Pacific Northwest
NATIONAL LABORATORY

PNNL-31687

Remote Home Energy Score Assessments

A Feasibility Study

August 2021

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U.S. DEPARTMENT OF ENERGY

Prepared for the U.S. Department of Energy
under Contract DE-AC05-76RL01830

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Acknowledgments
Earth Advantage would like to express gratitude to Madeline Salzman and Glenn Dickey of the US Department of Energy Home Energy Score program and Chrissi Antonopoulos of Pacific Northwest National Laboratory for their extensive technical input throughout the development of this analysis.

The author would also thank the following Home Energy Score Assessors for participating in this analysis:

- Jamie Fereday, Sol Coast Consulting and Design
- Jackie Zusi-Russell, Community Energy Project
- Laura Klement, Enerstructa LLC
- Tim Kaiser, Nitty Gritty Inspections, LLC
- Amanda Troxler, Orion Energy Score
- Edward Ntalo, Association of Energy Affordability (AEA)
- Matt Dean, Association of Energy Affordability (AEA)
- Jonathan Wrobel, Home Energy Score Portland

This work was funded by Pacific Northwest National Laboratory.

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Introduction

The delivery of Home Energy Scores (HES) has been significantly impacted over the last year by the recent pandemic and ongoing limitations to person-to-person interactions. There are also historic challenges in providing HES to more remote geographies where assessor infrastructure is not in place. Alternative approaches to in-person, on-site home energy assessments could help address these current restrictions, while also potentially providing opportunities for the efficient delivery of HES in certain use cases after COVID-related restrictions are lifted.

The high-level objective of this study was to gage under what circumstances remote HES assessments are feasible, reliable, and accurate. Earth Advantage analyzed this research question from the various perspectives;

- USDOE Home Energy Score program administrators
- Home Energy Score Partners and their program assessors
- Participating homeowners

From the program administrator's perspective, there needs to be confidence that the remote scores closely match what they would have been if the assessment had been performed on-site. The recommendations shown on a report generated from a remote score should closely match those of an onsite assessment. A remote assessment should be an option for all HES Partners and have direction on how to deliver those scores.

From the HES partner's and assessor's perspective, there needs to be understanding of what level of experience is needed, what system infrastructure is required, the time expenditure of the remote assessment process, and the limitations of a remote assessment.

From the homeowner's perspective, there needs to be an awareness and comfort with the time commitment, the level of knowledge of the home, the equipment needed, and any physical requirements of the remote assessment process.

During this study, Earth Advantage assessed methods for delivering Home Energy Score assessments remotely through web-based technology platforms and resident interaction in a diverse array of home types in different geographic locations. Earth Advantage developed remote assessment test protocols and integrated those testing protocols into existing Home Energy Score programs being overseen by USDOE Home Energy Score partners New York State Energy Research & Development Authority (NYSERDA), the Oregon Department of Energy (ODOE), and the City of Portland (PDX). Earth Advantage staff acted as the Remote assessor and gathered HES data remotely during the video sessions with participants. Authorized Home Energy Score assessors performed the onsite assessments that were then used to compare with the remote assessment data. This allowed the research to effectively test the efficacy of various

remote assessment approaches in a diverse array of home-types. Earth advantage identified the key components of a remote assessment infrastructure which included processes, tools, services, methods and mechanisms that would better enable remote assessments.

This report details methods, results, and findings of the HES remote assessment research. In addition, the report provides recommendations and best practices that could be used as guidance for the Home Energy Score administrator and the HES partners seeking to effectively conduct remote assessments.

Executive Summary

Earth Advantage conducted 26 remote sessions on homes located in 11 cities in New York and Oregon (Table 3). These remote assessments were completed within three different HES partnerships and included homes located in urban, suburban, and more rural locations within climate zones 4, 5, and 6. (Table 2). The homes evaluated represented a wide variety of home configurations and characteristics (Table 4 and 5). The majority of remote sessions, utilizing four video conferencing applications (Table 9), had some level of video or audio quality disruptions. These disruptions were only temporary and did not impact the ability to complete the remote assessment. While most of the remote sessions were conducted with the homeowner, a small percentage were conducted with a renter. The renters generally did not have as much knowledge about the home, which made getting accurate info more difficult. Earth Advantage tested two types of remote audits. One being fully remote where all data was collected through the video session and the other being a hybrid approach where a short visit to the property was needed to get exterior measurements. The majority of sessions were conducted fully remotely and in two cases a hybrid approach was used as part of the test (Table 14). The range of time for conducting a remote session was between 1 to 1.5 hours. It is estimated that providing a remote assessment option could reduce time and cost for the assessor and program administrators by 35%, primarily due to reductions in drive times (Table 15).

To measure the accuracy of the remote assessment approach, 25 of the homes also had an official onsite assessment conducted by a separate authorized HES assessor. For analysis, the onsite data was compared with the remote data. On average there was a 1 point score difference between the remote and onsite score, with an average score basis MBTU difference of 13% (Table 6 and Chart 2). The study found that 50% of the scores showed no difference in the HES score and 81% of homes were within a one-point difference (Chart 1). The study also found that 44% of the reports showed no difference in the cost-effective upgrades and 88% of reports only showed a one recommendation difference (Chart 3). The home assets that recorded significant differences (>10%) between the remote and onsite assessment were: Attic

Area, Window Area, Wall R Value, Cathedral Attic R Value, Window Types, and Duct Location (Table 7).

The remote assessment does have its limitations. Overly complex homes were found to be a challenge to assess remotely and they rely heavily on the homeowner's knowledge of the home or any available documentation. Some homes have complex designs with significant angles, numerous attics or foundations, cathedral attic areas, high levels of window glazing, multiple systems or other variables that can be difficult to assess during a remote session. The remote assessment is reliant on the homeowner's participation in the remote session and information that is provided to the remote assessor. There can be limitations related to the onsite individual's knowledge about the home. There may be a variety of scenarios where an impediment could impact the remote assessment or the ability for the homeowner to conduct the session. The study did encounter a few impediments that impacted the ability to conduct the remote sessions, but solutions were found in all of those cases (Table 13). Homeowners that participated in the study were pleased with the process and expressed support for a remote assessment option.

Overall, the research finds the remote assessment to be a feasible solution for HES partners to use when an onsite assessment is not an option or is limited. Though a remote option is not a total replacement for an onsite assessment, there are multiple applications where this approach could be effectively used. This option could be utilized when an assessor is not able to go onsite for a considerable amount of time. Possible scenarios include during extended inclement weather periods, when there are geographical constraints or long drive times, when there is a sick occupant, when an experienced assessor is injured or ill, and in case of an ongoing pandemic. This method could also be used as a cost-effective approach to filling the energy efficient upgrade pipeline with screened leads. Another option would be to use the remote assessment to conduct a follow up final assessment in order to verify upgrades have been made to a home.

Methods

Earth Advantage established a test methodology in close consultation with Pacific Northwest National Laboratory (PNNL) staff prior to conducting research using remote assessment protocols and systems. This methodology was refined after each stage of the research. Remote sessions were conducted in stages, with groups of 5 homes per stage. After each stage, the project team made refinements to the process. The goal of the research was to test homes of varying characteristics using a remote assessment process across multiple locations and climate zones. Ideally the homes had not already had a HES score completed. If a prior HES score had been created, that home data was not reviewed by the remote assessor until the remote assessment was complete.

HES Assessment Types Used
The remote assessor used the HES "preconstruction assessment" type so that standard HES assessment data collection and input processes can be used, but "unofficial" HES reports were generated and stored. The onsite assessor conducted a typical onsite assessment using the official assessment types (Initial, Corrected or Final). There was no collaboration between the remote and onsite assessors until after scoring was complete.

Data Collection Protocol
HES Data was collected remotely based on the HES Methodology and assessor data entry protocols. Assets were rated based on what the remote assessor could visibly see and confirm. Alternatively, assets were rated based on conversations with the owner or the onsite individual. On occasion, the remote assessor obtained documentation from the owner to determine specific specifications, retrofit activity, or other items not visible during the remote session. When no information or documentation was available, the home assets were rated based on the build year of the home or the HES defaults were used. If the owner had trade contractor documentation that indicated that upgrades had been performed on the home, it was then entered in HES accordingly. This process was used, for example, in the documentation of professional air and duct sealing.

Remote Assessment Types
The study included evaluating both a "fully remote" assessment protocol and a "hybrid/low-touch" assessment protocol.

- **Fully Remote Assessment:** All home data collected remotely through online sources, video conference with homeowner, and data/photo upload as needed.
- **Hybrid/Low-Touch Assessment:** Home data is collected online, through video conference with client, and a shortened site visit to assess home from the exterior. Windows and Foundation areas are measured from the exterior of the home.

The fully remote assessment process was the primary focus of this study since it was assumed that if the remote approach was deemed effective for a specific application, then the hybrid/low–touch approach would automatically be effective as well.

Remote Assessment System Technical Infrastructure
There are numerous data storage and communications systems that could be used by remote assessors and homeowners. Some are off-the-shelf and publicly-available, others are more

proprietary products currently being used by select assessors in several markets. The research team identified and tested key components for a remote assessment system that would be readily available by any potential user in any US market. Earth Advantage used a combination of systems to schedule, prep participants, conduct video sessions, collect data, and track for reporting. A list of the systems used for the study includes:

- **Acuity Scheduling** – Used to schedule participants and for questionnaire prior to remote session
- **Salesforce** – Used to track remote sessions and for reporting
- **Email Templates** – Used to prep onsite individual for the remote session and to gather follow up data
- **Video Conferencing Applications (Zoom Meetings, Google Hangout/Meet, Apple Facetime, Google Duo)** – Video applications used for conducting the remote session
- **Google Sheets** – Used to collect remote session data and participant feedback
- **GoFormz** – Used for HES data collection and screen capture upload
- **HES Scoring Tool** – Used to generate remote QA score and report. Also used to export data for comparing scores
- **Green Building Registry** – Used by onsite assessor to generate custom report delivered to owner

Research Participants and Onsite Individuals

The goal of the research was to test the remote assessment with a variety of homeowners having varying level of knowledge about the home and building science. This onsite individual could be a renter, family member, neighbor, realtor, trade professional or others.

In the majority of cases the remote session was conducted with one of the owners, but in a couple of cases it was conducted with a renter. The remote assessor scheduled the remote session with the participant and asked a series of questions to get more information. Then the participant was sent a preparation email to prep for the remote video session.

Remote Assessor

The remote assessor used for the research needs to be someone with considerable experience in the field both auditing homes and performing HES. Earth Advantage utilized their experienced staff for the remote assessor to provide a consistent way of scheduling and prepping homeowners for the session as well as gathering and recording data from the remote assessment. This staff member had considerable experience auditing homes and creating HES scores on a variety of housing stock.

Onsite Assessor
Earth Advantage worked with separate vendors to conduct the onsite assessment for the study. All of those assessors had backgrounds in residential energy efficiency and building science. They were all experienced in the HES process and authorized assessors in their geographical area.

Remote Session Scheduling System and Onsite Individual Preparation
Earth Advantage used a scheduling system to set up the remote video session with the onsite individual. This included a questionnaire integrated in the scheduling system that was used to gather info from the owner. Time slots were set at 1.5 hours to allow for enough time to conduct the remote session. Following the scheduling, a preparation email was sent to the participant to allow time for them to prepare for the remote session. Example preparation email and questionnaire are provided in Appendix C and D, respectively.

Video Conferencing Applications
The research tested four video conferencing applications (Zoom Meetings, Google Hangouts/Meet, Apple Facetime, and Google Duo) that are available on multiple mobile device platforms, three of which can also be used on a desktop application. All of these were off-the-shelf applications that do not require a user fee from the onsite individual. Participants were allowed to select from the list of four video conferencing options. If they had no preference then one was selected for them.

Online Sources
In addition to the Home Energy Score specific data points collected during the remote session, the research team used various online sources to gather home information prior to the remote session. The most commonly used sources were: Google Maps, real estate listings (Realtor.com, Redfin, Zillow, MLS, etc.), and tax records. These sources were used to review any photos of the property and get living areas. Google Maps satellite view was used to estimate the building dimensions, roof color, and the presence of solar PV or skylights.

Customer Relationship Management (CRM) Software
Earth Advantage used the Salesforce customer relationship management (CRM) software to track the remote sessions and catalog the name of the assessor performing the remote and onsite assessments, the score differences, and which assets were rated differently. This allowed for additional real–time reporting.

Choosing Test Homes and Soliciting Participants

Earth Advantage tested a variety of home vintages, construction types, number of stories, mechanical configurations, foundation types, and attic/roof types as part of the research. The intent of this analysis was to seek a diverse array of home types and identify any specific challenges with remote assessment protocols or systems based on those home characteristics. The research team identified and selected test homes through existing state of Oregon, city of Portland, and NYSERDA HES program channels and outreach efforts. Some participants were solicited through assessor outreach to prospective customers.

Remote Assessment Data Points

The research team collected the standard required HES data points during the remote session. The remote assessor recorded the source of the data and most of the data points would be gathered through screen capture during video conferencing or from the conversations with owners during these sessions. Homeowners were also allowed to provide any documentation they had in the form of permit plans, floor plans, invoices, or spec sheets. Those data points and the data sources used are listed in Table 1.

Table 1 – Remote HES Data Points

Data Point	Data Points needed	Desired Data Source(s)	Acceptable Data Source(s)	Expected Degree of Accuracy	Additional Documentation
Year Built	1	Homeowner documentation	MLS, tax records	Very Accurate	Home plans, MLS listing print out, or permit from build year
Conditioned Area	1	Home plans, Homeowner measurements or documentation.	Google Maps measurements, Tax records	Moderately Accurate	Floor Plans, Homeowner documentation, or tax records
Bedrooms	1	Homeowner provided	MLS, tax records	Very Accurate	
Stories	1	Exterior Photos	MLS, tax records	Very Accurate	
Average Ceiling Height	1	Homeowner Measurements or plans	Exterior Photos	Moderately Accurate	
Orientation	1	Google Maps		Very Accurate	
Professional Air Sealing	1	Homeowner photos or Documentation		Moderately Accurate	Trade Professional Documentation
Blower Door Test (CFM50)	1	Homeowner photos or Documentation		Moderately Accurate	Trade Professional Documentation
Roof Construction, Finish, Color, and Type	4	Google Maps and Homeowner Photo		Very Accurate	
Attic Insulation Type, Area and Level	3	Homeowner photos or Documentation		Moderately Accurate	Trade Professional Documentation
Foundation Type	1	Homeowner Exterior Photo or plans		Moderately Accurate	

Floor Insulation Type, Area and Level	3	Homeowner photos or Documentation		Moderately Accurate	Trade Professional Documentation
House Type	1	Google Maps, Homeowner Photo		Very Accurate	
Wall Construction, Finish, Depth	3	Homeowner photos or Documentation		Moderately Accurate	
Wall Insulation Level	1	Homeowner photos or Documentation	Build Year Energy Code de rated to Fair	Questionable Accuracy	Trade Professional Documentation
Window Type, Panes, and Glazing	3	Homeowner Photo or documentation		Moderately Accurate	Trade Professional Documentation
Window area	4	Homeowner Photo or documentation		Moderate to Questionable Accuracy	Trade Professional Documentation
Skylights Type, Panes, and Glazing	3	Homeowner Photo or Google Maps		Moderately Accurate	Trade Professional Documentation
Heating System Type, Make, Model, and Energy Guide.	4	Homeowner Photos or documentation		Very Accurate	Trade Professional Documentation
Cooling System Type, Make, Model, and Energy Guide.	4	Homeowner Photos or documentation		Very Accurate	Trade Professional Documentation
Duct location	1	Homeowner Photos or documentation owner		Moderately Accurate	
Duct Sealing and Insulation	2	Homeowner Photos or documentation owner		Moderately Accurate	Trade Professional Documentation
Water Heater Type, Make, Model, and Energy Guide.	4	Homeowner Photos or documentation owner		Very Accurate	Trade Professional Documentation
PV System Capacity, Panels, Direction and Year	4	Homeowner photos or documentation		Accurate	Trade Professional Documentation
Total Data Points	**54**				

Remote Data Collection

The research team used a data collection application called GoFormz to collect all the session data and screen shot photos from the remote assessment. When needed, the research team gathered follow up data from homeowners via email. The remote assessor took screen shots during the session and stored them in a data collection form along with the HES data gathered. This helped to streamline the process for the remote assessor.

Data Comparison and Analysis

Once the remote and onsite HES data was collected and scores generated, the research team analyzed the data to determine accuracy and discrepancies. The research team exported the HES data from the partner dashboard and performed a side-by-side comparison in Excel.

Real costs and Time Considerations
Earth Advantage documented the assessor time and costs for both the full remote and hybrid/low-touch approaches and compared those costs to the assessor costs for a traditional in-person home assessment.

Homeowner Burden
The research evaluated what burden and time commitments will be put upon the homeowner. Traditionally, homeowners are only involved in scheduling an assessment and to answer some specific questions during the assessment. The remote assessment processes will require more owner engagement in the assessment process and involve additional education. Earth Advantage documented the actual resident time requirements and asked homeowners to comment on their experience with the remote assessment process.

Timeliness of score delivery
With increased homeowner burden, the timeliness of the score delivery could be impacted. Earth Advantage compared the time required to deliver a remote assessment compared to time ranges for delivery of traditional in-person scores.

Testing Process - Fully Remote and Hybrid/Low Touch Assessment:

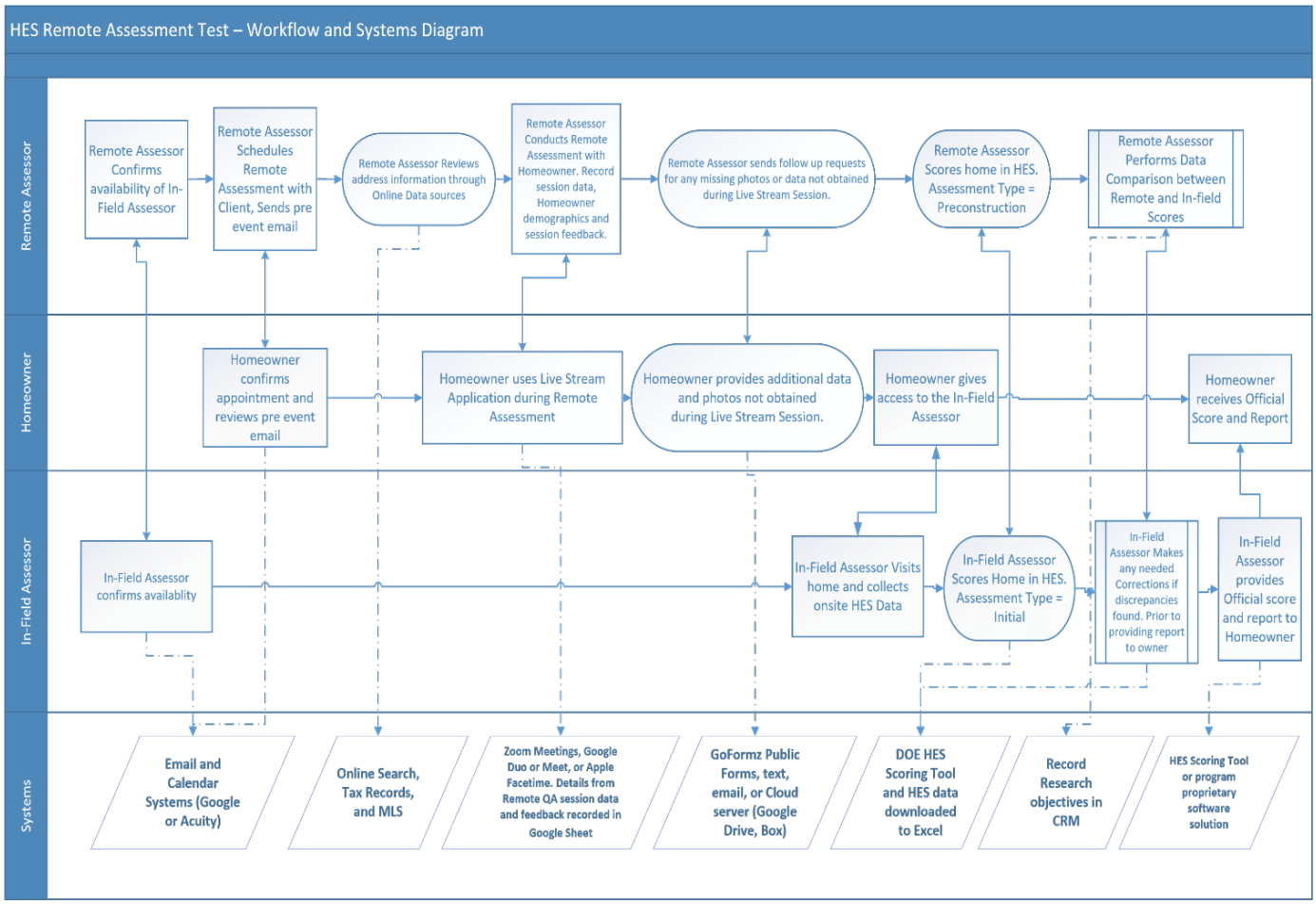
- **Remote Assessor** = HES Assessor performing the remote Assessment via video conferencing
- **In-Field Assessor** = HES Assessor visiting the home to perform official assessment
- **Onsite Individual** = Homeowner, Renter, Family member, Neighbor, or Trade Professional
- **Remote Video Session** = Video conferencing, video chat, or live stream session

1. Identify assessment opportunity and in-take home address.
    a. Undertake scheduling and preliminary screening.
    b. Screening will inquire as to any known impediments to conducting the remote session.
2. Review public information available for each home to confirm eligibility and to gather any available data (Orientation, Stories, Roof color, etc.).
    a. Availability of public information may differ based on the jurisdiction.
    b. Public information could include Google maps, MLS data, and property assessment data, permit data, etc.
    c. Identify the need to take into consideration complex building configurations.

3. Schedule a video session.
    a. Scheduling includes homeowner questionnaire, questionnaire is provided in Appendix C.
    b. Participant selects video conferencing application being tested: Facetime, Zoom, Google Duo, Skype, or Google Hangout.
4. Send introductory email to the client so they can prepare for remote video session.
    a. The introductory email will include instructions and what to expect during the session. Example email is provided in Appendix B.
5. Remote Assessor conducts the remote assessment through video conferencing and captures needed photos.
    a. Remote Assessors will capture photos/screenshots during the video session. There may be some additional follow up photos needed from the resident based on limitations with the video session. Photo list is provided in Appendix E.
    b. Conditioned area and window measurements can be provided by the owner or estimated by the remote assessor from photos and online data.
    c. If no information is available from the owner or from online sources, the remote assessor will use conservative defaults from the Home Energy Score assessor calculator or use regional building codes based on year.
6. ***Optional Hybrid Approach:*** *The Remote Assessor will visit the home and evaluate the exterior of home to gather data.*
    a. Conditioned area and foundation types/areas can be measured.
    b. Window measurements and types can also be taken at this time.
    c. May be an opportunity to evaluate any mechanical equipment located at exterior or in a garage.
    d. Review other attributes such as siding type, any presence of insulation on the outside of exterior wall sheathing and roof material type/color.
7. Remote Assessor will use the HES “preconstruction assessment” type in the Home Energy Score Tool with notation in the comment section of HES that it is a “Remote Assessment”.
8. An In-Field HES assessor will then schedule an onsite visit to collect onsite data needed to generate an official score through the traditional HES assessment processes. The In-Field Assessor will use the HES “Initial” type in the Home Energy Score Tool.

9. The Remote and In-field assessor scores will then be compared for accuracy. If there are any corrections needed on the Initial score, then a Corrected score will be created by the In-Field Assessor.
10. The In-Field Assessor will share the official score and report with the owner.

Diagram A – Remote Assessment Test Workflow Diagram Used as part of Study



Results

Selected Homes

During the study, Earth Advantage staff completed 26 Remote Assessments on homes located in 3 climate zones, 11 cities, in 2 states (Tables 2 and 3).

Table 2 – Research Home Locations, Climate Zone and HES Partner

Climate Zone	NYSERDA	ODOE	PDX
Zone 4	**3**	**10**	**4**
Zone 5		**8**	
Zone 6	**1**		

Table 3 – City and State Locations

City	New York	Oregon
Bend		6
Buffalo	1	
Coos Bay		3
Gales Creek		1
Hillsboro		4
Hood River		1
North Bend		2
Pelham	1	
Portland		4
The Bronx	2	
The Dalles		1

These test homes represented a variety of building configurations, year built, sizes and home characteristics (Table 4 and 5). The average onsite score created for the study was 4.6 with an 89 Score basis MBTU (Table 4). These numbers were similar to the national HES average of 5.

Earth Advantage completed 26 remote assessments and collected the necessary HES Data Points (Table 1). Onsite assessments were also conducted on all but home NY03. The remote vs onsite comparisons that follow include the 25 homes that did have onsite assessments and excludes NY03 (Table 6).

Table 4 – Onsite Assessment Home Characteristics

Remote HES Research	Average	Median	Low	High
Year Built	1951	1955	1898	2013
Conditioned Area	1930	1769	720	3528
# of Stories	1.7	2.0	1.0	3.0
Onsite Score	4.6	5.0	1.0	10.0
Onsite Score Basis MBtus	89	76	0	226

Table 5 - Research Homes Characteristics List:

Home ID	City	Year	Area	Stories	House Configuration	Primary Heating Type	Primary Water Heater Type	Primary Attic Type	Primary Foundation Type
OR01	Portland	1987	1287	1	Ranch	Gas Furnace	Gas Tank	Unconditioned Attic	Vented Crawlspace
OR02	Coos Bay	1971	3104	2	Custom	Heat Pump	Electric Tank	Cathedral	Daylight Basement
OR03	Hood River	1953	1402	1	Ranch	Baseboard Electric Resistance	Electric On Demand	Unconditioned Attic	Vented Crawlspace
OR04	Coos Bay	1922	1084	2	Bungalow	Gas Boiler	Electric Tank	Unconditioned Attic	Unconditioned Basement
OR05	The Dalles	1936	1456	1	Bungalow	Hydronic Gas Furnace	Gas Tank	Unconditioned Attic	Vented Crawlspace
OR06	North Bend	1966	1400	1	Ranch	Baseboard Electric Resistance	Electric Tank	Unconditioned Attic	Vented Crawlspace
OR07	Bend	1956	1850	1	Ranch	Heat Pump	Electric Tank	Unconditioned Attic	Conditioned Basement
OR08	Portland	1908	1488	1	Bungalow	Gas Furnace	Gas Tank	Unconditioned Attic	Conditioned Basement
NY01	The Bronx	1910	2717	3	Row Home	Gas Boiler	Gas Tank	Cathedral Attic	Conditioned Basement
OR09	Bend	1995	1566	1	Custom	Heat Pump	Gas On Demand	Unconditioned Attic	Vented Crawlspace
NY02	The Bronx	1935	2455	2	Row Home	Gas Boiler	Gas On Demand	Unconditioned Attic	Conditioned Basement
OR11	Gales Creek	2013	720	1	Custom	Heat Pump	Electric Tank	Unconditioned Attic	Unconditioned Basement
OR12	Coos Bay	1961	884	1	Straw Bale	Wood Heat	Propane On Demand	Cathedral Attic	Slab
OR13	Portland	1950	1050	1	Ranch	Baseboard Electric Resistance	Electric Tank	Unconditioned Attic	Vented Crawlspace
OR14	Bend	1898	1600	2	Ranch	Gas Furnace	Gas Tank	Unconditioned Attic	Vented Crawlspace
OR15	North Bend	1910	3034	2	Four Square	Ductless Mini Split Heat Pump	Heat Pump	Unconditioned Attic	Vented Crawlspace
OR16	Hillsboro	1966	1688	1	Cape Cod	Gas Boiler	Electric Tank	Cathedral Attic	Conditioned Basement
NY03	Bend	1937	2200	2	Ranch	Gas Fireplace	Heat Pump	Unconditioned Attic	Vented Crawlspace
NY04	Buffalo	1920	2700	3	Custom	Gas Furnace	Gas Tank	Unconditioned Attic	Unvented Crawlspace
OR17	Pelham	1916	3528	2	Custom Colonial	Hydronic Gas Furnace	Indirect Tank	Conditioned Attic	Conditioned Basement
OR18	Hillsboro	2001	1900	2	Cape Cod	Dual Fuel Heat Pump	Electric Tank	Unconditioned Attic	Conditioned Basement
OR19	Bend	1929	2400	2	Custom	Gas Furnace	Gas Tank	Unconditioned Attic	Vented Crawlspace
OR20	Portland	1961	2600	1	Bungalow	Gas Furnace	Electric Tank	Unconditioned Attic	Conditioned Basement
OR21	Hillsboro	1960	1080	2	Split Level	Heat Pump	Heat Pump	Cathedral Attic	Conditioned Basement

OR10	Bend	1966	3095	2	Ranch	Gas Furnace	Electric Tank	Unconditioned Attic	Daylight Basement
OR22	Hillsboro	2006	1902	3	Townhome	Gas Furnace	Gas Tank	Unconditioned Attic	Unvented crawlspace

Table 5 Notes: Home ID's are in the order of when the remote video session was conducted

Table 6 - Home Energy Scores and Basis MBtus

Home ID	Remote Score	Remote Score Basis MBtus	Onsite Score	Onsite Score Basis MBtus	Score Difference	Score Basis MBtus Difference	Recommendation Difference
OR01	4	80	5	76	-1	4	-1
OR02	1	114	1	119	0	-5	-1
OR03	3	97	4	88	-1	9	1
OR04	2	83	3	75	-1	8	0
OR05	1	130	2	119	-1	11	1
OR06	1	118	1	94	0	24	2
OR07	5	91	4	101	1	-10	-2
OR08	7	60	6	65	1	-5	-1
NY01	1	188	1	226	0	-38	1
OR09	5	94	7	73	-2	21	0
NY02	1	145	3	121	-2	24	1
OR10	10	12	7	55	3	-43	0
OR11	10	3	10	0	0	3	0
OR12	2	102	4	79	-2	23	1
OR13	7	69	7	72	0	-3	-1
OR14	9	33	9	33	0	0	0
OR15	1	133	1	135	0	-2	-2
OR16	7	69	7	75	0	-6	1
NY03	9	66	NA	NA	NA	NA	NA
NY04	5	95	6	83	-1	12	0
OR17	6	67	6	63	0	4	0
OR18	3	122	3	118	0	4	0
OR19	6	65	6	64	0	1	0
OR20	4	89	6	64	-2	25	0
OR21	1	156	1	173	0	-17	-1
OR22	6	65	6	55	0	10	0
Average	**4.5**	**90**	**4.6**	**89**	**1**	**15**	**0.7**

Assets with the Largest Differences

The following home assets had average differences greater than 10%:

- Attic Area
- Window Area

- Wall R Value
- Cathedral Attic R Value
- Window Types
- Duct Location

These differences were mostly related to instances where the remote assessor did not have the full set of information. Remote assessments rely on the video and images reviewed by the remote assessor and any information or documentation provided by the owner. If areas were not provided then the remote assessor had to estimate them. It was determined that heating system, cooling system and water heating system efficiency rating differences were minimal. Other differences in assets rating such as; Ceiling Height, Conditioned Area, Number of Stories, Attic R values, floor R values, Heating system coverage, duct insulation, duct sealing and air sealing were found to be minimal (Table 7).

Table 7 – Data Differences between the Remote and Onsite Score

Data Differences	Average	Median	Low	High
Conditioned Area	7%	3%	0%	38%
Attic Area	11%	9%	0%	31%
Foundation Area	10%	7%	0%	46%
Window Area	15%	13%	0%	49%
Ceiling Height	0.32	0	0	2
Number of Stories	0.04	0	0	1
Attic R Value	5.5	6	0	14
Wall R Value	4.3	4	0	15
Floor R Value	3.6	0.05	0	14
Heating System AFUE Rating	0	0	0	0.04
Heating System HSPF Rating	0.28	0.3	0	0.85
Cooling System SEER Rating	0.21	0	0	1
Water Heater EF Rating	0.02	0	0	0.25
Data Differences*	**% of Time the Data Entries were Different**			
Heating System Coverage	20%			
Window Types	36%			
Duct Insulation	4%			
Duct Sealing	0%			
Duct Location	16%			
Air Sealed	4%			

***Table 7 Notes:** Heating System Coverage is related to instances where there were 2 systems entered. Heating System Coverage, Window Types, Duct Insulation, Duct Sealing, Duct

Locations and Air sealed are shown as the percentage of time that the inputs were different. Majority of window type differences related to frame type and low e coating.

Home Energy Score Comparisons

The remote scores generated during the research were on average within 1 point of the onsite score (Table 6). Remote and Onsite scores were shown to be within 1 point 81% of the time and no difference 50% of the time (Chart 1). This is comparable to the current quality assurance (QA) requirement of being within 1 point.

Chart 1 – Remote vs Onsite Score Comparison

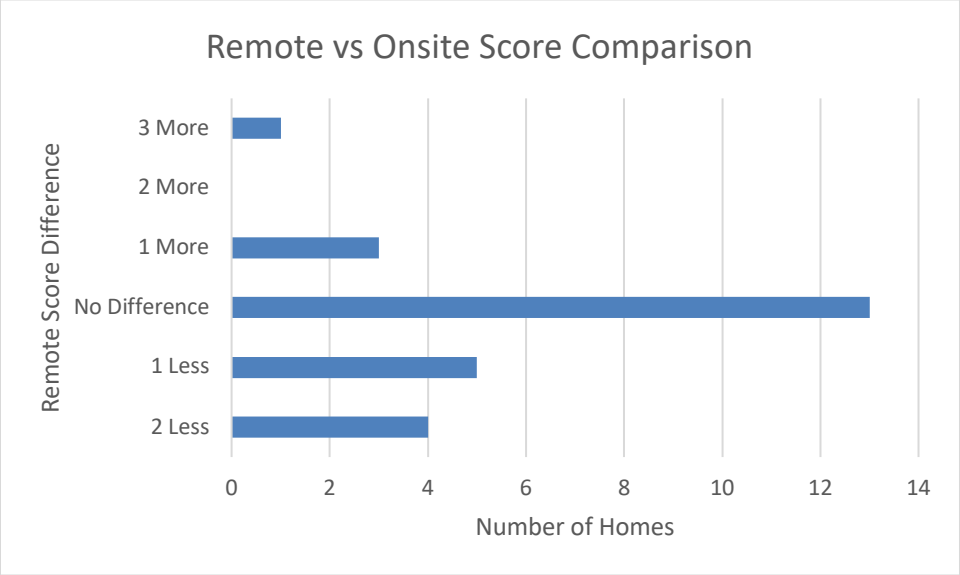


Chart 1 Outliers; Research ID OR10, 3 more score difference related to a large vaulted ceiling area found to be not insulated by onsite assessor. Research ID OR09, 2 less related to a ceiling height difference and R ratings. Research ID NY02, 2 less related to the renter having limited access to the home during the remote session. Research ID OR20, 2 less related to the walls being insulated. Research ID OR12, 2 less related to the walls being insulated.

MBTU Score Basis Comparison

The HES score basis MBtus was utilized to compare the remote score to the onsite score because it is the source of the 1-10 scale. The Remote assessment Score basis MBtus was on average within a 13% margin to the Onsite Score, or 8% median (Chart 2 and Table 6).

Chart 2 – Remote vs Onsite Score Basis MBtus Comparison

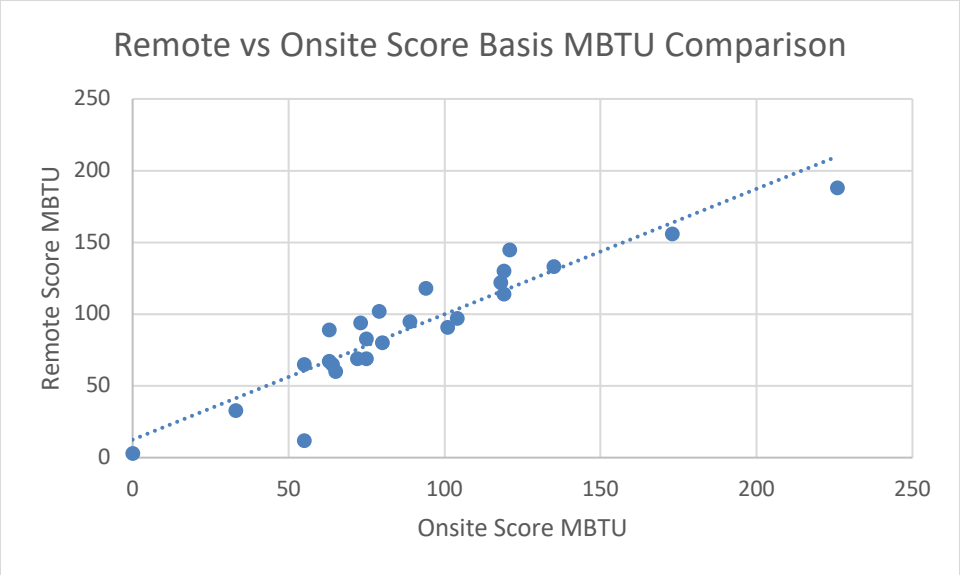


Chart 2 Outliers; Research ID NY01 226 MBTU; Walls were found to be insulated by onsite Assessor. Research ID OR10 55 MBTU; Large vaulted area found to be not insulated by onsite assessor.

Wall and Cathedral R Values

Closed cavity insulation ratings accounted for some of the largest differences in scores and MBTU. Exterior wall R ratings differed on average by 4.3 but in some cases as much as 15. In 4 cases the remote assessor rated the exterior walls as not insulated and then the onsite assessor after probing the walls found them to be insulated. In one case the reverse occurred; the onsite assessor found the exterior walls uninsulated, but remote assessor had indicated it as insulated. This can contribute to a 1 point or more difference in the score. With older building stock built before the energy codes of the mid 1970s, this likelihood increases. During the study the remote assessor would ask the owner if they knew if the exterior walls were insulated or had any documentation of retrofit activity. If no information is available, then the assessor used the calculator defaults provided by the DOE. This is the most conservative approach, but can be incorrect until someone goes onsite to verify.

Vaulted closed cavity ratings present a similar challenge to wall insulation and can also great impact the score. One example, Research ID OR10, is shown as an outlier in Chart 1. In this case the home was built in the 1960's prior to any energy codes. The owner had a partial photo of the insulation in the large vaulted area, but the onsite assessor found that insulation to be only

2-3 inches of fiberglass poorly rated. Since there is only an option at the lower end of the rating scale for roof insulation (R0 or R11), the assessor had to round down to R 0.

Recommendations Shown on Reports

In most cases the recommendations shown on the remote and onsite report were in alignment. If there was a score and MBTU difference, the study typically saw a slight difference in the number of recommendations made on the report. The upgrade recommendations shown on the reports differed by an average of 0.68 (Table 6). The study found that 88% of reports showed a difference in recommendations of 1 or less and 44% showed no difference (Chart 3). Not all upgrades will show up on a report because of the 10-year payback calculation that is prioritized. For example, if a gas heated home of moderate size has no insulation in the walls, it likely would not show up as a recommendation even if the remote assessor used conservative defaults for R ratings.

Chart 3 – Remote vs Onsite Recommendation Comparison

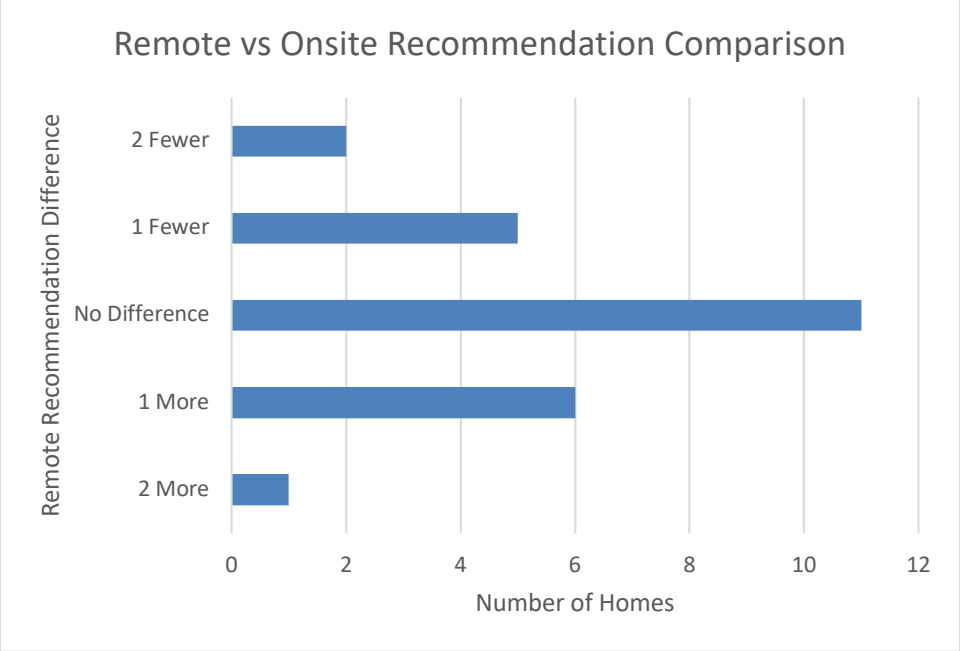


Chart 3 Outliers: Research ID OR07, 2 fewer related to difference in the foundation types, duct locations and heat systems fraction. Research ID OR06; 2 more related to differences in the conditioned attic area and exterior wall R value. Research ID OR15, 2 fewer related to a basement that was found to be unconditioned as the home has a boiler with no delivered heat in the basement or connection to main floor.

Onsite Individual

Earth Advantage conducted the remote assessments with a variety of onsite individuals (owners, renters, or family members). The majority of which were very engaged and showed strong interest in the value of a remote audit. Their building science knowledge levels and knowledge of the homes systems were varied and only a few had previous experience with an energy audit prior to the remote session (Table 8). Only two of the homes had had a prior HES score, which wasn't reviewed by the remote assessor until after the remote session. The average length of time the owner had lived in the home was 7 years. Overall, participants were generally engaged in the remote session and happy to be a part of the effort

The research team found that the onsite individual's knowledge of the home is critical and they may have limited or no knowledge about the property. This circumstance can hinder the remote assessment process. In two of the remote sessions, the onsite individual was a renter and had limited knowledge about the home. This made it difficult to get the complex HES data points such as closed cavity insulation, duct locations, or window types. The remote assessment heavily relies on this individual's ability to provide this information and could be limited based on their understanding of what is being requested and their knowledge of the home. Prepping the individual for the remote assessment was helpful in making the remote video session more efficient.

Table 8- Participant Questionnaire

Homeowner Building Science or Residential EE Knowledge	%
Somewhat Knowledgeable	36%
Moderately Knowledgeable	28%
Not Really Knowledgeable	24%
Very Knowledgeable	12%

Prior Experience with Energy Audit	%
No	64%
Yes	20%
Not Sure	16%

Preferred Video Conferencing Application	%
Zoom Meetings	52%
No Preference	22%
Apple Facetime	17%
Google Hangout Meetings	9%

Homeowner's Top Priority	%
Comfort Issues	48%
High Utility Bills	16%
Carbon Footprint Concerns	12%
Indoor Air Quality Issues	12%
Draftiness	6%
None	4%
Other	2%

Remote Video Session and Applications

Four video application options were offered and the majority of participants had experience with and selected the Zoom Meeting application (Table 8) Earth Advantage didn't find significant differences in reliability with the applications tested (Zoom Meetings, Google Duo, Google Meet/Hangouts, or Apple Facetime). Having the ability to schedule a remote session and send a meeting link to the participant is a nice feature to have, but not necessary. There are likely other video applications or proprietary systems that could be used, but the study found all of these video applications suitable for the remote video session. Video application features were noted in Table 9.

The onsite individual did need a supplemental light source, such as a flashlight or headlamp, while in low light areas otherwise the remote assessor wasn't able to see inside the attic, crawl, closet, utility room or basement areas. Most mobile devices will not allow the user to turn on the flashlight feature while operating a video conferencing application.

Though it did not prevent a remote session from occurring, some participants did mention it was somewhat awkward to hold the mobile device, flashlight, tape measure and navigate entering an attic or crawlspace.

The Remote Assessor took screen shots during the remote video session either through the application itself or with a separate application on the device or desktop. Screen shots were taken by the remote assessor during the session and stored in a data collection form along with the HES data gathered. This helped to streamline the process for the remote assessor.

Earth Advantage was able to obtain screen capture photos by either utilizing a Windows Snip and Sketch tool on a desktop computer, through the screen capture feature in the video conferencing app or through a mobile device by taking a screen shot. These images were uploaded to the Remote Assessment data collection form. *Appendix G: Remote Assessment data collection form.*

Video Applications, Devices and Connection

The study offered four video conferencing applications to participants and tested them in various scenarios. Earth Advantage recorded the video application available features that were tested (Table 9). The key features that were discovered are shown in the table as ***bold italic***. Others features are nice to haves and could be beneficial to a partner delivering this service.

Table 9 - Remote System Applications and Features Tested

Features	Facetime	Zoom Meeting	Google Hangout/Meet	Google Duo
Scheduling Feature	No	Yes	Yes	No
Live Stream Video Conference	Yes	Yes	Yes	Yes
Works over Wi-Fi or phone data	Yes	Yes	Yes	Yes
Mobile device App	Yes	Yes	Yes	Yes
Video Recording	No	Yes	Yes	No
Provider Capture Photos through App	Yes	No	No	Yes
Provider Capture Photos through Screen Capture	Yes	Yes	Yes	Yes
Impact on mobile device battery life	Moderate/High	Moderate/High	Moderate/High	Moderate/High
Ability for Provider to mark on screen during live stream	No	No	No	No
Requires user license for Provider	No	Yes	No	No
Requires user license for Assessor	No	No	No	No
App Customization	No	No	No	No
Integrates with other systems	No	Yes	Yes	No
Desktop Option	Yes	Yes	Yes	No

The research team found that there were limited video or audio disruptions during the remote sessions as long as a strong Wi-Fi signal was obtained by the participant. There were a few cases were only a network data connection was used and the video and audio weren't as reliable. The majority of disruptions occurred during times when the participant was in the basement, crawlspace or walking around the exterior. Video application, device or connection issues were documented during 84% of the sessions (Table 10, 11 and 12).

Table 10 – Video Applications

Video Conferencing Application	No Application Issues	Application Issues	Research Session
Apple Facetime	1	6	7
Google Duo	1		1
Google Meet	1	5	6
Zoom Meetings	1	11	11
Totals	**4**	**22**	**26**

Table 11 – Devices

Device Used	No Device Issues	Device Issues	Remote Session
Apple MacBook	1		1
Google Pixel		1	1
IPad	1		1
IPad 2018	1		1
IPad 2020	1		1
IPhone XR	1		1
IPhone 11	2		2
IPhone 11 Pro	1		1
IPhone 12 Max	1		1
IPhone 4		1	1
IPhone 6	1		1
IPhone 6s		1	1
IPhone 8	1	2	3
IPhone SE	2		2
Mac Laptop	2		2
Motorola G6	1		1
Note 9	1		1

Samsung Galaxy 2		1	1
Samsung S9	1	1	2
Sony Experia	1		1
Totals	**18**	**7**	**26**

Table 12 - Connection Type

Connection Type	No Connection Issues	Connection Issues	Remote Sessions
Network Data	1		1
Wi-Fi	3	22	25
Totals	**4**	**22**	**26**

The majority of device issues were related to battery life. Battery life was determined to be a factor in how successful the session was. Older phones with original batteries tended to lose battery charge rapidly using these applications. On average battery life was decreased by 30% over a 1-hour session. Lowest case was 3% battery loss and highest was 63% loss. During two of the sessions the battery was fully depleted and the owner had to switch devices or recharge and then call back.

Follow up Data

During the video sessions, the remote assessor needed follow up data 44% of the time. The remote assessor sought additional photos of home assets that had not been obtained during the video session or when the owner provided documentation. When data was not available during the video session, the remote assessor requested documentation or photos from homeowners via email. All of this information was provided via email with no issues. No third-party application was needed for the follow-up data.

Remote Session Impediments

There were impediments found either during the scheduling process or during the remote video session:

- Homeowner mobility issues
- Device connectivity issues
- Inaccessibility to areas of the home
- Language or communication barriers
- Limited or no information about the home
- Obstruction blocking view of home or assets (example; shrubs and trees blocking view of windows from exterior)
- Overly complex homes

Only 19% of the research sessions included a recorded impediment (Table 13). The majority of these were related to accessing the attic areas. In those cases, either trade partner documentation or the home build year was used in lieu of a visual inspection.

An additional impediment that was discovered during the research was if the onsite individual is a renter or not the homeowner. Renters tend to have limited knowledge of the property and in these cases we requested info from the landlord or had follow up photos sent via email.

Table 13 – Remote Session Impediments

Impediments	Research Session
Could not access attic	4
Mobility Issues	1
No Impediment	21
Totals	**26**

Hybrid/Low-Touch Assessment

Earth Advantage tested a Hybrid or Low-Touch Assessment in two cases (Table 14). In these cases, the remote assessor made an on-site visit and documented home characteristics and measurements from the exterior of the home only. Earth Advantage found that the hybrid approach is a reasonable option if the video session exterior walk-around did not produce good images for estimating windows, floor areas or foundation types. Tree and landscaping sometimes impacts the ability to see all the windows. If a home is complex and has a lot of angles, this can impede the ability to see all sides and corners of the home during the video session.

If limitations or impediments are identified during the remote session, then the Hybrid/low-touch assessment could be performed. Several USDOE HES Partners have expressed interest in the feasibility and efficacy of the hybrid/low-touch option in addition to a fully remote approach.

Table 14 – Remote Session Types

Session Type	New York	Oregon	Totals
Fully Remote	4	19	24
Hybrid		2	2
Totals	**4**	**21**	**26**

Time Burden and Real Costs

The cost for a HES Assessment can vary depending on the anticipated time for an assessment and site variables. These costs are usually dependent on the location and size of the home. The typical time spent with a participant on a remote session was between 1 and 1.5 hours. This is comparable to an onsite audit, but doesn't include any drive time. Some homes may take 1.5 – 2 hours depending on the complexity, number of attic and crawl areas or the number of systems. This also depends on the homeowner's engagement and discussions that are taking place. The remote session could potentially add more time for the homeowner as they need to participate during the entire remote session which can be different than the onsite experience. This did not appear to be an issue for the research participants as they were mostly very engaged and seemed pleased with the remote session. Based on the study findings, Earth Advantage found that the remote assessment option could save the assessor or program time delivering a report. Assuming there is an average drive time of 1 hour to deliver an onsite assessment, it's estimated there is a potential 35% in savings delivering a remote assessment. (Table 15). Drive times vary for different regions and this would impact savings estimates.

Table 15 – Time and Cost Analysis

Current Onsite Assessment Scenario	**Hrs.**
Assessor Prep for Onsite Assessment	0.15
Prep Owner for Assessment	0.15
Travel Time	1
Conduct Onsite Assessment	1.5
Enter HES Data and Generate Report	0.25
Admin or Follow Up	0.25
Total time per Audit	3.3
Estimated Assessor Rate	$50
Total Cost	**$165**

Remote Assessment Scenario	**Hrs.**	**Estimated Savings**
Remote Assessor reviews Online Data	0.25	
Prep Onsite Individual for Remote Video Session	0.15	
Travel Time	0	

Conduct Remote Video Session	1.25	
Enter HES Data and Generate Report	0.25	
Admin or Follow Up	0.25	
Total time per Audit	2.15	**35%**
Estimated Assessor Rate	$50	
Total Cost	**$108**	**$58**

The cost for a remote assessment would be up to the remote assessor or partner delivering the service. The project team doesn't foresee a remote assessment being more expensive than an onsite assessment, as it should be less costly due to decreased mileage expenses and the elimination of drive times. There are some overhead costs for the system infrastructure needed to deliver the remote audit, but the study found that those systems can be purchased from 3rd parties for relatively low monthly costs. It would be up to the program delivery to decide what systems are best utilized and which costs to take on. The more those systems are integrated there are additional efficiencies to be gained.

Estimated Remote System Monthly Costs

- Scheduling System Software = $0 - $50 a month
- Customer Relationship Management Software = Varies
- Data and Screen Capture Collection Application = $0 - $100 per user
- Video Conferencing Application = $0 - $50 per user
- HES Score and Report Generation = $0 - $50 per user

Discussion, Recommendations, and Best Practices

Remote Assessments are being offered by various utility programs and other organizations in various parts of the country. Their use has benefits and can be a valuable tool for programs and partners to use in evaluating homes. Identifying opportunities for energy efficiency improvements can be done remotely.

Scenarios when a Remote Assessment could be used:

- During ongoing pandemics
- Long period of inclement weather or poor outdoor air quality
- Long drive times
- No authorized assessors available in the region
- Owner is ill or does not want anyone in the home for long period of time
- Experienced assessor is ill or injured, but could still work remotely
- Option for prescreening homes to fill the program or contractor upgrade pipeline
- Provide follow up score after upgrades are made

Although the data demonstrates the feasibility of this approach, it is necessary to know its limitations and plan accordingly. Partners can use a decision tree to evaluate the applicability of a remote assessment option. There are some impediments and scenarios where it may not be the best fit. If these issues arise and there is no solution to proceed, then the decision to perform an onsite assessment should be evaluated.

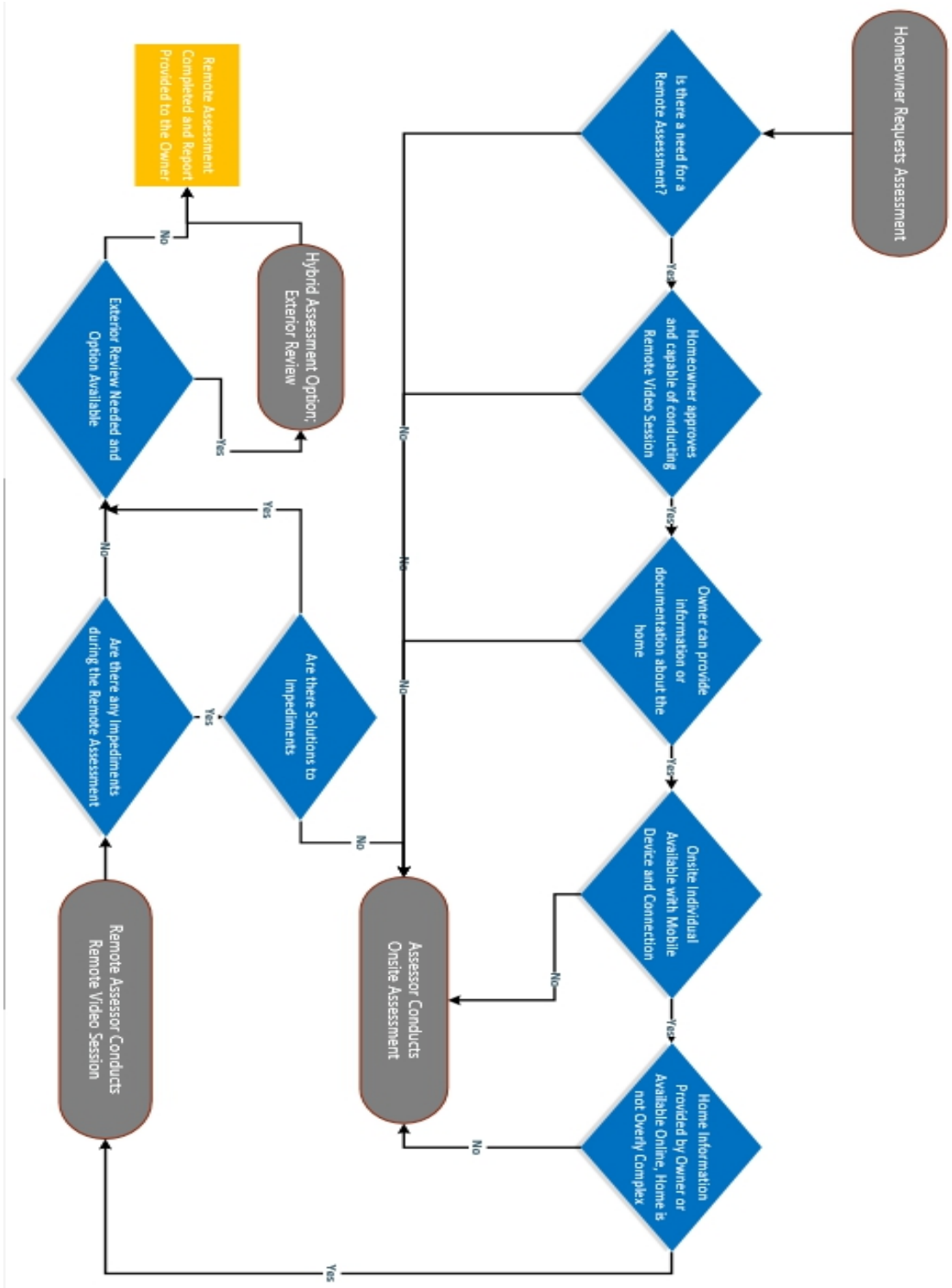


Image 1 - Example Remote Session Decision Tree

Scenarios when the Remote Assessment may not be effective;

- Very complex homes (Large conditioned areas, multiple stories with different dimensions, multiple wall angles or crawl areas, multiple HVAC systems, large % of glazing, etc.)
- Very limited or no information from the owner and online
- Onsite individual doesn't have a mobile device to use
- Onsite individual has very limited or no internet connection
- Exterior walls and vaulted ceiling cavity insulation needs to be determined
- Homeowner is not comfortable with participating in the video session or accessing the attic/crawlspace
- Owner requests onsite assessment
- Incentive program requires onsite verification or diagnostic testing
- Owner has a significant health and safety concern at the home

Remote Assessment System Infrastructure

During the study, Earth Advantage found that it is imperative for a partner or organization delivering a Remote Assessment to establish a Remote Assessment System Infrastructure. This should include and clearly identify all the key components to delivering a successful remote assessment. These can be standalone systems, but options for system integration and API connections is ideal. This could enhance the delivery of this service and make the process much more efficient. Earth Advantage has listed those key components for partners to evaluate and use in delivery.

Remote Assessment System Components;

- Onsite Individual
- Remote Assessor
- Remote Session Scheduling and questionnaire
- Video Conferencing Application
- Online Sources
- Remote Video Session Data Collection System
- System for collecting Follow Up Data, Documentation or Photos
- Customer Relationship Management System

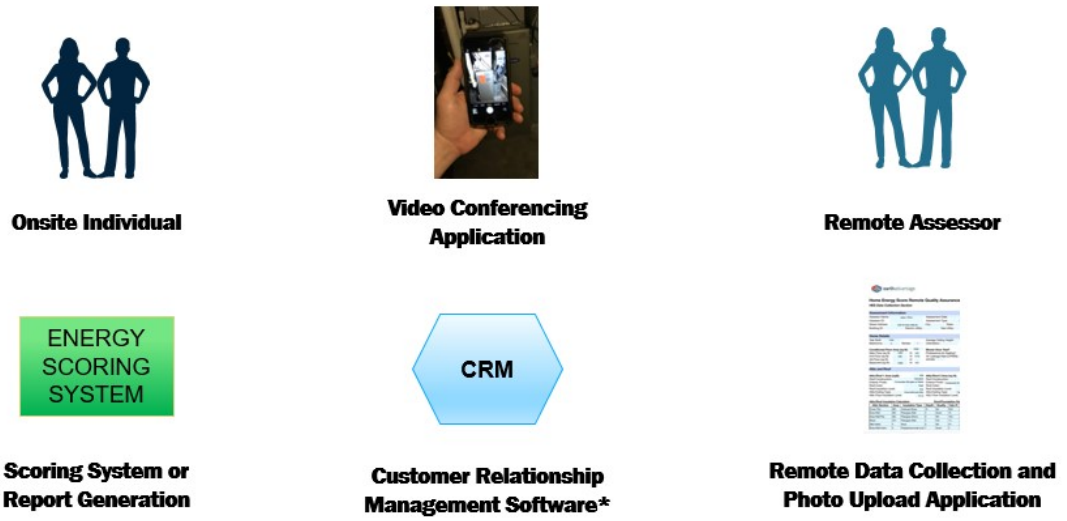


Image 2 – Remote System Components

Device and Remote Application Baseline Criteria

The study found that most mobile devices can be used by the onsite individual during the remote session. Though only four video conferencing applications were used in the study, there are likely others can be used. Here is a list of the baseline criteria for using those devices or video conferencing applications.

- Video conferencing application can be used on Android, IOS or other mobile devices platforms
- Alternative option is to use video conferencing application on laptop/desktop
- Video conferencing application works using Wi-Fi or network data connections
- Mobile device is connected to Wi-Fi or network data connections
- Application or device allows for screen capture by Remote Assessor
- No video conference application user fees for the onsite individual
- Option to provide a meeting link to onsite individual is ideal
- Preparation email sent to onsite individual prior to session
- Onsite individual has a supplemental light source
- Mobile device is fully charged

Remote Session Scheduling, Screening and Onsite Individual Preparation

It is critical to determine who will be participating in the remote session and what their knowledge level is. Partners can prepare the owner for the remote session and provide them

with instructions on how to provide any information they have about the home to the remote assessor. In providing a Remote assessment, the partner or remote assessor should consider using a scheduling system that includes a questionnaire. It's recommended they set the time slots to 1.5 to 2 hr. and ask any questions needed at the time of scheduling.

Following the scheduling and screening phase, the remote assessor or program staff will need to prep the onsite individual for the remote session. This can be done through an email template with the video session link inserted (Appendix B) and a list provided to the client of the needed tools and devices (Appendix F). In some cases the remote assessor may choose to send a remote video session kit to the client. It can also be beneficial to send the client a form that allows them to make a sketch of each floor of the home and even notate window dimensions (Appendix H – Homeowner Floor Sketch and Window Dimensions Form – Example) Regardless of options used it is very important to prep the individual for the session and make sure they feel safe while moving around the home.

Online Data

The study found that there is varying amounts of info related to an address online. If a home went through a real estate listing in the last 10 years it's very likely the listing info is still posting online on one of the listing sites; Zillow, realtors.com, Redfin, etc. The study also found that Google maps satellite and street view are good options to see images of the home and potentially take measurements. See Image 3. Another resource is local tax records through county or city jurisdictions. Programs typically know which resources are available and can include these in their data review prior to the remote video session.

Image 3 – Satellite Image with measurements

Remote Assessor
The remote assessment needs to be conducted by an experienced assessor with a higher level of qualifications or experience in residential properties. Participating assessors ideally would be a BPI Analyst/Auditor, experienced home inspector with extensive knowledge of scoring protocols, or an individual that has worked in a large amount of homes.

The assessor conducting the remote assessment needs to have considerable experience with residential building stock. The assessor should have experience inspecting and auditing the majority of home configurations and build types in their region. It is also ideal for them to have interacted with a lot of homeowners and have excellent customer service skills. The remote video session does involve additional interaction with a client so patience and customer service is key. They will also need to educate the individual about their home and how to locate the various home assets.

The remote assessor could be located anywhere and work out of a home or office setting. Ideally the remote assessor will have a desk with at least two screens, strong internet connection and access to all the remote system applications used. They could connect the remote session on a mobile device such as a tablet, but a remote desk is preferred.

Remote Session Impediments
There are some impediments that can make it very challenging to conduct the remote assessment. It's imperative to ask questions during the initial scheduling and screening process to identify any know impediments. This will give partners an understanding if the remote assessment is an appropriate option for the home or if solutions to the impediment are needed. Here are some impediments that could come up;

- Onsite individual mobility issue
- Mobile device connectivity issues
- Inaccessibility to some areas of the home
- Onsite individual with limited or no knowledge of the home
- Onsite individual language or communication barriers

During the screening process, partners can identify these impediments and offer solutions. Some owners may want a different person to conduct the remote session. In those cases it would make sense to talk with the owner separately to gather any information they have about the home. Renters, or other individuals who are not the owners, tend to have limited knowledge of the property and sometimes don't know how to access the attic or crawlspace. There also may be other tenants in the property that limit the individual's access to all areas of the home.

Health and Safety Considerations

The HES assessment doesn't include any data points or discussion related to health and safety concerns. Examples include; moisture issues, combustion appliance issues, trip hazards, radon, asbestos containing materials, plumbing leaks, roof leaks, knob and tube wiring or other electrical issues. Trained assessors often find these issues and point them out to owners while onsite during a comprehensive audit or evening during a HES assessment. There are scenarios where these issues would need to be addressed prior to making upgrades to the home. The remote assessor could miss these health and safety issues during a remote video session.

The project team recommends having a conversation with the owner about health and safety concerns and making it clear what the remote assessor will be evaluating. Providers may want to include some disclosures about the health and safety issues that they are unable to see and verify.

It's also important to ensure the safety of the onsite individual walking through the home during a remote video session. Remote Assessors and providers should prepare individuals for that session and point out any safety issues. This would include making sure they are comfortable walking through the home while holding a mobile device. The onsite individual should only use a safe ladder with 3 points of contact to access an attic space. If the individual is not comfortable doing this then there is no need to encourage them to do so. If at any time a health and safety issue is identified during the remote session the remote assessor should pause the walk through and discuss with the onsite individual.

Remote Data and Screen Capture Collection

The remote assessor will need a way of capturing assessment data and photos while conducting the remote video session. It's recommended that the remote assessor use a form application, standard fillable form or a proprietary data collection system to streamline the process. This form could include the commonly used calculations found in the assessor calculator; R value ratings and weighted averages. Also integrating window and floor area calculators could greatly help the remote assessors. It is also beneficial if screen capture photos can be inserted in the form through the application, but if not a separate application can be used. Screen capture photos can be obtained through the screen capture feature in the video conferencing app or through a mobile device by taking a screen shot. It would also be beneficial to have the ability to take screen shots from within the video conference application. Remote session data and photos can be stored as a backup in case QA is performed. This will also provide a backup in case there is a dispute or some issue with a score. See example Appendix G: Remote Assessment data collection form.

Follow up data
There will be times when follow up data is needed from the owner after the remote session is completed. The remote assessor can notate what info, photos or documentation was discussed with the onsite individual during the remote session. This list can be sent to the owner via email. This info could also be gathered through a cloud server folder link, mobile phone text, or through a proprietary system.

Customer Relationship Management Software
An organization providing a remote assessment should consider using a CRM system to manage their interactions with a homeowner and track remote assessments. This isn't required to offer a remote assessment, but would be ideal to use in tracking clients and to use consistent messaging and data capture.

Remote Assessment Quality Assurance
A QA Provider will still need to conduct quality assurance on a percentage of remote assessments. They will either need access to the screen capture photos and data collected by a remote assessor or a recording of their remote video session.

Another option is for the QA Provider to attend the remote video session with the assessor and onsite individual. They could collaborate with the assessor to find a session to attend and then conduct the QA per the Remote QA protocols.

In using a data and screen capture collection form, a HES provider can store those completed forms on a server or through a CRM system. The QA provider could randomly select one of the remote assessment addresses and request that completed form. This would give them the info need to conduct the QA.

Additional Data Points and Homeowner Priorities
Energy efficiency and utility costs tend to be the focus of an HES Assessment and report. Energy auditors or residential energy efficiency professionals typically collect additional data along with HES related data points. This additional data collected depends on the program objectives, incentive programs or what type of audit the owner has requested. This additional data could include information related to; Solar PV potential, additional plug load usage, lighting, home appliances, indoor air quality, ventilation, health and safety or electric panel or wiring needs. During a remote session, owners will want to talk about their pain points or priorities which can align with HES, but also will require these additional data sets. The program delivering a remote assessment may want to collect these data points to identify opportunities for improvements or alignment with incentive programs. This could also be the case with programs promoting electrification or carbon reduction initiatives. Not all of these recommended upgrades will need

to meet a 10-year payback requirement. HES does overlap with these additional priorities, but it's important to align recommended upgrades with the owner's priorities and the available incentives. Examples of additional assessment data is shown at the end of the example remote assessment form in Appendix G.

Gathering this additional data isn't seen as a barrier to providing a remote HES assessment and, if anything, it can only enhance it. It doesn't require much more time to gather this info from an owner during the remote video session. Aligning residential efficiency upgrades with the homeowner's priorities, and any program objectives or incentives, will only increase the likelihood of the home being upgraded. Collecting these additional data points can be integrated with the system process and added to the data collection tool used.

Advanced Remote Applications and Future Improvements

During the study, the project team found that online information is available for a large number of homes. Most was related to real estate listings which included photos. There are a number of advanced applications on the market that could be practical to use for remote auditing. These will likely get less expensive and more widely available over time. Most are available for a fee and worth investigating as options for providing this service.

3D Walkthroughs – Matterport

https://go.matterport.com/

Earth Advantage was able to use a 3D walkthrough created by Matter Port for a real estate listing on one of the remote assessments. This proved to be very effective in providing accurate measurements. Though this is the ideal scenario, it currently isn't going to be available for every remote assessment. It's worth reviewing real estate listings in preparation for a remote session to see what is available.

There may be other mobile device applications that are on the market that could be used by homeowners to take 3D images and create accurate dimensions.

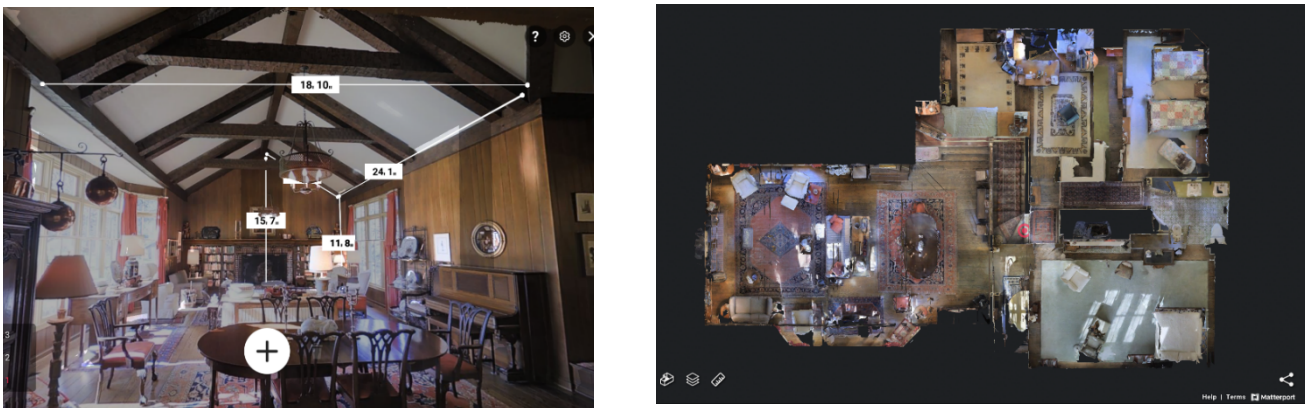


Image 4 - Matterport 3D walkthroughs on real estate listing.

Google Earth
https://www.google.com/earth/

This application can give detailed 360° images of a residential property. These could be used during a remote assessment. Earth Advantage found that the application does effect computer processing speed and may not be available for every address. It provides good rendering and may help in estimating floor areas and ceiling heights.

Image 5 - Google Earth image

Hover Report
https://hover.to/

This application uses exterior photos taken by a homeowner to build a 3D model of the home and give accurate dimensions. This gives an example of what is available now and possible advances for the future.

Organizations can get homeowners access to the HOVER mobile app to take photos of any residential property. Then they will deliver an interactive, 3D reconstruction within 24 hours.

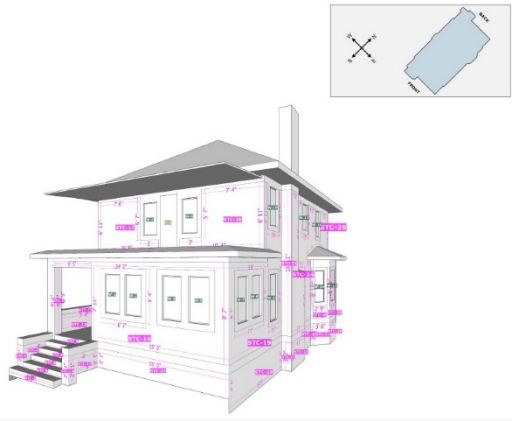


Image 6 - Hover Report Examples

Appendices

Appendix A: Remote Assessment Proposed Process

- **Remote Assessor** = HES Assessor performing the remote Assessment via video conferencing
- **Onsite Individual** = Homeowner, Renter, Family Member, Realtor, Trade Professional, or other
- **Remote Video Session** = Video conferencing, video chat, or live stream session

1. Identify remote assessment opportunity and in-take home address.
    a. Undertake scheduling and preliminary screening.
    b. Screening will inquire as to any known impediments to conducting the remote session.
2. Schedule a remote video session.
    a. Scheduling includes homeowner questionnaire, questionnaire example is provided in Appendix C.
    b. Provide video conference applications that meets minimum criteria.
3. Send introductory email to the client so they can prepare for remote video session.
    a. The introductory email will include instructions and what to expect during the session. Example email is provided in Appendix B.
4. Prior to remote video session, review public information available.
    a. Gather any available data online (Orientation, Stories, Roof color, etc.).
    b. Public information could include Google maps, MLS data, and property assessment data, permit data, etc.
    c. Availability of public information may differ based on the jurisdiction
    d. Identify the need to take into consideration complex building configurations.
5. Remote Assessor will conduct the remote assessment through video conferencing.
    a. Remote Assessors will capture photos/screenshots during the video session. There may be some additional follow up photos needed from the resident based on limitations with the video session. Photo list is provided in Appendix E.
    b. Conditioned area and window measurements can be provided by the owner or estimated by the remote assessor from photos and online data.

c. If no information is available from the owner or from online sources, the remote assessor will use conservative defaults from the Home Energy Score assessor calculator or use regional building codes based on year.

6. ***Optional Hybrid Approach:*** *If needed and it is an option, the Remote Assessor will visit the home and evaluate the exterior of home to gather data.*
    a. *Conditioned area and foundation types/areas can be measured.*
    b. *Window measurements and types can also be taken at this time.*
    c. *May be an opportunity to evaluate any mechanical equipment located at exterior or in a garage.*
    d. *Review other attributes such as siding type, any presence of insulation on the outside of exterior wall sheathing and roof material type/color.*
7. Remote Assessor will use the HES "preconstruction assessment" type in the Home Energy Score Tool with notation in the comment section of HES that it is a "Remote Assessment".
8. Remote Assessor provides the HES report or custom report to client with indication that it was conducted remotely.

Appendix B: Example Homeowner Preparation Email Template

[Homeowner Name]
We are pleased that you will be participating in a Remote HES Assessment. In preparation for your Remote Assessment Session, you will want to review the following details.

Your remote assessment session will be on [Date] at [Time] with [Remote Assessor]. Your video session will be conducted through [Video Conferencing Application]. Here is the meeting link to use on your device; [Meeting Link or phone number]

- The remote session will be approximately 1 - 1.5 hours in length.
- During the session, you will want to have a fully charged mobile device on hand and the [Video Conferencing App] application downloaded to that device.
- It may be preferable to have limited network activity at your home and a minimum amount of distractions.
- You will need a flashlight or headlamp, tape measure and a dust mask. The flashlight on your mobile device will likely not work while using a video conferencing application.
- The remote session will involve accessing most of the areas of the home and walking around the exterior.
- Prior to the session you will want to locate the access hatches to your crawlspace and attic spaces. Please clear out any personal items from those access points so you can safely access those areas. If you are uncomfortable with accessing these areas or there are any issues please let us know.
- You will also want to locate your heating, air conditioning and water heating equipment prior to the session.
- If you need to use a ladder to access an attic or crawlspace you'll want to have one on hand that is in good condition and you feel safe using. If you do not have one or cannot access these areas for any reason please let us know during the remote session.
- Let us know if there are any known health and safety issues in the home that could impede your participation in the remote session.
- You can provide any relevant documentation to the Remote Assessor prior to or during the session. Specifically related to upgrades that have been made to the home.
- If you have measurements of window areas or conditioned floor areas of the home, you can provide that information to the Remote Assessor.
- Attached is an optional form that can be used to make a basic sketch of the floor plan on each level of the home. You can also provide window measurements from each side of the home if you feel comfortable doing so. Again this is optional.

Please feel free to contact me with any questions prior to the Remote session. We appreciated you participation.

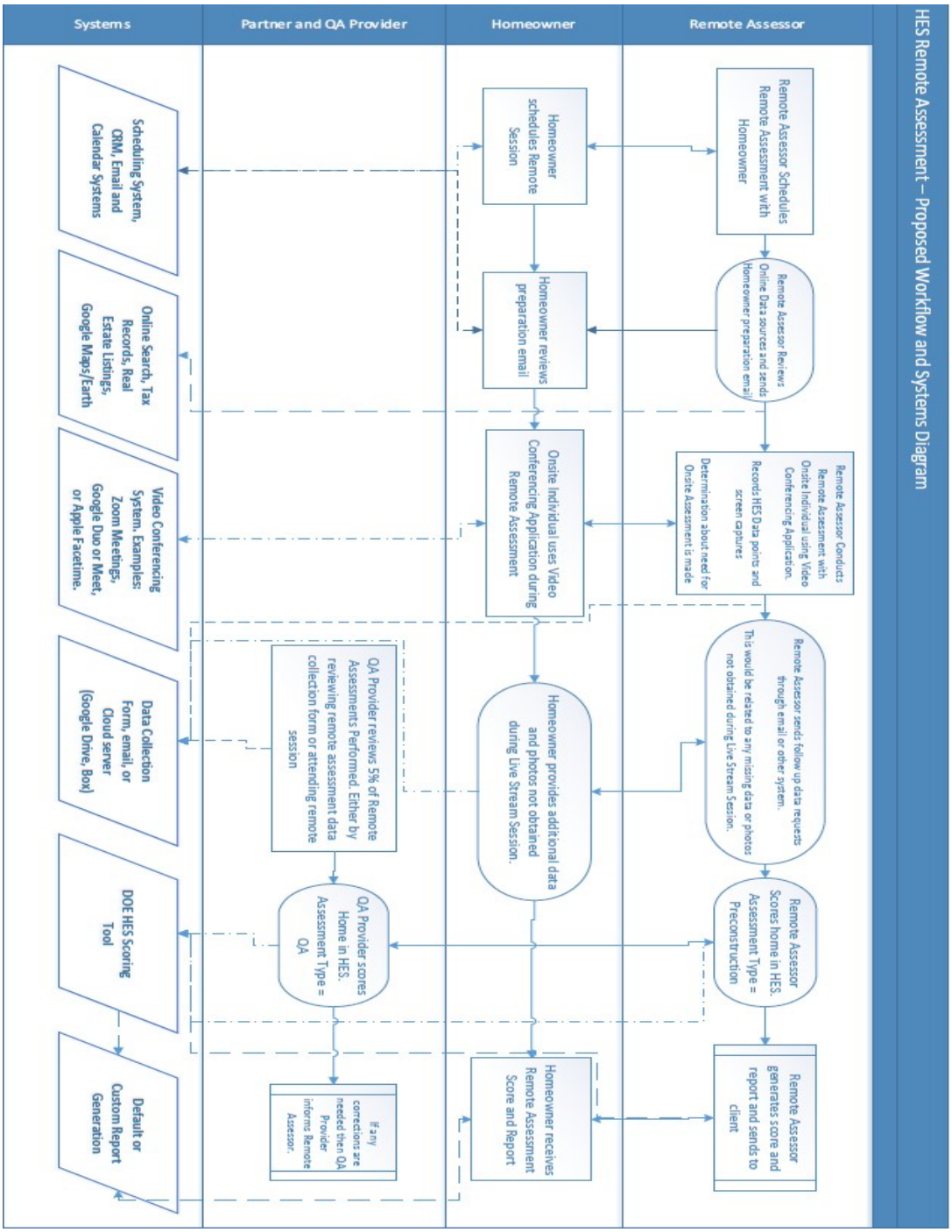
Thank you
[Remote Assessor]
[Contact info]

Appendix C: Example Homeowner Questionnaire

Please review the following questions and provide information;

- What are your primary reasons for wanting an energy assessment for your home?
- Have you ever had an energy audit on your home before?
- Do you have any documentation related to your home? Example: Building plans, floor plan, or upgrade documentation.
- How familiar are you with building science terminology or residential energy efficiency?
- What is the approximate year your home was built?
- How many bedrooms does the home have?
- What is the approximate conditioned area or square footage of your home?
- Have you made any improvements or upgrades to the home?
- Do you have a working mobile device with a Wi-Fi or network data connection at your home?
- Do you feel comfortable conducting a video conference session at your home with an assessor?
- Do you have any comfort issues? Example: Draftiness, uneven temperatures, etc.
- Are there any other concerns you have about your home that you have? Health and Safety, Indoor Air Quality, Moisture, Radon, etc.
- Do you know of any issues that would inhibit your ability to participate in the remote session? Examples; Mobility, language, access to crawlspaces or attics, or device connectivity.
- If so, is there someone that could help you during the remote session?

Appendix D: HES Remote Assessment – Proposed Workflow and Systems Diagram



Appendix E: Remote Assessor Screen Capture or Provided Photos List

Priority Screen Capture or Provided Photos

- Photo of each side of home and corners
- Photo of Foundation type
- Photo of Window type
- Photo of Attic insulation with ruler showing depth (minimum 2)
- Photo of Floor insulation with ruler showing depth (minimum 2)
- Photo of Heating system and model #/energy guide labeling (each system)
- Photo of Air Conditioning system and model #/energy guide labeling (each type)
- Photo of Ducts and examples of insulation/sealing (each location)
- Photo of Water Heater and model #/energy guide labeling

Supplemental Screen Capture or Provided Photos

- Floor diagrams
- Photo of retrofit documentation. Example; Invoice from contractor
- Photo of Access hatches
- Photo of Skylights
- Photo of missing or abnormal insulation
- Photo of professional Air Sealing
- Photo of Wall depth (if not standard)
- Photo of Blower Door reading or infiltration documentation
- Photo of Solar PV system or specs sheet
- Photo of Green Certification or verification
- Photo of anything outside ordinary building assembly such as foam board on exterior walls

Appendix F: Remote Assessment Tools for Onsite Individual

- Flashlight, headlamp or other light source
- OSHA rated ladder
- Dust mask
- Fully charged mobile device
- Measuring tape or measuring stick

Appendix G: Remote Assessment Data and Screen Capture Collection Form – Example

This is an example of the Remote Assessment Form used by Earth Advantage staff and filled out during remote video session. This form was developed by Earth Advantage and used for purposes of Remote QA. It was modified for the purposes of the study.

The 1st section shows examples of HES related data points that were collected and entered during the remote video section. Some additional data points were gathered that are not necessarily used in HES.

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Home Energy Score Remote Assessment Form

HES Data Collection Section

Remote Assessment Information

Assessor Name: Jason Elton
Assessor ID: ODOE
Street Address: 1234 N Test Ave
Building ID: OR12345
Homeowner Name: John Smith
Assessment Date: 2/9/2021
Assessment Type: Remote Research
City: Bend State: OR Zip: 97834
Electric Utility: PGE
Gas Utility: NW Natural
Remote Application: Zoom Meetings

Home Details

Year Built: 1952
Bedrooms: 3
Stories: 2
Average Ceiling Height: 8 ft Calc H: 8.0
Orientation: South

Conditioned Floor Area (sq ft): 2400
Main Floor (sq ft): 1200 H: 9 ft
2nd Floor (sq ft): H:
3rd Floor (sq ft): H:
Basement (sq ft): 1200 H: 7 ft
Measurement Method: Homeowner Measured

Blower Door Test? Yes
Professional Air Sealing? No
Air Leakage Rate (CFM50): 3200
ACH50: 10.0

WiFi in the Home: Yes

Attic and Roof

Attic/Roof 1 Area (sqft): 1100
Roof Construction: Standard
Exterior Finish: Composite Shingles or Metal
Roof Color: Medium
Roof Insulation Level: R-0
Attic/Ceiling Type: Unconditioned Attic
Attic Floor Insulation Level: R-19
Measurement Method: Remote Assessor Estimated

Attic/Roof 2 Area (sq ft): 250
Roof Construction: Standard
Exterior Finish: Composite Shingles or Metal
Roof Color: Medium
Roof Insulation Level: R-11
Attic/Ceiling Type: Cathedral Ceiling
Attic Floor Insulation Level:

Attic/Roof Insulation Calculator **Roof/Foundation Ratio:** 123%

Attic Section	Area	Insulation Type	Depth	Quality	Calc R	Attic #
Attic Flat	992	Fiberglass Blown	12	NA	37.2	Attic 1
Storage Flat	100	Fiberglass Batt	4	Fair	7.2	Attic 1
Attic Hatch	8	None	0	NA	0.4	Attic 1
Vault	250	Fiberglass Batt	4	Fair	7.2	Attic 2
				NA		
				NA		

Attic/Roof	Area	UA	Average R Value
Attic 1	1100	60.6	18.2
Attic 2	250	34.7	07.2

Foundation

Foundation 1 Area (sq ft): 1100 **Foundation 2 Area (sq ft):** 0
Foundation 1 Type: Conditioned Basement Foundation 2 Type:
Floor Insulation Level: R-0 Floor Insulation Level:
Wall/Slab Edge Insulation Level: R-11 Wall/Slab Edge Insulation Level:
Measurement Method: Trade Professional Documentation

Foundation Insulation Calculator

Floor Section	Area	Insulation Type	Depth	Quality	Calc R	Foundation #
Conditioned Basemen	1100	None		NA	00.4	Foundation 1
				NA		
				NA		
				NA		

Foundation	Area	UA	Average R Value
Foundation 1	1100	2750	00.4
Foundation 2	0	00	

Walls

Is this a Townhouse or Duplex? No **Same Type Walls All sides?** Yes
Position of Unit:

Front/All Wall Construction Type: Wood Frame with Rigid Foam Sheathing
Exterior Finish: Vinyl Siding Wall Depth: 4" Insulation Level: R-0
Insulation Rating Method: Remote Assessor Estimated

Back Wall Construction Type:
Exterior Finish: Wall Depth: Insulation Level:

Right Wall Construction Type:
Exterior Finish: Wall Depth: Insulation Level:

Left Wall Construction Type:
Exterior Finish: Wall Depth: Insulation Level:

Wall Insulation Calculator

Wall	Area	Insulation Type	Quality	Depth	Calc R
Wall 1	50	Fiberglass Batt	Fair	4	7.2
Wall 2	50	None	NA		0.4

Total Area	UA	Weighted Average R Value
100	131.9	00.8

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Window and Skylights

Same Type Windows All Sides? Yes
Windows Details
Front Area (sq ft): 88
Back Area (sq ft): 96
Right Area (sq ft): 72
Left Area (sq ft): 65
Measurement Method: Remote Assessor Estimated

Skylights Present?: Yes
Skylight Area (sq ft): 8
Number of Panes: Double Pane
Frame Type: Wood or Vinyl
Glazing Type: Clear
Or enter, U Factor: SHGC:

Front/All Windows
Number of Panes: Double Pane
Frame Type: Wood or Vinyl
Glazing Type: Clear
Or enter, U Factor: SHGC:
Shade Screen:

Back Windows
Number of Panes:
Frame Type:
Glazing Type:
Or enter, U Factor: SHGC:
Shade Screen:

Right Window
Number of Panes:
Frame Type:
Glazing Type:
Or enter, U Factor: SHGC:
Shade Screen:

Left Window
Number of Panes:
Frame Type:
Glazing Type:
Or enter, U Factor: SHGC:
Shade Screen:

Heating and Cooling Systems

Heating System 1 Type: Central Gas Furnce
Make/Model #: Carrier 12234
% Floor Area Served: 75
Efficiency (X AFUE, HSPF, COP): .95
Or Installation Year:

Thermostat Type: Smart Thermostat
Venting Type:
Energy Star? Yes
Default Efficiency:

Cooling System 1 Type: Central Air Conditioner
Make/Model #: Carrier 12344
Efficiency (X SEER, EER): 12
Or Installation Year:

Energy Star? No
Default Efficiency:

Duct Location 1: Conditioned Space
% of Ducts in location: 75
Ducts Sealed? No
Ducts Insulated? No

Duct Location 2: Unconditioned Attic
% of Ducts in location: 25
Ducts Sealed? No
Ducts Insulated? Yes

Duct Location 3:
% of Ducts in location:
Ducts Sealed?
Ducts Insulated?

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Heating System 2 Type: Ductless Mini Split
Make/Model #: Daikin
% Floor Area Served: 25
Efficiency (X AFUE, HSPF, COP): 10
Or Installation Year:
Thermostat Type:
Venting Type:
Energy Star?
Default Efficiency:

Cooling System 2 Type: Ductless Mini Split
Make/Model #: same
Efficiency (X SEER, EER): 15
Or Installation Year:
Energy Star?
Default Efficiency:

Duct Location 1: None
% of Ducts in location:
Ducts Sealed?
Ducts Insulated?

Duct Location 2:
% of Ducts in location:
Ducts Sealed?
Ducts Insulated?

Duct Location 3:
% of Ducts in location:
Ducts Sealed?
Ducts Insulated?

Water Heating Systems

Water Heater 1 Type: Gas Tank
Make/Model #: AO Smith XXX
Efficiency (X EF, UEF): .60
Or Installation Year: 2011
Storage Capacity: 50
Energy Star? No
Default Efficiency:
Location:

Water Heater 2 Type: Heat Pump
Make/Model #: Rheem XXX
Efficiency (EF, X UEF): 3.2
Or Installation Year:
Storage Capacity: 75
Energy Star? Yes
Default Efficiency:
Location:

Photovoltaic (PV) Systems

DC Capacity(kW): 7.5
Directions Panels Face: South
# of Panels: 25
Year Installed: 2018

Notes:

The 2nd section shows examples of screen capture photos or images gathered during the remote video section and uploaded to the form.

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Remote QA Photo Documentation Section

Instructions:

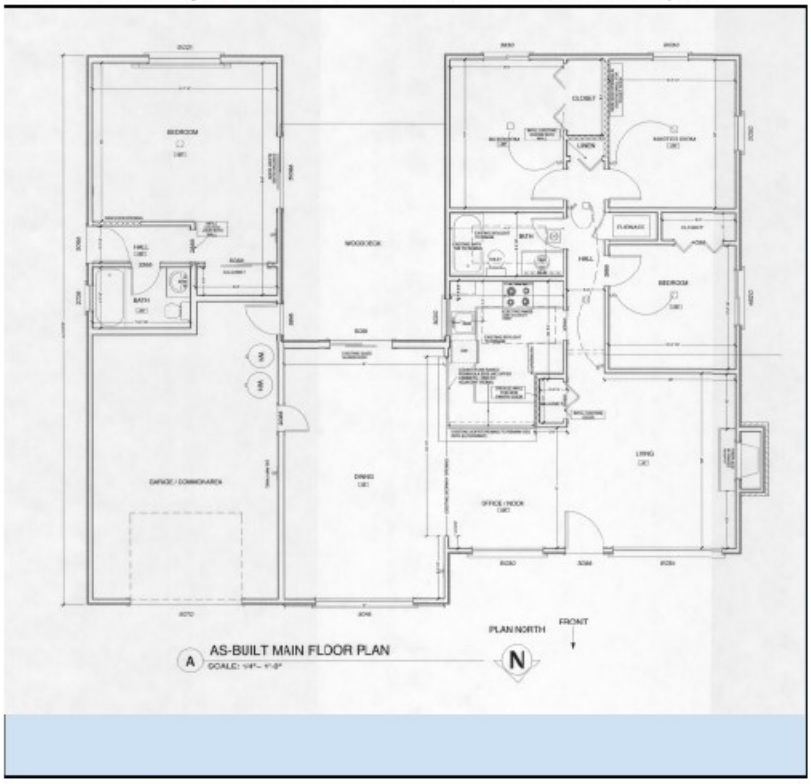
This form must be completed for every assessment conducted by an Assessor operating under a Remote Quality Assurance Agreement with Earth Advantage. This form has 25 images that must be included and options for additional images. Figure 1 must be completed.

Floor Plan: *Provide a legible scan or photo of a drawing/sketch showing the footprint of the home with dimensions. Note "unconditioned" areas and* include North arrow.

Photo or Sketch of floor plan

Floor Plan 2: (Optional)

Photo or Sketch of any Additional Conditioned floor areas not shown in floor plan.



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Floor Plan: (Additional Info) *Fill in the standard (Figure 1) house diagram indicating placement of mechanical equipment and ducts as appropriate and whether or not each is in conditioned or unconditioned space.*

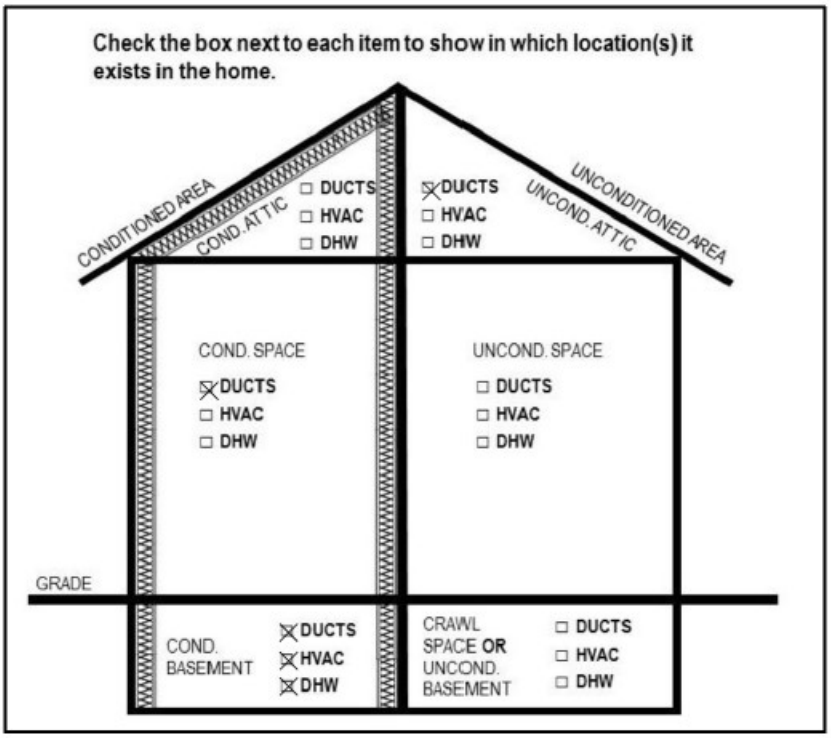
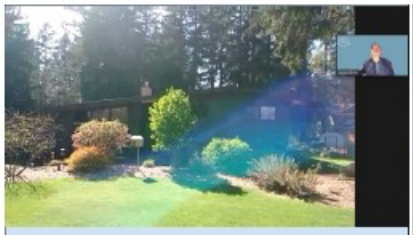


Figure 1. Standard House Diagram. Check off the equipment label in all locations where it exists in each home.

Exterior: (Elevations) *One photo per elevation, getting the whole side of the home in the frame whenever possible. Image must be straight-on to each elevation where possible, ideally with an item indicating scale included in the shot (i.e., visible yardstick or ruler).*

Elevations:

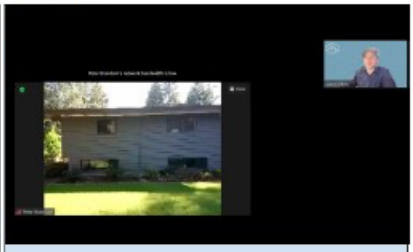
Front-Side - Street Facing Side



Rear-Side

Left-Side

Right-Side



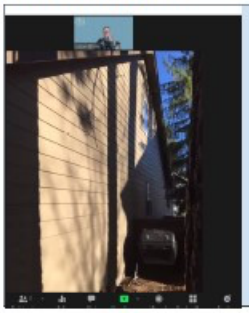
Exterior: (Elevations continued)

Exterior Corners: *One photo should also be taken on each corner outside the home to show how the exterior walls connect.*

Front Left-Side Corner

Front Right-Side Corner

Rear Left-Side Corner



Rear Right-Side Corner

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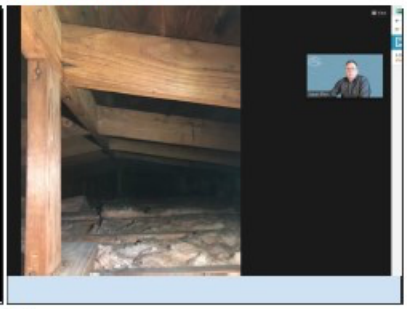
Attic (Insulation levels) *Ruler inserted to show insulation depth in 2-4 places, including some away from central locations.*

Insulation Section:

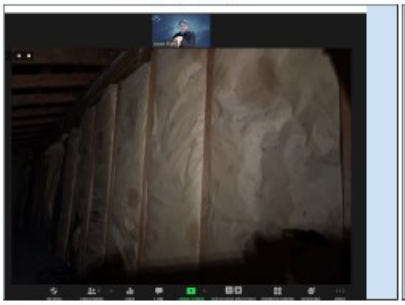
Notes:
Unconditioned attic with storage

Insulation Section:



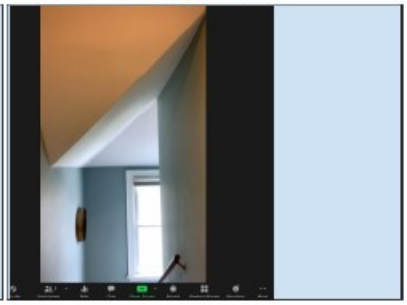
Notes:
Unconditioned attic

Insulation Section (Optional):



Notes:
Back of knee wall

Insulation Section (Optional):



Notes:
Cathedral areas

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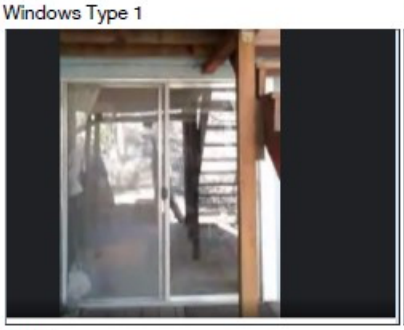
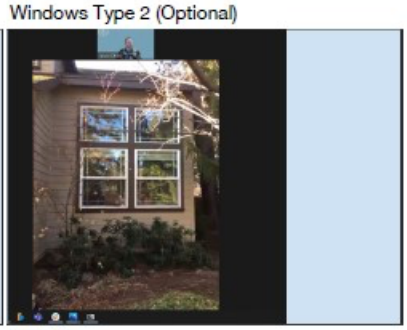
Exterior: (Windows) *Close-up of most common window type(s) on home to show number of panes and frame type.*

Windows Type 1



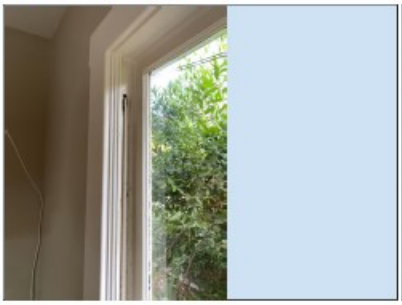
Notes:

Windows Type 2 (Optional)



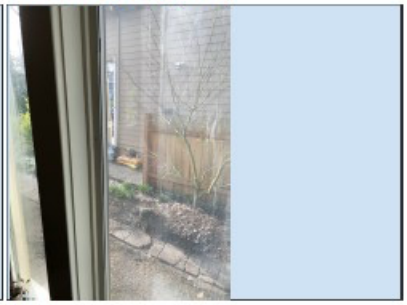
Notes:

Windows Type 3 (Optional)



Notes:

Windows Type 4 (Optional)



Notes:

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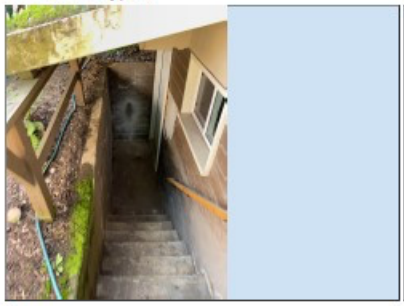
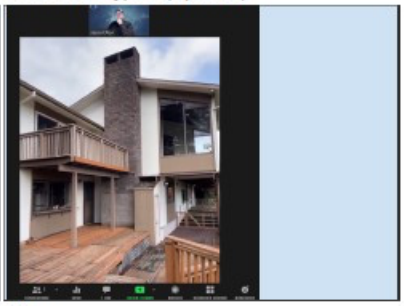
Exterior: (Foundations) *At least one photo per type of exterior foundation / slab insulation if present.*

Foundation type 1



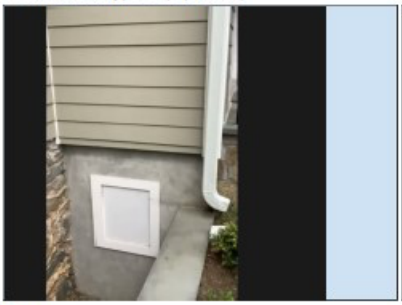
Notes:
Basement

Foundation type 2 (Optional)



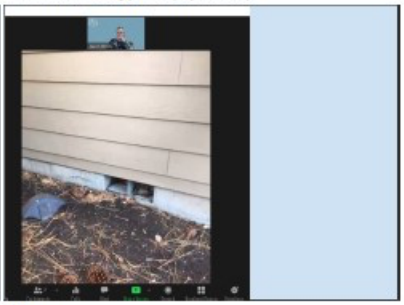
Notes:
Overhang

Foundation Type 3 (Optional)



Notes:
Unvented Crawlspace

Foundation Type 4 (Optional)



Notes:
Ventilated Crawlspace

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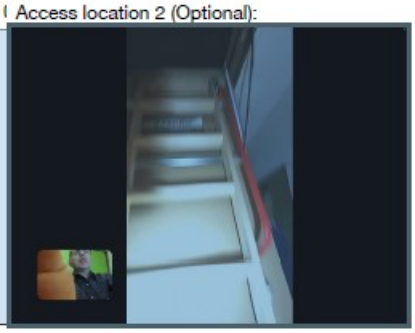
Attic / Crawlspace: (Accesses) *Doorway, pull-down stair, or hatch that provides access to conditioned space.*

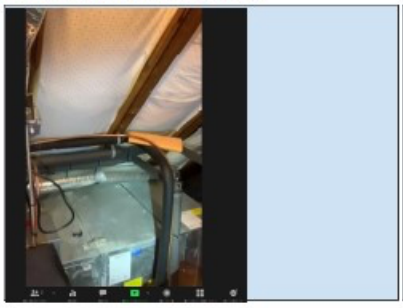
Access location 1 (Optional): Pull down hatch R

Access location 2 (Optional):



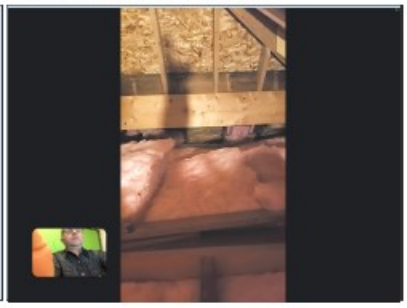
Attic / Crawlspace: (Missing insulation) *Include photo(s) of any areas with missing insulation or exceptions to the overall insulated condition. These photos are optional.*

Abnormal insulation location 1:



Notes:
insulation along roof line in attic

Abnormal insulation location 2:



Notes:

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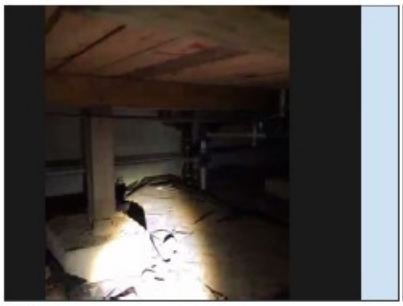
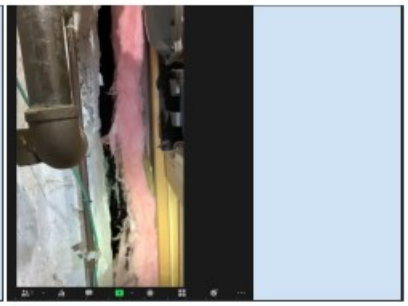
Foundation/Crawl Space (Insulation levels) *Ruler inserted to show insulation depth in 2-4 places, including some away from central locations.*

Insulation Section:



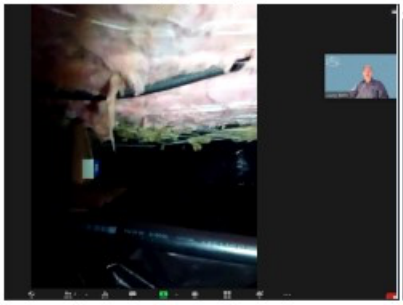
Notes:
Crawlspace

Insulation Section:



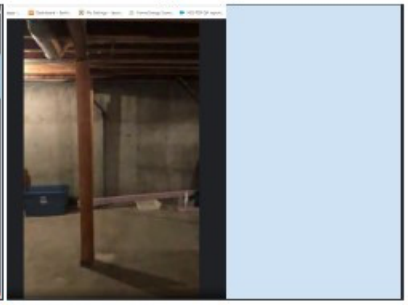
Notes:
Basement wall insulation

Insulation Section (Optional):



Notes:
Crawl space

Insulation Section (Optional):



Notes:
Basement walls and floor

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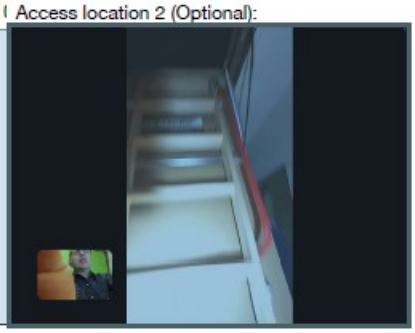
Attic / Crawlspace: (Accesses) *Doorway, pull-down stair, or hatch that provides access to conditioned space.*

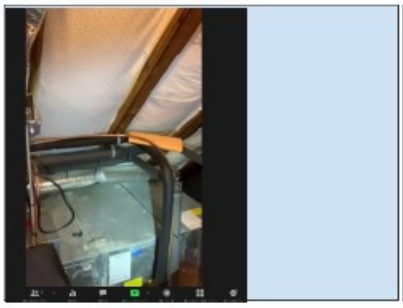
Access location 1 (Optional): Pull down hatch R

Access location 2 (Optional):



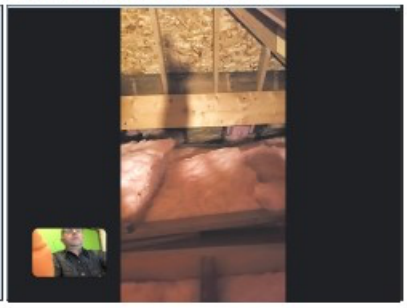
Attic / Crawlspace: (Missing insulation) *Include photo(s) of any areas with missing insulation or exceptions to the overall insulated condition. These photos are optional.*

Abnormal insulation location 1:



Notes:
insulation along roof line in attic

Abnormal insulation location 2:



Notes:

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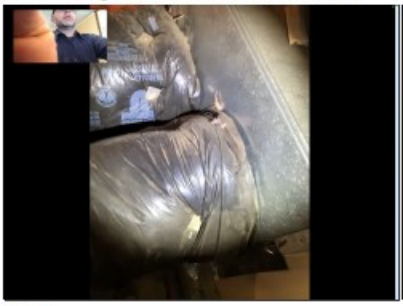
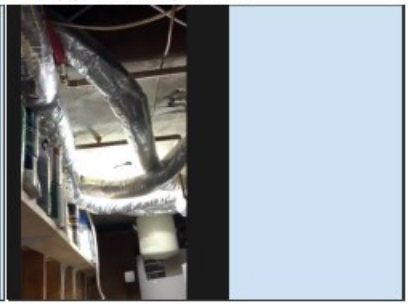
Ducts or Radiators: *Optional photos for up to 2 additional duct/pipe locations:*

Duct-sealing / insulation detail at location 3

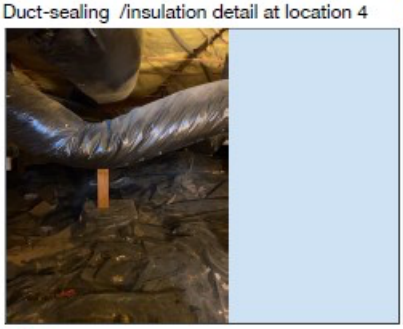


Duct/pipe location photo 3:

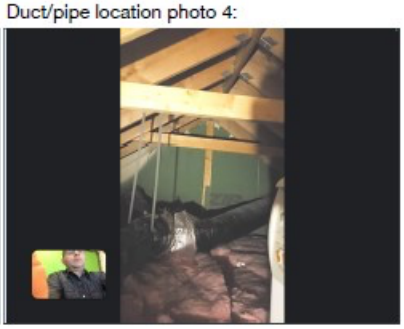


Notes:

Duct-sealing /insulation detail at location 4



Duct/pipe location photo 4:



Notes:

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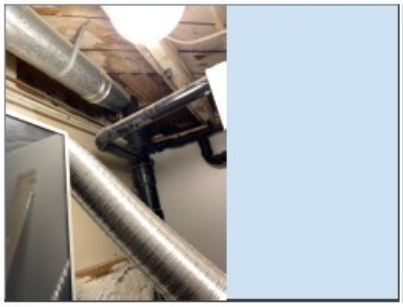
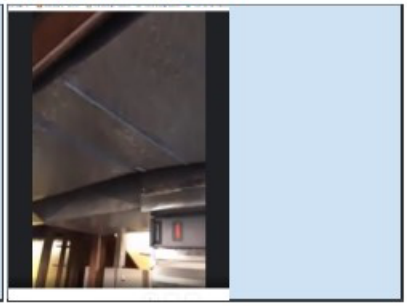
System Ducts or Radiators: *Status of duct-sealing and/or insulation in 2-4 places, including some away from central locations. Duct/pipe location photos should have a wide enough frame to see whether location is conditioned, unconditioned, vented, etc. Include basement locations if it is conditioned.*

Photos of at least 2 duct/pipe locations:

Duct-sealing / insulation detail at location 1



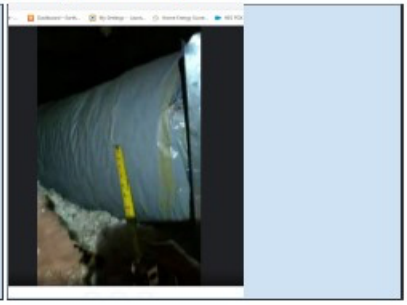
Duct/pipe location photo 1:



Notes:

Duct-sealing / insulation detail at location 2

Duct/pipe location photo 2:



Notes:

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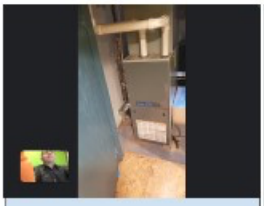
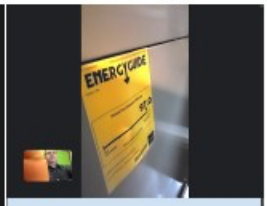
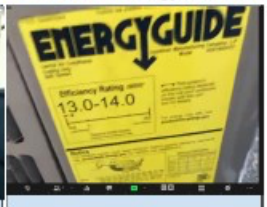
Mechanical Equipment: (HVAC Equipment) *Include At least one photo of the entire unit(s), and one or more of the data plates on HVAC equipment where details are legible, including manufacturer's name and ENERGY STAR emblem if present. Include a photo of the Energy Guide label if present.*

HVAC Unit 1 photo	HVAC Unit 1 plate	HVAC Unit 1 Energy Guide label
		

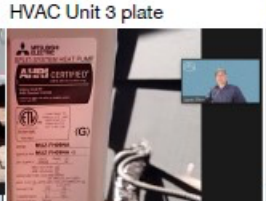
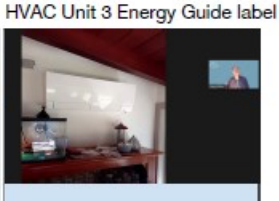
Notes:

If a 2nd Heating System or AC exists:

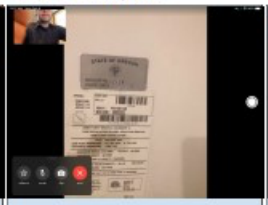
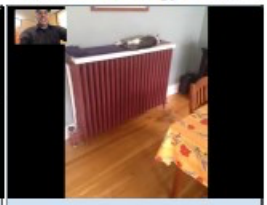
HVAC Unit 2 photo	HVAC Unit 2 plate	HVAC Unit 1 Energy Guide label
		

Notes:

Mechanical Equipment: (HVAC Equipment additional) *If there are additional HVAC systems you can add photos of them here.*

HVAC Unit 3 photo	HVAC Unit 3 plate	HVAC Unit 3 Energy Guide label
		

Notes:

HVAC Unit 4 photo	HVAC Unit 4 plate	HVAC Unit 4 Energy Guide label
		

Notes:

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Mechanical Equipment: (Domestic Water Heater) *Include at least 2 photos of each water heater including data plates if able. If not, show system fuel and type. Include a photo of the Energy Guide label if present.*

DHW Unit 1 photo

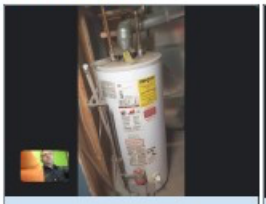
DHW Unit 1 plate

DHW Unit 1 Energy Guide label

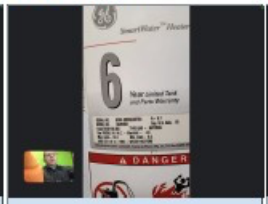
Notes:

If a 2nd unit exists:

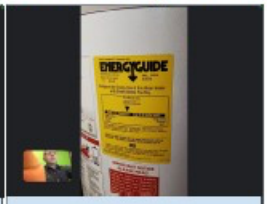
DHW Unit 2 photo



DHW Unit 2 plate



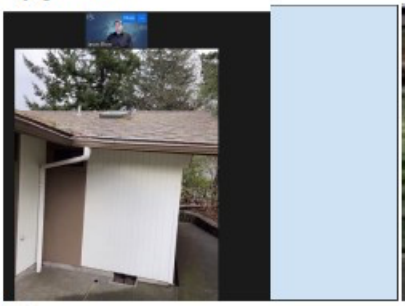
DHW Unit 2 Energy Guide label



Notes:

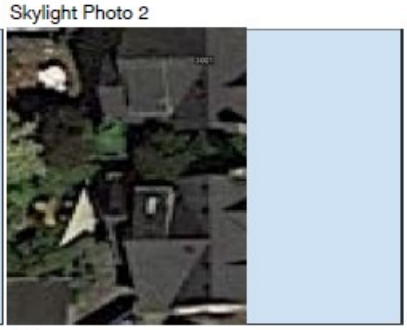
Walls & Envelope: (Skylights) *If present provide photos of skylights from inside house.*

Skylight Photo 1



Notes:

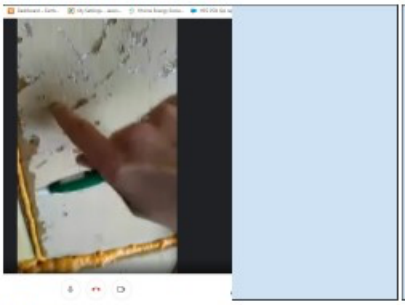
Skylight Photo 2



Notes:

Walls & Envelope: (Air-sealing) *Status of professional air sealing work through visual verification in attic/crawl space/basement where possible, or receipt of work done. If present, show evidence of spray foam/other appropriate sealant to seal building cavity penetrations.*

Air-sealing location 1:



Notes:

Air-sealing location 2:

Notes:

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Air-sealing location 3:

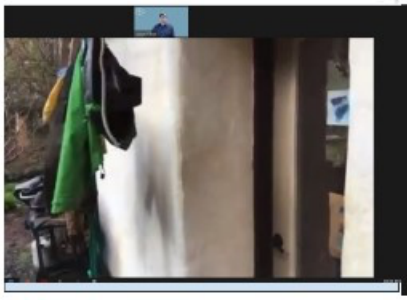
Notes:

Air-sealing location 4:

Notes:

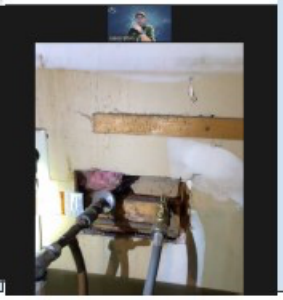
Walls & Envelope: (Wall Thickness) *If the wall(s) is/are not standard construction (2x4 or 2x6), include photo(s) of an exterior door jamb to show wall depth, with ruler included for scale.*

Wall thickness location 1 (Optional)



Notes:

Wall thickness location 2 (Optional)



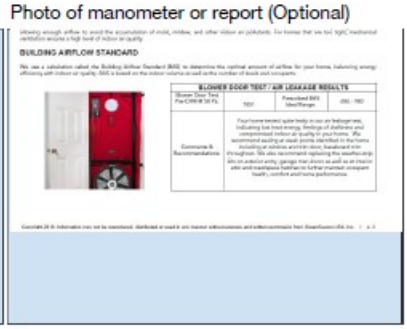
Notes:

Walls & Envelope: (Blower door) *Include photo of blower door reading or documentation if available.*

Photo of manometer or report (Optional)

Notes:

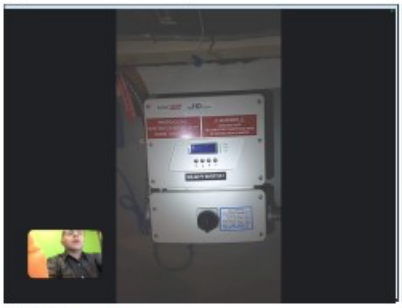
Photo of manometer or report (Optional)



Notes:

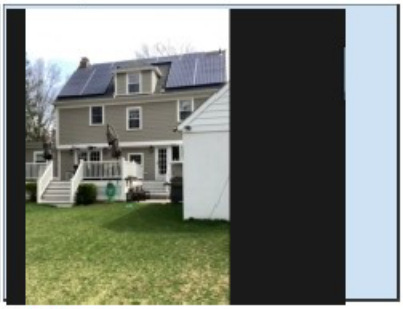
Other Items: (Solar) *If present document solar PV with photo of specification sheet and/or a photo the panels.*

Specification sheet or plate



Notes: Inverter

Photo of panels



Notes: Panels

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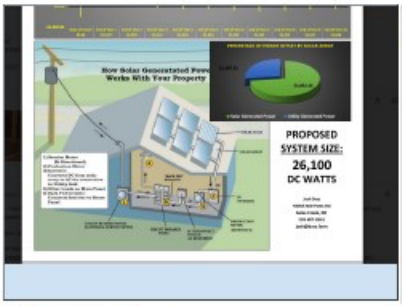
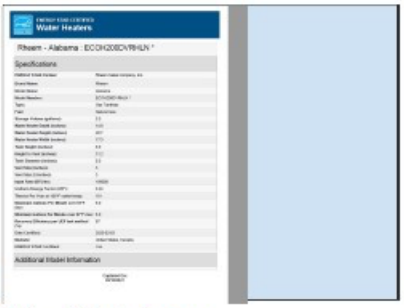
Other Items: (Certifications) *Green certifications or verifications achieved by the home where applicable. Include photo/scan of certificate or photo of sticker on electrical panel.*

Other Item 1



Notes: Solar Specs

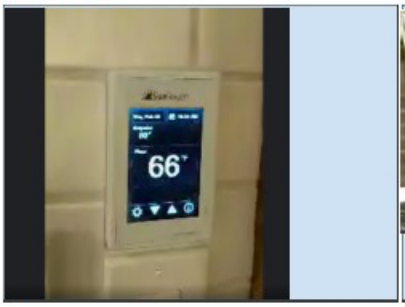
Other Item 2



Notes: Water heater specs

Other Items: (Anything outside the ordinary) *For example if the Assessor believes advanced wall framing techniques or higher than normal insulation levels exist, include photos that display wall depth at an exterior door.*

Other Photo 1:



Notes: electric radiant floor system in master bath

Other Photo 2:

Notes: Gas fireplace insert

This 3rd section shows examples of window dimensions entered and areas calculated for each side of the home. Windows dimensions were either estimated by the remote assessor or provide by the onsite individual.

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Cathedral Roof Calculator:

Rise	Run	Vaulted Room Area	Cathedral Area
4	11	400	425.6

Window Measurements

Width	Height	Number	Window Area	Side of Home
48	36	2	24.0	Front
40	50	3	52.1	Back
72	96	1	48.0	Back
15	20	3	06.3	Right
30	48	3	30.0	Right
36	48	2	24.0	Right
36	48	3	36.0	Left
24	24	2	08.0	Left
40	50	2	27.8	Left
			00.0	

Window Totals

Side of Home	Number of Windows	Total Area
Front	2	24
Back	4	100.1
Right	8	60.3
Left	7	71.8

This 4th section shows additional data points gathered during the remote video session during discussions with the onsite individual.

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Homeowner Motivation

Priority Motivator: Carbon Footprint Concerns
Secondary Motivator: Moisture Concerns
Third Motivator: Indoor Air Quality Issues

Appliances

Refrigerator: Standard
Range: Electric
Oven: Electric
Dishwasher: Standard
Clothes Washer: Standard
Dryer: Electric

Lighting

% LEDs or CFLs: 40%

Plug Loads

Are there other significant plug loads in the home?

Type 1: Hot Tub
Type 2: EV Charging
Type 3: Sauna
Type 4: Water Feature

Electric Panel

Capacity: 200
Unused Breakers: Yes

Solar Potential

Roof Age: 10
Roof Area: 300
Direction Facing: South
Shading: Minimal

Notes:
Good Solar Acces

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Ventilation

Exhaust Fan 1:	Bath Exhaust	Controls:	
Is it Functional:	Yes	Does it terminate Outdoors?	Yes
Exhaust Fan 2:	Continuous Exhaust	Controls:	
Is it Functional:	Yes	Does it terminate Outdoors?	Yes
Exhaust Fan 3:	Bath 2 Exhaust	Controls:	
Is it Functional:	No	Does it terminate Outdoors?	No
Exhaust Fan 4:	HRV	Controls:	
Is it Functional:	Yes	Does it terminate Outdoors?	Yes

Indoor Air Quality and Health and Safety

Are there IAQ or Health and Safety Issues? Yes

Type 1:	Combustion Issue	Type 2:	Particulates
Type 3:	Mold	Type 4:	Roof Leak
Type 5:	Moisture Concerns	Type 6:	

Notes:

Prior Retrofit Work

Is there evidence of prior retrofit work? Yes

Notes:

Appendix H: Example Homeowner Floor Sketch and Window Dimensions Form

Remote Assessment Documentation Section

Instructions:

Utilize this section to provide details about the home layout and the location of windows, heating, cooling, ducting and water heating equipment. You can also provide a photo of a floor plan.

Floor Plan: *Please make a basic sketch of each floor of the home with area sq ft. It does not need to be scale or very detailed. Please label the Front side of the home, which is typically the street address side. Note any areas of the home that are not conditioned, heated or cooled.*

Provide Space for entering Floor Plan

Floor Plan 2: (Optional)

Photo or Sketch of any Additional Conditioned floor areas not shown in floor plan.

Provide Space for entering any additional Floor Plan

Floor Plan: (Additional Info) *Fill in the standard (Figure 1) house diagram indicating placement of mechanical equipment and ducts as appropriate and whether or not each is in conditioned or unconditioned space.*

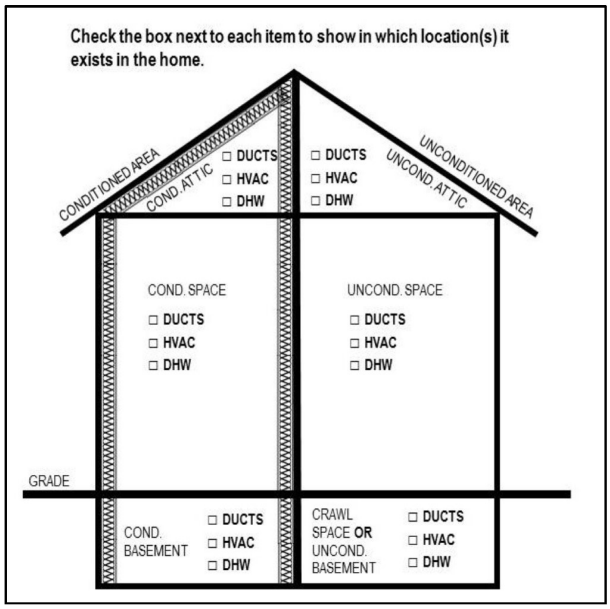

Figure 1. Standard House Diagram. Check off the equipment and duct locations in the home.