



GROUP A

# Forward Looking Research: Cross-Program Net-to-Gross Ratios for Hard-to-Reach Customers of Downstream Programs

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## Table of contents

1	EXECUTIVE SUMMARY.....	1
1.1	Study objective	1
1.2	Study methods and results	1
1.3	Key findings and recommendations	3
2	INTRODUCTION.....	5
2.1	E-5221 Resolution directive	5
2.2	Research questions	5
2.3	Background of HTR NTGR	6
2.4	Definition of hard-to-reach customers	6
3	METHODOLOGY.....	8
3.1	Data source	9
3.2	Data characterization	10
3.3	Net to gross ratio calculation	14
4	RESULTS AND FINDINGS.....	16
4.1	Residential	16
4.2	Commercial	17
5	CONCLUSIONS.....	20

## List of figures

Figure 1-1.	Coalesced NTGRs for evaluated PY2019-2021 direct install programs by sector.....	2
Figure 1-2.	Coalesced NTGRs for evaluated PY2019-2021 downstream rebate programs by sector.....	3
Figure 3-1	Residential measure group NTGRs in PY2019 to PY2021 for direct install programs.....	13
Figure 3-2	Commercial measure group NTGRs and number of participants in PY2019 to PY2021 by delivery type.....	14
Figure 4-1.	Coalesced residential cross-program NTGRs for direct install and downstream rebate delivery types.....	17
Figure 4-2.	Coalesced non-residential cross-program NTG ratios based on PY2019 to 2021 evaluation data for direct install and downstream delivery.....	18

## List of tables

Table 1-1.	Coalesced NTGRs for evaluated PY2019-2021 direct install programs by sector.....	2
Table 1-2.	Recommended updates to NTG_IDs and NTGRs for PY2026.....	4
Table 2-1.	Demographic and firmographic characteristics used to define hard-to-reach customers.....	7
Table 3-1.	Criteria for hard-to-reach customers in PY2019-2021.....	9
Table 3-2	Programs and number of participants included in this study.....	11
Table 3-3.	HTR and non-HTR participants using three sets of criteria.....	12
Table 4-1.	Coalesced cross-program residential NTGRs.....	16
Table 4-2.	Coalesced cross-program commercial NTGRs.....	18
Table 5-1.	Coalesced NTGRs for evaluated PY2019-2021 direct install programs by sector.....	20



## Glossary of terms

**California Database for Energy Efficiency Resources (DEER)** – Refers to the Database for Energy Efficient Resources and encompasses the California eTRM. This database contains information on energy efficient technologies and measures. DEER provides estimates of the energy-savings potential for these technologies in residential and non-residential applications. DEER is used by California Energy Efficiency (EE) Program Administrators (PAs), private sector implementers, and the EE industry across the country to develop and design energy efficiency programs.<sup>1</sup>

**California Energy Data and Reporting System (CEDARS)** – Refers to the database that securely manages California Energy Efficiency Program data reported to the California Public Utilities Commission (CPUC) by Investor-Owned Utilities (IOUs), Regional Energy Networks (RENs), and certain Community Choice Aggregators (CCAs).

**Delivery Type** – The delivery channel that describes how the energy efficiency measure or service was delivered to the program participant.

**Direct Install** – A delivery type that “incentivizes the delivery and/or installation of an energy efficient technology and/or service at a customer property by a program implementer-managed third-party contractor or trade professional.”<sup>2</sup>

**Downstream** – A delivery type that “incentivizes an energy-efficient technology or service to a participating customer for them to install or have installed.”

**Free-rider** – A program participant who would have implemented the program measure or practice in the absence of the program.<sup>1</sup>

**Measure** – A product whose installation and operation at a customer’s premises results in a reduction in the customer’s on-site energy use, compared to what would have happened otherwise.<sup>1</sup>

**Net to gross ratio (NTGR)** – A factor representing net program load impacts divided by gross program load impacts that is applied to gross program load impacts to convert them into net program load impacts.<sup>1</sup>

**Participant** – An individual, household, business, or other utility customer that received a service or financial assistance offered through a particular utility program, set of utility programs, or aspect of a utility program in a given program year.<sup>1</sup>

**Relative precision** – A ratio of the error bound divided by the value of the measurement itself. This provides the error on a relative basis that is frequently used to show uncertainty as a fraction of a quantity. In this report, all relative precisions are determined using a 90% confidence interval, which means that in repeated sampling 90 times out of 100 the true value will fall within the lower and upper bounds of the estimate.

**Sample Frame** – The population of program participants from which the sample of claims to evaluate is chosen.

**Tracking Data** – Refers to the officially claimed electric and gas impacts as captured in the CEDARS (defined above) data and reporting system.

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<sup>1</sup> CPUC. “California Energy Efficiency Evaluation Protocols: Technical, Methodological, and Reporting Requirements for Evaluation Professionals. Appendix B: Glossary of Terms.” April 2006.

<sup>2</sup> Resolution E-5221, Nov. 3, 2022, p. A-17. See <https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M498/K337/498337929.PDF>.



## 1 EXECUTIVE SUMMARY

This report provides the results of a study that was directed in Resolution E-5221<sup>3</sup> to determine whether net-to-gross ratios (NTGR) for hard-to-reach (HTR) customers differ from those for non-HTR customers who participate in residential and commercial deemed direct install (DI) and downstream energy efficiency rebate programs. DNV performed this work on behalf of the California Public Utilities Commission (CPUC). Rather than gathering new data, DNV coalesced the results from NTG surveys conducted through previous impact evaluations across multiple programs that were run in program years (PY) 2019-2021. The report presents the results of this investigation.

### 1.1 Study objective

Direct-install programs are the only program type that can claim a NTGR of 0.85 when they serve HTR customers. The objective of this study was to determine if there is evidence to answer the following questions for residential and commercial customers:

- For the direct install delivery type, is the NTGR for HTR customers higher than that for non-HTR customers?
- For the downstream rebate delivery type, is the NTGR for HTR customers higher than that for non-HTR customers?

The first of these questions was asked in Resolution E-4952<sup>4</sup> in 2018, “In review of the most recent evaluation results along with the overall 2017 deemed claims, Commission staff finds no support for the use of a higher NTG value for direct install programs into HTR markets versus the general market. However, Commission staff retains this NTG value subject to review of future evaluation results.” This study aimed to settle this standing question.

### 1.2 Study methods and results

To achieve the objectives of this study, DNV coalesced existing survey data across eight residential and commercial direct install and downstream rebate programs that were run in program years 2019 to 2021 and had been subsequently evaluated. Using the survey participant survey weights appropriate for their respective sample frames, new sample weights were assigned for each survey participant after combining the sample frames. Then, DNV verified the correctness of the use of the HTR net-to-gross ID among the direct install program participants in the sample and determined the HTR status of the downstream rebate program participants in the sample. Once these steps were completed, analysis of the coalesced survey responses was used to answer the research questions.

The coalesced results of the cross-program NTGRs for residential program participants in the sample of PY2019-2021 programs that were previously evaluated can be found in Table 1-1. All the residential NTGR values have a relative precision of  $\pm 5\%$  at the 90% confidence interval whereas three of the four commercial results were outside of the  $\pm 10\%$  relative precision threshold. Since a majority of the residential customers surveyed during these evaluations had received smart communicating thermostats (SCTs), the direct install NTGR results are presented without considering their responses. This was done because multiple evaluations regarding SCTs have been performed and yielded NTGRs specific to SCTs for both direct install and downstream rebate programs that were subsequently adopted in a DEER resolution.

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<sup>3</sup> Resolution E-5221, Nov. 3, 2022, p. 20. See <https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M498/K337/498337929.PDF>.

<sup>4</sup> Resolution E-4952, Oct. 11, 2018, p. A-49. See <https://docs.cpuc.ca.gov/publisheddocs/published/q000/m232/k459/232459122.pdf>.



**Table 1-1. Coalesced NTGRs for evaluated PY2019-2021 direct install programs by sector**

Delivery Type	Sector	NTGR ± Error Band and Survey Count			Statistically Significant Difference for HTR Customers
		HTR	Non-HTR	Overall	
Direct Install	Residential	0.89 ± 0.02 (769)	0.87 ± 0.02 (1,023)	0.88 ± 0.02 (1,792)	No
	Commercial	0.65 ± 0.16 <sup>†</sup> (10)	0.71 ± 0.05 (94)	0.70 ± 0.07 (104)	No
Downstream Rebate	Residential	0.72 ± 0.02 (995)	0.67 ± 0.01 (3,491)	0.67 ± 0.01 (4,486)	Yes
	Commercial	0.43 ± 0.19 <sup>†</sup> (22)	0.72 ± 0.09 <sup>†</sup> (244)	0.72 ± 0.10 <sup>†</sup> (266)	Yes <sup>†</sup>

\* Since SCTs delivered through direct-install programs have their own NTG\_ID in DEER (NTGR=0.95), they were excluded from the analyses used to answer research questions.

\*\* SCTs were purchased by all but one of the residential downstream program participants surveyed during the PY2019-2021 evaluations. SCTs delivered through downstream programs also have their own NTG\_ID in DEER (NTGR=0.50).

<sup>†</sup> The relative precision of the resulting NTGR is outside of the ±10% threshold.

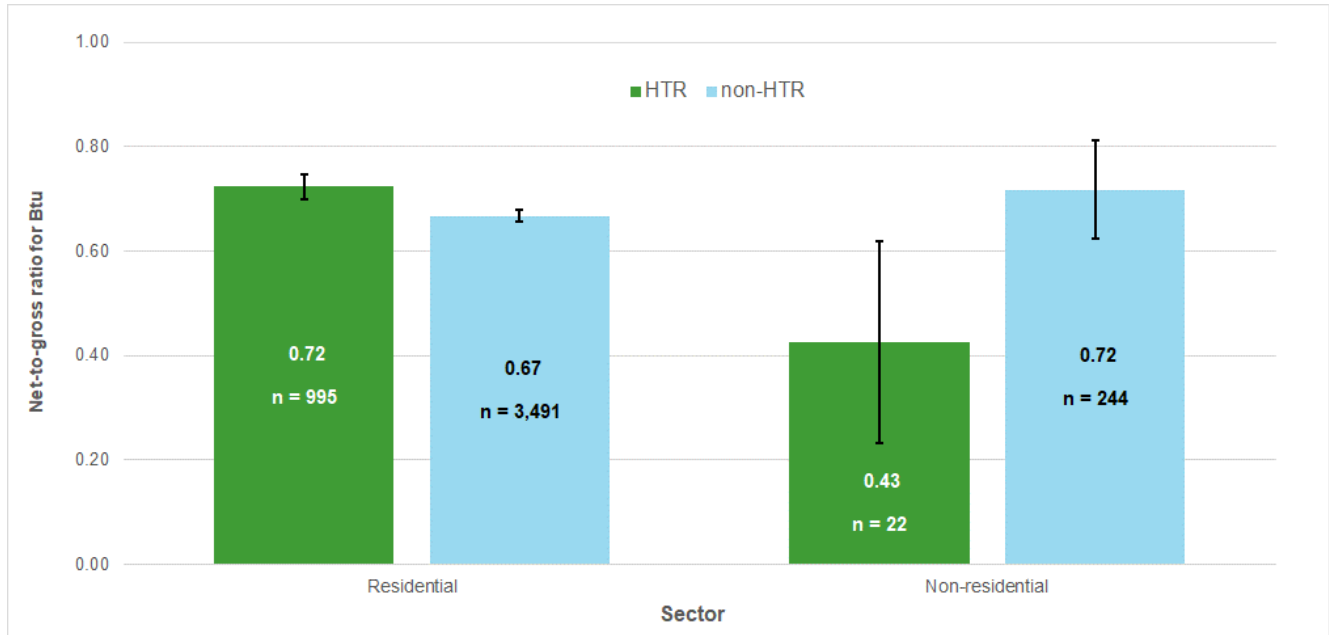
The results shown in Table 1-1 are also presented in charts contained in Figure 1-1 and Figure 1-2 with their respective error bars and participant survey counts shown. The larger error bars shown in the commercial results are due to much smaller sample sizes and a wider variance by measure group.

**Figure 1-1. Coalesced NTGRs for evaluated PY2019-2021 direct install programs by sector**



Residential NTGRs shown do not include SCT survey results. The commercial NTGR for HTR customers had a relative precision that exceeded the 10% target due to the small sample size.

**Figure 1-2. Coalesced NTGRs for evaluated PY2019-2021 downstream rebate programs by sector**



All but one residential downstream rebate program participants surveyed had purchased SCTs. The NTGRs shown for commercial customers had relative precisions that exceeded the 10% target.

### 1.3 Key findings and recommendations

The key findings and recommendations from the NTG study of 2019-2021 direct install and downstream rebate programs are as follows.

**Finding 1. For direct install programs, there is no evidence that the NTGR for HTR customers is higher than that for non-HTR customers in either the residential or commercial sectors.**

Among the residential direct install survey respondents, the NTGR is 0.89 for HTR customers and 0.87 for non-HTR customers; among the commercial participants, the NTGR is 0.65 and 0.71, respectively. We did not find statistically significant differences in NTGRs between the HTR and non-HTR populations for either residential or commercial customers.

**Recommendation: Update the default NTGR for direct install programs to 0.90 for all residential participants and 0.70 for all commercial participants as supported by the analysis results presented in Table 1-2.<sup>5</sup>**

<sup>5</sup> It is recommended that evaluated NTG\_IDs specific to the direct install delivery type remain in effect (e.g., Res-sAll-mHVAC-SCT-di = 0.95, Res-sMFm-mSHW-DemCtrlRecircPump-di = 1.00, and Res-sMFm-mSHW-TempCtrl-di = 0.94).



**Table 1-2. Recommended updates to NTG\_IDs and NTGRs for PY2026**

Sector	Existing/Related NTG_IDs	Recommended Change	New NTG_ID
Res	Res-Default>2: 0.55	Discontinue use for direct install programs	Res-Default-di: 0.90
	All-Default<=2yrs: 0.70	Discontinue use for direct install programs	
	Res-Default-HTR-di: 0.85	Expire	
Com	Com-Default>2yrs: 0.60	Discontinue use for direct install programs	Com-Default-di: 0.70
	All-Default<=2yrs: 0.70	Discontinue use for direct install programs	
	Com-Default-HTR-di: 0.85	Expire	

**Finding 2. For SCTs delivered through residential downstream rebate programs, there is evidence that the NTGR for HTR residential customers is five percent higher than that for non-HTR customers but significantly lower among customers who participated in commercial downstream rebate programs.**

Among residential downstream survey respondents—all but one of whom purchased SCTs—the NTGR was found to be 0.72 for HTR customers and 0.67 for non-HTR customers; this was found to be a statistically significant difference. That said, given that this analysis only involved one measure, it would be overreaching to apply these results more broadly. The commercial sector’s results, however, tell a different story. For commercial downstream survey respondents, the NTGR is 0.43 and 0.70 for HTR and non-HTR customers, respectively. But the relative precision for these results fall outside of the target of 10% since the results were limited by sample size and data variance.

**Recommendation: Results are not robust enough to support providing a different NTGR for HTR customers served by downstream rebate programs.**

**Finding 3: Hard to Reach definitions for geographical and business size criteria require further clarification.**

The business size criteria can cause some confusion when it comes to commercial customers. DNV reviewed all commercial customers who were classified as HTR and noticed that even though those customers meet the HTR criteria, they are not “in the spirit” of the HTR definition. For example, national brand stores are often classified as HTR when they are located in a disadvantaged community and show low energy usage. Whether it should be categorized as HTR is debatable since individual stores have access to companywide energy efficiency resources and do not often have the autonomy to make energy efficiency related decisions on their own. Using data analytics methods to map the business size criteria can be very challenging. For example, a chain store might be classified as HTR based on the utility account’s location and yearly energy usage or demand, without manual verification or more background information about the customer. The need for manual review limits any future commercial HTR studies at scale. We suggest monitoring HTR-related tracking data for instances that may not be defensible.

The accuracy of the geographic boundary of United States Office of Management and Budget (OMB) Combined Statistical Areas is also debatable. For example, the Combined Statistical Area of the Greater Sacramento Area includes El Dorado, Nevada, Placer, Sacramento, Sutter, Yolo, Yuba counties, among which Yuba is mostly rural compared to Sacramento County. Even though the geographical boundary based on the definition is clear, whether some counties should be included is debatable and the boundary may not be consistent during program administration and how users interpretate the definition since the OMB county list for Combined Statistical Areas may change over time.

**Recommendation: Clarify the HTR definitions regarding business size and geographical boundaries.**





## 2 INTRODUCTION

This report details the forward-looking research study of the default Net to Gross ratio (NTGR) for Hard-to-Reach (HTR) customers in the context of energy efficiency programs in California. Directed by the Resolution E-5221 for the 2024 DEER Update and conducted by DNV under CPUC oversight, this study reviews and potentially recalibrates the NTGR values used in savings claims for measures delivered to HTR customers through direct installation (DI) and downstream channels.

The report is structured into several key sections. Following this introduction, the methodology section details the approach for data collection, data characterization, and NTGR estimation. The subsequent sections will cover the study's findings, implications, and recommendations.

### 2.1 E-5221 Resolution directive

The following text is a direct quote from Resolution E-5221 that directs this research.

*Resolution E-4952 called into question the use of a higher NTGR for HTR customers. At that time, CPUC staff did not examine data specific to HTR customers, but instead CPUC staff used customer size as a proxy and assumed that smaller businesses would more likely be HTR customers.*

*Further research is needed to characterize the appropriate NTGR for residential and commercial HTR customers—in addition to those served through direct installation of measures—but also those served through downstream delivery mechanisms. The focus of the work would be to see if there is evidence for:*

- *A higher NTGR for HTR customers served through DI compared to non-HTR customers served through DI*
- *A higher NTGR for HTR customers served through downstream compared to non-HTR customers served through downstream*

*Primary research designed to inform NTGR values to use for HTR customers is needed. We direct CPUC staff to conduct this research. This work could go further to investigate HTR customer participation rates and depth of savings to assess whether HTR customers have equitable access to energy efficiency programs. The NTG research is to be completed by December 2023 and the results will be used to inform measure packages used for the PY2026-27 cycle.*

### 2.2 Research questions

The primary goal of this study is to characterize the appropriate NTGR for both residential and commercial HTR customers participating in direct install energy efficiency programs. Currently, only customers in direct install (DI) programs can use the default 0.85 NTGR. The study will also investigate the NTGR for customers participating in downstream programs as an exploratory effort. If a NTGR gap is found between HTR and non-HTR customers participating in downstream programs, then policy changes can be considered. This project will provide a more comprehensive understanding of the NTGR for HTR customers across different delivery types.

The focus of the study was to determine if there is evidence to answer the following questions for residential and commercial customers:

- For the direct install delivery type, is the NTGR for HTR customers higher than that for non-HTR customers?
- For the downstream rebate delivery type, is the NTGR for HTR customers higher than that for non-HTR customers?



## 2.3 Background of HTR NTGR

The default NTGR of 0.85 for HTR customers served through direct install (DI) programs was introduced to the DEER database in 2008 but was not mentioned in a CPUC decision or resolution at that time. Since then, references to the HTR NTGR are as follows:

- The CPUC first approved a definition for HTR customers in D.01-11-066.
- Resolution G-3497<sup>6</sup> (2014) provided additional clarification regarding the HTR definition.
- Resolution G-3510<sup>7</sup> (2015) clarified that the 0.85 NTGR for HTR customers is limited to programs, projects, and measures that utilize a DI delivery channel.
- D.18-05-041<sup>8</sup> clarified the definition of HTR customers but did not indicate whether the HTR NTGR remained limited for use with direct install programs only.
- E-4952<sup>9</sup> (2018) clarified that the HTR NTGR was only available for customers served through direct install programs. It also added that the NTGR of 0.85 was not supported by evaluation evidence, but they retained the HTR NTG\_ID, subject to review of future evaluation results.
- A guidance memo<sup>10</sup> issued by the CPUC on 01-01-2022 and amended on 05-27-2022 restated that the HTR NTGR can only be used customers served through direct install programs.

## 2.4 Definition of hard-to-reach customers

Energy efficiency programs have a critical role in reducing energy consumption and mitigating the impact of energy use on the environment. The CPUC has long recognized the importance of targeting hard-to-reach (HTR) customers who have traditionally been underserved by these programs due to various barriers. In Resolution G-3497 (December 2014), the Commission provided clarification on the definition of a hard-to-reach customer and Decision 23-06-055<sup>11</sup> broadened and updated the definition by including Native American Tribes, increasing the business size limit, and expanding residential income qualification coverage as shown in Table 2-1.

California Native American Tribes are defined as a hard-to-reach population, meeting the definition with only this one criterion. Beyond that, two criteria are considered sufficient if one of the criteria met is the geographic barrier type defined below. If the geographic requirement is not met, all three other criteria need to be met to be qualified as HTR. There are shared as well as different criteria for defining hard-to-reach for residential versus small business customers. For example, if a given residential customer lives outside the geographic area listed in Table 2-1, they only need to meet one of the income, housing type, and language criteria to qualify as HTR. If a given customer resides outside of rural or disadvantaged areas listed in Table 2-1, they must meet all three criteria of income, housing type, and language to qualify.

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<sup>6</sup> Resolution G-3497, Dec. 18, 2014, see <https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M143/K668/143668957.PDF>

<sup>7</sup> Resolution G-3510, Dec. 3, 2015, see <https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M156/K208/156208939.PDF>

<sup>8</sup> Decision D.18-05-041, May 31, 2018, see <https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M215/K706/215706139.PDF>

<sup>9</sup> Resolution E-4952, Oct. 11, 2018, see <https://docs.cpuc.ca.gov/publisheddocs/published/g000/m232/k459/232459122.pdf>

<sup>10</sup> [Guidance for Deemed Measures History: CPUC Guidance on Use of Default NTGR for Hard-to-Reach Customers - CEDARS \(sound-data.com\)](#)

<sup>11</sup> D.23-06-055, June 29, 2023, see <https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M512/K907/512907396.PDF>



**Table 2-1. Demographic and firmographic characteristics used to define hard-to-reach customers**

Criteria category	Barrier type	Details
<b>Small Business or Residential</b>	Cultural Accessibility	California Native American Tribes are hard to reach
<b>Small Business or Residential</b>	Language	Primary language spoken is other than English
<b>Small Business or Residential</b>	Geographic	Businesses or homes in areas other than the United States Office of Management and Budget Combined Statistical Areas of the San Francisco Bay Area, the Greater Los Angeles Area and the Greater Sacramento Area or the Office of Management and Budget metropolitan statistical areas of San Diego County, OR businesses or homes in disadvantaged communities, as identified by the California Environmental Protection Agency pursuant to Health and Safety Code Section 39711
<b>Small Business</b>	Business size	25 or fewer employees and/or classified as Very Small (customers whose annual electric demand is less than 20 kW, or whose annual gas consumption is less than 10,000 therm, or both)
<b>Small Business</b>	Leased or rented facilities	Investments in improvements to a facility rented or leased by a participating business customer
<b>Residential</b>	Income	Those customers who qualify for the California Alternative Rates for Energy (CARE), Energy Savings Assistance, or the Family Electric Rate Assistance Program (FERA)
<b>Residential</b>	Housing type	Multi-family and mobile home tenants (rent and lease)



### 3 METHODOLOGY

In our study, we leveraged the survey results from residential and commercial sector Net-to-Gross Ratio (NTGR) evaluations conducted over the past three program years, namely PY2019 to 2021. DNV has been pivotal in evaluating residential direct install programs and several downstream programs in this timeframe, utilizing participant surveys to assess net savings and subsequently derive NTGR values. Similarly, Quantum and DNV have conducted comprehensive evaluations of commercial deemed programs, deriving NTGRs for both downstream and direct install programs.

The secondary data sources include survey results from the following evaluations ranging from PY2019 to 2021:

- PY2019 Residential HVAC Impact Evaluation
- PY2020 Residential HVAC Impact Evaluation
- PY2021 Residential Direct Install Impact Evaluation
- PY2021 Local Third-Party Impact Evaluation
- PY2019 Non-residential Lighting Impact Evaluation
- PY2019 Small/Medium Commercial Impact Evaluation
- PY2020 Non-residential Deemed Pump and Food Service Impact Evaluation
- PY2020 Non-residential Lighting Impact Evaluation

For both residential and commercial populations, the primary source of HTR classification is customers flagged as HTR in claim-level tracking data. Program Administrators (PAs) identify customers who meet the HTR classification criteria and label them as either res-HTR-DI or com-HTR-DI. This dataset primarily pertains to direct installation measures and does not include information about customers who did not meet the criteria. To include downstream customers in the analysis we had to categorize non-direct install customers as HTR or non-HTR. We also mapped direct install customers who were not flagged as HTR in the tracking data to the HTR definition and further categorized them as HTR or non-HTR. This involved geocoding addresses to obtain location information. Combining this location data with Office of Management and Budget (OMB) Combined Statistical Areas and metropolitan statistical areas helps determine metropolitan area statuses. Additionally, we merged this location information with SB535 Disadvantaged Community data to ascertain whether a participant resides within a Native American tribe area or a disadvantaged community.

For residential program data, we encoded premises as being on CARE/FERA if they have a CARE flag or a FERA flag in the CARE or FERA column from the Customer Information System (CIS). In commercial programs, annual usage/demand data from the CIS was used to categorize business sizes.

It is crucial to note that the method employed to classify HTR participants was not exhaustive. Certain critical data points, such as the number of employees per commercial participant and facility lease statuses, remained unknown. Consequently, the classification relied heavily on the maximum annual usage/demand in the survey years and geographic information. This partial coverage could lead to inadvertent misclassification. The interplay of eligibility criteria, geographic information, and usage data creates a complex landscape, and unforeseen discrepancies can emerge. Ensuring accuracy demands vigilance. The path forward lies in continual data enhancement and methodological refinement. Regular updates, better data sources can enhance the accuracy of HTR classifications.



**Table 3-1. Criteria for hard-to-reach customers in PY2019-2021**

Customer Type	Barrier type	Mapping Details
<b>Either</b>	Cultural Accessibility	Participant's GEOIDs merged SB535DAC to identify if located in Native American area
	Geographic	Participant's GEOIDs merged with OMB data to identify metro/non-metro areas SB535DAC to identify if in DAC
<b>Small Business</b>	Language	No data
	Business size	No info on number of employees Participants billing data to obtain annual kW max or annual Therm usage
	Leased or rented facilities	No data
	Geographic	Participant's GEOIDs merged with OMB data to identify metro/non-metro areas SB535DAC to identify if in DAC
<b>Residential</b>	Language	No data
	Income	Customer information data with CARE flag
	Housing type	Customer information data with rental flag

### 3.1 Data source

This study leveraged a variety of data sources to categorize participants into HTR and non-HTR and evaluate the NTGR for HTR customers in energy efficiency programs. The following data sources were used:

- **Program tracking data.** Sourced from the California Energy Data and Reporting System (CEDARS), this data includes detailed information about program participation at the claim level, as filed by the Program Administrators (PAs) with the CPUC. This dataset was analyzed, cleaned, and re-categorized as necessary to ensure accuracy and relevance. The tracking data is used to identify program participants, installed measures, and claimed (ex-ante) savings. Additionally, it helps identify HTR-identified direct-install customers.
- **Secondary Research** – data mining. Various secondary research sources were mined for relevant data. We leveraged the previous years' survey results which contains information enabling us to map HTR groups and calculate NTGR for HTR groups among survey respondents. The secondary research comprises the core of our efforts.
- **Customer Information system (CIS) data.** Data from customer information systems were used to gain insights into the demographics and location of customers. The location was further processed to obtain the GEOID of each premise to be merged with the SB535DAC data.
- **Billing data.** Annual energy usage or peak demand data for each premise was obtained to identify if the business size meets the HTR requirement.

The datasets listed below have been used by DNV to identify HTR vs non-HTR residential and commercial customers for all premise IDs in California. DNV has developed a database to map residential tracking data claims and generate HTR flags.

- **CalEnviroScreen.** The California Environmental Protection Agency (CalEPA) calculates this metric, which provides a granular geographic picture of the environmental, public health, and socioeconomic conditions in California's 8,000 census tracts. It enables a relative ranking of the pollution burdens and socioeconomic vulnerabilities of communities across CA.



- **SB 535 Disadvantaged Communities Data:** Under Senate Bill 535, certain communities in California are classified as disadvantaged or Native American tribes based on the GEOID information. This information was used to identify whether a given participant is located within a Native American tribe area or a disadvantaged community.
- **U.S. Office of Management and Budget (OMB).** We used the U.S. OMB's combined statistical areas (CSAs) and metropolitan statistical areas (MSAs), which include the San Francisco Bay area (Alameda, Contra Costa, Marin, Merced, Napa, San Benito, San Francisco, San Joaquin, San Mateo, Santa Clara, Santa Cruz, Solano, Stanislaus and Sonoma counties), Greater Sacramento (El Dorado, Nevada, Placer, Sacramento, Sutter, Yolo, Yuba counties), Greater Los Angeles (Los Angeles, Orange, San Bernardino, Riverside, and Ventura counties), and San Diego to define metropolitan and non-metropolitan regions. (Non-metropolitan regions are one of the criteria used to identify HTR customers.)
- **U.S. Census Bureau data.** This dataset was used to determine the GEOID of commercial account premise that is not present in the CIS data. The GEOID information is essential when combining with the SB535 DAC data.

## 3.2 Data characterization

We aggregated the evaluation data across PY2019 to 2021 for this study. This section presents the data summary and characteristics. Table 3-2 shows the list of programs and the more than 9,800 participant survey results coalesced for this study.



**Table 3-2 Programs and number of participants included in this study**

Sector	Delivery Type	Program Year	Program Name	No. of Participants	
Commercial	Direct Install	2019	Commercial Direct Install Program	52	
		2020	Commercial Direct Install Program	53	
	Downstream	2019	Commercial Deemed Incentives Program	123	
			Agricultural Deemed Incentives Program	31	
			Agriculture Deemed Energy Efficiency Program	12	
			Commercial Deemed Incentives Program	48	
		2020	EnergySmart Grocery	1	
			Hospitality Program	2	
			Industrial Deemed Energy Efficiency Program	1	
			Industrial Deemed Incentives	1	
			School Energy Efficiency	1	
			2021	Small and Medium Commercial EE Program	45
	Residential	Direct Install	2019	Residential Energy Fitness program	349
				Direct Install for Manufactured and Mobile Homes	14
				Residential Direct Install Program	351
Comprehensive Manufactured Homes				83	
RES-CLEO				28	
RES-Manufactured Mobile Home				113	
RES-Direct Install Program				318	
RES-LADWP HVAC				653	
Local-CALS-Middle Income Direct Install (MIDI)				4	
3P-Res-Comprehensive Manufactured-Mobile Home				51	
Enhance Time Delay Relay				69	
Direct Install for Manufactured				101	
Residential Direct Install Prog				744	
Comprehensive Manufactured Home				133	
2020				RES-CLEO	6
		RES-MF Direct Therm Savings	117		
		RES-Manufactured Mobile Home	79		
		RES-Direct Install Program	144		
		RES-LADWP HVAC	58		
		3P-Res-Comprehensive Manufactured Mobile Home	131		
2021		Residential Direct Install Program	1,248		
	Comprehensive Manufactured Homes	206			
Downstream	2019	Residential Energy Efficiency	713		
		Plug Load and Appliances Program	289		
		RES-Residential Energy Efficiency Program	830		
		SW-CALS-Plug Load and Appliances-HEER	209		
		SW-CALS-Plug Load and Appliances-POS Rebates	377		
		SW-CALS-Residential HVAC-QI/QM	26		
		Residential Energy Efficiency	1,011		
		2020	Plug Load and Appliances Program	2	
			RES-Residential Energy Efficiency Program	649	
		SW-CALS-Plug Load and Appliance	380		



We further disaggregated the participants shown in Table 3-2 to HTR vs non-HTR using: a) the HTR-specific NTG IDs claimed in the tracking data; b) the HTR definitions in use during PY2019-2021 as provided in Table 3-1; and c) the HTR definitions to be used for PY2024 as per D.23-06-055. D.23-06-055 broadened the definition of HTR, and we mapped the participants using both the previous definition and the updated definition. The numbers of HTR and non-HTR participants among the coalesced survey respondents can be found in Table 3-3.

For the residential sector, in tracking data, most of HTR participants are from direct install program. After further mapping the participants to the HTR definition, the number of HTR participants both increased in direct install and downstream programs. The difference in HTR participant number is relatively small between the previous definition and updated definition for our sample, since the main differences is that the new definition includes Native American Tribes as HTR and only 0.3% of the state is tribal. Since the updated HTR definition from Decision 23-06-055 is effective Jan 1, 2024, and the participants in this study were from PY2019 to 2021 where the previous definition was still effective. Therefore, for the following NTGR analysis, we will be using the participants mapping results from tracking data plus HTR definition before Jan 1<sup>st</sup>, 2024.

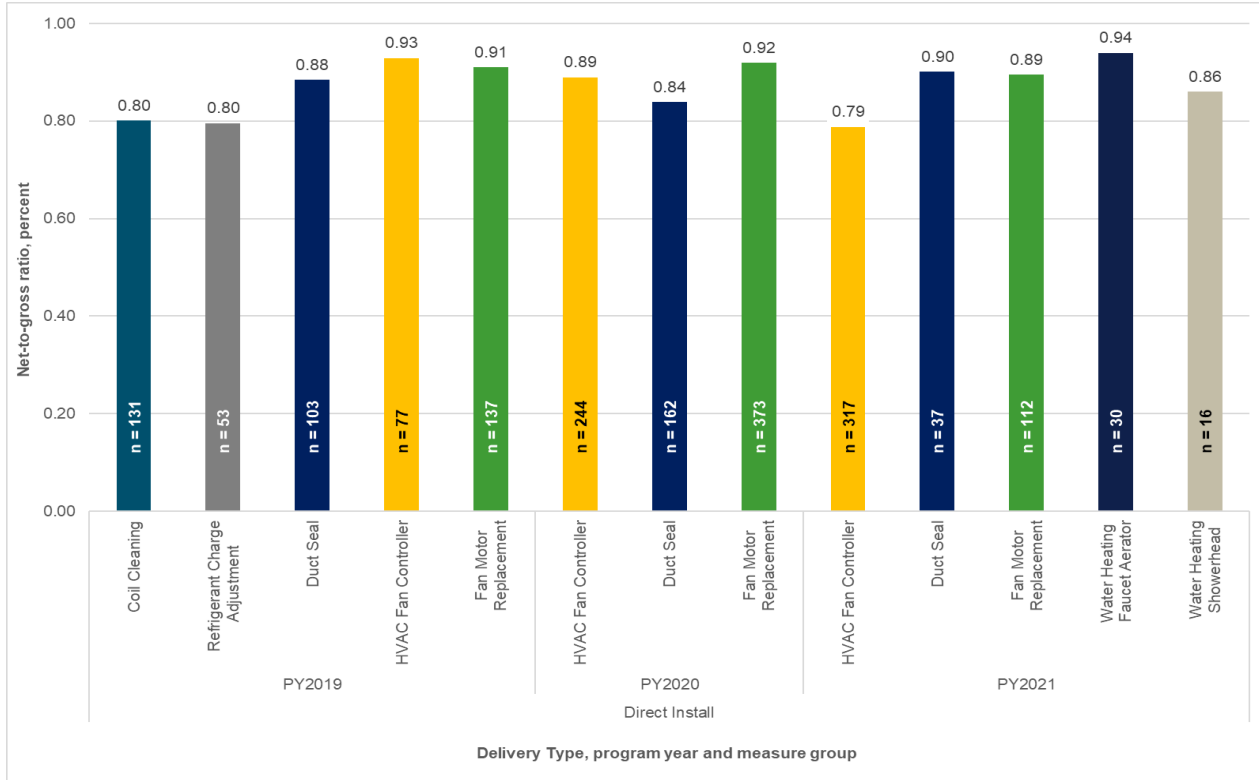
**Table 3-3. HTR and non-HTR participants using three sets of criteria**

Sector	Delivery Type	Number of Participants					
		Tracking Data		Tracking + previous HTR definition mapping		Tracking + new HTR definition mapping	
		HTR	Non-HTR	HTR	Non-HTR	HTR	Non-HTR
Commercial	Direct Install	6	99	11	94	12	93
	Downstream	-	265	22	243	23	242
Residential	Direct Install	734	4,267	1,663	3,338	1,684	3,317
	Downstream*	43	4,443	995	3,491	1,002	3,484
Residential w/o SCTs*	Direct Install	429	1,363	769	1,023	775	1,017
	Downstream*	0	0	0	0	0	0

\*All evaluated residential downstream rebates were for SCTs.

Figure 3-1 shows the measure-level NTGR and number of participants included in this study for residential sector excluding SCT records in each program year and delivery type. The overall NTGR across all residential direct install programs—excluding SCT records—is 0.88.





**Figure 3-1 Residential measure group NTGRs in PY2019 to PY2021 for direct install programs**

Measure level NTGR and number of participants incorporated in this study can be found in Figure 3-2 for commercial sector in PY2019 to 2021 and across the two delivery types, direct install and downstream. As the plot suggest, about 50% of the participants in this study installed a lighting measure. There is no evidence as found in commercial sector that the overall NTGR of DI programs are higher than that of downstream programs. The average NTGR of DI programs included in this study is 0.70 while the NTGR for downstream program is 0.71. The NTGR values across different measure groups in downstream programs vary significantly ranging from 0.31 to 0.99, resulting in relatively large variance and relative precision of the total NTGR of downstream programs. For lighting programs that were offered in both direct install and downstream rebate programs, the NTGRs are 0.71 and 0.63 respectively, though they did not differ to a statistically significant degree.

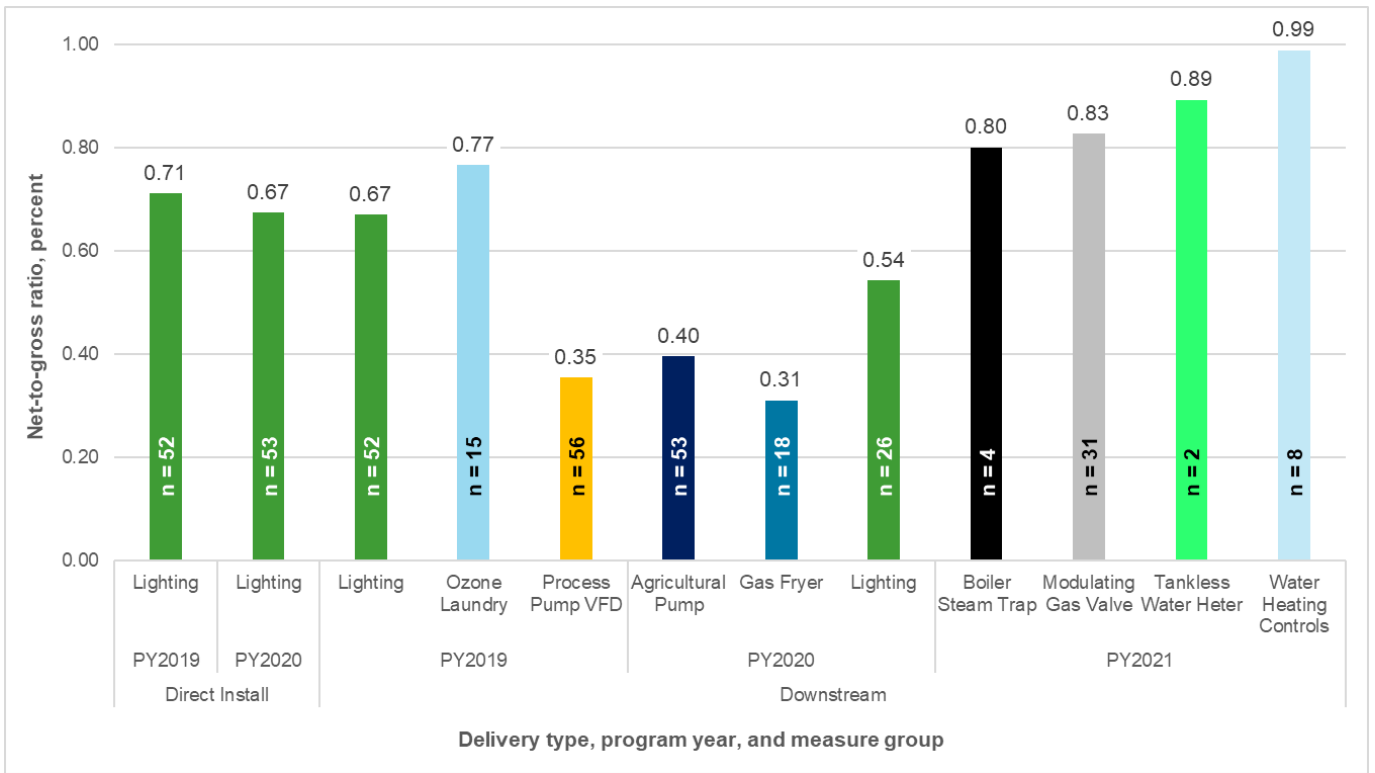


Figure 3-2 Commercial measure group NTGRs and number of participants in PY2019 to PY2021 by delivery type

### 3.3 Net to gross ratio calculation

To accurately determine the overall Net to Gross Ratio (NTGR) for both Hard-to-Reach (HTR) and non-HTR customers, we employed a domain analysis approach across various programs and years within the CPUC residential and commercial portfolios. This methodology is particularly effective as it utilizes the case weight of each observation to extrapolate sample results to the broader program participant population. Here, the case weight represents the number of customers a particular sample point corresponds to within the overall population. In our context, a sample point refers to a unique combination of a customer and a specific measure, such as a residential smart thermostat measure from Program Year (PY) 2020.

Upon calculating the case weight, we proceeded with a ratio analysis encompassing all relevant studies. This analysis involved calculating the total weighted y-variable (measure level net savings) and dividing it by the total weighted x-variable (measure level tracking savings). It's important to note that measure level net savings are derived by adjusting the measure level tracking savings by the evaluated attribution score, which reflects 1 minus the free ridership rate. For a given building sector, delivery type, and HTR status, the overall NTGR is computed using the following formula:

$$Overall\ NTGR = \frac{total\ weighted\ y\ variable}{total\ weighted\ x\ variable} = \frac{\sum weight \times NTGR \times claimed\ savings}{\sum weight \times claimed\ savings}$$

In this calculation, energy savings, whether in kWh or Therm, are converted to MMBtu for uniformity. The tracking savings (x-variable) are also converted to MMBtu, ensuring a consistent value across different fuel types. The weighted x-variable



thus becomes the product of the site weight and the claimed MMBtu savings. Similarly, the y-variable, or the estimated savings value for the sample, is calculated as the product of the NTGR, site weight, and claimed MMBtu savings.

Additionally, we computed the corresponding relative precision for each NTGR estimate. This step is critical as it ensures the reliability and accuracy of our NTGR calculations, providing a robust foundation for subsequent analysis and decision-making. Because the sample was originally selected without regard to HTR status, we had no control over the precision values and some of them are above 10%.



## 4 RESULTS AND FINDINGS

### 4.1 Residential

The coalesced results of the cross-program NTGRs for residential program participants in the sample of PY2019-2021 programs that were previously evaluated can be found in Table 4-1. All of the residential NTGR values have a relative precision of  $\pm 5\%$  at the 90% confidence interval.

**Table 4-1. Coalesced cross-program residential NTGRs**

Delivery Type	NTGR (n)		Statistically Significant
	HTR	Non-HTR	
Direct Install incl. SCTs	0.86 $\pm$ 0.04 (1,663)	0.85 $\pm$ 0.02 (3,338)	-
Direct Install w/o SCTs	0.89 $\pm$ 0.02 (769)	0.87 $\pm$ 0.02 (1,023)	No
Downstream*	0.72 $\pm$ 0.02 (995)	0.67 $\pm$ 0.01 (3,491)	Yes

\* All evaluated residential downstream rebates were for SCTs.

The residential NTGRs presented above—along with their corresponding error bars—are shown in a chart contained in Figure 4-1. The following conclusions can be drawn from these results:

1. For residential direct-install customers, there is strong evidence that the NTGR for all participants is about 90% and that, in aggregate, there is not a statistically significant difference between NTGRs of the HTR and non-HTR participants.
2. For downstream rebate customers who purchased SCTs, there is a statistically significant difference between the HTR and non-HTR customers of 5%.

**Figure 4-1. Coalesced residential cross-program NTGRs for direct install and downstream rebate delivery types**



\* All evaluated residential downstream rebates were for SCTs.

The figure shows that, for all direct install results, the mean NTGR estimates of HTR groups are not significantly higher than those of non-HTR. The NTGR value of HTR is  $0.89 \pm 0.02$ , while the NTGR of non-HTR is  $0.87 \pm 0.02$ . The error bars for HTR and non-HTR overlap, indicating no significant difference between the two groups, even though HTR group has a slightly higher NTGR than non-HTR customers. The residential direct install results contradict our first assumption that:

- For residential sector, a higher NTGR of 0.85 for HTR customers served through DI compared to non-HTR customers served through DI delivery channels.

The results suggest a NTGR of 0.90 for both HTR and non-HTR in direct install programs but do not support the assumption that HTR groups have a higher NTGR than non-HTR customer in direct install programs.

For downstream programs, the average NTGR estimates of HTR groups are higher than those of non-HTR. The NTGR value of HTR is  $0.72 \pm 0.023$  compared to the NTGR of non-HTR as  $0.67 \pm 0.012$ , indicating a significant difference between the two groups. The residential downstream results provide support to our second hypothesis that for SCT records:

- A higher NTGR for HTR customers served through downstream compared to non-HTR customers served through downstream delivery channels.

The results suggest that HTR groups in residential downstream programs have higher NTGR than non-HTR customers for SCT records.

## 4.2 Commercial

The coalesced results of the cross-program NTGRs for commercial program participants in the sample of PY2019-2021 programs that were previously evaluated can be found in Table 4-2.

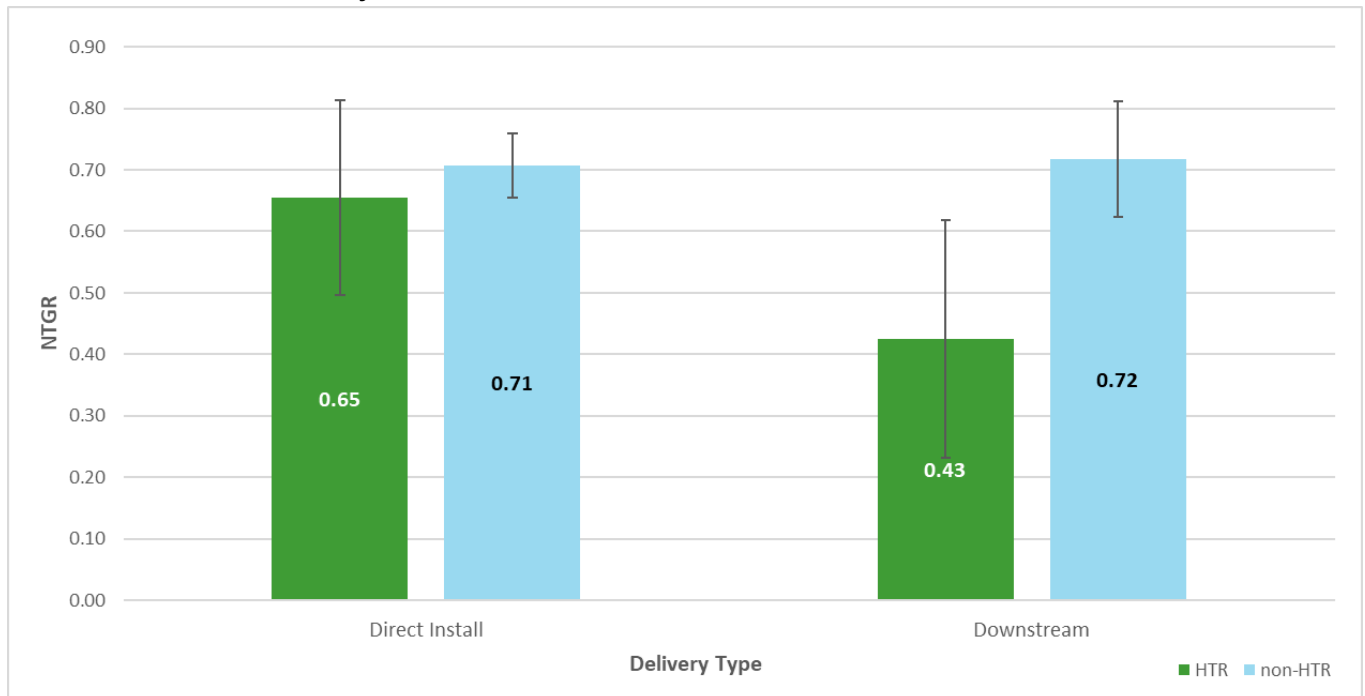
**Table 4-2. Coalesced cross-program commercial NTGRs**

Sector	Delivery Type	NTGR (n)		Statistically Significant Difference
		HTR	Non-HTR	
Commercial	Direct Install	0.65 ± 0.16* (10)	0.71 ± 0.05 (94)	-
	Downstream	0.43 ± 0.19* (22)	0.72 ± 0.09* (244)	Yes*

\*The relative precision of value(s) outside of the ±10% threshold

The results of the commercial section can be visualized in Figure 4-2, which depicts the comparison of NTGR between non-HTR and HTR based on the commercial evaluation survey results between PY2019 to 2021 from Quantum and DNV studies, stratified by delivery type (direct install and downstream). Note that, unlike the residential results, as shown in Table 4-1, not all the NTGR values are within a ±10% relative precision at the 90% confidence interval, especially the NTGR estimate of 0.43 for downstream HTR with a 45% relative precision, indicating the non-residential results are not as robust as residential results and that we may not be able to draw anything conclusive from the results.

**Figure 4-2. Coalesced non-residential cross-program NTG ratios based on PY2019 to 2021 evaluation data for direct install and downstream delivery.**



There are no gas savings for commercial direct install customers in this study because only lighting measures were installed. The average NTGR estimates of non-HTR groups (0.71) are higher than that of HTR (0.65). The NTGR value of HTR is 0.65 ± 0.1158 compared to the NTGR of non-HTR as 0.71 ± 0.052. Notably the error bars for HTR and non-HTR overlap, suggesting no significant difference between the two groups. Based on the commercial DI program results, the NTGR for



HTR customers is lower than the 0.85 NTGR default used for DI HTR customers. The commercial direct install results do not support our first hypothesis that:

- For commercial sector, a higher NTGR of 0.85 for HTR customers served through DI compared to non-HTR customers served through DI delivery channels.

It may be reasonable to have a higher default NTGR for the residential DI program, where the NTGR is 0.85 instead of the DI default agnostic NTG of 0.55, but this does not appear to be the case for commercial DI NTGR, which had a default value of 0.6.

For downstream programs, all of the NTGR estimates are outside of the  $\pm 10\%$  relative precision range, because the sample size was not large enough given the relatively large NTGR variation within the programs we studied. The NTGR value for HTR has relatively high relative precision, suggesting the value is not robust enough given the survey results in past three years. For downstream program, even though the NTGR estimates for HTR and non-HTR do not overlap, this does not guarantee a significant difference due to small sample size and large relative error.

The commercial downstream results do not provide support to our second hypothesis that:

- A higher NTGR for HTR customers served through downstream compared to non-HTR customers served through downstream delivery channels.

We do not see a significant difference between the NTGR between HTR and non-HTR groups and the NTGR of non-HTR can be higher than that of HTR. The DI programs NTGR of residential is higher than that of commercial, suggesting the commercial customers may be more aware of energy efficiency measures than residential customers. There are multiple reasons that can lead to this.

The classification of HTR and non-HTR is not accurate enough for commercial participants. Compared to residential participants HTR definition, there is a business size criterion that prescribes the max number of employees or annual energy usage. The information about number of employees is not available. The annual energy usage is based on customer's billing data. The classification was conducted at the account level, not the business level. For example, a strip mall is built as a collection of up to ten locales that are 2,000 sq.ft. each, and each has its own meter and electric account. If a large fast-food location takes four of these locales, it will have four separate account numbers. If viewed separately, a couple of these accounts could be considered low energy use accounts. The energy efficiency measures may be associated with one of these accounts. In addition, information about whether the facility of a commercial customer is rented or not is not available. We also noticed that accounts that meet the commercial HTR criteria may not be "in the spirit" of HTR. Locations such as national coffee chains, each one may exhibit low energy use or be located in a disadvantaged area, but whether they are HTR is debatable, due to the fact that they have access to energy use resources provided by their brand, and they do not have autonomy to make energy use decisions on their own.

Therefore, the classification of commercial customers is much more challenging compared to residential customers classifications due to limitations in data availability and small sample size, which leads to less robust results compared to residential NTGR results.

## 5 CONCLUSIONS

The main objective of this study was to estimate and compare the net-to-gross ratio (NTGR) for residential and commercial HTR vs. non-HTR customers in direct install and downstream programs in program year 2019 to 2021. The NTGR is a measure of the effectiveness of the program in achieving energy savings that are attributable to the program intervention, rather than other factors such as free ridership, spillover, or market effects. The NTGR is calculated as the ratio of net savings (program savings minus free ridership plus spillover) to gross savings (program savings).

The study employed a data analytics approach that collected and merged data from multiple resources including evaluation survey results, tracking data, customer information data and so on for different building sectors and program delivery types. The coalesced results of the cross-program NTGRs for residential program participants in the sample of PY2019-2021 programs that were previously evaluated can be found in Table 5-1. Notes to consider include:

- All the residential NTGR analysis results have a relative precision of  $\pm 5\%$  at the 90% confidence interval.
- Most of the commercial NTGR analysis results were outside of the  $\pm 10\%$  relative precision threshold.
- Since most of the residential customers surveyed during these evaluations had received smart communicating thermostats (SCTs), the results are presented both with and without those claims. This was done because multiple targeted evaluations regarding SCTs were previously performed and yielded NTGRs specific to SCTs for both direct install and downstream rebate programs; these were subsequently adopted in a DEER resolution.
- Only those NTGR results that excluded SCT claims were considered for the recommendations presented in Section 1 Executive Summary.

**Table 5-1. Coalesced NTGRs for evaluated PY2019-2021 direct install programs by sector**

Delivery Type	Sector	Smart Communicating Thermostat Participants	NTGR $\pm$ Error Band and Survey Count			Statistically Significant Difference for HTR Customers
			HTR	Non-HTR	Overall	
Direct Install	Residential	Excluded	0.89 $\pm$ 0.02 (769)	0.87 $\pm$ 0.02 (1,023)	0.88 $\pm$ 0.02 (1,792)	No
		Included	0.86 $\pm$ 0.04 (1,663)	0.85 $\pm$ 0.02 (3,338)	0.85 $\pm$ 0.02 (5,001)	No
	Commercial	None	0.65 $\pm$ 0.16 <sup>†</sup> (10)	0.71 $\pm$ 0.05 (94)	0.70 $\pm$ 0.07 (104)	No
Downstream Rebate	Residential	Excluded	N/A (0)	N/A <sup>†</sup> (1)	N/A <sup>†</sup> (1)	N/A <sup>†</sup>
		Almost Exclusively	0.72 $\pm$ 0.02 (995)	0.67 $\pm$ 0.01 (3,491)	0.67 $\pm$ 0.01 (4,486)	Yes
	Commercial	None	0.43 $\pm$ 0.19 <sup>†</sup> (22)	0.72 $\pm$ 0.09 <sup>††</sup> (244)	0.72 $\pm$ 0.10 <sup>††</sup> (266)	Yes <sup>††</sup>

\* Since SCTs delivered through direct-install programs have their own NTG\_ID in DEER (NTGR=0.95), they were excluded from the analyses used to answer research questions.

\*\* SCTs were purchased by all but one of the residential downstream program participants surveyed during the PY2019-2021 evaluations. SCTs delivered through downstream programs also have their own NTG\_ID in DEER (NTGR=0.50).

<sup>†</sup> Sample size too small to report.

<sup>††</sup> The relative precision of the resulting NTGR is outside of the  $\pm 10\%$  threshold.





The results of the commercial sector analyses are not as robust as those of residential sector due both to data limitations in participant classification and smaller sample sizes. To better quantify the NTGR for commercial participants, future efforts may be warranted to not only reach a higher number of participants in the NTG survey, but also to better classify and track the customer characteristics that are used as the criteria to identify HTR participants in future program tracking data.



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