

California Energy Commission
CONSULTANT REPORT

Report on Pre-Monitoring Activities

Lead Locally, EPIC Grant EPC-17-041

Prepared for: **California Energy Commission**
Prepared by: **Sonoma Clean Power Authority**



California Energy Commission
Edmund G. Brown Jr., Governor

February 15, 2019 | CEC-EPC-2017-041-DCR



California Energy Commission

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PREFACE

Project Overview

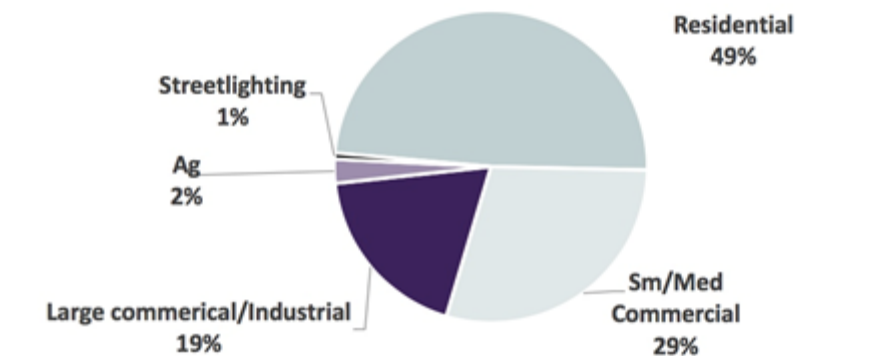
Sonoma Clean Power’s (SCP) “Lead Locally” project (Project), funded through the California Energy Commission’s (CEC) GFO-17-304 aims to identify strategies and technologies that can assist with the State’s goals of doubling the efficiency of existing buildings by 2030. The Project will include applied research and technology deployment activities, each of which will propose innovations that could stimulate the energy efficiency market. With the applied research work, the team will investigate a series of innovative technologies that have the potential to be integrated into existing program models. Lessons learned from the applied research projects will be funneled directly to consumers, contractors, real estate professionals, and building officials through SCP and its local partner organizations. The technology deployment work will be driven in part through the SCP “Advanced Energy Center”, a physical storefront where consumers can directly procure energy efficient products and services. The Advanced Energy Center has the potential to speed deployment of energy efficiency, make energy efficiency programs more accessible to all customers, and increase customer knowledge of energy efficiency and energy code requirements.

About Sonoma Clean Power and its Customers

SCP is a public power provider operating as a community choice aggregator (CCA) and the default electricity provider for Sonoma and Mendocino Counties. SCP exists to provide broad public benefits relating to affordability, reliability, climate change and sustainability, coordination with local agencies, customer programs, and to support the local economy. The default service for SCP customers is CleanStart, which provides customer with 45% renewable power and 87% carbon free power (2017 Climate Registry certified values). SCP customers also have the option to select EverGreen service, which is 100% renewable power produced entirely within the SCP service area.

SCP serves just over 220,000 accounts, of which 86% are residential accounts. On an annual basis, SCP’s load is comprised of about 50% residential energy use as shown in Figure P-1.

Fig P-1. SCP Customer Load for 2017



Sonoma Clean Power Authority (SCP), its employees, agents, contractors, and affiliates shall maintain the confidentiality of individual customers' names, service addresses, billing addresses, telephone numbers, email addresses, account numbers, and electricity consumption, except where reasonably necessary to conduct SCP's business or to provide services to customers as required by the California Public Utilities Commission (CPUC). SCP shall not, under any circumstance, disclose customer information for third-party telemarketing, e-mail, or direct mail solicitation. Aggregated data that cannot be traced to specific customers may be released at SCP's discretion.

Any questions or concerns regarding the collection, storage, use, or distribution of customer information, or those who wish to view, inquire about, or dispute any customer information held by SCP or limit the collection, use, or disclosure of such information, may contact Erica Torgerson, Director of Customer Service, via email at etorgerson@sonomacleanpower.org.

Project Team, Roles and Responsibilities

The applied research team is comprised of the following parties (referenced in this document as the Team), with roles and responsibilities outlined below.

Sonoma Clean Power serves as the prime coordinator with the CEC, and will be responsible for identifying project sites, initial outreach to customers, and reporting Project progress to the CEC.

Frontier Energy's lead roles are management of the applied research activities and associated subcontractors, execution of laboratory testing, recruitment and qualification of test sites, installation of instrumentation at test sites, analysis of monitored data, energy modeling, and technical reporting.

DNV-GL will provide independent Evaluation, Measurement, and Verification (EM&V) for the Project, specify required measurement points and accuracy levels for the instrumentation package, and evaluate performance relative to the metrics for success.

California Lighting Technology Center will manage the commercial daylighting project, select and evaluate daylighting technologies in both laboratory and field test settings, and assist in extrapolating field performance to estimate energy savings and peak electricity demand reduction for other space types and locations across California.

Energy Docs and **Rick Chitwood** will design and install the radiant panels, air-to-water heat pumps (AWHPs), and load reduction retrofits.

Chiltrix will serve as the vendor for the AWHPs and provide informal design guidance and field test support throughout the project.

PLT Multipoint and **Huvco** will serve as vendors for daylight harvesting sensors and daylight enhancement technologies, respectively, and provide informal design guidance and field test support throughout the project. Additional product vendors may join the Team and provide support as the Project proceeds.

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EXECUTIVE SUMMARY

This Report on Pre-Monitoring Activities documents the progress made to date with site recruitment for the Lead Locally applied research projects that require three to six months of pre-project monitoring data to effectively evaluate the energy savings potential for the targeted technologies. This includes phase change materials (PCM), radiant ceiling panels/air-to-water heat pumps, mini-split heat pumps, and commercial daylighting technologies. While the applied research experiments will be limited to a specific set of buildings and locations, findings from this work will inform Lead Locally technology demonstration and deployment activities.

The process for pre-monitoring sites for the appropriate applied research projects includes the following components:

1. Site-Selection Criteria - essential, important, and desired test site features and conditions.
2. Customer Data - review of existing (SCP) customer data sets related to identified site-selection criteria.
3. Customer Recruitment - outreach communications aligned with site-selection criteria and existing customer data, including interest form and customer calls to evaluate additional site-selection criteria not included in SCP data sets
4. Site Visits and Analysis of Findings - visits to all interested and qualified sites to confirm eligibility and alignment with the needs of the applied research projects.
5. Engagement with Selected Sites - confirmation of the site's program participation, including SCP customer signature of the Program Participation Agreement.

Supporting documents for these activities and processes are included in the Appendices.

Section 1: Introduction

The Lead Locally Grant is an innovative programmatic approach to existing buildings research, development and demonstration that includes a range of innovative technologies, program features, and market strategies to engage new customers in energy efficiency upgrades and deliver benefits to California's electric ratepayers. The Grant is led by Sonoma Clean Power (SCP) under funding by the California Energy Commission (CEC) through the Electric Program Investment Charge (EPIC) program. SCP is a community choice energy program providing electricity to 189,000 residential and 31,000 commercial customers in Sonoma and Mendocino Counties. This robust existing building initiative will also serve to complement current fire recovery efforts in Sonoma and Mendocino Counties, enabling SCP programs to have impact far and beyond the scope of this project.

The applied research portion of Lead Locally focuses on several innovative technologies to be evaluated through laboratory and field testing with the objective of expanding SCP's and other energy efficiency program administrators' portfolios of cost-effective retrofit options. These applied research projects are designed to remove uncertainty around the installed performance and cost of the technology, especially in combination with other retrofit measures, prior to broad deployment of the technology. This includes Lead Locally deployment activities through the Advanced Energy Center, a physical storefront located in downtown Santa Rosa California where consumers can directly procure energy efficient products and services. Several of these technologies will require pre-monitoring of project sites to establish a baseline against which the specified technology's performance can be evaluated. This includes collecting three to six months of pre-project monitoring data for the following applied research projects:

- phase change materials
- radiant ceiling panels/air-to-water heat pumps,
- mini-split heat pumps,
- commercial daylighting.

Purpose of this Document

This report details the progress made to date by the Lead Locally team to select and secure commitment from applied research sites that will require pre-monitoring. Lessons learned from these early customer recruitment efforts will inform future Lead Locally activities to secure the sites necessary for the remaining applied research projects, the technology demonstration projects, and ultimately the scaled deployment of projects to meet and hopefully exceed the Lead Locally goal to retrofit over 300,000 square feet of building space to achieve the Program's target reductions for site electric use.

Targeted Technologies

Pre-monitoring activities will be pursued for three applied research technologies and one technology demonstration (minisplit heat pumps). Six months of pre-retrofit monitoring data,

starting in the winter heating season and carrying through the summer cooling season, will be collected for phase change materials, radiant ceiling panels/air-to-water heat pumps, and mini-split heat pumps. Three months of pre-monitoring data, sufficient to establish baseline daylighting conditions and site use and operational practices, will be collected for the commercial daylighting technologies.

Radiant Panels with Air-to-Water Heat Pumps

Radiant ceiling panels are surfaces imbedded in the ceiling that heat and cool a house without moving air. This is done by heating and cooling water that is pumped through tubing in the panels. Conventional air conditioners and furnaces provide comfort by heating and cooling air and circulating it through ducts, which often waste 20% of heating and cooling energy through air leakage into the attic or crawlspace. Radiant ceiling panels solve this problem by directly heating or cooling the ceiling surface, increasing comfort through radiative heat transfer while reducing the perception of drafts and minimizing energy losses to the attic. This technology will be evaluated for residential applications during the applied research phase.

Phase Change Materials

PCMs are materials that absorb heat as they melt and release heat as they freeze. Unlike sensible energy storage in thermal mass, energy storage in a phase change occurs over a relatively constant temperature and requires much less volume. PCM melting points can be tuned to match the needs of the application, making PCMs an appealing technology for use in building envelopes, including in walls and attics. PCMs do not contribute to the R-value of the building envelope, but when installed adjacent to the insulation, the PCM can reduce the temperature difference across the insulation while it freezes or melts, thereby reducing heat transfer into or out of the conditioned space. For Lead Locally, a macro-encapsulated PCM product called Infinite R will be studied as a method for enhancing the effectiveness of attic insulation in both residential and commercial buildings. Only the residential application is included in the applied research phase and addressed in this report. Commercial applications are part of the technology demonstration phase.

Ducted Mini-Split Heat Pump

A “heat pump” is a highly efficient air conditioner that can also work in reverse and provide heat during the winter. A “split” system is one that is split into two pieces: an “indoor unit” and an “outdoor unit.” A mini-split heat pump (MSHP) is just a smaller version that can vary the speed of its components to match the current needs of the home, using less energy in the process. A ducted mini-split typically has one indoor unit and distributes conditioned air throughout the house using compact ductwork, in contrast to a ductless mini-split which typically distributes refrigerant to multiple small indoor units, each with its own fan-coil and often with a separate thermostat. The retrofit package that will be evaluated for Lead Locally includes envelope improvements that will reduce the required capacity of the MSHP, and integrated supply ventilation to improve indoor air quality. This technology will be targeted primarily to the single-family residential market.

Commercial Daylighting Retrofits

Recent advances in daylight harvesting technologies and control algorithms have opened the door to greater integration with related building systems and optimized overall performance, offering the potential for significant energy savings and peak load reduction in the commercial retrofit market. However, some of these technologies require further evaluation individually and in combination before lighting designers will feel comfortable including them for commercial building retrofits. Specific technologies that will be investigated include dimmable light-emitting diode (LED) lighting with motion- and photo-sensor-based controls and integrated communication technologies. In addition, daylighting management technologies will also be considered to help realize electric lighting savings and provide additional HVAC energy savings through automated management of solar heat gain and possibly natural ventilation and cooling. These technologies include automated Venetian blinds, roll-down shades, electrochromic glazing, tubular daylighting devices, sun-tracking skylights with mirrors and/or optical fibers, along with motion-sensing for detection of occupancy and photo-sensing to determine light levels for illumination and potential for glare from direct solar penetration.

Need for Pre-Monitoring

In the context of Lead Locally, pre-monitoring is defined as the baseline characterization of a field test site prior to the installation of the retrofit measures of interest. A meaningful baseline is required for the purpose of quantifying energy savings, and providing objective data related to operating conditions, temperature uniformity, infiltration rates, lighting quality, and other characteristics of a building. In some cases, the baseline may be a similar but unmodified space within the same test building, monitored in parallel with the retrofit space. In other cases, a physical baseline may be impossible because of a major remodeling effort or a significant change in usage patterns. In those cases, a theoretical baseline using building simulation may be necessary. For the purpose of this report, the term pre-monitoring refers to monitoring a space or entire building before it undergoes a retrofit.

For most technologies, the seasonal effects of weather have a large effect on energy use. Energy use drivers such as conduction through walls and attics, air infiltration, water mains temperature, sun angles, and occupancy levels all vary significantly over the course of year. As a result, pre-monitoring should be performed over an adequate time period to capture both winter and summer effects. Ideally this would be a full year, but for most projects six months is adequate if the test period starts in mid-winter or mid-summer. Six months of pre-monitoring is less expensive, more consistent with the overall project time frame, and helps avoid trying the patience of homeowners who may be anxious to have the retrofit completed.

There are four technologies that require an early pre-monitoring phase to meet the 3½ year timeline for Lead Locally. A summary of the pre-monitoring requirements is provided in Table 1.

Table 1: Overview of Pre-Monitoring Requirements

Technology	Number of Sites	Pre-Monitoring Duration	Planned Start Date	Essential Data to be Monitored
Radiant Panels with Air-to-Water Heat Pumps	5	6 months	February 15	<ul style="list-style-type: none"> • Cooling energy • Heating energy • Temperature uniformity • Relative humidity • Indoor set point • Indoor air quality
Phase Change Materials	5	6 months	February 8	<ul style="list-style-type: none"> • Cooling energy • Heating energy • Heat transfer through ceiling • Indoor set point • Attic temperature
Ducted Mini-Split Heat Pumps	5	6 months	February 15	<ul style="list-style-type: none"> • Cooling energy • Heating energy • Temperature uniformity • Relative humidity • Indoor air quality
Commercial Daylighting Retrofits	3	3 months	May 15	<ul style="list-style-type: none"> • Cooling energy • Heating energy • Lighting energy • Lighting levels • Color rendering • Glare

Section 2: Site Selection Criteria

In general, the Team has targeted field test sites that offer the best opportunities for success, in terms of both electricity savings and cost-effectiveness. If the technologies do not perform well in these applications, SCP will recommend investing remaining funds into promising alternative technologies identified through the Advanced Energy Center vendor solicitation. If the technologies prove successful, building energy simulations will be used to extrapolate the results to other CEC climate zones and less ideal applications.

The first step in the site selection process was to develop a screening matrix that lists the essential, important, and desired characteristics of the field test sites for each technology. The criteria were driven by technology performance considerations, cost limitations, or practical installation issues. Additional considerations included criteria that may influence the realization of energy savings (e.g. is the building occupied year-round), homeowner expectations (e.g. do they insist on home improvements outside the scope of the retrofit), and health and safety issues specific to any retrofits (e.g. presence of mold or asbestos). These criteria help ensure effective field tests with minimal complications.

Each candidate test site, or Pilot Home, was then assigned a score reflecting its overall fit for the specific technology to be field tested and the broader objectives of the Lead Locally program. Scores were established for sites that met all “essential” criteria for the technology, and were calculated using weighting factors and a point system for “important” and “desired” features. SCP customer care specialists and Frontier staff used the screening matrix to filter incoming interest from building owners to qualify sites. In some cases, the screening criteria proved overly restrictive and resulted in very few candidate test sites, and the criteria were loosened up in less critical categories. One example was the desire for slab-on-grade test sites for radiant panels and minisplits due to cost considerations. There were so few slab foundations in the sample of applicants that we removed this requirement, and simply gave additional points to the score. The time stamps for receipt of responses from interested customers with qualified sites were used to break ties when two sites had the same score.

Selection Criteria for Pre-monitored Technologies

The selection criteria for each pre-monitored technology is summarized in Table 2. An asterisk (*) indicates an essential criterion, while a numeric value (1-10) indicates weighting factor for important and desired criteria. While one yellow tagged home (partially damaged in the 2017 wine country fires) did apply for the program, it did not qualify to move forward in the screening program.

Table 2: Selection Criteria for pre-monitored technologies

Technology	Occupants	Site	Envelope	Mechanical
Radiant panels with air-to-water heat pumps	<ul style="list-style-type: none"> • Occupied* • Owned by current residents* 	<ul style="list-style-type: none"> • Built between 1978-2005 (5) • No asbestos on site* 	<ul style="list-style-type: none"> • Slab on grade (3) 	<ul style="list-style-type: none"> • HVAC system functional* • Split system AC or HP*

	<ul style="list-style-type: none"> • Occupants will remain for 2 years* • Full time residence* • No retired residents (1) • Nonsmokers (5) • No anticipated change in occupancy (5) • Not employees of energy industry (5) • Building owner enthusiastic (8) • Realistic owner expectations* 	<ul style="list-style-type: none"> • Single family detached* • One-story (10) • <2000 ft² conditioned area (10) • Attached garage (1) • Safe work environment* • No practical installation barriers* • No practical installation challenges (10) • Located Near Other Sites (10) • Features similar to other sites (10) • Near weather station (10) 		<ul style="list-style-type: none"> • Central cooling* • Electric heating (10) • HVAC >10 years old (3) • Ducts in attic or crawlspace* • Ecobee Thermostat (1)
Phase change materials	<ul style="list-style-type: none"> • Occupied* • Owned by current residents* • Occupants will remain for 2 years* • Full time residence* • Not employees of energy industry (5) • Building owner enthusiastic (8) • Realistic owner expectations* 	<ul style="list-style-type: none"> • No asbestos on site* • Single family* • One-story (8) • <1500 ft² conditioned area* • Climate Zone 2 (10) • Safe work environment* • No practical installation barriers* • No practical installation challenges (10) • Located Near Other Sites (6) • Features similar to other sites (4) • Near weather station (6) 	<ul style="list-style-type: none"> • Vented attic (9) • >R30, >R38 attic insulation (3,5) 	<ul style="list-style-type: none"> • HVAC system functional (8) • Central cooling (9) • Central heating (9) • Electric heating (8) • Whole-house fan (6) • Ecobee Thermostat (4)
Commercial daylighting retrofits	<ul style="list-style-type: none"> • Building owner enthusiastic (8) • Realistic owner expectations* 	<ul style="list-style-type: none"> • Operational yearlong* • 5 days/week* • Daytime hours* • Work space (5) • 2 or 3-story (5) • <5000 ft² conditioned area (5) • Unobstructed window views (10) • Safe work environment* • No practical installation barriers* 	<ul style="list-style-type: none"> • T-bar drop ceiling (8) • Plenum space in attic (8) • East, south, or west facing windows* • High window coolness factor (VT/SHGC) (9) 	<ul style="list-style-type: none"> • Gas or electric heating* • LED luminaires with controls base on occupancy and daylight levels (9) • Automatic controls for electric lighting (9) • Manual controls for daylighting (9) • Controls communications through standardized protocol (e.g., BACNET IP) (9)

		<ul style="list-style-type: none"> • No practical installation challenges (10) • Located Near Other Sites (6) • Features similar to other sites (4) 		
Ducted mini-split heat pump	<ul style="list-style-type: none"> • Occupied* • Owned by current residents* • Occupants will remain for 2 years* • Full time residence* • No retired residents (1) • Nonsmokers (5) • No anticipated change in occupancy (5) • Not employees of energy industry (5) • Building owner enthusiastic (8) • Realistic owner expectations* 	<ul style="list-style-type: none"> • Built between 1978-2005 (5) • No asbestos on site* • Single family detached* • One-story (10) • <2000 ft² conditioned area (10) • Attached garage (1) • Safe work environment* • No practical installation barriers* • No practical installation challenges (10) • Located Near Other Sites (10) • Features similar to other sites (10) • Near weather station (10) 	<ul style="list-style-type: none"> • Slab on grade (3) 	<ul style="list-style-type: none"> • HVAC system functional* • Split system AC or HP* • Central cooling* • Electric heating (10) • HVAC >10 years old (3) • Ducts in attic or crawlspace* • Ecobee Thermostat (1)

Section 3: Customer Data

As the community choice public power provider in Sonoma and Mendocino Counties, Sonoma Clean Power (SCP) has access to the individual names, service addresses, billing addresses, telephone numbers, email addresses, account numbers, and electricity consumption for its customers. SCP, its employees, agents, contractors, and affiliates will maintain the confidentiality of its customers' data, except where reasonably necessary to conduct SCP's business or to provide services to customers as required by the California Public Utilities Commission (CPUC). SCP will not, under any circumstance, disclose customer information for third-party telemarketing, e-mail, or direct mail solicitation.

SCP Data Sets Leveraged

In addition to internal customer billing data and account information, SCP has access to other customer and site level data including site fuel sources including propane and wood heat; participation in SCP programs; and parcel data from the Sonoma County and Mendocino County Assessor's and Recorder's Offices. SCP data points leveraged to inform site selection activities include the data points identified in the following table.

Table 3: SCP data used for site selection

Account Information	Billing Information/History	Program/Other Information	Parcel Data
• Customer Name	• Full time resident (year round energy use)	• Red/yellow tagged for fire recovery	• Building Square Footage
• Account Number	• Onsite PV/EV (rate schedule; electric demand patterns)	• Onsite EV	• Building Type (i.e., Single Family detached)
• Service Address	• Heating fuel		• Year Built
• Rate Schedule			• # floors
• Climate Zone			• # bedrooms/bathrooms

Customer provided data and recruitment/solicitation process

In addition to existing SCP customer data sets, the program required gathering additional data directly from customers (i.e.: type of heating system, whether the home had a slab-on-grade foundation or a crawlspace) for use in identifying strong candidates. To gather customer data, an SCP-delivered outreach campaign was developed to collect information. The team strongly believes that an effective strategy to recruit interested and qualified sites increased the likelihood that those sites could be selected for the project and reduced the risk of significant time and effort being spent visiting sites that turned out to be poorly suited for the project. By using this thorough pre-vetting process, the team disqualified only one site out of twenty eight based on the initial site visits.

To begin the site recruitment effort, SCP began a broad outreach effort. Based on the cost of direct mail, the initial customer outreach used earned digital media channels, including SCP-owned channels such as its email newsletter, social media channels and website, and earned

media through an SCP-delivered press release (all of these activities are further detailed in the next section). Interested customers were directed to an SCP-hosted web page with additional details on Lead Locally, expectations and benefits for customer participation, and information on the selection process. A separate 3-minute survey collected information from interested customers, called a “Participation Request.” The Participation Request form asked for information on identified screening criteria. The website launched on November 13, 2018 and the program stopped formally accepting Participation Requests on November 30, 2018. The initial site recruitment effort focused on three residential technologies: radiant panels, minisplit heat pumps, and phase change materials. The recruitment of commercial daylighting sites will commence in March 2019.

Table 4: Initial customer-provided data used for site selection

Ownership & Occupants	Building Structure	Existing HVAC systems	Applicant data
• Applicant Name	• Square Footage	• Existing central furnace using ducts	• Technologies the applicant is interested in for their home
• Home Address	• Approximate year home was built	• Existing central cooling using ducts	• Interest in being contacted for future upgrade opportunities
• Homeowner or tenant	• Is the attic ventilated	• Age of central cooling	• Potential connections in energy industry (conflict of interest and possible bias)
• Owner occupied or tenant occupied	• Gas or electric furnace	• Existing Whole House fan	

Section 4: Status of Customer Recruitment

Customer recruitment activities for the applied research projects that require pre-monitoring involved a funnel of customer acquisition, site qualification, and customer commitments for participation. This process included outreach activities, customer qualification and pre-screening, site visits and analysis of findings, and communications and engagement with the selected sites.

Outreach Activities

The following outreach activities were completed to generate a sufficient pool of customer interested in participation in the targeted applied research projects:

- Press release to SCP media contacts
- Landing page on SonomaCleanPower.org
- Email campaign to customers
- Social media campaign to customers

Press release to SCP media contacts

A press release was distributed to SCP Board members, and then to SCP media contacts, on 11/13/2018. The Board members were asked to share the information with their contacts. Although the team did not observe in media coverage in response to the press release, we did observe an initial few Participation Requests submitted on 11/14/18, likely in response to this.

Landing page on SonomaCleanPower.org

The website page launched on 11/13/2018. The page was monitored using Google Analytics. As of 11/29/18, more than 80% of people who visited the page went on to submit a Participation Request. This indicated that the promotional materials were on-target, and that the site copy was encourage to customers. Between 11/16/18 through 11/29/18, the page had seen 249 unique visitors with 207 Participation Requests submitted during that time.

Email campaign to customers

The email campaign to customers launched on Thursday, 11/15/2018 and was distributed to 1,495 customers. The email distribution list did not include all of Sonoma Clean Power's customers, as this list was unavailable for use by Sonoma Clean Power for non-critical communications at the time of program launch. Instead, the list was comprised of customers who had opted in to communications from Sonoma Clean Power, indicating that the list would likely be comprised of engaged customers.

The email netted high open rates and clickthrough rates and was responsible for a heavy uptick in Participation Request submittals between 11/15 - 11/19. In total:

- 613 unique opens (41.4% open rate);
- Opened a total of 1,585 times;

- The internal links were clicked on by 193 people, and were clicked a total of 272 times, indicating that customers reviewed the information once and then went back to review it again.

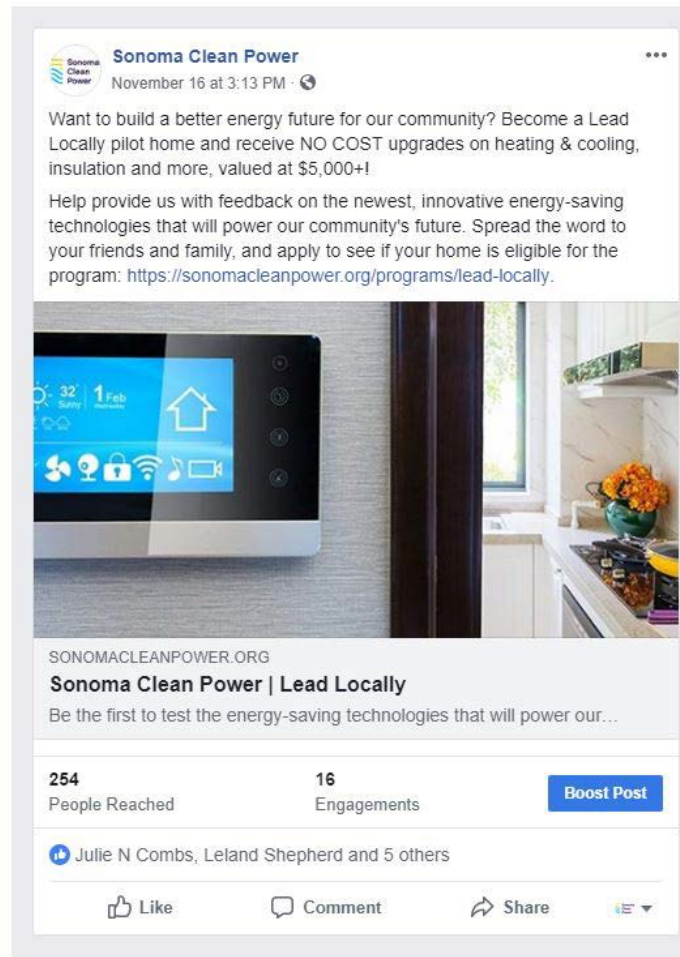
Social media outreach

SCP launched social media outreach beginning on 11/16/18. Although the program did not have budget for paid targeting of social media ads, the team did generate organic social media interest. The SCP team distributed messaging across the following channels, listed in order of engagement from end customers:

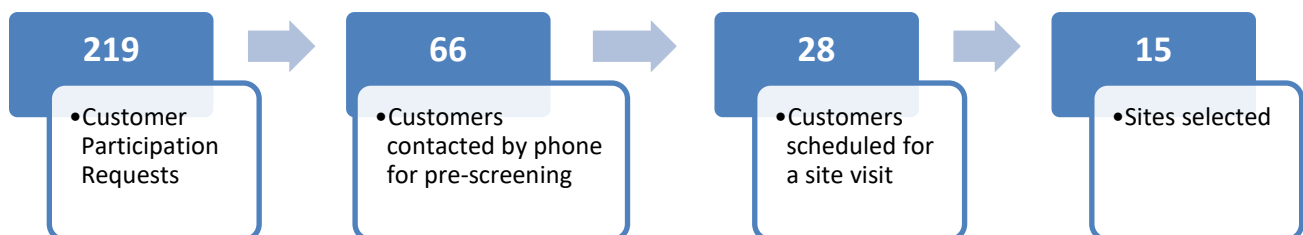
- Facebook
- Instagram
- LinkedIn
- Twitter

In particular, Facebook proved to be a useful outreach channel. SCP's Facebook posts were seen by between 200-400 users and received an unusually high click-through rate of 3.5 - 5.5%. The team expects that, with the addition of a limited advertising budget to increase the number of viewers of each post, Facebook may prove to be the strongest social media channel of the four.

Figure 1: Sample Facebook post



In response to initial recruitment, the team received 219 interested customer participation requests. The team winnowed down the number of interested applicants using the following steps, as further detailed below:



Initial Customer Qualification and Prescreening

For the 219 interested customers that responded to outreach activities, the team scored sites based on the information customers provided specific to the site selection criteria identified in

Table 4 in Section 3 above merged with existing SCP data sets. The team then used this scoring to identify candidates to further pre-screening to secure additional helpful information for site pre-qualification. These homeowners were contacted by phone and email and were asked to provide additional site-specific customer data and/or clarifying information. If the data provided did not make the customer ineligible, they were provided a detailed explanation of the technologies for which they were eligible, including both the benefits and the tradeoffs of participation, and were scheduled for a short walk-through audit to determine if there are any unexpected features of the building or its occupants that could affect its viability as a test site. This helped screen for possible issues such as incorrect screening results, unsafe conditions, or inadequate space for the equipment.

Site Visits and Analysis of Findings

Initial scoring based on SCP data, homeowner surveys, and phone calls led to site visits for the most promising candidate pilot homes. Three field test team members were fully briefed on the three technologies of interest, procedures for homeowner interactions, safety guidelines, and the information to be collected on-site. Site assessment forms used during these visits are attached in Appendix 1. The form for radiant panels was used for minisplits as well, because the criteria are nearly identical.

Summary of Site Visits

Site visits provided critical first-hand information about the feasibility of each site as a Pilot Home. Practical installation challenges, safety concerns, and homeowner attitudes were documented by the field test team. SCP staff was present for most site visits to answer questions about Lead Locally and the value of participation to all ratepayers. The field test team answered technical questions about the retrofit technologies, and what the installation would entail. Key scoring data collected during the site visits are summarized in Table 5.

Table 5: Key findings from visits to qualified sites

Site Number	Proposed Technology(ies)	Positive Attributes	Negative Attributes
186	• Radiant panels	<ul style="list-style-type: none"> • One-story • Climate Zone 2 • Attached garage • Old HVAC • Near other sites 	• None
44	• Radiant panels	<ul style="list-style-type: none"> • One-story • Climate Zone 2 • Attached garage • Whole-house fan • Near other sites 	• None
129	• Radiant panels	<ul style="list-style-type: none"> • One-story • Climate Zone 2 • Attached garage • Old HVAC • Near other sites 	• No local weather station
90	• Radiant panels	• One-story	• Built before 1978

	<ul style="list-style-type: none"> • Minisplit 	<ul style="list-style-type: none"> • Climate Zone 2 • Attached garage • Old HVAC • Near other sites 	<ul style="list-style-type: none"> • No local weather station
119	<ul style="list-style-type: none"> • Radiant panels 	<ul style="list-style-type: none"> • One-story • Climate Zone 2 • Attached garage • Old HVAC • Whole-house fan 	<ul style="list-style-type: none"> • Built before 1978
98	<ul style="list-style-type: none"> • Minisplit • PCM 	<ul style="list-style-type: none"> • One-story • Climate Zone 2 • Old HVAC • Electric heating 	<ul style="list-style-type: none"> • Retired residents • Not interested in radiant • No local weather station
176	<ul style="list-style-type: none"> • Radiant panels 	<ul style="list-style-type: none"> • One-story • Climate Zone 2 • Attached garage • Old HVAC 	<ul style="list-style-type: none"> • Retired residents • Over 2000 ft² • Not interested in minisplit or PCM
207	<ul style="list-style-type: none"> • Radiant panels • Minisplit • PCM 	<ul style="list-style-type: none"> • One-story • Climate Zone 2 • Attached garage • Near other sites 	<ul style="list-style-type: none"> • Retired residents • No local weather station • Installation challenge for radiant
211	<ul style="list-style-type: none"> • Minisplit • PCM 	<ul style="list-style-type: none"> • One-story • Climate Zone 2 • Attached garage 	<ul style="list-style-type: none"> • Built before 1978 • Not interested in radiant
171	<ul style="list-style-type: none"> • Radiant panels • Minisplit 	<ul style="list-style-type: none"> • One-story • Climate Zone 2 • Attached garage 	<ul style="list-style-type: none"> • Built before 1978 • Installation challenge for radiant • Installation challenge for minisplit
77	<ul style="list-style-type: none"> • Radiant panels • Minisplit 	<ul style="list-style-type: none"> • One-story • Climate Zone 2 • Attached garage • Old HVAC 	<ul style="list-style-type: none"> • Energy industry employee • Built before 1978 • Not interested in PCM • No local weather station
172	<ul style="list-style-type: none"> • Radiant panels 	<ul style="list-style-type: none"> • One-story • Climate Zone 2 • Attached garage • Old HVAC 	<ul style="list-style-type: none"> • Built before 1978 • Retired residents • Change in occupancy expected
143	<ul style="list-style-type: none"> • Radiant panels • Minisplit • PCM 	<ul style="list-style-type: none"> • One-story • Climate Zone 2 • Attached garage • Whole-house fan 	<ul style="list-style-type: none"> • Built before 1978 • Change in occupancy expected • No local weather station
182	<ul style="list-style-type: none"> • PCM 	<ul style="list-style-type: none"> • Climate Zone 2 • Attached garage • Slab-on-grade • Old HVAC 	<ul style="list-style-type: none"> • No local weather station • Installation challenge for radiant • Installation challenge for PCM
150	<ul style="list-style-type: none"> • Radiant panels • Minisplit 	<ul style="list-style-type: none"> • One-story • Climate Zone 2 	<ul style="list-style-type: none"> • Over 2000 ft² • No local weather station • Installation challenge for radiant
102	<ul style="list-style-type: none"> • Radiant panels • Minisplit 	<ul style="list-style-type: none"> • One-story • Climate Zone 2 • Attached garage • Near other sites 	<ul style="list-style-type: none"> • Energy industry employee • Over 2000 ft² • Not enthusiastic • No local weather station • Installation challenge for radiant
151	<ul style="list-style-type: none"> • Radiant panels • Minisplit 	<ul style="list-style-type: none"> • Climate Zone 2 • Attached garage • Near other sites 	<ul style="list-style-type: none"> • Energy industry employee • Retired residents • Over 2000 ft² • Not interested in PCM • No local weather station • Installation challenge for radiant
23	<ul style="list-style-type: none"> • Radiant panels 	<ul style="list-style-type: none"> • Climate Zone 2 	<ul style="list-style-type: none"> • Over 2000 ft²

	<ul style="list-style-type: none"> • Minisplit 	<ul style="list-style-type: none"> • Attached garage • Old HVAC • Whole-house fan 	<ul style="list-style-type: none"> • No local weather station • Installation challenge for radiant
47	<ul style="list-style-type: none"> • Radiant panels • Minisplit 	<ul style="list-style-type: none"> • Climate Zone 2 • Attached garage • Old HVAC 	<ul style="list-style-type: none"> • Retired residents • Over 2000 ft² • No local weather station • Installation challenge for radiant
175	<ul style="list-style-type: none"> • Radiant panels • Minisplit 	<ul style="list-style-type: none"> • Climate Zone 2 • Old HVAC 	<ul style="list-style-type: none"> • Over 2000 ft² • Installation challenge for radiant
180	<ul style="list-style-type: none"> • Radiant panels • Minisplit 	<ul style="list-style-type: none"> • Climate Zone 2 • Attached garage • Old HVAC 	<ul style="list-style-type: none"> • Retired residents • Not interested in radiant • No local weather station • Installation challenge for radiant • Installation challenge for minisplit
105	<ul style="list-style-type: none"> • PCM 	<ul style="list-style-type: none"> • Climate Zone 2 • Electric heating • Whole-house fan 	<ul style="list-style-type: none"> • Not interested in radiant • Not interested in minisplit
21	<ul style="list-style-type: none"> • PCM 	<ul style="list-style-type: none"> • Climate Zone 2 • Whole-house fan 	<ul style="list-style-type: none"> • Not interested in radiant • Not interested in minisplit
179	<ul style="list-style-type: none"> • PCM 	<ul style="list-style-type: none"> • Climate Zone 2 	<ul style="list-style-type: none"> • Installation challenge for PCM • Not interested in radiant • Not interested in minisplit
48	<ul style="list-style-type: none"> • PCM 	<ul style="list-style-type: none"> • Climate Zone 2 	<ul style="list-style-type: none"> • Window air conditioners • Features dissimilar to other sites • Not interested in radiant • Not interested in minisplit

Preliminary Site Selection based on Site Visit Results

The site visits provided sufficient information to finalize the scoring process and identify the best candidate sites to serve as Pilot Homes for the three technologies. The final rankings are summarized in Table 6, after removing sites that ultimately declined to participate.

Table 6: Preliminary site selection pending homeowner commitments

Ranking	PCM		Radiant		Minisplit	
	Site Number	Final Score	Site Number	Final Score	Site Number	Final Score
1	Site 105	102	Site 186	86	Site 44	83
2	Site 21	94	Site 119	71	Site 129	76
3	Site 143	94	Site 171	58	Site 90	71
4	Site 179	78	Site 77	56	Site 98	74
5	Site 182	78	Site 172	55	Site 211	68
Alternate	Site 48	75	Site 143	53	Site 150	52

The total number of minisplit sites has been reduced from six to five based on the results of the site selection process. Budgets for the minisplit project were based on slab-on-grade foundations for test sites, but nearly all candidate sites had crawlspaces. To ensure that no health hazards are introduced at the test sites, it was decided that existing vented crawlspaces should be converted to unvented crawlspaces, each with insulation and air sealing under the

floor and a vapor barrier to prevent moisture and soil gases from entering conditioned space. Because this process is relatively expensive, the number of test sites was decreased by one, while maintaining a sufficiently diverse sample of five.

Communications & Engagement with Selected Sites

The Team has sent out notifications to the homeowners that they have been selected and is currently communicating with these homeowners to secure their commitment to participate in the project. One additional step is required before the finalization of sites for the radiant panels and MSHPs. Because these measures both require fairly extensive load reduction measures (improved insulation, envelope tightening, crawlspace sealing), and because the retrofit packages are relatively complex, Lead Locally partners Mike McFarland of Energy Docs and Rick Chitwood will perform formal energy assessments to verify the feasibility of the sites for the planned energy upgrades. Both men are highly experienced in the industry and knowledgeable about advanced HVAC technologies, and may find unexpected problems that were previously missed. Mike and Rick will also be responsible for installing the retrofits, and are in the best position to verify that the planned retrofits can be performed in the selected houses within the budgets specified in the grant. These energy assessments will be conducted in the last half of February, and the instrumentation for approved sites will be installed soon thereafter, perhaps even the same day. Customers have been notified that it is possible the energy assessment may identify structural or other issues that could disqualify the home from receiving these specific retrofit technologies.

Participating customers are required to sign a Lead Locally Customer Participation and Access Agreement and are given a response date by which they need to confirm their intent to participate in the project and return a signed Participation Agreement to SCP. Participants also need to schedule a visit with Frontier Energy field technicians for the installation of temperature and energy monitoring sensors in key areas of their home. As noted above, sites selected for the mini-split heat pump and radiant ceiling panels are also asked to schedule and complete an advanced in-home energy assessment prior to the installation of monitoring equipment to identify additional energy saving upgrades that will be performed along with the replacement of the home's heating and cooling systems.

Email communications from the Sonoma Clean Power Lead Locally email account are followed up with pre-announced calls from the Frontier Energy customer care team to facilitate this process. Frontier customer care team members and field technicians will address questions from Participants regarding the project terms and conditions, proposed retrofit technologies, monitoring equipment, and all installation requirements and processes. SCP customer care team members will also support these communications and directly address any customer concerns of significance.

Customers that were not selected as a pilot home site were provided a courtesy update on their status with the program. These customers were thanked for their interest and encouraged to participate in future Lead Locally activities and offerings. For sites that received a phone call and site visit, additional information on their program status will be provided, including the list

of reasons that homes may not have been selected. All customers were informed that although they may not have been selected during this round of outreach, they may be contacted for participation in a future round. SCP staff will retain information on all interested customers to support engagement on such activities.

Three sites have been selected (one for each technology) as backup sites for instrumentation. These sites will not receive the no-cost technology upgrades unless one of the main sites is unable to participate for the full study period. These backup sites will be informed with full transparency as to their program status – that is, the back up sites will be well aware that they may not receive the no cost upgrades, but that they are volunteering only as a contingency plan and to help the program generate useful results.

Monitoring equipment and monitoring activities are performed as detailed in the existing *Lead Locally Research, Instrumentation, and Monitoring Plans* (for radiant panels, commercial daylighting, and PCMs) and the *Technology Demonstration Program Implementation Plan* (for minisplit heat pumps). In addition to customer sites, SCP plans to include the renovated existing commercial space at 741 4th St, Santa Rosa, CA, the Advanced Energy Center as a field test site for the commercial daylighting applied research technologies.

Section 5: Progress on Site Monitoring/Instrumentation

Once the selected homeowners have committed to participation in the program by signing a Participation Agreement, the field test team will begin instrumenting the homes to monitor baseline performance. As of February 15, 2019, most agreements have been signed, and instrumentation plans for each technology have been developed, but the instrumentation process has not yet begun. All instrumentation has been purchased from California-based vendors and several instrumentation packages have been assembled, but a few key components have not yet arrived at the Building Science Research Laboratory (BSRL) in Davis to allow finalization of the commissioning (or staging) process. Commissioning of the instrumentation package is necessary to ensure the instrumentation process runs smoothly (minimizing inconvenience to the building owner) and to configure the equipment to transmit data immediately after installation. Once commissioning is complete, the Customer Care team will set up appointments for installing instrumentation. In parallel to this process, all sites receiving radiant panel or minisplit retrofits will undergo an energy assessment to verify the acceptability of the Pilot Home and to identify low-cost envelope improvement opportunities that will reduce the required capacity and cost of the retrofit system. A summary of the current status, instrumentation needs, and next steps for each Pilot Home is provided in Table 7. This table will be updated on a quarterly basis as new sites are added, and progress on instrumentation and retrofit installation proceeds.

Table 7: Table illustrating status of instrumentation for 15 Pilot Homes

Site Number	Selected Technology	Proposed Instrumentation by Site	Next Steps by Site
Site 105	• PCM	<ul style="list-style-type: none"> • Datalogger (1) • Power meter (1) • Current transformers (3) • 16 channel input/output module (1) • Data acquisition unit (1) • Heat Flux Sensor (4) • Thermocouples (2) • Wireless temperature/humidity sensors (6) • Gas meter (1) • Cellular modem (1) 	<ul style="list-style-type: none"> • Commission instrumentation • Install instrumentation
Site 21	• PCM	<ul style="list-style-type: none"> • Datalogger (1) • Power meter (1) • Current transformers (3) • 16 channel input/output module (1) • Data acquisition unit (1) • Heat Flux Sensor (4) • Thermocouples (2) • Wireless temperature/humidity sensors (6) • Gas meter (1) • Cellular modem (1) 	<ul style="list-style-type: none"> • Commission instrumentation • Install instrumentation
Site 143	• PCM	<ul style="list-style-type: none"> • Datalogger (1) • Power meter (1) • Current transformers (3) 	<ul style="list-style-type: none"> • Sign participant agreement

		<ul style="list-style-type: none"> • 16 channel input/output module (1) • Data acquisition unit (1) • Heat Flux Sensor (4) • Thermocouples (2) • Wireless temperature/humidity sensors (6) • Gas meter (1) • Cellular modem (1) 	<ul style="list-style-type: none"> • Commission instrumentation • Schedule installation of monitoring package
Site 179	• PCM	<ul style="list-style-type: none"> • Datalogger (1) • Power meter (1) • Current transformers (3) • 16 channel input/output module (1) • Data acquisition unit (1) • Heat Flux Sensor (4) • Thermocouples (2) • Wireless temperature/humidity sensors (6) • Gas meter (1) • Cellular modem (1) 	<ul style="list-style-type: none"> • Sign participant agreement • Commission instrumentation • Schedule installation of monitoring package
Site 182	• PCM	<ul style="list-style-type: none"> • Datalogger (1) • Power meter (1) • Current transformers (3) • 16 channel input/output module (1) • Data acquisition unit (1) • Heat Flux Sensor (4) • Thermocouples (2) • Wireless temperature/humidity sensors (6) • Gas meter (1) • Cellular modem (1) 	<ul style="list-style-type: none"> • Sign participant agreement • Commission instrumentation • Schedule installation of monitoring package
Site 186	• Radiant	<ul style="list-style-type: none"> • Datalogger (1) • Modbus interface (1) • Power meter (2) • Current transformers (6) • 6 channel input/output module (1) • Volatile organic compounds (Air Quality) sensor (1) • Wireless temperature/humidity sensors (6) • Gas meter (1) • Cellular modem (1) • BTU meter (1) • ecobee4 smart thermostat • Window and door closure sensors (10) 	<ul style="list-style-type: none"> • Commission instrumentation • Perform energy assessment • Schedule installation of monitoring package
Site 119	• Radiant	<ul style="list-style-type: none"> • Datalogger (1) • Modbus interface (1) • Power meter (2) • Current transformers (6) • 6 channel input/output module (1) • Volatile organic compounds (Air Quality) sensor (1) • Wireless temperature/humidity sensors (6) • Gas meter (1) • Cellular modem (1) • BTU meter (1) • ecobee4 smart thermostat • Window and door closure sensors (10) 	<ul style="list-style-type: none"> • Commission instrumentation • Perform energy assessment • Schedule installation of monitoring package
Site 171	• Radiant	<ul style="list-style-type: none"> • Datalogger (1) • Modbus interface (1) • Power meter (2) • Current transformers (6) • 6 channel input/output module (1) 	<ul style="list-style-type: none"> • Verify no asbestos • Sign participant agreement • Commission instrumentation

		<ul style="list-style-type: none"> • Volatile organic compounds (Air Quality) sensor (1) • Wireless temperature/humidity sensors (6) • Gas meter (1) • Cellular modem (1) • BTU meter (1) • ecobee4 smart thermostat • Window and door closure sensors (10) 	<ul style="list-style-type: none"> • Perform energy assessment • Schedule installation of monitoring package
Site 77	• Radiant	<ul style="list-style-type: none"> • Datalogger (1) • Modbus interface (1) • Power meter (2) • Current transformers (6) • 6 channel input/output module (1) • Volatile organic compounds (Air Quality) sensor (1) • Wireless temperature/humidity sensors (6) • Gas meter (1) • Cellular modem (1) • BTU meter (1) • ecobee4 smart thermostat • Window and door closure sensors (10) 	<ul style="list-style-type: none"> • Commission instrumentation • Perform energy assessment • Schedule installation of monitoring package
Site 172	• Radiant	<ul style="list-style-type: none"> • Datalogger (1) • Modbus interface (1) • Power meter (2) • Current transformers (6) • 6 channel input/output module (1) • Volatile organic compounds (Air Quality) sensor (1) • Wireless temperature/humidity sensors (6) • Gas meter (1) • Cellular modem (1) • BTU meter (1) • ecobee4 smart thermostat • Window and door closure sensors (10) 	<ul style="list-style-type: none"> • Sign participant agreement • Commission instrumentation • Perform energy assessment • Schedule installation of monitoring package
Site 44	• Minisplit	<ul style="list-style-type: none"> • Datalogger (1) • Modbus interface (1) • Power meter (2) • Current transformers (6) • 6 channel input/output module (1) • Volatile organic compounds (Air Quality) sensor (1) • Wireless temperature/humidity sensors (6) • Gas meter (1) • Cellular modem (1) • ecobee4 smart thermostat (1) • Window and door closure sensors (10) 	<ul style="list-style-type: none"> • Commission instrumentation • Perform energy assessment • Schedule installation of monitoring package
Site 129	• Minisplit	<ul style="list-style-type: none"> • Datalogger (1) • Modbus interface (1) • Power meter (2) • Current transformers (6) • 6 channel input/output module (1) • Volatile organic compounds (Air Quality) sensor (1) • Wireless temperature/humidity sensors (6) • Gas meter (1) • Cellular modem (1) • ecobee4 smart thermostat (1) • Window and door closure sensors (10) 	<ul style="list-style-type: none"> • Commission instrumentation • Perform energy assessment • Schedule installation of monitoring package

Site 90	<ul style="list-style-type: none"> • Minisplit 	<ul style="list-style-type: none"> • Datalogger (1) • Modbus interface (1) • Power meter (2) • Current transformers (6) • 6 channel input/output module (1) • Volatile organic compounds (Air Quality) sensor (1) • Wireless temperature/humidity sensors (6) • Gas meter (1) • Cellular modem (1) • ecobee4 smart thermostat (1) • Window and door closure sensors (10) 	<ul style="list-style-type: none"> • Commission instrumentation • Perform energy assessment • Schedule installation of monitoring package
Site 98	<ul style="list-style-type: none"> • Minisplit 	<ul style="list-style-type: none"> • Datalogger (1) • Modbus interface (1) • Power meter (2) • Current transformers (6) • 6 channel input/output module (1) • Volatile organic compounds (Air Quality) sensor (1) • Wireless temperature/humidity sensors (6) • Gas meter (1) • Cellular modem (1) • ecobee4 smart thermostat (1) • Window and door closure sensors (10) 	<ul style="list-style-type: none"> • Commission instrumentation • Perform energy assessment • Schedule installation of monitoring package
Site 211	<ul style="list-style-type: none"> • Minisplit 	<ul style="list-style-type: none"> • Datalogger (1) • Modbus interface (1) • Power meter (2) • Current transformers (6) • 6 channel input/output module (1) • Volatile organic compounds (Air Quality) sensor (1) • Wireless temperature/humidity sensors (6) • Gas meter (1) • Cellular modem (1) • ecobee4 smart thermostat (1) • Window and door closure sensors (10) 	<ul style="list-style-type: none"> • Commission instrumentation • Perform energy assessment • Schedule installation of monitoring package

Section 6: Conclusion and Next Steps

This Report details progress to date for the pre-monitoring of three Lead Locally applied research technology projects and one technology demonstration. This monitoring helps the Project Team establish pre-retrofit baselines against which to evaluate the performance of the technologies once they are installed. This includes collecting three to six months of pre-project monitoring data for the following projects:

- phase change materials
- radiant ceiling panels/air-to-water heat pumps,
- mini-split heat pumps,
- commercial daylighting.

Assessment of Progress

Based on this progress, The SCP team assesses that the Lead Locally Project is generally on schedule for critical path early milestones given that these pre-monitoring activities are the project deliverables with longest lead times.

Next Steps

As these pre-monitoring activities, detailed in the existing and approved *Lead Locally Research, Instrumentation, and Monitoring Plans* advance, SCP can, at the direction of the Contract Manager, include any or all of the tables included in this report in future *Monthly Progress Report* submittals for the duration of the pre-monitoring period (approximately through September 2019).

Appendix 1: Site Assessment Forms

Site Visit Form

Phase Change Materials

Contact Information

Homeowner Name(s)	
Address	
Phone Number (s)	
Frontier Inspector Name	

Yes	No	Maybe	Occupants	Notes
			Occupied year-round?	
			Owned by current residents?	
			Will remain in home for the next 2 years?	
			Expected change in occupancy level? (kids leaving for college, etc.)	
			Homeowner enthusiastic about project?	
			Does homeowner have realistic expectations?	

Yes	No	Maybe	Site Features	Notes
			Single family?	
			Single story?	
			Conditioned floor area less than 1500 ft ² ?	
			Functional heating system?	
			Functional cooling system?	
			Central heating?	
			Electric heating?	
			Attic venting?	
			Whole house fan?	
			Ecobee thermostat?	
			Asbestor concerns evident?	

Other Important Observations (Take photos to document)

Attic (insulation depth/material, dimensions, ceiling height, roof slope, sufficient vent area)	
Building Envelope (exterior/interior materials, observable insulation and air/water leakage issues)	
HVAC System (heating/cooling system type, efficiency, indoor unit location, duct location/insulation, ventilation type, supplemental systems)	
Installation Challenges (space limitations, electrical issues, physical impediments)	
Monitoring Challenges (outlet availability, wire runs, access to desired sensor locations)	
Safety Concerns (asbestos, mold, rickety structures, protruding nails)	
Homeowner Attitudes (positivity, knowledge, interest, risk tolerance)	

Site Visit Form

Radiant Ceiling Panels

Contact Information

Homeowner Name(s)	
Address	
Phone Number (s)	
Frontier Inspector Name	

Occupant Information

Yes	No	N/A	Occupants	Notes
			Expected change in occupancy level? (kids leaving for college, etc.)	
			Smokers?	
			Retired?	
			Working from home?	
			Stay at home parent?	
			School age children?	

General Site Features

Yes	No	N/A	Feature	Notes
			Attic accessible? (Note type, e.g. vented, open, or sealed and access location.)	
			Crawlspace accessible? (Note type, e.g. vented, open, or sealed and access location.)	
			Odd ceiling geometries: (i.e. domed, partially sloped, etc.)	
			Ceiling framing: (e.g. 24 in. o.c., etc.)	
			Joist size: (e.g. 2x6)	
			General framing condition: (i.e. no visible dry rot, termites, etc.)	
			Moisure issues: (Note any evidence of leaks or excess humidity.)	
			Asbestos concerns evident?	
			Electrical service panels are in good condition?	
			Panel Locations:	
			HVAC systems on dedicated circuits and # of HVAC circuits:	
			Nubmer of available breaker spaces:	
			Wall space available adjacent to service panel?	
			Advanced energy features? (e.g. solar, energy storage, etc.)	
			Home automation systems? (Note types/brands.)	

Additional Notes

Attic	
Building Envelope	
Monitoring Challenges	
Safety Concerns	

HVAC Features - Cooling

Yes	No	Maybe	Feature	Notes
			Functional cooling system?	
			Ducted cooling?	
			System Type: (AC or HP)	
			Configuration Type: (Split or Package)	
			Outdoor or Package Unit Location: (e.g. side yard, roof, etc.)	
			Indoor Unit Location: (e.g. crawlspace, indoor cabinet, etc.)	
			Ducts Location: (e.g. attic, conditioned space, etc. If same as cooling write "X".)	
			General Supply Register Locations: (e.g. floor, ceiling, wall)	
			Return Grille Location: (Note specific room(s).)	
			Supplemental cooling? (e.g. window/portable Acs, mini-split in recent addition, etc. Note rooms.)	

HVAC Features - Heating

Yes	No	N/A	Feature	Notes
			Functional heating system?	
			Electric heating?	
			Integrated with cooling system? (Note level of integration, i.e. same ducts but different blower, etc.)	
			Ducted heating?	
			System Type: (Furnace or HP)	
			Indoor Unit Location: (e.g. crawlspace, indoor cabinet, etc.)	
			Ducts Location: (e.g. attic, conditioned space, etc. If same as cooling write "X".)	
			General Supply Register Locations: (e.g. floor, ceiling, wall)	
			Return Grille Location: (Note specific room(s).)	
			Supplemental heating? (e.g. wall heater, fireplace, etc. Note rooms.)	

HVAC Features - Ventilation and Other

Yes	No	N/A	Feature	Notes
			Ceiling fans? (Note rooms.)	
			Whole house fan?	
			Bathroom exhaust fan(s)? (If only some, note which are not.)	
			Kitchen hood? (Note if exhausted or circulating type.)	
			Oher mechanical ventilation? (Note type and location.)	
			Ecobee thermostat?	

Additional Notes

HVAC System (heating/cooling system type, efficiency, indoor unit location, duct location/insulation, ventilation type, supplemental systems)	
Installation Challenges (space limitations, electrical issues, physical impediments)	
Safety Concerns (asbestos, mold, rickety structures, protruding nails)	
Homeowner Attitudes (expectations, positivity, knowledge, interest, risk tolerance)	

Photo Checklist

Clean camera lense before taking pictures. Check focus. This is a minimum, take ALL the pictures.	
	Site exterior, front.
	Site exterior, back.
	Site exterior, left side.
	Site exterior, right side.
	Outdoor unit from 15 feet.
	Outdoor unit from 3 feet.
	Outdoor unit nameplate.
	Indoor unit.
	Indoor unit nameplate.
	Ducts, registers, return grille, etc.
	Interior of return plenum.
	Each supplemental system and nameplates.
	Mechanical ventilation fans.
	Electrical service panel, with cover.
	Electrical service panel, without cover.
	Utility meters.
	Attic (multiple).
	Crawlspace (multiple).
	Thermostats and other controls.
Note additional photos taken:	