

CEC-500-2020-038: Complete and Low-Cost Retail Automated Transactive Energy System (RATES)

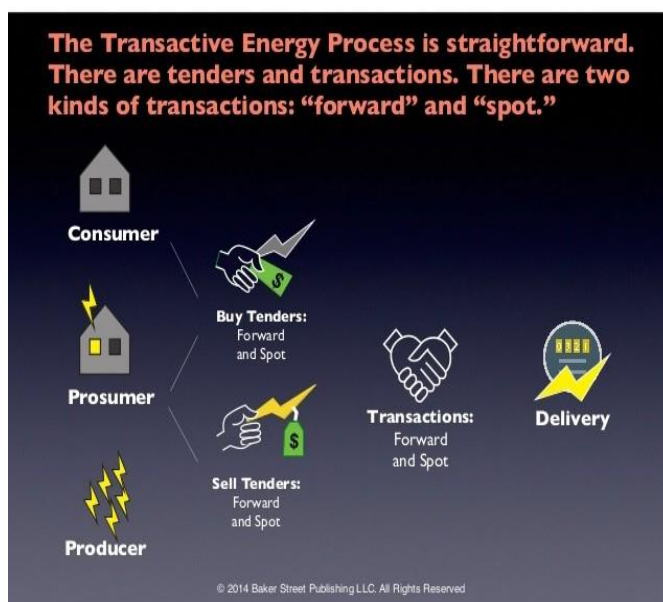
OPPORTUNITY

Existing Demand Response programs, tariffs and wholesale markets in California are focused primarily on reliability and peak load reduction. The end-use loads enrolled in these programs tend to have high opportunity costs so participation in these programs is low. Participation logistics - including metering, telemetry, baseline estimation, verification and settlement - still serve as a barrier to wider participation. Substantial research and technology development over the past decade have pointed toward a vast untapped potential for balancing electricity supply and demand in near-real time through better management of customer loads and distributed energy assets.

PROJECT DESCRIPTION

This research project demonstrated a Retail Automated Transactive Energy System (RATES) for a decentralized energy market interfaced with customers, a distribution operator, a load-serving entity, and a wholesale market. RATES was developed with the goal to maximize the potential for residential and small commercial customers to self-manage their electricity use to save money as California achieves its 100 percent clean energy and electrification goals by 2045.

The proposed solution includes an innovative retail tariff with real-time, actionable prices and bill stability. The solution also offers a platform to communicate the price offers (buy and sell tenders) to customers so that operation of their electrical devices can be automated for their benefit. The platform interfaces with SCE and the California ISO, including scheduling, metering, and billing calculations for the tariff. The solution also provides an IoT energy management system that interfaces with SCE smart meters, off-the shelf customer devices, photovoltaics, electric vehicles, and artificial intelligence assistants in response to prices. Based on the optimization results, the agents automatically accept portions of the tenders and create forward transactions for electricity in hourly, 15-minute, and five-minute intervals with the tendering parties.



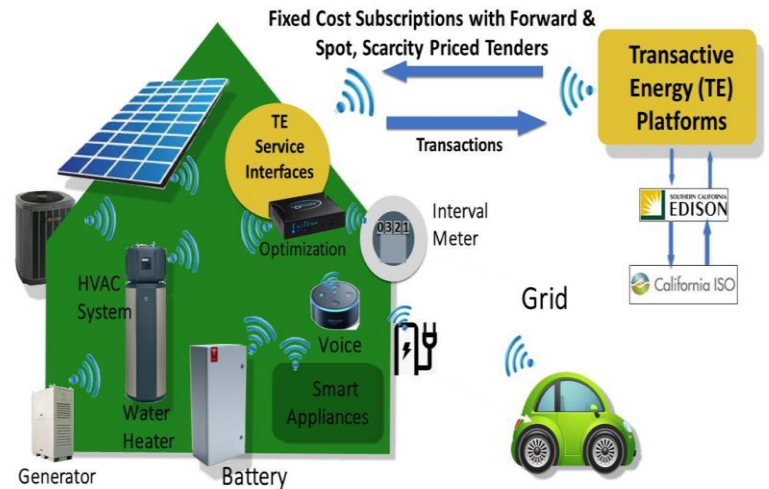
HOW RATES WORKS

Essentially, RATES uses a simple, innovative tariff. The tariff offers electric customers "subscriptions" for fixed hourly kW of electricity shaped to their historical usage at a fixed monthly cost. The monthly cost is based on their current tariff. If the customer uses more or less kW in an hour than subscribed, RATES automatically sells back kW or buys more kW at real-time tendered prices that vary with supply, demand, and other grid conditions.

What is Transactive Energy? The GridWise Architecture Council's Framework defines transactive energy (TE) as "A set of economic and control mechanisms that allows the dynamic balance of supply and demand across the entire electrical infrastructure using value as a key operational parameter."

The tariff also protects customers and suppliers from volatile bills, fairly allocates costs among customer classes, and supports investments in clean generation, storage, and energy efficiency. Another benefit of RATES is that customers do not need to see or understand, unless they are curious, the technical details of RATES because the customer interface is very simple. Ultimately, customers who install home automation will gain savings and help California achieve its clean energy goals by switching from their current tariff to a new tariff and then, with their permission, some of their devices will change when they operate to use more low-price electricity. Below is a step-by-step process how RATES works:

- Each customer receives transactive buy and sell tenders (offers) from the IOU through RATES.
- Optimization agents help the customer decide how much of each buy or sell tenders to accept as transactions. The transactions specify the price and quantity.
- The net purchases from transactions from all participating customers is totaled for a set of future intervals.
- A “market maker” algorithm issues new tenders at prices that may vary depending on the net purchases.
- The tenders are received by the transactive energy service interface and optimization agents for individual devices.
- The optimization agents determine the response of devices to the forward (future) tender prices, weather forecasts, and customer preferences.
- Based on the optimization results, the agents automatically accept portions of the tenders and create forward transactions for electricity in hourly, 15-minute, and five-minute intervals with the tendering parties.



BENEFITS



RATES can help to meet California’s clean energy goals, cost-effectively



RATES can be highly beneficial in comparison to conventional tariffs and demand response programs for storage, EV charging, and HVAC management



Opportunities to reduce customer bills through better energy management informed and automated by RATES Increased bill stability with electricity subscriptions



Targeted subscriptions for low-income customers and fairness



Opportunities to monetize the flexibility grid services of energy management, smart appliances and controls, and technologies



Opportunities to reduce the cost of electric vehicle charging for the customer Increased transparency for the customer into energy use and costs

RESULTS

The RATES project achieved what was expected and met the goals of the project. The team demonstrated the feasibility of integrating wholesale and retail market operations using a transactive system.

As importantly, the project showed that low-cost, off-the-shelf, and even existing customer IoT devices, energy storage, photovoltaics, and electric vehicles can be leveraged and incorporated into RATES.

Validating the core principles and concepts of RATES has spawned independent projects, including using dynamic variable prices provided by RATES. In addition, SCE is examining an extension of this project to continue research objectives that may not have been addressed in the original scope.

RECOMMENDATIONS

The following recommendations are the step-by-step installation of RATES in California and support of the further development of RATES and its wide adoption.

1. Extend and apply the current RATES pilot for additional research results at reasonable costs.
2. CPUC initiates workshops and rulemaking to implement opt-in subscription transactive tariffs for IOUs.
3. The CPUC and the CEC should establish a policy for hosting the RATES transactive energy platform.
4. Installation of RATES for customers with storage, electric vehicles, and other flexible devices.
5. After a few more years of experience with step 4, make the tariff opt-out for most customers.
6. Enhance the RATES interface to the California ISO to frequently create wholesale tenders.

These Findings are based on the report “Complete and Low-Cost Retail Automated Transactive Energy System (RATES),” which is available on the Demand Response Emerging Technologies website: <https://www.dret-ca.com/>