITH BETTER RESOURCE PLANNING: THE CASE OF ASSAM

*Launched in 2019, the Partnership to Advance Clean Energy – Deployment (PACE-D 2.0 RE) is a flagship program of the United States Agency for International Development (USAID) with India's Ministry of New and Renewable Energy to help national and state partners develop an enabling environment for faster and more cost-effective deployment of renewable energy. PACE-D 2.0 RE worked with the Government of Assam to develop tools and methods that can help the state distribution utility, Assam Power Distribution Company Limited (APDCL), create medium- and long-term resource plans, optimize power purchase costs, and boost uptake of renewable energy.*

## CHALLENGES IN RESOURCE PLANNING

APDCL is a wholly owned public entity of the Government of Assam that distributes power to different customer categories across the entire state. In 2020, Assam experienced 7,257 million units (MU) of demand (compared to the 9,124 MU projected). The state's total installed generation capacity is 2,124 MW, with an energy mix dominated by coal (63 percent), hydro (30 percent), and solar (7%). Power purchase makes up around 85 percent of the total cost for APDCL's entire distribution business.

Traditionally, the distribution utility based its medium- and long-term resource plans on compound annual growth rates and historical data trends. Such methods did not consider the new drivers (such as demand-side management, electric vehicles, and behind-the-meter distributed energy resources) and other factors causing demand to vary. This often causes them to overestimate demand. With power purchase generally guided by the demand forecast, misestimation burdens APDCL with financial strain and leads to higher tariffs for consumers.

*The utility wants to optimize and manage surplus/deficit power purchase, looking to volatile renewables as a low-cost candidate. A sophisticated but easy-to-use software could equip APDCL to overcome these challenges.*

## THE BRIGHT IDEA

APDCL partnered with PACE-D 2.0 RE to develop a tool that would not only help harness variable renewable energy (which is now more economical than conventional energy), but could also accommodate the demand impact of cutting-edge innovations such as grid-level storage, electric vehicles, and distributed energy resources.

The team conducted a gap analysis and found a clear need for high-end software, scientific methods, and sophisticated artificial intelligence (AI) algorithms to project demand accurately and optimize power procurement. Products already on the market were either cost-prohibitive or not tailored to the realities of India's resource planning, which call for demand forecasting, resource mapping, and power procurement optimization. India needed a tool that was user-friendly, had state-of-the-art simulation and visualization capabilities, and would be freely available for distribution utilities across the

country. Together, PACE-D 2.0 RE experts and APDCL engineers developed a tool that met each of these needs in 18 months. APDCL engineers participated in developing system requirement specifications, collecting data, developing use cases and test cases, procuring hardware, training staff, and finally conducting factory acceptance testing for each module of the software before its deployment.

## ABOUT DISCOM REPOSE

DISCOM Renewable Energy Procurement Optimization and Smart Estimation (REPOSE) is a sophisticated, interactive, robust, and dynamic software with a comprehensive set of advanced methods for forecasting demand, integrated resource mapping models, and power procurement optimization technology built into three modules.


*Figure 1: DISCOM REPOSE landing page*

***The software helps distribution companies (DISCOMs) forecast demand; plan their generation mix from available, retiring, and upcoming resources; and optimize future purchase costs.***

DISCOM REPOSE provides hourly, weekly, and yearly visualizations of demand and resource adequacy (type, amount, and time) over a ten-year horizon.

The tool is flexible: utilities can use any of the modules on its own or all three for integrated planning. Users can review different scenarios by varying the generation mix. The plans optimize resources to lower costs, maximize renewable energy, and reduce emissions.

## KEY BENEFITS

With DISCOM REPOSE, APDCL is now equipped with AI-driven statistical and scientific methods to estimate demand in an uncertain environment. Using deterministic and probabilistic methods, the utility can create medium- and long-term power plans to address real-time demand and increase renewable energy penetration. APDCL is also in a better position to revisit its power purchase costs and future contracts. Outcomes include:

## A. DEMAND FORECASTING

Using the first advanced algorithms of their kind in India, the demand forecasting module simulates each consumer category by applying the best-fitting statistical and scientific methods. These may include trend analysis, compound annual growth rate, econometrics, ARIMA, ANN, and partial end use. The software selects the best fit after considering future year growth, R2 (the statistical index), and standard error. DISCOM REPOSE enriches its forecast by adding the impact of policies, demand drivers (such as electric vehicle penetration, open access, LEDs, or distributed energy resources), and transmission and distribution losses over the next ten years.

***With these inputs, the module produces annual and monthly demand projections and an extrapolated hourly demand profile.***

Figure 2 shows an hourly demand profile that will be used in resource optimization for up to ten years. The profiles help APDCL determine its demand and energy sales for the monthly peak and the spike and duration of the peak.

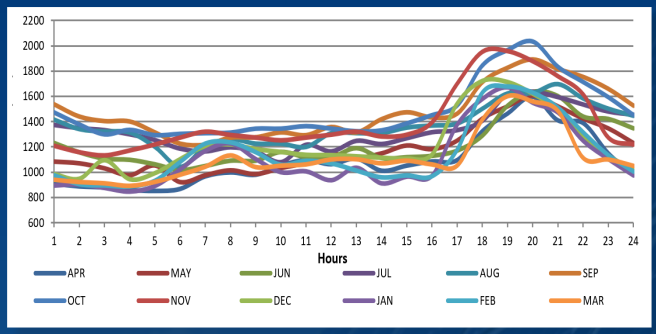


*Figure 2. Forecasted hourly profile of the peak day for each month - FY 2021 (illustrative)*

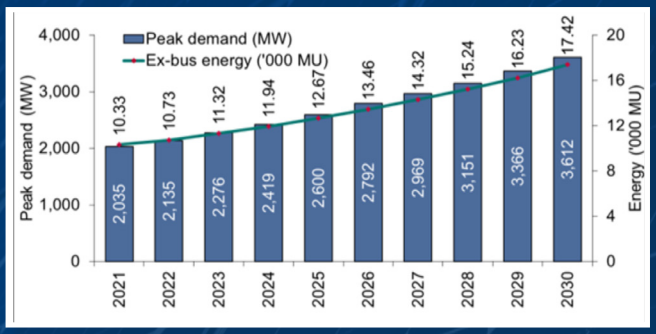


*Figure 3: Yearly energy requirement (MU) and peak demand (MW) (Illustrative)*

In Figure 3, the software forecasts yearly energy requirement (MU) and peak demand (MW) for the utility.

## B. RESOURCE MAPPING

Renewable energy is an attractive candidate to replace fossil fuels due to its lower cost and emissions. However, its variability and intermittency make it challenging to integrate into generation schedules.

By using Monte Carlo simulation techniques and mixed-integer linear programming algorithms, DISCOM REPOSE's resource mapping module optimizes generation commitments after considering each resource's technical and commercial constraints. It can balance a variety of types of resources, including thermal, hydropower, and variable renewables such as wind and solar.

APDCL planners can study the seasonality of demand and take weather conditions into account when shaping generation strategies. Spanning several-year periods, this resource mapping also helps the team factor in when resources will retire and predict what new resources will be needed to balance the forecasted demand.

*With such visibility, utility can better plan generation schedules and dispatches at hourly and weekly intervals, as indicated in Figure 4.*

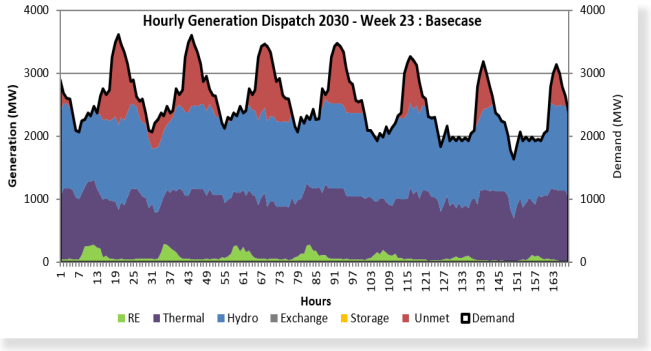


*Figure 4: Hourly generation dispatch schedules (illustrative)*

## C. POWER PROCUREMENT OPTIMIZATION

Good demand forecasting and resource mapping tools let APDCL keep a finger on the pulse of demand growth and how its portfolio can best meet that demand. However, the cost of procuring power is a colossal share of APDCL's total distribution expense, so optimizing that cost is critical to financial sustainability.

REPOSE indicated that under the business-as-usual scenario, procurement is likely to cost around $8 billion over the next ten years. However, if it conducts business as usual, APDCL will not be able to meet Assam's energy capacity needs from FY 2026 onward. To address this problem, the software generated different plan options.

1. The first option was the traditional addition of thermal plants, which would increase CO2 emissions to 11.7 million tons and raise the procurement cost to $9.3 billion. Under this scenario, renewables remained at 6 percent of the mix, which did not meet APDCL's renewable purchase obligation (RPO) targets.
2. The second option included the addition of renewables and storage, which led to 27 percent renewable energy in the portfolio and cost $8.8 billion.
3. Considering daily and hourly needs, REPOSE fine-tuned the second option by adding power exchange support. This cut the generation procurement cost to $8.6 billion and met all the utility's targets (27 percent renewables in energy mix, RPO, emission reduction).

*The REPOSE tool is helping Assam reduce its power purchase cost by approximately 9 percent compared to the thermal option by better integrating existing generation and focusing on renewables, storage, and exchange.*

## EXPANDING IMPACT

APDCL is using DISCOM REPOSE to recalibrate its long-term and medium-term plans, save on costs, and help drive new renewable energy (grid-connected solar, hybrid storage) in the state. The simulation is helping the utility:

- *Add 98 MW of thermal energy, 723 MW of hydropower, and an incredible 2,737 MW of renewable energy to the state generation mix by 2030*
- *Maintain 12 percent planning reserves*
- *Reduce greenhouse gas emissions by 3.6 million tons of $CO_2$ in FY 2030*

To complement the tool, PACE-D 2.0 RE is amplifying utility planners' hands-on learning with DISCOM REPOSE trainings. The Government of Assam is supporting institutional capacity-building for decision makers and implementers to use DISCOM REPOSE results effectively, which will help them create policies that successfully address Assam's pressing energy needs. Moreover, with this tool and its ongoing partnership with PACE-D 2.0 RE, APDCL is on track to increase renewables penetration to meet India's ambitious renewable energy target by 2030.



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