FINAL TECHNICAL REPORT

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Note: Only two of the three planned phases of this project were completed. Research and testing were not fully implemented and thus **all results and conclusions should be considered preliminary.**

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Executive Summary

The America Saves! Energizing Main Street Small Businesses project engaged the 1,200-member National Main Street Center (NMSC) network of downtown organizations and other local, regional, and national partners to test a methodology for sharing customized energy efficiency information with owners of commercial buildings smaller than 50,000 square feet. Led by the National Trust for Historic Preservation's Preservation Green Lab, the project marshalled local staff and volunteers to gather voluntarily-disclosed energy use information from participating businesses. This information was analyzed using a remote auditing tool (validated by the National Renewable Energy Lab) to assess energy savings opportunities and design retrofit strategies targeting seven building types (food service and sales, attached mixed-use, strip mall, retail, office, lodging, and schools).

The original project design contemplated extensive leveraging of the Green Button protocol for sharing annualized utility data at a district scale. Due the lack of adoption of Green Button, the project partners developed customized approaches to data collection in each of twelve pilot communities. The project team encountered considerable challenges in gathering standardized annual utility data from local partners. After overcoming these issues, the data was uploaded to a data storehouse. Over 450 properties were benchmarked and the remote auditing tool was tested using full building profiles and utility records for more than 100 commercial properties in three of the pilot communities. The audit tool demonstrated potential for quickly capturing, analyzing, and communicating energy efficiency opportunities in small commercial buildings. However, the project team found that the unique physical characteristics and use patterns (partial vacancy, periodic intensive uses) of small commercial buildings required more trouble-shooting and data correction than was anticipated. In addition, the project revealed that remote technology alone (such as audits) is not sufficient to convince most owners of commercial buildings or businesses to invest in energy efficiency. Additional, one-on-one personal communication is critical. A combination of technology and well-planned direct contact is likely to produce the highest rate of energy efficiency implementation in the small commercial building market sector.

Note that only two of the three planned phases of this project were completed. As a result, research and testing were not fully implemented and thus all results and conclusions from the America Saves! Energizing Main Street Small Businesses project should be considered preliminary.

In addition to the National Main Street Center, local organizations, and regional utilities, the America Saves! project partners included the National Renewable Energy Laboratory, Energy Center of Wisconsin (Seventh Wave), Lend Lease, Building Energy, and Energy RM.

Objectives and Accomplishments

Project Objectives	Actual accomplishments
1. Demonstrate how the Green Button national data standard enables automatic collection of energy data from thousands of small commercial buildings and development of low cost applications that can assess the energy savings potential of numerous small commercial buildings within a traditional business district.	Unfortunately, through this project we determined that Green Button data exchange and other automated 3rd party data access protocols are not in use by most utilities. A major accomplishment, therefore, was overcoming the lack of Green Button data adoption. The project team shifted focus to obtaining data authorization forms in other ways, including assisting customers in obtaining data via individual online accounts and obtaining batched data from some utilities in order to test remote analytics. The lack of Green Button adoption did reduce the number of buildings included in the project, but we were able to assess the energy savings potential of more than 450 commercial buildings in five traditional business districts. Without a widely adopted data protocol standard used across utilities, the data transfer was a more time consuming step of the process. We had to standardize the utility data ourselves in order to provide EnergyRM with consistent and uniform datasets that could be handled in large batches by their algorithm.
2. Identify and promote national best practices in existing utility-supported retrofit programs that currently focus on small buildings and businesses.	America Saves supported local energy program managers in creating long-term community relationships in the hard-to-reach small commercial market, helping them understand and fulfill the energy goals of small business utility customers and doing so at a low customer acquisition cost compared to conventional programs. Many of these energy efficiency programs hadn't focused on small buildings and businesses. We received feedback from utilities that they otherwise would not have had as much access and uptake in this specific market without America Saves' help to introduce them to the local Main Street program and providing a structure of engagement with the small business customer.
3. Deploy, test, and validate scalable, low-cost assessment and management tools for local program partners in regional pilot projects to	We deployed, tested, and validated an assessment tool for use in connecting small commercial districts with local energy efficiency programs.

achieve average energy savings in small commercial buildings of 20% or more.	America Saves delivered customized building energy savings and analysis reports to small businesses participating in the America Saves program. These reports included an initial analysis with charts of monthly/annual utility use (both electric and gas, if applicable), by end-use. The charts provided building owners with their total annual energy cost (in dollars) as well as their relative energy use, broken down by end-use. Additionally, the reports included the results of the FirstView analysis, performed by America Saves partner EnergyRM, which provided building owners with an estimated potential energy savings, in dollars and percent saved (achieved through future retrofits and upgrades), and identified possible causes of higher-than-expected or inefficient energy use. The reports were meant to encourage small building owners to take the "next step" towards increased investment in energy efficiency solutions. This could take the form of a number of actions, including: installation of a smart meter, contacting a local contractor to inquire about retrofit costs, scheduling an energy audit, signing-up for online bill pay, researching their energy efficiency financing options as outlined in the personalized America Saves report, or participating in a local utility incentive program. We saw much greater success, implementation, and action on the part of business owners when there was some level of hand-holding or person-to-person interaction. Small business owners have very little time to devote to learning about energy efficiency, researching their options, etc. Therefore, the custom, people-based approach that we implemented through America Saves complemented the character and personality of Main Street programs across the country. In the end, the technology-based components of America Saves ended up providing more of a supportive role, supplementing the person-to-person path.
4. Using remote measurement and verification, verify savings resulting from retrofit projects conducted by local programs within the targeted business districts at a national scale	Preliminary testing for a small batch of eight buildings was completed by the end of the shortened performance period. At the end of the project period, America Saves had just passed the mark for having the 12-month post-retrofit utility history for the eight sites that went through retrofits in the Fond du Lac, Wisconsin pilot. With the pre- and post-retrofit utility histories in hand, we completed the preliminary testing for eight sites and compared the achieved savings with the already documented projected savings for these retrofit projects.

Goals	Actual accomplishments
5. Implemented an information system to collect, store and analyze energy data from small commercial buildings, including customer consent, building characteristics, and utility billing data.	The Building Energy Community Engagement Platform was been implemented to store, analyze, and transfer data (building attributes and energy use) from small commercial buildings.
6. Collecting data from 5000 sites in at least five climate zones	America Saves collected data from 1,200 sites in the Kentucky, Massachusetts, Washington State, California, Wisconsin, and Texas. We have close to 600 meters and over 8,500 utility history records. The building types include attached mixed-use, retail, and office. As we have communicated throughout the project, the lack of Green Button program adoption has made it much more difficult to obtain and standardize customer data. While we developed workarounds to overcome this, we did not benchmark the target goal of 1,000 buildings by the end of Phase 2. However, we did iteratively improve our data automation and reporting procedures and were able to benchmark 450 sites. This investment in optimizing the process allowed us to gradually decrease the time it takes for each remote analysis. It also improved the quality of the analysis and the customer reports.
7. One utility program that has committed incentives to a district-based energy conservation program and has agreed to pilot data collection and analysis in small commercial buildings in the district.	Alliant Energy (WI) committed to providing incentives to the Main Street District in Fond du Lac, Wisconsin and agreed to pilot data collection and analysis in small commercial buildings in the district. In addition, Seattle City Light (WA), Puget Sound Energy (WA), Eversource/NStar (MA), National Grid (MA), Delta Gas, San Marcos (TX) Electric Utility, Atmos Energy and Georgetown's municipal electric utility (TX), Oklahoma Gas and Electric, Oklahoma Natural Gas (OK), Cascade Natural Gas (WA), and Kentucky Utilities all agreed to pilot data collection and analysis in small commercial buildings in the district.
8. The project has established baseline energy performance of at least 1000 sites including at least three target types of small commercial buildings.	We established baseline energy use for 450 sites at the end of Phase 2. We have building data for more than 1,200 sites, with close to 600 meters and over 8,500 utility history records. The building types included attached mixed-use, retail, and office. We completed the energy modeling simulations for 103 buildings in three commercial districts. In the three districts, the average energy savings potential is 18.3 percent.

9. Using the data warehouse, the project has determined strategies for cost effective energy savings in at least three target types of small commercial buildings.	By connecting the data warehouse with EnergyRM's FirstView tool, we were able to diagnose building operating issues and estimate the potential energy savings that can be achieved by retrofitting a building. FirstView determines the potential energy and utility costs savings for the five major energy end uses, (electricity base load, electric cooling, electric space heat, gas space heat, and gas base load) from 12 months of electricity and gas utility data for a particular building. Using the messages flags from the diagnostics and the end use savings, we were able to tailor recommendations for the building owner. The building types included attached mixed-use, retail, and office.
10.The project has quantified the potential energy savings of each surveyed building in at least one participating commercial district.	The America Saves team worked to incorporate energy efficiency savings projections and measures into the FirstView analysis tool. We completed energy modeling simulations for 103 buildings in three commercial districts; the average energy savings potential was 18.3 percent. The FirstView analysis tool determined the areas for the most energy efficiency improvement in each building, quantifying both the energy and dollar saving potential.
11. The project has tested at least one RMV product to validate the applicability of the approach within at least one building type.	At the end of the project period, America Saves just passed the mark for having the 12-month post-retrofit utility history for the sites that went through retrofits in the Fond du Lac pilot. With the pre- and post-retrofit utility histories, we completed the preliminary testing for eight sites and compared the achieved savings with the already documented projected savings for these retrofit projects. Eleven other Fond du Lac buildings had retrofits but we weren't able to obtain complete sets of 12-months of post-retrofit utility history from the utility in time to complete the preliminary analysis by the end of the performance period.

Project Summary

Original hypotheses

- The foremost barriers for small businesses are pressing priorities of time and money – investing in complex energy systems is simply out of reach for many small building and business owners. Even when owners have capital, they lack time required to evaluate energy efficiency opportunities, solicit bids, hire contractors, and oversee quality installation.
- Access to energy data is a cornerstone of national energy program scalability. However, small business customers typically don't want, need, or use energy data, which has thwarted many data acquisition efforts around the country.
- Without pairing energy data with a long-term energy management relationship, evaluating which energy services customers actually need is expensive, and it is difficult to know when customers are ready to act.
- The Green Button national data standard emerged in 2012 to allow for the automated exchange of energy data between utilities, service providers, and customers – will a new market for energy saving hardware and applications.
- Our program solves the small commercial + energy efficiency misalignment problem by introducing a new role at the center of this intricate set of relationships: the Community Energy Manager (CEM). This model harnesses market innovations and deploys them at a local scale. The focus of this program is the 1,200 communities within the National Main Street Center's network, an affiliate program of the National Trust and a formal partner of the Preservation Green Lab.
- We see short-term engagement pilot communities as places where we can quickly test our methods and assumptions about the program in general, or specific aspects of the program. We also see short-term engagements as a way to rapidly execute data collection, analysis, and implementation and then use those findings and results to further refine the program and provide case studies focused on actual savings through the America Saves! program.
- The foremost barriers for small businesses are more pressing priorities of time and money – investing in complex energy systems is simply out of reach for most.
- Even when owners and businesses have capital, they lack time required to evaluate energy efficiency opportunities, solicit bids, hire contractors, and oversee quality installation.

Approaches used

America Saves supported local energy program managers in creating long term community relationships in the hard-to-reach small commercial market, helping them

understand and fulfill the energy goals of small business utility customers and doing so at a low customer acquisition cost compared to conventional programs.

Target Market

- The program focused on seven building types (food service and sales, attached mixed-use, strip mall, retail, office, lodging, and schools) in buildings smaller than 50,000 square feet. The focus of this program was the 1,200 communities within the national Main Street network, an affiliate of local commercial district revitalization programs, served by an affiliate of the National Trust and a formal partner of the Preservation Green Lab.
- The seven building types that were the focus of this program represent 2.2 million buildings and 18.9 million square feet – 45.2 percent of all commercial buildings, and 28.7 percent of total commercial floor area.

Deployment Partners

- The required set of actors in each community, to ensure success, were the following: the community energy manager (CEM), local community-based or economic-based organization with enough capacity to carry and lead the project at the local level, university students and/or research labs, volunteer base, utility buy-in and participation, utility contractors, local or regional economic development organizations, local energy efficiency financing programs, business owners, and building owners. Some examples of local community and economic-based organizations we worked with were: community development corporations (CDCs), business improvement districts (BIDs), merchants associations, ecodistricts, sustainability districts, and Main Street programs. These groups were essential partners in conceiving and launching our local pilots.
    - For example, during the set-up phase in our two Kentucky-based America Saves pilots we met with a team of local partners, well in advance of kicking-off the effort, to determine a collaborative and supportive approach. In Louisville, this took the form of meetings with local business districts and associations, the downtown development organization, a small business micro-loan program, government officials, workforce development organizations, local impact investors, utilities, and community environmental groups. These strategic and thoughtful meetings allowed us to map out overall opportunities and a collective timeline for the launch and implementation of the program.

Outreach

- America Saves utilized a broad and dynamic outreach strategy. Our primary target audience, during outreach, were Main Street program directors, business improvement district (BID) directors, sustainability district leaders, and other community development corporation (CDC) organizations. In order to reach these

network-based audiences, the America Saves outreach team spent ample time meeting with partners and collaborators at the national and local levels, person-to-person. During these meetings, we introduced the program and discussed its merits and applicability to existing district and community goals and programming. Many of these meetings took place either at a conference (e.g. the National Main Street Center's annual conferences) or during local site visits which were initiated following expressions of interest in participating in the America Saves program. Additionally, our America Saves partners and team members distributed information (both formally and informally) about the program to their networks. We participated in several state-based webinars, organized through the Main Street network, as well as other regional or state Main Street gatherings. During the first and second years of the program we prioritized outreach to communities with the understanding that we were looking for ready and willing participant neighborhoods and communities to sign-up. It was during years one and two that we recruited the vast majority of our demonstration and pilot communities. The second year of the program included development of the America Saves website to support the program's branding and marketing. Additionally, this website served as a tool specifically for those communities where we were already working, providing them a single source for all of the necessary forms, resources, and materials needed to participate in America Saves. Finally, we also included a survey for recruitment, which was frequently utilized.

- Our national and regional outreach strategies connected us with more than 30 communities during the life of the project. Some communities reached out to us directly after learning about the program and asked for more information. We connected to other communities via individuals or organizations in our professional networks. Some communities were specifically targeted in the very beginning and asked to be a part of the very first cohort of pilot communities. The first cohort was developed by leveraging existing relationships between the National Main Street Center and local Main Street programs that were interested in becoming early adopters. The effectiveness of our outreach was improved by our offer of incentive grants to support community participation in the program (grants ranged from $1,500 - $8,000, depending upon the scale of the community and local effort). Many local organizations run on shoestring budgets and even very small grants to support their work are viewed as enticing opportunities. As we advanced from the first group of pilots, we found it easier to encourage communities to sign-up where there was already demonstrated interest and support for energy efficiency or sustainability in the community. With each new interested community, we set-up an America Saves outreach team site visit and hold a public workshop to talk directly with business owners, utilities, and the CEM about the program and its implementation requirements.
- Most outreach to local business and building owners was the responsibility of the Community Energy Manager (CEM). In most cases, this role was played by the local

Main Street director. In addition to the CEM working on business recruitment, there was usually a team of volunteers assembled to help implement the outreach goals of the CEM. This meant that local community volunteers (ranging from retirees to business owners to students) with a wide range of understanding of energy efficiency and sustainability were the primary people speaking directly with business owners in the community about participating in and signing-up for America Saves. To support local outreach, the America Saves team provided a robust package of outreach materials to the CEM. This package included marketing-oriented door hangers to flyer the community, volunteer handbooks to train the volunteers on how to talk about the program and gather the necessary data, 1-pagers to provide talking points for each likely audience (e.g. business owner, utility representative, etc.), and America Saves buttons and window clings to help increase the visibility of the program in the community. We encouraged CEMs and their volunteers to attend business association meetings and other local community meetings (with high turnouts of business owners and building owners) to talk about the program and encourage sign-ups.

- Some specific examples of successful local business/building owner outreach strategies include Middlesboro, KY and Dayton, OH. In Middlesboro, the CEM recruited the local church pastor to become an advocate for the program. His influence with the community was strong and resulted in an increased level of participation. In fact, Middlesboro saw the highest rate of participation of business owners out of all our pilot communities, reaching nearly 100 percent. In Dayton, the CEM thought about ways to integrate America Saves participation into a local green business certification program, which already targeted the downtown businesses. This kind of parallel local effort and integration of America Saves into the parallel effort was exactly the kind of successful approach needed.

Deployment

- After a prospective community was determined to be a good match with America Saves, we forwarded them the grant application, which kickstarted the approval process. For the most part, the grant component of America Saves served as our method to incentivize participation in the program. Because America Saves was a “research & development” project, we decided that grants would help communicate the experimental nature of the project and provide the community with some benefit through participation, no matter the outcome. The process for defining a good grantee candidate included identification of the following key attributes:
  - Local capacity: will the community have the people and time necessary to commit to this work in order to achieve successful results?
  - Strong local volunteer base
  - Availability of building data and utility data (both gas and electric).

  - Strong relationships with building owners, business owners, university students, and utilities
  - Some existing interest in sustainability or energy efficiency

- A major component of the grant application included a requirement to present a plan for how each community intended to meet their established goals and timeline. How many businesses were they targeting for participation in the program? Which data recording mechanisms would they use to support data collection? Who would implement the data collection process? What were the proposed data delivery dates? This sort of plan formalization, facilitated through the grant application format, supported our needs in working with communities towards a common goal and held the communities accountable to their intended deliverables.
- The training of the CEM and their volunteers usually included a site visit, or, in a few cases, a combination of a webinar and phone calls. The America Saves team provided ample training materials, documents, and forms to support the needs of the communities. We also made ourselves available along the way, on an on-going basis, for questions or guidance.
- To kick-off each local America Saves effort, the America Saves outreach team, led by the Preservation Green Lab and the National Main Street Center, traveled to each community to organize and lead a series of meetings and one-to-one conversations with business owners, community members, volunteers, and utility representatives.
- Following the kick-off meeting, the CEM initiated the local data collection and business sign-up effort. Once all data was collected in each community, and submitted to America Saves, personalized energy savings reports were generated by the Preservation Green Lab (using Energy RM FirstView analysis – see next section) for each participating business. Then, the America Saves outreach team returned to each community to deliver the personalized reports to businesses (the CEM was also involved in the report delivery and was essential in getting these one-to-one meetings set-up and scheduled). In addition to the America Saves outreach team and the CEM, America Saves organized a utility energy auditor (or utility small business energy efficiency representative) to attend the one-to-one meetings with business owners. During those meetings, each business owner received their personalized remote energy savings report along with local information from an energy efficiency expert about the specific existing energy efficiency incentives and programs available to them. In some cases, the business owner also received a no-cost energy assessment on the spot. In Middlesboro and Boston, some business owners also received free retrofit products (e.g. LEDs) immediately.
- America Saves delivered customized building energy savings and analysis reports to small businesses participating in the America Saves program. These reports included an initial analysis with charts of monthly/annual utility use (both electric and gas, if

applicable), by end-use. The charts provided building owners with their total annual energy cost (in dollar) as well as their relative energy use, broken down by end-use. Additionally, the reports included the results of the FirstView analysis, performed by America Saves partner EnergyRM, which provided building owners with an estimated potential energy savings, in dollars and percentages, (achieved through future retrofits and upgrades) and identified possible causes of higher-than-expected or inefficient energy use. The reports were meant to encourage small building owners to take the "next step" towards increased investment in energy efficiency solutions. This could take the form of a number of actions, including: installation of a smart meter, contacting a local contractor to inquire about retrofit costs, scheduling an energy audit, signing-up for online bill pay, researching their energy efficiency financing options as outlined in the personalized America Saves report, or participating in a local utility incentive program.

Data and Technical Activities

- The communities provided us with building information and data authorizations forms from the businesses, which we submitted to the corresponding utility. The utilities each provided us data in a different way – pdf's of bills, spreadsheets of utility histories, or access to an online portal to download customer .csv files. Each utility's history information was formatted in different ways using different field names, field types, and number format.
- Green Button data exchange and other automated 3rd-party data-access protocols are not in use by most utilities. Without a widely adopted data protocol standards used across utilities, the data transfer was a time-consuming step of the process. In order for each building's data to be remotely analyzed quickly and consistently, America Saves converted all the utility and building data into uniformly formatted fields. Using an online data warehouse platform, America Saves transferred the building attribute and utility history data from each community to EnergyRM for remote analysis. The online warehouse tool was helpful for data delivery, although it did take time to determine how to best input the data to that was identifiable and readable by EnergyRM's algorithm. Data transfer was handled in smaller batches and the process was iteratively improved to foster distribution of larger datasets as the project progressed.
- FirstView is EnergyRM's end-use disaggregation tool, a representative no-touch audit technology product. The FirstView software uses algorithms to disaggregate five major energy end uses (electricity base load, electric cooling, electric space heat, gas space heat, and gas base load) using 12 months of electricity and gas utility data for a particular building. FirstView's algorithms, which are communicated through "message flags," are also used to identify possible causes of higher-than-expected energy use.

- The message flags are intended to provide recommendations to contractors or building auditors to help them focus efforts on particular building systems (for example occupant energy intensity, shell and systems efficiency, or controls effectiveness) that are possible causes of high energy use. This is intended to reduce the time and capital needed to complete a more detailed building energy assessment. The FirstView message flags significantly informed the customized business energy savings reports produced through America Saves for local Main Street programs and business owners.
- FirstView message flags include:
    1. Low internal electric energy consumption
    2. Moderate internal electric energy consumption
    3. High internal electric energy consumption
    4. Ultra-high internal electric energy consumption
    5. Ultra-high external electric energy consumption
    6. Excessive Heating
    7. Inefficient shell and ventilation
    8. Excessive Cooling
    9. Inefficient cooling
    10. Possible erratic operation or occupancy
- The America Saves partner, the National Renewable Energy Lab (NREL), built a reference guide to define how to interpret and communicate each of the message flags from the FirstView tool. This allowed us to automate and scale the custom report generation, lessening the need for someone to individually create the content for each report.
    - The FirstView software also determines the potential energy and utility costs savings for the five major energy end uses, both on a per building and per community scale.
- NREL compared simulated energy uses with estimates from FirstView to validate its accuracy in disaggregating energy end uses, estimating annual energy use, and estimating energy savings. The comparison of energy end-uses aligns reasonably well, with most comparisons higher than 95 percent accuracy. The project team created 2,952 simulation results to evaluate FirstView. The simulation results were created based on five different types of buildings (small office, medium office, standalone retail buildings, primary schools, and main-street buildings), four vintages (from pre-1980 era to 2013) and four different climate zones (2A, 4B, 4C, and 5A) under ASHRAE (2014).
- NREL participated in America Saves education activities, such as Main Street conferences and the development of the America Saves resources website, to promote DOE energy efficiency funding products, tools for energy efficiency, as well as access to the results (small business energy efficiency savings guides) of the joint

collaboration between NREL and the Small Business Association (SBA). These tools were incorporated into both the evaluation results and additional America Saves education and outreach materials. These materials were distributed at the last three annual National Main Street Conferences and during public meetings with America Saves pilot communities.

- We established baseline energy use for 450 sites by the end of Phase 2. We have building data for more than 1,200 sites, with close to 600 meters and over 8,500 utility history records. The building types include attached mixed-use, retail, and office. We have completed the energy modeling simulations for 103 buildings in three commercial districts. In the three districts, the average projected energy savings potential is 18.3 percent.
- We completed the early stages of a cost database for installed measures. As of the end of phase 2, it includes the measures of the pilot installation. We had planned to continue to populate it with additional measures during phase 3.
- At the end of the project period, America Saves just passed the mark for having the 12-month post-retrofit utility history for the sites that went through retrofits in the Fond du Lac pilot. We re-requested utility history from Alliant Energy (WI). With the pre- and post-retrofit utility histories, we completed the preliminary testing for eight sites and compared the achieved savings with the already documented projected savings for these retrofit projects. The preliminary results of the savings were between -26 percent and 28 percent, averaging only 2.1 percent. Further testing was planned for occur in Phase 3 of the project. Eleven other Fond du Lac buildings had retrofits, but we weren't able to obtain complete sets of 12-months of post-retrofit utility history from the utility in time to complete the preliminary analysis.

Course Corrections

Customer Acquisition

- In our original implementation plan we relied on assumptions about local capacity and the general interest in sustainability among our partner networks. Main Street programs are local economic and downtown development programs. Many have very limited staff (most have one staff, a handful might have two or three). Most programs are structured as nonprofit organizations, although some are quasi-governmental (such as improvement districts). During recruitment and implementation, we discovered that some of our assumptions about the staffing, interest in sustainability, and volunteer capacity of these groups were unreasonably high. Many of these local programs were stretched so thin that they had less time to devote to implementation and project management of America Saves at the local level then was needed for a fully successful outcome. As a result, the America Saves team had to be creative about ways in which we were able to offer increased support and guidance. Some of

this extra support took the form of energy data acquisition, volunteer management, and business outreach. Additionally, we learned that small economic development organizations are similar to small businesses when it comes to interest in and knowledge of general sustainability and energy efficiency. In most cases, the CEM did not have the luxury of being as entrepreneurial as we originally had hoped.

Data Acquisition

We encountered significant data-related barriers to entry, including some (particularly energy data collection and standardization) that were more substantial than we could have anticipated.

- The lack of national Green Button program adoption made it much more difficult to obtain and standardize customer energy data. We found that utilities and data service providers have little interest in enabling automated 3rd-party data access. We hope this will change in coming years as demand from advocates and customers increases. America Saves was at the forefront of a movement toward voluntary data transparency that will likely take years to be fully realized.
    - One utility engaged through America Saves did use Green Button, although their participation was intended for use by customers rather than third parties. This allowed us to gain some experience with this program and test its viability for community-engagement energy efficiency program. America Saves set up an account profile within the utility's website and individually added each enrolled business customer into the profile. Once added, the utility enabled the America Saves user to download 9-13 months of utility history, requesting either an .xml or .csv output. Although it was advertised on the utility website that 13 months of utility history would be available, only 9 months of electric history were available for most of the accounts. Not all accounts were eligible for Green Button, and America Saves had to manually request data from the utility for many of the enrolled customers. Utility history had to be individually downloaded for each account and there was no avenue for linking the utility's data source with our data warehouse directly, making batch processing or automated transfer impossible.
- A primary challenge was the difficulty in acquiring complete data sets adequate for credible and reliable results from the FirstView analysis tool, especially for multi-tenant and restaurant/high energy use cases typical of the "Main Street" building stock.
- We discovered that some of the received history datasets from utilities were incomplete. Examples of data quality errors were non-continuous monthly energy data, non-overlapping gas and electric histories, and unspecified read date of meters.
- Some data records were initially not fully complete due to the challenges of training Main Street directors and volunteers to accurately collect building-attribute data and

secure data-sharing agreements with utilities. As referenced above, the topic of energy efficiency remains relatively intimidating for the average business owner and even many professionals who are well-versed in building data, architecture, and downtown development.

- Some utilities were not willing to participate in the America Saves program, despite the requests from the local America Saves sponsor. This prevented certain communities from participating in the full America Saves program, since we would not be able to use the remote analytic tool for the full community portfolio.
- The non-uniformity of “Main Street” buildings of mixed use, character, and vintage was also challenging. During the benchmarking process, we found that some of the participating businesses did not have consistent or predictable energy use throughout the year, making it difficult to develop a reliable model using the FirstView remote analysis algorithm.
  - To problem-solve, we requested additional billing history from the utility in an effort to find a 12-month period with less erratic energy usage.
  - We also circled back with the communities, via business owners and the CEMs, to learn more about the characteristics of the businesses with erratic usage. We learned, in many cases, that some of these spaces had been recently vacant (not uncommon in small commercial districts) during a portion of the benchmarking period.
  - Our experience has shown that this complexity of tenants and users within physically unique individual properties is perhaps the most challenging aspect of benchmarking small commercial buildings in our Main Street communities.

Departure from Planned Methodology

- Utility data authorizations required substantial face-to-face engagement with businesses (ratepayers) and CEMs. We developed individual utility-specific approved authorization forms, which were then distributed to participating business owners for signature (authorization) and approval to share their utility data with the America Saves team.
- Due to the research and development nature of the project, we worked closely with each pilot community to develop and continuously improve data collection processes and authorization solutions. This semi-custom approach and creative problem-solving required more time-consuming manual processing of the data than originally anticipated.

Assessment of Project Results

Despite the limited use of the Green Button protocol for the automated transfer of utility customer billing data in utilities, our data warehouse software was adapted to perform

the energy baseline performance analysis. The warehouse analyzed the energy costs and baseline energy for five communities: The Capitol Hill Ecodistrict (Seattle), Downtown Middlesboro (KY), Downtown Fond du Lac (WI), Hyde Jackson Square Main Street (Boston), and San Marcos (TX – electric customers only). Downtown Middlesboro, Downtown Fond du Lac, and Hyde Jackson Square Main Street were the most robust programs and are described in more detail below.

Fond du Lac (WI) Summary

- Businesses in Fond du Lac, one of our first participating America Saves pilots, widely participated in their utility partner program, Focus on Energy. Over twenty buildings were audited, resulting in 36 projects (in some cases including several in one building, depending on the number of use types and businesses within the building), with several more still in the queue. The Fond du Lac Main Street program's existing relationships with small businesses, along with the support of America Saves, were essential in securing the audits and implemented retrofit projects. The Main Street program manager recruited an influential business owner early on, who was very pleased with the audit and retrofit work that occurred, and became an advocate for the program. Focus on Energy was pleased to work with America Saves because it provided them with improved access and program uptake for this specific market. America Saves introduced them to the local Main Street program and provided a structure of engagement with the small business customer.

Middlesboro (KY) Summary

- Once all of the data (building + energy) was collected for Middlesboro's 100 plus participating businesses, we worked directly with Kentucky Utilities (KU) to pilot their new and revised small business energy efficiency program for communities in southeast Kentucky. KU agreed to pilot the program in Middlesboro, in partnership with America Saves, because Middlesboro is in the service area of KU and America Saves had developed a relationship with Middlesboro businesses. America Saves also had a very effective local partner and CEM, Discover Downtown Middlesboro, to help reach local business owners regarding the new KU efficiency program. America saves conducted joint outreach alongside KU's energy efficiency implementer (Matrix Energy) and met with Middlesboro America Saves businesses. The Matrix Energy representative was able to conduct real-time assessments and even provide new, no-cost, LED lightbulbs on the spot. Without the America Saves connection to Middlesboro businesses, KU wouldn't have had the organized or collective access to the community.

Hyde Jackson Square (MA) Summary

- The America Saves pilot in Boston's Hyde Jackson Square focused on increasing business owner participation in the locally offered, city-managed energy efficiency

program for small business, Renew Boston. We leveraged the local CEM's existing relationships with business owners and our person-to-person interaction and support to business owners to encourage an increase in sign-ups for Renew Boston. The America Saves outreach team visited the neighborhood three times. During each trip, we met with businesses to learn about their needs, distributed custom energy savings potential reports, or provided them with additional information about how to take the "next step." America Saves organized meetings for a Renew Boston contractor to meet one-to-one with business owners to assess their compatibility with Renew Boston. The development of a strong relationship between Hyde Jackson Square and Renew Boston produced lasting results. The Renew Boston contractor now makes regular visits to Hyde Jackson Square to work with the Hyde Jackson Square CEM to encourage energy efficiency actions throughout the neighborhood.

Additional Learnings

- A significant overall learning from the America Saves project was that there was much greater success, implementation, and action on the part of business owners when there was some level of person-to-person interaction. Small business owners have very little time to devote to learning about energy efficiency, researching their options. The custom, people-based revised approach of America Saves seemed to complement the character and personality of Main Street programs across the country. The technology-based, remote auditing and analysis components of America Saves provided a supportive platform for these personal interactions. The America Saves program experiences suggests that a combination of the two approaches – technological and personal – offer the best potential for future success at a larger scale.
- The biggest motivator in getting small business owners to move from audit to action was demonstrating how easy and low cost it could be to take that action. Many owners were willing to move forward with a no-cost action (e.g. LEDs or online billpay). Other owners were motivated to invest in deeper retrofits when they could see the benefits of short payback periods.
- America Saves reduced the transaction cost (time and money) for delivering energy efficiency to the small commercial sector through by overcoming barriers and putting information in the hands of property and business owners. Our customized energy savings potential reports required very little investment of time by the business owner in order. When we distributed the reports, we brought along energy efficiency experts to make it easy for the business owner to get more detailed guidance and plan follow-up actions.
- Through the work completed up to phase 2, we were able to demonstrate that a remote auditing system can identify energy saving strategies for small commercial building owners. In the three most robust pilot communities, we identified average energy savings potential of 20.1 percent. The FirstView tool flagged energy end-uses

that were higher than expected and offered potential solutions to reduce energy end-use. FirstView determined the potential energy and utility costs savings for the five major energy end uses (electricity base load, electric cooling, electric space heat, gas space heat, and gas base load) using 12 months of electricity and gas utility data for a particular building. Using the messages flags from the diagnostics and the end use savings, we are able to tailor recommendations for the building owner and business district.

What Worked

- America Saves succeeded in reducing the transaction cost (time and money) for delivering energy efficiency information and opportunities to small commercial building and business owners.
- America Saves moved small building and business owners from the audit and energy efficiency assessment stage to energy efficiency actions, by identifying low-cost options and a clear and easy path to implementation.
- America Saves increased participation in utility-based energy efficiency programs. The collection, evaluation, and dissemination of energy and cost savings data, by building component and/or system, supported decision-makers in utilizing the data to assess efficiency trade-offs and make decisions.
- America Saves overcame the lack of Green Button data adoption through customized work-around solutions. We created and standardized utility data transfer methods, formatting, and authorizations in order to provide EnergyRM with consistent and uniform datasets that could be handled in large batches by their algorithm.
- Throughout, we focused on iteratively improving the data automation and reporting procedures. This investment in optimizing the process allowed us to gradually decrease the time required for each remote analysis. It also improved the quality of the analysis and the small business customized reports.

Looking to the Future

While the formal DOE-funded phases of America Saves are now complete, our project team and partners will continue working to advance the goals of the project. The Preservation Green Lab will focus its efforts in Louisville, KY, in particular, where we have strong local interest in implementing energy efficiency retrofits as part of a broader effort to create a pilot sustainability district in the NuLu neighborhood. We have strong local partners in Louisville working with us to advance this effort, including Louisville Gas and Electric, the Louisville Downtown Partnership, the University of Louisville, and the City of Louisville.

In addition, the pilot communities that came into the America Saves program through the National Main Street Center and their network of 1,200 commercial districts are all planning to follow through with continued education, outreach, and implementation efforts. Our newest group of Main Street pilot communities is in Oklahoma, where partnerships with regional utilities, the University of Oklahoma, and the Oklahoma Main Street Program (within the state Department of Commerce) have blossomed this year and there is great enthusiasm to build on the America Saves program.

Finally, the Preservation Green Lab and our National Main Street Center partner will be sharing lessons learned and information about energy efficiency through our national communications channels, including newsletters, websites, and possible training programs.

Products Developed

A. Publications (list journal name, volume, issue), conference papers, or other public releases of results. If not provided previously, attach or send copies of any public releases to the DOE Program Manager identified in Block 15 of the Assistance Agreement Cover page

    a. NREL reports in draft stage

        i. Technical report: “Methodology to Assess No Touch Audit Software Using Simulated Building Utility Data”; Howard Cheung and James E. Braun (Purdue University), Rois Langner (National Renewable Energy Laboratory). DRAFT.

        ii. Technical report: “Methodology to Assess No Touch Audit Software Using Field Data”; Jie Cai, James E. Braun (Purdue University), Rois Langner (National Renewable Energy Laboratory). DRAFT

B. Web site or other Internet sites that reflect the results of this project

    a. http://www.americasavesenergy.org/

    b. http://hydejacksonsquare.org/centre-street-saves/

C. Networks or collaborations fostered

    a. Main Street Districts with local utility programs

        i. Downtown Fond du Lac Partnership (WI)

        ii. Hyde Jackson Square Main Street (Boston, MA)

        iii. Discover Downtown Middlesboro (KY)

        iv. Oklahoma Main Street (state level coordinating program)

            1. Sapulpa Main Street

            2. Main Street Enid

            3. El Reno Main Street

            4. Shattuck Main Street

            5. Main Street Guymon

b. Eco-districts
    i. Seattle (WA)
c. Nulu sustainability district (Louisville, KY)
d. Utilities/Energy Efficiency Programs
    i. Focus on Energy
    ii. Alliant Energy
    iii. Renew Boston
    iv. RISE Engineering
    v. National Grid
    vi. Eversource
    vii. Kentucky Utilities
    viii. Delta Gas
    ix. Matrix (contractor for KU)
    x. Oklahoma Gas and Electric
    xi. Oklahoma Natural Gas
    xii. ClearResult (contractor for OG&E)

D. Technologies/Techniques (none)

E. Inventions/Patent Applications, licensing agreements
    a. License agreement with Building Energy

F. Other products, such as data or databases, physical collections, audio or video, software or netware, models, educational aid or curricula, instruments or equipment
    a. Survey guides for training

Computer Modeling Information

For full background and analysis, see forthcoming NREL technical reports, currently in draft stage:

- Technical report: “Methodology to Assess No Touch Audit Software Using Simulated Building Utility Data”; Howard Cheung and James E. Braun (Purdue University), Rois Langner (National Renewable Energy Laboratory). DRAFT.

- Technical report: “Methodology to Assess No Touch Audit Software Using Field Data”; Jie Cai, James E. Braun (Purdue University), Rois Langner (National Renewable Energy Laboratory). DRAFT

General modeling information relevant to this project is summarized below:

A. Model description, key assumptions, version, source and intended use

   a. Energy RM provides software-based analytics and metering services to the energy efficiency sector. EnergyRM’s DeltaMeterTM provides individual building energy diagnostics, a benchmarking and baseline certification tool, and a large portfolio assessment tool.

   b. FirstView, EnergyRM’s end-use disaggregation tool, is a representative no-touch audit technologies product. It is intended use is for small commercial buildings, as a lower cost option to full audits. It adjusts for weather, occupancy, and operating hours.

   c. The FirstView software uses algorithms to disaggregate five major energy end uses (electricity base load, electric cooling, electric space heat, gas space heat, and gas base load) from 12 months of electricity and gas utility data for a particular building. The algorithm also estimates annual energy use, estimates energy savings, and diagnoses building operation issues.

   d. The message flags are intended to provide recommendations to contractors or building auditors to help them focus efforts on particular building systems (occupant energy intensity, shell and systems efficiency, or controls effectiveness) that are possible causes of high energy use. This will reduce the time and capital needed to complete a building energy assessment.

   e. In evaluating this product, NREL provided an objective technical review of the accuracy of the algorithms used in FirstView and an evaluation of the recommendations (message flags) FirstView provides to help building energy auditors identify causes of high energy use.

f. EnergyRM's remote audit tool has been comprehensively evaluated in thousands of schools and office buildings, and is compliant with IPMVP standards.

B. Performance criteria for the model related to the intended use

a. 1 year of continuous monthly energy data for electric and gas (if applicable)

b. Building location

c. Overall floor area

d. Primary use types and associated floor areas

e. Amount of space without temperature control

f. Amount of space subjected to heating and cooling equipment control

g. Type of energy for heating water (electricity, gas, etc.).

h. Number of occupants and percentage of occupied floor area (recommended)

i. Occupied hours per week (recommended)

j. Space heating equipment type (gas furnace, heat pump, etc.) (recommended)

k. Year of construction (recommended)

C. Test results to demonstrate the model performance criteria were met (e.g., code verification/validation, sensitivity analyses, history matching with lab or field data, as appropriate)

a. NREL compared simulated energy uses with estimates from FirstView to validate its accuracy in disaggregating energy end uses, estimating annual energy use, and estimating energy savings. The draft reports that summarizing the results of the validation efforts are currently in review.

b. The comparison of energy end-uses aligns reasonably well, with most comparisons higher than 95 percent accuracy. The project team created 2,952 simulation results to evaluate FirstView. The simulation results were created based on five different types of buildings (small office, medium office, standalone retail buildings, primary schools, and main-street buildings), four vintages (from pre-1980 era to 2013) and four different climate zones (2A, 4B, 4C, and 5A) under ASHRAE (2014).

c. While the report is still in review, NREL preliminarily found that the tool had good accuracy in estimating energy end uses, particularly in small buildings. For certain types of buildings (primary schools, medium offices buildings) the uncertainty in the end uses were up to 10%. The energy saving estimates had an uncertainty of 20% in all building types. The study found that the tool accurately diagnosed high summer gas use in standalone retail buildings, high electricity baseloads in office and main-street buildings, and unnecessary reheat in office buildings.

D. Theory behind the model, expressed in non-mathematical terms

a. The EnergyRM tool is a screening process to convert the audit process from a data heavy registration process into a method of designating specific energy efficiency opportunities.

b. FirstView is EnergyRM's end-use disaggregation tool, a representative no-touch audit technology product. The FirstView software uses algorithms to disaggregate five major energy end uses (electricity base load, electric cooling, electric space heat, gas space heat, and gas base load) using 12 months of electricity and gas utility data for a particular building. FirstView's algorithms, which are communicated through "message flags," are also used to identify possible causes of higher-than-expected energy use.

c. The message flags are intended to provide recommendations to contractors or building auditors to help them focus efforts on particular building systems (for example occupant energy intensity, shell and systems efficiency, or controls effectiveness) that are possible causes of high energy use. This will reduce the time and capital needed to complete a more detailed building energy assessment. The FirstView message flags significantly informed the customized business energy savings reports.

E. Mathematics to be used, including formulas and calculation methods

a. The remote audit tool uses proprietary set of algorithms and equations, inverse modeling, and energy signature analysis to analyze building performance and opportunities for savings.

F. Whether or not the theory and mathematical algorithms were peer reviewed, and, if so, include a summary of theoretical strengths and weaknesses

a. EnergyRM's DeltaMeter was third-party reviewed by Quantum Energy Services and Technologies, Inc. (QuEST) for compliance with IPMVP. The review concluded that the DeltaMeter "not only meets the requirements for adherence to IPMVP, but it is even more rigorous, includes more features,

and is a clearer, more prescriptive process than has been commonly implemented previously. This enhanced process is sufficiently robust to meet the requirements to be part of a utility's energy supply portfolio and to provide building operators an improved basis for performance."

G. Hardware requirements (not specified)

H. Documentation (e.g., users guide, model code)

   a. "REQUIRED_DeltaMeter-Data_Input.xls"

   b. DMUserGuide.docx