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Energy Efficiency & Electrification Soft Costs in New York

2021 UPDATE

December 12, 2022

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NYSERDA Record of Revision

Document Title
Energy Efficiency and Electrification Soft Cost December 2022

Revision Date	Description of Changes	Revision on Page(s)
December 2022	Original Issue	Original Issue

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Definitions and Acronyms

Acronyms	Definition
ASHP	Air-source heat pump
CI	Confidence interval
DIY	Do-it-yourself
DPS	Department of Public Service
ESCO	Energy service company
Hard Costs	Materials and equipment costs, excluding any contractor markups
HID	High intensity discharge
HVAC	Heating, ventilation, and air conditioning
IQR	Interquartile range
LED	Light-emitting diode
Multifamily	Buildings with five or more attached units
NYSERDA	New York State Energy Research and Development Authority
QA/QC	Quality assurance and quality control
Residential	All dwellings consisting of one to four units
RTU	Rooftop unit (type of HVAC system)
SAC	Strategic Advisory Committee
SIC	Standard Industrial Code
Soft Costs	All other project-related costs (not for materials and equipment) including marketing and acquisition, project/system design and development, installation labor, transaction costs, project financing and cash flow, supply chain/stocking, and quality assurance
VFD	Variable frequency drive
VRF	Variable refrigerant flow (type of ASHP HVAC system)

Executive Summary

On April 26, 2018, the New York State Department of Public Service (DPS) and NYSERDA published the *New Efficiency: New York* report,[1] which describes plans to accelerate the state's energy efficiency goal by 40%. The report calls for 185 trillion British thermal units of cumulative, annual, site-specific energy savings by 2025, relative to forecasted consumption. The target is based on savings in buildings and the industrial sector across all fuel sources (electricity, natural gas, heating oil, and propane). The Climate Leadership and Community Protection Act (Climate Act), signed July 2019 and effective January 1, 2020, formally adopted this energy efficiency target and puts the State on a path to complete carbon-neutrality across all sectors of the economy, including power generation, transportation, buildings, industry and agriculture.

Project Goals & Approach

To achieve New York's energy goals, it is critical to investigate cross-cutting market barriers and opportunities that impact the soft costs associated with energy efficiency and electrification project development. Soft costs represent a substantial portion of project costs—over 50% in some cases. Soft cost reductions are part of New York's strategy to make energy efficiency and electrification more affordable, inclusive, and accessible to residents and businesses in New York, thus supporting the State's transition to a clean and equitable energy economy. Soft costs encompass all project-, marketing-, or staff training-related costs—including marketing and customer acquisition, project design, project installation, transaction costs (training, certifications, permits), quality assurance, and recruiting/hiring.[2]

This report represents results from the second iteration in a five-year longitudinal study to quantify soft costs across eight energy efficiency and electrification prototypical projects. For this study, NYSERDA contracted with Cadmus ("the Market Evaluation Team") to conduct research to quantify soft costs across eight energy efficiency and electrification "prototypical projects."[3] This research specifically involved surveying contractors across the residential, commercial, and multifamily sectors. The Market Evaluation Team completed an initial version of this study (the 2019 study) to set a market baseline for soft costs of energy efficiency and electrification projects. This study serves as an update to the 2019 study and compares results across these two time periods.

Results from this year's study reflect significant fluctuations in the market stemming from the COVID-19 pandemic and the general economic environment (e.g., high inflation levels). As a result of these fluctuations, it is challenging to draw meaningful comparisons in costs between this year and the 2019 study. Nonetheless, research findings provide insights that NYSERDA (or other entities) can leverage to influence or assist market actors in reducing soft costs, though the direct impacts of interventions in the current environment remain uncertain.

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1 NYSERDA and Department of Public Service. April 2018. *New Efficiency: New York*.

2 See the *Soft Cost Categories* section for a detailed definition of soft costs.

3 See the *Prototypical Projects* section for a detailed definition of each prototypical project.

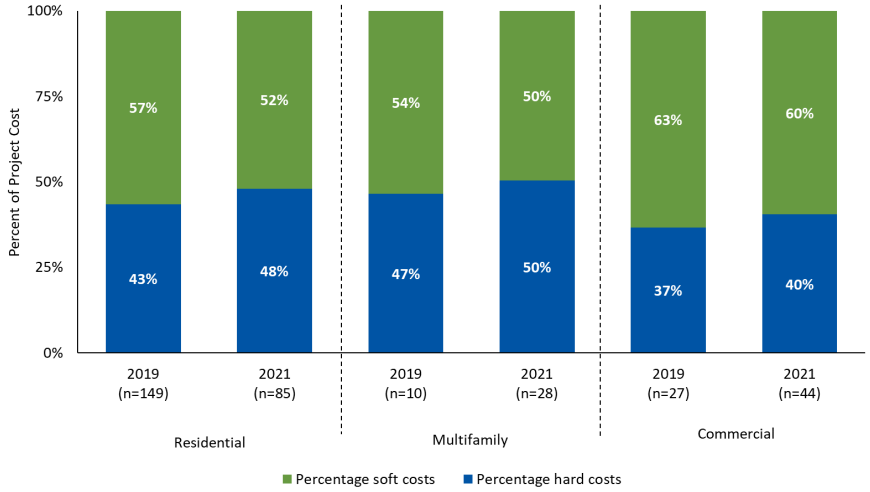
The period between the two studies—2019 to 2021—was a time of drastic change, not just in the energy efficiency and electrification market in New York State but across the world. The COVID-19 pandemic upended the economy and supply chain, causing delays in receiving products, labor shortages, and changes in consumer behavior driving a measurably increased cost of doing business across most economic sectors. This, combined with other economic factors, led to significant inflation: according to the U.S. Bureau of Labor Statistics, since 2019, the residential and nonresidential Producer Price Index increased by 24.7% and 26.4%, respectively.[4] Even absent these wider economic changes, many of the technologies studied in this work are comparatively new to the market, and thus subject to wider swings in costs than more established technologies. Moreover, incentive programs for building electrification technologies underwent several changes during this period, including New York's heat pump incentive program moving to utility administration. Altogether, these factors cannot easily be isolated or controlled for in the analysis, and accordingly, have had a substantial impact on the results of this study, likely driving an increase in both soft and hard costs, and making direct comparisons across pre- and post-pandemic study periods challenging. The Market Evaluation Team took these factors into consideration when drawing insights from the study's results.

Key Findings

In the 2021 study, the Market Evaluation Team found modest increases in cost for several prototypical projects, but these increases were far greater for hard costs than for soft costs. For example, the average increase in total project costs in the residential sector was 21%, with hard costs increasing 31% and soft costs increasing only 13% from 2019 to 2021. This resulted in hard costs comprising a greater share of total project costs in 2021 than in 2019 across all three sectors, as shown in Figure 1.

[4] U.S. Bureau of Labor Statistics. "*Producer Price Index by Commodity – Inputs to Industry.*" https://www.bls.gov/ppi/tables/. The Producer Price Index measures the average change over time in the prices domestic producers receive for their output and is considered a measure of price changes at the wholesale level. For example, the hard costs measured in this study are part of the Producer Price Index. This differs from the Consumer Price Index (CPI), which measures the changes in the price of goods and services paid by consumers.

Figure 1. Hard vs. Soft Cost Estimated Breakdown by Sector, 2019 vs. 2021



Note: Percentages presented in this chart are relative to total project cost estimates for a specific prototypical project within a specific year. That is, a soft cost percentage being higher in 2019 does **not** indicate that 2019 has higher absolute soft costs. Numbers may not add to 100% due to rounding.

Consistent with 2019, installation labor in 2021 comprised approximately one-half of soft costs across all sectors. Following this was marketing and customer acquisition costs, which increased more in the residential sector than in the other sectors.

When examining the residential building electrification (HVAC replacement) prototypical project, the Market Evaluation Team found several statistically significant changes from 2019 to 2021, as shown in Table 1. Specifically, five of six soft cost categories were significantly higher in 2021, with the largest increases in marketing and customer acquisition and recruiting and hiring costs. The Market Evaluation Team observed increases for these two soft cost categories in other prototypical projects and sectors, such as residential whole-home efficiency and commercial HVAC.

Table 1. HVAC Replacement Soft Costs 2019 vs. 2021

Soft Cost Category	2019 HVAC: ASHP (n = 69-97)	2021 HVAC: ASHP (n = 46-55)	Change ($)	Change (%)
Marketing and Customer Acquisition	$1,215	$1,973	+$758**	+38%
Project Design and Development	$248	$319	+$71*	+22%
Installation	$2,337	$2,671	+$334*	+13%
Transaction Costs	$582	$884	+$302*	+34%
Quality Assurance	$251	$282	+$31	+11%
Recruiting and Hiring	$68	$138	+$70**	+51%
Total Soft Costs [a, b]	**$4,702**	**$6,268**	**+$1,566**	**+25%**

The following notation denotes statistical significance at the different confidence levels: * p < 0.20, ** p < 0.10, *** p < 0.05

[a] Due to the calculation method for total soft costs (summing of individual cost buckets, with sample differences across the set), it is not possible to test statistical significance for total soft cost changes from 2019 to 2021.

[b] Given that five of six soft cost categories are statistically higher in 2021 than 2019 for the HVAC Replacement prototypical project, it is reasonable to assume that 2021 soft costs are higher than 2019 soft costs.

Increases in marketing and customer acquisition were mainly driven by bid preparation costs, with $450 of the $1,566 increase in residential building electrification soft costs (29%) coming from bid preparation cost increases. This is likely due to numerous factors, including greater customer interest in efficient HVAC systems sized for the entire home (which are more complex bids than like-for-like existing system replacements and thus take longer to draft/approve), an increase in home energy audits (64% of decision-makers reported completing a home energy audit in 2021 compared to 46% in 2019), and the entrance of new service providers into the market (the average years of experience among residential HVAC service providers fell by 5.4 years between the two study periods; 16.7 to 11.3).

Additionally, NYSERDA started the Cooperative Advertising and Training Program for Clean Energy Partners[5] in 2020, which provided cost share to contractors to promote clean energy technologies. Through mid-2022, this program supported over 200 firms with incentives on marketing ranging from 50-80% of marketing costs, with a cap of $100,000 per year for installers. Across the life of the program, NYSERDA funded a total of 1,178 opportunities with an average incentive of $12,057. While the Market Evaluation Team was unable to directly link incentives received through this program to survey data, several installers who responded to these surveys received incentives during this time. Thus, it is reasonable to assume that installers receiving these incentives increased their spend on marketing opportunities.

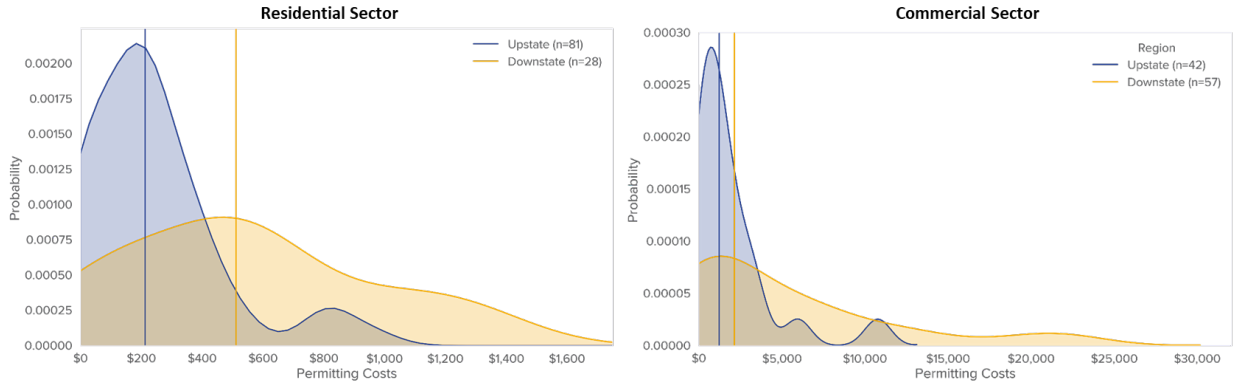
The Market Evaluation Team found recruiting and hiring cost increases across many prototypical projects, with statistically significant increases for building electrification service providers in the residential (HVAC replacement and whole-home efficiency) and commercial (HVAC: Variable Refrigerant Flow [VRF]) sectors. These increases were likely a result of the tight labor market, with abnormally high turnover, temporarily increased unemployment benefits, and increased demand (from greater interest in clean HVAC technologies and more energy audits, as the previous paragraph about marketing and customer acquisition notes) that led to a shortage of workers available to complete prototypical project installations. These factors, combined with the previously-mentioned market effects, contributed to an increase in labor rates, which rose between 5.3% and 7.1% from 2019 to 2021 as firms struggled to recruit and hire qualified workers.[6]

Permitting trends in 2021 remained consistent with those from 2019. Permitting costs remained noticeably higher among downstate service providers than their peers upstate due to a more complex and expensive permitting environment. Figure 2 shows upstate and downstate permitting costs for the residential and commercial sectors. Both graphs follow the same pattern—upstate service providers' permitting costs converge closer to 0 whereas downstate service providers reported a wider array of permitting costs.

5 https://portal.nyserda.ny.gov/CORE_Solicitation_Detail_Page?SolicitationId=a0rt0000011YFNMAA4

6 RSMeans. 2021.

Figure 2. Upstate and Downstate Permitting Costs



Key Considerations for New York State Energy Programs

Building on the findings above, the Market Evaluation Team identified the following key considerations that could be implemented to support strong growth development of New York's energy programs. Please note, in several cases, the Market Evaluation Team also built on key considerations identified in the 2019 report. Full details on these considerations and NYSERDA's responses can be found in the *Conclusions and Recommendations* section.

- **Implement market condition monitoring.** Several market forces have had a significant impact on energy efficiency and building electrification projects in New York, likely contributing to observed increases in hard and soft costs. To stay abreast of relevant market conditions, NYSERDA could monitor market indicators (e.g., Producer Price Index, HVAC equipment stock levels/shipment data, utility program participation levels) that can impact the completion of energy efficiency and building electrification projects. Specifically, NYSERDA can identify indicators that impact each of its core focus areas to ensure it has a comprehensive view of what is happening in the market. Staying informed of relevant market conditions can ensure that NYSERDA's programs are responsive to changing market needs and economic conditions.
- **Provide standardized bid packages and trainings on approved relevant software.** Increases in marketing and customer acquisition costs were driven by bid preparation costs, possibly representing increased interest in whole-home systems and the entrance of new service providers. NYSERDA may consider or continue working with industry groups to develop more, or to increase awareness of existing, standardized/templatized bid packages for specific measures or entire projects (for less complex projects). NYSERDA could further develop training, technical services, and other such offerings to help contractors gain experience with, and thereby become more efficient in, bid preparation. NYSERDA may also consider offering training on approved software packages that help service providers expedite the bid process—while also highlighting key information, such as projected energy savings—that can help them close the sale.
- **Create and educate contractors on standardized project design and installation procedures**. Total soft costs are highly impacted by the cost associated with project design and installation work, which accounts for nearly half of total project soft costs across all sectors, and are widely dispersed

(i.e., contractors vary in how long it takes to complete a prototypical project installation). To reduce costs, NYSERDA may consider creating or expanding facilitation of standardized installation, design, and quality control approaches by encouraging industry best practice or through requirements in incentive programs. Through this process, it would be critical to work with key manufacturer partners to standardize approaches and offer contractor training programs.

- **Expand or accelerate workforce development initiatives.** For New York to achieve its energy and climate goals, it is necessary to increase the number of contractors active in the clean energy market. Current data show that contractors are already increasing investments in recruiting. The Market Evaluation Team hypothesized that recruiting investments will need to increase further to achieve the state's goals. NYSERDA may explore how to accelerate its workforce development initiatives to support expansion of qualified technicians who can install energy efficiency and electrification measures. For example, NYSERDA may consider or continue offering special incentives to service providers who complete a set of relevant training programs. Alternately, NYSERDA could consider expanding partnerships with key manufacturers to connect service providers to relevant training options.
- **Encourage the development of a unified and streamlined permitting process.** Permitting can be a driver of variability in project costs, with substantial differences observed across sectors. There is also a substantial difference in permitting costs by region, with permitting costs for downstate contractors higher and more dispersed than for their upstate counterparts. NYSERDA may consider or continue developing a unified, streamlined permitting process for key technologies and encourage adoption across New York State municipalities, which would entail the creation and dissemination of model codes for various technologies. There are several examples in New York State where model codes have been developed regionally and at the state level for various renewable energy technologies, including the Long Island Unified Solar Permit Initiative (LIUSPI), NYS Unified Solar Permit, and Suffolk County Model Geothermal Code, showing there is precedent for such codes. It will be important to work directly with service providers and local officials to determine the appropriate design for a model code to ensure it acts as intended.

Introduction and Background

On April 26, 2018, the New York State Department of Public Service (DPS) and NYSERDA published the *New Efficiency: New York* report,[7] which describes plans to accelerate the state's energy efficiency and electrification goal by 40%. The report calls for 185 trillion British thermal units of cumulative, annual, site-specific energy savings, relative to forecasted 2025 consumption. The Climate Leadership and Community Protection Act (Climate Act), signed July 2019 and effective January 1, 2020, adopted this energy efficiency target and puts the State on a path to complete carbon-neutrality across all sectors of the economy, including power generation, transportation, buildings, industry and agriculture. The new target is based on savings in buildings and the industrial sector across all fuel sources (electricity, natural gas, heating oil, and propane). In NYSERDA's support for more energy-efficient buildings, a need exists to investigate cross-cutting barriers and opportunities that are not specific to one market sector.

NYSERDA and Cadmus ("the Market Evaluation Team") completed an initial version of this study (the 2019 study) to set a market baseline for soft costs of energy efficiency and electrification projects. That research found that energy efficiency and electrification projects can pose significant soft costs—in some cases well over half of an energy efficiency or electrification project's total installed cost. The 2019 study also found significant variability in soft costs within a specific energy efficiency or electrification project type, which has helped prove that opportunities exist for soft cost reduction. The 2019 study included several recommendations for the areas in which NYSERDA can look for soft cost reduction opportunities.

Between the 2019 and 2021 studies, the energy efficiency and electrification market in New York has been affected by several factors, specifically related to its status as a nascent market, to program administration and design changes, and to the general market impacts resulting from the COVID-19 pandemic. Thus, though findings in this study corroborated many of the trends observed in the 2019 study, the unprecedented confounding factors had a major role in soft cost changes.

Given these findings, addressing soft cost barriers remains critical to reducing the overall price of energy efficiency and electrification, maintaining market growth, and meeting the state's ambitious energy efficiency and electrification goals. The first step in this process is to identify and quantify the soft costs that affect energy efficiency and electrification projects and to identify potential cost-reduction opportunities.

For this study, the Market Evaluation Team and NYSERDA used the same definition of soft costs as in the 2019 study (i.e., marketing and acquisition costs, project/system design and development, installation labor, transaction costs, project financing and cash flow, supply chain/stocking, and quality assurance/quality control [QA/QC]).

[7] NYSERDA and New York State Department of Public Service. April 2018. *New Efficiency: New York*.

In contrast, hard costs are defined as the cost for equipment (i.e., air-source heat pump [ASHP], light fixtures) and materials (i.e., insulation, other raw material inputs) needed to complete an energy efficiency and electrification project. An update to this study is planned for 2023.

The following research questions guided this research:

- How are various soft cost categories defined and prioritized (by impact/size) in each sector?
- What are the most significant (in dollar value) soft cost categories affecting energy efficiency and electrification projects in New York by sector? (For follow-up assessments in 2021/2023: How do soft costs change over time?)
- What percentage of total project costs is represented by soft costs? (For follow-up assessments in 2021/2023: What is the trend of this soft cost percentage?)
- What degree of variation exists for each major soft cost category for prototypical energy efficiency and electrification projects in each sector?
- To what extent do soft costs differ across geographical areas in New York State? How does this compare to other states or regions?
- Are there opportunities to reduce soft costs and, if so, what are they?

This report begins by describing the methodology employed, including the research design, data collection methods, sample composition, and data analysis approach. Next, the bulk of the report covers the detailed findings from assessing results, trends, and drivers across sectors, at the sector level, and for prototypical projects when the sample size allows. Finally, the report closes with the conclusions and recommendations section, which synthesizes conclusions drawn from the findings and presents the Market Evaluation Team's recommendations for NYSERDA's path forward.

Methodology

This section describes the study's overall research design, research methods used, sample composition and how to interpret results, and analysis methodology.

Research Design

Using the work completed in the 2019 Energy Efficiency & Electrification Soft Costs baseline study, the Market Evaluation Team held initial meetings with NYSERDA to determine the scope of work for this study. The Market Evaluation Team and NYSERDA then made several modifications to the baseline study plan to improve results:

- **Dropped two commercial prototypical projects:**
  - **Performance Contract** projects are on a very long time horizon, which meant service providers had difficulty providing accurate estimates.
  - **HVAC: RTU** (rooftop unit) project soft cost quantifications are less valuable to the study team (i.e., NYSERDA and the Market Evaluation Team) than other HVAC technologies and the inclusion of this prototypical project cannibalized the available sample of service providers for other prototypical projects.
- **Split the multifamily prototypical project into two projects,** one that kept the same design as 2019 and one that switched the HVAC measure to an efficient steam boiler. Because air source heat pumps (ASHPs) are not common in multifamily buildings, the Market Evaluation Team had difficulty finding qualified contractors in 2019. To expand the contractor pool, the Market Evaluation Team added the efficient steam boiler project, which is more in line with current market conditions.
- **Revised the screening criteria** to allow contractors to qualify for a broader set of prototypical projects. Previously, contractors were forced into one type of prototypical project based on their Standard Industrial Code (SIC), which proved not to be highly accurate.

These changes were necessary to ensure the study focused on areas of high importance to NYSERDA and kept pace with current trends in electrification.

Prototypical Projects

The Market Evaluation Team explored eight distinct, prototypical projects across three sectors—residential, commercial, and multifamily. The residential sector only captures buildings with one to four units, whereas the multifamily sector captures buildings with five or more units. As noted earlier, the Market Evaluation Team and NYSERDA decided to remove two commercial prototypical projects from quantification in this year's study and added a subcomponent to the multifamily prototypical project.

These prototypical projects, listed in Table 2, received rigorous testing with a variety of stakeholders, from NYSERDA, the Market Evaluation Team, and experts in New York State.

Table 2. Finalized Prototypical Project Descriptions

Prototypical Projects Used in Service-Provider and Decision-Maker Surveys		
Residential Sector		
HVAC System Replacement	Building Type	Single-family home; family of 3 (2 adults, 1 child) living there year-round
	Building Size	2,000 sq. ft., 2-story home—living and kitchen downstairs with bedrooms upstairs Colonial, 50 years old
	Existing Conditions	Standard efficiency, gas-powered condensing boiler for heating; window air conditioning units for cooling
	Equipment Installed	Ductless heat pump with 1 outdoor unit and 3 indoor heads. Indoor heads will be installed in the kitchen, living room, and bedroom (on second floor). Existing gas boiler retained in place as backup heat.
Insulation and Air Sealing	Building Type	Single-family home; family of 3 (2 adults, 1 child) living there year-round
	Building Size	2,000 sq. ft., 2-story home—living and kitchen downstairs with bedrooms upstairs Colonial, 50 years old; R19 insulation
	Existing Conditions	R19 insulation in ceiling; crawl space/basement uninsulated; typical attic leakage in bypasses
	Equipment Installed	R49 insulation (blown-in) for ceiling and R30 insulation (fiberglass) for crawl space/basement; air sealing for whole house, attic and basement bypasses
Comprehensive Whole-Home Efficiency Projects Addressing HVAC Plus Insulation and Air Sealing	Building Type	Single-family home; family of 3 (2 adults, 1 child) living there year-round
	Building Size	2,000 sq. ft., 2-story home—living and kitchen downstairs with bedrooms upstairs Colonial, 50 years old; R19 insulation
	Existing Conditions	**HVAC**: Gas-powered condensing boiler; standard thermostat **Insulation**: R19 insulation in ceiling; crawl space/basement uninsulated; typical attic leakage in bypasses; typical metal ductwork
	Equipment Installed	**HVAC:** ASHP mini-split (ductless); Wi-Fi–connected thermostat **Insulation:** R49 insulation (blown-in) for ceiling and R30 insulation (fiberglass) crawl space/basement; air sealing for whole house, attic & basement bypasses
Commercial Sector		
Lighting Retrofit	Building Type	Retail store (one floor)
	Building Size	10,000 sq. ft.
	Existing Conditions	**Indoor**: Linear fluorescent **Outdoor**: HID Assume no controls currently installed
	Equipment Installed	**Indoor:** 1:1 LED retrofit using LED retrofit kits (not changing fixtures) **Outdoor:** 100% fixture replacement with LED Install lighting controls in a networked system, including features such as daylighting and auto-dimming
HVAC Retrofit: Variable Refrigerant Flow (VRF)	Building Type	Commercial office building
	Building Size	30,000 sq. ft.
	Existing Conditions	**Fuel type**: Gas **Equipment**: Four (approximately 10-ton) packaged rooftop air-conditioning units with gas-fired heating, each controlling a single zone
	Equipment Installed	**Fuel type**: Electric **Equipment**: VRF system with 1 main outdoor unit and 10 indoor zones Assume significant updates to the electric service will not be required

Prototypical Projects Used in Service-Provider and Decision-Maker Surveys		
Building Management Project Involving System/ Operational Optimization for Energy Efficiency and Electrification	Building Type	Commercial office building
	Building Size	100,000 sq. ft
	Existing Conditions	**HVAC:** System has older controls and requires hardware and software updates **Lighting**: Newer control system does not require a hardware update (only software)
	Equipment Installed	**HVAC:** Upgrade controls system for air handling unit; assume 25% of sensors need replacement (but no additional sensors); conduct static pressure reset and economizer optimization **Lighting:** Assume no system/hardware upgrades, only reprogramming (daylighting and auto-dimming); integrate with HVAC controls system
Multifamily Sector		
Buildings Undergoing Energy Efficiency and Electrification Retrofit	Building Type	Pre-war walk-up apartment building (market-rate)
	Building Size	24 units (4 stories)
	Existing Conditions	**HVAC**: Gas-fired, one-pipe steam system **Insulation**: Low ceiling/attic insulation level **Lighting (indoor—in-unit and common areas):** CFL (in-unit) and linear fluorescent (common areas) **Lighting (outdoor):** HID
	Equipment Installed (ASHP)	**HVAC:** ASHP mini-splits **Insulation:** add blown-in insulation to ceiling/attic **Lighting (indoor—in-unit and common areas):** LED; no fixture replacement **Lighting (outdoor):** LED; no fixture replacement
	Equipment Installed (Steam)	**HVAC:** Higher-efficiency steam system **Insulation:** Add blown-in insulation to ceiling/attic **Lighting (indoor—in-unit and common areas):** LED; no fixture replacement **Lighting (outdoor):** LED; no fixture replacement

Soft Cost Categories

Throughout the study, the Market Evaluation Team refers to two categories of costs: hard costs and soft costs. Hard costs are defined as materials and equipment costs, excluding any markups contractors add when selling to customers. Soft costs, by contrast, are non-equipment costs.

Table 3 presents the final soft cost categories and components used in the study. During the baseline study, the Market Evaluation Team revised these soft cost category definitions through rigorous testing with our own subject matter experts, external advisors, and NYSERDA experts and program managers.

The Market Evaluation Team also asked service providers about supply chain/stocking costs and project financing/cash flow. Experts had recommended not to quantify these soft costs because they are often determined by non-project-specific factors (such as a company's financial health or a facility's size). Therefore, the Market Evaluation Team asked a series of qualitative questions to understand some key facets of these soft costs that can have an impact on a contractor's soft costs. The Market Evaluation Team asked some service providers other questions of interest to NYSERDA, such as the differences between whole-home and supplemental ASHP installations in the residential sector and the differences between market-rate and affordable housing retrofits in the multifamily sector.

Table 3. Soft Cost Categories for Quantification (Service Providers)

Category	Component
Marketing and Customer Acquisition	**Marketing and/or customer education costs** (hours), including dedicated marketing staff
	Preparation for each bid, including time spent on building assessment and system sizing before the project has been contracted, which may include initial audits to gather necessary building information
	Project signing and contracting
	Other marketing or customer education costs (dollars), such as email marketing, advertising, or trade show visits
Project/System Design and Development	**Designing, scoping, and customizing the project** for an individual, including energy modeling (if needed), after the project has been contracted
Installation Labor	**Installation labor** to install the system and manage the installation, including both the contractor's staff and any subcontractors
Transaction Costs	**Obtaining permits** to complete the work compliant to local, state, and federal regulations
	Obtaining licenses necessary to execute [PROTOTYPICAL PROJECT] installations
	Acquiring and maintaining the training and certifications necessary to execute [PROTOTYPICAL PROJECT] installations
Quality Assurance/ Quality Control (QA/QC)	**Quality assurance and quality control activities** to ensure the work has been completed per agreed-upon project design and standards
	Required callbacks to the customer to assist with equipment issues/servicing
Recruiting and Hiring	**Recruiting and hiring employees** with the skills and expertise necessary to execute [PROTOTYPICAL PROJECT] installations

The Market Evaluation Team also assessed a set of soft costs for decision-makers, as shown in Table 4. Though not used in the final soft cost quantifications, as the majority of soft costs are borne by the contractors, these results provide insight into interventions that can be made from an end-user perspective. Some soft costs, such as transaction costs and supply chain/stocking, are not applicable to decision-makers, as these costs are primarily borne by service providers.

Table 4. Soft Cost Categories (Decision-Makers)

Category	Component
Marketing and Acquisition	**Finding a contractor to complete the project**, including preparing a bid package, price negotiations, and signing the contract
Project/System Design and Development	**Revising project scope** based on discussions with key stakeholders and the vendor
Installation Labor	**Project management** to ensure the work is going as planned, including meeting with service providers, inspecting the job site, and managing service provider invoicing
Project Financing and Cash Flow	**Time needed to acquire funding** to complete [PROTOTYPICAL PROJECT], such as preparing information on the project for internal stakeholders, and applying for loans/grants
Quality Assurance/ Quality Control (QA/QC)	**Time and money spent on maintaining the new system**, including training staff, repairs completed internally and repairs completed via a hired contractor

Research Methods

To complete the Energy Efficiency and Electrification Soft Costs baseline study, the Market Evaluation Team used a suite of research methods to gather the necessary data. These included surveys with service providers, surveys with decision-makers, and reviews with an advisory committee of experts. This section describes our approach to each method.

Surveys

The Market Evaluation Team developed prototypical, project-specific surveys for energy-service providers and decision-makers operating in New York State to clarify soft and hard costs as well as the timelines associated with completing the selected, prototypical, energy efficiency and electrification projects. These surveys were suited to the commercial, multifamily, and residential sectors, prototypical energy efficiency and electrification projects, and respondent types.

Service Providers

The Market Evaluation Team conducted a quantitative survey with energy-service providers in New York State to collect data on the breakdown of installed costs (including soft costs) and on additional project topics related to equipment stocking and customer acquisition. Energy-service providers are defined as contractors or energy service companies (ESCOs) that work within the residential, commercial, or multifamily sectors to provide energy efficiency and electrification upgrades or equipment replacements to improve efficiency. Service providers across the three sectors include electrical contractors, insulation contractors, general contractors, HVAC contractors, controls contractors, plumbers, and ESCOs.

The Market Evaluation Team invited contacts with valid email addresses to complete the survey online then followed up with a reminder email to nonrespondents.

To develop the energy-service providers' sample frame, the Market Evaluation Team used data from Data Axle (formerly InfoGroup) and Exact Data as the primary sources, supplemented with contacts from these additional sources:

- NYSERDA's contractor lists: Multifamily Building Solutions Network, Home Performance Contractors, RTEM Qualified Vendors, NYSERDA technical reviewers, EmPower Contractors, and NYS Clean Heat Contractors
- Manufacturer qualified contractor lists: Mitsubishi, Daikin Comfort, LG, KMC Controls, Automated Logic, Computrols, Alterton
- Relevant trade associations: New York State Plumbing-Heating-Cooling Contractors Association, Northeast Sustainable Energy Association

To increase response rates, the Market Evaluation Team also worked with several trade organizations and manufacturers to distribute the survey to their members. Toward the end of the survey fielding period, the Market Evaluation Team also employed snowball recruiting, which involved offering an additional incentive to service providers who refer another service provider to take the survey.

Table 5 in the next section, *Sample Composition and Interpretation*, shows the targeted number of completions versus the achieved number of completed service-provider surveys.

Decision-Makers

The Market Evaluation Team conducted a quantitative survey with residential decision-makers and a qualitative survey with commercial and multifamily decision-makers to gather insights on the impact of soft costs on project decisions and any associated points of friction.

The Market Evaluation Team used an online panel (purchased from Qualtrics) to survey residential-sector homeowners and landlords (in the single-family market).

Decision-makers in the commercial and multifamily sectors included property owners and managers who recently completed one of the prototypical commercial or multifamily projects. The Market Evaluation Team drew upon Data Axle data to develop a sample frame for these sectors and supplemented with contacts from property management company websites (e.g., Colliers, AJ Clarke, ABS Real Estate, and Pemco Group) and trade associations (e.g., New York Building Managers Association, New York Capital Region Apartment Association, and International Facility Management Association).

The Market Evaluation Team invited contacts with a valid email address to complete the survey online then followed up with a reminder email to nonrespondents.

Table 5 in the next section, *Sample Composition and Interpretation*, shows the targeted number of completions versus the achieved number of completed decision-maker surveys.

Strategic Advisory Committee

The Market Evaluation Team re-engaged a group of three market experts, who served on a Strategic Advisory Committee (SAC), to provide additional direction and input to the project. The SAC had reviewed the methodology and results during the baseline study and provided comparable technical review for this year's study. Specifically, the SAC reviewed the completed draft report to ensure that the findings, conclusions, and recommendations are realistic and applicable to the general market.

Sample Composition and Interpretation

The Market Evaluation Team collected survey data from a total of 413 respondents, 183 service providers, and 230 decision-makers. Table 5 shows the distribution of the sample by sector and prototypical project. The Market Evaluation Team achieved some of its sample-size targets across prototypical projects; however, several persistent challenges resulted in a lower-than-desired completion rate for the following prototypical projects:

- Commercial and multifamily prototypical projects were highly complex and specialized, making it hard to reach contractors qualified to respond to the survey because their populations were small compared with the larger population of general contractors.
- Some prototypical projects in the multifamily and commercial sector were more forward-looking than commonly found in the market today, again reducing the population of contractors qualified to

respond to the survey. Specific examples of such projects include HVAC: VRF and multifamily (including ASHPs in every unit).

- Multifamily and commercial projects were typically completed by larger firms, posing challenges in finding the right contact. Larger firms tended to have more specialized employee roles (such as a dedicated marketing team, recruiting team, etc.) than would a smaller firm.

Table 5. Final Sample Composition (2021)

Prototypical Project	Service Providers		Decision-Makers	
	Completions (+ partial)	Goal	Completions (+ partial)	Goal
Residential	**87 (+27)**	**166**	**221**	**204**
HVAC: ASHP	56 (+12)	68	77	68
Insulation	19 (+9)	68	67	68
Whole-Home Efficiency	13 (+5)	30	77	68
Multifamily	**40 (+13)**	**30**	**4**	**10**
EE Retrofit (ASHP)	13 (+5)	10	4	10
EE Retrofit (Steam)	27 (+8)	20		
Commercial	**56 (+36)**	**122**	**5**	**10**
HVAC: VRF	31 (+26)	34	1	5
Lighting	14 (+5)	68	4	7
Building Mgmt. Systems	11 (+5)	20	-	2
Total	**183 (+76)**	**318**	**230**	**224**

For the commercial and multifamily prototypical projects, the Market Evaluation Team lowered the sample size targets from 2019 to 2021, due to an overestimation of the total population of available contractors in 2019. Though the Market Evaluation Team achieved a more balanced sample in 2021 than in 2019 (i.e., the distribution of service provider responses across sectors was more equal), the Market Evaluation Team also identified additional steps to improve the response rate for future iterations of the study. The recommended actions are presented in the *Conclusions and Recommendations* section.

As noted in the *Surveys* section above, the Market Evaluation Team used multiple sources to sample from. Some of these sources, such as manufacturer or NYSERDA's qualified contractor lists, introduce an element of bias into the sample. For example, some contractors are likely to have lower customer acquisition costs due to the free advertising they receive through their presence on one of NYSERDA's qualified contractor lists. The Market Evaluation Team and NYSERDA discussed the benefits and drawbacks of using each sample source and ultimately decided to use the sample sources listed even though the sample was not truly random.

Residential sampling resulted in a strong number of completed surveys, which meant the Market Evaluation Team could conduct robust statistical analyses to identify the drivers of soft costs in each type of prototypical project. Because the residential sector also had the strongest sample size during the baseline study, the Market Evaluation Team could compare changes from the baseline to 2021.

Compared to the baseline study, sample sizes for the commercial and multifamily sectors were larger this year, providing less variability in results. However, given the small sample sizes from the baseline study, it was not possible to assess changes over time for some prototypical projects.

The Market Evaluation Team did not attempt to generalize the results of small samples to the broader population and instead focused on presenting the information with practical significance (rather than statistical significance). As a result, to uncover soft cost changes for the commercial and multifamily sectors over time, the Market Evaluation Team recommends tracking changes in the interquartile range (IQR).[8] Tracking the IQR helps account for some of the variability typically present among smaller sample sizes, as it does not rely on a single-point estimate (such as a mean or median).

Analysis Methodology

The Market Evaluation Team used several methods to analyze the drivers of soft costs, including statistical comparisons of group means, standard deviations, and IQRs, as well as correlation analyses.

Approach to Quantifying Soft Costs

The Market Evaluation Team used survey data as the primary source to generate the soft cost estimates presented in this study. The survey was designed to ask about specific soft cost components in a manner easy for contractors to quantify. As detailed in *Appendix A. Soft Cost Category and Component Calculations*, our questions about each soft cost component used the most appropriate units (labor hours, dollars, percentage, or a combination), timeframe (per project or per year), and reference point (past year or hypothetical project), as determined by initial research with experts during the baseline study. The Market Evaluation Team mapped each of these questions to a soft cost component and category for the final calculation.

To calculate soft costs using all applicable data (hours and dollars), the Market Evaluation Team transformed labor hours into dollars using the same methodology as the baseline study. As detailed in *Appendix A. Blended Labor Rates Calculation*, the Market Evaluation Team used labor rates from RSMeans, along with several customizations for the trade type, the location where a contractor worked, the prototypical project, and the specific soft cost category the question asked about. This led to a set of blended labor rates that the Market Evaluation Team used in the calculations, presented in Table 6. Compared to the baseline study (2019), labor rates rose by between 5% to 7% across contractor types.

[8] The interquartile range (IQR) is the middle 50% of the statistical dispersion of a dataset. It is equal to the difference between the 3rd quartile (i.e., 75th percentile) and 1st quartile (i.e., 25th percentile).

Table 6. Final Blended Labor Rates Used for Quantification

Soft Cost Category	Commercial			Multi-family	Residential		
	Lighting	HVAC: VRF	Bldg. Mgmt.		HVAC	Insulation	Whole-Home
Upstate							
Marketing and Customer Acquisition	$67.65	$66.13	$67.65	$64.95	$63.80	$67.27	$63.61
System Design	$73.44	$71.92	$73.44	$70.74	$69.58	$73.05	$69.39
Installation Labor	$73.44	$71.92	$73.44	$70.74	$69.58	$73.05	$69.39
Transaction Costs	$60.20	$59.28	$60.20	$58.58	$57.88	$59.97	$57.77
Training and Certifications	$75.10	$72.98	$75.10	$71.33	$69.71	$74.57	$69.44
QA/QC	$81.15	$78.72	$81.15	$76.83	$74.98	$80.54	$74.67
Downstate							
Marketing and Customer Acquisition	$101.68	$99.40	$101.68	$97.62	$95.88	$101.11	$95.60
System Design	$110.37	$108.09	$110.37	$106.32	$104.58	$109.80	$104.29
Installation Labor	$110.37	$108.09	$110.37	$106.32	$104.58	$109.80	$104.29
Transaction Costs	$90.47	$89.10	$90.47	$88.04	$87.00	$90.13	$86.83
Training and Certifications	$112.88	$109.69	$112.88	$107.21	$104.77	$112.08	$104.37
QA/QC	$121.96	$118.31	$121.96	$115.48	$112.69	$121.05	$112.23

After completing data collection, the Market Evaluation Team cleaned the data using a two-step process: first removing errors and then "far-out" outliers. The process began by removing any data points that were clearly errors or unrealistic for the given question (i.e., entering either zero or 50,000 hours for residential HVAC installation labor). By removing these data points, the Market Evaluation Team could calculate more accurate summary statistics, such as the mean and IQR. The Market Evaluation Team acted as conservatively as possible in this step, removing only data points clearly entered in error.

The Market Evaluation Team then used John Tukey's (1977) method for removing outliers known as "Tukey fences." These are bounds set on a dataset to identify data points that fall far outside the IQR. Tukey proposed the bounds outlined in Equation 1 for fences to determine outliers.

Equation 1. Tukey's Fences

$$-Q_1 - k(Q_3 - Q_1), Q_3 + k(Q_3 - Q_1)$$

where k=1.5 indicates an outlier and k=3 indicates data that are "far out"

The Market Evaluation Team selected the Tukey fence value of k=3 to take a more conservative approach with the data-cleaning process, specifically because no benchmark data were available for comparisons. This method proved impossible for prototypical projects with very small sample sizes (<15) as not enough responses were available to reliably determine if one was an outlier. In these instances, the Market Evaluation Team used only the initial process of removing responses that were clearly errors

or not realistic. *Appendix A. Soft Cost Quantification Methodology* provides a full description of the soft cost quantification methodology.

Multiple Linear Regression

The Market Evaluation Team used multiple linear regression to assess the degree to which variations in contractors' soft costs can be explained by firmographic variables, collected by and constructed from the survey data. In other words, the models assess correlations between one firmographic variable and the contractors' soft costs, controlling for other firmographic variables included in the model. In each prototypical project, as sample size allowed, the Market Evaluation Team regressed each soft cost category (y/dependent variable) against a set of explanatory variables (x/independent variables). In these models, the Market Evaluation Team used the x variables listed in Table 7.

Table 7. Linear Regression Variable Definitions and Scales

Variable	Definition	Coefficient Interpretation [a]
Intercept	Baseline soft costs of operation when all independent variables in regression set to 0	Not used for interpretation—exists only to scale the model appropriately
Region	Upstate or downstate contractor indicator variable (=0 if downstate contractor, =1 if upstate contractor)	The average difference in soft costs for a contractor in upstate New York relative to a contractor in downstate New York
Employees	Number of employees working for the firm in New York State	The average incremental change in soft costs for a firm with one additional employee
Installations	Number of yearly installations completed for the specific prototypical project/job type	The average incremental change in soft costs for a firm with one additional annual installation
Percent revenue bin (1-5)	The percentage of the firm's yearly revenue coming from the prototypical project/job type installations; bins are 1: <20%, 2: 20-39%, 3: 40-59%, 4: 60-79%, 5: 80%+	The average incremental change in soft costs for a firm one revenue bin level higher
Win rate [b]	The percentage of bids a firm reports winning from all bids they create for prototypical project installations	The average incremental change in soft costs for a firm with a one percentage point higher win rate
Fixed effects	Control for differences in means soft cost values among prototypical projects	-
n	Sample size	-
R^2	Explanatory power of the regression (i.e., how much of the change in the dependent variable can be explained by the variables in the model)	-

[a] Note: "All else equal" implied for all coefficient interpretations.

[b] Win rate is determined by two questions in the survey: the number of bids a contractor creates for the example prototypical project in the past 12 months and how many of those bids resulted in a contract. The win rate variable is calculated by dividing the number of winning bids by the total number of bids. As such, there are a few cases where the Market Evaluation Team omitted win rate from a regression due to its interaction with the dependent variable by the way win rate is calculated.

Detailed Findings

This section describes findings from the research activities described above and is organized as follows:

- **Market Forces and Changes:** summary of forces impacting the New York energy efficiency and building electrification market during the study period and changes from the baseline
- **Cross-Sector Trends:** view of soft cost results across sectors, focusing on market-level trends
- **Residential Sector:** deep dive into the residential sector (one to four units) and its three prototypical projects (HVAC replacement, insulation and air sealing, and whole-home efficiency)
- **Commercial Sector:** results at the commercial sector level, with differences by prototypical project when sample size allowed
- **Multifamily Sector:** results at the multifamily-sector level (five or more units), with differences by prototypical project when sample size allowed

Each section contains data from both service providers and decision-makers, as applicable, with the soft cost quantification data sourced from the service provider surveys.

Fluctuations in Market and Economic Conditions

The energy efficiency and electrification market in New York State experienced drastic changes from the baseline evaluation period (2019) to the current period (2021). These changes led to several confounding factors that influenced energy efficiency and electrification project cost estimates between the two years. This section examines the major market changes and the impact of those changes on this study.

Nascent Market

Many of the electrification and efficient technologies included in this study, especially heat pumps and building controls, are technologies that are rapidly developing and changing. By design, this study includes several newer technologies, such as a variable refrigerant flow (VRF) system in a commercial building and heat pumps in a multifamily building retrofit, that are not common in the market today.

These technologies interject a degree of uncertainty for service providers who install them, resulting in increased soft costs. For example, service providers who are less familiar with a technology may estimate a higher design and installation cost to compensate for time spent learning and troubleshooting. Similarly, service providers may need to complete additional trainings to learn how to install these technologies or may need to hire and train additional workers to install newer technologies. Heat pumps and other building electrification technologies are still in an early phase of development, with heat pumps representing 17.4% of the residential units sold in 2017,[9] and having penetration of

[9] NYSERDA. September 27, 2019. *2019 HVAC Market Characterization Residential Building Stock Assessment.*

12% for split systems and 2% for unitary systems in the commercial market,[10] as of 2019. As the heat pump and building electrification market matures, volatility in hard and soft costs is expected.

Given the growing opportunities for building electrification technologies, the data shows that new contractors are entering the market. For example, the average years of experience for residential HVAC contractors who responded to our survey in 2019 was 16.7; in 2021, this dropped to 11.3. Less experienced contractors tend to take more time for project installations than their more experienced peers and may buffer their estimates to build in time for "learning on the job" given their lack of familiarity with a specific technology. As discussed in the *HVAC Replacement* section, Residential HVAC service providers who are less experienced (below the mean of 11.3 years) estimated soft costs to be $1,300 greater ($6,810 compared to $5,510) than service providers with a higher level of experience (above the mean of 11.3 years).

Program Changes

Incentive programs can have a large impact on both hard and soft costs for energy efficiency and electrification projects. In New York State, incentive programs underwent significant changes from the baseline study to 2021, namely a change in administration of the heat pump incentive programs from NYSERDA to the individual utilities. Any change in program administration, no matter how smooth, can lead to confusion in the market among both service providers and decision-makers. When service providers face uncertainty, they are likely to increase costs to cover any change in margin or additional work that may occur to handle the change. These cost increases are then passed onto the customer, resulting in higher total project costs. Thus, it is likely that the change in incentive program administration contributed to a temporary increase in some efficiency and electrification project-related costs while service providers assessed the new program design. Further, a change in administration can lead to new marketing opportunities; in this case because individual utilities have a different set of customer data and ways to connect with customers. This can lead to increased customer interest and demand for efficient technologies.

Pandemic and General Economy Impacts

Since the baseline study was completed in 2019, the New York market and economy has undergone several changes, many exacerbated by the COVID-19 pandemic. Specifically, impacts to the acquisition of goods, the labor market, and consumer behaviors have led to a different market in 2021.

- **Acquisition of Goods**: Lockdowns and labor shortages resulted in decreased production, shipping delays, restricted supply, and increased the costs for both raw materials and fully assembled equipment. The price of materials, such as metal, has increased dramatically, forcing manufacturers of metal products to also increase prices. This is reflective of the residential and nonresidential Producer Price Index, which saw increases by 24.7% and 26.4% since 2019, respectively, according to the U.S. Bureau of Labor Statistics.[11] Increased prices of materials have caused price markups at

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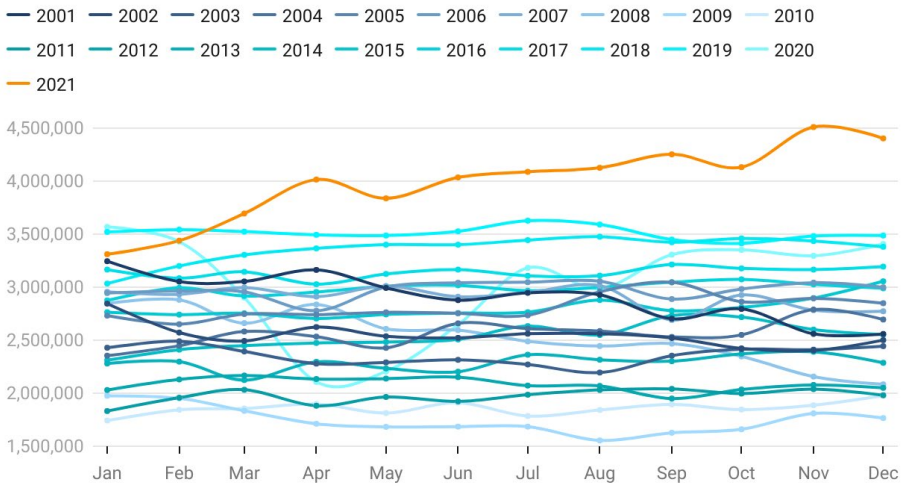
[10] NYSERDA. *Commercial Baseline Study HVAC Market Assessment*.

[11] U.S. Bureau of Labor Statistics. "*Producer Price Index by Commodity – Inputs to Industry*". https://www.bls.gov/ppi/tables/.

all stages of production, distribution, purchase, and installation. For service providers, these market changes impacted hard and soft costs for all energy efficiency and electrification projects, as the Northeast Urban Consumer Price Index saw an increase of 6.3% over this period. Other challenges for service providers included low stocks of materials, delayed deliveries, and project scheduling conflicts. These increases had a direct impact on project hard costs.

- **Labor Market**: Due to impacts from the COVID-19 pandemic, the labor market saw a greater need for recruiting and hiring to meet demand across all aspects of the supply chain. Prioritization of health, safety, and family among laborers led to higher and unmet demand in the labor market, especially for jobs that relied on in-person interaction. This is indicated by the increase in turnover, shown in Figure 3. In this chart, 2021 is represented by the orange line, which shows turnover rates substantially greater than other recent years. Compounding this was the temporary increase in unemployment benefits, which factored into employees' labor market participation decisions. As a result, firms provided increases in benefits and wages to attract employees and meet labor needs. Between 2019 and 2021, RSMeans reported an increase in labor rates ranging from 5.3% to 7.1% as firms struggled to recruit and hire qualified workers.[12] According to The Construction Association, 61% of surveyed firms that experienced project delays in 2021 said workforce shortages was the top reason.[13] These changes led to higher labor costs, which were passed on to customers.

Figure 3. Monthly Labor Turnover, 2001-2021



Source: U.S. Bureau of Labor Statistics, Job Openings and Labor Turnover Survey.
Visualization by SHRM, 2022

- **Consumer Behaviors:** COVID-19 lockdowns and restrictions and/or mandates increased the time spent inside the household, both from a leisure and a business perspective. As a result, consumers were more likely to have a better grasp of the areas in their home with poor performance (i.e.,

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12 RSMeans. 2021.

13 The Construction Association. *2021 Workforce Survey Analysis.* Accessed March 2022. https://www.agc.org/sites/default/files/2021%20Workforce%20Survey%20Analysis.pdf.

drafty rooms) and where energy is being used. During the pandemic, U.S. households accumulated approximately $2.7 trillion in excess savings, roughly 13% of GDP.[14] This greater understanding of home energy performance, along with the extra household savings, likely increased the demand for and the ability to pay for home improvements that involved energy efficiency and electrification projects.

Cross-Sector Trends

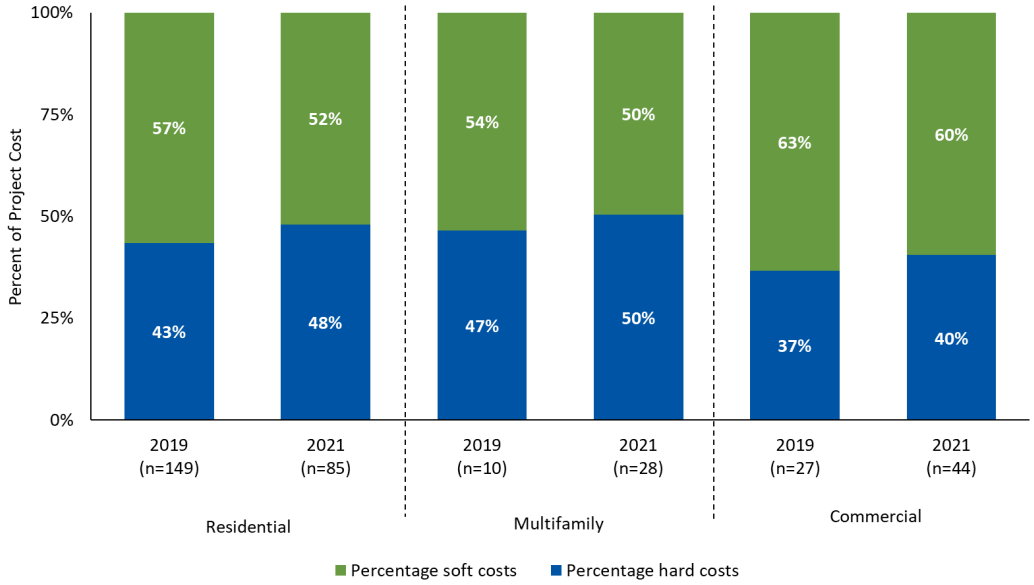
This section details overarching soft cost trends across the three sectors: residential, commercial, and multifamily. Specifically, this section contains high-level findings related to the breakdown of hard versus soft costs, the largest sources of soft costs, and variability in soft costs. More detailed information is reserved for each sector's specific section.

Hard versus Soft Costs

Across sectors, service provider estimates for the percentage of total project costs that are hard or soft changed from 2019, with hard costs comprising a slightly larger share of total project costs in 2021 than in 2019. As shown in Figure 4, this trend was observed across all three sectors, with a shift between 3% to 5%. This difference is indicative of the substantial changes in hard costs observed by this study due to supply chain issues, with hard costs rising approximately three times as fast as soft costs in the residential sector, as shown in Table 8. Figure 4 shows the *share* of total project costs that are soft and hard costs (this share will always add to 100%); soft cost percentages falling does not mean that the absolute value of soft costs fell.

[14] TD Economics. *Where the Road of Excess [Saving] Leads.* https://economics.td.com/us-excess-savings#:~:text=Highlights,to%20roughly%2013%25%20of%20GDP.

Figure 4. Hard vs. Soft Cost Estimated Breakdown by Sector, 2019 vs. 2021



Note: Percentages presented in this chart are relative to total project cost estimates for a specific prototypical project within a specific year. That is, a soft cost percentage being higher in 2019 does **not** indicate that 2019 has higher absolute soft costs. Numbers may not add to 100% due to rounding.

As noted in the *Fluctuations in Market* section, several factors probably impacted the results in this year's study, which is important to consider when comparing to 2019 results. Specifically, supply chain issues and inflation led to substantial increases in equipment costs. Only one of the differences from 2019 to 2021 listed in Table 8 is statistically significant: soft costs for Residential HVAC Replacement increased by 18% and hard costs by 38%. All other differences listed in Table 8 are not statistically significant but rather are directional due to low sample sizes across either one or both years.

Table 8. Soft Cost and Hard Cost Changes 2019 vs. 2021

Sector/Prototypical Project	Soft Costs			Hard Costs		
	2019	2021	Change	2019	2021	Change
Residential	-	-	**+13%**	-	-	**+31%**
HVAC Replacement	$6,722	$7,927	+18%***	$5,387	$7,430	+38%***
Insulation and Air Sealing	$4,130	$3,686	-11%	$2,260	$2,438	+8%
Whole-Home	$9,214	$11,754	+28%	$7,474	$10,560	+41%
Multifamily	-	-	-	-	-	-
EE Retrofit: Steam	N/A [a]	$74,475	-	N/A [a]	$71,632	-
EE Retrofit: ASHP	N/A [a]	$196,596	-	N/A [a]	$196,261	-
Commercial	-	-		-	-	-
HVAC: VRF	$139,097	$153,463	+10%	$84,138	$90,257	+7%
Lighting	N/A [a]	$26,914	-	N/A [a]	$24,814	-
Building Controls	N/A [a]	$93,755	-	N/A [a]	$44,120	-

*** denotes statistical significance at the 95% confidence level ($p < 0.05$)

[a] Removed comparison due to high variability from small sample size.

Sources of Soft Costs

A few trends emerge when looking at soft costs at a sector level only, as shown in Table 9. First, consistent with 2019, installation labor comprises approximately one-half of project soft costs across sectors and is the largest contributor to soft costs. Marketing and customer acquisition, the next largest category, accounts for about one-third of soft costs in the residential sector and 15% to 20% in the commercial and multifamily sectors.

Table 9. Soft Cost Category Averages and Spread by Sector, 2019 vs. 2021

Soft Cost Category	Residential		Commercial		Multifamily	
Year	2019	2021	2019	2021	2019	2021 [a]
Sample Size	(n=129-145)	(n=62-94)	(n=33-42)	(n=43-80)	(n=8-13)	(n=9-32)
Marketing and Customer Acquisition	27%	31%	21%	16%	14%	21%
	(26%-28%)	*(29%-31%)*	*(12%-38%)*	*(12%-30%)*	-	*(6%-28%)*
Project Design	5%	5%	7%	8%	9%	10%
	(4%-6%)	*(3%-5%)*	*(6%-10%)*	*(5%-21%)*	-	*(6%-12%)*
Installation	51%	46%	53%	63%	48%	50%
	(50%-54%)	*(43%-56%)*	*(24%-69%)*	*(34%-77%)*	-	*(35%-76%)*
Transaction Costs (Trainings, Certifications, Permits)	11%	12%	13%	8%	20%	13%
	(9%-12%)	*(7%-14%)*	*(5%-25%)*	*(3%-11%)*	-	*(7%-16%)*
Quality Assurance	5%	4%	6%	5%	8%	6%
	(3%-5%)	*(3%-5%)*	*(3%-9%)*	*(2%-8%)*	-	*(5%-7%)*
Recruiting and Hiring	1%	3%	0%	1%	1%	2%
	(0%-1%)	*(2%-6%)*	*(0%-1%)*	*(0%-1%)*	-	*(0%-2%)*

Note: Note that the top percentage is the average and the bottom percentages (in *italics* in parentheses) are the spread.
Note: Columns may not add to 100% due to rounding. These results are relative to the total soft costs within a sector within a year. Thus, a certain soft cost category comprising a lower percentage of sector soft costs in 2021 than 2019 (such as installation labor for residential) does not indicate a change in absolute soft cost values. See individual sector sections for more details.
[a] Due to low sample sizes in the Multifamily sector, the spread is generally larger than in the Residential or Commercial sectors.

As described in the sector-level sections that follow, marketing and customer acquisition costs were significantly higher in 2021 than 2019, specifically for bid preparation in the residential sector and the commercial HVAC prototypical project, which caused the shift in total soft cost composition. Notably, marketing and customer acquisition costs are a lower percentage of total soft costs in the commercial and multifamily sectors than in the residential sector, which may be due to the fact that commercial and multifamily projects are, on average, more complex and require more design and installation time.

The Market Evaluation Team found that recruiting and hiring costs were a comparatively small percentage of total project soft costs, with an average of only 1% to 3% across sectors. However, these costs grew from 2019 to 2021 for several prototypical projects (see sector-level sections for full details), probably due to challenges faced by firms in the current labor market, as discussed in the *Pandemic and General Economy Impacts* section.

Key Findings: Cross-Sector Trends
• Hard costs rose substantially across all prototypical projects, likely due to pandemic-induced supply chain issues. Soft costs rose as well, albeit at a somewhat lower rate. • Consistent with 2019, installation labor was consistently the largest contributor to sector-level soft costs, accounting for approximately half of soft cost estimates. Following this was marketing and customer acquisition costs, which increased more in the residential sector than other sectors.

Residential Sector

This section details soft cost results for the residential sector. The section begins with a sector-level view of soft costs then moves into the three prototypical projects: HVAC replacement, insulation and air sealing, and whole-home efficiency. Each section contains the following types of information, primarily sourced from service-provider surveys:

- Soft cost estimates for prototypical projects
- Drivers of soft costs variation (win rate, contractor region, etc.)
- Additional soft cost-related topics (supply chain/stocking, project financing, etc.)
- Results from decision-maker surveys (separate data collection effort from prior three topics)

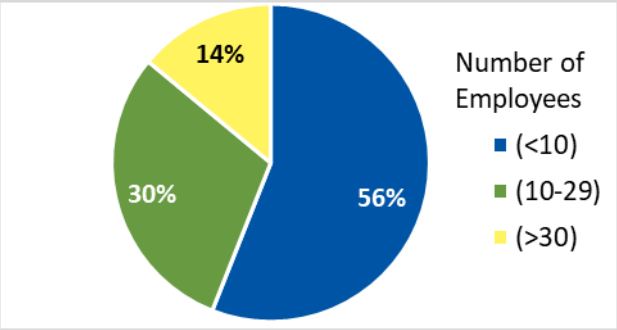
Sector-Level

The Market Evaluation Team gathered survey responses from 114 residential contractors, 68 of whom completed a HVAC project, 28 an insulation project, and 18 a whole-home efficiency project within the past 12 months.[15] Seventy-four percent primarily worked in upstate New York, and 26% worked downstate. The representation of residential upstate and downstate service providers in 2021 remained nearly the same as in 2019.

Fifty-six percent worked in a company employing fewer than 10 employees, as shown in Figure 5. The 2021 service providers sample had a slightly higher representation from companies with between 10 and 29 employees compared with the 2019 sample, while companies with fewer than 10 or greater than 30 employees had a slightly smaller representation in the 2021 sample.

Figure 5. Residential Service Provider Firm Size (2021)

[15] These sample sizes include partial responses.



Source: Residential Contractor Survey Q F1: "Including yourself, approximately how many employees work for your company in New York state?" (n=114)

Soft Cost Estimates

Table 10 displays residential sector soft costs by absolute value, collected from surveys with service providers. Across most soft cost categories, the whole-home efficiency project estimate is relatively equal to the sum of the HVAC replacement and insulation and air sealing project estimates. This is expected for soft cost categories, such as installation labor, project design, and quality assurance, as the whole-home efficiency project specification combines measures from the HVAC replacement and insulation and air sealing projects. The Market Evaluation Team observed this trend in 2019 as well for several soft cost categories, which provides confidence that service providers are evaluating the projects appropriately.

Based on the prototypical project specifications (building size and type), the Market Evaluation Team estimates that a 3.5-ton system would be the proper size for the HVAC replacement project and a 3-ton system for the whole-home efficiency project.[16] This equates to soft costs per thermal ton of $1,791 for HVAC replacement and $3,867 for whole-home efficiency, up from $1,343 and $3,329 in 2019, respectively.

[16] The HVAC replacement system sizing assumes the home has standard insulation and air sealing. In contrast, the whole-home efficiency prototypical project sizing assumes the home received comprehensive air sealing and insulation improvements at the time of heat pump installation. The Market Evaluation Team has found that air sealing and insulation improvements might typically reduce the heating load by 10% to 20%. Thus, the Market Evaluation Team assumed a reduction in heating load by 15% for the whole-home efficiency project as compared with the residential HVAC replacement project.

Table 10. Residential Soft Cost Category Absolute Values, 2019 vs. 2021

Soft Cost Category	HVAC Replacement		Insulation and Air Sealing		Whole-Home Efficiency	
	2019 (n=69-98)	2021 (n=45-55)	2019 (n=22-30)	2021 (n=11-22)	2019 (n=18-30)	2021 (n=8-17)
Marketing and Customer Acquisition	$1,215	$1,973**	$1,565	$1,818	$2,834	$3,464
Project Design	$248	$319*	$357	$219	$416	$625
Installation	$2,337	$2,671*	$3,138	$3,571	$5,259	$5,047
Transaction Costs (Training, Certifications, Permits)	$582	$884*	$523	$418	$1,105	$1,148
Quality Assurance	$251	$282	$229	$180	$328	$597
Recruiting and Hiring	$68	$138**	$35	$129	$46	$719**
Total Soft Costs [a]	**$4,702**	**$6,268 [b]**	**$5,846**	**$6,335**	**$9,988**	**$11,599**

Statistical significance is denoted by the following notation: * p < 0.20, ** p < 0.10, *** p < 0.05.
[a] Due to the calculation method for total soft costs (summing of individual cost buckets, with sample differences across the set), it is not possible to test statistical significance for total soft cost changes from 2019 to 2021.
[b] Given that five of six soft cost categories are statistically higher in 2021 than 2019 for the HVAC replacement prototypical project, it is reasonable to assume that 2021 soft costs are higher than 2019 soft costs.

As shown in Table 11, the major soft cost categories remained relatively consistent from 2019 to 2021, with installation labor generally comprising close to half of total project soft costs. Marketing and customer acquisition and, to a lesser extent, recruiting and hiring costs, comprised a larger percentage of total soft costs in 2021 than in 2019. As discussed in the *HVAC Replacement* section below, this is primarily driven by higher bid preparation costs—that is, service providers are spending more on preparing bids within a year, which contributes to increased per-project costs. The Market Evaluation Team hypothesizes this is likely due to numerous factors, including greater customer interest in efficient HVAC systems sized for the entire home (which are more complex bids than like-for-like existing system replacements and thus take longer to draft/approve)[17], an increase in home energy audits (64% of decision-makers reported completing a home energy audit in 2021 compared to 46% in 2019; see the *Decision-Makers* section) and the entrance of new service providers into the market (the average years of experience among residential HVAC service providers fell by 5.4 years between the two study periods; 16.7 to 11.3; see the *HVAC Replacement* section).

Consistent with 2019, transaction costs (permitting, training and certifications, and licensing) make up a smaller portion of soft costs for insulation contractors than for HVAC or whole-home efficiency contractors. Given the greater complexity of HVAC replacements and whole-home efficiency projects

[17] While the Residential HVAC prototypical project includes a heat pump system sized to serve the entire home, the questions related to marketing (which include bid preparation) referenced all of the service provider's work on ductless heat pumps. The Market Evaluation Team made this choice after finding during the 2019 study planning that service providers would not be able to provide an accurate estimate of marketing-related costs for only heat pump systems serving the entire home.

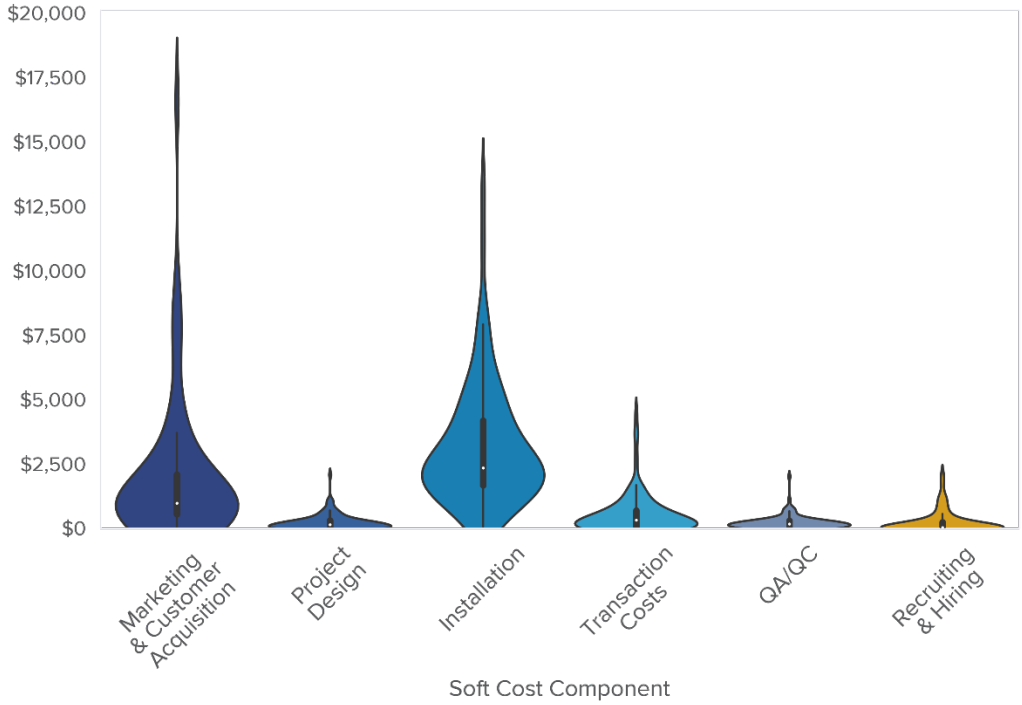
(both involving ASHP installations), this finding proved consistent with the Market Evaluation Team's expectations.

Table 11. Residential Soft Cost Category Shares, 2019 vs. 2021

Soft Cost Category	HVAC Replacement		Insulation and Air Sealing		Whole-Home Efficiency	
	2019 (n=69-98)	2021 (n=45-55)	2019 (n=22-30)	2021 (n=11-22)	2019 (n=18-30)	2021 (n=8-17)
Marketing and Customer Acquisition	26%	31%	27%	29%	28%	30%
Project Design	5%	5%	6%	3%	4%	5%
Installation	50%	43%	54%	56%	53%	44%
Transaction Costs (Trainings, Certifications, Permits)	12%	14%	8%	7%	11%	10%
Quality Assurance	5%	4%	4%	3%	3%	5%
Recruiting and Hiring	1%	2%	1%	2%	0%	6%
Total Soft Costs	**$4,702**	**$6,268**	**$5,846**	**$6,335**	**$9,988**	**$11,599**

Figure 6 shows the distribution of aggregated residential soft costs by category. The violin plots represent the spread of the cost estimates—that is, estimates are more widely dispersed for a long tail and/or a longer body shape.

Figure 6. Residential Sector Soft Costs Violin Plot



For example, QA/QC costs in the residential sector center closer to zero, while marketing and customer acquisition, installation, and transaction costs disperse more widely. Soft costs with a larger spread (i.e., wider across a larger part of the x-axis) represent a reduction opportunity, as some contractors doing a similar job spend more than others. The marketing and customer acquisition violin plot has a particularly unique shape, with a couple of outlier estimates creating the long tail. Though the installation labor violin plot has a similar shape to marketing and customer acquisition, it is a more normalized curve.

Drivers of Soft Costs

This section describes soft cost drivers within the residential sector. In most cases, residential sector-level findings are highly consistent with individual prototypical project-level findings, as the residential sector-level data comprise data combined from each of the three prototypical projects. Subsequent sections provide a more detailed analysis for each residential prototypical project.

As shown in Figure 7, firm-by-firm analysis shows that hard and soft costs display a weak positive correlation. That is, companies with higher hard costs are somewhat more likely to also have higher soft costs. The marker colors in the scatterplot also capture the differences in hard and soft costs between prototypical project types as well as the sample size for each prototypical project type. Insulation costs, for example, have hard and soft costs clustered at lower values, while whole-home costs show generally larger hard and soft cost values and little evidence of clustering.

Figure 7. Residential Sector Hard Costs vs. Soft Costs

The Market Evaluation Team used linear regression models to assess the degree to which residential sector soft costs can be explained by the firmographic variables collected. Table 12 shows regression estimates for residential-sector project soft costs, regressed on firmographic variables. Except for the number of employees in a service provider's firm, firmographic variables included in the regression

model had little explanatory power over total soft costs in the residential sector. In other words, a contractor's region, the number of installations they completed in the prior year, and their win rate do not correlate with total soft costs. The estimated "Employees" coefficient suggests that, for every additional employee, residential service providers spend an average of $128 more per project, all else being equal. This suggests that adding head count can increase cost, perhaps because the firm has higher overhead costs. Added headcount also means a firm may be conducting additional work beyond project installations, such as marketing, which can increase cost.

Table 12. Residential Total Soft Costs Regression Estimates

Dependent Variable: Total Soft Costs			
Independent Variable	**Coefficient**	**Standard Error**	**P-value**
Intercept	$6,245.838	1,446.347	0.000
Region (=Upstate)	-$1,968.048	1,538.247	0.209
Employees	$127.762	59.668	0.040***
Installations	$2.538	5.087	0.621
Win Rate	$21.119	23.170	0.368
HVAC Replacement Fixed Effects	$469.325	1,095.269	0.671
Insulation and Air Sealing Fixed Effects	-$3,396.538	1,100.867	0.004***
Whole-Home Efficiency Fixed Effects	$9,173.051	1,940.509	0.000***
n	41		
R^2	0.551		
Adjusted R^2	0.472		

Note: Standard errors in parentheses. * $p < 0.20$, ** $p < 0.10$, *** $p < 0.05$. Prototypical project fixed effects included to control for differences in means soft cost values among prototypical projects. Including these variables equalizes the differences in mean soft cost values and allows for comparisons.

Permitting

The Market Evaluation Team explored the relationship between the contractor's location and permitting costs, as prototypical project-level findings show differences in the distribution of permitting costs for upstate and downstate contractors. Table 13 shows estimated coefficients for a regression of residential sector permitting costs on firmographic variables, including region.

The estimated coefficient for the region indicator variable suggests that residential contractors in upstate New York spend an average of $269 less on permitting than do residential contractors in downstate New York, all else being equal.

Figure 8 illustrates this relationship graphically, with the vertical lines indicating median values for each group and excludes the controls included in the regression model. Subsequent sections show that this relationship varies, depending on the prototypical project type. This trend is consistent with data from 2019, where the Market Evaluation Team found upstate contractors spent spending $224 less on permitting costs.

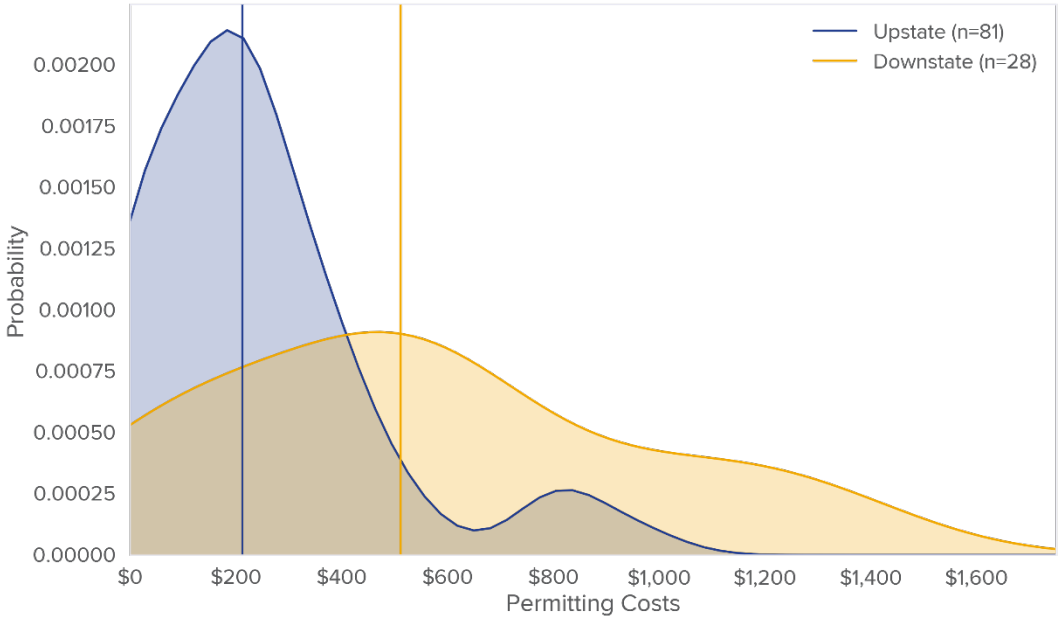
The regression model estimates reported in Table 13 present a second, noteworthy finding. The fixed effects coefficients for each prototypical project, which captures the average difference in permitting costs for each sector's service providers relative to other residential sector service providers, indicates that permitting costs vary by prototypical project, all else being equal. This is represented by the fact that all three fixed effects coefficients are statistically significant, with the insulation and air sealing fixed effects coefficient representing that these service providers spend less on permitting costs than other residential contractors, reflecting the fact that permitting is not required or sought for every project.

Table 13. Residential Permitting Costs Regression Estimates

Dependent Variable: Permitting Costs			
Independent Variable	**Coefficient**	**Standard Error**	**P-value**
Intercept	$358.554	88.749	0.000
Region (=Upstate)	-$268.721	95.671	0.009***
Employees	-$4.891	3.385	0.160
Installations	$0.143	0.300	0.638
Win rate	$1.124	1.340	0.409
HVAC Replacement Fixed Effects	$293.274	69.511	0.000***
Insulation and Air Sealing Fixed Effects	-$156.055	69.926	0.034***
Whole-Home Efficiency Fixed Effect	$221.336	128.063	0.095**
n	34		
R^2	0.468		
Adjusted R^2	0.349		

Note: Standard errors in parentheses. * $p < 0.20$, ** $p < 0.10$, *** $p < 0.05$. Prototypical project fixed effects included to control for differences in means soft cost values among prototypical projects.

Figure 8. Residential Permitting Costs Distribution and Mean by Region



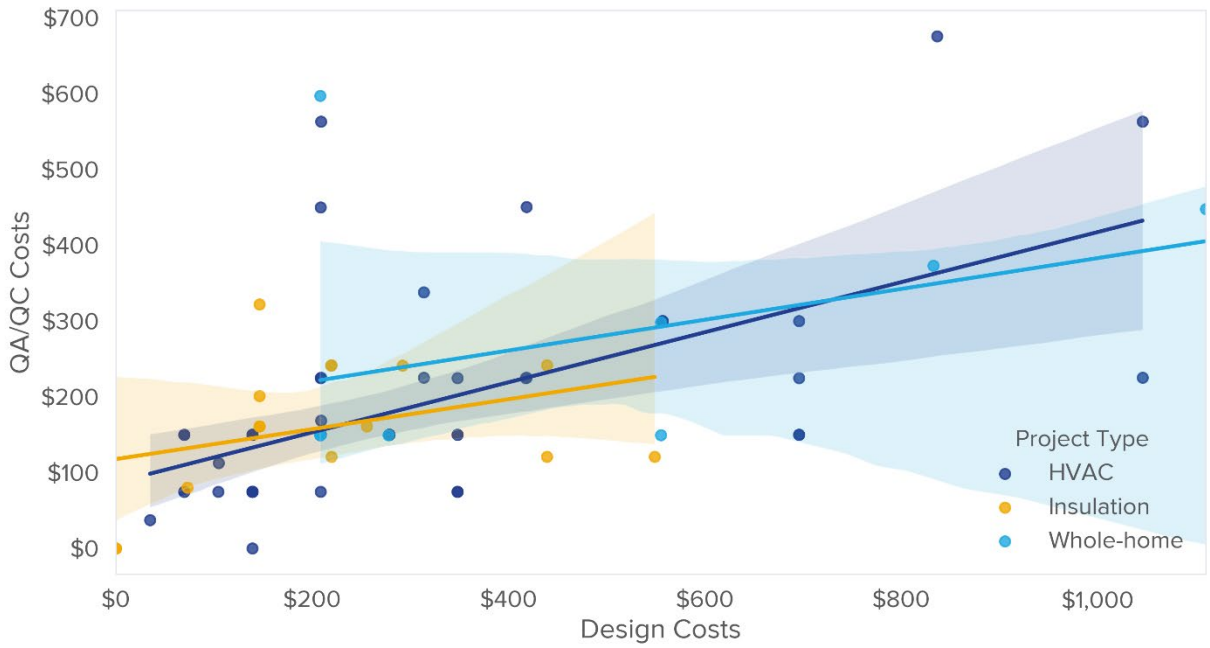
QA/QC and Design Costs

The Market Evaluation Team analyzed the extent to which a company's design spending relates to the company's QA/QC spending. Two reasonable hypotheses emerged regarding this relationship:

- Companies that spend more on design costs may have more thoroughly planned projects and consequently spend *less* on QA/QC.
- Alternatively, companies that spend more time on design may be more thorough in general and ultimately spend *more* on QA/QC after installation.

Figure 9 characterizes this relationship for each of the three residential project categories. Though the relationship remains positive for each category, the best-fit relationship (purple line) is most prominent for the HVAC replacement project. The strength of this relationship may be attributed to random chance induced by the small sample size (as illustrated by the wide 95% confidence interval shaded area around each line), but it may also be partly attributed to ASHP installations being more comprehensive and demanding that contractors not only spend more time on design but also spend more time on QA/QC for the numerous measures installed.

Figure 9. QA/QC Design Cost Correlations



Note: HVAC r-squared = 0.327. Insulation r-squared = 0.117. Whole-home r-squared = 0.161

Decision-Makers

The Market Evaluation Team surveyed 221 residential decision-makers to understand their experience completing prototypical project installations, with 67 for HVAC replacement, 77 for insulation and air sealing, and 77 for whole-home.

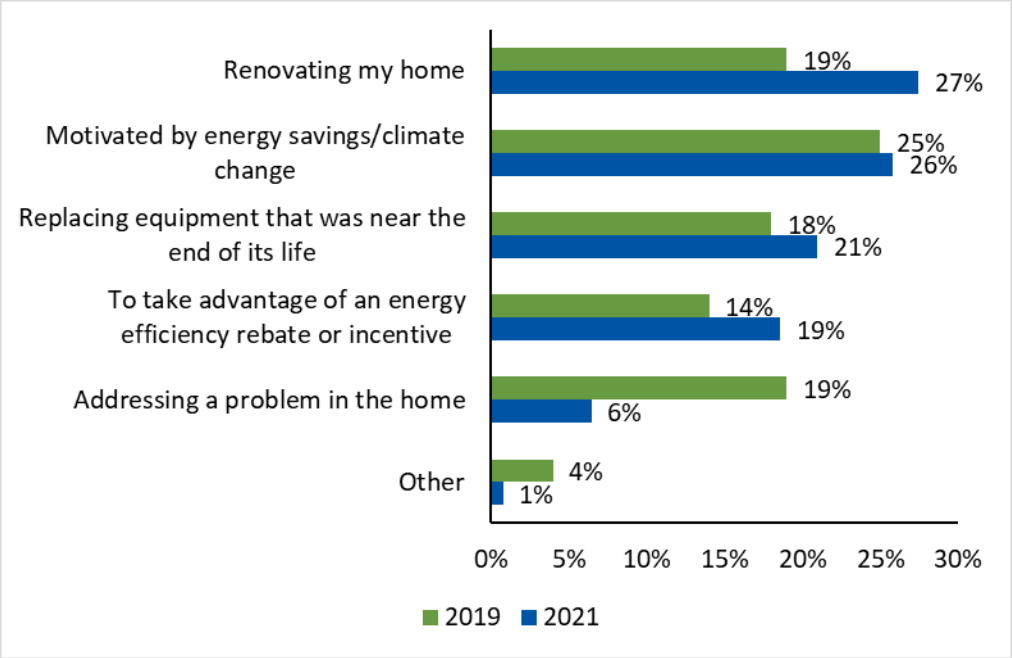
Prior to installation, 64% of decision-makers completed a home energy audit. Whole-home decision-makers were significantly more likely to have an energy audit completed before the project (82%), compared to decision-makers for installations of HVAC (65%) and insulation (47%). Decision-makers in 2021 were more likely to report conducting home energy audits than in 2019 (46%). The emergence of virtual audits and demand for audits due to increased time spent inside the home during this period could have increased the audit rate. Additionally, NYSERDA streamlined the audit and program workflow processes for their statewide energy audit program beginning in January 2020 which may have helped to reduce barriers to participation.

The Market Evaluation Team asked residential decision-makers about their primary motivations to complete an energy efficiency or electrification project. More than one-quarter of respondents said the completion of home renovations or the desire for energy savings was the top factor, as shown in Figure 10. Since 2019, the primary motivator has shifted toward home renovations—from 19% to 27%— while the percentage for energy savings or climate change has stayed relatively constant (25% to 26%).

During the last two years, with reduced travel and additional available funds, many decision-makers have been motivated to renovate the spaces in which they have spent much of their time. Additionally,

primary motivators for each prototypical project varied, with the largest portion of the sample answering that energy savings/climate change motivated HVAC replacement, home renovations motivated whole-home projects and energy savings/climate change or home renovations were equally impactful on the motivation for insulation projects.

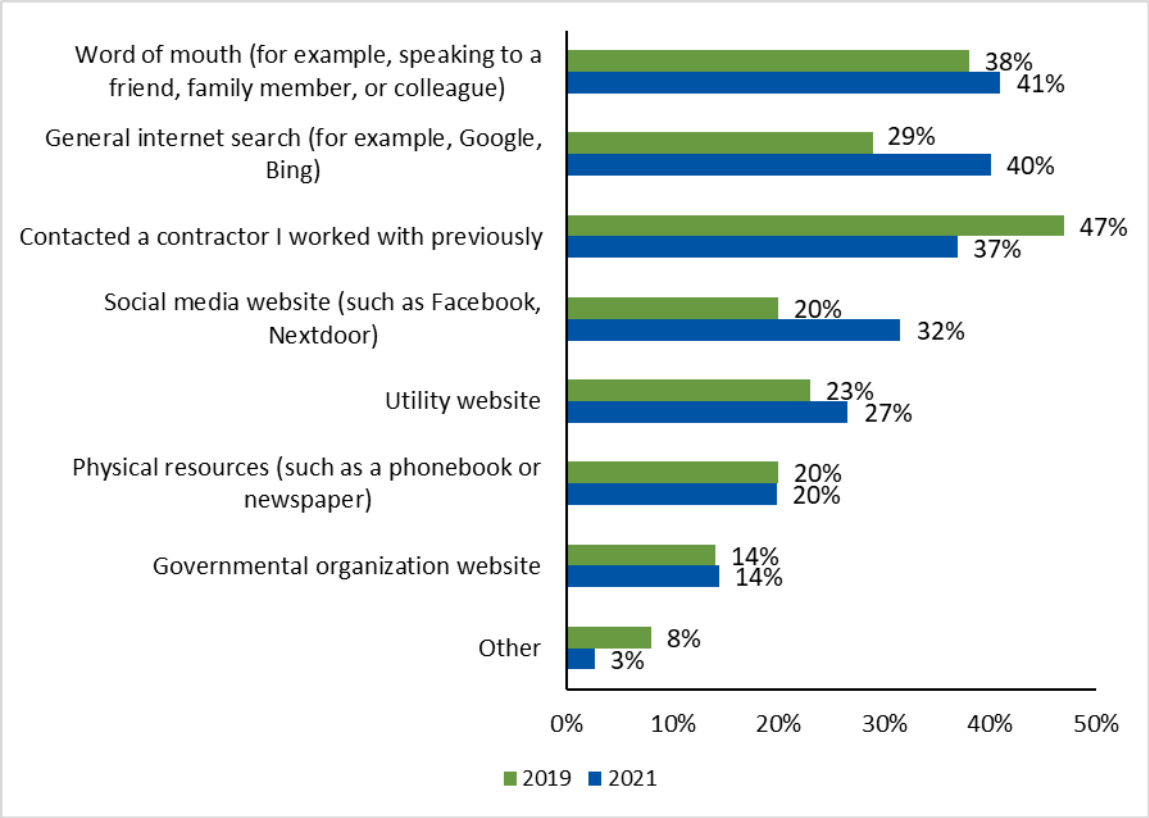
Figure 10. Primary Motivator for Completing Prototypical Project



Source: Residential Decision-Maker Survey Q B2: "What was your primary motivation for completing this [Field-PROJECT_TYPE] project?" (n=124)

In 2021, as shown in Figure 11, respondents found a contractor to complete their home efficiency projects through word-of-mouth (41%) followed by general internet searches (40%). In 2019, only 29% of contractors were found through the internet. Fewer contractors were found based on previous work or relationships. In 2021, 37% of decision-makers contacted contractors they had worked with in the past, compared with 47% in 2019. Greater use of the internet and the convenience and limitations of online interactions in general probably influenced decision-makers in search of a contractor. During the time between the two study periods, NYSERDA increased its targeted digital advertising and general awareness spending, which is likely a contributing factor to the difference in methods listed in Figure 11.

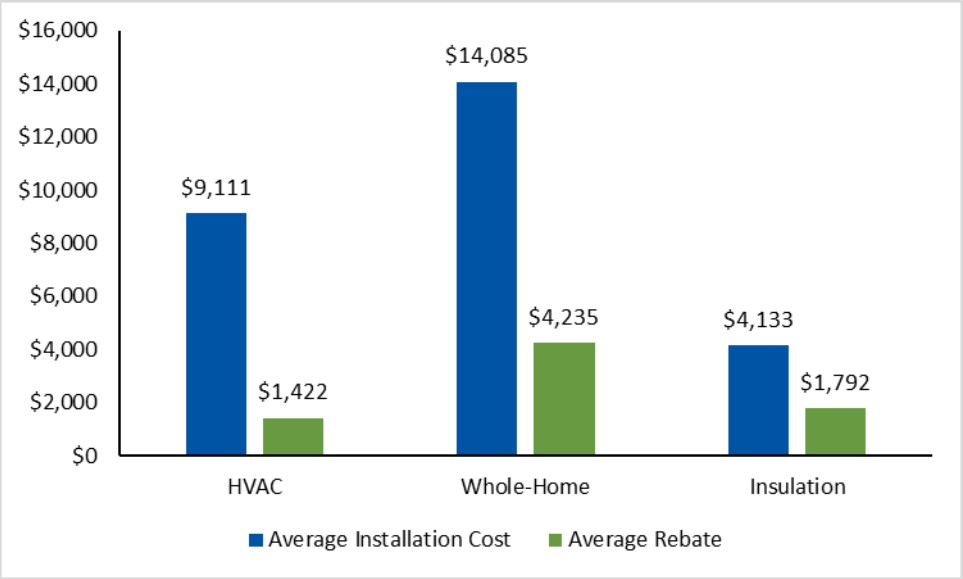
Figure 11. Contractor Search Methods Used



Source: Decision-Maker Survey Q C1: "What sources did you use to search for a contractor to complete the [PROJECT_TYPE] project?" Multiple responses allowed. (n=221)

For decision-makers in the residential sector, HVAC and whole-home efficiency projects cost significantly more than insulation projects, as expected due to the substantially higher labor and materials costs for an ASHP installation. As shown in Figure 12, residential decision-makers conducting only insulation and air sealing improvements often had nearly the entire insulation project cost covered by rebates (96%). In comparison, decision-makers completing whole-home and HVAC replacement projects had a smaller amount of the project cost covered by rebates (32% and 16%, respectively).

Figure 12. Average Installation Costs and Rebate

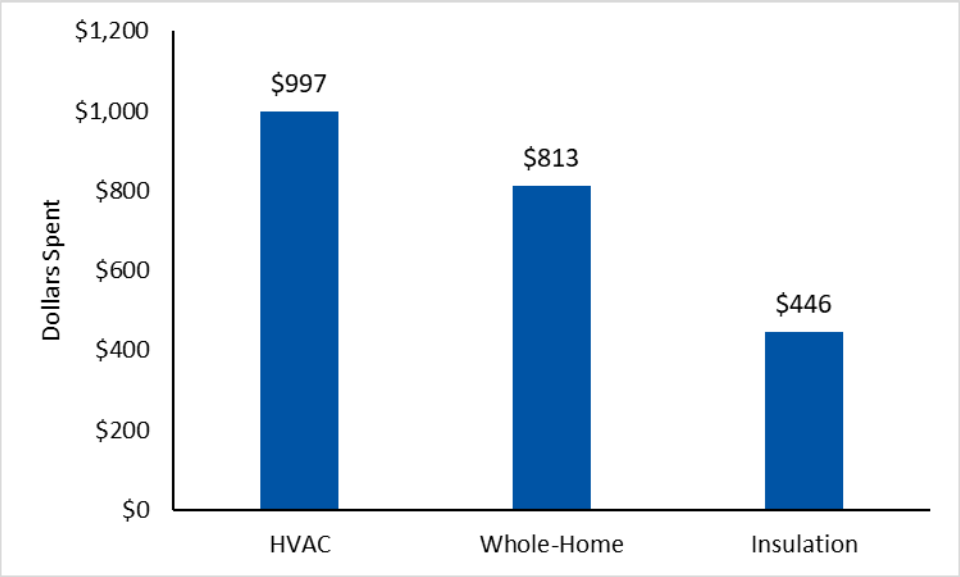


Source: Residential Decision-Maker Survey Q E1: "What was the total installed cost for the [PROJECT_TYPE] project? Please include everything you paid, including contractor labor to install the equipment and the materials themselves." (n=221)

The Market Evaluation Team asked decision-makers if they encountered issues securing financing to complete their projects. Of respondents who encountered issues (n=43/222), 28% were for HVAC replacement projects and 26% were for whole-home projects. This differs little since 2019 when 28% of decision-makers encountered issues while acquiring project financing (n=95/207). In 2021, only 5% of decision-makers completing insulation projects encountered issues. This is expected given that insulation and air sealing work is less expensive and a greater portion of the project cost may be covered by available incentives.

The Market Evaluation Team asked respondents about QA/QC costs required after completing projects. Of 221 respondents, 32% had to call their contractor back for repair and maintenance issues. Among customers who had repair and maintenance issues, time spent contacting and managing contractors for repairs had a median of four hours for HVAC replacement (n=29), three hours for insulation (n=8), and five hours for whole-home efficiency (n=33). As shown in Figure 13, HVAC and whole-home projects had, on average, the most expensive labor and material costs for repairs.

Figure 13. Cost for Post-Installation Repairs



Source: Residential Decision-Maker Survey Q F4: "About how much (in dollars) did you spend on the contractor(s) you hired to fix the issue(s)? Please include the total cost you paid, both labor and materials." HVAC n=28; Insulation n=8; and Whole-Home n=33.

Key Findings: Residential Sector

- Hard costs rose faster than soft costs for all residential sector prototypical projects. Soft cost increases were driven by marketing and customer acquisition and recruiting and hiring.
- The spread of permitting costs is wider for downstate contractors than for those upstate, suggesting a more complex permitting landscape that downstate contractors need to navigate.
- A positive relationship exists between QA/QC and project design costs, most prominently for the HVAC replacement (building electrification) prototypical project.
- Compared to 2019, decision-makers were more likely to complete home energy audits before project installation and were more likely to find contractors via online search.

HVAC Replacement

This section presents soft costs for residential HVAC replacement projects for 2021, with details of prototypical project soft cost estimates, drivers, and other related topics. The Market Evaluation Team gathered responses from 56 residential service providers (as well as 12 partial responses) who completed an HVAC replacement project within the previous 12 months. Of these, 43 contractors were located upstate and 13 were located downstate (the 12 partial respondents did not provide a response). Of 63 contractor respondents, 52% worked for a company with under 10 employees, which is comparable to the 54% of contractor respondents in 2019 who worked for a company with under 10 employees.

Prototypical Project Cost Estimates

When presented with the residential HVAC prototypical project, contractors provided estimates of both hard and soft costs, as defined in Table 14.

Table 14. HVAC Replacement Prototypical Project Details (2021)

Attribute	Definition
Building Type	Single-family home; family of 3 (2 adults, 1 child) living there year-round
Building Size	2,000 sq. ft, 2-story home—living and kitchen downstairs with bedrooms upstairs Colonial, 50 years old
Existing Conditions	Standard efficiency, gas-powered condensing boiler for heating; window AC units for cooling
Equipment to Be Installed	Ductless heat pump with 1 outdoor unit and 3 indoor heads. Indoor heads will be installed in the kitchen, the living room, and the bedroom (on the second floor). Existing gas boiler retained in place as backup heat.

Table 15 summarizes the high-level results. For an average installed project cost of $15,357, 49.9% of costs were hard (equipment-related) costs and 50.1% were soft costs.

Table 15. HVAC Replacement Hard and Soft Cost Estimates (2021)

Component	Average Cost Per Project	Standard Deviation	1st Quartile	3rd Quartile	Sample Size
Average Total Installed Cost	$15,357	$5,212	$12,000	$18,000	56
Percentage Soft Costs	50.1%	13%	40%	60%	56
Value Soft Costs	$7,927	$3,971	$4,783	$9,563	56
Percentage Hard Costs	49.9%	12.6%	40.0%	60.0%	56
Value Hard Costs	$7,430	$2,551	$5,575	$8,978	56

Compared to 2019, average total project costs in 2021 increased by $3,248 per project, or 27%. Both hard and soft cost categories saw statistically significant increases during the two-year period, but increases were nearly three times as large for hard costs (38%) compared to soft costs (18%). The increases in hard and soft costs were likely related to shortages of HVAC equipment and raw materials, scarcity of labor, and supply chain disruptions brought about by the COVID-19 pandemic. See the *Fluctuations in Market and Economic Conditions* section for more details on these impacts.

Table 16. HVAC Replacement Prototypical Project Cost Estimate 2019 and 2021 Comparison

Cost Category	2019 (n = 97-102)	2021 (n = 56)	Change
Hard Costs	$5,387	$7,430	+$2,043***
Soft Costs	$6,722	$7,927	+$1,205**
Total Project Costs	$12,109	$15,357	+$3,248***

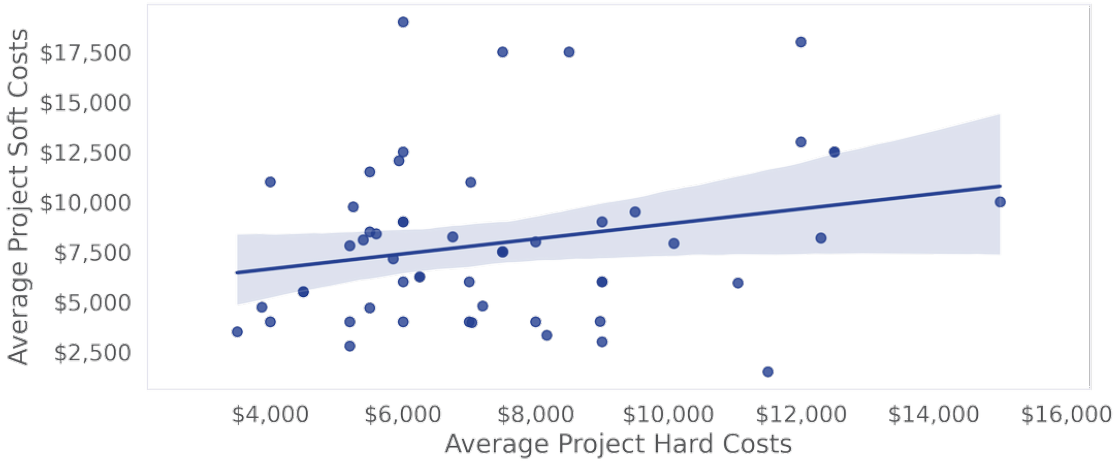
The following notation denotes statistical significance at the different confidence levels:
* $p < 0.20$, ** $p < 0.10$, *** $p < 0.05$

Figure 14 presents a trend from 2021 that is consistent with 2019 results. When plotting a specific service provider's estimate of hard and soft costs, there is only a weak relationship between the two when using a linear model to add a best-fit line. That is, service providers with higher soft costs do not necessarily have higher hard costs as well. The lack of a close relationship between hard and soft costs

shows that not all service providers take the same amount of effort to complete various steps of an energy efficiency or electrification project.

For example, if two service providers have similar hard costs (around $9,000) but different soft costs ($6,000 for one and $8,000 for the other), an opportunity exists for more expensive service providers to find efficiencies in their work and to lower the cost for project delivery. When this example is considered across an entire market, it shows that opportunities remain to reduce soft costs.

Figure 14. Contractor Prototypical Project Cost Estimates: Hard vs. Soft Costs (2021)



The Market Evaluation Team collected data to construct estimates for the six specific soft cost categories that contribute to the total soft cost estimate, as shown in Table 17. In 2021, installation costs were the highest, at $2,671 per HVAC replacement project (43% of the estimated project soft costs). Marketing costs, including bid preparation, were the second highest, at $1,973 per project (31%). These two soft cost categories were also the highest share of total project soft costs in 2019 but were weighted even more toward installation than marketing (i.e., the estimates were further apart). All other soft costs comprise the remaining one-third of prototypical project soft costs.

Table 17. HVAC Replacement Soft Cost Component Estimates (2021)

Soft Cost Category	Soft Cost Component	Per Project Cost	Per Project %	Component Cost	Std. Deviation	1st Quartile	3rd Quartile	Sample Size
Marketing & Customer Acquisition	Marketing and/or customer education	$1,973	31%	$646	$705	$125	$967	55
	Bid preparation			$1,060	$1,498	$287	$1,005	50
	Project signing/ contracting			$268	$206	$128	$319	52
Project Design	Designing, scoping, and customizing the project	$319	5%	$319	$243	$139	$383	51
Installation	Installation labor	$2,671	43%	$2,671	$1,637	$1,670	$3,342	52
Transaction Costs	Obtaining permits	$884	14%	$347	$319	$158	$474	50

Soft Cost Category	Soft Cost Component	Per Project Cost	Per Project %	Component Cost	Std. Deviation	1st Quartile	3rd Quartile	Sample Size
	Acquiring and maintaining training, certifications, and licenses			$538	$754	$92	$636	46
QA/QC	QA/QC activities	$282	4%	$198	$140	$75	$225	53
	Required callbacks to the customer to assist with equipment issues/ servicing			$84	$138	$13	$94	54
Recruiting & Hiring	Recruiting and hiring employees	$138	2%	$138	$223	$0	$195	43

There were several differences when compared to 2019, with all soft cost categories except for QA/QC costs increasing significantly from 2019 to 2021 (as shown in Table 18). Approximately half of the increase is due to changes in marketing and customer acquisition costs, which is driven by increases in bid preparation and general marketing costs, as shown in Table 19.

Table 18. HVAC Replacement Soft Costs 2019 vs. 2021

Soft Cost Category	2019 HVAC: ASHP (n = 69-97)	2021 HVAC: ASHP (n = 46-55)	Change
Marketing and Customer Acquisition	$1,215	$1,973	+$758**
Project Design and Development	$248	$319	+$71*
Installation	$2,337	$2,671	+$334*
Transaction Costs	$582	$884	+$302*
Quality Assurance	$251	$282	$31
Recruiting and Hiring	$68	$138	+$70**
Total Soft Costs [a, b]	**$4,702**	**$6,268**	**+$1,566**

The following notation denotes statistical significance at the different confidence levels: * p < 0.20, ** p < 0.10, *** p < 0.05

[a] Due to the calculation method for total soft costs (summing of individual cost buckets, with sample differences across the set), it is not possible to test statistical significance for total soft cost changes from 2019 to 2021.

[b] Given that five of six soft cost categories are statistically higher in 2021 than 2019 for the HVAC Replacement prototypical project, it is reasonable to assume that 2021 soft costs are higher than 2019 soft costs.

Table 19. HVAC Replacement Project Marketing and Customer Acquisition Analysis (2019 vs. 2021)

Soft Cost Category	2019 (n = 69-99)	2021 (n = 43-55)	Change [a]
Marketing and Customer Acquisition	**$1,215**	**$1,973**	**$758****
Bid Preparation	$600	$1,060	$460***
Marketing and/or Customer Education (General)	$384	$646	$262***
Project Signing/Contracting	$231	$268	$37

The following notation denotes statistical significance at the different confidence levels: * p < 0.20, ** p < 0.10, *** p < 0.05

[a] Changes do not sum due to rounding.

Due to the changes discussed in the *Fluctuations in Market and Economic Conditions* section above, service providers likely responded to greater interest in heat pump technologies, changes in Clean Heat program design (increasing incentives on whole-home projects), and increased market activity by preparing more bids for heat pump systems that serve the entire home than in 2019.[18] In addition, increases in customers searching online for contractors to complete work (as presented in the residential *Decision-Makers* section above, where online searches increased from 29% to 40%) increases the need for an online presence, which adds to contractor overhead. Given that marketing and customer acquisition is a necessary expense to win work, it is expected that service providers are putting additional effort toward this cost category in a growing and more competitive market.

In addition, the increase in market activity likely encouraged more service providers to enter the market. This is supported by data collected from service providers—the average years of experience installing HVAC systems was 16.7 years for the residential HVAC sample in 2019, but fell to 11.3 years in 2021. Some soft cost increases can be partially explained by a less experienced service provider market. Service providers with less experience tend to overestimate the time required for technical aspects of projects; this time is included in project design and development, installation, and transaction costs. The Market Evaluation Team found this trend in the service provider data, where service providers with a level of experience below the mean (11.3 years) provided soft cost estimates that were $1,300 higher than service providers with a level of experience above the mean ($6,810 for less experienced compared to $5,510 for more experienced). Tangentially, the increase in recruiting and hiring costs (103% higher in 2021 than 2019) signifies that a less experienced workforce is installing ASHPs.

Additionally, NYSERDA started the Cooperative Advertising and Training Program for Clean Energy Partners[19] in 2020, which provided cost share to contractors to promote clean energy technologies. Through mid-2022, this program supported over 200 firms with incentives on marketing ranging from 50-80% of marketing costs, with a cap of $100,000 per year for installers. Across the life of the program, NYSERDA funded a total of 1,178 opportunities with an average incentive of $12,057. While the Market Evaluation Team was unable to directly link incentives received through this program to survey data, several installers who responded to these surveys received incentives during this time. Thus, it is reasonable to assume that installers receiving these incentives increased their spend on marketing opportunities.

As discussed earlier, the Market Evaluation Team noted that the difference in soft costs from 2019 to 2021 can be explained by several market changes—specifically, heat pumps are a nascent market, administration of New York's heat pump incentive program has shift to the utilities, and the COVID-19

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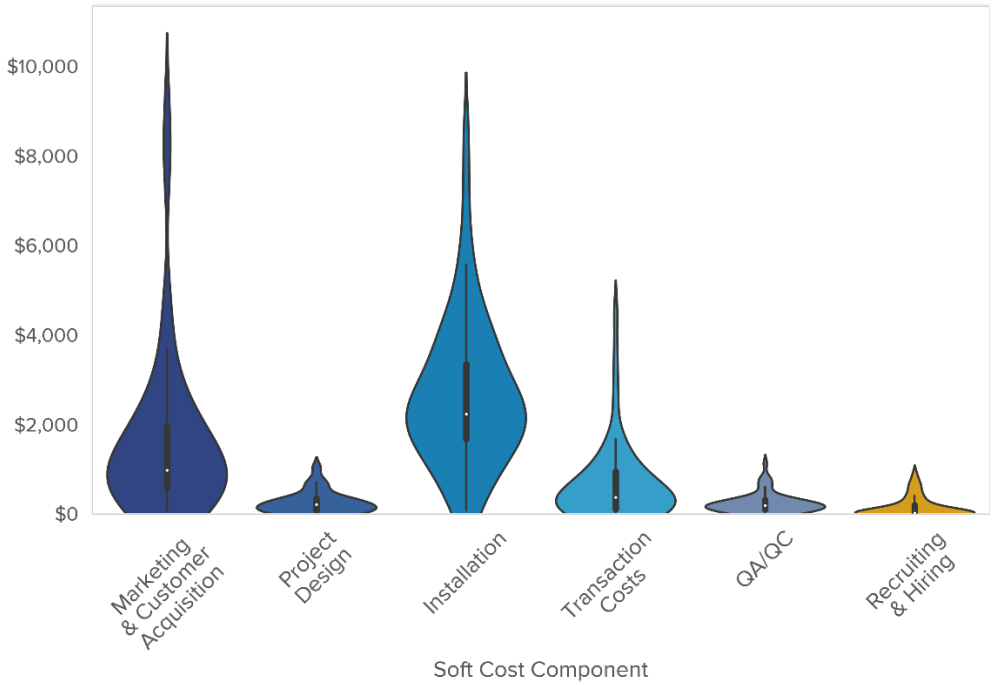
[18] While the Residential HVAC prototypical project includes a heat pump system sized to serve the entire home, the questions related to marketing (which include bid preparation) referenced all of the service provider's work on ductless heat pumps. The Market Evaluation Team made this choice after finding during the 2019 study planning that service providers would not be able to provide an accurate estimate of marketing-related costs for only heat pump systems serving the entire home.

[19] https://portal.nyserda.ny.gov/CORE_Solicitation_Detail_Page?SolicitationId=a0rt0000011YFNMAA4

pandemic has had an impact on the overall market. For example, $364 of the $1,566 difference (23%) is due solely to changes in labor rates from 2019 to 2021. That is, using the labor rates from 2019 to calculate 2021 soft costs, the total would be $364 lower. See the *Fluctuations in Market* section above for additional details on these impacts.

Figure 15 shows the distribution of HVAC replacement soft costs, with the largest spread of soft costs for installation, marketing and customer acquisition, and transaction costs. Although marketing and acquisition costs have a slightly larger range, for any given HVAC replacement project, it is more likely installation costs will be higher on average.

Figure 15. HVAC Replacement Soft Costs Violin Plot



Soft Cost Drivers

This section investigates what is driving the differences in soft costs. Specifically, this section examines the correlation of soft costs with several explanatory variables.

Regional Differences

Similar to the 2019 results, the Market Evaluation Team found that downstate project costs were higher than upstate project costs. As shown in Table 20, in 2021 the average HVAC replacement project cost was $16,308 downstate compared with $15,069 upstate, a $1,239 difference. This difference is driven entirely by soft costs; downstate the soft costs are $1,877 higher and the hard costs are $638 lower. Though neither difference is statistically significant due to the small sample sizes, these directional differences are expected given the higher "cost of doing business" in downstate New York. Specifically,

downstate service providers are subject to several upward cost pressures, including a more complex permitting and installation environment and a higher cost of living.

Table 20. HVAC Replacement Project Soft Cost Estimates by Region (2021)

Cost Category	Upstate (n = 43)	Downstate (n = 13)	Difference
Hard Costs	$7,578	$6,940	-$638
Soft Costs	$7,491	$9,368	+$1,877
Total Project Costs	**$15,069**	**$16,308**	**+$1,239**

The box-and-whisker plot in Figure 16 illustrates the range of reported hard and soft costs by location (upstate and downstate New York). Each box represents the interquartile range of the data. The solid line in the middle of the box is the median, and the small white box is the mean. As in 2019, a slightly larger spread of soft costs is observed for downstate contractors, which may be expected given the greater cost of operating in the downstate market.

Figure 16. HVAC Replacement Prototypical Project Cost Estimates: Box and Whisker Plot by Region

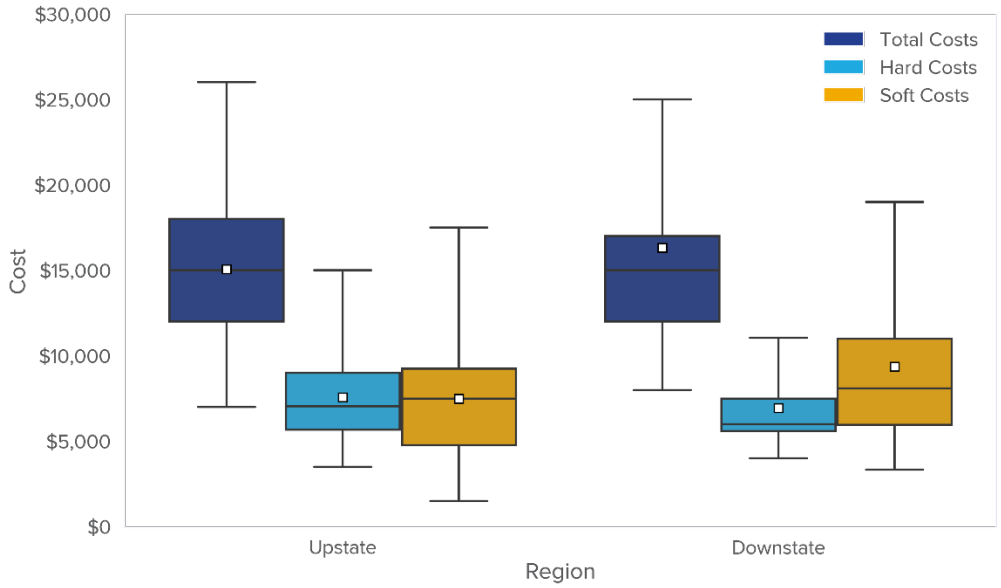


Figure 17 shows individual soft cost categories split by upstate and downstate residential HVAC service providers, which follow the same trend of the above data. The largest differences between the two are market and customer acquisition, installation, and transaction costs, which account for 87% of the total difference. Among these, the largest comparative difference is for transaction costs, which are over twice as high for downstate service providers. The transaction costs category contains permitting costs, which are shown in Figure 18. Given that permitting is directly related to local codes and ordinances, this difference is expected. Differences are not significant due to the small downstate sample for 2021, but directionally they fit trends observed in the 2019 study.

Figure 17. Soft Cost Category Mean Comparison: Upstate vs. Downstate

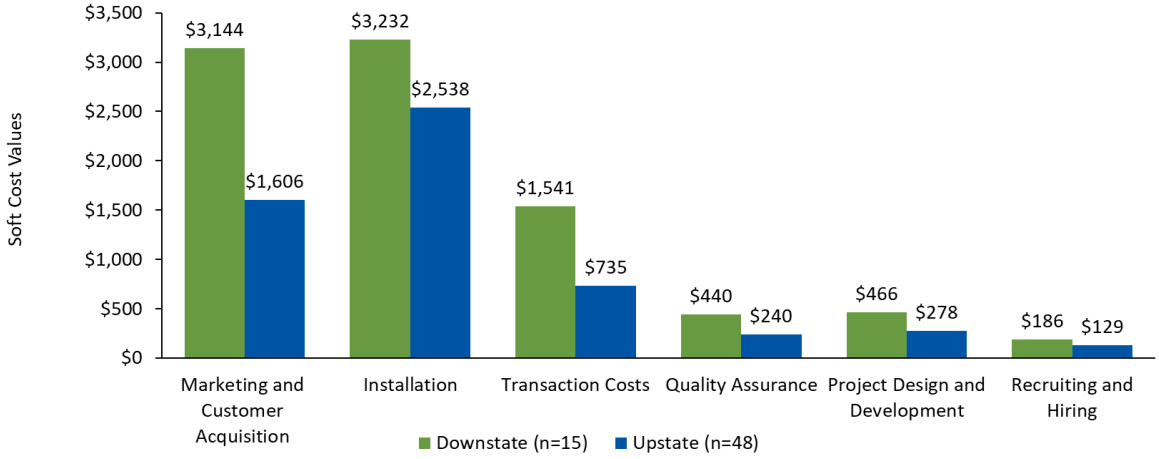
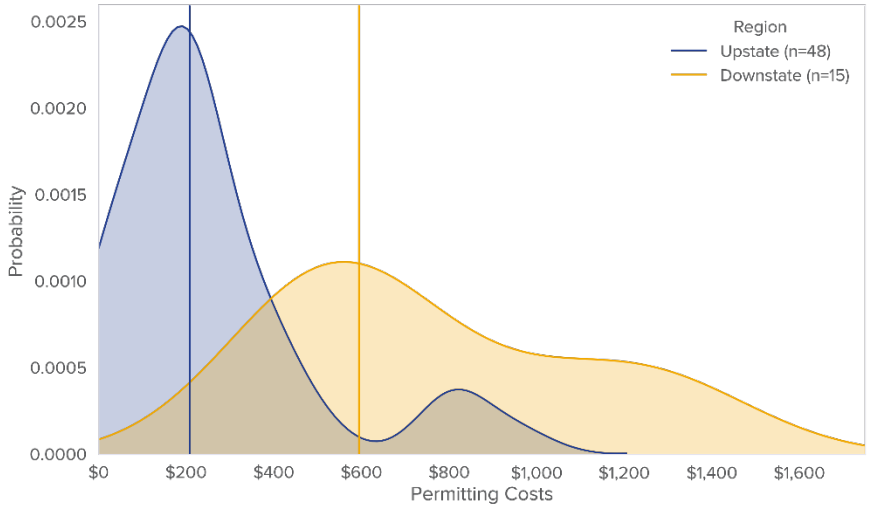


Figure 18. HVAC Service Provider Upstate vs Downstate Permitting Cost Distribution Estimates



Additional Topics

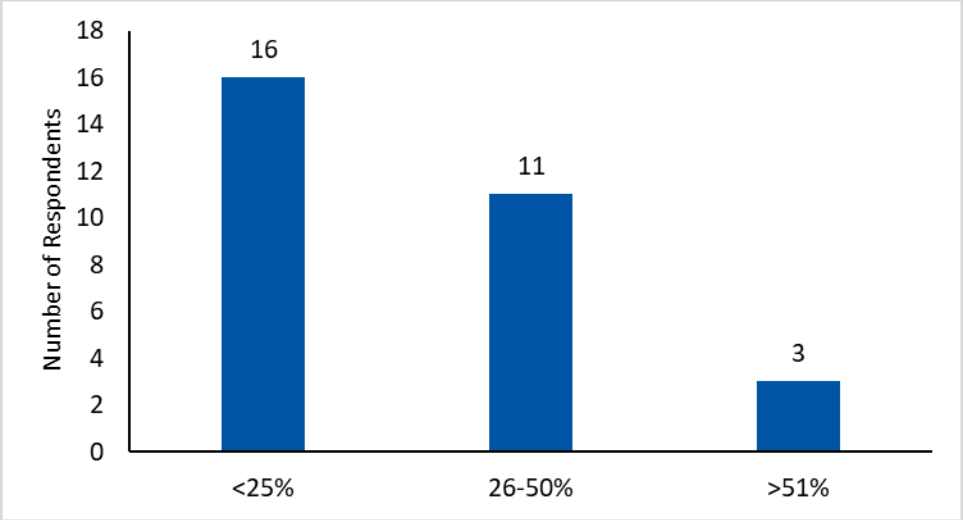
This section details some additional findings from HVAC service providers that are not directly tied to soft cost estimates.

Whole-Home versus Supplemental

The Market Evaluation Team asked service providers about their experience installing ductless heat pumps in both a whole-home and supplemental (i.e., not the primary heating system) capacity. Sixty percent of respondents said less time was spent on project initiation for ductless heat pumps in a supplemental capacity compared with whole-home capacity.

For those respondents that reported fewer hours needed for ductless heat pump project initiation in a supplemental capacity, the Market Evaluation Team asked by how much (as a percentage) project initiation costs (i.e., bid preparation, project design, etc.) were lower than those in a whole-home capacity. Figure 19 shows that approximately half of respondents answered that project initiation time for projects completed in a supplemental capacity took 25% less time than those in a whole-home capacity. On average, the labor needed for project initiation was 34% less for projects completed in a supplemental capacity compared to a whole-home capacity.

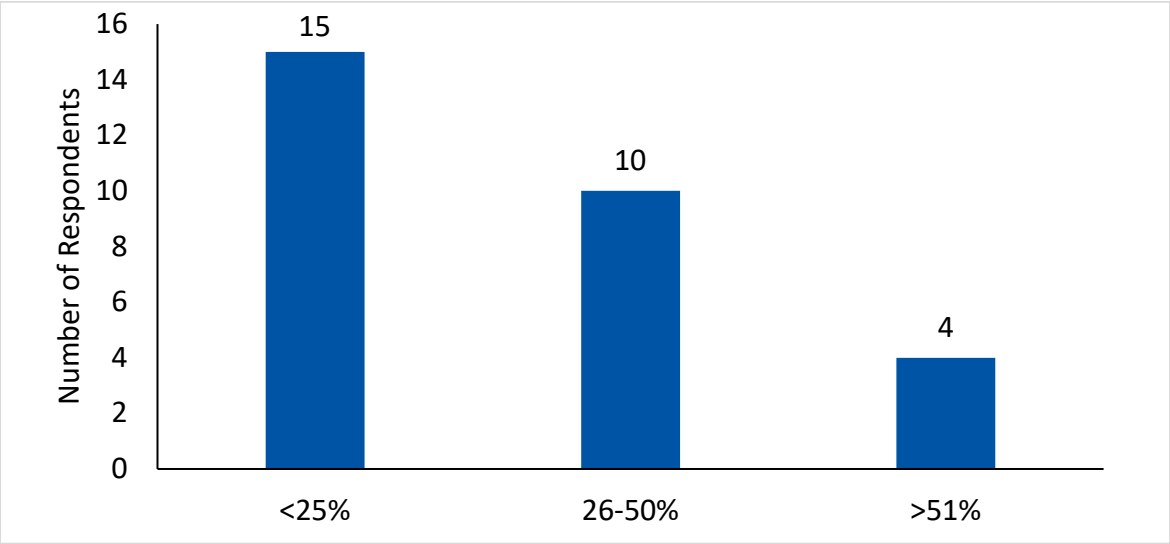
Figure 19. Percentage by Which Supplemental Heat Pump Project Initiation Hours are Less than Whole-Home Heat Pump Projects



Source: Residential HVAC Survey Q F2: "By what percent do you think these hours are lower? Please enter the percent as a whole number (i.e., 10%=10)." (n=30)

Similarly, the majority (54%) of service providers said that labor spent on project implementation (i.e., installation labor, QA/QC, etc.) was lower for ductless heat pumps in a supplemental capacity than in a whole-home capacity. As shown in Figure 20, around half thought that the percentage of additional labor would be under 25% higher. On average, the labor needed for project implementation was 35% less for projects completed in a supplemental capacity compared to a whole-home capacity.

Figure 20. Percentage by which Supplemental Heat Pump Project Implementation is less than Whole-Home Heat Pump Project



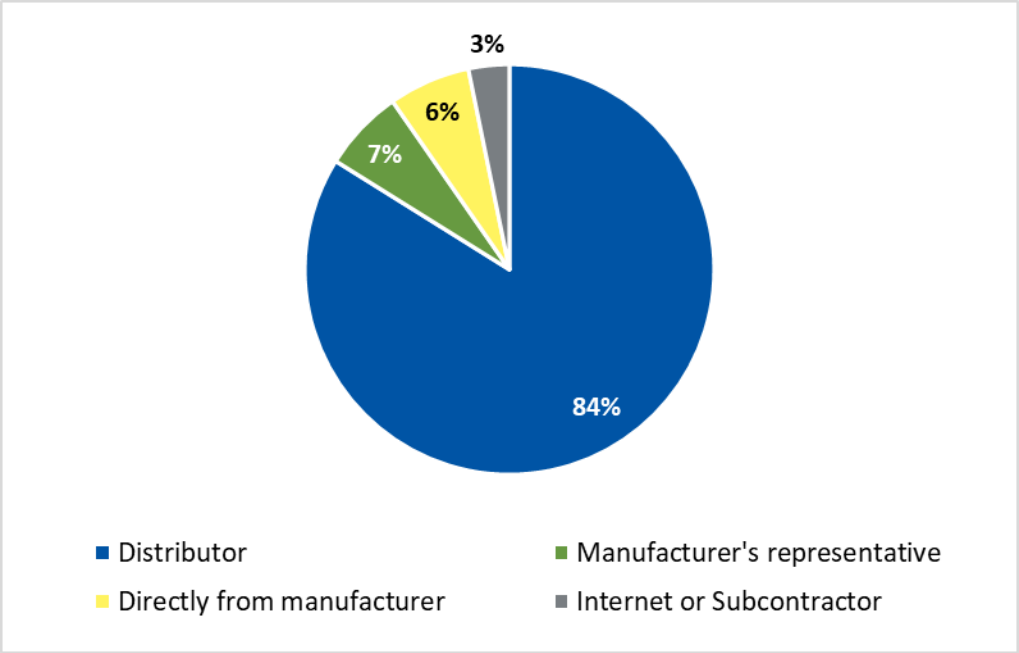
Source: Residential HVAC Survey Q F4: "By what percent do you think these hours are lower? Please enter the percent as a whole number (i.e., 10%=10)." (n=29)

When asked how ductless heat pumps installed in a supplemental capacity differ from those installed in a whole-home capacity, contractors said supplemental projects are generally smaller and simpler installations and therefore quicker to install and requiring fewer labor hours. Contractors also said less equipment such as line sets, line hides, and communication wire is needed, which reduces material costs for these projects. One contractor said supplemental installations offer installers more flexibility in selecting the best route for electrical work and, therefore, the ideal location for the unit.

Equipment Stocking

The Market Evaluation Team asked service providers how they sourced the equipment needed for residential HVAC replacement projects. Approximately 84% sourced their equipment directly from the distributor, while the remainder worked directly or indirectly with the manufacturer or used their subcontractors. Disruptions in the supply chain led to longer lead times. Any source of equipment that requires additional transportation, packaging, labor, or price markup will add additional cost for the contractor.

Figure 21. Sources for Obtaining Ductless Heat Pump Equipment

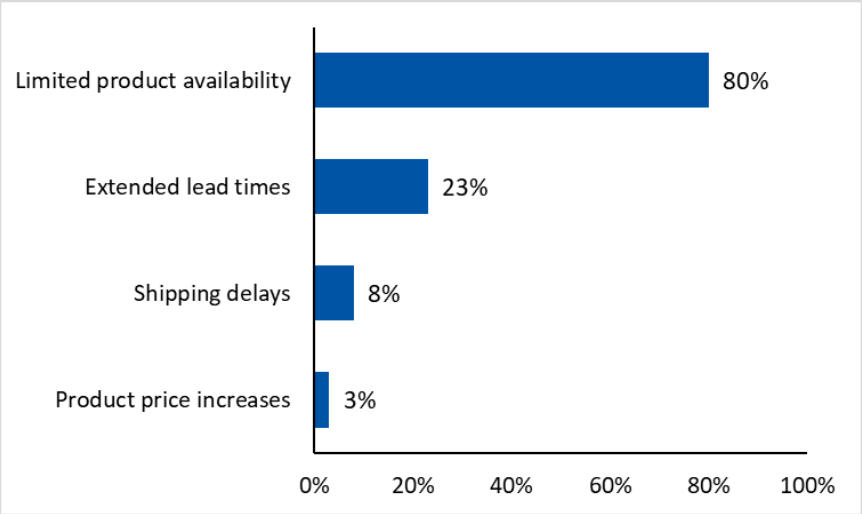


Source: Residential HVAC Survey Q G3: "From where do you source your ductless heat pump equipment? (Select all that apply)" (n=62)

The Market Evaluation Team also asked service providers whether they rely on one source to purchase their equipment or if they have identified multiple avenues to obtain necessary equipment in the event one source cannot provide it. Thirty-one percent of service providers said they source their ductless heat pump equipment from a single source, while 36% have a primary source but will buy from others.

To further understand the setbacks caused by supply chain disruptions, the Market Evaluation Team asked service providers to elaborate on the types of issues that arose while completing HVAC projects. Figure 22 shows that 80% of contractors faced issues of limited product availability when trying to complete residential HVAC replacement projects, while extended lead times and shipping delays also contributed to project setbacks. One service provider said, "There are massive supply chain issues with ductless equipment caused by increased demand but mainly caused by the pandemic. Overseas equipment is harder to source, and we have regularly been experiencing months long delays in getting equipment."

Figure 22. Issues Faced by HVAC Contractors



Source: Residential HVAC Survey Q G6: "In the past year, has your business encountered any issues with acquiring the needed equipment to install ductless heat pumps?" (n=40)

Key Findings: HVAC Replacement

- Both soft and hard costs rose for HVAC replacement (building electrification) projects from 2019 to 2021, but hard costs rose faster than soft costs.
- Service providers saw the largest cost relative increases in marketing and customer acquisition and recruiting and hiring, two areas that were substantially impacted by current market forces.
- Service providers with a level of experience below the mean (11.3 years) provided soft cost estimates that were $1,300 higher than service providers with a level of experience above the mean ($6,810 for less experienced compared to $5,510 for more experienced).
- Downstate contractors continue to have higher soft costs—specifically in marketing/customer acquisition, installation, and transaction costs.
- Both upstate and downstate contractors face issues acquiring equipment for HVAC replacement projects, with the majority of contractors sourcing equipment from distributors.
- As expected, HVAC replacement projects completed in a supplemental capacity typically cost contractors less time and money compared to those completed in a whole-home capacity.

Insulation and Air Sealing

This section details soft costs for the residential insulation and air sealing project in 2021, specifically, the review of prototypical project soft cost estimates, soft cost drivers, and additional related topics. The Market Evaluation Team gathered responses from 19 residential contractors (plus nine partial responses) who completed an insulation and air sealing project within the past 12 months. Of these,

57% said that 60% or more of their company's revenue came from projects involving insulation and air sealing improvements in single-family homes. Twenty respondents (71%) reported having fewer than 10 employees, seven reported between 10 and 29 employees, and one reported more than 30 employees. These firmographic characteristics were consistent with the 2019 sample.

Prototypical Project Cost Estimates

The Market Evaluation Team asked contractors to provide information on their hard and soft cost expenditures in the last 12 months as well as estimates regarding the residential insulation and air sealing prototypical project, defined in Table 21.

Table 21. Insulation and Air Sealing Prototypical Project Details

Attribute	Definition
Building Type	Single-family home; family of 3 (2 adults, 1 child) living there year-round
Building Size	2,000 sq. ft, 2-story home—living and kitchen downstairs with bedrooms upstairs Colonial, 50 years old; R19 insulation
Existing Conditions	R19 insulation in ceiling; crawl space/basement uninsulated; typical attic leakage in bypasses
Equipment to Be Installed	R49 insulation (blown-in) for ceiling and R30 insulation (fiberglass) for crawl space/basement; air sealing for whole house, attic and basement bypasses

Table 22 summarizes high-level results, with total project costs broken into hard and soft costs. For an average installed project cost of $6,124 in 2021, approximately 58% was soft costs ($3,686) and 42% was hard costs ($2,438). As was the case in 2019, soft costs made up a larger portion (six to eight percentage points more) of total costs for insulation and air sealing projects compared with HVAC installations.

As shown in Table 23, hard costs in 2021 made up a larger percentage of total project costs, with an average increase of 7% from 2019. The increase in hard costs is smaller than changes in prototypical projects that include more complex equipment, indicating the market may have experienced fewer price and supply shocks. Changes since 2019 are not statistically significant and should be viewed as directional.

Table 22. 2021 Insulation and Air Sealing Hard Cost and Soft Cost Estimates

Metric	Mean	Standard Deviation	1st Quartile	3rd Quartile	Sample Size
Total Installed Cost	$6,124	$2,565	$4,100	$7,750	19
% Soft Costs	57.7%	16.3%	50%	70%	19
Value Soft Costs	$3,686	$2,085	$1,560	$4,888	19
% Hard Costs	42.3%	16.3%	30%	50%	19
Value Hard Costs	$2,438	$1,101	$1,438	$3,100	19

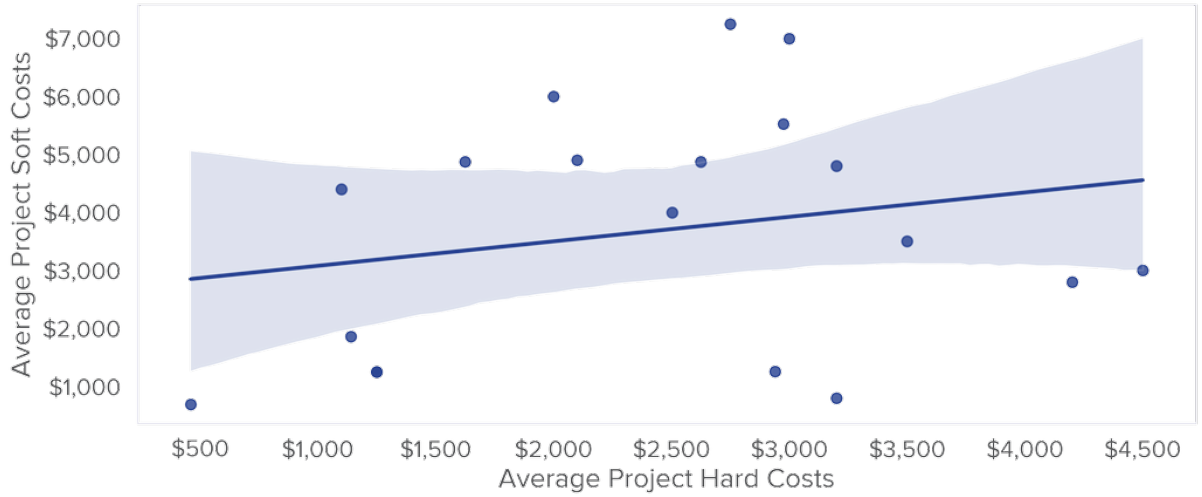
Table 23. Insulation and Air Sealing Hard Cost and Soft Cost Estimates, 2019 vs. 2021

Cost Category	2019 (n=25-27)	2021 (n=19)	Change
Hard Costs	$2,260	$2,438	+$178
Soft Costs	$4,130	$3,686	-$444

Total Installed Cost	$6,390	$6,124	-$266

As with other residential prototypical projects, firm-by-firm analysis shows that hard costs and soft costs do not correlate well (Figure 23). This is indicated by the large margin of error (shaded area) and shallow positive trend line.

Figure 23. Insulation and Air Sealing Soft Costs vs. Hard Costs



As shown in Table 24 and Table 25, the Market Evaluation Team also collected data on and constructed estimates for the six specific soft cost categories. Installation costs continued to be the largest soft cost, at 56% of total soft costs, an identical percentage to 2019. Marketing and customer acquisition costs rose slightly as a percentage of total soft costs (29% in 2021 from 27% in 2019), because bid preparation costs increased by 54%. Recruiting and hiring costs increased dramatically, by 269%, but are not statistically different and only comprise a small portion of the total soft cost difference.

Table 24. 2021 Insulation and Air Sealing Soft Cost Component Estimates

Soft Cost Category	Soft Cost Component	Per Project Cost	Per Project %	Component Cost	Std. Deviation	1st Quartile	3rd Quartile	Sample Size
Marketing & Customer Acquisition	Marketing and/or customer education	$1,818	29%	$399	$525	$121	$484	19
	Bid preparation			$1,157	$2,148	$238	$807	19
	Project signing/contracting			$261	$152	$135	$404	17
Project Design	Designing, scoping, and customizing the project	$219	3%	$219	$158	$146	$274	15
Installation	Installation labor	$3,571	56%	$3,571	$2,770	$1,753	$5,270	17

Soft Cost Category	Soft Cost Component	Per Project Cost	Per Project %	Component Cost	Std. Deviation	1st Quartile	3rd Quartile	Sample Size
Transaction Costs	Obtaining permits	$418	7%	$156	$258	$0	$170	15
	Acquiring and maintaining trainings, certifications, and licenses			$262	$390	$27	$270	15
QA/QC	QA/QC activities	$180	3%	$154	$88	$121	$242	17
	Required callbacks to the customer to assist with equipment issues/ servicing			$26	$34	$1	$44	16
Recruiting & Hiring	Recruiting and hiring employees	$129	2%	$129	$277	$0	$67	11

Note: Sum of "Per Project Cost" column will not add to "Value Soft Costs" data point from Table 22 as those estimates are from a different question set than the data points in this table.

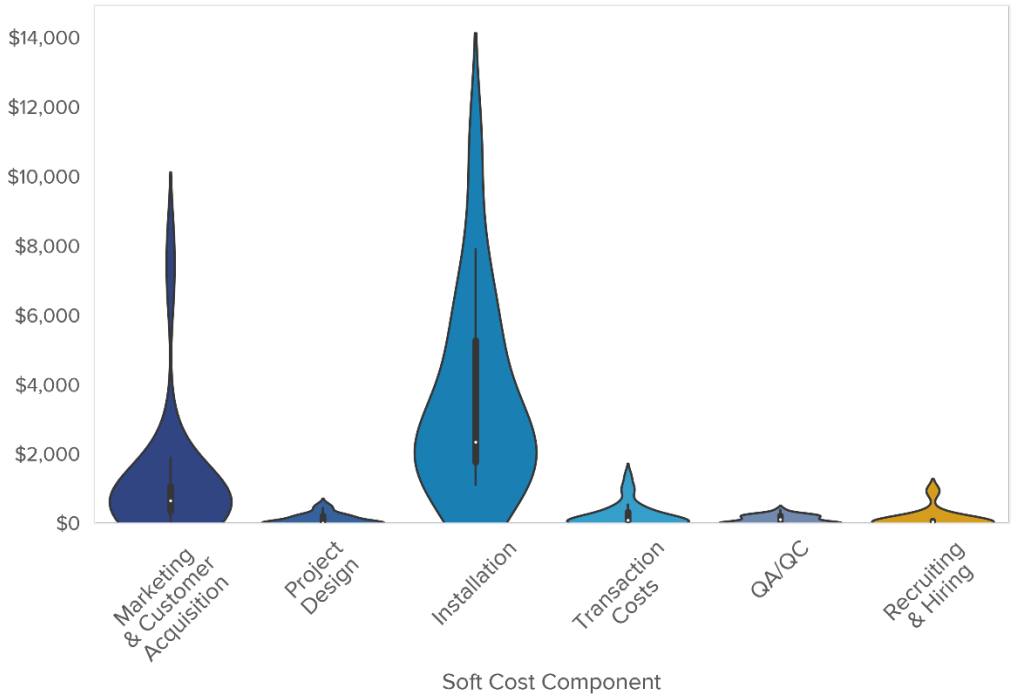
Table 25. Insulation and Air Sealing Soft Cost Component Estimates, 2019 vs. 2021

Soft Cost Category	2019 (n = 22-30)	2021 (n = 11-19)	Change
Marketing and Customer Acquisition	$1,565	$1,818	+$253
Project Design and Development	$357	$219	-$138
Installation	$3,138	$3,571	+$433
Transaction Costs	$523	$418	- $105
Quality Assurance	$229	$180	-$49
Recruiting and Hiring	$35	$129	+$94
Total Soft Costs	**$5,846**	**$6,335**	**+$489**

Note: Sum of "Per Project Cost" column will not add to "Value Soft Costs" data point from Table 22 as those estimates are from a different question set than the data points in this table.
No results in this table are statistically significant from 2019 to 2021 due to small sample sizes.

Figure 24 conveys the distribution of soft cost category estimates. Only two categories—installation and marketing and customer acquisition—exhibited a dispersed set of soft cost estimates, which is shown by the long tail of responses. This shows that insulation and air sealing service providers do not all operate at the same level of work efficiency and that soft cost reduction opportunities may exist. All other soft cost categories have a tight dispersion and are centered close to 0.

Figure 24. Insulation and Air Sealing Violin Plot



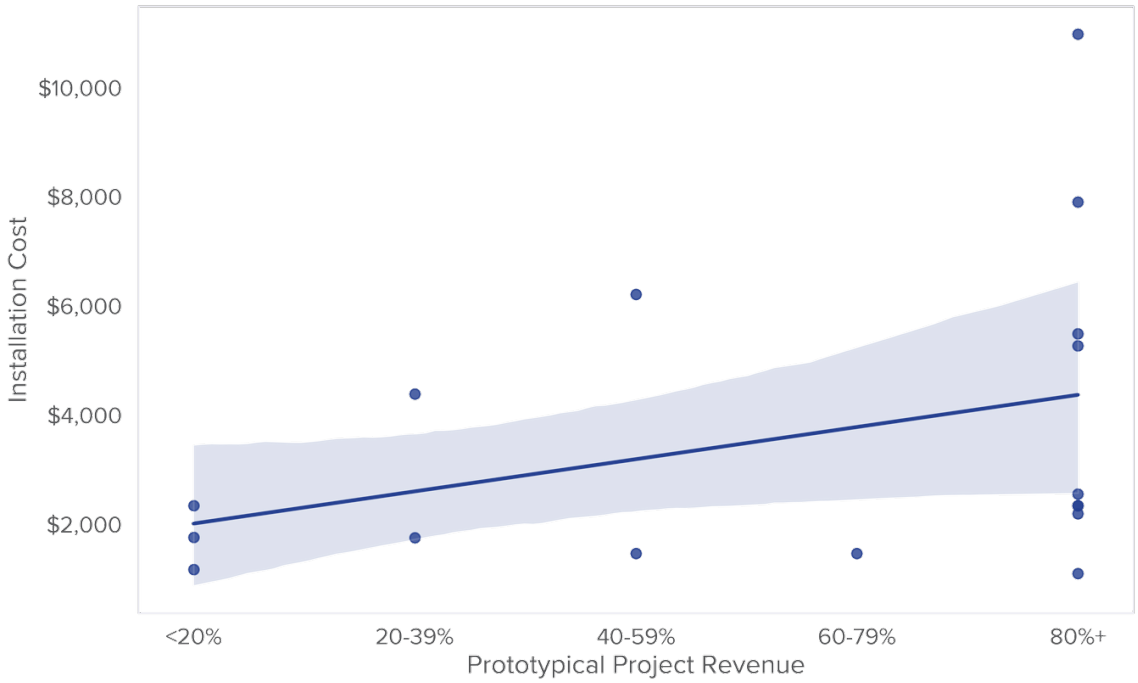
Soft Cost Drivers

The Market Evaluation Team reviewed several soft cost categories for insulation and air sealing projects to determine what may be driving soft costs.

Installation Labor

Figure 25 shows that firms specializing in insulation and air sealing work have directionally higher, but not significantly higher, installation costs compared to firms whose revenue is made up only partially from insulation and air sealing work. In 2019, the Market Evaluation Team observed a "specialization effect," whereby specialized firms had significantly lower installation costs. The Market Evaluation Team hypothesizes that the lack of trend in 2021 is due to the supply chain disruptions and price increases observed during the survey period as well as the comparatively small sample size of responses.

Figure 25. Installation Costs vs. Percentage Revenue from Insulation and Air Sealing



Economies of Scale

Several other notable trends emerged from the insulation and air sealing data. First, bid preparation costs and marketing costs—the two largest soft cost components after installation—tend to vary little (if at all) by company size or by the number of insulation and air sealing projects conducted in a year (job count). The Market Evaluation Team evaluated these relationships by splitting the data on the median value of the independent variable of interest (that is, bid preparation costs and marketing costs) and by plotting the distribution of these variables. For company size, small is defined as any firm with fewer than 10 employees. For number of jobs, "few" was determined based on the median value. It should be noted that the sample sizes are small, so the findings are directional.

For bid preparation costs, shown in Figure 26, and marketing costs, shown in Figure 27, company size and job count appear to have little effect, with only slightly lower bid preparation costs among firms that complete more installations.

During the baseline study, the Market Evaluation Team discussed the prospect of economies of scale in energy efficiency and electrification markets with market experts. Though some market experts expected more evidence of economies of scale, one was not surprised and suggested that larger companies completing a greater number of projects are still not completing enough to outpace the additional overhead that accompanies greater project volume.

Figure 26. Bid Prep Costs by Company Size and Install Count

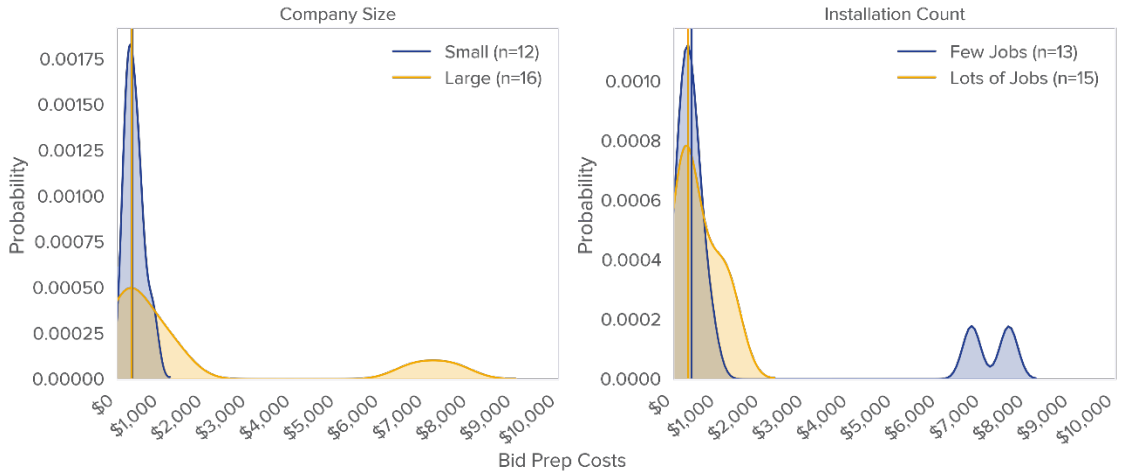
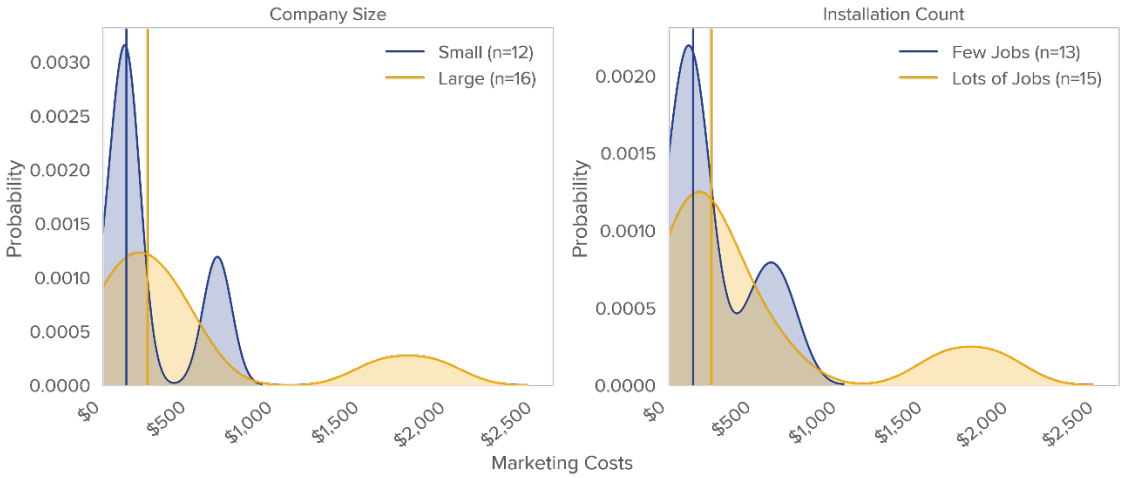


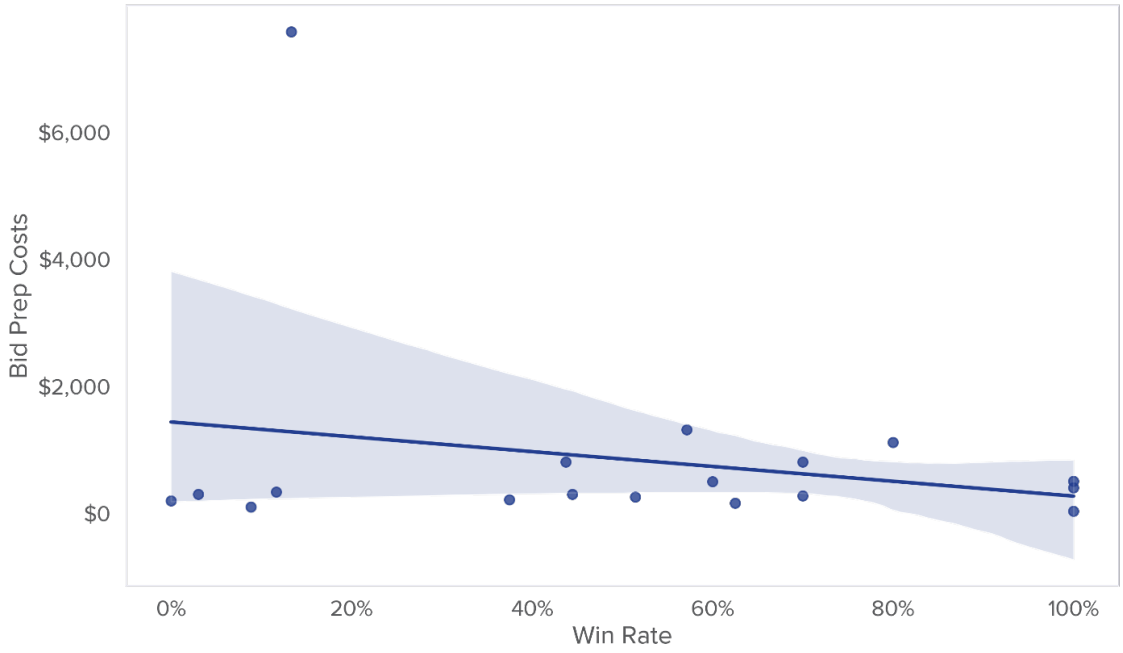
Figure 27. Marketing Costs by Company Size and Installation Count



Win Rate

Figure 28 shows bid preparation costs by win rate. The 2021 data do not show a strong correlation, which is indicated by the large margin of error (shaded area) and shallow positive trend line. In 2019, the Market Evaluation Team found that firms with greater win rates and that specialized in insulation and air sealing tended to have lower bid preparation costs. This suggested evidence in favor of an “expertise” effect, whereby some firms have higher proficiency with bid preparation, yielding high win rates and thus lower bid preparation costs per project.

Figure 28. Insulation and Air Sealing Bid Preparation Costs by Win Rate

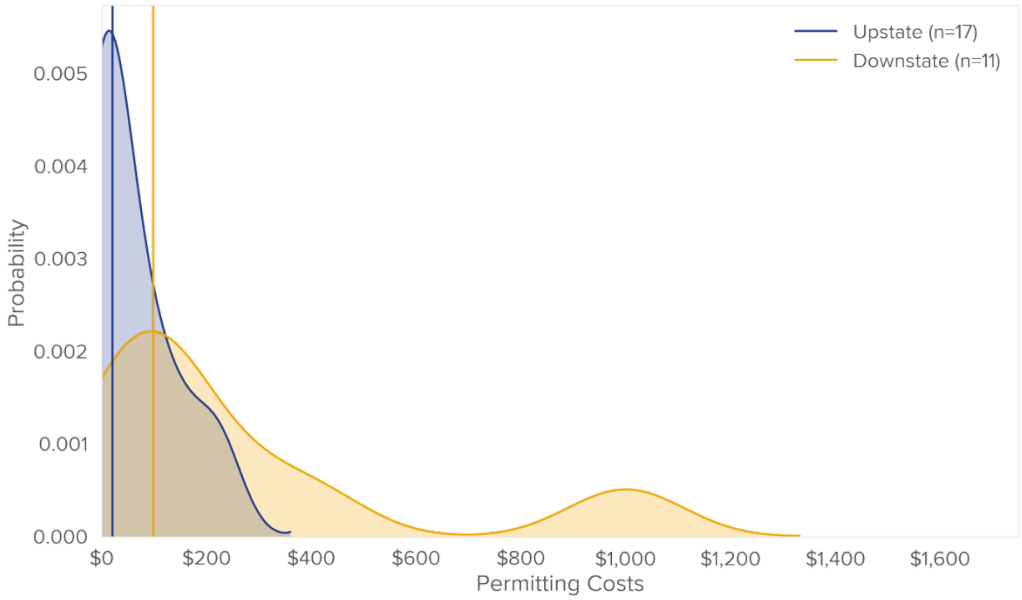


Contractor Region

The Market Evaluation Team found slight differences in the distributions of permitting costs between upstate and downstate New York contractors, though median permitting costs are similar in both regions. Specifically, permitting costs for upstate New York contractors tend to be narrowly distributed close to zero. However, downstate New York contractors' permitting costs tend to be much more widely distributed and *slightly* larger on average, as shown in Figure 29. The 2019 data suggested the opposite distribution, where permitting costs were narrowly distributed downstate and widely distributed upstate.

These findings suggest that downstate New York has subregions or circumstances where permitting costs are disproportionately high, indicating a possible intervention opportunity from NYSERDA.

Figure 29. Insulation and Air Sealing Permitting Costs by Region



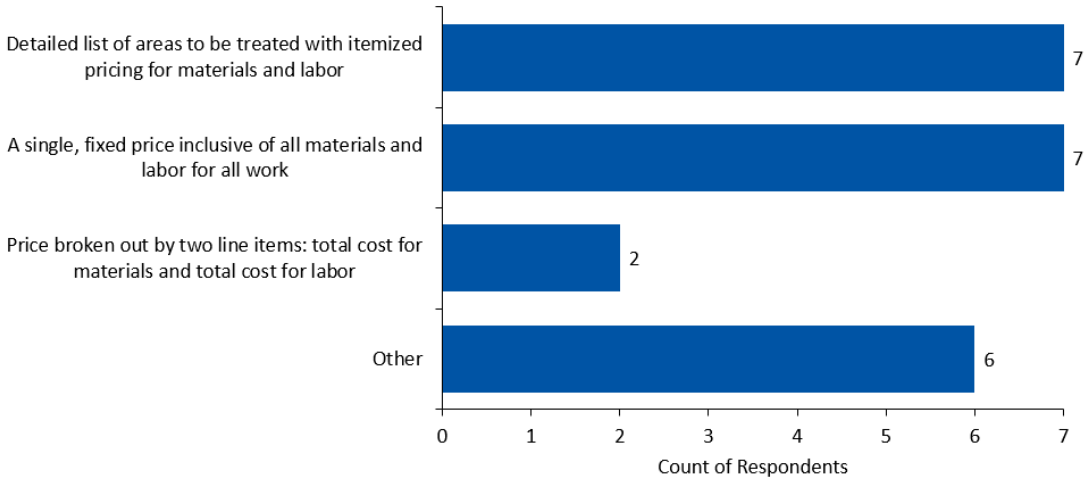
Additional Topics

This section presents some additional findings from insulation and air sealing service providers that are not directly tied to soft cost estimates.

Bid Preparation Software

The Market Evaluation Team asked service providers about the level of detail they typically provide customers in air sealing and insulation improvement project bids. As shown in Figure 30, most said bids included either a detailed list of areas to be treated along with itemized pricing for materials and labor or a single fixed price inclusive of all materials and labor for all work. Among respondents who did things differently, they typically mentioned providing bids using cost per area or treatment.

Figure 30. Level of Detail Provided in Customer Bids



Source: Residential Service Provider Survey Q C6: "What level of detail do you typically provide in your air sealing and insulation improvement project bids to potential customers?" (n=22)

Half of the respondents (n=22) said they use software in developing and preparing insulation and air sealing bids for customers. They mentioned a variety of software programs, and EmPCalc and Quickbooks were used the most used. Of the 14 respondents who said they typically provide estimates of energy savings with the bid (n=26), nine (64%) said these estimates are generated by energy modeling software, three use a list of savings by improvement type, and two use a general rule of thumb.

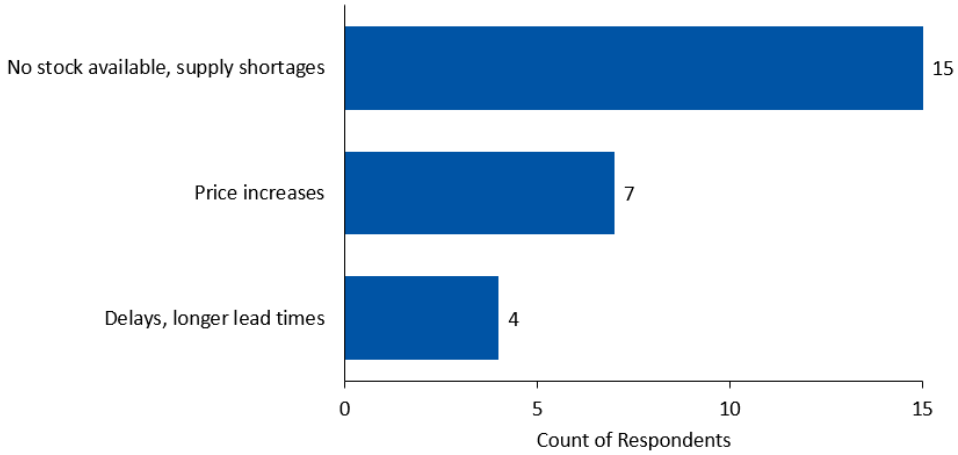
Equipment Stocking and Acquisition

The Market Evaluation Team asked respondents about equipment stocking and acquisition of materials. For single-family jobs, 70% of respondents (n=20) typically used cellulose insulation and 25% used spray foam. 80% reported keeping insulation and other needed materials for air sealing and insulation projects in stock to have it readily available for customers.

Service providers were asked about what kinds of costs were incurred. The most common costs were warehouse and storage costs related to keeping air sealing and insulation materials in stock. Other costs mentioned were shipping and product increases, mortgage, labor to transport assets, and extra costs for heating.

In the past year, 16 of 21 respondents said their business encountered issues with acquiring the needed materials and supplies for air sealing and insulation projects. Of these, nearly all mentioned difficulty with acquiring stock and material shortages, which in turn led to project scheduling delays, as shown in Figure 31. Many experienced price increases to shipping and materials from suppliers as well as delays to delivery.

Figure 31. Issues Encountered in Acquiring Materials for Air Sealing and Insulation Projects



Source: Residential Service Provider Survey Q F6: "What issues did you encounter? " (n=16)

Key Findings: Insulation and Air Sealing

- Similar to 2019, installation labor comprised the majority of insulation and air sealing soft costs. Unlike other residential sector prototypical projects, marketing and customer acquisition was not a key driver of soft costs in 2021. The Market Evaluation team hypothesizes that this may be due to the influence of contractors completing low-moderate income-qualified projects.
- Compared to 2019, recruiting and hiring costs increased by 269%.
- There is little evidence of economies of scale in bid prep and marketing costs among residential insulation and air sealing contractors.
- Insulation and air sealing permitting costs tend to be slightly more widely distributed for downstate New York contractors than for upstate New York contractors, opposite of 2019 data.
- 76% of respondents said their business encountered issues with acquiring the needed materials and supplies for air sealing and insulation projects.

Whole-Home Efficiency

This section details soft costs for the residential whole-home efficiency project by specifically reviewing the prototypical project soft cost estimates, soft cost drivers, and additional related topics. The Market Evaluation Team gathered responses from 13 residential contractors who completed a comprehensive whole-home efficiency project in a single-family home within the past 12 months. Forty-five percent (n=22) firms with fewer than 10 employees, while 36% had 10 to 29 employees. The remaining firms (18%) had 30 or more employees. Compared to 2019, the proportion of contractors working at firms with fewer than 10 employees was smaller (45% in 2021 compared to 65% in 2019).

Due to the lower sample size than other residential prototypical projects, it was not possible to analyze the data at the same depth.

Prototypical Project Cost Estimates

The Market Evaluation Team asked contractors to provide information on their hard and soft cost expenditures within the last 12 months as well as provide estimates for the residential whole-home efficiency prototypical project, described in Table 26. This prototypical project combines the HVAC replacement and insulation and air sealing projects into one package.

Table 26. Whole-Home Efficiency Prototypical Project Details (2021)

Attribute	Definition
Building Type	Single-family home; family of 3 (2 adults, 1 child) living there year-round
Building Size	2,000 sq. ft, 2-story home—living and kitchen downstairs with bedrooms upstairs Colonial, 50 years old; R19 insulation
Existing Conditions	**HVAC:** Gas-powered condensing boiler; standard thermostat **Insulation:** R19 insulation in ceiling; crawl space/basement uninsulated; typical attic leakage in bypasses; typical metal ductwork
Equipment to Be Installed	**HVAC:** ASHP mini-split (ductless) with 1 outdoor unit and 3 indoor heads. **Insulation:** R49 insulation (blown-in) for ceiling and R30 insulation (fiberglass) for crawl space/basement; air sealing for whole-house, attic, and basement bypasses

Table 27 summarizes the high-level hard and soft cost estimates. Service providers estimated an average total installed cost of a residential whole-home efficiency project at $22,314, the largest of the three residential prototypical projects. Of the average total installed cost, 48% were hard (equipment-related) costs, while 52% were soft costs. This proportion of soft costs for whole-home efficiency was largely consistent with that of residential HVAC replacement.

Table 27. Whole-Home Efficiency Hard Cost and Soft Cost Estimates (2021)

Metric	Value	Std. Deviation	1st Quartile	3rd Quartile	Sample Size
Total Installed Cost	$22,314	$14,203	$17,250	$25,000	10
% Soft Costs	52%	7%	55%	55%	10
Value Soft Costs	$11,754	$8,113	$7,200	$13,825	10
% Hard Costs	48%	7%	45%	45%	10
Value Hard Costs	$10,560	$6,337	$8,285	$12,469	10

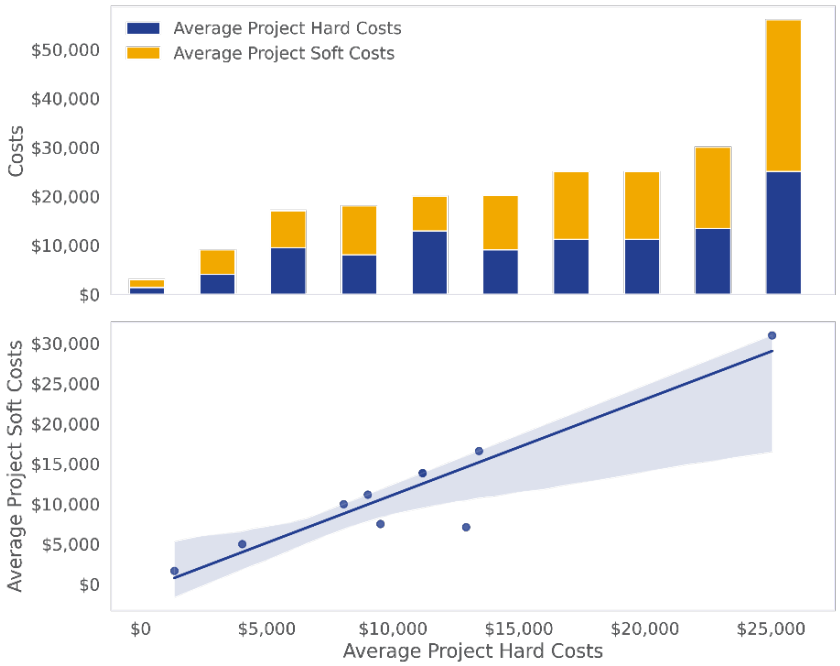
Compared to 2019, the average total project costs in 2021 have increased by $5,626 per project, an increase of 33%, as shown in Table 28. Both hard and soft cost categories saw increased costs during the two-year period, but increases were relatively larger for hard costs (41%) compared to soft costs (29%). The increases in hard and soft costs were likely related to the shortages of HVAC equipment and raw materials, scarcity of labor, and supply chain disruptions brought about by the COVID-19 pandemic. See the *Fluctuations in Market* section for additional details on these impacts.

Table 28. Whole-Home Efficiency Prototypical Project Cost Estimate 2019 and 2021 Comparison

Cost Category	2019 (n = 20)	2021 (n = 10)	Change
Hard Costs	$7,474	$10,560	+$3,086
Soft Costs	$9,214	$11,754	+$2,540
Total Project Costs	$16,688	$22,314	+$5,626

The firm-by-firm analysis of hard and soft cost estimates found a different trend appeared than for the HVAC replacement and insulation and air sealing prototypical projects. For whole-home prototypical projects, hard and soft costs positively correlate, as shown in Figure 32. That is, companies with higher hard costs tend to have higher soft costs, though not perfectly, as the corresponding bar graph helps illustrate. Though this trend is stronger for the whole-home prototypical project compared to other residential sector projects, the small sample sizes (n=10) makes this finding directional.

Figure 32. Whole-Home Soft Costs vs. Hard Costs 2021



The Market Evaluation Team collected data on and constructed estimates for six specific soft cost categories. As shown in Table 29 and Table 30, installation costs are the largest, at $5,047 per project (44%), down from the 53% estimated in 2019. Marketing costs, including bid prep costs, is the second largest soft cost category, at $3,464 per project (30%), similar to the 28% in 2019. Recruiting and hiring costs had the only statistically significant difference, with costs growing by $673, from $46 to $719, over the two-year period. As discussed in the *Fluctuations in Market* section, the labor market posed several challenges for service providers.

Table 29. Whole-Home Efficiency Soft Cost Component Estimates (2021)

Soft Cost Category	Soft Cost Component	Per Project Cost	Per Project %	Component Cost	Std. Deviation	1st Quartile	3rd Quartile	Sample Size
Marketing & Customer Acquisition	Marketing and/or customer education	$3,464	30%	$1,643	$2,300	$158	$2,049	17
	Bid preparation			$1,447	$1,364	$403	$1,906	15
	Project signing/contracting			$375	$355	$191	$318	9
Project Design	Designing, scoping, and customizing the project	$625	5%	$625	$599	$208	$763	10
Installation	Installation labor	$5,047	44%	$5,047	$3,440	$2,567	$6,106	11
Transaction Costs	Obtaining permits	$1,148	10%	$775	$1,085	$333	$543	8
	Acquiring and maintaining trainings, certifications, and licenses			$374	$419	$101	$414	13
QA/QC	QA/QC activities	$597	5%	$433	$528	$149	$429	10
	Required callbacks to the customer to assist with equipment issues/ servicing			$164	$208	$21	$205	12
Recruiting & Hiring	Recruiting and hiring employees	$719	6%	$719	$783	$20	$1,246	11

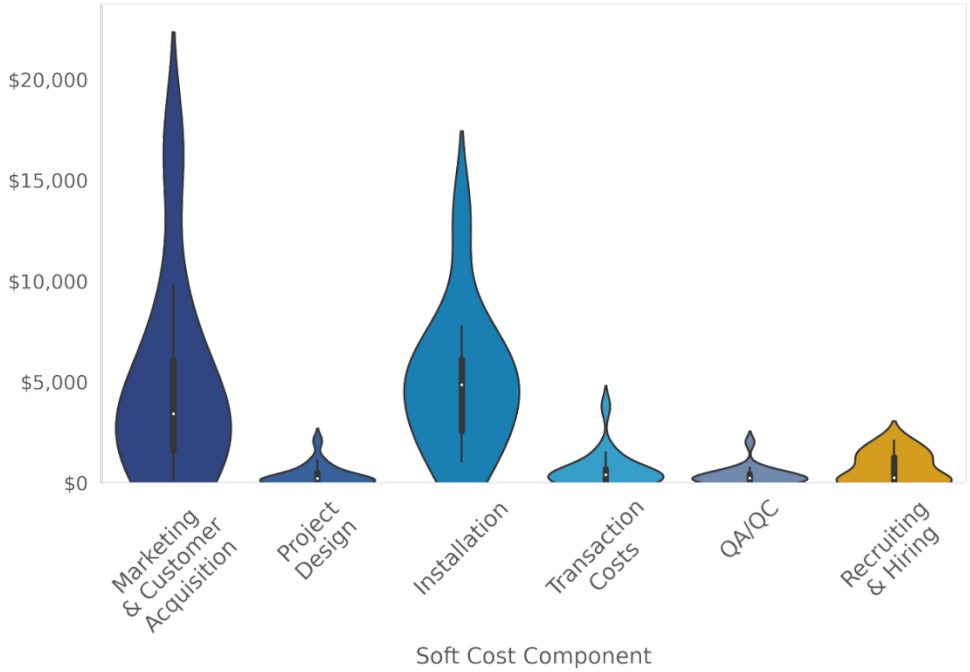
Table 30. Whole-Home Soft Cost 2019 vs. 2021 Comparison

Soft Cost Category	Whole Home		
	2019 (n = 17-28)	2021 (n = 8-17)	Change
Marketing and Customer Acquisition	$2,834	$3,464	+$630
Project Design and Development	$416	$625	+$209
Installation	$5,259	$5,047	-$212
Transaction Costs	$1,105	$1,148	+$43
Quality Assurance	$328	$597	+$269
Recruiting and Hiring	$46	$719	+$673**
Total Soft Costs	**$9,988**	**$11,599**	**+$1,611**

The following notation denotes statistical significance at the different confidence levels: * p < 0.20, ** p < 0.10, *** p < 0.05

Figure 33 shows the distribution of soft cost category estimates. The relative distributions of each soft cost component are roughly consistent with those of HVAC replacement and insulation and air sealing prototypical projects, with installation labor and marketing and customer acquisition costs comprising the widest spread of estimates.

Figure 33. Whole-Home Efficiency Soft Cost Component Violin Plot



Soft Cost Drivers

The Market Evaluation Team used several techniques to examine whole-home efficiency project soft cost data collected from contractors. Analysis was limited by a slightly lower sample size compared to HVAC replacement and insulation and air sealing data. In general, firmographic variables had relatively low explanatory power over total soft costs. Whole-home efficiency soft cost trends were also highly consistent with those of HVAC replacement, insulation and air sealing, and 2019 whole-home efficiency findings.

The following sections explore prominent trends in the whole-home efficiency soft cost data in greater detail.

Economies of Scale

The Market Evaluation Team evaluated the existence of economies of scale by splitting the data on the median value of the independent variable of interest (bid preparation costs and marketing costs) and plotting the distributions of these variables. Small firms are defined as firms with fewer than 10 employees. “Few jobs” is split by the median number of whole-home efficiency projects completed in the past year. There is little evidence of economies of scale in bid preparation and marketing costs among whole-home efficiency service providers, as shown in Figure 34 and Figure 35 by the closely spaced vertical lines indicating the median values of the respective soft cost distributions.

These findings are consistent with findings from the 2019 study.

Figure 34. Whole-Home Efficiency Bid Preparation Costs by Company Size and Install Count

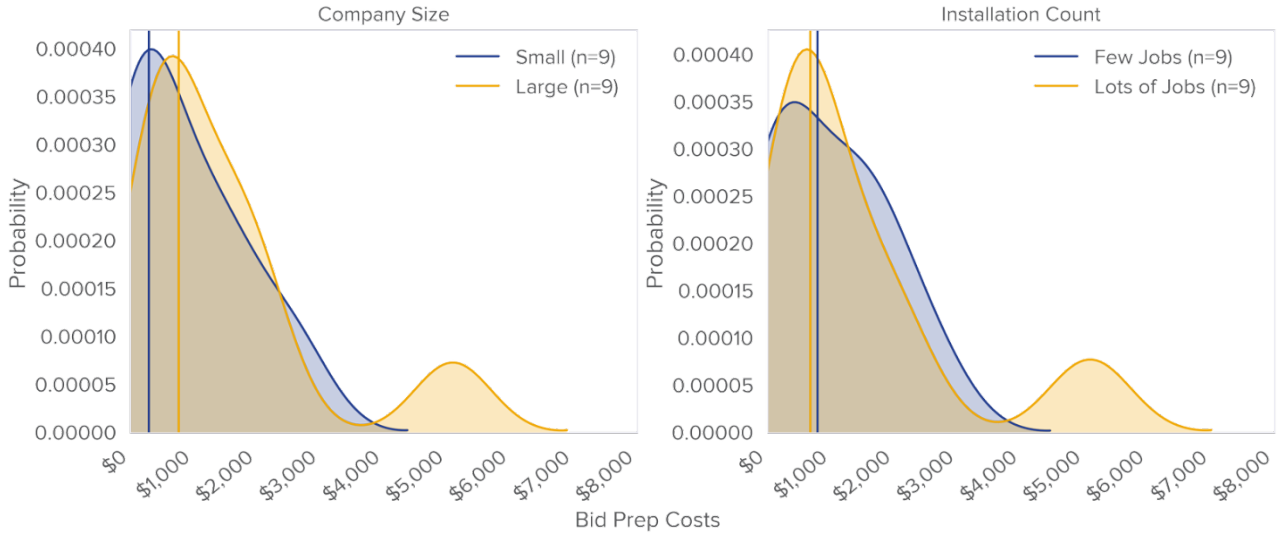
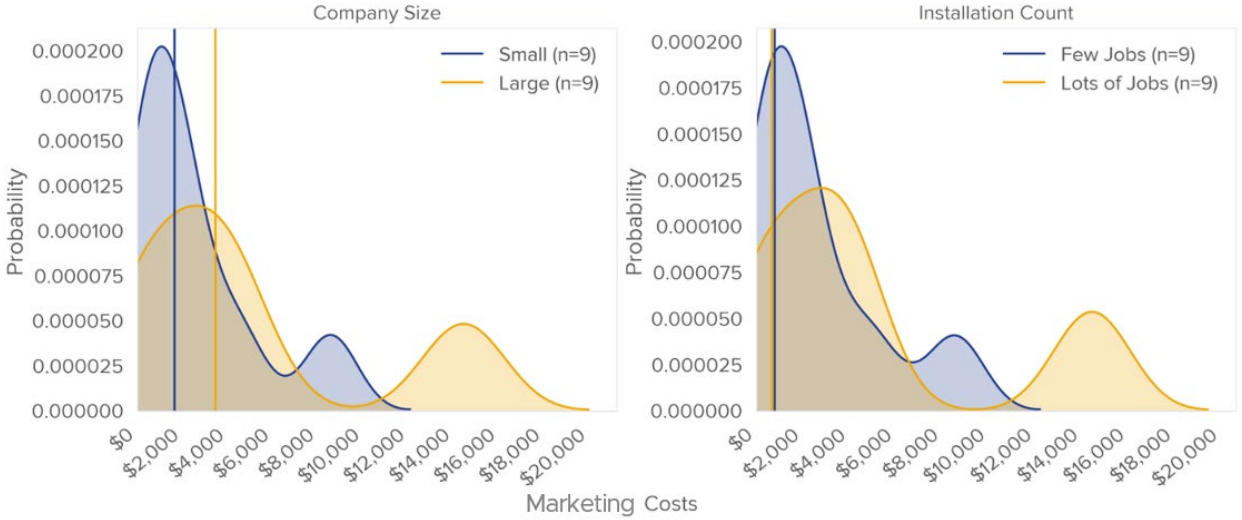


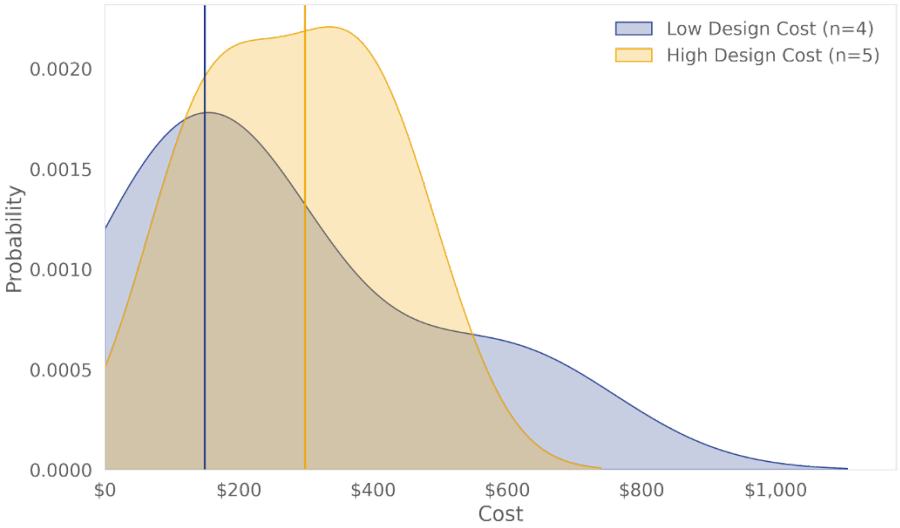
Figure 35. Whole-Home Efficiency Marketing Costs by Company Size and Install Count



QA/QC and Design Costs

The Market Evaluation Team also analyzed the extent to which a company's expenditures on design is correlated with its expenditures on QA/QC. The Market Evaluation Team found that service providers who spend more on design also tend to spend more on QA/QC, suggesting that contractor inclination for detail throughout the project may vary among residential contractors (i.e., some may be more thorough across all project steps). Figure 36 illustrates this relationship among whole-home efficiency service providers. This figure separates service provider respondents based on the median design cost. This trend is consistent with the trend observed in the 2019 study.

Figure 36. Whole-Home Efficiency QA/QC Costs by Design Costs



Additional Topics

This section details some additional findings from whole-home efficiency service providers that are not directly tied to soft cost estimates.

Energy Savings Estimates

The Market Evaluation Team asked service providers if they typically include estimates of project energy savings in their bid proposals. Ten of 16 respondents (63%) said they did, with the majority using energy modeling. For the 38% of service providers who answered they do not provide energy savings estimates in their bids, the Market Evaluation Team asked why that was the case. One service provider said, "There is no good way of [providing energy savings estimates]. All of the software is too imprecise to give a quality number I can stand behind." Another contractor said the reason is "…Most customers are concerned and motivated by discomfort issues [as opposed to energy savings]." It appears some service providers are not interested in purchasing additional software to provide energy savings estimates if they believe doing so will not impact their win rate or if they believe the estimates will not fairly represent the retrofit savings to the customer.

Client Bids

The Market Evaluation Team inquired about the bid proposal process for service providers who provide energy efficiency retrofit and electrification services to identify the current practices that may drive overall soft costs for these projects. One aspect of bid proposals that might add considerably to overall cost is the bid software. Sixty-nine percent (n=16) of whole-home service providers use software to develop their bid proposals.

Many service providers said they use of software such as EmPCalc, TREAT, Snugg Pro, Wrightsoft, and some internally created tools that use Microsoft Excel. The variation in types of software, along with the 31% of service providers who do not use software at all, suggests there is no clear favorite. Further

studies may obtain insight on what features appeal to service providers and whether the cost of the software is the biggest indicator of software use in bid proposal preparation. NYSERDA has also conducted impact evaluation studies that examine the realization of actual energy savings versus modeled energy savings coming out of various modeling tools/software programs.

Service providers who did not use software to prepare their bid proposals gave the following reasons:

- The custom nature of these projects is not accounted for when using software
- No need for software
- Small company and cannot afford the software

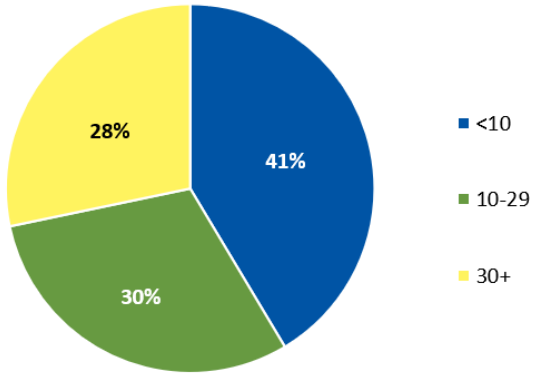
It is reasonable to assume that larger companies, benefiting from a larger project load, can justify the use of software that adds to the cost of their projects.

Key Findings: Whole-Home Efficiency
• Whole-home projects display similar trends to both HVAC and insulation projects with increased hard and soft costs being observed. Additionally, increases in marketing and customer acquisition costs and recruiting and hiring costs mirror trends in other building electrification-focused prototypical projects. • Installation costs for whole-home projects continue to be the largest soft cost category. • Some contractors appear to be more thorough throughout the entire project process, as evidenced by higher project design and QA/QC costs.

Commercial Sector

The Market Evaluation Team conducted surveys with a variety of commercial service providers to investigate soft costs associated with three different energy efficiency and electrification projects: HVAC replacement (VRF), lighting retrofit, and a building controls retrofit. The Market Evaluation Team gathered responses from 92 commercial service providers, 57 of which completed a VRF project, 19 completed a commercial lighting project, and 16 completed a building controls project within the past 12 months. Of surveyed service providers, 42% primarily worked in upstate NY and 58% worked downstate (n=97). Forty-one percent worked for a company with less than 10 employees, as shown in Figure 37. These results are consistent with 2019 results which reported 45% working upstate, 55% working downstate, and 37% working for a company with less than 10 employees.

Figure 37. Number of Employees for Commercial Service Providers



Source: Commercial Contractor Survey Q F1: "Including yourself, approximately how many employees work for your company in New York state?" (n=99).

Prototypical Project Cost Estimates

The Market Evaluation Team asked contractors to estimate soft costs for three prototypical projects in the commercial sector, as shown in Table 31.

Table 31. Commercial Sector Prototypical Projects

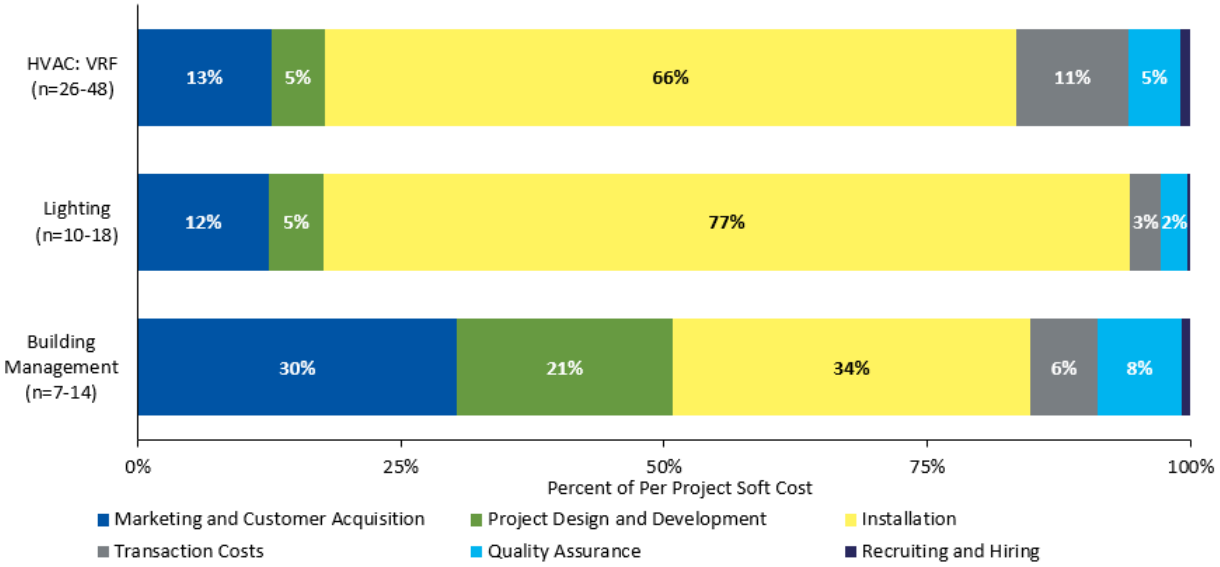
Prototypical Project	Attribute	Definition
HVAC Retrofit: Variable Refrigerant Flow (VRF)	Building Type	Commercial office building
	Building Size	30,000 sq. ft.
	Existing Conditions	**Fuel type**: Gas **Equipment**: Four (approximately 10-ton) packaged rooftop air-conditioning units with gas-fired heating, each controlling a single zone
	Equipment to Be Installed	**Fuel type**: Electric **Equipment**: VRF system with 1 main outdoor unit and 10 indoor zones Assume significant updates to the electric service will not be required
Lighting Retrofit	Building Type	Retail store (one floor)
	Building Size	10,000 sq. ft.
	Existing Conditions	**Indoor**: Linear fluorescent **Outdoor**: HID Assume no controls currently installed
	Equipment to Be Installed	**Indoor:** 1:1 LED retrofit using LED retrofit kits (not changing fixtures) **Outdoor:** 100% fixture replacement with LED Install lighting controls in a networked system, including features such as daylighting and auto-dimming

Prototypical Project	Attribute	Definition
Building Management Project Involving System/ Operational Optimization for Energy Efficiency and Electrification	Building Type	Commercial office building
	Building Size	100,000 sq. ft
	Existing Conditions	**HVAC:** System has older controls and requires hardware and software updates **Lighting**: Newer control system does not require a hardware update (only software)
	Equipment to Be Installed	**HVAC:** Upgrade controls system for air handling unit; assume 25% of sensors need replacement (but no additional sensors); conduct static pressure reset and economizer optimization **Lighting:** Assume no system/hardware upgrades, only reprogramming (daylighting and auto-dimming); integrate with HVAC controls system

Figure 38 shows the breakdown of soft cost categories across each commercial prototypical project. Across all three prototypical projects, installation labor comprised the largest share of soft costs, with the lighting and HVAC: VRF projects weighted most heavily towards installation labor. Of all prototypical projects, the HVAC: VRF project had a complex and technical installation, leading to a longer install time and the need for more specialized labor. Comparatively, the building management project had a relatively equal distribution of soft costs for three categories: installation labor, marketing and customer acquisition, and project design and development. Even though both the building management and HVAC: VRF projects have more complex design needs, the installation labor required for a building management project is substantially lower.

Table 32 shows the absolute values for each soft cost category by prototypical project, which helps to provide context to the results in Figure 38.

Figure 38. Soft Cost Estimate Breakdown for Commercial Prototypical Projects



Note: Numbers may not add to 100% due to rounding.

Table 32. Soft Cost Category Absolute Value Estimates by Commercial Prototypical Project (2021)

Soft Cost Category	HVAC: VRF (n = 26-48)	Lighting (n = 10-18)	Building Mgmt. Systems (n = 7-14)
Marketing and Customer Acquisition	$10,440	$2,950	$21,662
Project Design	$4,112	$1,227	$14,669
Installation	$51,997	$18,150	$24,286
Transaction Costs (Training, Certifications, Permits)	$8,335	$701	$4,579
Quality Assurance	$3,945	$585	$5,693
Recruiting and Hiring	$792	$78	$620
Total Soft Costs	**$79,622**	**$23,691**	**$71,509**

Compared to 2019, two soft cost categories were significantly higher for the HVAC: VRF project: marketing and customer acquisition (80% confidence interval) and recruiting and hiring (95% confidence interval), as shown in Table 33. For marketing and customer acquisition, increases in market activity due to increased customer interest in energy efficiency and electrification technologies likely caused the increase from 2019. For recruiting and hiring, the tight labor market and comparatively inexperienced labor force contributed to the statistically increased costs. Given the relatively complex installation procedures required for a VRF installation, skilled labor is an even more critical component than for some other types of energy efficiency and electrification projects. See the *Fluctuations in Market* section for more details.

Table 33. Soft Cost Category Absolute Value Estimates For HVAC: VRF Project (2019 vs. 2021)

Soft Cost Category	2019 (n = 12-20)	2021 (n = 26-48)	Change
Marketing and Customer Acquisition	$8,755	$10,440	+$1,685*
Project Design	$4,213	$4,112	-$101
Installation	$50,471	$51,997	+$1,526
Transaction Costs (Training, Certifications, Permits)	$5,437	$8,335	+$2,898
Quality Assurance	$3,690	$3,945	+$255
Recruiting and Hiring	$151	$792	+$641***
Total Soft Costs	**$72,718**	**$79,622**	**+$6,904**

The following notation denotes statistical significance at the different confidence levels: * $p < 0.20$, ** $p < 0.10$, *** $p < 0.05$

Figure 39 shows the distribution of aggregated commercial sector soft costs by category. The violin plot represents the spread of cost estimates (i.e., estimates are more widely dispersed for a long tail and/or a longer body shape). For example, QA/QC costs in the commercial sector center closer to zero, while marketing and customer acquisition, project design, installation, and transaction costs disperse more widely. Soft costs with a larger spread (i.e., wider across a larger part of the x-axis) represent a reduction opportunity, as some contractors doing a similar job spend more than others.

Figure 39. Commercial Sector Soft Costs Violin Plot

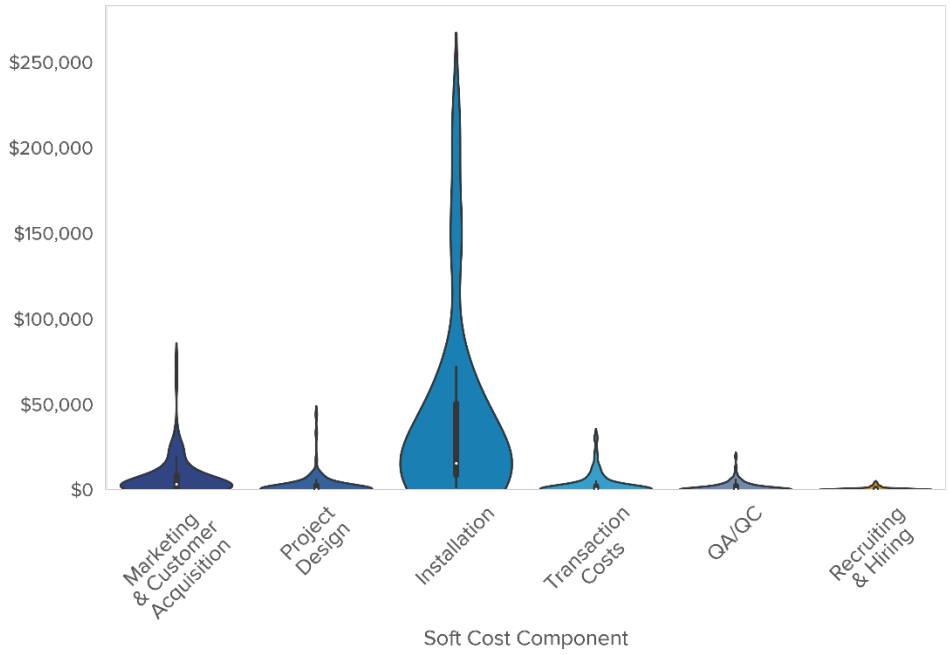


Table 34 through Table 36 show the 2021 soft cost estimates for each commercial sector prototypical project.

Table 34. Commercial HVAC: VRF Soft Cost Component Estimates (2021)

Soft Cost Category	Soft Cost Component	Per-Project Cost	Per Project (%)	Component Cost	Std. Deviation	1st Quartile	3rd Quartile	Sample Size
Marketing & Customer Acquisition	Marketing and/or customer education	$10,440	13%	$3,038	$7,192	$128	$2,217	48
	Bid preparation			$5,471	$8,255	$989	$5,133	46
	Project signing/ contracting			$1,932	$1,731	$596	$2,982	29
Project Design	Designing, scoping, and customizing the project	$4,112	5%	$4,112	$3,010	$1,729	$6,627	30
Installation	Installation labor	$51,997	65%	$51,997	$65,380	$8,647	$65,395	26
Transaction Costs	Obtaining permits	$8,335	10%	$5,564	$6,320	$1,164	$7,689	30
	Acquiring and maintaining training, certifications, and licenses			$2,771	$4,133	$10	$3,404	33
QA/QC	QA/QC activities	$3,945	5%	$3,117	$2,545	$1,259	$4,526	30
	Required callbacks to the customer to assist with equipment issues/ servicing			$828	$1,122	$113	$1,006	28
Recruiting & Hiring	Recruiting and hiring employees	$792	1%	$792	$1,148	$0	$844	33

Table 35. Commercial Lighting Soft Cost Component Estimates (2021)

Soft Cost Category	Soft Cost Component	Per-Project Cost	Per Project (%)	Component Cost	Std. Deviation	1st Quartile	3rd Quartile	Sample Size
Marketing & Customer Acquisition	Marketing and/or customer education	$2,950	12%	$1,232	$1,808	$0	$1,201	17
	Bid preparation			$1,012	$789	$440	$1,084	18
	Project signing/ contracting			$705	$553	$356	$745	11
Project Design	Designing, scoping, and customizing the project	$1,227	5%	$1,227	$903	$469	$1,692	10
Installation	Installation labor	$18,150	77%	$18,150	$17,595	$4,780	$22,064	10
Transaction Costs	Obtaining permits	$701	3%	$566	$643	$45	$748	15
	Acquiring and maintaining training, certifications, and licenses			$135	$313	$0	$120	13
QA/QC	QA/QC activities	$585	2%	$406	$340	$132	$792	10
	Required callbacks to the customer to assist with equipment issues/ servicing			$179	$168	$25	$304	12
Recruiting & Hiring	Recruiting and hiring employees	$78	0%	$78	$197	$0	$25	15

Table 36. Commercial Building Management System Soft Cost Component Estimates (2021)

Soft Cost Category	Soft Cost Component	Per-Project Cost	Per Project (%)	Component Cost	Std. Deviation	1st Quartile	3rd Quartile	Sample Size
Marketing & Customer Acquisition	Marketing and/or customer education	$21,662	30%	$2,666	$3,317	$163	$3,517	9
	Bid preparation			$15,723	$23,683	$2,644	$17,433	14
	Project signing/ contracting			$3,273	$3,368	$1,017	$5,084	7
Project Design	Designing, scoping, and customizing the project	$14,669	21%	$14,669	$15,900	$3,146	$21,523	8
Installation	Installation labor	$24,286	34%	$24,286	$21,368	$9,492	$36,423	7
Transaction Costs	Obtaining permits	$4,579	6%	$4,258	$4,456	$1,000	$6,809	9
	Acquiring and maintaining training, certifications, and licenses			$321	$326	$82	$482	8
QA/QC	QA/QC activities	$5,693	8%	$5,388	$6,452	$2,439	$4,709	7
	Required callbacks to the customer to assist with			$305	$317	$0	$488	9

	equipment issues/ servicing							
Recruiting & Hiring	Recruiting and hiring employees	$620	1%	$620	$765	$140	$669	7

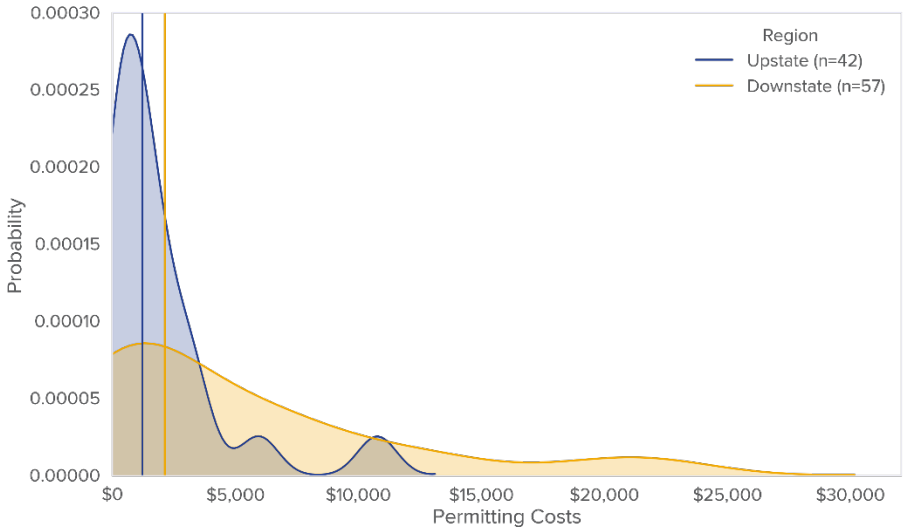
Soft Cost Drivers

This section details what could be driving differences in several soft cost categories.

Permitting

The Market Evaluation Team explored the relationship between the contractor's region and permitting costs. Figure 40 plots the distribution of commercial permitting costs for upstate and downstate contractors, with the vertical lines indicating median values for each group. Though both upstate and downstate service providers had a relatively similar median permitting cost, downstate service providers had a larger spread of permitting costs compared to upstate service providers (Figure 40). This larger spread is consistent with trends observed in the residential sector and reflects the more complex and expensive permitting environment downstate. In 2019, the same trend was present (a larger spread of permitting costs among downstate contractors) but the difference in mean by region was greater by about $1,000. Given the relatively large total cost of these projects, this difference is not statistically significant.

Figure 40. Commercial Sector Permitting Costs by Region



Additional Topics

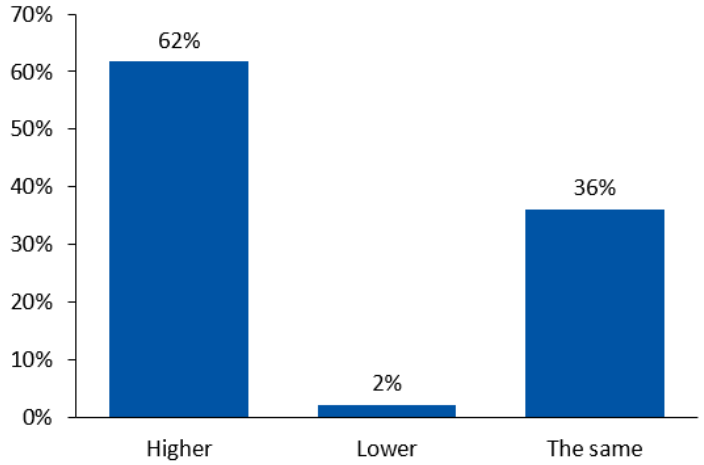
This section details some additional findings from commercial service providers that are not directly tied to soft cost estimates.

ASHP Customer Acquisition Costs

HVAC: VRF providers were asked whether they thought costs associated with customer acquisition for commercial VRF systems were higher, lower, or the same as other commercial HVAC systems installed.

62% of respondents believed these associated costs were higher for commercial VRF than other HVAC technologies as shown in Figure 41.

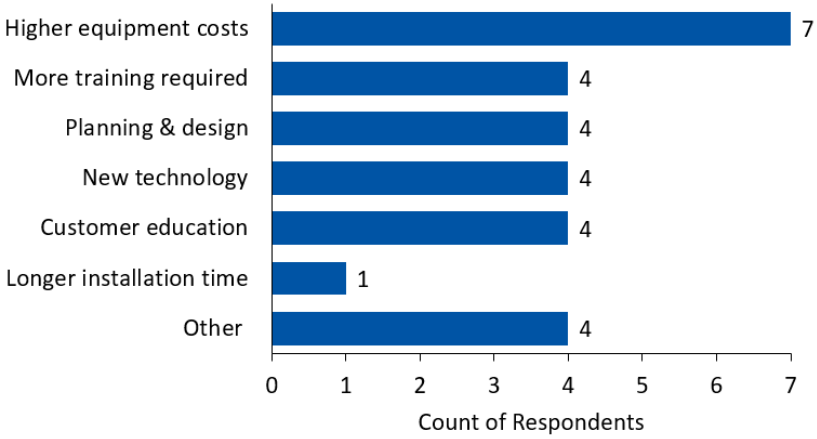
Figure 41. Commercial HVAC: VRF Customer Acquisition Costs



Source: Commercial HVAC VRF Survey Q C8: "Would you say the costs associated with customer acquisition for commercial VRF systems are higher, lower, or the same as other commercial HVAC systems you install? " (n=47)

The Market Evaluation Team asked why respondents believed customer acquisition costs are higher for commercial VRF systems than other HVAC technologies as shown in Figure 42. Higher equipment costs associated with HVAC: VRF projects were indicated as the main reason for higher costs.

Figure 42. Drivers of Higher HVAC: VRF Customer Acquisition Costs



Source: Commercial HVAC VRF Survey Q C9a: "Why do you say that the customer acquisition costs are higher for commercial VRF systems than other HVAC technologies? " (n=24)

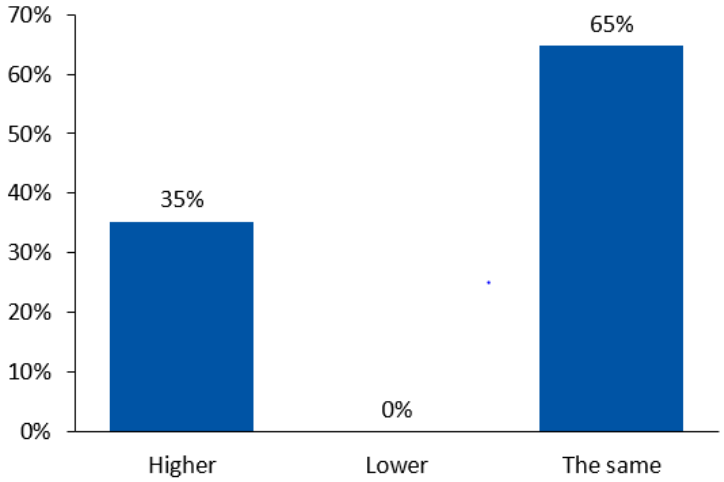
Lighting Customer Acquisition Costs

Commercial lighting providers were asked whether they thought costs associated with customer acquisition for commercial lighting systems were higher, lower, or the same as other commercial HVAC

systems installed that don't include lighting controls. 65% of respondents believed these associated costs were about the same for commercial VRF than other HVAC technologies as shown in Figure 43 (n=17).

35% of respondents said commercial lighting projects were higher. These respondents mentioned that these higher costs are associated with additional labor for lighting controls, additional low-voltage wiring, and engineering time.

Figure 43. Commercial Lighting Customer Acquisition Costs



Source: Commercial Lighting Survey C9: "Would you say the costs associated with customer acquisition for commercial lighting projects that include lighting controls are higher, lower, or the same as other commercial lighting projects that do not include lighting controls? " (n=17)

Equipment Stocking

The Market Evaluation Team asked questions regarding equipment stocking practices. one-quarter of respondents (20%; n=61) said they kept equipment in stock to have it readily available for customers; and 45% of respondents (n=60) said they encountered issues in acquiring equipment. Though sample sizes were small, contractors working with lower-priced components were more likely to keep equipment in stock—for example, controls contractors (those completing the building management system project) and lighting contractors.

Contractors noted long lead times, manufacturer delays, and ordering obsolete equipment as barriers to equipment acquisition. Table 37 shows equipment stocking practices for each prototypical project type, while Table 38 shows equipment stocking issues.

Table 37. Equipment Stocking Practices by Project Type

Equipment in Stock	HVAC: VRF	Lighting	Building Mgmt. Systems	Total
Yes	2	6	4	**12**
No	32	8	9	**49**

Source: Commercial Contractor Surveys Q F1 "Do you keep [EQUIPMENT TYPE] in stock to have it readily available for customers?" (n=61)

Table 38. Issues Acquiring Equipment by Project Type

Stocking Issues	HVAC: VRF	Lighting	Building Mgmt. Systems	Total
Yes	16	7	4	**27**
No	18	6	9	**33**

Source: Commercial Contractor Surveys Q F4 "In the past year, has your business encountered any issues with acquiring the needed equipment to install [PROJECT TYPE]?" (n=60)

Key Findings: Commercial Sector

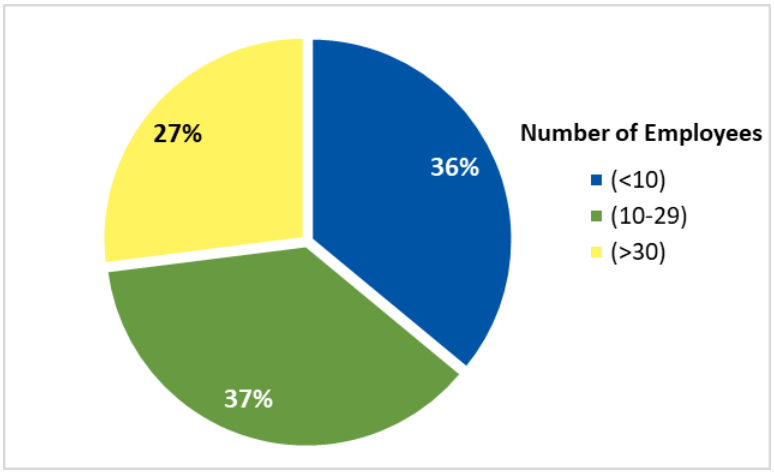
- Commercial sector soft costs are highly variable, with installation labor and marketing and customer acquisition contributing at varying levels to project-level soft costs.
- Market forces since the baseline study have put pressure on commercial HVAC contractors which resulted in significant marketing and customer acquisition and recruiting and hiring costs increases.
- Permitting costs are substantially higher and more dispersed downstate, consistent with other sector findings.

Multifamily Sector

This section, which details soft cost results for the multifamily sector for two prototypical projects (Energy Efficiency [EE] Retrofit ASHP and EE Retrofit Steam), contains the following types of information: soft cost estimates for prototypical projects, drivers of soft costs variation (i.e., win rate, contractor region, etc.), and additional soft cost-related topics (i.e., supply chain/stocking, project financing, etc.). These projects are all for buildings with five or more units and are reported separately from the residential sector.

The Market Evaluation Team gathered responses from 53 service providers (18 for ASHP, and 35 for steam) who completed a multifamily energy efficiency retrofit and electrification project within the previous 12 months. Of these, 53% primarily worked upstate and 47% primarily worked downstate. Figure 44 shows a range of contractor company sizes, by number of employees, that provide multifamily energy efficiency retrofit and electrification projects. Firm sizes did not differ between service providers completing ASHP versus steam retrofits.

Figure 44. Multifamily Service Provider Firm Size



The Market Evaluation Team gathered responses from 13 service providers who completed energy efficiency retrofit and electrification projects involving air source heat pumps (ASHPs) and 27 who completed energy efficiency retrofit projects involving high-efficiency steam systems in multifamily buildings over the past 12 months. The Market Evaluation Team asked respondents to provide information on their hard and soft cost expenditures during this period as well as estimates for a prototypical multifamily building efficiency project, as listed in Table 39. The Energy Efficiency (EE) Retrofit: ASHP project is consistent with the 2019 study, whereas the EE Retrofit: Steam project is new for the 2021 study. The Market Evaluation Team added this prototypical project due to the relative rarity of ASHPs in multifamily buildings, which led to small sample sizes in the 2019 study.

Table 39. Multifamily Prototypical Project Details

Attribute	Definition
Building Type	Pre-war walk-up apartment building (market-rate)
Building Size	24 units (4 stories)
Existing Conditions	**HVAC**: Gas-fired, one-pipe steam system
	Insulation: Low ceiling/attic insulation level
	Lighting (indoor—in-unit and common areas): CFL (in-unit) and linear fluorescent (common areas)
	Lighting (outdoor): HID
Equipment Installed (ASHP)	**HVAC:** ASHP mini-splits in each unit **Insulation:** add blown-in insulation to ceiling/attic **Lighting (indoor—in-unit and common areas):** LED; no fixture replacement **Lighting (outdoor):** LED; no fixture replacement
Equipment Installed (Steam)	**HVAC:** Higher-efficiency steam system **Insulation:** Add blown-in insulation to ceiling/attic **Lighting (indoor—in-unit and common areas):** LED; no fixture replacement **Lighting (outdoor):** LED; no fixture replacement

EE Retrofit: ASHP

For an average installed project cost of $392,857 (from costs provided by the 14 service providers), hard (equipment-related) costs were 51% and soft costs were 49%, as shown in Table 40. Compared to 2019, the interquartile range (IQR) of total installed cost was more widely dispersed, at $372,500 in 2021 versus $180,000 in 2019. The increase in the IQR shows a wider variability in estimates in 2021 than 2019; however, with small sample sizes in both years and given the size of this prototypical project, substantial variability is expected.

The estimates provided for this prototypical project assumed the building had 24 units. On a per-unit basis, the average installed project cost in 2021 is $16,369. This cost includes all work (both in-unit and common areas). Due to the methodology used in this study, the in-unit and common area costs cannot be separated.

Table 40. EE Retrofit: ASHP Hard Cost and Soft Cost Estimates (2021)

Metric	Value	Std. Deviation	1st Quartile	3rd Quartile	Sample Size
Total Installed Cost	**$392,857**	**$250,643**	**$227,500**	**$600,000**	**14**
% Soft Costs	49%	6%	51%	51%	14
Soft Costs	$196,596	$131,394	$78,080	$305,400	14
% Hard Costs	51%	6%	49%	49%	14
Hard Costs	$196,261	$120,738	$122,000	$298,200	14

Table 41 shows soft costs by category. As with other sectors, installation labor is the largest contributor to project soft costs at 76%. After installation labor, service providers estimated that several other soft cost categories would be a relatively similar size. This trend is different than in other sectors, where marketing and customer acquisition was a clear second-largest soft cost. As discussed earlier, this may be due to the comparatively smaller number of firms completing this work, leading to a lesser need for marketing services.

Multifamily service providers said transaction costs were one of the second-tier contributors to total soft costs, specifically permitting costs, which accounts for almost 92% of transaction costs. The inter-quartile range (IQR) for permitting costs is quite large—over $17,000 per project —and represents the variation in what service providers need to do to acquire permits for multifamily building work. Multiple market experts interviewed for the baseline study corroborated this finding, and one said “permitting rules vary greatly by locality, which can be confusing and difficult to deal with.” Another expert noted that he has experienced multiple cases where permit acquisition “delayed construction by multiple months due to numerous application revisions.”

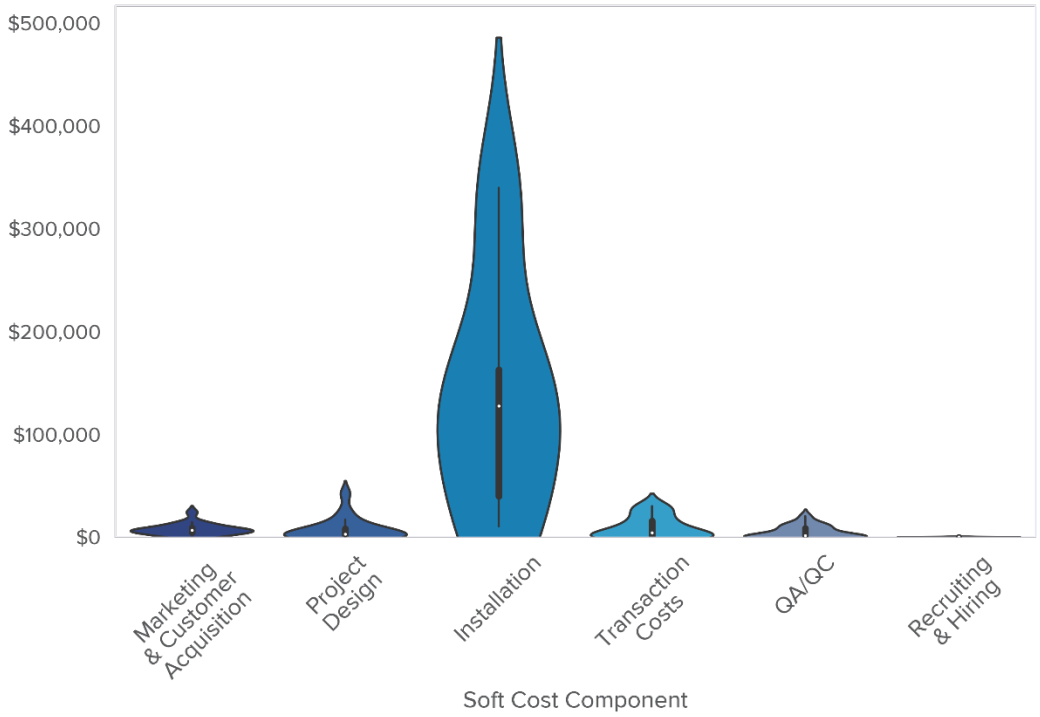
Table 41. EE Retrofit: ASHP Soft Cost Component Estimates (2021)

Soft Cost Category	Soft Cost Component	Per-Project Cost	Per Project (%)	Component Cost	Std. Deviation	1st Quartile	3rd Quartile	Sample Size
Marketing & Customer Acquisition	Marketing and/or customer education	$10,419	6%	$3,777	$3,101	$1,188	$5,206	14
	Bid preparation			$3,809	$3,890	$824	$5,039	15

Soft Cost Category	Soft Cost Component	Per-Project Cost	Per Project (%)	Component Cost	Std. Deviation	1st Quartile	3rd Quartile	Sample Size
	Project signing/ contracting			$2,833	$1,721	$1,561	$4,293	12
Project Design	Designing, scoping, and customizing the project	$11,711	6%	$11,711	$11,977	$4,952	$14,864	12
Installation	Installation labor	$137,593	76%	$137,593	$115,813	$39,843	$162,698	10
Transaction Costs	Obtaining permits	$12,913	7%	$11,865	$10,903	$2,601	$20,428	14
	Acquiring and maintaining training, certifications, and licenses			$1,048	$1,023	$261	$1,409	9
QA/QC	QA/QC activities	$8,874	5%	$7,669	$4,973	$5,001	$10,953	10
	Required callbacks to the customer to assist with equipment issues/ servicing			$1,205	$1,790	$110	$1,557	12
Recruiting & Hiring	Recruiting and hiring employees	$168	0%	$168	$191	$-	$286	9

As shown by the distribution of soft cost categories in Figure 45, installation labor is the most widely dispersed category, consistent with other sectors. This is mainly due to the substantially higher amount of labor needed for the ASHP installation compared to the efficient steam system installation. Unlike other sectors, marketing and customer acquisition costs are more tightly packed around the mean value, possibly due to the specialized nature of this work leading to fewer firms bidding for jobs. That is, a restricted pool of available service providers will lead to a lower need for spending on marketing and customer acquisition given the comparatively fewer choices customers have when requesting a bid.

Figure 45. EE Retrofit: ASHP Soft Costs Violin Plot



EE Retrofit: Efficient Steam System

In addition to the EE Retrofit: ASHP project (which was consistent with the 2019 study), the Market Evaluation Team added an energy efficiency retrofit project with a high-efficiency steam boiler replacement for the HVAC measure. All other prototypical project specifications remained the same. Soft costs for multifamily steam retrofit projects accounted for 51% of total project costs for the 2021 evaluation period. Table 42 shows the total installation cost for multifamily steam retrofit projects of $146,107 with an IQR of $148,750. This cost is substantially lower than the EE retrofit: ASHP prototypical project, which is expected given the lower amount of labor, training, and design needed to complete a steam retrofit, a more mature technology. This is true for both soft and hard costs, which are approximately half as much for the steam retrofit than the ASHP retrofit.

The estimates provided for this prototypical project assumed the building had 24 units. On a per-unit basis, the average installed project cost in 2021 is $6,088. This cost includes all work (both in-unit and common areas). Due to the methodology used in this study, the in-unit and common area costs cannot be separated.

Table 42. EE Retrofit: Steam Hard Cost and Soft Cost Estimates (2021)

Metric	Value	Std. Deviation	1st Quartile	3rd Quartile	Sample Size
Total Installed Cost	**$146,107**	**$141,704**	**$51,250**	**$200,000**	**14**
% Soft Costs	51%	4%	51%	51%	14
Value Soft Costs	$74,475	$72,637	$25,790	$101,800	14

% Hard Costs	49%	4%	49%	49%	14
Value Hard Costs	$71,632	$69,075	$25,460	$97,600	14

The project costs for the EE retrofit: steam project are substantially lower than for the EE retrofit: ASHP prototypical project, which is expected given the lower amount of labor, training, and design needed to complete a steam retrofit, a more mature technology. This is true for both soft and hard costs, which are approximately half as much for the steam retrofit than the ASHP retrofit. Table 43 shows the differences in top-down cost estimates between these two projects.

Table 43. Multifamily Project Comparison: Hard and Soft Cost Estimates (2021)

Metric	Efficient Steam	ASHP	Difference
Total Installed Cost	**$146,107**	**$392,857**	**+$246,750**
% Soft Costs	51%	49%	-
Value Soft Costs	$74,475	$196,596	+$122,121
% Hard Costs	49%	51%	-
Value Hard Costs	$71,632	$196,261	+$124,629

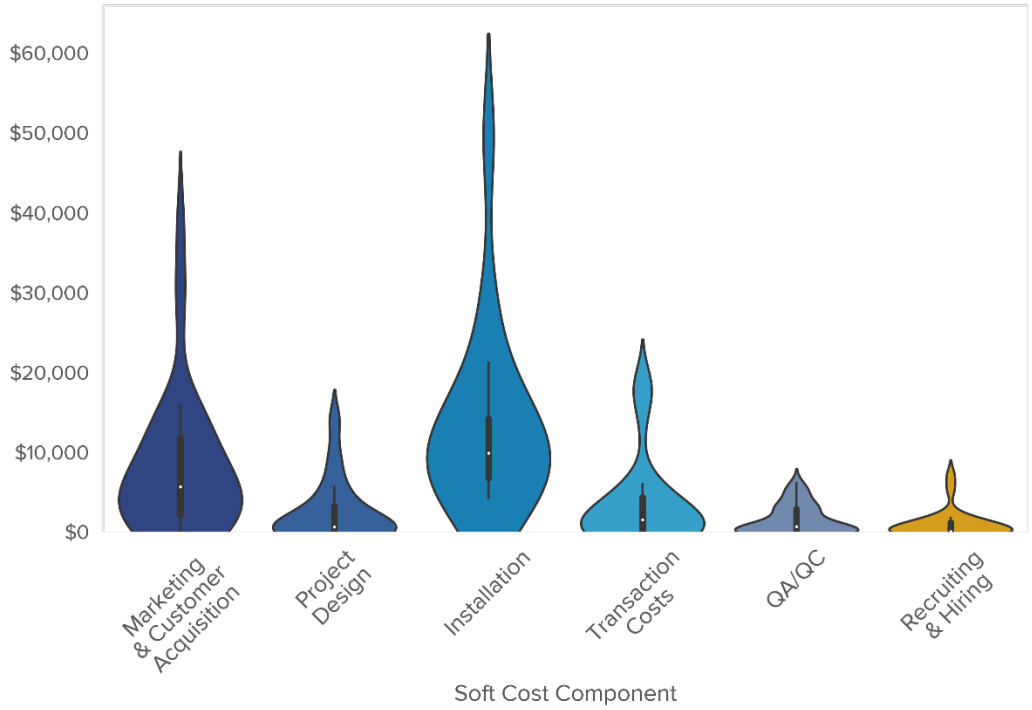
Table 44 shows soft costs for the EE retrofit: steam prototypical project by category and component. As with other sectors, installation labor is the largest contributor to project soft costs but comprised a smaller amount of total project soft costs than other sectors. This is different than the EE retrofit: ASHP project where installation labor comprised a much greater share of total project soft costs. As discussed earlier, this is likely due to the greater level of system design, installation, and training needed to install ASHPs. However, the magnitude of the difference between the two prototypical project installation costs is directional given the small sample sizes.

Table 44. EE Retrofit: Steam Soft Cost Component Estimates (2021)

Soft Cost Category	Soft Cost Component	Per Project Cost	Per Project %	Component Cost	Std. Deviation	1st Quartile	3rd Quartile	Sample Size
Marketing & Customer Acquisition	Marketing and/or customer education	$10,672	28%	$6,066	$7,548	$237	$9,748	32
	Bid preparation			$2,855	$2,896	$617	$3,954	28
	Project signing/contracting			$1,752	$1,726	$520	$2,392	27
Project Design	Designing, scoping, and customizing the project	$4,406	12%	$4,406	$4,159	$1,415	$5,659	23
Installation	Installation labor	$13,388	35%	$13,388	$11,339	$6,791	$14,148	17
Transaction Costs	Obtaining permits	$6,034	16%	$1,757	$1,458	$534	$2,591	22
	Acquiring and maintaining trainings, certifications, and licenses			$4,277	$6,081	$564	$4,030	24
QA/QC	QA/QC activities	$2,778	7%	$1,887	$1,502	$768	$2,881	22
	Required callbacks to the customer to assist with equipment issues/ servicing			$891	$1,308	$61	$1,386	21
Recruiting & Hiring	Recruiting and hiring employees	$952	2%	$952	$1,766	$0	$1,161	24

As shown by the distribution of soft cost categories in Figure 46, installation labor and marketing and customer acquisition are the most widely dispersed categories, consistent with other sectors.

Figure 46. EE Retrofit: Steam Soft Costs Violin Plot



Additional Topics

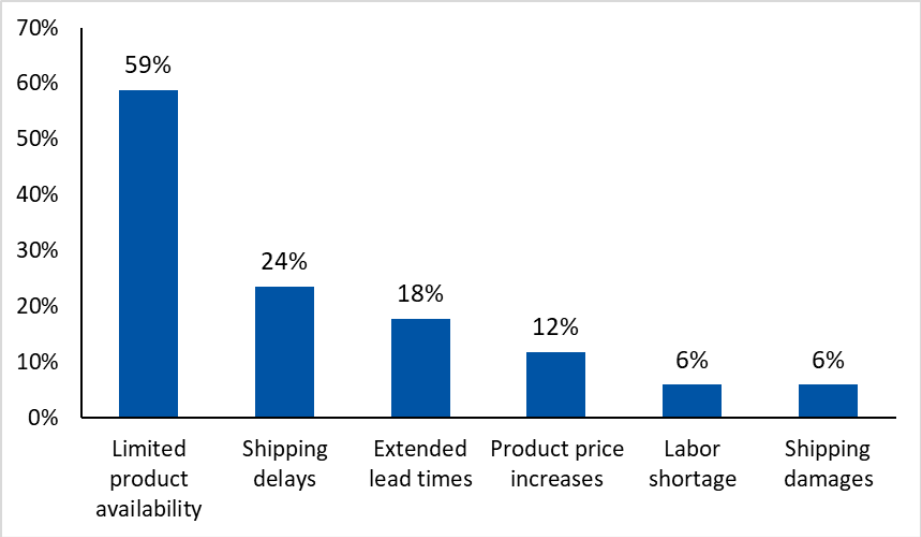
The Market Evaluation Team asked contractors other questions to provide additional context to their responses about soft costs or to explore topics of interest from the NYSERDA team that could not be incorporated into quantifying soft costs. For the multifamily sector, these questions related to equipment stocking and project financing.

Equipment Stocking

Of the 23% (10 of 44) of service providers who said they keep equipment on the site for multifamily energy efficiency retrofit and electrification projects, lighting equipment was the most common with four mentions, followed by insulation and air sealing products with three mentions. Given that these are lower-priced items that can fit a number of projects, it is expected that service providers would be more likely to keep this equipment in stock.

The Market Evaluation Team asked contractors if they had encountered any issues in acquiring the necessary equipment to complete multifamily energy efficiency and electrification projects. Eighteen contractors reported such issues, consistent with other the commercial and residential sectors. Figure 47 shows that limited product availability was a top issue, reported by nearly half of service providers. Contractors also noted price increases, increased lead times, and shipping issues.

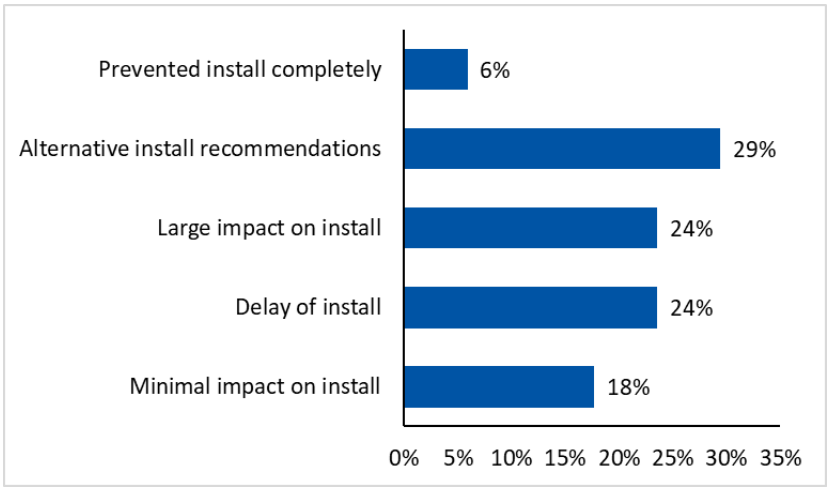
Figure 47. Issues Encountered by Contractors



Source: Multifamily Retrofit Contractor Survey Q F4: "What issues did you encounter?" (n=18)

The Market Evaluation Team also asked multifamily service providers who experienced issues related to supply chain disruptions (limited product, shipping delays, etc.) how these disruptions impacted installations. 82% said the supply chain disruption they mentioned had some impact; of these, 6% said supply chain disruptions prevented the installation entirely. Many contractors experienced installation delays and had to find alternatives to complete the retrofit. Figure 48 shows the types and impacts of supply chain issues.

Figure 48. Supply Chain Impacts on Installations of Multifamily Retrofit Projects



Source: Multifamily Retrofit Contractor Survey Q F5: "How, if at all, does availability of equipment or lead time required for equipment delivery impact what equipment you specify to complete multifamily energy efficiency retrofit projects?" (n=16)

Financing

Service providers were asked about issues experienced by clients in securing financing to pay for energy efficient retrofit projects. Out of 41 contractor respondents, 32% said they did. Of these, insufficient capital was the most common reason, cited by four. Service providers said interested clients also found it hard to navigate programs and means of assistance for completing these types of retrofits (three mentions), which made it hard to secure available financing options (three mentions). One service provider said: “There aren't many companies financing these retrofits and customers don't want to mortgage their homes to finance these.”

Key Findings: Multifamily Sector

- While the share of hard and soft costs as a percentage of total install cost is roughly the same for the ASHP and efficient steam system projects, both hard and soft costs (across all categories) are substantially higher for ASHP projects.
- Multifamily installations incorporating an ASHP have substantially higher installation costs that projects involving an efficient stream system retrofit.
- While the absolute values are nearly identical, marketing and customer acquisition costs make up a larger share of prototypical project soft costs for steam projects than for ASHP projects, driven by the aforementioned installation cost.
- Most contractors are experiencing shortages of equipment which in some cases prevents retrofit projects entirely and often extends project timeline.
- Multifamily customers are experiencing issues with securing financing for retrofit projects due to insufficient capital, and confusion while applying for assistance programs and other means of assistance.

Conclusions and Recommendations

Like the 2019 baseline study, this report quantifies the soft costs associated with energy efficiency and electrification projects in New York, identifies the largest contributors to project soft costs, assesses the degree and drivers of variation within soft cost categories, and seeks to identify opportunities for soft cost reduction. This report also reviews changes in energy efficiency and electrification project costs from the 2019 study and identifies possible causes for observed changes.

Results from this year's study reveal a market in flux due to drastic impacts stemming from the COVID-19 pandemic and the general economic environment. As such, it is highly likely that the prototypical project cost quantifications were impacted by these factors, factors that were not present in the baseline study and thus make comparisons difficult.

Nonetheless, research findings provide insights that NYSERDA (or other entities) can leverage to influence or assist market actors in reducing soft costs, though the direct impacts of interventions in the current environment remain uncertain. Recommendations in this report focus on technical assistance and workforce development programs that NYSERDA can implement or continue to stimulate soft cost reductions. NYSERDA and New York State may also consider expanding existing regulatory options, such as building energy benchmarking, energy labeling, and stretch codes, to drive demand for energy efficiency and electrification, and reduce costs.

In the following section, the Market Evaluation Team builds on conclusions and recommendations from NYSERDA's past research and the 2019 baseline report. Specifically, the conclusions and recommendations presented here explore how key findings from soft cost research (identified in this study) may inform the design and implementation of energy efficiency and electrification soft cost reduction strategies in New York. Some recommendations build on recommendations included in the 2019 study but which remained relevant in this study. Additionally, the box at the end of this section provides recommendations for future research, which can help policymakers deepen understanding of energy efficiency and electrification soft costs in New York.

Conclusion 1: Several market forces had a significant impact on energy efficiency and building electrification projects in New York.

A number of market forces impacted costs of energy efficiency and electrification projects between the baseline and 2021 studies, including the nascent status of the heat pump market, significant changes to New York incentive and market programs, the impacts of the COVID-19 pandemic on the supply chain, and the recent increases in inflation. As it relates to the latter, the Northeast Urban Consumer Price Index rose by 6.3% and the residential and nonresidential Producer Price Index increased by 24.7% and 26.4%, respectively. These increases impacted all hard and soft costs in this study. (See *Fluctuations in Market* section for more details.)

Conclusion 2: Total energy efficiency and electrification project costs increased, though hard costs increased at a greater rate than soft costs.

Across four of seven prototypical projects with sufficient sample sizes, total project costs increased from 2019 to 2021—with hard costs making up the majority of the increase. For example, the average increase in total project costs in the residential sector was 21%, with hard costs increasing 31% and soft costs increasing only 13% from 2019 to 2021. Similarly, the differences in soft (+18%) and hard costs (+38%) were statistically significant ($p<0.05$) for the HVAC replacement project. Changes were not statistically significant for insulation and air sealing or whole-home efficiency projects. (See *Hard versus Soft Costs* section for additional details.) Supply chain issues and raw material price increases had an impact on hard costs, with the residential and nonresidential Producer Price Indices increasing by 24.7% and 26.4% since 2019, respectively.

Recommendation: To stay abreast of relevant market conditions, NYSERDA could monitor market indicators (e.g., Producer Price Index, HVAC equipment stock levels/shipment data, utility program participation levels, etc.) that can impact the completion of energy efficiency and building electrification projects. Specifically, identify indicators that impact each of NYSERDA's core focus areas to ensure that NYSERDA has a comprehensive view of what is happening in the market. Staying informed of relevant market conditions can ensure that NYSERDA's programs are responsive to market needs.

> **NYSERDA Response to Recommendation**: Implemented. NYSERDA conducts cost surveys with participating contractors on an annual basis, at a minimum, to stay abreast of changes in both material and labor costs in the residential and multifamily sectors. NYSERDA also maintains a membership with Heating, Air-Conditioning Refrigeration Distributors International (HARDI) to access market data and insights in the HVAC industry, and NYSERDA's Clean Heat Connect upstream partners network serves as a resource for information regarding current market trends. Additionally, NYSERDA monitors market conditions for relevant focus areas in the multifamily, residential, and commercial/industrial sectors.

Conclusion 3: Increases in marketing and customer acquisition costs were driven by bid preparation costs, possibly representing increased interest in whole-home systems and the entrance of new service providers.

One of the primary drivers of soft cost changes was increases in bid preparation costs. For example, out of the $1,566 increase in total soft costs for the residential building electrification (HVAC replacement) prototypical project, $450 (29%) was due to increases in bid preparation costs. While other cost areas increased as well for residential building electrification service providers, bid preparation was a primary driver. While not tested in this study, the Market Evaluation Team hypothesizes that this change reflects an increase in the number of bids that service the entire home (which are more complex than supplemental systems) as well as a learning curve associated with new contractors entering the market. Regarding the latter, the Market Evaluation Team notes that the average years of experience for contractors decreased by 5.4 years in 2021 compared to 2019. Additionally, this may be reflective of an increase in home energy audits conducted prior to ASHP installation (the survey includes 'home assessments' in bid preparation costs). This is corroborated by residential decision-maker data, where

the share of customers receiving an audit before installing an ASHP increased from 46% in 2019 to 64% in 2021.

Recommendation: NYSERDA may consider working with industry groups to develop more, or to increase awareness of existing, standardized/templatized bid packages for specific measures or entire projects (for less complex projects). Training, Technical Services, and other such offerings could also be further developed to help contractors gain experience with, and thereby become more efficient in, bid preparation.

Recommendation: NYSERDA may also consider offering training on approved software packages that help service providers expedite the bid process while also highlighting key information, such as projected energy savings, that can help them close the sale.

> **NYSERDA Response to Recommendations**: Implemented. NYSERDA provides training and technical support, including use of program software and preparation of bid packages and proposals, to all participating contractors and service providers in its residential and multifamily programs. However, since NYSERDA does not implement standard incentive programs for small businesses, this recommendation is not relevant for the commercial sector.

Conclusion 4: Soft costs for building electrification measures showed a statistically significant increase, likely reflecting the entry of a new workforce into the market.

Compared to 2019, the Market Evaluation Team found several statistically significant changes in residential building electrification (HVAC replacement) project soft costs. Specifically, five of six soft cost categories were statistically higher in 2021 than in 2019, with the highest absolute changes for marketing and customer acquisition, installation, and transaction costs. While recruiting costs had a relatively small absolute change, the percentage change (+103%) was the largest of all soft cost categories. These increases are corroborated by other data from this survey – the average years of experience among residential HVAC service providers fell from 16.7 in the 2019 study to 11.3 in the 2021 study. A service provider who is newer to the market may estimate a greater number of hours for a specific task than a more experienced service provider, building in time for learning on the job.

Recommendation: There is evidence to support investment from NYSERDA to create or expand facilitation of standardized installation, design, and quality control approaches by encouraging industry best practice and/or through requirements in incentive programs. Specific examples could include (1) standard installation procedures, including optimized (sequenced and/or integrated) outdoor and indoor installation work; (2) standardized design guides/software that contractors can use to design and specify systems, satisfy the needs of most building conditions, and that minimize the need for skilled trade labor; or (3) standardized approaches to quality control schemes, including standardized and efficient training and accreditation schemes for installers and designers, as well as system inspection processes. An alternative market intervention to NYSERDA-facilitated training would be for NYSERDA to subsidize trainings that adhere to a specific, NYSERDA-approved best-practices curriculum. While the study did not investigate specific aspects of the project design or installation process that could be improved, the above recommendations represent a best estimate based on market knowledge.

Recommendation: NYSERDA may consider working with key manufacturer partners to standardize approaches and offer contractor training programs on design, installation, and quality control best practices. These efforts would be particularly effective for newer technologies, where there is a lack of market knowledge and fewer qualified professionals to complete installations. It is reasonable to assume that workforce development initiatives can accelerate the adoption of newer technologies into contractors' business models. One market expert the Market Evaluation Team interviewed specifically provided support for this recommendation, noting that training will be particularly helpful for overcoming skepticism of new technologies among contractors and, subsequently, their customers.

> **NYSERDA Response to Recommendations**: Implemented. NYSERDA has created and market-tested standardized packages of envelope improvements via its Comfort Home pilot program and will be expanding those packages to include a wider range of housing typologies and measure packages for use in both its LMI and market-rate residential programming. Similarly, NYSERDA has created standardized retrofit playbook guides for common multifamily building types and is testing standardized measure packages that align with common investment opportunities in multifamily buildings through the Low Carbon Pathways program. The commercial/industrial sector is publishing best practices guidance and conducting educational webinars for relevant stakeholders focused on decarbonization in the commercial and industrial space.

Conclusion 5: Service providers experienced challenges finding qualified labor to complete EE project installations.

Across nearly all prototypical projects, the Market Evaluation Team found increases in recruiting and hiring costs. Among prototypical projects involving building electrification technologies in the residential (HVAC replacement and whole-home efficiency) and commercial (HVAC: VRF) sectors, these increases were statistically significant. These cost increases are consistent with content discussed in the *Pandemic and General Economy Impacts* section; abnormally high turnover and labor shortages turned into project delays, with 61% of surveyed firms that experienced project delays in 2021 citing labor shortages as the top reason.

Recommendation: For New York to achieve its energy and climate goals, it is clearly necessary to increase the number of contractors active in the clean energy market. Current data show that contractors are already increasing investments in recruiting. The Market Evaluation Team hypothesizes that recruiting investments will need to increase further to achieve the state's goals. NYSERDA may explore how to accelerate its workforce development initiatives to support expansion of qualified technicians who can install energy efficiency and electrification measures. For example, NYSERDA may consider offering special incentives to service providers who complete a set of relevant training programs. Alternately, NYSERDA could consider expanding partnerships with key manufacturers to connect service providers to relevant training options.

> **NYSERDA Response to Recommendation**: Implemented. NYSERDA is working to better market current initiatives that are underutilized by contractors and manufacturers. Any new initiatives are contingent on securing additional funding, as current funding is available only for building electrification training.

Conclusion 6: Downstate service providers experience additional cost pressure that is not felt by upstate service providers, leading to higher soft costs.

Consistent with findings in 2019, the gap between downstate and upstate service providers' costs was exclusively driven by soft costs. For the residential HVAC replacement project, the Market Evaluation Team found that soft costs were $1,877 (or 25%) higher for downstate service providers; comparatively, hard costs were marginally lower, at $638 (or 8%), for downstate service providers. Among specific soft cost categories, marketing and customer acquisition, installation, and transaction costs accounted for 87% of the difference between upstate and downstate service providers. While these findings were not statistically significant due to low sample sizes, the directional trend is consistent with expectations and reflected in the higher downstate labor rates (see *Final Blended Labor Rates* section).

One soft cost category that was consistently higher downstate across sectors was permitting. While upstate permitting costs tended to converge closer to zero, downstate permitting costs were more widely dispersed, pulling the mean higher. This finding is consistent with data from 2019 and is expected, given the more complex and expensive permitting landscape downstate.

Recommendation: NYSERDA may consider conducting qualitative research among downstate service providers to identify more specific aspects of the energy efficiency and electrification project process that are pain points.

Recommendation: NYSERDA may consider developing a unified, streamlined permitting process for key technologies and encourage adoption across New York State municipalities. This would entail the creation and dissemination of model codes for various technologies. There are several examples in New York State where model codes have been developed regionally and at the State level for various renewable energy technologies, including the Long Island Unified Solar Permit Initiative (LIUSPI), NYS Unified Solar Permit, and Suffolk County Model Geothermal Code, showing there is precedent for such codes. It will be important to work directly with service providers and local officials to determine the appropriate design for a model code to ensure it acts as intended.

> **NYSERDA Response to Recommendation**: Rejected. This recommendation does not align with NYSERDA's approach to codes and permitting since creating separate permits for clean energy equipment in buildings creates new barriers to adoption. Instead, NYSERDA creates tools and resources to help authorities that have jurisdiction enforce the code more consistently. Those resources include statewide training, pilots to support third-party compliance and online permitting, and dynamic code compliance checklists to ensure that buildings are designed and built to code.

Future Research: Energy Efficiency and Electrification Soft Costs

At the conclusion of the 2021 study, the Market Evaluation Team and NYSERDA identified options for changing the design of future iterations of this study.

- **Deep-Dive Market Insights**: To deepen our understanding of the HVAC and building retrofit market, the Market Evaluation Team proposes conducting a deep-dive project with key partners participating in the Empire Building Challenge. This would involve interviews with experts and relevant contractors/building managers from the Empire Building challenge sites, a review of available Empire Building Challenge data, and a limited set of quantitative surveys with HVAC service providers to update the results from this study. The Market Evaluation Team envisions a set of 4-6 case studies and a memo summarizing key findings as an output.
- **Revised Sampling Approach**: After the baseline study, the Market Evaluation Team and NYSERDA made several changes to the study design to improve the results. Going forward, the Market Evaluation Team recommends several additional changes to further improve the results and boost the sample size. In the 2019 and 2021 studies, the Market Evaluation Team attempted a general population sampling approach initially, which did not produce the desired levels of confidence and precision. For the next year's approach, the Market Evaluation Team would recommend foregoing a true general population sampling approach at the beginning of study fielding and instead immediately implement several techniques used in the year 1 and 3 studies to boost response rate.
  - Engaging trade organization/other industry partners before fielding starts to get them on board from the beginning
  - Conducting snowball recruiting from the beginning
  - Increasing the incentive to $50 per survey complete (currently $25)

Appendix A. Soft Cost Quantification Methodology

This section details the methodologies used to quantify soft costs, calculate blended labor rates, and clean and analyze the final data.

Soft Cost Category and Component Calculations

The Market Evaluation Team used different methods to calculate various soft cost components. For each, the Market Evaluation Team asked about the soft cost in terms of dollars, labor hours, or both. The Market Evaluation Team identified which unit would be most appropriate through interviews with market experts and conferring with internal Market Evaluation Team subject-matter experts during the baseline evaluation, which the Market Evaluation Team used in this evaluation as well.

Table A-1 presents each soft cost component (column second from left) and the method used to transform each survey response into a dollar estimate. Soft cost components with multiple rows indicate when the soft cost component is composed of multiple data points. Soft cost components then roll up to soft cost categories (far left column). In all cases where the unit is "hours," the data point is multiplied by the blended labor rates from Table A-8 to convert all data into dollars.

Table A-1. Soft Cost Category and Component Calculations

Soft Cost Category	Soft Cost Component	Data Points Used	Scale of Data	Units	How to Quantify	Notes
Marketing & Customer Acquisition	Marketing and/or customer education	Amount spent on marketing and customer education	Yearly	Dollars	Divide by number of projects	Some surveys asked for the % specific to the prototypical project technology
		Hours spent on marketing and customer education	Yearly	Hours		
	Bid preparation	Hours spent on bid preparation	Per bid	Hours	Multiply by number of bids and divide by number of projects	-
	Project signing/ contracting	Hours spent on project signing	Per project	Hours	-	-
Project Design	Designing, scoping, and customizing the project	Hours spent on system design	Per project	Hours	-	-
Installation	Installation labor	Hours spent on installation labor and project management	Per project	Hours	-	-

Soft Cost Category	Soft Cost Component	Data Points Used	Scale of Data	Units	How to Quantify	Notes
Transaction Costs	Obtaining permits	Hours spent obtaining permits	Per project	Hours	-	-
		Dollars spent obtaining permits	Per project	Dollars	-	-
	Acquiring and maintaining trainings, certific ations, and licenses	Amount spent on trainings and certifications	Yearly	Dollars	Divide by number of projects	-
		Labor hours spent on trainings and certifications	Yearly	Hours		-
QA/QC	QA/QC activities	Hours spent on QA/QC	Per project	Hours	-	-
	Required callbacks to the customer to assist with equipment issues/ servicing	Hours spent on callbacks	Yearly	Hours	Divide by number of projects	-
Recruiting & Hiring	Recruiting and hiring employees	Hours spent on recruiting and hiring	Yearly	Hours	Divide by number of projects	-
Final Roll-Up	Total project cost	Cost to customer	Per project	Dollars	-	-
	Hard cost	Percentage equipment and materials	Per project	Percen tage	Subtract from 1 to get % soft costs	-

Blended Labor Rates Calculation

To accurately transform hours estimates into dollars, the Market Evaluation Team calculated blended labor rates. Blended labor rates have three components: burdened labor rates, prototypical project adjustments, and soft cost category adjustments. This appendix describes how the Market Evaluation Team calculated each of these.

Burdened Labor Rates

Burdened labor rates account for other business costs not explicitly included in the soft costs survey, such as worker's compensation insurance, fringe benefits (e.g., vacation pay, employer-paid health benefits, pension costs), and fixed overhead (e.g., federal and state unemployment costs, social security

taxes, builder's risk insurance costs, public liability costs).[20] RSMeans data were on a national scale (i.e., all United States average), customized for 41 specific trade types. Though RSMeans provided trade-specific base hourly rates, including fringes and worker's compensation insurance, it used the same fixed overhead value for all trade types.

In addition to burdening base hourly labor rates with the costs described above, the Market Evaluation Team needed to adjust the rates to be more specific to this study. First, as the data were on a national scale, the Market Evaluation Team used location factors from RSMeans to account for the contractor's location (upstate or downstate).[21] The location factors were on a county-by-county level compared to the national average. To calculate a location factor for the two regions (upstate and downstate), the Market Evaluation Team averaged all labor-specific location factors for counties included in each region. This led to increased upstate rates by 10.5% and downstate rates by 66.1%. Second, the Market Evaluation Team only included trades that would work on the prototypical projects included in the study. Further, the Market Evaluation Team selected specific trade types in consultation with NYSERDA and the SAC. Table A-2 (upstate) and Table A-3 (downstate) show burdened labor rates and inputs used in the study and Equation 2 shows the equation to calculate burdened labor rates.

Equation 2. Burdened Labor Rate Calculation

$$Labor\ Rate_{Burdneed} = Labor\ Rate_{Base+fringes} \times Location\ Adjustment \times Worker's\ Comp\ Insurance \times Fixed\ Overhead$$

Table A-2. Burdened Labor Rates, Upstate

Trade Title	Base Hourly Rate inc. fringes (US)	Adjusted Base Rate (+10.5%)	Worker's Comp Insurance	Fixed Overhead	Burdened Labor Rate
Helper (average)	$42.05	$46.46	11.90%	18.50%	$60.58
Administrative[1]	$34.31	$37.91	10.80%	18.50%	$49.01
Electricians	$63.70	$70.38	4.10%	18.50%	$86.29
Insulation Workers	$60.95	$67.34	8.50%	18.50%	$85.52
Plumbers, Pipefitters, and Steamfitters	$68.03	$75.16	4.70%	18.50%	$92.60
HVAC and Refrigeration Mechanics[1]	$49.61	$54.81	10.80%	18.50%	$70.87
Maintenance and Repair Workers, General	$24.14	$26.68	12.00%	18.50%	$34.81

[1]Not in RSMeans data; see below for calculation method.

[20] Source: RSMeans Labor Rates, Overhead, and Profit, 2021.

[21] Source: RSMeans Location Factors, 2018.

Table A-3. Burdened Labor Rates, Downstate

Trade Title	Base Hourly Rate inc. fringes (US)	Adjusted Base Rate (+66.1%)	Worker's Comp Insurance	Fixed Overhead	Burdened Labor Rate
Helper	$42.05	$69.83	11.90%	18.50%	$91.06
Administrative[1]	$34.31	$56.97	10.80%	18.50%	$73.67
Electricians	$63.70	$105.78	4.10%	18.50%	$129.69
Insulation Workers	$60.95	$101.22	8.50%	18.50%	$128.54
Plumbers, Pipefitters, and Steamfitters	$68.03	$112.96	4.70%	18.50%	$139.17
HVAC and Refrigeration Mechanics[1]	$49.61	$82.38	10.80%	18.50%	$106.51
Maintenance and Repair Workers, General	$24.14	$40.09	12.00%	18.50%	$52.32

[1]Not in RSMeans data; see below for calculation method.

The RSMeans data do not include two trades—administrative and HVAC and Refrigeration workers. For these, the Market Evaluation Team used yearly income data from the New York Department of Labor to compare total compensation in these trades to a category included in RSMeans (electricians). As shown in Table A-4, the Market Evaluation Team calculated an index for these trades to properly scale the electrician base hourly rate. The Market Evaluation Team used the average worker's compensation insurance for both trades.

Table A-4. Administrative and HVAC Worker Base Hourly Rate Calculation

Trade Title	Mean Annual Wage	Index to Electricians	Base Hourly Rate inc. fringes (US)
Electricians	$83,030	100	$63.70
Administrative	$44,720	53.9	$34.31
HVAC and Refrigeration Mechanics	$64,660	77.9	$49.61

Prototypical Project Adjustments

Because each prototypical project is completed by a different set of contractors, the Market Evaluation Team created a set of prototypical project-specific burdened labor rates. To do this, the Market Evaluation Team consulted with NYSERDA and the SAC to identify the contractor types that work on each prototypical project. These results are shown in Table A-5. The Market Evaluation Team then averaged the rates for the contractor types relevant to each prototypical project to calculate an average burdened labor rate per prototypical project, as shown in Table A-6. The helper and administrative rates are consistent across all prototypical projects.

Table A-5. Prototypical Project Adjustments

Trade Title	Commercial			Multi-family	Residential		
	Lighting	HVAC: VRF	Bldg. Mgmt.		HVAC	Insulation	Whole Home
Helper	✓	✓	✓	✓	✓	✓	✓
Administrative	✓	✓	✓	✓	✓	✓	✓
Electricians	✓	✓	✓	✓	✓		
Insulation Workers				✓		✓	✓

Trade Title	Commercial			Multi-family	Residential		
	Lighting	HVAC: VRF	Bldg. Mgmt.		HVAC	Insulation	Whole Home
Plumbers, Pipefitters, and Steamfitters		✓					
HVAC and Refrigeration Mechanics		✓		✓	✓		✓
Maintenance and Repair Workers, General [a]							

[a] This trade title was used in the 2019 study for the commercial sector Performance Contract prototypical project, which was removed for this study.

Table A-6. Prototypical Project-Specific Burdened Labor Rates

Trade Title	Commercial			Multi-family	Residential		
	Lighting	HVAC: VRF	Bldg. Mgmt.		HVAC	Insulation	Whole Home
Upstate							
Contractor	$86.29	$83.25	$86.29	$80.89	$78.58	$85.52	$78.20
Helper	$60.58	$60.58	$60.58	$60.58	$60.58	$60.58	$60.58
Administrative	$49.01	$49.01	$49.01	$49.01	$49.01	$49.01	$49.01
Downstate							
Contractor	$129.69	$125.13	$129.69	$121.58	$118.10	$128.54	$117.53
Helper	$91.06	$91.06	$91.06	$91.06	$91.06	$91.06	$91.06
Administrative	$73.67	$73.67	$73.67	$73.67	$73.67	$73.67	$73.67

Soft Cost Category Adjustments

The final step to calculate blended labor rates is to adjust the rates for the percentage of time spent by the three different labor types—contractors, helpers, and administrative staff—presented in Table A-6. Table A-7 shows the percentages of labor assigned to each labor type for each soft cost category. These percentages are based on the solar soft costs study from NREL and LBNL,[22] as well as discussions with internal Market Evaluation Team subject-matter experts, NYSERDA, and the SAC.

[22] NREL and LBNL. 2012. *Benchmarking Non-Hardware Balance-of-System (Soft) Costs for U.S. Photovoltaic Systems Using a Bottom-Up Approach and Installer Survey*. 2012.

Table A-7. Labor Percentages by Soft Cost Category

Soft Cost Category	Percent Contractor	Percent Helper	Percent Administrative
Marketing and Customer Acquisition	50%	0%	50%
System Design	50%	50%	0%
Installation Labor	50%	50%	0%
Transaction Costs	30%	0%	70%
Training and Certifications	70%	0%	30%
QA/QC	80%	20%	0%

Final Blended Labor Rates

Using the percentages in Table A-7, the Market Evaluation Team calculated a blended labor rate that is customized for each prototypical project, contractor region, and soft cost category. These rates are presented in Table A-8.

Table A-8. Final Blended Labor Rates Used for Quantification

Trade Title	Commercial			Multi-family	Residential		
	Lighting	HVAC: VRF	Bldg. Mgmt.		HVAC	Insulation	Whole Home
Upstate							
Marketing and Customer Acquisition	$67.65	$66.13	$67.65	$64.95	$63.80	$67.27	$63.61
System Design	$73.44	$71.92	$73.44	$70.74	$69.58	$73.05	$69.39
Installation Labor	$73.44	$71.92	$73.44	$70.74	$69.58	$73.05	$69.39
Transaction Costs	$60.20	$59.28	$60.20	$58.58	$57.88	$59.97	$57.77
Training and Certifications	$75.10	$72.98	$75.10	$71.33	$69.71	$74.57	$69.44
QA/QC	$81.15	$78.72	$81.15	$76.83	$74.98	$80.54	$74.67
Downstate							
Marketing and Customer Acquisition	$101.68	$99.40	$101.68	$97.62	$95.88	$101.11	$95.60
System Design	$110.37	$108.09	$110.37	$106.32	$104.58	$109.80	$104.29
Installation Labor	$110.37	$108.09	$110.37	$106.32	$104.58	$109.80	$104.29
Transaction Costs	$90.47	$89.10	$90.47	$88.04	$87.00	$90.13	$86.83
Training and Certifications	$112.88	$109.69	$112.88	$107.21	$104.77	$112.08	$104.37
QA/QC	$121.96	$118.31	$121.96	$115.48	$112.69	$121.05	$112.23