

Virtual Visions: The Future of Field Work

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ABSTRACT

The COVID-19 pandemic and requirements for social distancing resulted in rapid and significant changes to facility operations. This complicated impact evaluation of utility energy efficiency programs, and particularly affects on-site measurement and verification (M&V). While some facilities have ended COVID-19 access restrictions, many still have special requirements and considerations that impact M&V approaches. Out of necessity, evaluators and M&V practitioners transitioned to relatively safe yet potentially lower rigor approaches to verifying energy savings, such as virtual site visits.

This paper outlines a virtual site visit approach for project verification. We investigate whether the approach is viable for energy savings verification and provides the required rigor to confirm energy savings. We discuss the pros and cons of a virtual site visit approach and look at lessons learned from conducting over 1,000 virtual visits for a broad range of energy savings measures within energy efficiency programs across the United States. We cover the different approaches and considerations before, during, and after a virtual site visit, along with the tools and technology used. We also cover the challenges experienced during the site visits and observations from working with site contacts to verify different energy efficiency measures.

The paper also focuses on feedback provided by eight utility energy efficiency program managers on their perceptions of virtual site visit efficacy, considerations to ensure that impact evaluations proceed with minimal interruptions, and their expectations regarding future budget impacts and the role of virtual visits for their programs even after the pandemic is under control.

Introduction

The COVID-19 pandemic has resulted in significant and rapid changes to facility operations and caused significant uncertainty about future operations. This has complicated impact evaluation of utility energy efficiency programs and particularly affected on-site project verifications. Energy efficiency program managers provide guidance for impact evaluation activity, including updated industrial impact policies and alternative approaches to project verification. As part of this guidance, program managers began approving virtual site visits as an option to verify savings for some projects.

To verify projects and observe performance parameters at a specific project site, a virtual site visit involves using a web-based audio and video connection to replace in-person interactions with a project-specific site contact. The evaluator uses additional information, such as submitted project documentation (invoices, specification sheets, and calculation models) and participant-provided meter or trend data as part of the verification strategy.

The virtual site visit methodology can be useful for developing savings estimates from rebated measures by incorporating site-specific conditions where physical access to the site is not feasible. However, the virtual process could potentially place a burden on the customer if not conducted properly, which may also lead to lower customer satisfaction. In general, the virtual method relies on a site contact having adequate knowledge of the project and equipment, as well as access to the site. More specifically, the virtual site visit methodology has limitations on requisite data collection when considering safety

concerns for the site contact performing the verification. Other limitations may occur because of restrictions on the verification effort related to the customer's privacy and operating policies.

This paper outlines a virtual site visit approach for project verification. We investigate whether the approach is viable for energy savings verification and provides the required rigor to confirm energy savings. We discuss the pros and cons of a virtual site visit approach and look at lessons learned from conducting over 1,000 virtual visits for a broad range of energy savings measures within energy efficiency programs across the United States. We collected feedback from eight utility energy efficiency program managers regarding virtual site visit efficacy and involvement in future evaluations, as well as considerations to ensure that impact evaluations proceed with minimal interruptions and details of expected future budget impacts. We also explored their expectations regarding the future for virtual visits and its role in their programs even after the pandemic is under control.

Overall, our findings revealed that technology has advanced sufficiently to where virtual site visits can be a viable approach for verifying certain measure types in some sectors. Site contacts and energy efficiency program administrators provided encouraging feedback on the virtual site visit approach. We believe that virtual visits will endure, continuing to represent a viable option for future impact evaluations, particularly for verifying measures that are relatively straightforward or would otherwise require an intensive investment of time, budget, and travel. Although there are challenges, the process will continue to be refined, technologies will improve, evaluators will gain experience conducting virtual visits and using virtual technologies, and customers will become more accustomed to the virtual visit approach.

Virtual Site Visit Verification Approach

To allow a virtual site visit, the customer uses a secure video application that enables the evaluator to remotely verify site-specific conditions, the installed equipment, and nameplate data. To verify savings, the evaluator uses a combination of:

- Virtual site visit observations, such as a video recording, an interview with the site contact, and photos taken during the virtual tour, and
- Additional information, such as submitted project documentation (invoices, specification sheets, and calculation models) and participant-provided meter or trend data.

The virtual site visit process is designed with customer and staff safety and well-being as the top priority. We have refined our approach over the past two years and will continue to refine the process by incorporating feedback from our clients and customers as well as lessons learned from conducting virtual visits across the United States. The virtual M&V process is adapted to be compliant with the established evaluation frameworks of each client. The approach defined below is robust and was designed as a long-term tool to verify energy savings and peak demand reduction.

Virtual Site Visit Best Practices

In a virtual atmosphere it is critical to adapt to the customers' needs and expectations and to maximize the value of the site visit, which sometimes involves quick thinking and making adjustments during calls to complete the verification process. Table 1 highlights key aspects of a successful virtual data collection strategy.

Table 1. Recommendations for a Successful Virtual and Contactless Strategy

Key Aspect	Contactless Strategy
Customer-Centric	<ul style="list-style-type: none"> • Develop a virtual approach that prioritizes customer comfort, preference, privacy concerns, and operational policies, and that is designed to minimize the customer burden throughout data collection and inspection. • Provide technical support to the customer through pre-site visit verification equipment tests (of mobile phones, tablets, and other technologies), clear guidelines, and options to safely and securely upload any additional data needed by the evaluator. • Conduct verification using the site contacts’ preferred video conferencing tool and schedule visits at the convenience of site staff. If the site contact is uncomfortable conducting verification through a live video call, work with them to find alternatives such as pictures or offline videos. • Set appointment times with site contacts at their earliest convenience to ensure that the verification process will involve minimal wait times.
Safety-Focused	<ul style="list-style-type: none"> • Keep safety as the top priority and aim to work with each customer to verify projects safely and securely at the facility. • Include considerations to minimize risks associated with projects that require climbing ladders, opening electrical panels, and other potentially dangerous activities. • If on-site power metering is required, work with the site contact to ensure that a trained professional is available to install the meters and that all safety requirements are followed and the necessary personal protective gear is used.
Innovative	<ul style="list-style-type: none"> • Adapt to the rapidly changing environment by providing a variety of virtual platforms to support various customers, and develop strong protocols to ensure the accuracy of resulting verification and analyses. • Continuously look for opportunities to improve both the capabilities and processes to meet M&V requirements.
Testing and Practicing	<ul style="list-style-type: none"> • Test the virtual site visit approach internally and through pilot studies before deploying large-scale M&V activity in the field. • Design a process for the long-haul that retains the virtual/contactless option moving forward. Provide the necessary testing and training budget required to ensure successful virtual site visits.
Using Comprehensive Protocols to Address Challenges	<ul style="list-style-type: none"> • Design evaluation and M&V protocols that address challenges related to modified hours of operation and changes in production, as well as other atypical activities during the COVID-19 period. • Work with clients to address permanent and temporary facility closures, lower occupancy and/or production levels, and other relevant issues. • Consider various approaches for project verification to increase the likelihood of projects being adequately verified.
Continuously Improving and Calibrating	<ul style="list-style-type: none"> • Continuously adapt the virtual site visit process to meet evaluation needs. • Apply lessons learned from various projects across the country to ensure that the solution best meets the clients’ needs efficiently, safely, and cost-effectively.

The process for conducting virtual site visits and the reference documents used to guide this process are illustrated in Figure 1.

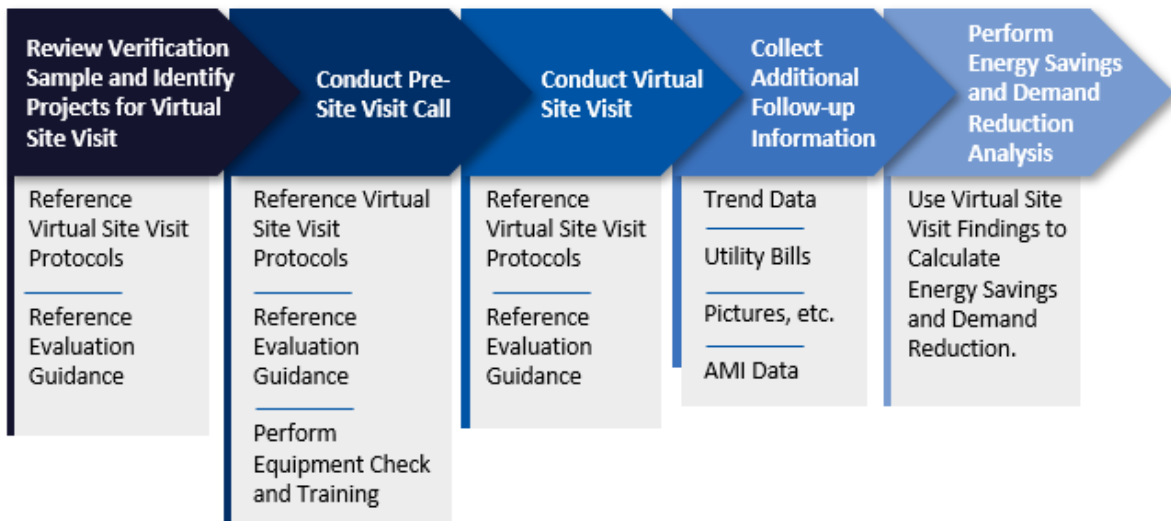


Figure 1. Virtual Verification Process

It is critical for the evaluation team to develop protocols that address steps to consider before, during, and after the virtual site visit. This will allow for a uniform approach that captures the required data in the most efficient manner, reducing the customer burden. It is also critical to update evaluation frameworks and policies to account for virtual site visits and to include the proposed virtual approach as part of those frameworks. This will ensure that evaluators and clients agree on the approach.

Virtual Visit Platforms

Several tools are used to conduct virtual site visits and several factors need to be considered when selecting the appropriate tool. Tool selection involves a balance of different priorities to ensure a successful site visit. There are several additional considerations:

- **Customer Experience:** The evaluation team should generally provide several options to the customer while also deferring to the customers’ preference of tools. If the customer has video conferencing software available at the facility, the evaluation team should generally adjust to use this software. This allows for increased customer satisfaction as well as a higher level of cooperation and success.
- **Data Security:** Data security is a critical consideration for both the utility clients and the site contacts. Virtual calls can be recorded¹, and it is important to ensure that these recordings are secure and the evaluators have total access to all the data collected during the site visit. The evaluation team must ensure that any software used follows the appropriate security protocols necessary to protect customer data.
- **Tool Capability:** Most video conferencing tools have the features required for a successful virtual visit. There are slight differences between some of the more popular tools; for instance, pictures can be taken within the Stream platform and additional features, such as pointers, can be used to guide customers. The most common platforms used in virtual site visits are Microsoft Teams and

¹ Ensure that permission is granted by the customer and all data security and facility rules are followed before recording or taking pictures during a virtual site visit.

Zoom. Some customers prefer to conduct virtual visits on their phone using Facetime or Google Duo.

- **Reliability:** Platform reliability is critical to the success of a virtual call. Avoid platforms that have not been tested or that do not have appropriate customer support.
- **Ease of Use:** It is important that the virtual site visit tool is easy to use for the site contacts and for the evaluators. Pick a tool that has a simple user interface and meets all the requirements of a virtual site visit. Make sure that evaluators are trained on the tool and offer training to the customer ahead of the call.
- **Compatibility and Accessibility:** The selected tool should have cell phone accessibility as well as laptop/desktop accessibility. This is important because some customers prefer to walk through facilities on their cell phones, making it easier to capture nameplates and equipment specifications. More broadly accessible tools make it easier to adapt when issues arise during a site visit.

Project Characteristics

Since the start of the COVID-19 pandemic, Cadmus has worked diligently with our clients to transition M&V activities to virtual site visits to ensure the timely and successful completion of evaluation activities. We collected measure characteristics from 1,042 virtual sites visits across evaluations all over the United States. The data we provide in this paper covers a broad range of energy savings measures and programs. For the purpose of this paper, we summarized this data into broader categories in order to display measure and program distributions visually. For instance, we assessed over 250 measures for our virtual site visits, which are summarized into the 17 measure groups shown in Figure 2. As the figure shows, the majority of measures, unsurprisingly, were for lighting. This was followed by HVAC and variable speed drive measures. The Other category consists of a mix of measures we only assessed infrequently, such as forklift chargers, efficient rectifiers, and livestock waterers.

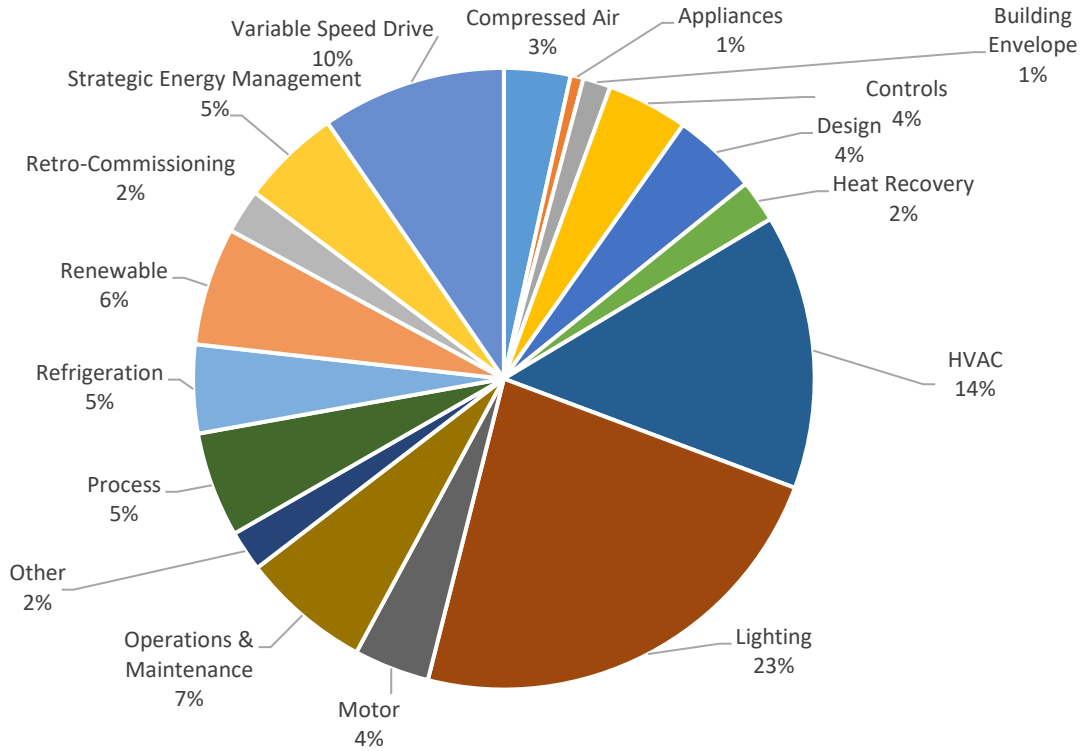


Figure 2. Virtual Site Visit Measure Distribution

Figure 3 categorizes the measure distribution across programs types. Energy efficiency programs across the U.S. have different names for the various offerings. For the purpose of this paper, we grouped similar offerings into the seven categories displayed below. The majority of projects we verified through virtual site visits were at industrial and commercial facilities, followed by new construction and agricultural facilities. The commercial facilities include several building types, such as offices, retail stores, and grocery stores. Renewable projects appear across all offerings but were grouped into one offering since they generally have similar characteristics.

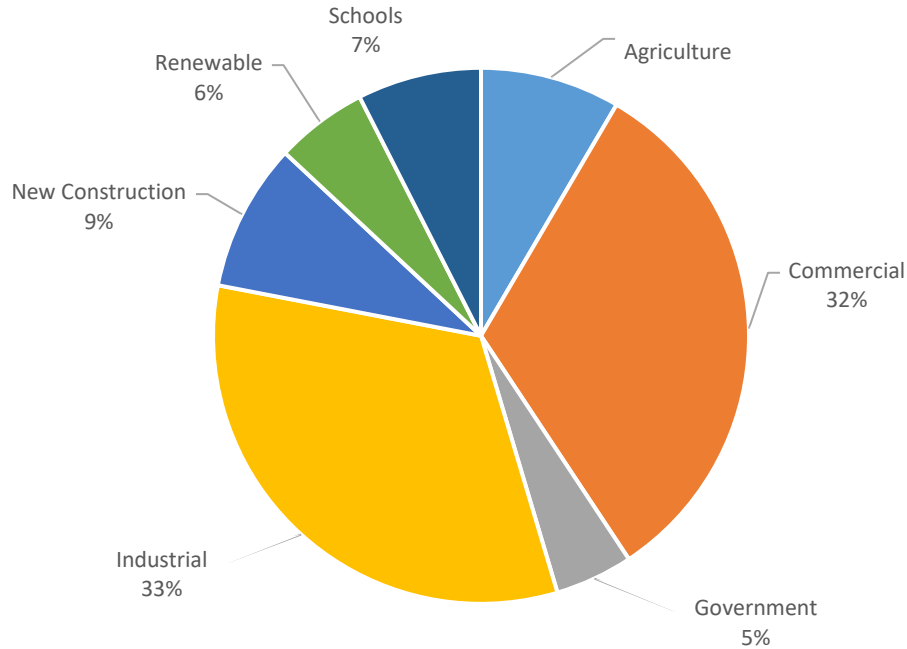


Figure 3. Virtual Site Visit Measure Distribution across Offerings

Figure 4 displays the distribution of fuel types across all projects verified through virtual visits. Most measures we virtually visited used electricity as their predominant fuel type.

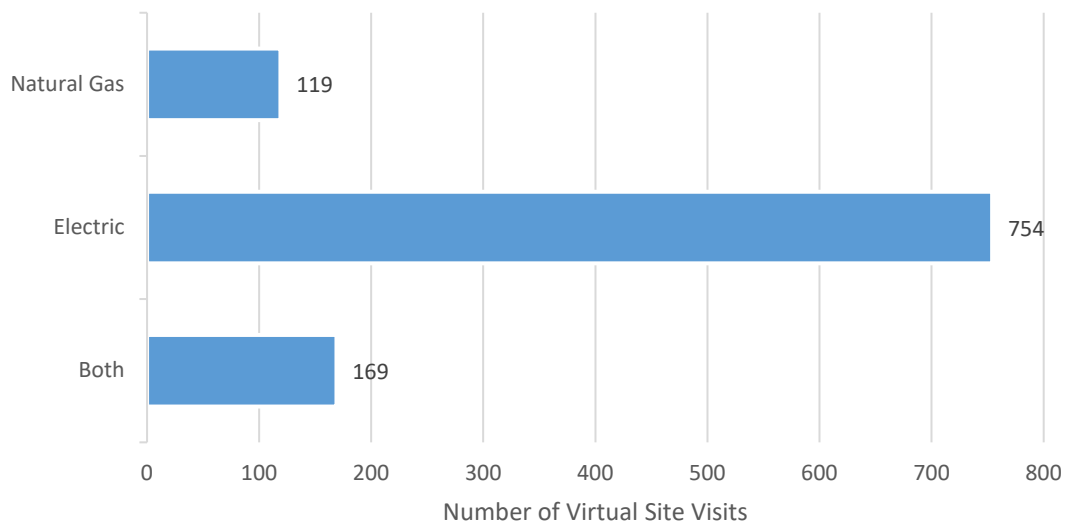


Figure 4. Virtual Site Visit Fuel Distribution

Figure 5 displays the distribution of virtual site visit tools used to conduct M&V activities. As mentioned above, we generally used whatever tool the customer preferred. If the customer deferred to us, we generally used Microsoft Teams. However, depending on project complexity, we may have used a video conferencing tool such as Stream, which has additional features such as pointers to guide the customer during the verification visit. We had similar success with all the tools listed below. The challenges we have faced with virtual site visits were more related to internet connectivity and customer awareness of the tool than with the tool capability.

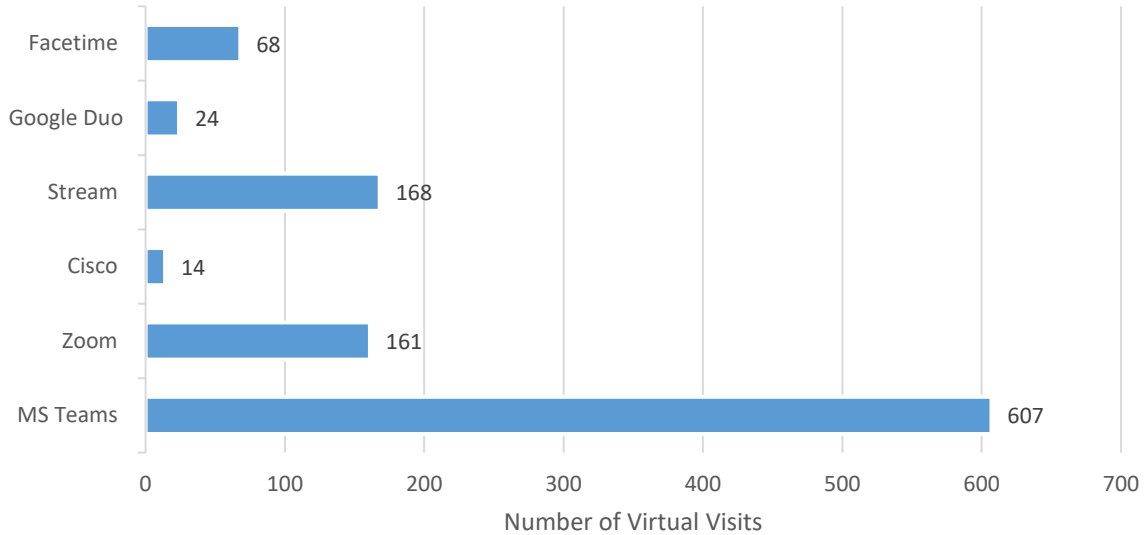


Figure 5. Virtual Site Visit Tools

Lessons Learned, Barriers, and Opportunities

Cadmus outlined several guidelines based on lessons we learned conducting virtual site visits. We also discuss barriers and opportunities resulting from our experience conducting virtual visits. Virtual visits can vary in complexity depending on the projects being evaluated. Each site visit requires accounting for different considerations. The most critical aspect of a successful virtual visit is pre-site visit preparation and, more importantly, selecting the appropriate projects to verify through the virtual approach.

Table 2 summarizes some considerations and best practices for a successful virtual site visit.

Table 2. Virtual Site Visit Considerations and Best Practices

Consideration	Overview
Safety	<ul style="list-style-type: none"> The sites and measures selected must be deemed safe for verification by a site contact. The virtual method relies on a site contact accessing rebated equipment for verification, and sometimes this equipment may be located in spaces that are not easy to access or may require professional training to access. For example, sites that do not require the site contact to climb ladders or access electrical panels are appropriate for a virtual site visit.
Data Security, Privacy, and Participant Operational Policies	<ul style="list-style-type: none"> Participants’ operational policies must be followed and privacy concerns must be addressed. A virtual site visit would not be feasible if the customer’s policies explicitly forbid virtual access to their location. For example, videos or photos may not be allowed in research and development facilities. A virtual site visit is also not possible if the customer refuses access due to privacy and data security concerns. These concerns could be mitigated through one of several procedures: <ul style="list-style-type: none"> Use universally accepted virtual tools with tested security provisions and protocols, such as Microsoft Teams or FaceTime. Ensure that all recorded video calls, photos, and requested materials can be saved and uploaded to a secure location that is only accessible to key personnel.

Consideration	Overview
	<ul style="list-style-type: none"> • A customer’s operational policies regarding the pandemic might not allow qualified site inspection staff to gain even virtual access to project sites during operating hours due to stricter restrictions within the facility for on-site staff.
Site or Project Characteristics	<ul style="list-style-type: none"> • Sites that involve a large number of measures may not be good candidates to verify virtually. It is not efficient for the site contact to attempt to walk the evaluator through a site with 5 dissimilar projects, for instance, which would involve a significant imposition of time and effort for the customer to verify each technology. • Additionally, sites that involve a significant number of projects that are similar in nature can be difficult for the site contact to validate appropriately (for instance, projects that involve the same lighting or refrigeration equipment installed in different parts of facility during different periods in a program year will need to be identified, recorded, and verified separately). • Some projects and measures are not easy to verify virtually because of their size, complexity, and other characteristics. Extremely large projects or projects involving complex measures (such as combined heat and power, large air compressors, or unique process-related equipment) are likely not good candidates for virtual site visits. Verification of these projects involves metering and requires detailed information on operating parameters, as well as additional data collection (including, process temperatures, and run times of production equipment). In contrast, projects that involve anti-sweat heaters, small air compressor measures (air dryers and no-loss drains), small HVAC equipment, small lighting measures, or controls may be good candidates for virtual site visits because they typically do not require information other than nameplate data and operating conditions to develop savings estimates. • Projects that involve high equipment counts are not good virtual site visit candidates. For example, a lighting project with 1,000 light fixtures² would require significant effort from the site contact to verify and record the quantity, make, and model of the equipment, as well as the equipment locations, operating conditions, and other inputs that inform the savings calculation. • Projects that are not centrally located are difficult to verify virtually. For example, a project with four boilers in four different locations would require the site contact to move across the facility, involving a lot of time and effort. Changing locations within the facility while using recording equipment may also raise safety concerns and could involve lost internet or call connectivity issues that compromise data quality. • Projects that cannot be clearly visually verified may not be ideal for virtual site visits. For example, air leak repairs are difficult to verify visually or to verify over a virtual call. In addition to the need for detailed leak repair logs and accessibility issues, inspections may require ultrasonic detection equipment that might not be available on the site (or that the site contact is not trained to use). • Projects with available trend data or metered data may be good candidates for virtual site visits. For example, a project involving an air compressor or chiller that has trending capability or metered data allows the virtual site visit to be focused on verifying setpoints, hours of operation, and nameplate information, and the evaluation team can incorporate these inputs with the available data. • Sites where metering data is necessary for the evaluation are not good candidates for virtual site visits, unless facility staff are able and willing to install and remove the metering equipment.
Site Contact Knowledge and Burden	<ul style="list-style-type: none"> • Site contacts must have sufficient knowledge of the project and equipment and be able to perform the virtual visit and gather data required for verification.

² Verifying 1,000 light fixtures through on-site verification would also be challenging and this would generally involve a sampling approach by space type or fixture type which can generally be difficult to do virtually.

Consideration	Overview
	<ul style="list-style-type: none"> The evaluator will need to consider the time burden placed on the site contact—this person will need to participate in a pre-site visit call and a virtual site visit preparation call, will need to provide supporting documentation such as images and video, and will need to be available for follow-up questions: this is a larger burden than is typical with an on-site visit.
Data Collection Quality and Input Assumptions	<ul style="list-style-type: none"> Virtual site visits rely on data collection by site contacts, who may not have the appropriate background and training to gather necessary savings calculation inputs. The evaluator will need to provide such training through clear communication with the site contact, which could entail video call guidance support, M&V plan support, and providing data request details prior to virtual site visit. Site contacts will participate in an interview with the evaluator, in which the evaluator determines the site contact’s ability to capture inputs such as production levels, hours of operations, impacts due to COVID-19, and willingness to complete a virtual site visit, among other topics. An appropriate site contact must demonstrate being knowledgeable of the projects and business contexts and the ability to safely gather necessary data without undue burden.
Technology	<ul style="list-style-type: none"> Possible technical limitations such as issues with internet connectivity or cell phone reception, or lack of video or photography technology and scanning equipment, could prevent implementation of virtual site visits. For example, connectivity issues with equipment located underground may prevent the evaluator from using live videos. This can be mitigated by accepting non-live video recordings, photos of nameplates, or pre-recorded video for reference and review.

Virtual Site Visit Opportunities and Barriers

Every M&V methodology has various advantages and disadvantages. Considerations for the level of rigor, customer convenience, cost, measure complexity, expertise required, and safety all factor into the decision of which M&V approach is best. We compiled a list of the advantages and disadvantages of virtual site visits based on diverse measures across many different commercial and industrial sectors.

Advantages

- **Shorter Duration:** Virtual site visits involve no travel and less wait time to get started, and result in shorter site visits. Site visits can be further streamlined by sending data collection points to the site contact ahead of the virtual visit. This generally results in a more efficient data collection process with better preparations³.
- **Safe for COVID-19:** The popularity of virtual site visits rose significantly over the past 1.5 years due to the COVID-19 pandemic. This is a relatively safe approach that allows for social distancing.
- **Lower Cost:** Due to the shorter duration of most site visits and the added potential of streamlining those visits, virtual visits generally cost less to conduct than on-site visits.
- **Opportunity to Have More Team Members on the Call:** Virtual visits allow for having more team members to help with the visit. This allows for a more efficient site visit and additional support at a reduced cost to the client.

³ Note that a shorter duration is not always the case. For more complex measures that require in-depth M&V and additional rigor it may be quicker and easier for the evaluator to perform an on-site visit. As discussed above, site visit selection is critical for a successful virtual visit.

Disadvantages

- **Less Rigor (in some cases):** Some virtual visits can result in less rigor. The evaluator relies on the site contact when guiding the visit and needs to balance customer convenience with the data collection requirements. Virtual visits also generally make spot measurements and metering much more challenging. We have had some success with site contacts taking these measurements for us, but it requires that contact to have the right training and availability.
- **Technical Difficulties:** Challenges with internet connection and video conferencing tools can result in an unsuccessful virtual visit. It is important to ensure that internet connection is available throughout, especially with the site contact walking around the facility. If there are gaps in internet connection the site contact can supplement data collection with pictures.
- **Customer Inconvenience:** During on-site visits it is common for the site contact to avoid getting involved by providing access to the measures and letting the evaluators collect all the data. In a virtual visit the evaluator relies on the site contact to walk them through the equipment and collect data. This can be an additional inconvenience for the customer.
- **Difficulties with Scheduling:** Scheduling was significantly more challenging for virtual visits. The COVID-19 pandemic may have affected site contact availability. Once virtual visits were scheduled, there were significantly more cancellations and rescheduling than with on-site visits pre-pandemic, which had the potential to cause project delays and also increased data collection costs.

Energy Efficiency Program Staff Feedback

Cadmus obtained feedback through discussions and interviews with energy program managers and staff across the United States and aggregated the results into high-level opinions and insights. This section is focused on five discussion questions. It is important to note that, for the most part, there is wide agreement that virtual site visits will endure and be a part of M&V evaluations moving forward.

- **Question 1:** How would you rate the success of virtual site visits in conducting M&V activities, where 1 means *not successful* and 10 means *very successful*?

All staff rated the success of virtual visits as a 9 or 10. They highlighted that the transition to virtual was critical for evaluation success and was one of the biggest reasons M&V activity could be completed. A few staff also mentioned that the transition was smoother and easier than expected, that they were surprised by the speed of ramp up, and that the results exceeded their expectations.

- **Question 2:** Do you plan to continue to accept the virtual site visit approach as an M&V option moving forward?

All energy efficiency program staff agreed that virtual site visits are here to stay and are an important aspect of the M&V process moving forward. Some staff said this is now a criterion they explicitly call out in the RFP process and it is important for contractors to demonstrate virtual site visit experience. Staff agreed that the virtual M&V approach is not a catch-all and that on-site visits are still an important verification activity, especially when a project has a high complexity and where spot measurements and meter data is required.

- **Question 3:** Do you think virtual visits were convenient or inconvenient for customers?

Most staff felt that the virtual visits did not add any inconvenience to the customers⁴. Some staff highlighted that considering the COVID-19 pandemic, transitioning to virtual visits made it more convenient for customers to support the M&V work. A couple of staff felt this could potentially be inconvenient if the site contact needed to learn how to access the video conferencing platform and would need to walk the evaluator through the measure but agreed that the virtual option could work well with appropriate preparation and guidance.

- **Question 4:** What concerns or barriers do you see with virtual site visits?

Most staff acknowledged that there are some limitations to virtual visits, especially for projects that have added complexity and require on-site data collection. There was some concern related to customer inconvenience in situations when the customer would be expected to do a lot of the “heavy lifting” in a virtual visit (versus having the evaluator conduct M&V activity during an on-site visit). However, overall the staff agreed that there was minimal concern and that if appropriate projects are selected for virtual visits, they would not expect any issues or barriers.

- **Question 5:** What suggestions do you have or opportunities do you see to improve the virtual site visit process?

Most staff agreed that the current process works well. They recommended that we continue to refine the process and look for new technologies and platforms that can aid in the virtual site visit process. Staff also think that customer awareness of the virtual site visit process is important and that letting customers know what to expect with this type of project at their facility is important.

Conclusions

Overall, based on our experience and the feedback from energy efficiency staff, virtual site visits are a viable option for verification across different measure types and sectors. Site contacts and energy efficiency program staff provided encouraging feedback on the virtual site visit approach. We believe that virtual visits will endure and will continue to remain a viable option for future impact evaluations even after the COVID-19 pandemic has passed. Although there are challenges, the process will continue to be refined, technologies will improve, evaluators will gain experience, and customers will become more accustomed to the virtual visit approach, all of which will ensure higher success rates and a smoother verification process. The key criteria for success are to ensure the correct selection of projects that qualify for a virtual visit, prepare a robust M&V plan, be flexible and adaptable during calls when issues arise, and work with the customer to ensure a smooth process and increased customer satisfaction.

⁴ Note that we received similar feedback from the vast majority of customers. In most cases the customers were satisfied with the virtual visit and thought it was convenient and easy to get through