# Connecticut C1902 ECB Baseline and Code Compliance

## Draft Results and Recommendations

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## CODE COMPLIANCE

### Main Takeaways

- Estimated Code Compliance is ~85%
- Compares well with prior study (C19)
- Comparable in magnitude with compliance results from neighboring states
- Compliance of newly constructed buildings is improving over time
- Weak requirements for documenting & approving compliance at building departments

### Recommendations

- Consider developing COMCheck and Building plan repositories for future compliance efforts
- Making sure the population and sample frame has complete data
- Supplement plan reviews with site verifications (which was not possible during this study)

## ECB Baseline

| Main Takeaways | Recommendations |
| --- | --- |
| Average efficiencies from the sample exceed PSD requirements | Consider including program protocol to obtain billing data after first year of occupancy to develop EUI value |
| Inadequate information to develop EUI estimates for buildings | Consider revising baseline assumptions in PSD using measure specific values from this study (for measures with large sample) |
| Sample did not include water/ground-source heat pumps | |



# Population and Sample

*Code Compliance & Baseline*

## Population Characteristics & Sample

**Population from purchased Dodge data**

- 369 projects permitted in 2019 – 2020 Q1
- Include new projects, alterations, additions
- 228 sites with plans available for download from Construction.com
- 146 projects with building area available

**Sample size and stratification guided by previous studies**

- Sample frame restricted to sites with available square-footage
- 5 strata by sq.ft. - Small, Medium, Large, X-Large, and XX-Large

**Sample maintained relatively same proportion for sq.ft. and county**



# Code Compliance – Data Collection & Methodology

*Code Compliance*

## Data Collection

### Data sources

- Construction drawings available from Construction.com
- Construction drawings obtained from Building Departments
- Literature review
- Qualitative information from code official IDIs

### Process

- Review construction drawings
- Get supplemental information on the installed equipment (mfg. specifications, etc.)
- Input information in Excel based data collection tool
- Use the data from the tool to run COMCheck
- Review results from COMCheck



*Code Compliance*

## Methodology

### Code Compliance Estimates

- Used COMCheck for site level compliance analysis
- Applicable code used in COMCheck (IECC 2015)
- Individual site compliance estimates were aggregated to determine the overall compliance levels
- Compliance estimates generated at end-use level – envelope, lighting, DHW, HVAC

# Baseline – Data Collection & Methodology

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*Baseline*

## Data Collection

### Data sources

- Construction drawings available from Construction.com
- Construction drawings obtained from Building Departments
- Literature review
- Market actor interviews
- Web-surveys

### Process

- Review construction drawings
- Get supplemental information on the installed equipment (mfg. specifications, etc.)
- Input information in Excel based data collection tool

*Baseline*

## Data Collection - Issues

### Web-Surveys

- Web-surveys for baseline data collection were scrapped due to very low response rate
- Respondents stopped the survey 1/3rd way into the questionnaire
- Repeated attempts were made to reach the respondents

### Market Actor Interviews

- A similar recruitment issue with market actors
- Small number of interviews did not yield much information on baselines for replacement market



*Baseline*

## Methodology

### Baseline Estimates

- System level data aggregated by size categories at site level
- Categories consistent with PSD
- Baseline estimates compared with:
  - 2021 & 2022 PSD
  - IECC 2015 – expected code in effect for projects permitted during 2019-2020 Q1
- Site-level data aggregated to get the overall baseline values

*Baseline*

## Methodology – Parameters Investigated

| Category | Measure | Parameter |
|---|---|---|
| Lighting | Lighting | LPD |
| | Controls | watts controlled, area |
| HVAC | Chillers | kW/ton |
| | Unitary AC & HP | SEER/EER & HSPF/COP |
| | Water/ground source HP | EER & COP |
| | Gas fired boilers and furnaces | AFUE/thermal efficiency |
| | Gas fired radiant heaters | Thermal efficiency |
| | Variable refrigerant flow HVAC | EER & COP |
| Water Heating | Gas fired water heaters | EF/Thermal efficiency |
| Custom | Whole building | EUI value |

- Commercial kitchen and clothes washer information not consistently available in the plans
- DCV and VFDs do not have specific parameters for baseline



# Code Compliance Findings

*Code Compliance*

## Findings

| Stratum | n | Envelope | Lighting | Heating | Cooling | Hot Water | Total |
|---|---|---|---|---|---|---|---|
| 1 | 27 | 81% | 96% | 100% | 80% | 88% | 89% |
| 2 | 4 | 100% | 100% | 100% | 90% | 100% | 98% |
| 3 | 9 | 50% | 100% | 100% | 76% | 100% | 85% |
| 4 | 1 | 0% | 100% | 100% | 0% | 0% | 40% |
| | | | | | | | |
| Unweighted | | 58% | 99% | 100% | 62% | 72% | 78% |
| Weighted by Counts | | 68% | 98% | 100% | 76% | 90% | 86% |
| Weighted by Area | | 57% | 100% | 100% | 73% | 94% | 85% |

Compliance increased compared to previous years

Without site visits or owner interviews, envelope details could not be verified and corrected

**Comparison with prior study: (CT C19)**

- **99% compliance in envelope (26% with defaults)**
- **95% compliance in HVAC**
- **92% compliance in lighting**
- **73% overall compliance**



*Code Compliance*

## Findings

Compliance increased compared to previous years

Lighting

- With an exception of a handful of lighting fixtures, all fixtures were LED
- Overall, lighting was found to be 46% better than code

Envelope

- When compliant, envelope was found to be 12% better than code
- Without site visits or owner interviews, envelope details could not be verified and corrected to get the best result

## Findings

### Code Official Interviews

- Several key barriers identified
  - Contractor knowledge of building code
  - Builders driven by cost and time pressure – not understanding the energy saving value of code compliance
  - Staffing and resource constraints at local building departments
  - Lack of trainings for local officials
  - Weak requirements for documenting & approving compliance



## Baseline Findings

*Baseline*

## Lighting

| Building Type | Counts | LPD % Better than Code | 2015 IECC LPD | LPD % Better than 2021 PSD | LPD % Better than 2022 PSD | Recommended |
|---|---|---|---|---|---|---|
| Elderly/Assisted Living | 2 | **-8%** | **0.57** | **3%** | **-20%** | |
| Dining: Cafeteria/Fast Food | 9 | 41% | 0.9 | 30% | 27% | |
| Health Care Clinic | 2 | 67% | 0.9 | 59% | 58% | |
| Hotel/Motel | 1 | 65% | 0.87 | 53% | 29% | |
| Library | 1 | 75% | 1.19 | 34% | 39% | |
| Office | 4 | 37% | 0.82 | 34% | 19% | |
| Police/Fire Station | 3 | 29% | 0.87 | 22% | 8% | |
| Retail | 4 | 68% | 1.26 | 48% | 26% | |
| School/University | 10 | 42% | 0.87 | 36% | 27% | |
| Town Hall | 3 | 41% | 0.89 | 32% | 21% | |
| Warehouse | 1 | 21% | 0.66 | 3% | 0% | |
| **Overall** | | **46%** | | **32%** | **21%** | |

Adj. factor:

40% better than IECC 2015

20% better than IECC 2021 (2022 PSD)

Overall LPDs were found to be better than PSD



*Baseline*

## Heating Systems Efficiencies

| Measure Categories | n | Efficiency | IECC 2015 | 2021 PSD | 2022 PSD |
|---|---|---|---|---|---|
| Boilers, Large (>2,500 MBH) | 8 | 92.5% | 82% Ec | 82% Ec | 90% Ec |
| Boilers, Medium (300 MBH to 2,500 MBH) | 22 | 95.7% | 80% | 80% Et | 90% Ec |
| Boilers, Small (<300 MBH) | 5 | 87.2% AFUE | 80% AFUE | 82% AFUE | 92% Ec |
| Steam Boilers, All Sizes | 117 | 82.3% | 79% Et | 79% Et | 82% Ec |
| Furnace, All Sizes | 175 | 91.7% | 80% Ec | 80% Ec | 90% Et |
| Radiant Heaters | 157 | 95.3% | N/A | 80% | 80% |

Average furnace and boiler efficiencies observed to exceed PSD. Results in lower savings.

2022 PSD incorporates findings from X1931 study for boilers and furnaces. No recommendations made in this study.

*Baseline*

## HW Systems in Sample

| HW Heating System | n | Efficiency | IECC 2015 | 2021 PSD | 2022 PSD | Recommendation |
|---|---|---|---|---|---|---|
| Electric, Storage <12 kW | 14 | 1.0 | 0.53 | N/A | N/A | N/A |
| Gas, Instantaneous | 38 | 0.96 | 80% Et | 80% | 80% | 95% |
| Gas, Condensing | 2 | 0.97 | N/A | 80% | 80% | - |
| Gas, Storage | 34 | 0.96 | 80% Et | 80% | 80% | 95% |

Average storage for gas HW heaters ranged between 130 and 140 gallons

Gas HW heaters were found to have higher efficiency compared to PSD requirements



*Baseline*

## Cooling Systems in Sample

| Measure Categories | n | SEER/EER | IECC 2015 | 2021 PSD | 2022 PSD | Recommendation |
|---|---|---|---|---|---|---|
| Chiller, Air-Cooled, >=150 | 4 | 10.1 | 10.1 | 10.1 | 10.1 | - |
| DOAS - DX ≥ 135,000 and < 240,000 | 7 | 12.0 | 10.8 | 11.0 | 11.0 | - |
| DX < 65,000 | 98 | 15.1 SEER | 13 SEER | 14 SEER | 14 SEER | 15 SEER |
| DX ≥ 135,000 and < 240,000 | 15 | 12.3 | 10.8 | 11.0 | 11.0 | - |
| DX ≥ 240,000 and < 760,000 | 11 | 11.8 | 9.8 | 10.0 | 10.0 | - |
| DX ≥ 65,000 and < 135,000 | 22 | 12.1 | 11.0 | 11.2 | 11.2 | 12 EER |
| DX ≥ 760,000 | 3 | 10.2 | 9.5 | 9.7 | 9.7 | - |
| Split System < 65,000 | 166 | 14.0 SEER | 13 SEER | 13.0 SEER | 13.0 SEER | 14 SEER |
| Split System ≥ 135,000 and < 240,000 | 1 | 11.6 | 10.8 | 11.0 | 11.0 | - |
| Split System ≥ 240,000 and < 760,000 | 1 | 13.0 | 9.8 | 10.0 | 10.0 | - |
| Split System ≥ 65,000 and < 135,000 | 4 | 13.2 | 11.0 | 11.2 | 11.2 | - |

Efficiencies for PTACs and Split units were found to exceed PSD requirements

*Baseline*

## Heat Pumps

| Technology | n | Mode | Efficiency | IECC 2015 | 2021 PSD | 2022 PSD | Recommendation |
|---|---|---|---|---|---|---|---|
| Single Package < 65,000 | 6 | Heating | 3.4 COP | 3.0 COP | 8.0 HSPF | 8.0 HSPF | - |
| | | Cooling | 11. 6 EER | 9.0 EER | 14 SEER | 14 SEER | - |
| Split Systems < 65,000 | 55 | Heating | 10.2 HSPF | 8.2 HSPF | 8.2 HSPF | 8.2 HSPF | 10.2 HSPF |
| | | Cooling | 17.3 SEER | 14 SEER | 14 SEER | 14 SEER | 17.3 EER |
| Single Package ≥ 135,000 and < 240,000 | 4 | Heating | 3.2 COP | 3.2 COP | 3.2 COP | 3.2 COP | - |
| | | Cooling | 12.5 EER | 10.4 EER | 9.3 EER | 10.6 EER | - |

Split HP efficiencies were found to exceed PSD requirements

PTHP efficiencies were also found to exceed cooling PSD efficiency requirements

Higher baseline efficiencies will result in lower energy savings



*Baseline*

## Variable Refrigerant Flow Systems

| VRF Technology | n | Mode | Efficiency | 2021 PSD | 2022 PSD | Recommendation |
|---|---|---|---|---|---|---|
| Multisplit with Heat Recovery ≥ 135,000 btu/h and < 240,000 btu/h | 4 | Heating | 3.7 HT COP | 3.2 HT COP | 3.2 HT COP | 3.7 HT COP |
| | | | 2.9 LT COP | 2.05 LT COP | 2.05 LT COP | 2.9 LP COP |
| | | Cooling | 12.1 EER | 10.4 EER | 10.4 EER | 12.1 EER |
| Multisplit with Heat Recovery ≥ 240,000 | 6 | Heating | 3.2 HT COP | 3.2 HT COP | 3.2 HT COP | - |
| | | | 2.2 LT COP | 2.05 LT COP | 2.05 LT COP | 2.2 LT COP |
| | | Cooling | 10.3 EER | 9.3 EER | 9.3 EER | 10.3 EER |
| Multisplit with Heat Recovery ≥ 65,000 btu/h and < 135,000 btu/h | 1 | Heating | 3.8 HT COP | 3.3 HT COP | 3.3 HT COP | - |
| | | | 2.6 LT COP | 2.25 LT COP | 2.25 LT COP | - |
| | | Cooling | 14.0 EERR | 10.8 EER | 10.8 EER | - |

VRF system efficiencies were found to exceed PSD requirements

## Conclusion & Recommendations

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### Code Compliance – Findings & Recommendations

Estimated Code Compliance is ~85%

- Reasonable within the study constraints
- Compares well with prior study (C19)
- By association, is comparable in magnitude with compliance results from neighboring states

Compliance of newly constructed buildings is improving over time

Accuracy can be increased by:

- Making sure the population and sample frame has complete data
- Supplement with site verifications (which was not possible during this study)

## Code Compliance – Findings & Recommendations

Consider developing COMCheck and Building plan repositories for future compliance efforts



## Baseline – Findings & Recommendations

Average efficiencies from the sample exceed PSD requirements

Inadequate information to develop EUI estimates for buildings

- Consider including program protocol to obtain billing data after first year of occupancy to develop EUI value
- These values can be revised/reassessed at a regular intervals

Consider revising baseline assumptions in PSD using measure specific values from this study (for measures with large sample)

# C1902A Midstream Commercial HVAC & Water Heating and Foodservice Net-to-Gross

NMR Group, Inc.

## MIDSTREAM COMMERCIAL HVAC, WATER HEATING & FOODSERVICE

### Main Takeaways

**Net-to-Gross:** The Midstream Programs are **accelerating adoption of energy-efficient equipment in Connecticut**. Distributors, contractors and customers indicated the program impacts purchasing decisions through several influence pathways.

Specifically, the review found **NTG values of 68% for HVAC & Water Heating and 81% for Foodservice & Laboratory**.

**Net-to-Gross:** Distributor interviews and contractor and customer survey results found **spray valves and furnaces to have the lowest NTG ratios**, with spray valves in particular having very little program-attributable savings

**Process:** The program requires distributors to pass down 100% of the incentive to end-users via a line item on invoices. However, most Foodservice customers **did not know if the incentive was shown on their invoice**, and over half of HVAC/Water Heating contractors said **distributors did not always list the incentive on their invoice.**

**Process**: **Most Foodservice customers were unaware of the program discount until taking our survey**, and those who were aware typically found out from dealers or distributors rather than EnergizeCT marketing. **HVAC and Water Heating distributors also suggested increasing end-user marketing**, particularly to larger institutional customers.

### Recommendations

Update Appendix 3 of the Connecticut PSD with the NTG values from this study

Adjust measure offerings to minimize free-ridership and increase attributable savings

Increase oversight of the rebate passthrough requirement

Increase program marketing targeting end-users, including sustainability departments or officers at large or institutional customers

# C1902A Midstream Commercial Objectives and Methodology

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## Objectives

**Primary objective:** establish prospective Net-to-Gross (NTG) ratios to be applied in the Program Savings Document (PSD) for future program years.

- NTG ratios are applied to gross savings to reflect *savings that are attributable to a program—a.k.a., net savings.*

**Secondary objectives:** Gain insight into

- market actor decision making
- in-program and out-of-program sales of efficient equipment
- customer market events (e.g., replace on failure, new construction)
- barriers to participation.

## Methodology

### Two methods used to determine NTG:

**(1) Distributor counterfactual:** Distributors' estimated share of sales of high efficiency equipment in 2022 if the program continues, compared to the estimated share if the program ends.

**(2) Causal pathway:** Three main causal pathways by which midstream programs influence behavior among distributors, contractors, and end-users:

- **Stocking**: Program influence on equipment distributors keep in stock, and how what was in stock influenced contractor/end-user decisions. This can impact the end-user in a replace-on-failure situation.
- **Upselling**: Program influence on the distributor promoting or upselling high-efficiency units and the impact on the contractor/end-user's purchasing decision.
- **Price**: The program influence on the distributor lowering the price of the units and that influence on the contractor/end-user's purchase decision.



# C1902A Midstream Commercial NTG Results

*Midstream Commercial HVAC & Water Heating and Foodservice*

## NTG Results Summary

Multiple survey and IDI approaches yield similar NTG ratios:

- Upstream HVAC & water heating between 57% - 68%
- Upstream Foodservice & Laboratory NTGR between 81% - 83%

| Program | Distributor Only Counterfactual Method | | Distributor, Contractor, & Customer Causal Pathway Method | | |
|---|---|---|---|---|---|
| | Sample size (n)* | NTG | Distributor sample size (n) | Contractor/ customer sample size (n) | NTG |
| HVAC & Water Heating | 28 | **57%** | 28 | 27 | **68%** |
| Foodservice & Laboratory | 34 | **83%** | 27 | 74 | **81%** |



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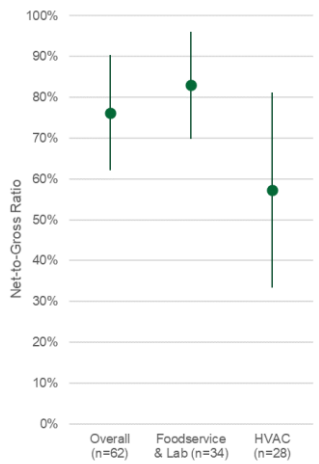
## Distributor NTG Results

| Subprogram | n* | Net-to-Gross Ratio | Precision** |
|---|---|---|---|
| HVAC & Water Heating | 28 | 57% | 24% |
| Foodservice & Lab | 34 | 83% | 13% |
| **Overall** | **62** | **76%** | **14%** |

*Number of distributor-measure responses. We completed 30 distributor IDIs, covering up to 3 measures per IDI.
**Absolute precision, at 90% confidence.

**Net-to-Gross Ratio by Subprogram**
*(line indicates 90% confidence interval)*



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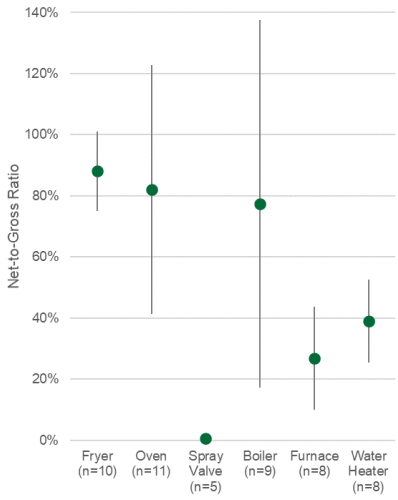
## Distributor NTG Results

| Measure* | n | Net-to-Gross Ratio | Precision** |
|---|---|---|---|
| Fryer | 10 | 88% | 13% |
| Oven | 11 | 82% | 41% |
| Spray Valve | 5 | 1% | 1% |
| Boiler | 9 | 77% | 60% |
| Furnace | 8 | 27% | 17% |
| Water Heater | 8 | 39% | 14% |

*Only measures with n ≥ 5
**Absolute precision, at 90% confidence

- **Spray valves**. The low NTG value of 1% is corroborated by results from interviews and surveys indicating high levels of free-ridership and market saturation.
- **Furnaces.** The relatively low NTG of 27% is corroborated by results from interviews and surveys indicating limited program influence at current incentive and efficiency levels.

**Net-to-Gross Ratio by Measure**
*(line indicates 90% confidence interval)*

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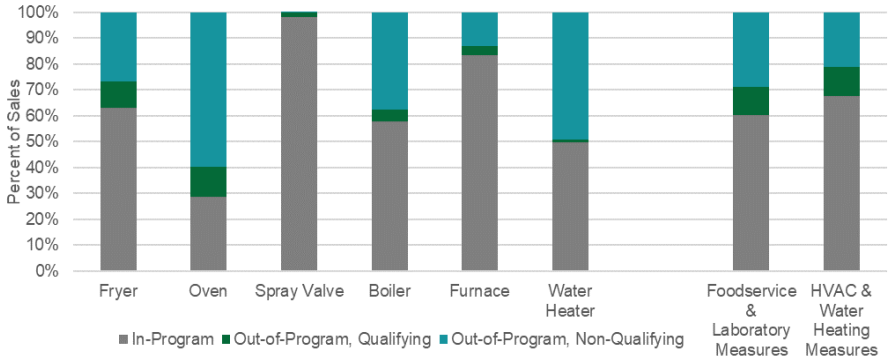
## Distributor Market Analysis

Market analysis of distributor IDI results suggests the **market has caught up to the program for some measures**, particularly spray valves and furnaces.

| | In-Program | Out-of-Program |
|---|---|---|
| **Qualifying** | Unit Quantities from program tracking data | Total Sales of High-Efficiency Units – Program Units |
| **Non-qualifying** | Assumed to be zero | Total Unit Sales – Sales of High-Efficiency Units |

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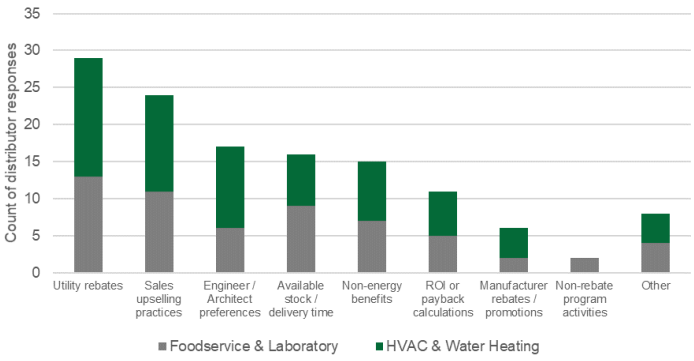
# Distributor View of Program Influence

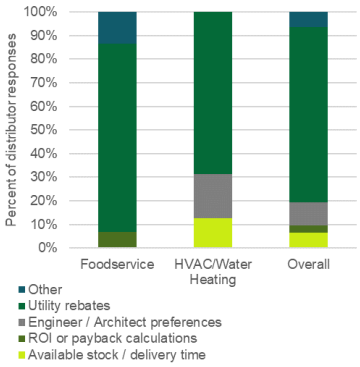
Distributors primarily cited **utility rebate**s as influencing sales of high efficiency equipment, with **upselling practices** as a secondary driver

- HVAC/WH distributors cited engineer/architect preference & available stock as stronger drivers than Foodservice dealers

Which, if any, of the following influence sales of high efficiency equipment?




Thinking about the same list of factors, what is the strongest driver when it comes to selling high efficiency equipment?

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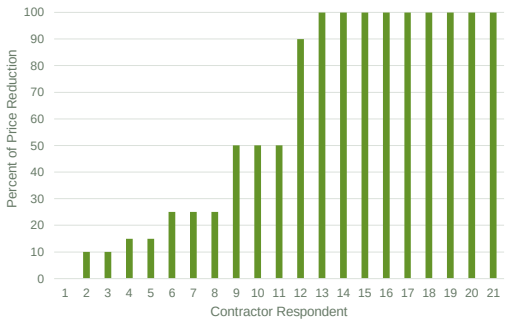
# HVAC & Water Heating Program Influence—Pricing

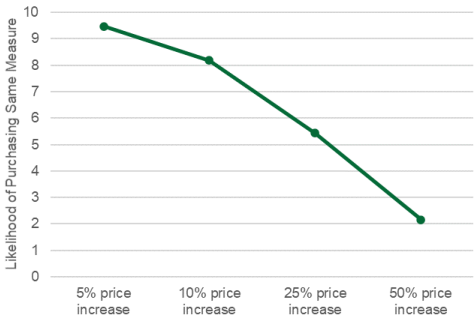
Most contractors said **they would not pass down 100% of the cost savings** from their distributor to their customer **if the program did not require it**.

- Those who would pass down all savings said they do so to beat competitors and get the sale

If your distributor charged you less for a piece of equipment, how much if any of that price difference would you pass on to your customers *(assuming there was no EnergizeCT requirement to do so)*?




Please answer on a scale of 0 to 10 where 0 means 'the customer definitely would NOT purchase the same high efficiency measure' and 10 means 'the customer definitely WOULD purchase the same measure'

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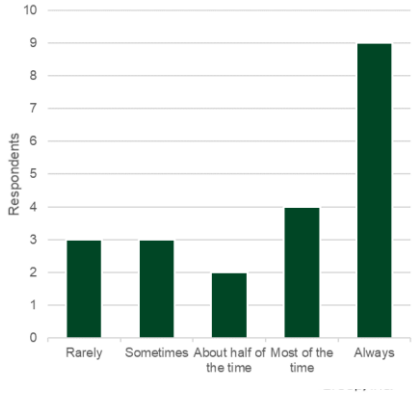
## HVAC & Water Heating Influence—Pricing

Distributors reported passing down 100% of the incentive to the buyer; however **less than half of contractors said distributors always listed the dollar amount of the discount on their invoice**.

**How often did the distributor list the dollar amount of the discount on your invoice?**







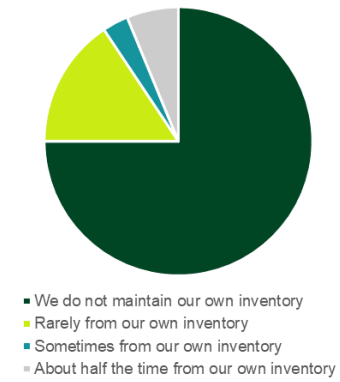

## HVAC & Water Heating Program Influence—Stocking

Most contractors (75%) reported that they **do not maintain their own inventory of equipment**.

Contractor equipment **recommendations are supplier-driven**:

- High NTG contractors said they make recommendations based on **supplier information and support:**
  - "Based on information from supply houses and representatives"
  - "Supply houses present products to our equipment sales team"
  - "Sizes and recommendations from our suppliers"
- Low NTG contractors said they make recommendations based on **specific brands and existing supplier relationships:**
  - "We keep to one brand to keep service and quality to its highest point"
  - "Brands that have the highest reliability and/or that we have a relationship with"
  - "We deal with two brands and install those unless a customer wants another brand"

How often are your sales of [measure type] fulfilled out of your own inventory, rather than purchased from a distributor?



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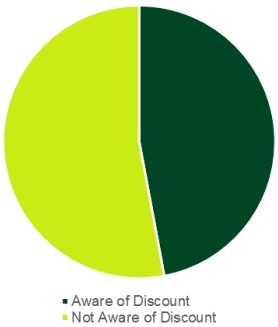
# Foodservice Program Influence—Pricing

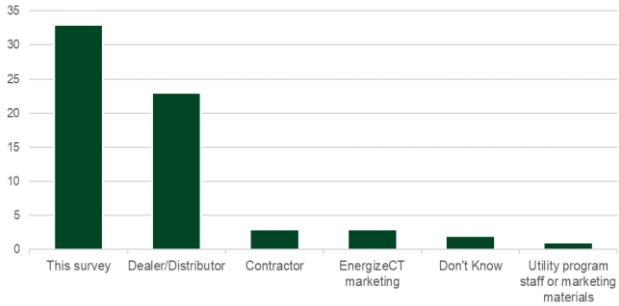
Despite program requirements to include a line item for the rebate on invoices, most Foodservice customer respondents (33 out of 65) were not aware of the rebate until taking the survey

- End user awareness is not necessary for midstream program influence to occur, but **lack of awareness represents a missed opportunity for customer engagement**

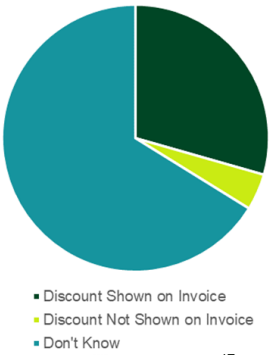
Were you aware of the discount at the time your org purchased the equipment?




How did your organization first learn about the discount?




Did your invoice include a line item for the dollar amount of the discount?



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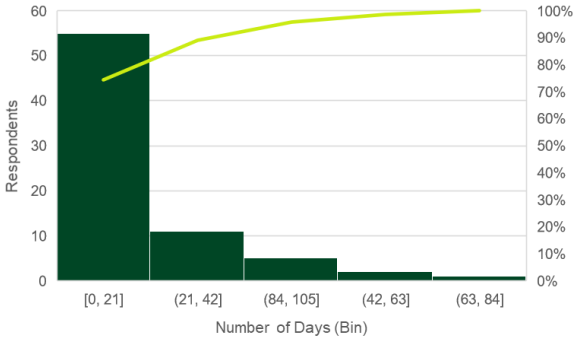
# Foodservice Program Influence—Stocking

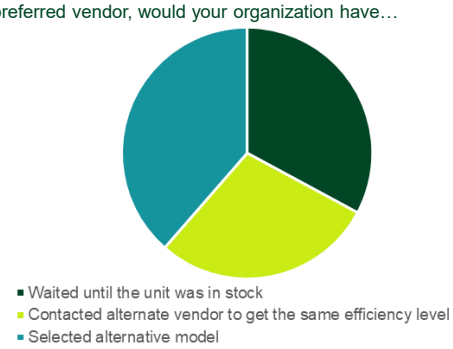
Foodservice dealer **equipment availability is key** to customer purchase decisions

- About 75% of Foodservice customers installed equipment within 3 weeks of deciding to purchase
- About 67% of Foodservice customers would not wait for their desired high efficiency equipment to be in stock

About how many days elapsed between the decision to purchase and installation of the new tech?




If the efficiency level of the ES certified equipment you purchased had not been in stock at your preferred vendor, would your organization have…



*Midstream Commercial HVAC & Water Heating and Foodservice*

# NTG Results Benchmarking

Comparison of results with MA shows relatively higher NTG for the CT program.

- The MA HVAC/Water Heating program offers many of the same equipment types as the CT program, and the same implementation vendor and many of the same distributors are active in the programs in both states.

| Program / Measure | Distributor/Contractor/Customer Causal Pathway | | |
|---|---|---|---|
| | Distributor Sample Size (n) | Contractor or Customer Sample Size (n) | NTG |
| **Connecticut HVAC & Water Heating and Foodservice & Laboratory Program** | | | |
| HVAC & Water Heating | 28 | 27 | **68%** |
| Foodservice & Laboratory | 27 | 74 | **80%** |
| **Massachusetts HVAC and Water Heating Program** | | | |
| Volume WH | 7 | 13 | **44%** |
| Instantaneous WH | 1 | 10 | **38%** |
| VRF | 3 | 18 | **30%** |
| Package | 4 | 5 | **55%** |
| Storage WH | 6 | 24 | **29%** |
| Indirect WH | 6 | 20 | **36%** |

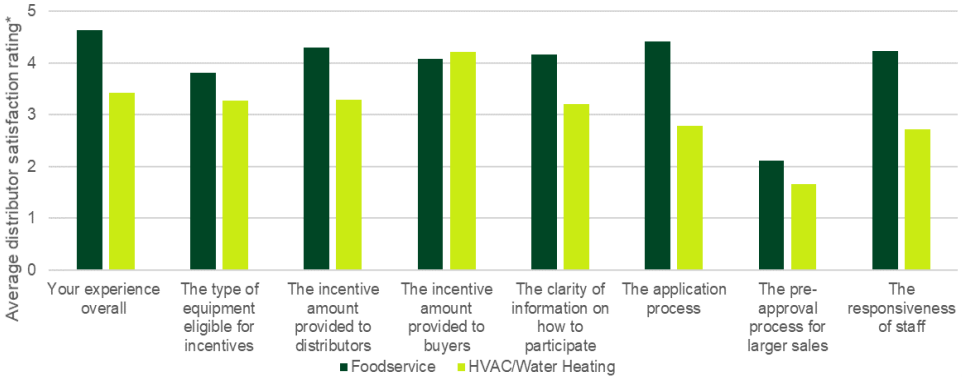
[1] C&I Upstream HVAC & Gas Water Heating NTG Study. MA20X08-B-CIHVACNTG, Sep 2021, https://ma-eeac.org/wp-content/uploads/MA20X08-B-CIHVACNTG_Final_Report_Clean_9.10.pdf

## C1902A Midstream Commercial Process Results

## Process Results—Distributor Satisfaction

**HVAC/Water Heating distributors gave consistently lower ratings than Foodservice dealers**, particularly on application process and staff responsiveness

- The **pre-approval process** was rated far lower than other program processes, across both subprograms
- Findings from MA20X08 corroborate these results. A primary reason for high efficiency sales outside of the program in MA included that the "**program pre-approval process was difficult to navigate and slow**"




*Savings-weighted distributor average



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## Process Results—Distributor Satisfaction

Distributor's **lower satisfaction responses** reflected several themes:

**Payment processing** (13 responses, mostly HVAC/Water Heating)

- "It's a great program but the biggest complaint is that I can't get paid. They are supposed pay within 10 days, and every year when we close the fiscal year it's a nightmare because they wait at least 60 days." (HVAC)
- "Payments are painfully slow, to the tune of 6 months." (HVAC)
- "Reimbursement. …It takes a while to get paid back." (HVAC)

**Qualification/eligibility** (7 responses, both subprograms)

- "You have to look up qualifying products because the fact that it is Energy Star doesn't mean it qualifies." (Foodservice)
- "Additional equipment should be available such as high intensity IR heaters, natural gas heat pumps, and gas chillers." (HVAC)
- "Lack of knowing what town qualifies and what products qualify is the biggest obstacle." (HVAC)

**Implementer transition** (3 responses, Foodservice)

- "[The prior implementation vendor] was phenomenal, but we haven't heard from the new one and stopped participating since we don't know how to get the rebate." (Foodservice)
- "Historically there have been no obstacles, but with the new implementer, we don't know what to do yet." (Foodservice)

## Process Results—Distributor Suggested Improvements

Distributor **suggestions to encourage more high-efficiency sales** reflected three themes:

**Streamline processes** (e.g., payment processing, online system):
- "If the [qualified product list] had a designated amount we could program into our system, we'd be more apt to take advantage of it."
- "Make it easier on the wholesaler. In CT I don't even know where to login for the rebate... I couldn't figure out the website"
- "There's a new process where we have to validate addresses…seems like an extra step that might restrict process."
- "Why do I need to know the footprint of the restaurant?"

**Increase end user marketing:**
- "More end user marketing to larger facilities would help."
- "Work more with sustainability departments or officers at institutional buyers to make sure they are aware of rebates."
- "Not sure if upper-level managers are aware."

**Increase incentives to suppliers and end users:**
- "The second problem is the incentive to the wholesaler—why should we do all this work for $10?"
- "My salesmen are out there selling—offering a rebate is a nicety for the customer but doesn't benefit the salesmen."
- "Keeping the rebates high, and SPIFFing the seller (sales commissioning)"



## Thank You

*Code Compliance & Baseline*

# Population Characteristics & Sample

**Code Compliance**

| Stratum | Stratum Description | % Count | | % Area | |
|---|---|---|---|---|---|
| | | N =146 | n = 41 | N | n |
| 1 -Small | <=25,000 sq. ft. | 51% | 78% | 5% | 8% |
| 2 - Medium | Up to 60,000 sq. ft. | 12% | 12% | 7% | 10% |
| 3 - Large | Up to 250,000 sq. ft | 32% | 34% | 55% | 65% |
| 4 - X-Large | Up t0 400,000 sq. ft. | 5% | 2% | 21% | 17% |
| 5 - XX-Large | Over 400,000 sq. ft. | 1% | 0% | 12% | 0% |

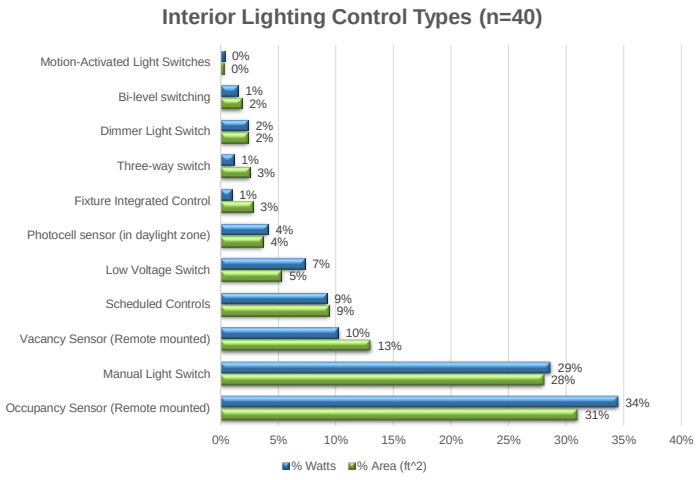
**Baseline**

| Stratum | Stratum Description | % Count | | % Area | |
|---|---|---|---|---|---|
| | | N =146 | n = 52 | N | n |
| 1 -Small | <=25,000 sq. ft. | 51% | 62% | 5% | 8% |
| 2 - Medium | Up to 60,000 sq. ft. | 12% | 10% | 7% | 8% |
| 3 - Large | Up to 250,000 sq. ft | 32% | 27% | 55% | 71% |
| 4 - X-Large | Up t0 400,000 sq. ft. | 5% | 2% | 21% | 13% |
| 5 - XX-Large | Over 400,000 sq. ft. | 1% | 0% | 12% | 0% |



*Baseline*

# Lighting Controls




Remote mounted occupancy sensors are the most common type of lighting controls

Manual controls are still a large part of the mix

*Baseline*

## Heating Systems in Sample

| Technology | n | % Installed Capacity | | |
|---|---|---|---|---|
| | | Total | Gas | Electric |
| Steam boilers | 117 | 1.3% | 1.5% | 0.0% |
| HW boilers | 35 | 59.1% | 68.0% | 0.0% |
| Central & dict furnaces | 175 | 22.9% | 26.3% | 0.0% |
| Condensing boilers | 2 | 1.8% | 2.1% | 0.0% |
| Radiant heaters | 157 | 1.9% | 2.2% | 0.0% |
| Air-source heat pumps | 65 | 3.4% | 0.0% | 26.0% |
| Variable refrigerant flow systems | 11 | 9.7% | 0.0% | 74.0% |

Boilers and Furnaces represented the largest gas users

Electric space heating account for 13% of space heating capacity



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## Data collection

### Participating Customer & Contractor Web Survey

- HVAC & Hot Water Contractor Survey Topics
  - Program awareness
  - Influence of distributor promotion, price, and stocking practices
  - Feedback on program experience, and market event
- Foodservice Customer Survey Topics
  - Program awareness
  - Influence of dealer promotion and stocking practices
  - Feedback on program experience, and market event

| | Foodservice Customers | HVAC/DHW Contractors |
|---|---|---|
| Total Sample | 1167 | 192 |
| Target Completes | 70 | 70 |
| Email Sent | 900 | 44 |
| Postcard Sent | 267 | 148 |
| **Completes** | **68** | **25** |
| **Response Rate** | **5.8%** | **13.0%** |

### Participating Distributor & Dealer Interviews

- In-Depth Interview (IDI) Topics
  - Free-ridership and market uplift
  - Differences in MA and CT programs
  - Feedback on program design, recent changes, and program suggestions

| | Foodservice Dealers | HVAC/DHW Distributors | Total |
|---|---|---|---|
| Total Sample | 26 | 31 | **57** |
| Target Completes | 15 | 15 | **30** |
| Email & Phone Call | 21 | 25 | **46** |
| **Completes** | **15** | **15, plus 1 partial** | **30, plus 1 partial** |
| **Response Rate** | **71%** | **60%** | **65%** |

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# Causal Pathway Detailed NTG Results

We assessed program influence on stocking, upselling, and pricing among distributors/dealers, contractors, and end-use customers. The causal pathway approach reflects the design of each sub-program, as follows:

- HVAC/WH Distributor → Contractor *(about 95% of HVAC/WH distributors said they sell to contractors)*
- Foodservice Dealer → Customer *(about 95% of Foodservice dealers said they sell to end-use customers)*

Resulting NTG ratios are similar to the NTG results from Distributor-Only counterfactual method

| Program | Distributor Weighted Attribution | | | | Contractor (HVAC&WH) and Customer (Foodservice) Weighted Attribution | | | | NTG |
|---|---|---|---|---|---|---|---|---|---|
| | Sample size (n) | Stocking Attribution | Upselling Attribution | Pricing Attribution | Sample size (n) | Stocking Attribution | Upselling Attribution | Pricing Attribution | |
| **HVAC & Water Heating** | 28 | 33% | 24% | 100% | 27 | 14% | 54% | 61% | **68%** |
| **Foodservice & Laboratory** | 27 | 72% | 63% | 100% | 74 | 27% | 69% | 58% | **81%** |