

Memorandum

To: Hanna Lee and Joan Wang, Bonneville Power Administration
From: Dulane Moran, Alicia Starkey, Courtney Dale, and Ethan Wilkes, Cadeo
Date: June 15, 2021
Subject: Task Order 33 Insulation Installer Survey and Supply Chain Interviews: Summary Memo

Summary

In 2020, Bonneville contracted with Cadeo to conduct research designed to inform updates to its Residential HVAC Market Model, which comprehensively estimates efficiency improvements from all factors that affect residential HVAC energy consumption, including building shell improvements obtained through insulation. The research presented in this memo provides new information on non-programmatic insulation activity based on secondary market data and primary data collection with the region's insulation supply chain.

The Northwest has a long history of weatherization programs that provide technical and financial support to improve the thermal performance of existing homes. To better estimate residential building shell improvements occurring outside of programs and to provide updated information on the insulation market overall, Bonneville and Cadeo (the research team) completed three main tasks:

- **Task 1** acquired the best possible information on the insulation market from existing secondary sources. As part of this task the team obtained region-wide estimates of insulation sales by application (wall, ceiling, and floor), insulation type (batts, blown-in, spray foam), and project trigger (new construction or retrofit) from third party data vendor Principia Consulting.¹
- **Task 2** focused on collecting information directly from market actors most closely involved with the installation of insulation in existing single-family homes in the Northwest. As part of this task the team developed a population frame covering the regional insulation supply chain (installers, wholesale/distribution entities, and manufacturers) and conducted interviews and surveys to obtain market insights and understand standard practice and market trends.
- **Task 3** combined data from Task 1 and Task 2 to develop quantitative inputs representing regional insulation activity in existing homes. These inputs will inform updates to the current Residential HVAC Market Model, expected to be completed in 2022.

The primary focus of this memo is to present the results of the Task 2 supply chain surveys and interviews. When appropriate to provide context, this memo references the region-wide insulation sales estimates obtained in Task 1, however results from Task 1 and Task 3 are documented in separate workbook deliverables and are not included in this memo.²

¹ The team refers to Principia analyses occasionally in this summary memo; however the purchase agreement prohibits sharing or publicly reporting detailed data analyses.

² The team prepared separate spreadsheets summarizing the cataloging results from Task 1 and the model inputs (Task 3) representing insulation market change during the analysis period (2016-2021).

Methodology

To complete Task 2 the team undertook several key activities designed to ensure robust coverage of the insulation market, including a statistically representative survey of regional insulation installers. As a first step, the team created a population frame of insulation professionals by combining several sources including a purchased list, publicly available program trade ally lists, insulation contractors registered with Construction Contractors Board (CCB), and web scraping to improve the representativeness of Idaho and Montana.³ Upstream contacts, those associated with wholesale distribution or manufacturing, were also identified in this process.

The team then prepared a data collection plan and sampling approach reflecting needs of the research and response rate expectations. Interviews with manufacturers and wholesale distribution contacts occurred in January 2021 and a survey of insulation contractors occurred in March and April of 2021.

Table 1. Data Sources and Objectives

Source	Coverage	Objectives
Secondary Market Data	Regional insulation sales in OR, WA, ID and MT	Obtain estimate of total regional insulation sales by home type (single family, multifamily, manufactured home) application (wall, ceiling, floor), type (batts, loose fill, spray foam) and installation trigger (new construction, retrofit).
Insulation Contractor Survey	61 regional insulation contractors	Obtain information about standard practice for insulation work in existing homes, including jobs and average square footage per job by application, standard approaches to estimating R-value, insulation removal, and target R-values. Obtain estimates on the portion of work occurring in efficiency programs and the portion associated with major renovations.
Supply Chain Interviews	4 wholesale/distributor contacts 4 manufacturer contacts	Obtain qualitative insight into market-wide trends, including their estimates of sales by application, portion of sales to contractors vs. homeowners, and the importance of energy-efficiency programs.

Market Insights and Implications

This section provides a cross-cutting summary of key findings and implications for regional programs, planning, or data collection. Subsequent sections provide more detail on methodology and results.

Key Finding 1: Market data indicate that new construction and associated code requirements are major drivers in the insulation market. Code requirements emerged as a major consideration of interviewed insulation manufacturers, who position their products as a solution to shell performance and air tightness requirements. Principia data indicate that new construction is associated with approximately three times the volume of insulation sold and installed in the region each year relative to existing homes. While the

³ See Appendix A for a detailed description of the population development steps.

installer survey focused specifically on the portion of work installers complete in existing homes, responses indicate R-value targets for existing homes that meet or exceed, code requirements established for new residential construction. For example, in attics, installers report striving to reach R-49, which is higher than some regional programs and at or above code for most of the region.

- **Implication:** Insulation retrofit projects are not required to meet residential new construction code and do not require a permit, creating uncertainty about standard practice in existing homes.⁴ Nevertheless, survey data provide evidence that insulation upgrades for existing homes are meeting or exceeding code established R-value expectations for new homes.

Key Finding 2: Survey data indicate that program/non-program insulation projects vary primarily in ancillary components like air sealing, venting, and some program quality control elements. The survey explored differences in program and non-program work from the perspective of the installers that do both. Among those reporting work in programs, about half (49%, or 22 of 45) reported no difference between program and non-program jobs, indicating that target R-values are similar. Those that reported differences acknowledged programs operate with set thresholds, such as requiring homes have existing insulation below a certain level in order to qualify for program subsidies. Weatherization programs may also require multiple applications (for example wall, ceiling or floor) and/or air sealing, duct sealing, or venting.

- **Implication:** While verifying the specific components that differ between program and non-program weatherization projects was outside the scope of this project, programs are likely providing value primarily in their additional requirements for air sealing, venting, and pre-project screening. Note that the residential HVAC market model update to be completed in 2022 will provide quantitative estimates of the amount of insulation market activity occurring outside of programs.

Key Finding 3: Major renovation projects, which are likely permitted and inspected for code compliance, may account for a substantial portion of the insulation work happening outside of programs. Principia's market-wide insulation sales estimates are categorized as new construction or "retrofit and renovation". The "retrofit and renovation" category includes a variety of projects ranging from weatherization-focused insulation installation to major residential alterations and additions that require a permit and are ultimately inspected by a code official. There is not a bright line definition for major renovations and there are several types of residential permits that can be triggered when a homeowner decides to add square footage, remove existing walls, convert unfinished space to livable space, or expand a home's footprint. Adding insulation to a home does not, on its own, require a permit, but these more comprehensive major renovation and alteration projects require code-compliant insulation levels. To understand the portion of insulation work associated with projects that would be driven by code requirements and inspected as part of larger projects, the research team asked installers about the portion of their work (outside of energy efficiency programs) associated with major renovation projects. Because a general contractor or the homeowner is typically responsible for pulling the permits on these projects (not the insulation installer), this question required installers to estimate the portion of their work that had required *someone* obtain a permit. Installers reported a weighted average of 41% of their work outside of programs was associated with these types of projects. Interestingly, 61% of contractors indicated that they are likely or very likely to insulate beyond the area of the home covered by the permit.

⁴ Major residential alterations and additions to existing homes and attic, basement, or garage conversions typically require a permit. These permits are generally focused on electrical, mechanical, and plumbing systems; however, the permit and inspection process will ensure that insulation meets residential code requirements. In no case does adding insulation alone require a permit or trigger residential code.

Implications

- The square footage of installed insulation beyond the area of the home covered by the permit is a grey area as it is not technically code-driven and may be eligible for program incentives. There may be an opportunity for weatherization programs to engage with these homeowners to expand insulation activity associated with major renovation and alteration projects beyond the area covered by the permit to completely insulate a home.
- There remains uncertainty around the total volume of insulation associated with major renovation and alteration projects and lack of clarity around what constitutes a major renovation project. The estimates provided by surveyed installers represent the portion of *their* work they believe is in this category but likely does not reflect the total volume as insulation could be installed by a general contractor or homeowner. This topic was not a primary focus of this research, and more work would be required to fully understand the energy savings associated with code-driven insulation for projects outside the purview of new construction.

Key Finding 4: Survey results updated assumptions and improved understanding about standard practice. The primary objective of the survey research included confirming or updating expected values for a variety of topics related to insulation standard practice (Table 2). This information is important for calculating inputs for the Residential HVAC Market Model, as it enables the team to convert market-wide estimates of insulation sales in pounds to estimates of fully weatherized homes.

Survey results:

- Confirmed expected values for insulation thickness and target R-value of floor insulation.
- Indicated higher target R-values for attics and walls than the thresholds established by the Regional Technical Forum.
- Allowed the team to update conservative placeholder assumptions about the portion of insulation removed prior to new insulation being installed. This increased the starting R-value estimated for all retrofit projects, which means it takes less insulation volume to achieve targeted R-value than it would if all insulation were removed first.⁵ Prior to obtaining these results, the team had assumed that all existing insulation would be removed. Installers most commonly removed insulation in existing floors. In instances where existing insulation is removed, installers indicated it is typically because of damage caused by water or rodents, wiring or plumbing repairs, or failure of the existing insulation (hanging, falling, or improper original installation).

Table 2: Standard Practice: Previous Estimates vs. Survey Results

Topic	Application	Previous Estimate	Survey Results*
Portion of existing insulation removed prior to installation	Attic	100%	21%
	Walls		8%
	Floor		44%
Starting R-value (accounting for removal)	Attic	R-0 (no insulation, remaining prior to installation)	R-17
	Walls		R-7
	Floor		R-15

⁵ Starting R-value is calculated based on installer reported removal practices. The starting R-value is zero when insulation is removed. For the portion of work in which insulation is not removed, the team applied the average existing insulation R-value.

Topic	Application	Previous Estimate	Survey Results*
Target R-value	Attic	R-38	R-48
	Walls	R-11	R-19
	Floor	R-30	R-30
Insulation thickness	Attic	15"	16"
	Walls	5"	5"
	Floor	8"	10"

*Weighted to adjust for surveyed installer's total insulation installation square footage by application

Detailed Findings

This remainder of this document includes the following sections:

- A summary of the installer survey findings and a discussion of application specific findings.
- The perspectives of manufacturers and distributors, as obtained from in-depth interviews.
- An updated insulation product flow map.
- Appendices that provide more detail on population frame development and the sources that informed the secondary market data review.

Installer Survey

Research topics for insulation installers centered on collecting information about standard practice in insulation work as well as "typical" projects by application (attic, walls, and floor). For the full survey instrument, see Appendix B. Survey questions explored:

- The portion of insulation jobs that include each application (wall, ceiling, floor).
- The portion of insulation jobs associated with energy efficiency and low income weatherization programs.
- For installers that complete both program-affiliated and non-program projects, any common differences in typical project attributes.
- The portion of their insulation work occurring in major retrofit or renovation projects.
- Standard approaches to assessing and implementing work for each application (wall, ceiling, floor), including:
 - Removal practices for existing insulation.
 - How installers estimate existing R-value.
 - Typical existing R-value installers found in existing homes.
 - Typical R-value targeted for new insulation.
 - Any rules of thumb on thickness of newly installed insulation.

Survey Fielding

Developing a comprehensive contact list for the market required merging several sources, reviewing them for relevance and quality, and removing duplicates. For more detail on the sources and process, and for a more detailed disposition, see Appendix A.

The full survey launched in February 2021 and concluded in April 2021, with outreach occurring by phone. If respondents requested to complete the survey via email, the team provided a link electronically and followed up to encourage completion. Ultimately, this effort resulted in 61 completes (including two partial completes), yielding in a final response rate of 17%.

Survey respondents spanned the region and resulted in completes that largely matched the installer population frame, obtaining solid representation from Idaho and Montana.

Table 3: Survey Completes and Population Distribution

State	% Northwest Resident Population	% Installer Population Frame	% Installer Survey Completes
Idaho	12%	11%	16% (10)
Montana	7%	13%	13% (8)
Oregon	29%	34%	33% (20)
Washington	52%	41%	38% (23)

Weighting and Imputation

The research team used these survey data to build upon the secondary market data obtained in Task 1 and calculate inputs for BPA’s residential HVAC market model. The model inputs required weighting of several work volume variables to reflect the relative volume of non-programmatic insulation work reported by each firm.

To better reflect real-world differences in installer sizes and practices, the analysis team weighted survey data by the participants’ 2019 installed square footage in existing homes, as reported by insulation application (walls, floors, and attics). Each survey participant estimated the number of jobs conducted each year, and the average size of those jobs in each application. The team multiplied the average job size by the number of jobs to estimate the 2019 existing-home installed square footage. In cases where a respondent did not report an average per-job square footage, the analysis team imputed data by using the median job size within the application – assuming that job sizes for the missing respondents would be similar to that of a “typical” installer.

The team applied the derived weights to calculate the following values:

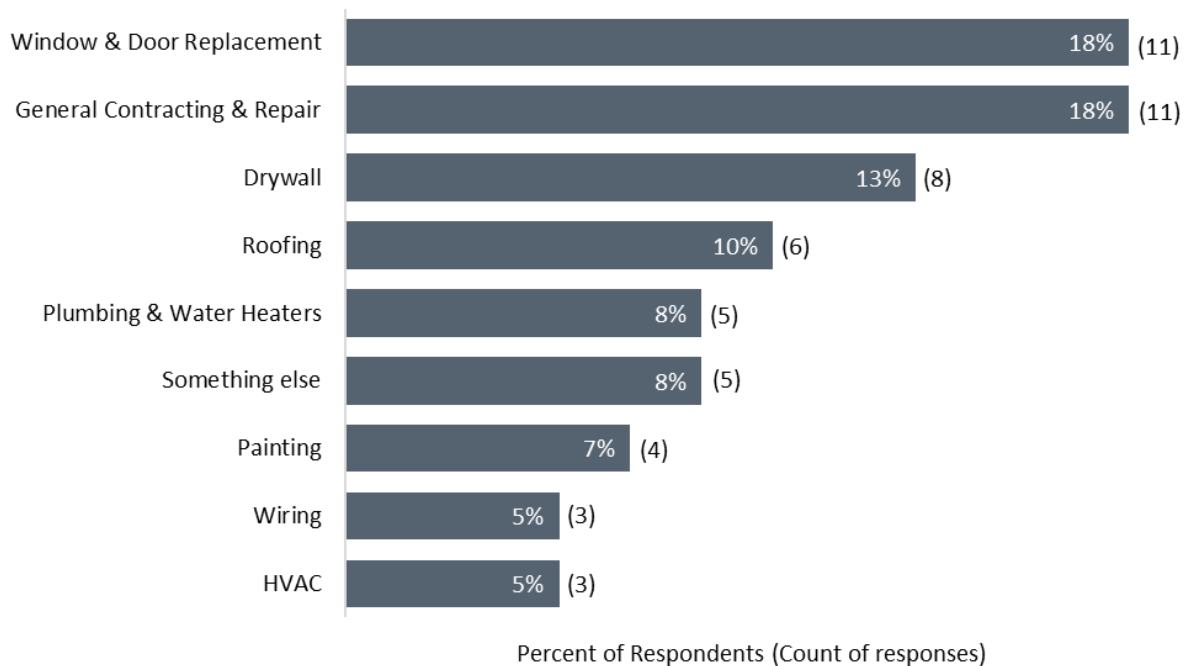
- Average starting insulation R-value
- Average target insulation R-value
- The average portion of projects existing insulation is removed
- Target insulation thickness

The team also adjusted two survey responses that were not segmented by insulation application – the percentage of work associated with an efficiency program and the percentage of work in renovations and additions (versus retrofits). In these two cases, the team weighted responses by each respondent’s sum of attic, floor, and wall square footage reported by year.

Characteristics of Surveyed Firms

The survey reached a substantial number of local insulation firms, with 78% of installers (46 of 59 reporting) indicating their firm had only one location in the Northwest and operated a median of four trucks. While all respondents reported that their firm provided insulation services in existing homes (a qualifying condition for continuing the survey) installers also reported their firms offer a variety of other services in addition to insulation. **Figure 1** shows the additional services provided with the “something else” category including audits and siding replacement.

Figure 1. Other Services Provided (Multiple Responses Allowed; 61 respondents)



Note: Percentages may total more than 100%, as respondents were able to choose more than one type.

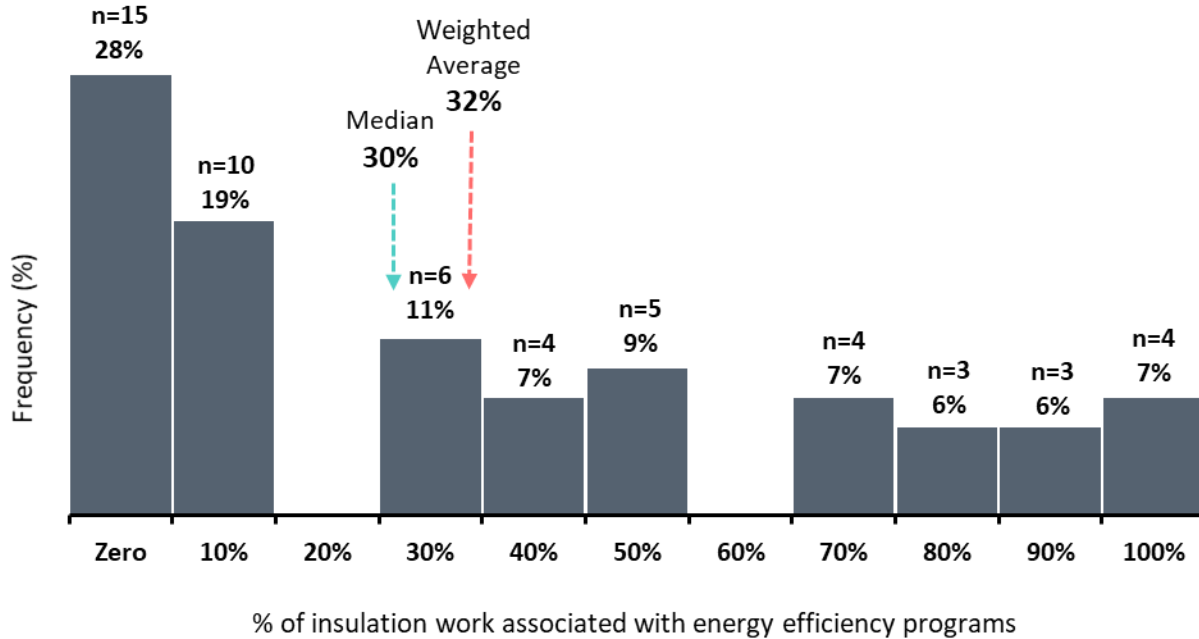
The team sought to understand the prevalence of air sealing services provided by insulation firms. Eighty percent of installers (47 of 59) reported provide air sealing services. Of those, installers report sealing up common leaks with spray foam prior to insulation work at about 85% of insulation jobs, using infrared cameras at about 15% of jobs, and conducting blower door tests at 16% of homes.

Program Versus Non-Program-Associated Work

The research team asked installers about their work affiliated with energy efficiency programs, both to understand how common it was for insulation professionals to be engaged with programs and to explore any differences between program and non-program work. Installers reported a weighted average of 34% of their insulation work in existing homes was affiliated with an energy efficiency program.⁶ Responses indicate that this market skews away from programs. Forty seven percent of respondents reported doing 10% or less of their work in programs while only 25% report that more than half of their work is in programs.

⁶ Defined as a situation where a homeowner or contractor receives a subsidy or other encouragement to complete home upgrades, including low-income programs.

Figure 2: Installer-Reported Portion of Energy Efficiency Program Work (54 Respondents)



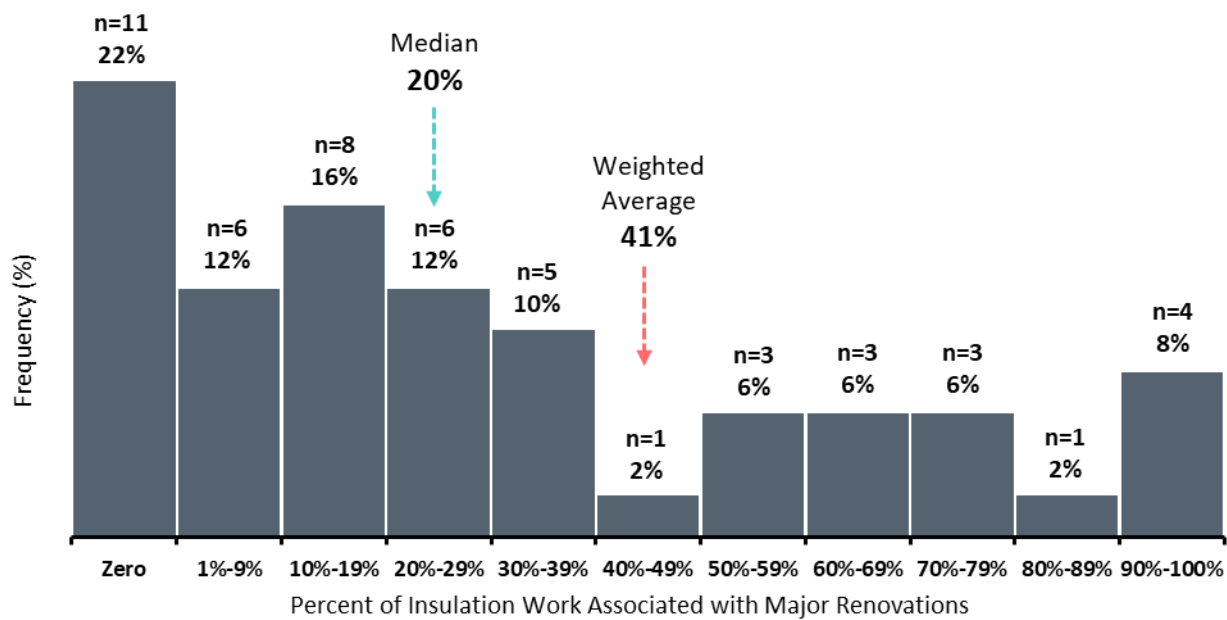
The team asked installers reporting any work (non-zero) in programs if program-affiliated projects differed from projects installed outside of programs. Of the 45 respondents able to answer, about half (49%, or 22 of 45) reported no difference and 18% reported that they weren't sure about a difference (8 of 45). The team found no statistically discernable relationship between those with a higher or lower percent of energy efficiency program work and their perspective on how program work differs from typical insulation work. Among those reporting a difference between program affiliated jobs and non-program affiliated (n=15), the most common reasons referred to requirements for specific qualifying conditions – homes must have insulation *below* a certain level to qualify for the program and then must have insulation *at or above* a specific level after work was completed. Their responses also referenced other program requirements, such as having to complete multiple measures (i.e., duct sealing, or multiple applications, venting, air sealing). Several simply mentioned that programs allowed them to provide incentives. None of their descriptions indicated that they installed different levels of insulation in non-program homes (though the survey did not ask respondents to go through detailed application-based comparisons of program and non-program work).

Major Renovations and Alterations

One area of continued uncertainty is the volume of insulation being installed in major renovations or alterations (projects that would require a permit and typically be inspected to ensure code compliance). Major renovations and alterations are distinct from retrofit projects associated with weatherization objectives, in that major renovation projects typically require a permit and inspection upon completion by a code official. There is not a bright line definition for major renovations and there are several types of residential permits that can be triggered when a homeowner decides to add square footage, remove existing walls, convert unfinished space to livable space, or expand a home's footprint. Adding insulation to a home does not, on its own, require a permit, but these more comprehensive major renovation and alteration projects require code-compliant insulation levels. The research team asked installers about the portion of their work outside of programs associated with these major renovation projects. Because a general contractor or the homeowner is typically responsible for pulling the permits on these projects (not the insulation installer), this

question required installers to estimate the portion of their work that had required *someone* obtain a permit. Fifty-one respondents provided an estimate, ranging from zero to 100% of their work. Weighted by the total square footage of insulation each firm completed, 41% of non-program work was in renovations and additions.

Figure 3: Percent of Insulation Work Associated with Renovations or Alterations (51 respondents)



Application-Specific Findings

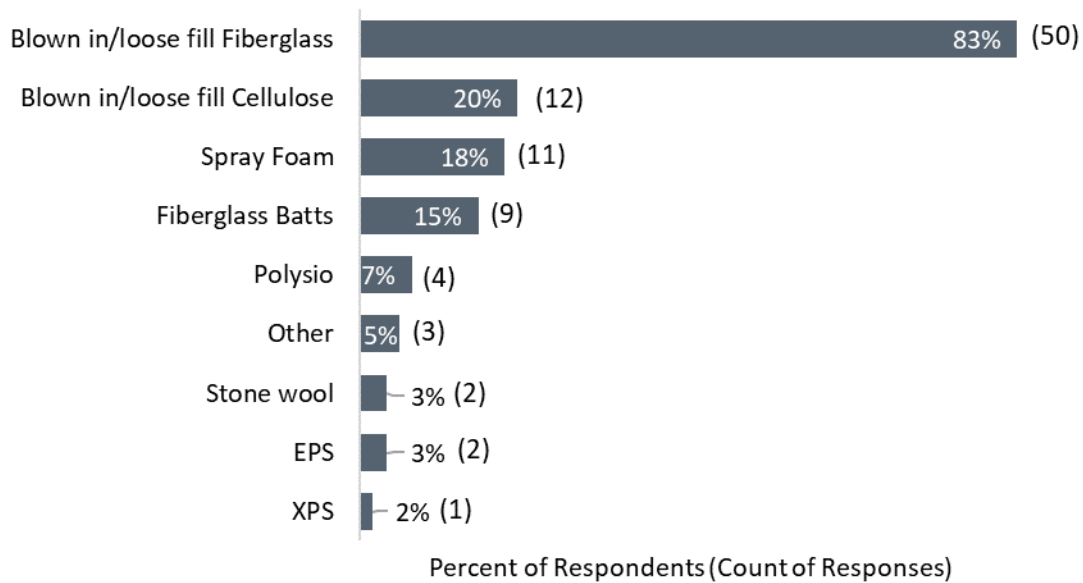
Principia data indicate substantially more insulation is installed in attics in existing homes than in walls or floors. Survey data from professional installers indicate more balance among applications. This discrepancy is likely explained by the large quantity of fiberglass installation in attics reported in the Principia data, which is not installed by insulation contractors but by homeowners, handymen, or similar. These smallish, dispersed projects are not measurable from the installer survey data. The sections below provide a more detailed discussion of application-specific findings.

Attics

Installers reported a typical attic insulation job is about 1,520 square feet on average. Surveyed installers completed an average of 143 non-program attic insulation jobs in existing homes in 2019. The total amount insulation each firm installed in attics in 2019 averaged 215,990 sqft (median 80,000 sqft).⁷ Installers reported using primarily blown-in fiberglass for attic insulation products, followed somewhat distantly by blown-in cellulose. Principia, by contrast, indicates that fiberglass batts and rolls are the most commonly used for attic insulation. The difference in reported product choice by these professionals could indicate that sales to homeowners, handymen, or general contractors (who are unlikely to have the trucks and blowing equipment required to apply blown-in materials) involve different material choices.

⁷ Estimated by multiplying the number of attic jobs by typical sqft of attic jobs for each firm and then averaging across firms to get mean total sqft.

Figure 4. Insulation Type Typically Used for Attic or Ceiling Projects
(Multiple Responses Allowed; 60 Respondents)



Note: Percentages may total more than 100%, as respondents were able to choose more than one type.

Installers selecting more than one type of insulation provided an explanation for when they would choose a different product. The most common reason installers choose a different insulation type is when a customer requests a specific type. In open ended comments, several installers mentioned that some customers perceive products like cellulose to be more sustainable. Installers also mentioned that they choose a different product when there are space constraints in an attic and another product provides a higher R-value per inch.

Installers find a range of existing R-values (from R-5 to R-38) in attic spaces prior to beginning a project. Existing R-values are estimated by measuring the depth of the insulation (with a ruler or tape measure) and accounting for the type of insulation previously used. About 21% of insulation is removed before beginning attic projects. In these scenarios, installers most frequently mentioned removing insulation when the material is damaged (from pests, water infiltration or other damage) or when other upgrades need to be completed (most commonly wiring).

When completing attic projects, installers target R-values between R-21 to R-60 with an average thickness of 16 inches, depending on the type of insulation used. [Figure 5-Figure 7](#) display the typical R-value found at project initiation, the R-value after insulation is removed, and the final targeted R-value as reported by installers.

Figure 5. Existing R-Value: Attics

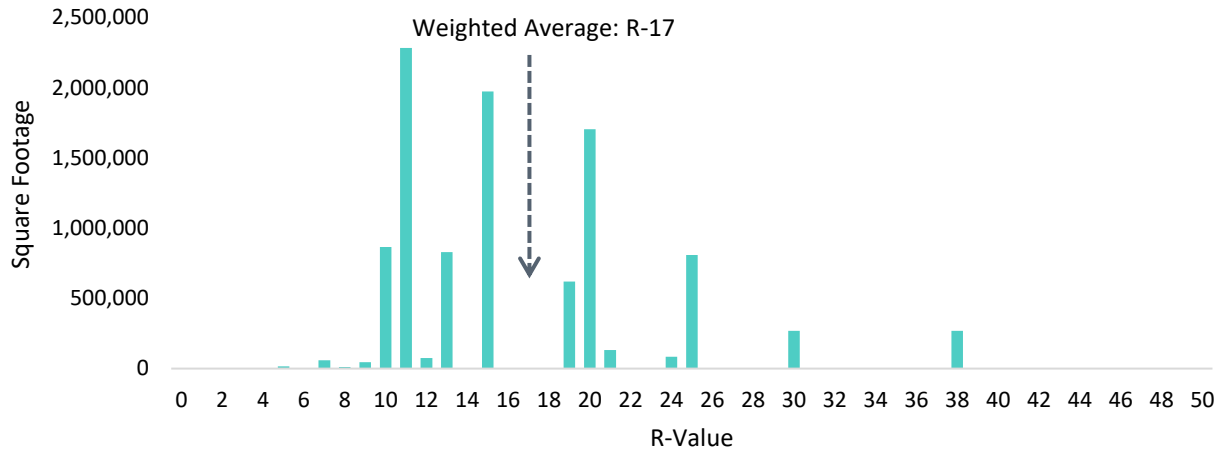


Figure 6. Calculated R-Value After Removal: Attics⁸

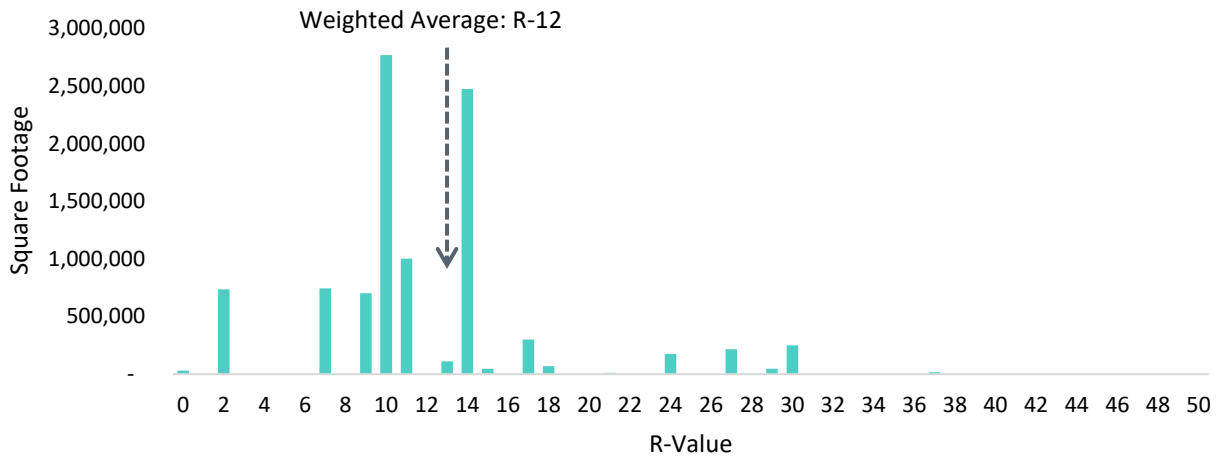
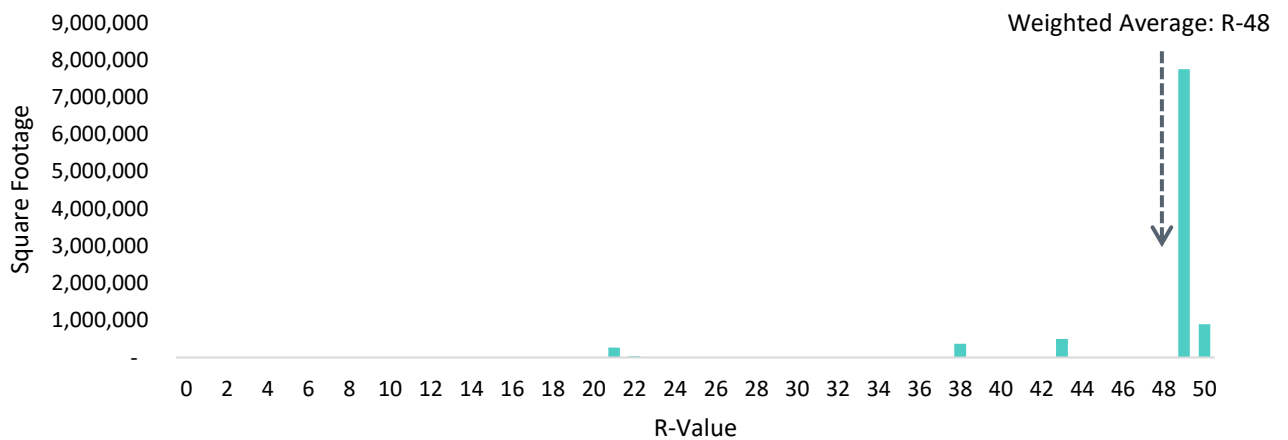


Figure 7. Target R-Value at Project Completion: Attics*

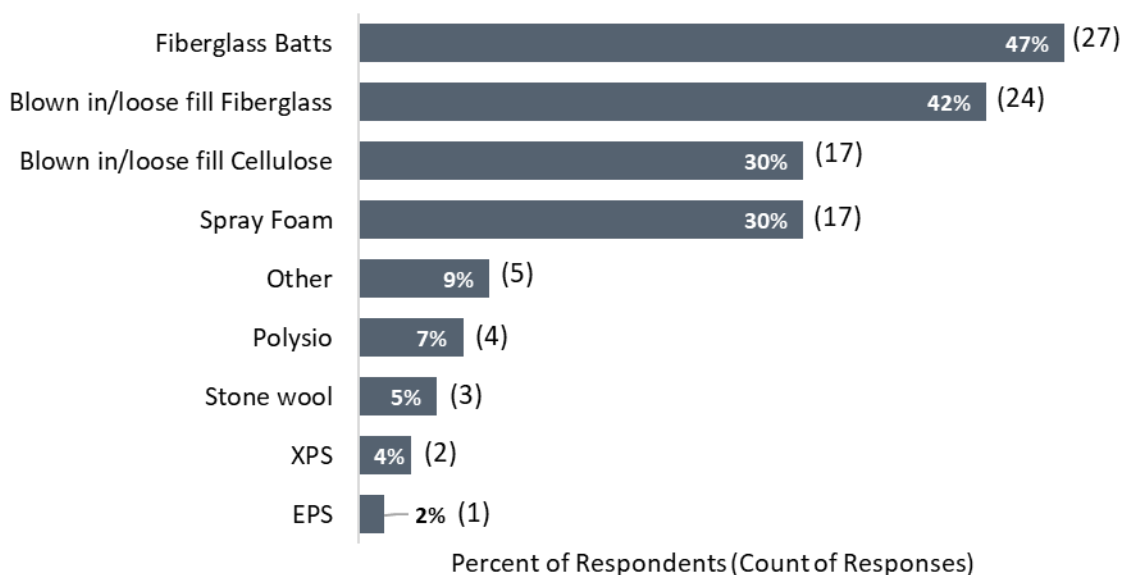


*Note: A small number of responses indicated a target of R-60.

Walls

For those who do wall insulation (n=48), the number of non-program wall jobs completed in 2019 averaged 95 projects. Installers reported wall projects being approximately 1,675 square feet on average. Overall, the total wall insulation installed per installer in 2019 was 145,194 sqft on average (median 38,000 sqft).⁹ When asked about the wall insulation type they typically use, installers were fairly split between blown-in or loose fill fiberglass (42% of respondents) and fiberglass batts (47% of respondents) insulation types; however, blown in cellulose and spray foam were also frequently used (Figure 8).

Figure 8. Insulation Type Typically Used for Wall Projects
(Multiple Responses Allowed; 57 Respondents)



Note: Percentages may total more than 100%, as respondents were able to choose more than one type.

Many installers stated that they do not use any other insulation type. In instances where installers selected more than one insulation type (n=22), the survey followed up to confirm the most common type they use (single response only). Of those who chose more than one insulation type, 46% use fiberglass batts or rolls as the most common second choice and 32% said they use blown in fiberglass. These choices likely reflect the share of projects with open wall cavities (typically 2X6 construction) compared to closed (typically 2X4 construction). In open ended survey comments, installers noted that they would use blown in insulation for wall cavities with 2x4 studs and batted insulation for 2x6 studs. Walls in homes built prior to the late 1970s were likely to be built with 4-inch studs and uninsulated, as they were built prior to building code requiring a 6-inch wall. These older homes are common target of insulation retrofit projects and are most cost-effective when loose fill insulation is blown in through small holes rather than removing large sections of interior or exterior wall finishing in order to install batts. Six-inch walls are mostly likely to be associated with newer

⁸ The calculated R-value after removal is a calculated value. The team used a starting R value of zero when insulation is removed and the average existing insulation R-value otherwise.

⁹ Estimated by multiplying the number of wall jobs by typical sqft of wall jobs for each firm and then averaging across firms to get mean total sqft.

construction, additions, or major remodels, in which case fiberglass batts are likely.¹⁰ Installers will also choose a different insulation when their customer requests a certain type.

Installers reported target R-values between R-11 to R-26 when completing projects with an average thickness of five inches, depending on the type of insulation used or wall cavity dimensions. The wide range reflects different wall cavity depths and the range of possible R-values for different insulation products. At the minimum, fiberglass batts or loose fill adds an R-11 to a four-inch wall. Spray foam in a six-inch wall cavity adds an R-26. This is consistent with BPA's weatherization specifications and wall insulation measures.

To estimate the R-value of the existing insulation, installers most commonly measure the thickness of the existing insulation in the wall stud cavity (either 2x4 construction or 2x6). The research team did not ask installers to estimate the share of wall jobs by cavity depth and entered the midpoint between the estimates as the response. As is visible in [Figure 9](#), the distribution of existing R-values is bifurcated, with a substantial number of R-0 walls and a substantial number of walls with R-8 or greater. Installers report removing approximately 8% of existing wall insulation prior to installing new insulation, typically when it is damaged (from moisture, animals, or other deterioration) or during a remodeling project. The R-value after removal is a calculated value. The team used a starting R-value of zero when insulation is removed and the average existing insulation R-value otherwise. After removing the insulation, the adjusted R-value for walls is R-6 ([Figure 10](#)).

¹⁰ Some remodels remove wall finishes but do not add depth to the 4-inch walls. These are likely to receive an R-11 batt.

Figure 9. Existing R-Value: Walls

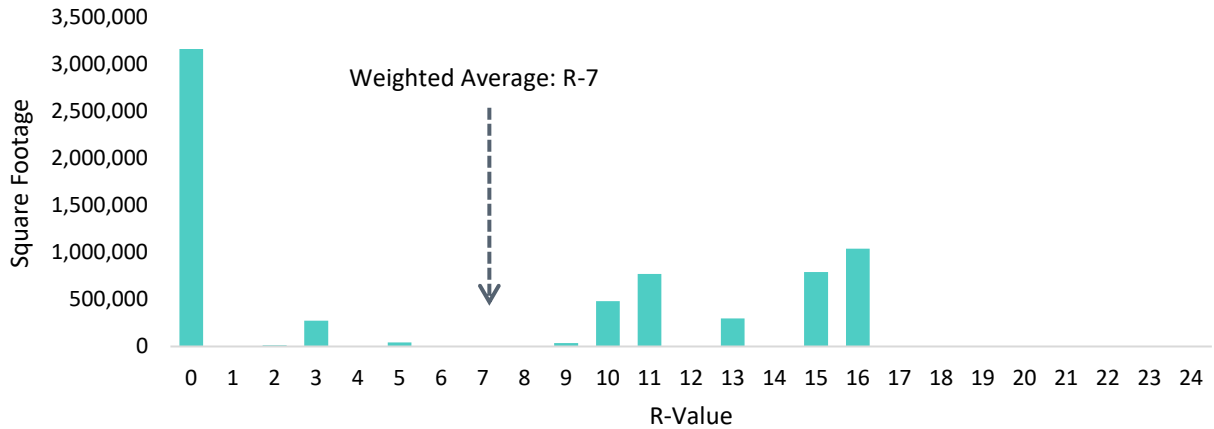


Figure 10. Calculated R-Value After Removal: Walls

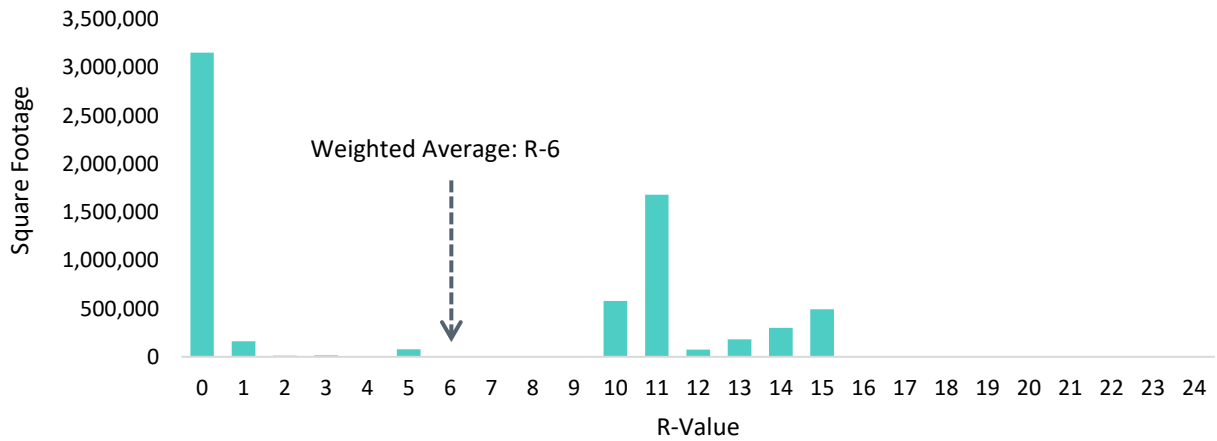
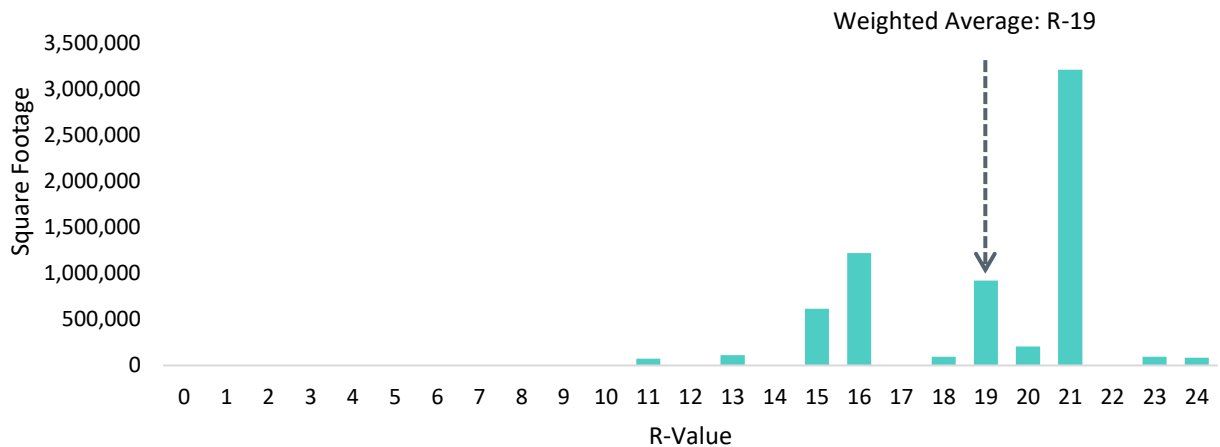


Figure 11. Target R-Value at Project Completion: Walls

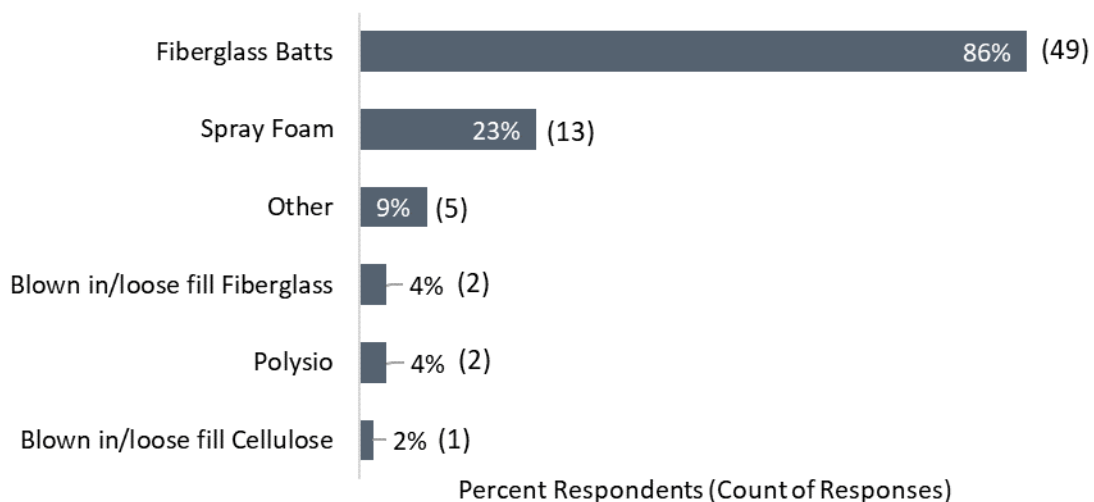


Floors

Floor insulation projects ranged from 500 to 7,000 square feet, with an average of 1,557 square feet. Surveyed installers reported completing an average of 123 floor insulation jobs in 2019 in existing homes. The total insulation installed in floors in 2019 averaged about 186,744 sqft (median 91,250 sqft).¹¹

As seen in Figure 12, 86% of installers reported using fiberglass batts in floor projects followed distantly by spray foam (23%). Installers frequently report choosing a different insulation when requested to by a customer (n=14); however, several installers remarked they don't use any other type of insulation for floors (n=10).

Figure 12: Insulation Type Typically Used for Floor or Crawlspace
(Multiple Responses Allowed; 57 Respondents)



Note: Percentages may total more than 100%, as respondents were able to choose more than one type.

By measuring the depth of the insulation, installers find R-values ranging from R-0 to R-38 in floor spaces prior to beginning a project. Installers report removing 44% of existing floor insulation before installing new insulation. The rate of removal is reportedly higher for floor insulation projects compared to walls or attics, reflecting the prevalence of deterioration in insulation under floors—most commonly from animals, water, or performance failure. Installers target R-values between R-15 to R-38 when completing projects with an average thickness of 10 inches.

Like walls, BPA's weatherization specifications require installers to completely fill floor cavities, using sufficient supports to ensure that insulation doesn't sag away from the sub-floor. BPA's measures require, at a minimum, the final R-value is the product of the least-insulating product installed to the full depth of the cavity. An installer targeting R-19 or R-25¹² is likely insulating 6-inch floor cavities, while installers that target R-30 may more commonly insulate 8-inch or deeper floor cavities.

¹¹ Estimated by multiplying the number of floor jobs by typical sqft of floor jobs for each firm and then averaging across firms to get mean total sqft.

¹² A range is possible in floor insulation because there is no penalty for "overstuffing" a floor cavity. Walls might see damage resulting from such installation practices.

Figure 13. Existing R-Value: Floors

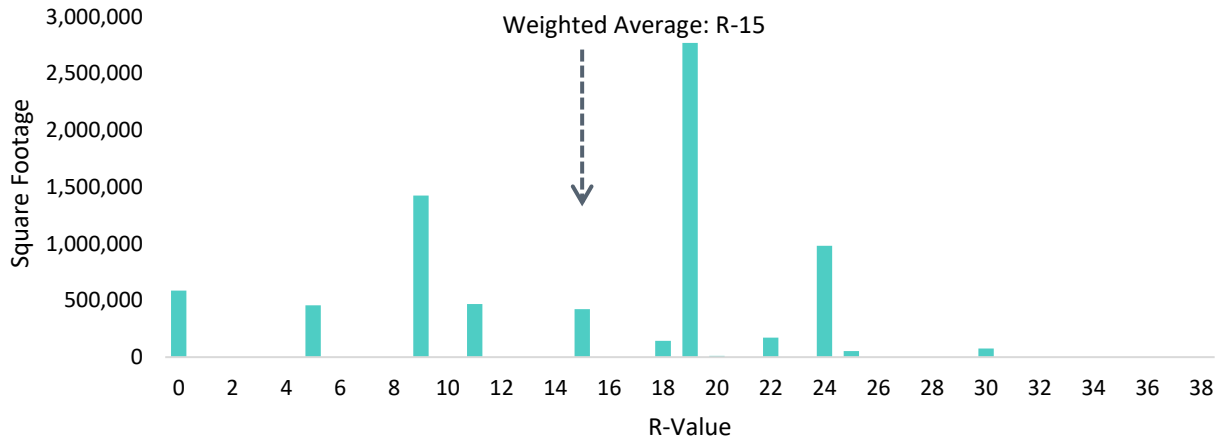


Figure 14. Calculated R-Value After Removal: Floors

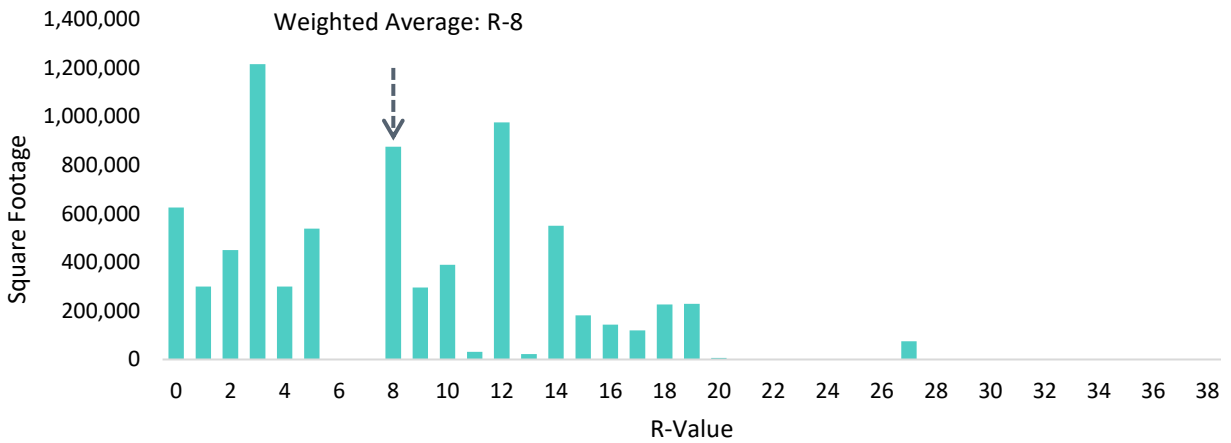
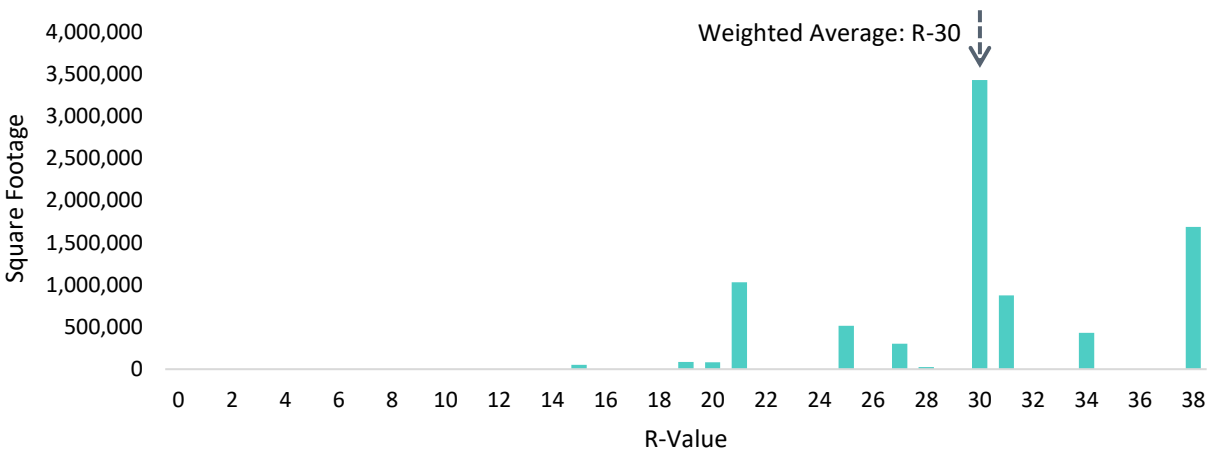


Figure 15. Target R-Value at Project Completion: Floors



Supply Chain Interviews

Research topics for the supply chain interviews, which included four manufacturers and four retail/wholesale distributors, were designed to provide insight into broader market activity, as these contacts would be expected to view trends at a different scale than individual installation firms. While the team did not expect that manufacturers and distributors would have good visibility into local sales drivers, the interviews explored some of these topics to confirm/disconfirm that hypothesis. Discussion topics included:

- Their estimate of the portion of insulation sold and installed by application in existing homes.
- The portion of sales to contractors vs. homeowners, or for manufacturers the portion sold through distribution vs. retail/wholesale sales.
- Their perspectives on the effect of efficiency programs and how that has changed over time.
- Their perceptions of overall sales trends.

At a high level, interviewees were knowledgeable about the composition of their customers and the major market drivers for the products they sell. However, they were less knowledgeable about what customers did with products after the point of purchase. Insulation manufacturers and distributors primarily sell to trade professionals who are experts in their fields and do not require support at the point of sale.

Manufacturer Perspective

The team interviewed four insulation manufacturers to investigate their perspectives of market trends for insulation products. Consistent with Principia market-wide estimates, manufacturers emphasized the impact of the new construction market as a driver for sales and described installation standard practices that were generally suited to new construction rather than retrofits. Manufacturers could offer only a general sense of the residential share of insulation and the main drivers of sales. They were unable to estimate the effect of efficiency programs, typical field installation practices (beyond manufacturer recommended best practices), or the share of insulation installed in specific building components (attics, floors, or walls).

Insulation Market Characteristics

Manufacturer respondents estimated that between 50% and 65% of insulation is installed in residential buildings (Table 4).¹³ However, they were unable to break sales into specific building components beyond describing the products that are appropriate in various applications (such as blown-in for attics or batts for walls). Each manufacturer described unique pathways to market for their products. The majority of fiberglass insulation is sent from the manufacturer to a regional distributor, with the remaining amount going into retail. Products that require specialized equipment or installation training such as spray foam and rockwool typically are shipped directly to installers.

¹³ One contact manufactured panel building products (such as acoustical tiles), which includes insulated building components. The interview confirmed the research team's hypothesis that few of these products are installed in single family residential buildings.

Table 4. Manufacturer Estimates of Insulation Market

Manufacturer Type	Share of Sales to Residential	Market Pathway
Mineral/Stone/Rockwool Insulation Manufacturer	50-60%	75% to installers 25% to distributors
Fiberglass Insulation Manufacturer	65%	Majority to distributors Remainder to retail
Spray Foam Insulation Manufacturer	65%	75% to installers 25% to certified distributors ¹⁴
Panel Building Products Manufacturer	2%-5%	75% to retail 15% to installers 10% to distribution

Residential Retrofit Market Drivers

Manufacturers were asked to describe drivers of their sales. Manufacturers typically identified new construction as the primary driver in the residential market (Table 5) and described the effect of changing building codes and installation practices consistent with new construction best practices for the products they manufacture.¹⁵ As an example of both of these trends, the spray foam manufacturer responded to a question on the impact of energy efficiency programs by describing the benefit of their product toward meeting building codes: increasing R-value

"[Efficiency programs] would really come in to play in the codes, which require an airtight home...It's a pretty major driver" -Spray Foam Manufacturer

requirements and emerging air tightness requirements have increased adoption for spray foam products in new construction while retrofit applications remain expensive and more technically complicated. Respondents also provided interesting feedback on other drivers, often highlighting unique features of their product, including non-energy benefits, air tightness, and moisture control for the Northwest's mixed-humid climate.

Of the manufacturers interviewed, the fiberglass manufacturer representative had the most experience with utility programs in the Northwest. He described a burst of program activity related to ARRA funding from 2009 to 2015, which supported a growth in low-income weatherization and home-performance-focused programs in the Northwest.¹⁶

¹⁴ Spray foam requires highly specialized equipment operated by trained installers, which affects the market path for this product.

¹⁵ The one exception came from an insulation manufacturer firm representative that had previously worked for a utility energy efficiency program implementer.

¹⁶ Home Performance with Energy Star is a DOE-supported standard for testing the energy use and issues affecting the health and safety of a home <https://www.energy.gov/eere/buildings/home-performance-energy-star>.

Table 5. Manufacturer Responses to Insulation Market Drivers

Manufacturer Type	New Construction out of Residential Sales	Role of Efficiency Programs on Sales	Renovations and Additions	Other Drivers
Mineral/Stone/Rockwool Insulation Manufacturer	60%	Not a driver	Not common	Building owners – Sound dampening, chemical off-gassing Builders – Meeting code at minimum cost
Fiberglass Insulation Manufacturer	Majority of sales	Decreased since ARRA high point	Similar market to insulation retrofits	Evolving building code
Spray Foam Insulation Manufacturer	80%	Codes are a bigger driver of sales	10% of residential sales	Building code, such as WA air tightness requirement
Panel Building Products Manufacturer	100% New Construction or Renovation	Not very common, products are applicable to new construction	Half of residential sales, typically multifamily	Increasing multifamily new construction Engineered panel products can be designed for durability in the Northwest’s mixed-humid climate, like managing condensation in a building cavity

Installation Practices

Manufacturer responses regarding installation practices were specific to the insulation products that are represented by the respondent and again reflected new construction. For example, the spray foam manufacturer described installation practices that reflect new construction or major remodel activities because that product is most effective and cost competitive with open building cavities. In retrofit activities, they universally recommended removing any existing insulation that would reduce performance and adherence of the foam. Fiberglass supply chain actors claimed that fiberglass batts were the ideal products for wall insulation, indicating a focus on new construction or major remodels (as batts are easiest to install when one can access the framing). Similarly, all respondents recited building code requirements when asked about typical or recommended R-value installation or depth.

Distributor Perspective

The research team also sought input and insight from distributors, completing interviews with four regional distributors of insulation products. Distributors typically work directly with building and trades professionals. These customers have expertise in technical aspects of installing insulation, energy efficiency program requirements, and building codes.

Perhaps reflecting this, distributors were unable to provide substantial insight into main drivers of insulation sales for existing homes, the types of buildings in which insulation is installed, and the share of insulation applied to different building components.

"There's no way to know [if what portion of insulation sales goes into new construction or retrofit]. Contractors could be putting in one order for 10 jobs... I really couldn't tell you. When someone comes in to buy a product, there's really no way to know where they take it."

-Fiberglass Insulation Distributor

Distributor Sales Characteristics

The majority of sales from an insulation distributor go directly to contractors, with a small remainder going to homeowners. Distributors of fiberglass products reported some interaction with homeowners as customers, although these transactions were rare. Spray foam distributors typically work directly with contractors because their products can only be installed with significant training and expensive equipment.

When asked about how their sales are typically allocated across applications, three of the four distributors described percentages that reflect the typical allocation for new construction projects (~50 walls, 25% attics, and 25% floors).¹⁷ Retrofit projects typically favor attic installation over walls and floors, as it is the most accessible area of the home.

Residential Market Drivers

Like the manufacturer firm representatives, the interviewed distributors defaulted to residential new construction building energy code when asked about the impact of efficiency programs. For example, when asked about the impact of energy efficiency programs, one distributor mentioned that manufacturers were not producing cost-competitive fiberglass products to meet Oregon's building code requirement of R-23 insulation in the walls, and that inconsistent code enforcement meant this efficiency opportunity was frequently neglected. Another reported spray foam insulation was becoming more common to comply with Washington air leakage codes requirements.

Distributors tended to minimize the effect of efficiency programs and considered codes required for new construction as the most significant driver of both sales volume and installation practices as described in [Table 6](#). This finding is consistent with analysis of Principia data indicating that new construction sales are approximately three times retrofit and renovation.

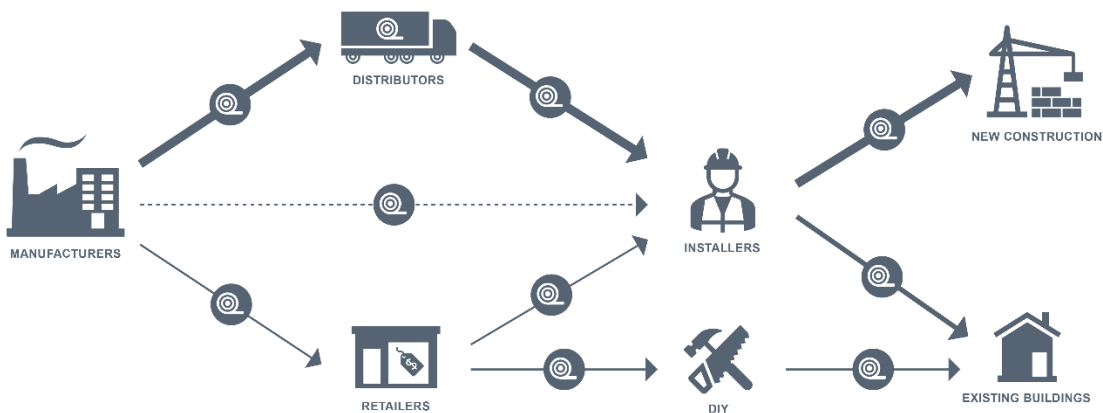
¹⁷ In the Northwest, newly built homes are more frequently double story homes than those that are candidates for insulation retrofits. This means the walls have greater square footage than the attics and floors. In older homes (often ranch homes), the attic and floor square footage tends to be greater than the wall square footage.

Table 6. Distributor Insulation Market Drivers

Distributor Firm	New Construction out of Residential Sales	Share of Sales to Retrofit & Additions	Share of Sales Associated with Efficiency Programs	Insulation Material Represented
Distributor 1	50%	25%	25%	All types, primarily fiberglass batts and rolls
Distributor 2	90%	Small	Small	Spray foam
Distributor 3	Unsure	Unsure	Small, and decreasing over time	All types, primarily fiberglass batts and rolls
Distributor 4	70%	Very low	Small	Fiberglass batts and rolls

Insulation Product Flow

The diagram below reflects the flow of insulation products as reported by distributors and installers. Distributors reported that more than 75% of their sales are to professional installers. Almost 55% of surveyed installers reported purchasing their insulation from distributors. The next most frequent insulation source was manufacturers (25%), followed by wholesalers (12%) and retailers (7%). Note that in this diagram distribution and wholesale supply are combined, as both are generally open only to professional contractors and sell in bulk to these firms.



Appendix A: Task 2 Data Collection Details

Survey Process and Detailed Disposition

Developing a comprehensive contact list for the market required merging several sources, reviewing them for relevance and quality, and removing duplicates. More detail on this process is discussed in this Appendix.

To field the survey the team began by randomizing the population frame and selecting 60 cases to support a pretest. The pretest occurred in December 2020 and resulted in eight completed surveys. The pretest provided encouraging response and cooperation rates, however responses to several questions indicated the need to adjust question wording. Specifically, the team clarified the wording of a question designed to understand the ratio of insulation work occurring in major renovation projects—work that would typically require a permit and be completed to code, but not otherwise be counted as new construction.

The full survey launched in February 2021, with outreach occurring by phone. If respondents requested to complete the survey via email, the team provided a link electronically and followed up to encourage completion.

Table 7. Final Disposition: Pretest and Full Survey

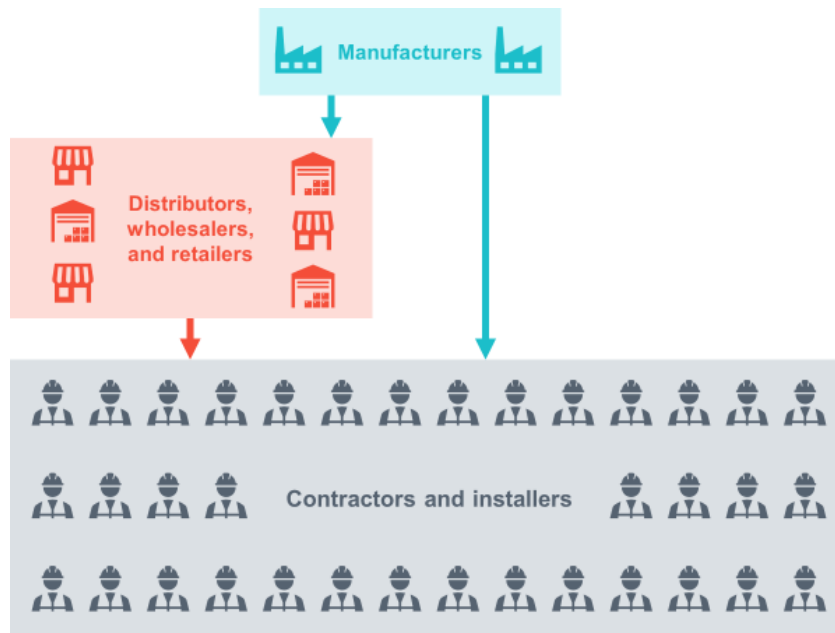
Status	Pretest	Full survey	Total
Complete	8	51	59
Partial complete	0	2	2
Refusal or break off	8	43	51
No contact made	28	212	240
Not attempted	0	5	5
List Errors			
Duplicate	1	9	10
Business or contact no longer available	1	7	8
Bad or wrong number	7	61	68
Did not pass screening	7	78	85
Total list errors	16	155	171
Adjusted population frame			341

List errors identified through outreach are removed from the viable population frame for purposes of calculating response rate as these records are not technically part of the true population and would have been excluded in advance if possible. The final dataset includes data from eight pre-test respondents, 53 full-launch respondents – two of whom provided partially completed surveys. This results in a combined 18% response rate (calculated based on full and partial completes relative to adjusted population frame).¹⁸

¹⁸ 90/10 confidence/precision with a finite population correction on a viable frame of 341 requires 57 completes.

Population Frame Development

Informed by the secondary data, the team worked to identify the population involved in delivering insulation to the Northwest market—the manufacturers, distributors, and installers who make, sell, and install insulation in regional homes. This primary data collection was designed to support the overall project objectives by filling in specific gaps in knowledge and confirming/disconfirming key assumptions about standard practice. Standard practice assumptions affect estimated thermal performance improvement and square footage of



installed insulation derived from the sales data.

The population of interest included insulation contractors (weatherization contractors responsible for installation) and the insulation supply chain (retail/wholesale distribution and manufacturing contacts). Like many markets, the insulation market is a pyramid, with a limited set of major manufacturers at the top,¹⁹ followed by a middle layer of wholesale, retail, and distribution sales, and finally a much larger number of firms and individuals who install insulation products in existing

homes.²⁰

Installation firms

The research team used a multi-stepped process to build the installer population frame (discussed in more detail in Appendix A).

1. First, the team obtained contact list purchased from InfoUSA included SIC codes associated with general contracting, home improvements, insulation contractors, and window and door suppliers.
2. The team cleaned this list to remove obviously unqualified categories (for example, organizations focused specifically on commercial buildings). The cleaned list revealed a smaller than expected number of insulation contractors (177 records). To support planned data collection, the team took additional steps to expand the population frame.
3. The original list was augmented by adding contacts acquired through web scraping program trade ally and Construction Contractor Board (CCB) lists. This process added primarily to the population for

¹⁹ According to Technavio, a global market research firm, five major manufacturers dominate the market: BASF, Knauf Insulation, Owens Corning, Paroc Group, Rockwool International, however there are 11 members of the North American Insulation Manufacturing Association (which represents only fiberglass and mineral wool insulation products) and numerous manufacturers supplying the global market. The market is also characterized as a growth market that remains relatively low on a scale of “fragmented” to “concentrated” indicating a somewhat fragmented industry.

²⁰ There is some evidence that the global insulation market has increasingly aligned with this typical supply chain model since 2003, when a series of fires in insulation manufacturing plants consolidated the supply chain for some products. According to some sources, insulation manufacturers have increasingly embraced distribution and wholesale supply at the expense of direct-to-contractor sales. We will confirm this in interviews with manufacturers and mid-stream suppliers. <https://insulation.org/io/articles/the-state-of-the-manufacturing-market/>

Oregon and Washington; indicating additional steps were required to expand the population for Idaho and Montana.

4. The team then used the Google Places API and searched Google Maps via SerpAPI, a tool that assists in search engine webscraping, identifying additional records for Idaho and Montana. This process also returned records for Oregon and Washington, but in general those were duplicate records, having been identified through previous steps.
5. To prioritize the list and prepare for data collection, the team applied a variable to reflect our relative confidence that a record is likely qualified to respond to our survey.
 - A “high probability” assignment indicates that the contact is likely involved in completing insulation projects in existing homes. This assignment was applied to records originating from trade ally lists, CCB records, cleaned Google Place/SerpAPI searches, or records on the InfoUSA list associated with a primary or secondary SIC code of 174205 (Insulation, Cold and Heat).
 - A “low probability” assignment indicates low confidence that the contact is likely involved in completing insulation projects in existing homes. This assignment was applied to a subset of the remaining InfoUSA list, based on an assessment of remaining primary SIC codes.

To increase confidence in the “high probability” list and prepare for outreach, the team reviewed the entire list, removing any remaining duplicates through a manual process that ensured the record retained was the complete and recent. In addition, the team identified any organizations added through the expansion process but not immediately associated with insulation. Confirming the completeness, recency, and qualification of records identified through this process required human review of each record and Google searches to verify eligibility and contact information.²¹ Prior to finalizing the list, we also cross-checked it with a contact list being assembled to support weatherization program outreach as part of a separate effort at BPA. This cross-check identified an additional 20 contacts from likely qualified firms (verified by Internet searches).

This process resulted in an estimated “high probability” population specifically associated with insulation of approximately 521 firms.

Table 8: Population Frame to Support Survey Testing and Fielding

State	Region		High Probability
	% Population	Count	% Sample frame
Idaho	12%	58	11%
Montana	7%	68	13%
Oregon	29%	179	34%
Washington	52%	216	41%
Subtotal		521	

²¹ This classification process resulted in a substantial portion of the InfoUSA list to be designated to the “low probability” category. The bulk of these records are for builders and general contractors, who could install insulation in new homes or small projects but are also likely to use the “high probability” insulation firms as subcontractors.

Additional Detail on Population Frame Sources

To support survey data collection scoped for this research, the team first had to build a population frame of regional insulation contractors and representatives from the insulation supply chain. Because of the fragmented nature of trades and contracting in general, this task required pulling information from a variety of sources, detailed below:

InfoUSA. As a first step, and to cast a wide net of potentially qualified contacts, the team purchased a list from InfoUSA that included records with primary and secondary SIC codes associated with insulation installation and residential contracting. One of the valuable attributes of lists from InfoUSA is the inclusion of detailed information (number of employees, revenue ranges, latitude/longitude, titles, and email addresses) for each firm record. The original list with counts for records in each major SIC code is provided in [Table 9](#).

Table 9: InfoUSA ORIGINAL List Disposition

SIC Code	Description	Count
Insulation and Contracting		
152103	General Contractors	3,684
152105	Home Improvements	577
174205	Insulation Contractors	177
Insulation & Contracting Subtotal		4,438

Developing a high-quality list of likely qualified contacts required several steps. “Insulation” as a product category is quite diverse and includes products ranging from marine insulation, industrial products, sound proofing, and even aerospace technology.

To further filter the original list and focus more specifically on the population of interest the team analyzed the general contractor population to identify additional unqualified records. The general contractor SIC contained a variety of primary and secondary SIC codes that indicated the inclusion of a specialized firm that would not also install insulation. Examples of removed SIC codes (each of which were flagged and the records reviewed to confirm they were unqualified²²) removed include:

- Apartments
- Architectural designers and services
- Bathfitter bathroom remodeling
- Construction management (all new construction)
- Specialty contractors (all of whom worked in commercial and industrial sector, including performance contracting)
- Deck builders
- HVAC equipment sellers
- Log cabin manufacturers
- Retaining walls
- Road building
- Roofing distributor
- Service station builders
- Cleaning services
- Solar equipment distributors

²² In most cases, reviewing these records involved a quick Google search to confirm the nature of the firm.

- Tank removal

Webscraping. Given the uncertainty in the qualified status of many of the records on the InfoUSA list, which included a large number of contacts associated with the SIC code for general contracting, the team identified approximately 40 potential sources of additional contact information for insulation-specific contractors including utility and weatherization program trade ally lists and CCB registrations. Each list was reviewed to assess overall scope and accessibility via webscraping. Many of the lists contained few, if any, insulation contractors (many lists consisted mainly of HVAC contractors or similar, with limited recommendations for weatherization) or were not formatted to enable scraping.²³

Guided by this assessment the list was prioritized to reflect accessibility, relevance, and record count. The team then used Python programming to pull information from websites into a spreadsheet. Several of the larger regional utilities (PSE, Seattle) do not provide lists that are accessible via web access. Ultimately, records were added from five additional sources:

- Energy Trust. Energy Trust’s trade ally list included 103 records associated with insulation.
- Oregon CCB provided 88 records associated with the term “insulation.”
- Washington CCB provided 228 records associated with the term “insulation.”
- Tillamook PUD provided 33 records of contractors associated with weatherization.
- Snohomish PUD provided 7 records of PUD-registered insulation contractors.

The team combined the new records with the InfoUSA records, matching the InfoUSA variables where possible and assigning NULL for missing values and then removed duplicates in the list based on contact criteria: Company Name, Phone, Email, Street Address, City, State, Zip. We applied the following logic:

- If the duplicate included an Energy Trust record, use the contact information from the Energy Trust list.
- If the duplicate reflected records for contacts in multiple branches, or multiple contacts at the same firm, keep both records.
- If the duplicate includes a record with a location outside of the Northwest, keep the regional record.

Table 10: Preliminary population frame: pre-API searches and supply chain contact removal

State	Higher Probability		Lower Probability	
	Count	% Sample frame	Count	% Sample frame
Idaho	38	8%	194	11%
Montana	15	3%	190	11%
Oregon	182	39%	502	29%
Washington	228	49%	851	49%
Subtotal	463		1737	

²³ The small utilities, (Grays Harbor, Benton PUD, Clallam PUD, McMinnville) often provided only a handful of contacts in a PDF format that did not enable scraping. As part of final list QC, we can manually search to confirm we have captured these firms through our other efforts (CCB, InfoUSA, and larger trade ally lists). For an example of this scenario, see Clallum’s list at <https://clallampud.net/wp-content/uploads/2020/02/Installer-List-Rack-Card-09-21-Copy-2.pdf>. Of the 15 contractors listed, only one is flagged for insulation. This firm is included on our list as it was scraped from the Washington CCB records.

API Searches. The InfoUSA and webscraping effort described enabled us to assign records to “high” and “low” probability status and expanded the population specifically associated with insulation. However, Idaho and Montana appeared underrepresented in the high probability group.

This was not surprising, given the accessibility of CCB lists for both Oregon and Washington and the presence of trade ally lists for both states. To augment Idaho and Montana we used two approaches. First, we accessed the Google Place Search API. The limitations of API access resulted in a list of 118 records, 52 of which were supply chain contacts (manufacturers, distributors, and retail/wholesale entities). Only 22 of the records appeared to be associated with qualified installation firms. To expand our coverage, we then accessed a separate service (SerpAPI) to access Google Maps API and identify additional firms. While we were focused primarily on expanding the population for Idaho and Montana, this process identified 321 records in nine states and two Canadian Provinces.

We then removed out of region records, combined the results of the Google and SerpAPI search efforts and cleaned the combined “high probability” list to 1) remove duplicates, 2) identify supply chain contacts, and 3) remove unqualified records (for example home builders, or those who focus on commercial & industrial insulation products). We moved all supply chain contacts to a separate contact list. We found a great deal of duplication between the additional records and our previously developed list, which indicated to us that our efforts were likely providing good coverage.

Ultimately, the steps described above allowed us to expand the population frame for Idaho and Montana and build a contact list to support supply chain interviews.

Supply Chain Population and Disposition

The team developed a supply chain population frame by combining several sources. Starting with a list of known organizations, based on trade organizations (such as the North American Insulation Manufacturers (NAIMA), and the Spray Polyurethane Foam Alliance (SPFA)), the team augmented this list with manufacturer and retail/wholesale distribution contacts identified through the webscraping and list cleaning process undertaken as part of the installer population frame development

This process resulted in a list of 128 contacts from 46 unique organizations across 13 states. The presence of out-of-region contacts is expected given the national reach of manufacturing and distribution organizations. The bulk of the contacts (109 of 119 or 85%) are in Washington (36), Oregon (25), Idaho (23) and Montana (25). The team retained multiple records for the same firm when they represented different locations, anticipating that it might require multiple contacts to get through to large organizations.

Table 11. Supply Chain Population

Role	Unique Organizations	Unique contacts
Manufacturer	19	21
Distributor	11	40
Retail/wholesale	16	67
Total	46	128

Appendix B: Task 2 Installer Survey Instrument

Descriptor	This Instrument
Instrument Type	Short-answer interview
Estimated Time to Complete	15-20 minutes
Population Description	Contacts at firms associated with the installation of insulation in existing homes.
Completion Goal	61
Type of Sampling	Stratified by state
Fielding Firm	Cadeo

Research Objectives

Research topics for installers are centered on collecting information on standard practice in insulation work as well as “typical” projects (both program-subsidized and non-program). This work will provide context and clarity to the existing data sources. Research topics are mapped to questionnaire topics in the table below.

Research topic	Questions
The portion of insulation jobs that include each application (wall, ceiling, floor)	Q2, Q12, Q11, Q22
The portion of insulation jobs that are associated with a program (either subsidy, low-income grant or cost share, or other rebate process)	Q6,
For installers that complete both program-affiliated and non-program projects, any typical or systematic differences in the project attributes (do they differ by application, pre/post testing, threshold for performance, or other practice)?	Q7, Q8,
What portion of work in existing homes is associated with major renovations and additions (code-driven)	Q9, Q10
Standard approaches to assessing and implementing work:	Q11, Q13, Q14, Q20 Q21 23, 24, Q32, Q33 Q41, Q42,
For each application (wall, ceiling, floor)	
How frequently is existing insulation removed? In what scenarios? How common are those scenarios?	Q15, Q16, Q25, Q26, Q35, Q36
How do installers estimate existing R-value in each building component?	Q17, Q27, Q37
What is the typical existing R-value installers find?	Q18, Q28, Q38
What is the typical R-value they target?	Q19, Q29, Q39
Do they use rules of thumb on thickness targets? If so, what are they? Does this vary by type (loose fill, batts/rolls, poly)?	Q30, Q20, Q40

The research team added an objective associated with efforts to estimate the portion of insulation sales associated with permitted projects that install insulation to comply with Energy Code requirements, for example when a home undergoes major renovation or the addition of floor area. Although this may be explored in more depth through a separate task order, we have included two additional questions (Q9 and Q10) to provide a qualitative understanding from the perspective of insulation installers about the prevalence of these code-driven insulation projects.

Outreach Script (Phone)

Hi my name is _____, and I'm calling from Cadeo. Do you install insulation in existing homes?

If yes. We are a market research firm working on a project for the Bonneville Power Administration. We are conducting research on insulation practices in existing homes to help encourage additional insulation investment. The region needs to understand this market better so that energy efficiency programs can be designed effectively.

As part of this project, we are inviting qualifying insulation professionals to share their experience installing insulation. As a thank you for your time, we're offering a \$50 Amazon gift card for those who participate.

We would very much like to incorporate your insights into this work. Your input is extremely valuable. We'd like to talk to someone who can speak to your firm's insulation work and what a typical job looks like. Would that be you, or should I follow up with someone else?

If respondent is not the best contact, ask for name and contact information for best contact.

If respondent is best contact. My questions should take approximately 20 minutes. Your responses will be kept confidential and used for research purposes only. Is this a good time to talk, or should we schedule a better time?

If no. Thank and terminate.

If yes. Confirm: schedule or continue.

[If needed: This work is being sponsored by the Bonneville Power Administration.

[If needed: We are not selling anything. Your responses will be kept confidential and results aggregated for reporting.]

Email Outreach

Hi [NAME]

I'm following up on a voice mail left earlier this week. My firm, Cadeo, is conducting important research for the Bonneville Power Administration on how insulation professionals approach their work in existing homes. We are conducting research on insulation practices in existing homes to help encourage additional insulation investment. It is important for the region to understand this market better so that energy efficiency programs can be designed effectively. We are offering a \$50 Amazon e-gift, as a thank you, to complete a 20-minute interview over the telephone. We'd like to talk to someone who can speak to your firm's insulation work and what a typical job looks like.

We are not selling anything, and your responses will be kept confidential.

Please let me know some times you might have available to speak with me. I look forward to hearing from you via email or by phone (my number is below).

Many thanks,

Survey

Thank you so much for your time today, do you have any questions for me before we get started?

First, we'd like to understand a bit about you and your company. We want to make sure we have a good representation of firms of different sizes and with different specialties. Your responses will be kept confidential and used only to describe regional insulation activity.

[ASK ALL]

1. I'm going to list several services, please tell me if your company does any of the following...

[MULTIPLE RESPONSE]

- a. Install insulation in homes **[If respondent indicates that their company does NOT install insulation in homes, thank and terminate. Note that this should be caught at respondent screening and scheduling, but just in case.]**
 - b. Plumbing
 - c. Wiring
 - d. Drywall
 - e. Painting
 - f. Window replacement
 - g. Roofing
 - h. General contracting or building
 - i. Something else? Please specify: [OPEN-ENDED RESPONSE]
- 98. Don't know
-99. Refused

We are focused today on understanding the overall insulation market for existing single-family homes, which include duplex and triplex type construction and manufactured homes, excluding new construction.

[ASK ALL]

2. Approximately how many residential insulation jobs does your firm do **in existing homes** in a typical year (if part of a larger firm: out of this location)?
 - a. [OPEN-ENDED RESPONSE] Note: if they do zero work in existing homes, for example because they work only in new construction, they are not qualified. Thank and terminate.
- 98. Don't know
-99. Refused
3. And how many of these jobs are in manufactured homes?
 - a. [Open-ended response]

- 98. Don't know
- 99. Refused

[ASK ALL]

- 4. About how many trucks do you operate?
 - a. [OPEN-ENDED RESPONSE]
- 98. Don't know
- 99. Refused

[ASK ALL]

- 5. About how many square feet of insulation did your firm (location, if part of a larger organization) install in **existing homes in 2019**? (Interviewer note: in all cases we are excluding new homes.)
 - a. [Open-ended response]
- 98. Don't know
- 99. Refused

[ASK ALL]

- 6. And, what portion of your insulation work in existing single-family homes is associated with an energy efficiency program (If needed: where a homeowner or contractor receives a subsidy or other encouragement to complete home upgrades, including low-income programs)?
 - b. [Open-ended response]

[ASK IF Q6>ZERO]

- 7. **[If greater than zero]** Do program-affiliated projects differ from projects installed outside of programs?
 - a. Yes
 - b. No
- 98. Don't know
- 99. Refused

[ASK IF Q7=A. YES]

- 8. How do the program-affiliated projects differ? (For example, programs tend to require insulation below a threshold to qualify or may require air sealing or other diagnostics to qualify. These requirements can reduce the number of projects that go through a program.)
 - a. [Open-ended response]

Great, the rest of my questions are focused only on your work OUTSIDE of efficiency or weatherization programs....

[ASK ALL]

9. Insulation is often installed in existing homes during major renovations or additions, for example finishing a basement, adding a room, or completing a major kitchen remodel. As I understand it, these projects often require a permit, which is typically obtained by a general contractor or homeowner. Approximately what portion of the work you do outside of efficiency or weatherization programs is associated with these types of major renovations or additions that are likely to be permitted?

[Probe if needed: I understand that insulation installers are not typically involved in obtaining the permit. We're just interested in understanding how much of the work you do is involved in these more extensive renovations and additions projects, even if you are a sub to a general contractor or homeowner.]

10. In these scenarios, how common is it to add insulation in areas beyond the area covered by the permit (such as insulating a whole attic when only the kitchen is remodeled)? Would you say it is:
- Very common
 - Somewhat common
 - Not at all common?
- 98. Don't know
-99. Refused

[ASK ALL]

We have some questions that are more specific to each type of the insulation applications including attics or ceilings, walls, and floors. **Again, these questions are focused only on your work OUTSIDE of efficiency or weatherization programs....**

Attic Insulation Practices

11. First, thinking about projects in attics or ceilings...
What is the typical square footage of attic or ceiling insulation projects?
- [Open-ended response]
12. About how many insulation jobs in 2019 included attic insulation?
- [Open-ended response]

[ASK ALL]

13. What type of insulation do you typically use for attic insulation projects?
- Blown in/loose fill - Cellulose
 - Blown in/loose fill - Fiberglass
 - Blown in/loose fill – Spray Foam (SPF)
 - Batts or rolls - Fiberglass
 - Batts or rolls – Stone wool
 - Rigid insulation - Polyiso
 - Rigid insulation - EPS
 - Rigid insulation – XPS
 - Something else? Please specify: [Open-ended response]

14. Under what circumstances would you choose a different insulation type?
a. [Open-ended response]

[ASK ALL]

15. **In what portion of attic insulation projects do you remove existing insulation**
a. 0%
b. 1% or more, enter number [Record value]
- 98. Don't know
-99. Refused

[ASK IF Q15>ZERO]

16. **[If greater than zero]** In what scenarios is insulation removed?
a. [Open-ended response]
- 98. Don't know
-99. Refused

[ASK ALL]

17. When you do not remove the existing insulation, how do you determine the existing R-value in an attic? [Interviewer note: if they say "by measuring it" let's confirm how they do that.]
a. [Open-ended response]
18. What is the typical existing R-value you find before projects?
a. [Open-ended response]
19. And what R-value do you target for completed attic insulation projects?
a. [Open-ended response]
20. Thinking about your most common attic insulation job, with the most common material you use, how thick is the insulation when the job is done?

Wall Insulation Practices

Next, let's think about wall insulation projects in existing homes.

21. What is the typical square footage of wall insulation projects?
a. [Open-ended response]
22. About how many insulation jobs in 2019 included wall insulation?
a. [Open-ended response]
23. What type of insulation do you typically use for wall insulation projects?
a. Blown in/loose fill - Cellulose
b. Blown in/loose fill - Fiberglass

- c. Blown in/loose fill – Spray Foam (SPF)
- d. Batts or rolls - Fiberglass
- e. Batts or rolls – Stone wool
- f. Rigid insulation - Polyiso
- g. Rigid insulation - EPS
- h. Rigid insulation – XPS
- i. Something else? Please specify: [Open-ended response]

24. Under what circumstances would you choose a different insulation type for walls?
- a. [Open-ended response]

[ASK ALL]

25. **In what portion of wall insulation projects do you remove existing insulation**

- c. 0%
 - d. 1% or more, enter number [Record value]
- 98. Don't know
- 99. Refused

[ASK IF Q24>ZERO]

26. **[If greater than zero]** In what scenarios is existing wall insulation removed?

- b. [Open-ended response]
- 98. Don't know
- 99. Refused

[ASK IF Q24>ZERO]

[ASK ALL]

27. When you do not remove the existing insulation, how do you determine the existing R-value in a wall?

- a. [Open-ended response]

28. What is the typical existing R-value you find in walls before projects?

- a. [Open-ended response]

29. And what R-value do you target for completed wall insulation projects?

- a. [Open-ended response] [Note: if they say “fill the cavity” or similar, ask about the depth they typically find (for example, distributor interview with installed sales guy: older houses will have 2X4 construction, “only so much room” R13 max. 2X6 could get up to R25 with just spray foam, according to him it depends on how old the house is, aim for a full cavity.)]

30. Thinking about your most common wall insulation job, with the most wall insulation material, how thick is the insulation when the job is done?

Floor insulation practices

Finally, about floor/crawlspace insulation projects in existing homes.

31. What is the typical square footage of floor/crawlspace insulation projects?
 - a. [Open-ended response]
32. About how many insulation jobs in 2019 included floor/crawlspace insulation?
 - a. [Open-ended response]
33. What type of insulation do you typically use for floor/crawlspace insulation projects?
 - a. Blown in/loose fill - Cellulose
 - b. Blown in/loose fill - Fiberglass
 - c. Blown in/loose fill – Spray Foam (SPF)
 - d. Batts or rolls - Fiberglass
 - e. Batts or rolls – Stone wool
 - f. Rigid insulation - Polyiso
 - g. Rigid insulation - EPS
 - h. Rigid insulation – XPS
 - i. Something else? Please specify: [Open-ended response]
34. Under what circumstances would you choose a different insulation type for floor/crawlspace?
 - a. [Open-ended response]

[ASK ALL]

35. **In what portion of floor/crawlspace insulation projects do you remove existing insulation**
 - a. 0%
 - b. 1% or more, enter number [Record value]
- 98. Don't know
- 99. Refused

[ASK IF Q24>ZERO]

36. [If greater than zero] In what scenarios is existing floor/crawlspace insulation removed? Don't know
 - a. [Open-ended response]
- 98. Don't know
- 99. Refused

[ASK ALL]

37. When you do not remove the existing insulation, how do you determine the existing R-value in a floor/crawlspace?
 - a. [Open-ended response]
38. What is the typical existing R-value you find in floor/crawlspace before projects?
 - a. [Open-ended response]
39. And what R-value do you target for completed floor/crawlspace insulation projects?

- a. [Open-ended response]
 - b. [Note: if they say "fill the cavity" or similar, ask about the depth typically available]
40. Thinking about your most common floor insulation job, with the most floor insulation material, how thick is the installed insulation when the job is done?

Other Topics

[ASK ALL]

41. Do you also provide air sealing services?
- a. Yes
 - b. No
- 98. Don't know
-99. Refused

[ASK IF Q43=YES]

42. In what portion of your insulation projects do you perform the following air sealing services:
- a. Blower door testing?
 - b. Use an infrared camera?
 - c. Use spray foam cans to seal up common leaks prior to insulation work?

[ASK ALL]

43. We know that 2020 has been a strange year. What types of adjustments or changes are you making in response to COVID-19?

Firmographics

Finally, we have just a few questions about your company. These help us understand the representativeness of our research.

[ASK ALL]

44. Do you typically buy insulation directly from a manufacturer, a distributor, wholesaler, or retailer?
45. How many locations do you have in the Northwest (Oregon, Washington, Idaho and Montana?)

Thank you again for your time today. Those are all of my questions.

Record name/firm. If possible, phone or email of respondent, clarify to whom the incentive should be sent (individual vs. firm). Confirm email address for Amazon e-gift card delivery.

Thank you!

Appendix C: Task 1 Secondary Market Data Summary

In Task 1, the team identified existing sources of information on the insulation market, reviewing numerous sources to document their coverage and relevant insight. Ultimately, the team relied on several primary sources. (Table 12)²⁴

Table 12. Secondary Market and Data Sources Used

Source	Coverage
Principia	Construction industry data source, providing information on residential building insulation demand for the four Northwest states for 2016-2019. Data are organized by insulation type, application (floor, wall, ceiling), and separate new construction from retrofit and renovation. Data also isolate residential building type (single family, multifamily, manufactured homes). Sales estimates provided in pounds and revenue.
BPA BOOM Report	BPA program data on insulation savings used to allocate regional program savings.
RCP	Regional electric program savings reported by regional program administrators.
ASHRAE	Insulation technical specifications consistent with HVAC and insulation industry practice.
DOE	Information about different insulation types, including the R-value per inch.
Colorado Energy	Serves as a comparison point for DOE R-value per inch data.
7th Power Plan	Weatherization potential estimates for 2016-2021 used as a check on independently calculated market savings estimates.

After reviewing the coverage and quality of available data sources the team acquired the Principia data set,²⁵ which provided a breakdown of regional insulation sales by state by year for the years 2016-2019. The data enable separation of projects by project trigger (new construction vs. retrofit and renovation (R&R)), insulation type (batts & rolls, loose fill, foam) and application (wall, ceiling, floor). The data are provided in millions of pounds by type and application. Using Colorado Energy, ASHRAE and DOE values,²⁶ the team then converted these data into an estimate of cubic feet of installed insulation. This conversion to volume allowed the team to estimate the total volume of insulation installed by type and application in existing homes. The resulting data will help inform program strategy and be used as inputs to the next update of the BPA Residential HVAC Market Model.

²⁴ The team also performed an extensive review of the data from RBSA I and RBSA II but found the regional sales data acquired from Principia offered better regional market coverage. The stock data could not support the specific analyses required of this work.

²⁵ The team acquired data from Principia Consulting, a research firm focused on building materials and the construction industry. <https://www.principiaconsulting.com/u-s-residential-insulation-market-demand-at-a-glance/>

²⁶ ASHRAE provides standard values for R-value per inch by insulation type as well as pounds per cubic foot of insulation installed, by type. These values were used to convert the sales in pounds recorded by Principia into an estimate of improved thermal performance. Several of the assumptions underlying this initial estimate require additional testing and will be informed by the data collection described in this memo.