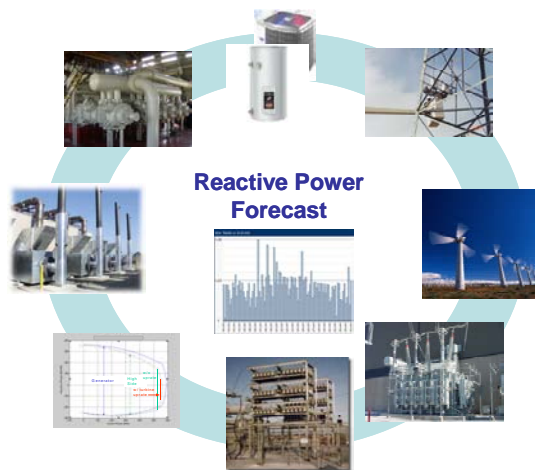


# Transmission Efficiency Initiative: Host Demonstration Project

## Reactive Power Forecasting to Assist in VAR Planning



*Reactive power forecasting*

Reactive power planning, or volt-ampere-reactive (VAR) planning, is an effort to find the most economic investment plan for new reactive sources at selected load buses while ensuring proper voltage profile and satisfying operational constraints. VAR planning has been analyzed without much consideration of the time-varying nature of reactive power. In practice, resource and transmission planners focus on future active power demand through conventional load forecasts, using a typical power factor band for the reactive power flow at grid interface points. Federal Energy Regulatory Commission reports and North American Electric Reliability Council planning standards state the importance of reactive power in large electric power systems. They provide principles for efficient and reliable reactive power supply and consumption, and they specify operating guidelines, such as the requirement of synchronous generators to regulate voltage and standard power factor design capability for power plants at the point of interchange.

However, many recent, noticeable voltage stability problems due to a lack of reactive power resources or their inappropriate controls indicate that the existing utility practices and specified operating guidelines might need to improve. System planners and operators need tools and

Reactive power forecasting helps to

- Gain insights into reactive power profiles and characteristics
- Enable secure and efficient grid VAR planning and operations
- Sustain economic voltage support service and compensation conditions

methods to better foresee the dynamic changes of reactive power demands and resources. They need to better recognize significant changes of network reactive power demand and supply based on loading (notice the ever-increasing motor and power electronics loads and their nonlinearity), voltage profile, and topology changes due to maintenance, contingency, and consequent mitigation measures. It is also important to clearly understand the interplay and impact of switching operations of reactive power resources, load tap changes of transformers, and power electronics-based reactive power compensators. The existing, deterministic planning and operating guidelines might not perform well under dynamically changing operating conditions, and this situation might threaten grid security and efficiency.

### **Project Scope**

As part of EPRI's Transmission Efficiency Initiative, Con Edison is evaluating a possible demonstration project of a systematic methodology and tool to track and forecast time-varying reactive power. The capability to forecast the reactive power demand and resources should enable secure and efficient VAR planning and allow economic voltage support service and compensation. The project can help system planners and

operators gain insights to the reactive power profile and characteristics and might provide new, efficient planning and operating practices.

### **Expected Benefits**

The immediate value of this project is its provision of the accurate, reactive power forecast over a wide range of time horizons. More knowledge of reactive power demand allows system planners to optimally allocate reactive resources to minimize the reactive power flow over transmission lines and, therefore, reduce the transmission losses. Better reactive power forecasting allows system operators to control the reactive power to improve voltage profiles and reduce transmission losses. Reduction of reactive power flow over transmission system enables more utilization of existing transmission capacity.

### **Project Approach and Schedule**

The project team will develop an accurate reactive power forecasting tool to facilitate VAR planning and operations.

The envisioned project tasks are the following:

1. Conduct a survey on industrial practices on volt/VAR planning and operations. The survey might cover common challenges and future opportunities to improve in this area, along with recommendations.
2. Investigate the key variables in determining the reactive power demand. This task might require a thorough investigation of characteristics and profiles of residential, commercial, and industrial reactive power demands and potential distributed energy resources, including intermittent, renewable resources. It also investigates the impact of modern transmission technologies and system operating conditions (voltage, loading, and topology) on the reactive power. A study of the methods for representing the net changes of reactive power demand in the distribution system at the transmission level might be useful, as well.

3. Develop reactive power forecasting models. This task might collect the historical data and analyze the patterns correlated with seasonal weather changes and operating condition to design short- or mid-term forecasting models. For long-term forecasts, the general level of economic activity might provide useful information as a key driver for projections of energy consumption. It might be worth investigating changing regulation policies and enabling technologies for energy-efficient appliances.
4. Assess the benefits through this project. It might demonstrate the beneficial impact of the forecasted reactive power in terms of improved system security and efficiency. It is expected to provide an improved framework for voltage control and reactive power interchange principles using the reactive power forecast.

It is expected to take 12 months to perform and develop the technical studies and methodology for forecasting reactive power for system planners and operators.