# Progress Energy Service Company

***Optimized Energy Value Chain***

## Scope of Work

Progress Energy Service Company's (Progress Energy's) Optimized Energy Value Chain project involved deployment of advanced metering and distribution automation systems. The project implemented two-way communications to allow Progress Energy to manage, measure, and verify targeted demand reductions during peak periods. New information and communications systems capture commercial and industrial (C&I) meter data for billing and future implementation of new pricing programs and service offerings. Progress Energy implemented a distribution management system, automated switching, and integrated voltage and reactive power control to reduce line losses and improve service reliability. The project also installed advanced transmission systems, including on-line monitoring equipment on key and "at-risk" transmission substations and transformer banks. In addition, Progress Energy installed 255 electric vehicle charging stations in the Carolinas and Florida service territories.

## Objectives

The project reduced peak loads, overall energy use, and operations and maintenance costs while improving distribution system efficiency, reliability, and power quality. The electric vehicle component aimed to encourage use of electric vehicles.

## Deployed Smart Grid Technologies

- **Communications infrastructure:** The project deployed a wireless mesh advanced metering infrastructure (AMI) communications system, a two-way network that connects the meter to various cellular backhaul points and a high-speed network that connects the substations to a central processing center. The infrastructure is based on industry-open standards to handle the added two-way communication between the new substation devices and the distribution supervisory control and data acquisition (DSCADA) system. The new network replaces existing remote terminal units and is fully integrated to allow direct communications between the central data processor and substation devices.
- **Advanced metering infrastructure:** The project deployed 130,315 smart meters, which replace Progress Energy's remaining electro-mechanical meters, providing full coverage of its service territory.

### At-A-Glance

**Recipient: Progress Energy Service Company**

**State: Florida, North Carolina, and South Carolina**

**NERC Region: SERC Reliability Corporation and Florida Reliability Coordinating Council**

**Total Project Cost: $526,585,524**

**Total Federal Share: $200,000,000**

**Project Type: Advanced Metering Infrastructure
Customer Systems
Electric Distribution Systems
Electric Transmission Systems**

**Equipment**

- **130,315 Smart Meters**
- **AMI Communications Systems**
  - **Meter Communications Network (Wireless Mesh)**
  - **Backhaul Communications (cellular)**
- **4,103 Direct Load Control Devices**
- **Distribution Automation Equipment for all 2,460 circuits**
  - **Distribution Management System**
  - **Cellular SCADA Communications Network**
  - **Automated Distribution Circuit Switches**
  - **Automated Capacitors**
  - **Automated Voltage Regulators**
  - **Equipment Condition Monitors**
- **255 Electric Vehicle Charging Stations**

**Prepay Pilot Program for 1,000 Customers**

- **250 In Home Displays**
- **Cellular, Internet, Landline Notifications**

**Key Benefits**

- **Reduced Costs from Distribution Line Losses and Equipment Failures**
- **Reduced Electricity Costs for Customers**
- **Reduced Operating and Maintenance Costs**
- **Reduced Meter Reading Costs**
- **Deferred Investment in Generation, Transmission, and Distribution Capacity Expansion**
- **Improved Electric Service Reliability and Power Quality**
- **Reduced Ancillary Service Cost**
- **Reduced Truck Fleet Fuel Usage**

This system provides automated meter reading, improved meter accuracy, enhanced outage response and notification, and improved theft-of-service detection. More detailed and timely data on peak electricity usage improve load forecasting and capital investment planning.

- **Direct load control devices:** Direct load control systems in Florida used to control heating, ventilating, and air conditioning (HVAC) systems and pool pumps were expanded to enable better two-way communications and to maintain and transition existing demand response capacity. The existing systems were capable only of one-way "paging" communications, and the upgrade enables Progress Energy to control the load to receive feedback about effectiveness. This capability gives Progress Energy greater control during peak load periods and thus helps defer transmission and distribution capacity additions.
- **Prepay pilot:** A prepay pilot program was deployed for 1,000 customers in the South Carolina service area. The program allowed customers to monitor their energy usage and make decisions about when and how to fund their accounts. The pilot helped to validate perceived benefits/values of such a program and determine customer preferences for communication and ways to pay bills.
- **Distribution automation systems:** The newly deployed systems can perform real-time state estimation by running load-flow models, which aid in understanding systems operation. These advanced grid modeling capabilities provide tools for more cost-effective integration of customer-owned distributed energy resources. Substation upgrades include equipment condition-monitoring devices, which alert the utility of any problem with the substation equipment, preventing failures and reducing operations and maintenance costs.
- **Distribution system energy efficiency improvements:** Automated capacitor and regulator controls automate the distribution systems, allowing for greater control of power quality and enabling more cost-effective voltage and reactive power control (integrated volt-VAR control, or IVVC). Increased voltage controls allow for smaller voltage drops over the distribution feeders and improved power factors, reducing line losses and increasing overall efficiency of the system.
- **Advanced transmission systems:** Improved monitoring and sensing equipment was part of the condition-based management task. This equipment allows grid operators to better assess the state of the equipped transformers and further optimize maintenance cycles. Additionally, this equipment provides visibility to developing fault conditions and allows for the preemption of transformer failures. Savings are realized from reductions in equipment replacements, cleanup costs from transformer failures, and oil consumed by transformer systems. Progress Energy prioritizes equipment installations based on an evaluation of transformers throughout the transmission grid, considering their criticality to the system, condition, age, operational history, and resulting risk profile. The monitoring system consists of a commercially available multi-gas and moisture sensor for the main tank of the transformer, a multi-gas sensor for the tap changer compartment for load tap changing transformers, a bushing monitoring system, and a communications system for collecting the data and integrating it into the Progress Energy enterprise system.
- **Electric vehicle charging stations:** Progress Energy installed stations in the Carolinas and Florida in 255 locations in the Progress Energy service territory**.** The stations help to encourage early adoption of electric vehicles. The stations also provide Progress Energy with information regarding the charging practices of electric vehicle owners, which can be used to plan for the future increase in the number of electric vehicles on the road.

## Benefits Realized

- **Reduced electricity costs for customers:** IVVC improves customer efficiency by enabling a reduction in the average voltage of electricity delivered. As customer efficiency improves, customer usage (MWh) and electric bills decline. Environmental impact reductions constitute another IVVC benefit, as the amount of electricity that must be generated for a given number of customers drops as customer efficiency improves. Finally, IVVC can reduce electric demand (megawatts) by deferring or avoiding investments in generation, transmission, and distribution capacity, reducing the electric rates customers pay.
- **Reduced operating and maintenance costs:** The AMI system enables efficiency in dispatching field crews which, in turn, reduces meter reading operations miles and costs and associated greenhouse gases. AMI also allows for remote monitoring and troubleshooting of meters on its system.
- **Reduced meter reading costs:** The AMI system allows for faster, more efficient outage detection and diagnosis, as well as reduced restoration times. System operators can ping meters to get a clearer picture of what is happening in the field and deploy restoration field crews more efficiently. In many cases, the AMI system identifies the outage, a crew is dispatched, and power is restored without any customer calls.
- **Deferred investment in generation, transmission, and distribution capacity expansion:** Distribution automation equipment such as automated switches, capacitors, and reclosers has enabled more efficient operation of the grid. In addition to improved utilization, these assets have increased availability of data that can be utilized to more accurately forecast the need for capacity expansion investment.
- **Improved electric service reliability and power quality:** By combining the use of automated switches and reclosers with the distribution management system, outages and restoration times can also be reduced. The switches and reclosers use sensing capabilities to enable the creation of loop-based feeders, offering faster restoration times, which contribute to improved system reliability.
- **Reduced truck fleet fuel usage:** AMI has reduced vehicle miles traveled for meter reading, resulting in lower truck fleet fuel usage and greenhouse gas emissions for this portion of operations.

## Lessons Learned

- Progress Energy's project teams experienced issues with regular business functions when employees were taken from their day-to-day jobs and put to work on the SGIG project. Other utilities planning such projects should consider potential resource restrictions.
- Progress Energy asked that security features be pre-loaded on devices from vendors. These features caused problems during initial configuration, so Progress Energy recommends not requesting pre-loading.
- When dealing with vendors, a clear outline of requirements is critical. Test scripts should be provided to the vendors along with the list of devices. The vendor should be told to confirm all necessary compatibility before sending devices.

## Future Plans

Progress Energy merged with Duke Energy in July 2012 (mid-project). The future plans noted below apply to Progress in its new role as part of Duke Energy.

- **Innovating new benefits from smart capabilities.** Duke Energy has established an ongoing innovation program to identify new ways to benefit from smart grid capabilities. Customer-facing ideas currently being evaluated include customer prepay, improving customer outage communications, using meters to verify post-storm service restoration, improving detection of tiny (1-3 premise) service interruptions, and offering home energy management solutions. The innovation program is also employed internally to identify how smart grid data and capabilities can be used to streamline utility operations or improve business process outcomes.

- **Enhancing data analytics and grid modeling**. While capabilities delivered by the smart grid are proving valuable to utilities and customers today, the data produced by associated equipment can be even more valuable in the long run. Day-to-day operating data can be aggregated over time into semi-permanent data models of a distribution network. These data models describe a distribution network in its normal, optimized state—topology, equipment settings and ratings, impedances, voltages, etc. When temporary issues (storms, outages, etc.) cause the distribution network to change, the data model can be used as a goal to which to return. And when conditions change more permanently—such as when a new industrial plant or photovoltaic solar generation system is added to a circuit—the data models can be used for scenario planning, determining optimum configurations leading to a new normal state. As customer-sited generation and other distribution challenges grow, the value of modeling cannot be understated.
- **Continuing grid modernization in other states.** Duke Energy is anxious to leverage the lessons learned from its Smart Grid Investment Grant projects to the benefit of its customers in other states. Duke Energy is currently developing deployment plans and securing regulatory approvals for additional smart investments in several states.

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