



## Smart Meter Investments Benefit Rural Customers in Three Southern States

### 1. Summary

Tri-State Electric Membership Corporation’s (Tri-State) Smart Grid Investment Grant (SGIG) project has produced benefits for the small, member-owned cooperative and its customers in several ways. Customer satisfaction and services have improved; meter operations costs are down; write-offs from unpaid bills dropped in part because of a popular advanced bill payment (pre-pay) program; and lessons were learned during project implementation. Table 1 summarizes key results based on data through the middle of 2013, when their fiscal year ends.

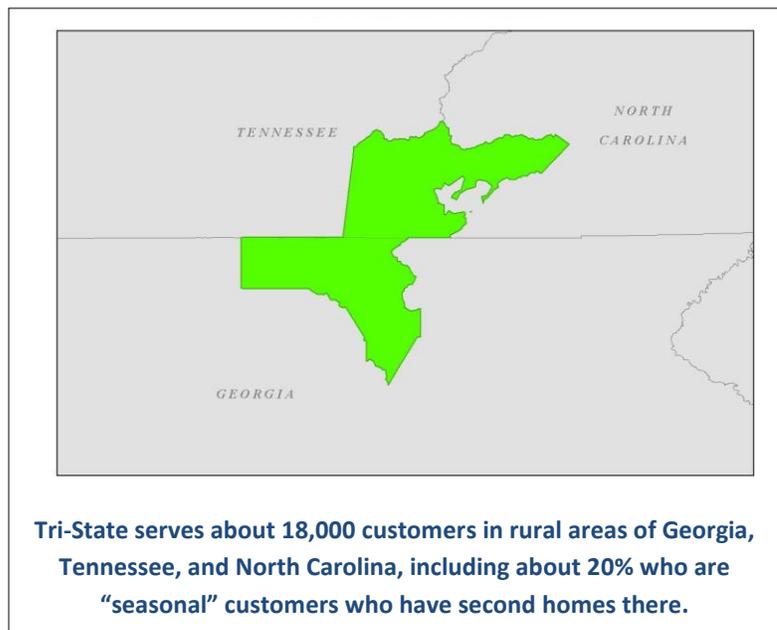
*Under the American Recovery and Reinvestment Act of 2009, the U.S. Department of Energy and the electricity industry have jointly invested over \$7.9 billion in 99 cost-shared Smart Grid Investment Grant projects to modernize the electric grid, strengthen cybersecurity, improve interoperability, and collect an unprecedented level of data on smart grid operations.*

Table 1. Summary of Key Results	
<b>Improvements in Customer Satisfaction and Services</b>	<ul style="list-style-type: none"> <li>i. A popular “My Usage” web portal is helping customers to manage their consumption and costs.</li> <li>ii. A pre-pay billing program is helping customers manage monthly bills and household budgets.</li> <li>iii. Tri-State’s many second home owners can remotely monitor their usage and assess the status of their homes; several have been able to fix faulty appliances after finding anomalies in their usage patterns.</li> <li>iv. Improved outage detection has reduced restoration times.</li> </ul>
<b>Cost Savings from Operational Improvements</b>	<ul style="list-style-type: none"> <li>v. Meter operating costs have been reduced from a high of about \$450,000 in 2011 to a little more than \$150,000 in 2013 after smart meters were installed. This is a cost reduction of about 65%.</li> <li>vi. The pre-pay program and automated connection/disconnection capabilities of smart meters contributed to a 50% reduction in write-offs from unpaid bills. These costs fell from a high of about \$52,000 in 2011 to less than \$25,000 in 2013 after smart meters were installed.</li> <li>vii. These savings, along with the DOE co-funding under the SGIG program, contribute to a payback period of less than five years for Tri-State’s entire smart metering investment.</li> </ul>
<b>Lessons Learned from Project Implementation</b>	<ul style="list-style-type: none"> <li>viii. The selected smart meter vendor agreed to initially host Tri-State’s “head-end” hardware, data, and software. This reduced system integration issues and accelerated the transition to a fully functioning advanced metering infrastructure for Tri-State.</li> <li>ix. Offering the pre-pay billing program required Tri-State to comprehensively review and redesign its bill payment, bill due date, delinquency notification, and penalty charge policies and business practices. The redesign was one of the keys to successful implementation.</li> </ul>

## 2. Introduction

Tri-State is an electric distribution cooperative serving about 18,000 mostly residential customers (about 84%) in rural areas in northern Georgia, southeastern Tennessee, and southwestern North Carolina. More than 20% of Tri-State's customers are "seasonal" and own second homes for use during summer and winter vacations. Tri-State owns no power plants and purchases all of its electricity from the Tennessee Valley Authority (TVA). As a result of its rural, mountainous location, and the nature of its customer base, meter operations costs were one of the company's largest expenses, after electricity purchases.

Tri-State's SGIG project involves territory-wide installation of about 15,000<sup>1</sup> smart meters, line monitoring for improved outage detection, pre-pay billing options, and a web portal for usage monitoring by customers. The total budget for the project is about \$2.4 million, including about \$1.1 million in funding from DOE under SGIG and the American Recovery and Reinvestment Act of 2009.



The communications architecture that supports the smart metering system consists of two-way communications between: (1) meters and substations using power line carrier systems and (2) substations and the head-end advanced metering infrastructure (AMI) server using fiber optic lines. Having had positive experiences with power line carrier systems, Tri-State implemented this architecture because of the reliability it provides in sparsely populated and mountainous areas where radio networks can be less reliable, and because it used existing fiber optic lines and repeaters so additional equipment and infrastructure investments were not required.

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<sup>1</sup> In 2009, before Tri-State's SGIG project, 3,000 customers received smart meters as part of a pilot program.

### 3. Improvements in Customer Satisfaction and Services

Tri-State customers say they like the “My Usage” web portal because they are better able to understand how and when they use electricity and find ways to manage their monthly bills. In fact, they believe it is one of the best programs offered by the utility. Figure 1 is a “screen shot” of a typical customer’s web view and shows daily usage and the days’ high and low temperatures. It also shows the average daily usage and a summary of recent alerts. This information is also available through a mobile app for customers with smart phones. Upon request, Tri-State sends alerts when a customer’s consumption reaches a specified level.

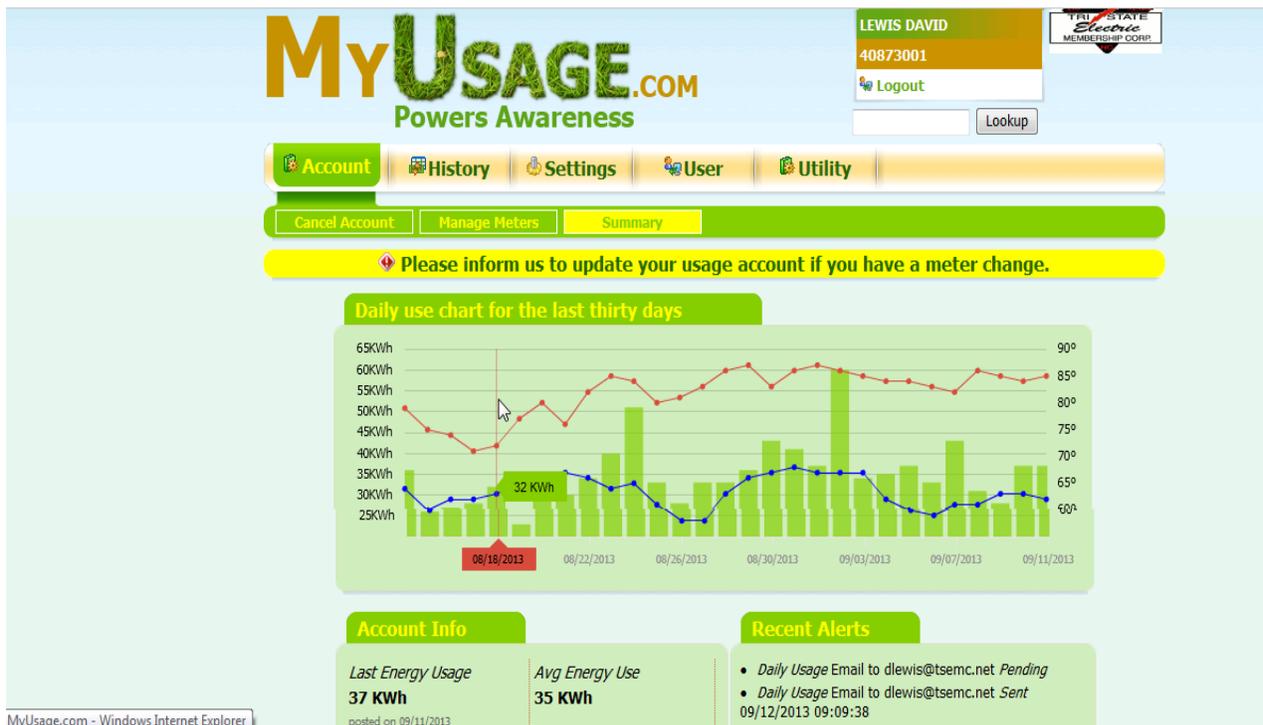


Figure 1. Web portal screen shot shows daily variations in electricity use.

Tri-State’s many second home owners are able to use their web portal to monitor their usage and check on the status of their homes. Several have been able to identify and remedy problems with heating and cooling equipment, well pumps, and even broken pipes by noticing unexpected variations in their normal electricity use. In doing so they were able to make repairs before a whole month of higher usage was billed.

Tri-State’s voluntary pre-pay program is becoming a popular option for many customers, especially those who want more control over their household budgets. Tri-State saw pre-pay as a program that could reduce their write-off costs while at the same time giving payment options for their customers.

Participation grew from 600 customers in 2012 to more than 800 in 2013.

Customers can monitor their usage and evaluate if conservation actions are needed to stay within pre-set budgets.

Tri-State sends alerts by text, email, or phone to notify participating customers of low balances and pending disconnects. Customers with written-off

balances can now be reconnected automatically as long as 30% of the purchased credits go toward the debt; previously service could not be reinstated until the debt was paid in full.

Disconnections due to insufficient credits have gone down for the participants in the program as customers learn to manage their consumption against their budget and electricity credits.



Tri-State is using smart meters to improve outage management. For example, they have detected outages in subdivisions with vacant second homes, reconnected service without being notified by customers, and prevented potential property damages such as frozen pipes that burst from lack of heat.

After a tornado struck in January 2013, followed by six inches of snow, about 6,000 of Tri-State's customers were without power. Tri-State used the on/off status of the smart meters to pinpoint outage locations and dispatched repair crews using geographic information systems (GIS) for speedier restoration of services. In another example, Tri-State was able to restore power to a mobile home park before anyone had called to report the outage, reducing the duration of the outage and improving customer convenience.

#### 4. Cost Savings from Operational Improvements

Tri-State's business case for investing in smart meters was based on projected cost savings from reduced personnel and truck rolls resulting from meter reading automation, more reliable readings, and the use of remote disconnections and reconnections.<sup>2</sup> Before the SGIG smart meter installations, the meter department required four full-time employees and four trucks to disconnect and reconnect meters, perform collections activities, retrieve missing meter readings, replace failing meters, and manually read all of Tri-State's poly-phase meters. Following the SGIG smart meter installations, Tri-State has been able to cut in half the number of vehicles and employees necessary to maintain meter operations, and one of the two

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<sup>2</sup> These savings were confirmed during a 2008 smart meter pilot program involving 3,000 customers that was implemented by Tri-State before SGIG.

remaining workers has half of their time assigned to non-metering functions servicing Tri-State's underground lines. These savings, along with the DOE co-funding under the SGIG program, contribute to a payback period of less than five years for Tri-State's entire smart metering investment.

Figure 2 shows Tri-State's meter operations costs over a nine-year period. The three cost components shown include associated labor, overhead, and transportation costs and are based on the costs associated with (1) reading meters (including those that did not report usage for some reason); (2) connecting and disconnecting meters due to collection activities, maintenance, service transfers, and meter removals; and (3) maintaining meters for diagnostic activities, repairs, materials, and replacement costs.

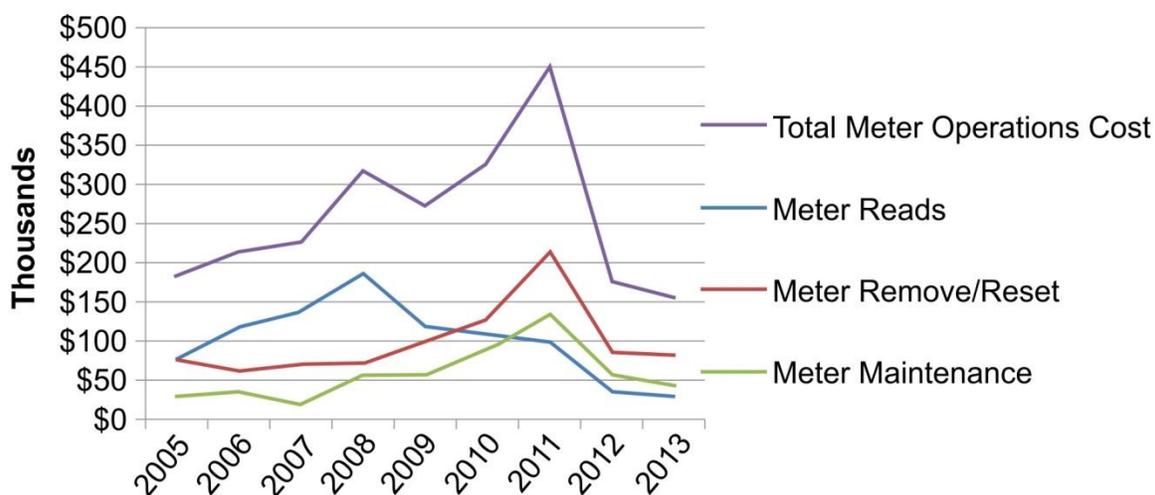


Figure 2. Tri-State's Meter Operations Costs 2005-2013.

Prior to the installation of smart meters, Tri-State's meter operations costs rose steadily, due in part to the aging of its automated meter reading (AMR) system and growing needs for meter maintenance and replacement. After the smart meter deployment, meter operations costs fell sharply from a high of about \$450,000 in 2011 to \$156,000 in 2013, a 65% decrease. In 2013, for example, truck rolls were reduced by about 10,400 and almost 42,000 vehicle miles traveled were avoided, thus saving money and reducing environmental emissions.

Write-offs from unpaid bills were about 0.2% of residential revenues for Tri-State<sup>3</sup>. While Tri-State expected a reduction in write-offs from smart metering, the impact was much greater than expected. Tri-State's new capabilities to remotely connect and disconnect meters were a contributing factor, as was the pre-pay program. By targeting locations with high customer

<sup>3</sup> Tri-State's residential revenues for 2013 are estimated to be about \$20 million.

turn-over rates and needs for frequent collection activities, Tri-State was able to reduce the average write-off balance by 50% to about 0.1% of residential revenues.

Figure 3 shows Tri-State’s write-offs from 2006-2013 and the reductions following the installation of smart meters. Annual write-offs rose steadily before 2010 due in part to the effects of a slow economy, but fell in half after smart meters were installed.



Figure 3. Tri-State’s Write-Off Costs 2006-2013.

## 5. Lessons Learned from Project Implementation

Tri-State’s SGIG deployment of smart meters replaced an outdated AMR system. In 2000, Tri-State completed deployment of an AMR system and saved money by reducing manual meter reads. However, the system did not cover poly-phase meters<sup>4</sup> for some commercial customers. By 2008, many of the AMR meters, and legacy substation equipment, began failing, and the manufacturer decided to discontinue making some of the necessary parts. Before SGIG, Tri-State began replacing its AMR system with a smart meter pilot program in 2008.

Tri-State benefitted from these early experiences with AMR and smart metering during the 3,000 person pilot program when they began their system-wide deployment of smart meters under the SGIG program. Tri-State credits this knowledge and know-how with improving their ability to implement a successful project, including vendor selection, timely component delivery, quality control, systems integration, and customer outreach and education.

<sup>4</sup> Poly-phase meters are used for larger customers receiving poly-phase service. Many smaller residential customers receive single-phase service and have single-phase meters.

Tri-State was able to keep their system integration costs relatively low compared with other utilities because of its long-standing relationships with vendors, including the one involved in the 2008 pilot smart meter program. Having experiences with smart meters and Tri-State, the selected vendor was able to commit to an aggressive delivery schedule and provide hosting services for head-end hardware, data, and software that enabled a relatively smooth transition to full integration with Tri-State's customer information system. For example, other SGIG smart meter projects encountered unexpected complications and schedule delays when new systems from different vendors were brought together for the first time under the pressure of tight schedules, while Tri-State did not.

Tri-State wisely conducted a comprehensive review of its billing policies and business practices before offering its pre-pay program. After the review, and because of the new features and capabilities for both the utility and its customers, Tri-State determined it needed to update almost all of its policies related to bill payments, bill due dates, delinquencies, penalties, and account connections and disconnections. Tri-State also consulted with other utilities and took advantage of the [National Rural Electric Cooperative Association's Cooperative Research Network's](#) knowledge base to avoid pitfalls and replicate best practices, including information on successful methods for promoting new pre-pay and usage monitoring programs.

## **6. Future Plans Include Follow-on Activities**

TVA, Tri-State's electricity supplier, offers wholesale time-of-use rates for its distribution company customers. With smart meters, Tri-State can now use customers' consumption data to better understand customer demand and the cost impact of implementing retail time-of-use rates for its customers in the future. Tri-State is focusing on achieving energy conservation benefits, cost savings, and reduced financial risks by better understanding the supply/demand cost structure. The data from the smart meters can be used by customers to gain a better understanding of usage patterns so they can make more educated decisions about consumption and costs when time varying rates are in place. Tri-State plans to evaluate applications of voltage controls and reactive power management, including voltage reductions during peak demand periods, to further reduce its electricity purchasing costs under wholesale time-of-use rates.

Tri-State plans to expand its marketing and outreach efforts to increase participation in its pre-pay and usage monitoring programs. With both the utility and its customers realizing benefits from these programs, Tri-State is considering new ways to take full advantage of them. Tri-State's smart meter data and web portal will play important roles in educating customers about

energy consumption and the impacts of retail time-of-use rates.

Tri-State plans to expand its Outage Management System to include feeder data, customer-driven outage reporting, and predictive troubleshooting along with ongoing efforts to integrate smart meter data with the company’s GIS. These changes improve Tri-State’s capabilities to pinpoint fault locations, dispatch repair crews more efficiently, and accelerate outage restoration times.

## 7. Where to Find More Information

To learn more about national efforts to modernize the electric grid, visit the DOE Office of Electricity Delivery and Energy Reliability’s [website](#) and [www.smartgrid.gov](http://www.smartgrid.gov). DOE has published several reports that contain findings on topics similar to those addressed in Tri-State’s SGIG project and this case study. Web links to these reports are listed in Table 2.

Table 2. Web Links to Related DOE Reports	
SGIG program, progress, and results	<ul style="list-style-type: none"> <li>i. <a href="#">Progress Report II, October 2013</a></li> <li>ii. <a href="#">Progress Report I, October 2012</a></li> <li>iii. <a href="#">Tri-State’s SGIG Project Description</a></li> <li>iv. <a href="#">SGIG Case Studies</a></li> </ul>
Recent Publications	v. <a href="#">Smart Meter Investments Yield Positive Results in Maine, February 2014</a>
Improvements in Customer Satisfaction and Services	<ul style="list-style-type: none"> <li>vi. <a href="#">Lessons Learned: Customer Engagement, Updated January, 2014</a></li> <li>vii. <a href="#">Voices of Experience, Insights into Smart Grid Customer Engagement, July 2013</a></li> <li>viii. <a href="#">Analysis of Enrollment Patterns In Time-Based rate Programs, July, 2013</a></li> <li>ix. <a href="#">Demand Reduction from the Application of AMI, Pricing Programs, and Customer Based Systems – Initial Results, December, 2012</a></li> </ul>
Smart meter operational improvements	x. <a href="#">O&amp;M Savings from AMI – Initial Results, December, 2012</a>