



A Modernized Approach for Energy Demand Forecasting

India requires accelerated deployment of renewable energy technologies to meet the needs of the nation's growing population of more than one billion people. A new approach to energy planning is critical to India's transition to a more self-reliant future, powered by renewable energy.

● Demand Forecasting

Distribution Companies (DISCOMs) with highly precise energy forecasts will increase performance while providing reliable clean energy to consumers at an affordable cost.

DISCOMs traditionally base resource plans on Compound Annual Growth Rate (CAGR) and historical data trends. Through the Partnership to Enhance Clean Energy Deployment 2.0 Renewable Energy (PACE-D 2.0 RE), the U.S. Agency for International Development (USAID) provides DISCOMs in Assam and Jharkhand with a modernized approach to strategic energy planning. The new approach helps DISCOMs to use statistically advanced techniques with higher degree of accuracy. Better forecasts can optimize power procurement with renewable energy options which is cheaper, cleaner, and requires less time to commission.

PACE-D 2.0 RE developed the demand forecasting tool as part of the DISCOM Renewable Procurement Optimization & Smart Estimation (REPOSE) software and will train analysts, planners, and forecasters to effectively reap its full benefits. The software analyzes data beyond past usage and considers various economic and policy drivers as well as disruptive technologies. Using an advanced algorithm that is the first of its kind in India, the software creates forecast models for each consumer category by applying best-fit statistical and scientific methods such as trend analysis, CAGR, econometric, ARIMA, ANN, and partial end use. The results create an hourly energy demand profile which informs medium- and long-term resource plans for up to 15 years. DISCOMs can then optimize procurement at least cost.

SOFTWARE HIGHLIGHTS

- Creates dynamic models that consider economic drivers, demographics, policies, and game-changing technologies
- Uses statistically advanced techniques such as econometrics, end-use, Autoregressive Integrated Moving Average (ARIMA), Compound Annual Growth Rate (CAGR), and Artificial Neural Networks (ANN)
- Provides advanced analysis and risk assessments
- Faster analysis despite larger datasets
- Higher precision in predicting demand
- Intuitive and user-friendly interface
- Available for DISCOMs at no cost
- Yearly and monthly forecasts with extrapolation at week-day, week-end and hourly projections

RESULTS



- Reduce power purchase costs by up to 10 percent
- Integrate renewable energy technologies to the grid more easily and with less risk
- Reduce stranded capacity
- Balance energy supply with consumer demand through better procurement planning
- Up skill DISCOM planners

SOFTWARE OUTPUTS

- Long-term forecasting provides estimates for all consumer categories in terms of million units (MUs) and annual peak demand (MW)
- Medium-term forecasting provides an hourly demand profile (MW) and seasonal energy demand (MUs), as well as weekday and weekend demand (MW & MUs)
- Probabilistic algorithm helps DISCOMs select most likely scenarios



Consumer Data
Historical Demand Data
Weather Data
Demographic Variables
Econometric Variables
Policies
Drivers

- CPP & OA
- AT&C Loss
- DER
- EV
- DSM



Algorithm



- CAGR
- Trend Analysis
- Econometric
- ARIMA
- ANN
- Partial End Use

Long Term Forecast (Up to 10/15 yrs.)

- Annual Energy Consumption (MU)
- Annual Peak Demand (MW)

Medium Term (3 to 5 yrs.)

- Seasonal/Monthly Energy Forecast (MU)
- Seasonal/Monthly Peak Demand (MU)

Load Profile (Medium- & Long-Term Horizon)

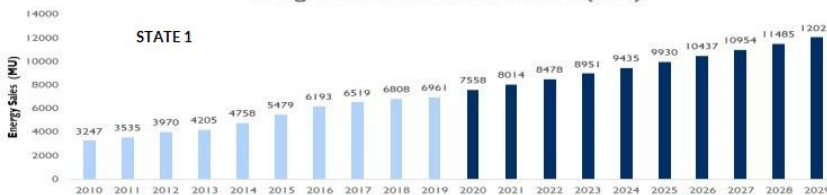
- Hourly load profile (MW)
- Weekday / Weekend Demand (MW & MU)
- Demand statistics



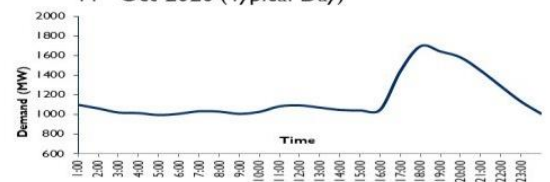
Output

SAMPLE OUTPUTS

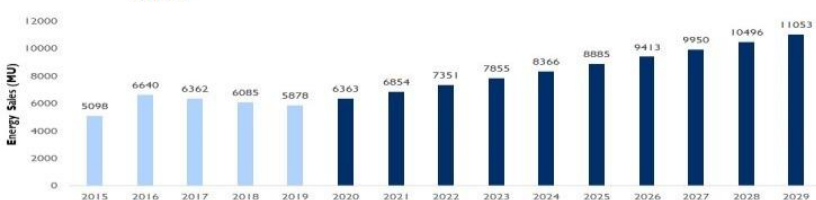
Long Term Demand Forecast (MU)



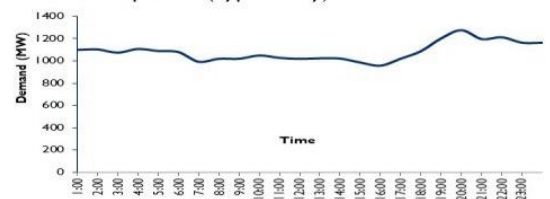
Hourly Demand Forecast Value for 11th Oct 2020 (Typical Day)



STATE 2



Hourly Demand Forecast Value for 3rd Sep 2020 (Typical Day)





SMARTER RESOURCE MAPPING FOR DISCOMs IN RE RICH ENVIRONMENT

BACKGROUND

Partnership to Advance Clean Energy Deployment (PACE-D 2.0 RE) is a flagship program launched by USAID/India in partnership with the Ministry of New and Renewable Energy (MNRE), and the Government of India (GoI).

The Integrated Resource Mapping (IRM) tool is developed as part of DISCOM Renewables Procurement Optimization & Smart Estimation (REPOSE) software. IRM tool is the second component that helps DISCOMs to plan schedule mixed generation resources with economic dispatch at least cost possible for the demand forecasted, while Demand Forecasting (DF) is the first component of DISCOM REPOSE that can assist DISCOMs with forecasting granular demand. The present conventional methods used for planning lags in handling the complex phenomenon of renewable energy variability or simply ignore their contribution in capacity planning. IRM can assist the DISCOMs/GENCOs to optimize the generation portfolio for the future years by handling renewables both in terms of energy in MU and capacity in MW.

● INTEGRATED RESOURCE MAPPING

Resource mapping/planning is the activity to balance the load and generation resources at an optimal cost. Demand Forecasting tool provides the demand profile in weekly and hourly intervals. IRM integrates the demand profile with scheduling of generation resources considering various technical and commercial constraints of generation resources (thermal, hydro and renewables like wind solar etc.,) to meet projected demand for the next 10/15 years. The lack of resource mapping activity will lead to the following conditions

- Lack of clarity on new resources addressing type of resource, what capacity, how much energy, when the resource to be planned.
- Frequent surplus/deficit instants throughout the year
- Lack of tools to handle renewables in planning expertise
- Higher tariffs due to non-optimal scheduling of resources at DISCOM level

Having a robust methodology for generation mapping is important to the electric utility for better planning by optimizing the existing and future contracts.

● ABOUT THE TOOL

IRM is an advanced tool that maps the demand with generation for the long-term (up to 10/15 Years) horizon.

- Available for DISCOMs and GENCOs at no cost
- Year wise generation mapping at weekly and hourly time intervals
- Intuitive and user-friendly Interface
- Scientific methods and advanced techniques used for load-generation balance

● IMPACTS

- Optimize generation schedules
- Increase in RE Penetration
- Assessment of Year-on-Year surplus/deficit
- Avoid Stranded Capacity
- Better Power Procurement Planning
- Re-skilling of Planners

VALUE OFFERED



Existing generation mapping tools use Merit order Dispatch (MoD), which does not consider all the technical and commercial parameters of generation units. The software addresses the same by using the following:

- Renewable generation variability and uncertainty are captured at hourly intervals through probabilistic methods like Monte-Carlo simulation methods. This helps to access the maximum possible renewables in the system without impacting system security.
- Advanced methods like Mixed Integer Linear programming (MILP) techniques minimize the power generation cost for the total planning horizon.

SOFTWARE OUTPUTS

- Annual generation adequacy up till 15 years: analysis at weekly level to handle renewables variability and seasonal surplus/deficit details. This helps DISCOMs to plan short term procurement well in advance.
- Hourly generation schedules: IRM dispatch the generation optimally at hourly intervals. This helps DISCOMs to understand the ramping and flexibility needs with high renewables in the grid
- Scenario Building: Utilities can perform the studies while accounting the uncertainties for demand and renewables



Generation type

- Thermal (Coal, Gas etc.)
- Hydro (reservoir based & run of river)
- Renewables (Wind, Solar etc.)

Constraints

- Technical (ramp rates, technical minimum, etc.)
- Commercial (cost)

Input



Algorithm



- Mixed Integer Linear Programming (MILP)

Generation mapping (up to 10/15 years)

- Weekly generation mapping in MU
- Hourly generation mapping in MW
- Seasonal Surplus/deficit
- Scenario analysis
- Seasonal summary

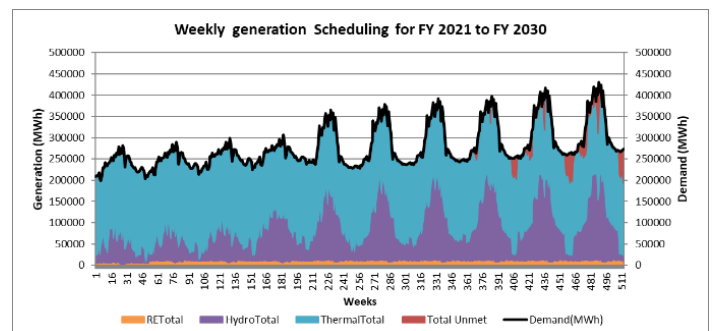
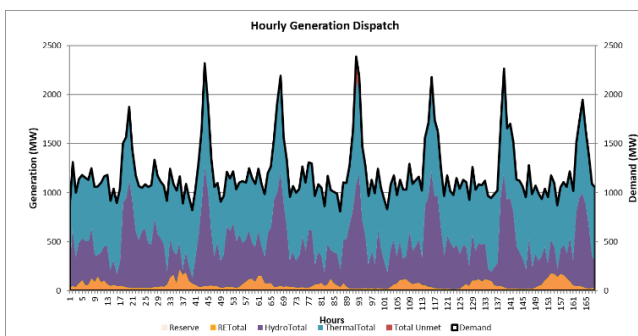
Load-Generation Profile

- Hourly load profile (MW)
- Hourly generation dispatch (MW)
- Generation statistics

Output



RESULTS GENERATED



POWER PROCUREMENT OPTIMIZATION FOR DISCOMs IN RE RICH ENVIRONMENT

BACKGROUND

Partnership to Advance Clean Energy Deployment (PACE-D 2.0 RE) program is designed to support the Government of India (GoI) target of installing 175 GW renewable energy by 2022. One of the program's aims is to mainstream renewable energy into power sector planning by developing software which can support DISCOMs with robust long-term power sector plans at high RE and EV scenarios. The program is launched in January 2019 by USAID/India in partnership with the Ministry of New and Renewable Energy (MNRE). The Power Procurement Optimization (PPO) tool is developed as part of DISCOM Renewable Energy Procurement Optimization & Smart Estimation (REPOSE) software. The PPO tool allows DISCOMs to analyse and select the best possible power purchase contracts to optimize the overall system level cost.

● POWER PROCUREMENT OPTIMIZATION

The conventional methods of power procurement optimization lag in handling the variations in the demand, RE variability and cannot assist the utilities in estimating the flexible generation requirements. This leads to the following:

- The increased financial risks associated with the demand-supply gaps
- Seasonal surplus/deficit conditions throughout the year
- Possibility of having energy surplus and capacity deficit

PPO tool can support the DISCOMs/GENCOs to optimize the procurement cost for future years by handling the RE uncertainties, Renewable Purchase Obligation (RPO) targets and selection of Power Procurement Agreements (PPAs). It considers the existing and future contracts considering various technical and commercial constraints of generation resources (thermal, hydro and renewables like wind solar etc.,) while meeting the RE targets with reduced consumer tariffs.

The tool works in sync with the other modules of REPOSE software such as,

- a) Demand Forecasting (DF) tool that provides the demand profile in weekly and hourly intervals, and
- b) Integrated Resource Mapping (IRM) tool that integrates the demand profile with the scheduling of existing/new generation resources to meet the projected demand.

● ABOUT THE TOOL

PPO is an advanced tool that estimates least cost of power purchase contracts under different scenarios for the long-term (up to 10/15 years) horizon.

- Available for DISCOMs and GENCOs at no cost
- Visibility of flexible generation requirements to meet dynamic variations in demand and RE
- Intuitive and user-friendly Interface
- Scientific methods and advanced techniques are used for optimizing the

● IMPACTS

- Optimize power procurement cost with existing and future contracts
- Assessment of flexible generation to increase the RE penetration
- Assessment of stranded capacity for thermal units
- Better power procurement planning
- Minimized tariffs with least

VALUES OFFERED



The software assists the DISCOMs to develop least cost procurement plans by:

- Optimizing the power procurement cost through selection of best possible technologies by performing simulations at weekly and hourly intervals over the next 10/15 years.
- Estimating the required flexible generation to allow maximum possible renewable

SOFTWARE OUTPUTS



- Annual Procurement Plan up to 10/15 years: Analysis at the hourly & weekly level, providing types of resources, its quantity and deficit details.
- It helps DISCOMs to plan medium/long term procurement well in advance.
- Scenario Building: Utilities can perform the studies considering the various types of contracts in hand and flexible generation technologies.
- Annual and Seasonal outlook of the system adequacy with details like weekly deficit, capacity and energy requirement.

Generation type

- Thermal (Coal, Gas etc.)
- Hydro (reservoir based & run of river)
- Renewables (Wind, Solar etc.)

Constraints

- Technical (ramp rates, technical minimum, etc.)
- Commercial (cost)
- Future Contracts

Input



Algorithm



- Mixed Integer Linear Programming (MILP)

Output



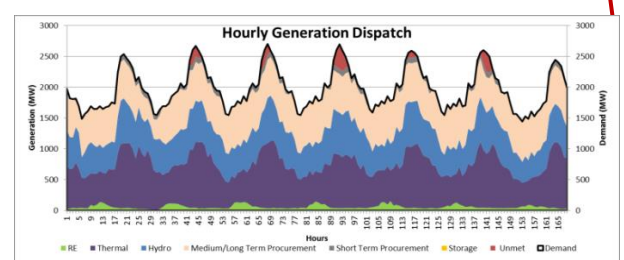
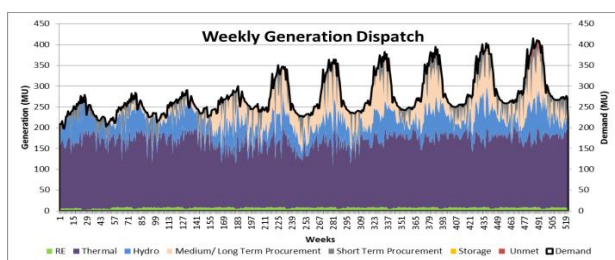
Power Procurement Plan (upto 10/15 years)

- Selection of PPAs
- Flexible generation assessment
- Weekly MW capacity and energy profile
- Status of RPO targets
- Optimization of cost with RE Maximization

Load-Generation Profile

- Hourly load-generation scheduling
- Generation statistics like dispatch and cost parameters

RESULTS GENERATED



ABOUT PACE-D 2.0 RE

Through PACE-D 2.0 RE, USAID works with the Ministry of Renewable Energy to help national and state partners develop an enabling environment to promote a faster and more cost-effective deployment of renewable energy. PACE-D 2.0 RE partners with distribution companies (DISCOMs) from Assam, Jharkhand, and Gujarat to adopt innovative approaches to DISCOM resource planning, optimizing power procurements with renewable energy options. The views expressed in this publication do not necessarily reflect the views of the United States Agency for International Development or the United States Government. For more information, visit <https://www.pace-d.com/>.

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