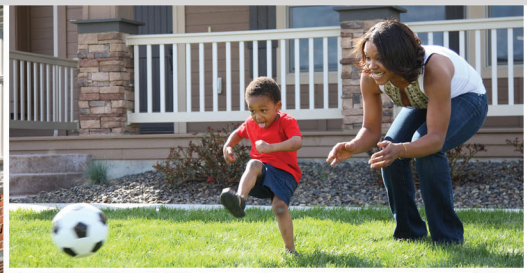
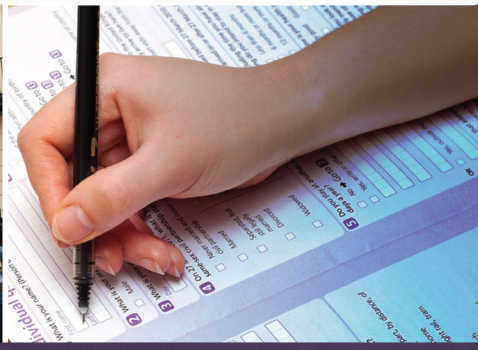
Final Report

FY 2015 Utility Allowance Comparison Study

Improper Payment for Quality Control for Rental Subsidy Determination Study





FINAL

Final Report

FY 2015 Utility Allowance Comparison Study

Improper Payment for Quality Control for Rental Subsidy Determination Study

Prepared for:

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August 31, 2016

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Executive Summary

The U.S. Department of Housing and Urban Development's (HUD) Quality Control (HUDQC) Study provides national estimates of the extent, severity, costs, and sources of errors in tenant subsidies for the largest housing programs administered by the Office of Housing and the Office of Public and Indian Housing (PIH). In conjunction with the HUDQC Study, the Utility Allowance Comparison (UAC) Study was designed to measure the extent of utility allowance subsidy error, relative to actual tenant-paid utility expenses. Additionally, it aimed to evaluate the accuracy and usefulness of the HUD Utility Schedule Model (HUSM). Its focus is to provide national estimates of the dollars spent on allowances by PHAs/Projects and on utility expenses by households, and to measure the extent to which these amounts differ. The national estimates provided in this report cover Fiscal Year (FY) 2015 for programs administered by the Office of Housing and the Office of PIH.

HUD administers its rental housing assistance programs through third-party program administrators, including PHAs, public and private project owners, and contracted management agents. In the programs examined, eligible tenants receive a utility allowance, in the form of a tenant rent reduction, to offset utility costs for which the household is financially responsible. PHAs/Projects set utility allowances using a variety of models and are required to update them when utility rates increase by at least 10 percent. Allowances consider unit characteristics and are equal to an estimate of utility costs for reasonable, energy-conservative use to sustain a healthy living environment. The estimate is not determined on a household by household basis and is not intended to equal a given household's actual out-of-pocket costs. However, the utility allowance estimate, on average, should reasonably compensate for tenant-paid costs across households. When evaluating allowances, this study refers to "subsidy error" as any utility allowance amount that differs from, or does not match, a household's out-of-pocket utility costs.

A. Methodology

Study Standards. Standardized concepts and rules were established to ensure that the study objectives were fulfilled consistently across all households. We invited program experts to participate in establishing and reviewing the standards used in this study.

The Sample. The basis of the study sample was the FY 2015 HUDQC Study sample and covered the largest housing programs:

- PHA-administered Public Housing (Public Housing)
- PHA-administered Section 8
  - Moderate Rehabilitation
  - Housing Choice Voucher program
- Office of Housing-administered projects (Owner-administered)
  - Section 8 New Construction/Substantial Rehabilitation, Loan Management, and Property Disposition
  - Section 202 Project Rental Assistance Contracts (PRAC)
  - Section 202/162 Project Assistance Contracts (PAC)
  - Section 811 PRAC

The sample excluded those households from the HUDQC Study sample that did not receive a utility allowance in FY 2015 and did not have tenant-paid utility expenses during this time. Public Housing flat rent households were also excluded from the study. The nationally representative sample included 1,628 households from 374 projects in the United States and Puerto Rico that received housing assistance through Public Housing, PHA-administered Section 8, and Owner-administered programs. Among these households, 436 (27 percent) from 190 projects had complete data to calculate utility allowances and expenses, were considered respondents, and were used to produce reliable analytical findings.

Weighting. The basis of the analytical weights were the FY 2015 HUDQC Study weights. Population counts per program were calculated based on the assisted housing universe files provided by HUD in July 2015 to compile weights for the HUDQC Study. The sum of the HUDQC Study weights among the households in the study's sample represented those in the HUD-assisted population who have a utility allowance or utility expenses, or the UAC Study's estimated population of interest.

HUDQC Study weights were adjusted using a nonresponse adjustment factor to mitigate nonresponse bias. The adjustment distributed the HUDQC Study weights of the nonrespondents to the respondents so that the sum of the study's analytical weights equaled the estimated population of interest. Weighted estimates provided herein are nationally representative and reliable.[1]

The Data Collection Process. The data collection effort included creating more than 20 data collection instruments, contacting and obtaining information from PHA/Project staff and utility companies, and hiring and training 73 field interviewers. Field interviewers obtained data from tenant files and interviewed tenants using computer-assisted personal interviewing software developed for this study. The automated data collection process included built-in consistency and edit checks that prompted interviewers to probe inconsistent and anomalous responses. Collected data were electronically transferred daily to study headquarters, and copies of paper documents from which data were collected were sent to study headquarters via overnight mail. Received data were reviewed and, where applicable, third-party data requests related to utility consumption and rates were processed by study headquarters.

Data Analysis and Error Determination. Three main utility metrics, as defined in Exhibit ES-1, were calculated for each responding household in the sample, using the information reported by the PHA/Project, household, and third-party utility companies. Subsidy errors were calculated by subtracting the Utility Expenditure from the utility allowance metrics—either Actual or HUSM. A discrepancy of $2 or less between the expenditure and allowance was not counted as an error. This $2 differential was used to eliminate rounding differences and minor calculation discrepancies that have little effect on program-wide subsidy errors.

[1] *Appendix B: Weighting Procedures and Reliability of Estimates* details the weighting methodology and an additional analysis that tested the reliability of presented estimates.

Exhibit ES-1
Definition of Main Utility Metrics

Utility Metric	Definition
Actual Utility Allowance	The monthly utility allowance amount on Forms HUD-50058/50059
Utility Expenditure	The average monthly utility cost incurred by the household
HUSM Utility Allowance	The monthly utility allowance amount estimated by the HUSM

B. Major Findings

National Utility Metric Estimates.[2] Analysis of the FY 2015 project-provided information, tenant files, household interviews, and data from third-party utility companies indicated that:

- PHAs/Projects provided an estimated $4.3 billion in utility allowances to assisted households in FY 2015. On average, households received a monthly Actual Utility Allowance of $105.
- Assisted households paid an estimated $4.8 billion out of pocket annually for tenant-purchased utilities. The monthly Utility Expenditure for households was $116, on average.
- The HUSM would have provided households with an estimated $4.7 billion in allowances to help cover utility expenses in FY 2015. Households would have received $113, on average, per month as a HUSM Utility Allowance.

Regardless of the utility metric, annual costs were typically highest in the PHA-administered Section 8 program, followed by Owner-administered and Public Housing programs. Exhibits ES-2 and ES-3 summarize this information.

Exhibit ES-2
Total Annual Estimates of Utility Metrics (in $1,000s)

Administration Type	Actual Utility Allowance	Utility Expenditure	HUSM Utility Allowance
Public Housing	$650,815	$757,068	$690,639
PHA-administered Section 8	$2,870,330	$3,188,736	$3,162,382
Total PHA-administered	$3,521,146	$3,945,804	$3,853,021
Owner-administered	$822,283	$817,070	$817,577
Total	**$4,343,429**	**$4,762,875**	**$4,670,598**
95% Confidence Interval	**±$359,570**	**±$392,959**	**±$300,137**

Data in this exhibit are weighted.
Note: Numbers may not add up exactly due to rounding.

[2] Estimates in subsequent tables should be viewed in conjunction with 95 percent confidence intervals.

Exhibit ES-3
Average Monthly Estimates of Utility Metrics

Administration Type	Actual Utility Allowance	Utility Expenditure	HUSM Utility Allowance
Public Housing	$113	$131	$120
PHA-administered Section 8	$117	$130	$128
Total PHA-administered	$116	$130	$127
Owner-administered	$76	$75	$75
Total	**$105**	**$116**	**$113**
95% Confidence Interval	**±$9**	**±$10**	**±$7**

Data in this exhibit are weighted.

National Subsidy Error Estimates. All summary error estimates represent the summation of net household-level errors, meaning that a household was determined to have a net subsidy underpayment error, no error,[3] or a net subsidy overpayment error separately for the Actual Utility Allowance and the HUSM Utility Allowance. Major findings are as follows:[4]

Actual Utility Allowance

The Actual Utility Allowance was the monthly utility allowance amount on Forms HUD-50058/50059. Exhibit ES-4 provides annual total estimates of Actual Utility Allowance subsidy error, and Exhibit ES-5 provides the monthly average Actual Utility Allowance subsidy error estimates, each by program type.

- The average monthly underpayment was $27.17 ($326 annually). Multiplying and weighting the $326 by the approximately 3.43 million households represented by the study sample resulted in an overall underpayment of approximately $1.12 billion per year.
- The average monthly overpayment was $16.98 ($204 annually). Multiplying and weighting the $204 by the approximately 3.43 million households represented by the study sample resulted in an overall annual overpayment of approximately $0.70 billion per year.
- **Aggregate gross subsidy error of $1.82 billion annually**. When combined, the average gross erroneous payment was $44 ($27.17 + $16.98). The study found that the total annual gross subsidy error was approximately $1.82 billion ($1.12 billion + $0.70 billion).
- **Aggregate net subsidy error of $0.42 billion annually**. Underpayment and overpayment errors partly offset each other. The net overall average monthly subsidy error was -$10 (-$27.17 + $16.98). The study found that the total annual net subsidy error was approximately -$0.42 billion per year (-$1.12 billion - $0.70 billion).

[3] No error in this context refers to a subsidy match where the allowance is within ±$2 of the Utility Expenditure.

[4] National annual totals in the text and exhibits were calculated using exact values and were weighted. Although household-level numbers are presented, using them to calculate national annual totals will result in different amounts due to both rounding and weighting.

Exhibit ES-4
Total Annual Estimates of Actual Utility Allowance Subsidy Error (in $1,000s)

Administration Type	Subsidy Underpayment	Subsidy Overpayment	Gross Erroneous Payment	Net Erroneous Payment
Public Housing	$194,920	$88,634	$283,554	-$106,286
PHA-administered Section 8	$760,593	$441,931	$1,202,524	-$318,662
Total PHA-administered	$955,513	$530,565	$1,486,078	-$424,948
Owner-administered	$164,326	$169,166	$333,492	$4,840
Total	**$1,119,839**	**$699,731**	**$1,819,571**	**-$420,108**
95% Confidence Interval	**±$258,739**	**±$184,086**	**±$277,222**	**±$353,291**

Data in this exhibit are weighted.
Note: Numbers may not add up exactly due to rounding.

Exhibit ES-5
Average Monthly Estimates of Actual Utility Allowance Subsidy Error

Administration Type	Subsidy Underpayment	Subsidy Overpayment	Gross Erroneous Payment	Net Erroneous Payment
Public Housing	$34	$15	$49	-$18
PHA-administered Section 8	$31	$18	$49	-$13
Total PHA-administered	$31	$17	$49	-$14
Owner-administered	$15	$16	$31	$0.45
Total	**$27**	**$17**	**$44**	**-$10**
95% Confidence Interval	**±$6**	**±$4**	**±$7**	**±$9**

Data in this exhibit are weighted.

HUSM Utility Allowance

The HUSM Utility Allowance was the monthly utility allowance amount estimated by the HUSM. Exhibit ES-6 provides annual total estimates of HUSM Utility Allowance subsidy error, and Exhibit ES-7 provides the monthly average HUSM Utility Allowance subsidy error estimates, each by program type.

- The average monthly underpayment was $24.38 ($293 annually). Multiplying and weighting the $293 by the approximately 3.43 million households represented by the study sample resulted in an overall underpayment dollar error of approximately $1.00 billion per year.
- The average monthly overpayment was $22.15 ($266 annually). Multiplying and weighting the $266 by the approximately 3.43 million households represented by the study sample resulted in an overall annual overpayment dollar error of approximately $0.91 billion per year.
- **Aggregate gross subsidy error of $1.92 billion annually.** When combined, the average gross erroneous payment was $47 ($24.38 + $22.15). The study found that the total annual gross subsidy error was approximately $1.92 billion ($1.005 billion + $0.913 billion).

- **Aggregate net subsidy error of $0.09 billion annually.** Underpayment and overpayment errors partly offset each other. The net overall average monthly subsidy error was -$2 (-$24.38 + $22.15). The study found that the total annual net subsidy error was approximately -$0.09 billion per year (-$1.00 billion - $0.91 billion).

Exhibit ES-6
Total Annual Estimates of HUSM Utility Allowance Subsidy Error (in $1,000s)

Administration Type	Subsidy Underpayment	Subsidy Overpayment	Gross Erroneous Payment	Net Erroneous Payment
Public Housing	$192,480	$126,481	$318,961	-$65,999
PHA-administered Section 8	$641,354	$615,023	$1,256,377	-$26,330
Total PHA-administered	$833,834	$741,504	$1,575,338	-$92,330
Owner-administered	$171,145	$171,634	$342,779	$490
Total	**$1,004,978**	**$913,138**	**$1,918,117**	**-$91,840**
95% Confidence Interval	**±$206,992**	**±$163,231**	**±$289,461**	**±$234,930**

Data in this exhibit are weighted.
Note: Numbers may not add up exactly due to rounding.

Exhibit ES-7
Average Monthly Estimates of HUSM Utility Allowance Subsidy Error

Administration Type	Subsidy Underpayment	Subsidy Overpayment	Gross Erroneous Payment	Net Erroneous Payment
Public Housing	$33	$22	$55	-$11
PHA-administered Section 8	$26	$25	$51	-$1
Total PHA-administered	$27	$24	$52	-$3
Owner-administered	$16	$16	$32	$0.05
Total	**$24**	**$22**	**$47**	**-$2**
95% Confidence Interval	**±$5**	**±$4**	**±$7**	**±$6**

Data in this exhibit are weighted.

Overall, the following conclusions can be drawn:

- No statistically significant results were found between the Actual Utility Allowance and the Utility Expenditure or between the HUSM Utility Allowance and the Utility Expenditure. On average, allowances—either Actual or HUSM—in FY 2015 were not statistically different in value from the amount paid out of pocket for utility costs.
- Neither form of the utility allowance—either Actual or HUSM—produced subsidies that were statistically significantly closer to households' Utility Expenditure than the other.
- Annual total gross erroneous payment estimates indicated that both the Actual and HUSM Utility Allowance did not entirely subsidize the Utility Expenditure on a case by case basis. Monthly average estimates of net erroneous payments indicated that under and over subsidy levels offset each other to provide Actual and HUSM Utility Allowances that reasonably covered Utility Expenditures for the population as a whole.

- Public Housing properties provided allowances on a monthly basis that were most discrepant with households' out-of-pocket expenses, whereas the PHA-administered Section 8 program had the largest total annual subsidy errors.

C. Recommendations

Findings from the study suggest general actions or policies that should be considered with respect to utility allowances. We present the following recommendations that may decrease utility allowance subsidy error rates in HUD programs, based on insights we have gathered during this study.

1. **Focus Utility Allowance Modification Efforts on Electricity.** If HUD would like to have more alignment between utility allowances and out-of-pocket utility expenses, resources should be dedicated to aligning electricity subsidies. The majority of households with a utility allowance have an allowance to cover tenant-paid electric costs, and the electric component showed large gross differences and net differences as an under subsidy overall. HUD should focus on implementing changes to electric utility allowance levels, in either the HUSM tool or in regulations that surround other utility allowance determination methods, prior to evaluating allowances for other utilities. HUD should also consider implementing these changes on a program-specific basis. Owner-administered properties are typically newer structures built under modern and stringent energy codes, and those households may not consume as much electricity. Conversely, Public Housing properties were typically built prior to stringent energy codes and may consume more electricity. Also, HUD regulations prevent Public Housing households from receiving an allowance to cover air conditioning, but tenants may be required to pay out of pocket for the electricity to fuel the air conditioning. By providing assisted households with electric utility allowance levels that better reflect out-of-pocket expenses, the amount of subsidy error associated with utility allowances will likely decrease.
2. **Implement HUSM Improvements and Trainings.** Study findings showed that current HUSM users are producing incorrect allowances via the tool. HUD should consider making improvements to the HUSM tool to increase the accuracy of data entry and calculated utility allowances. Improvements may include:
   - Updating the tool to better align with utility rate industry norms
   - Updating the tool to include currently excluded characteristics of units (e.g., six bedrooms or larger) rented by the assisted housing population
   - Developing location options that are site-specific for Public Housing and Owner-administered properties

   In addition, HUD should consider providing HUSM technical training and assistance to PHA/Project staff to supplement the HUSM instruction document already available. Web-based forums and interactive trainings focused on best practices and troubleshooting to accurately use the HUSM to produce allowances would provide comprehensive support to HUSM users and potentially increase the use of the tool. Accurate and increased use of an improved HUSM tool would result in more consistent and transparent allowances being provided to households nationally.

3. **Perform Project-level Reviews and Approvals of Utility Allowance Levels.** HUD should consider requiring review and approval of utility allowance levels by HUD-contracted compliance agencies for all HUD-assisted programs. In addition, PHAs/Projects should be held accountable for supplying concrete documentation of utility allowance determination methods and data. Analytical findings showed that Owner-administered programs provided allowances to households that were closest to actual tenant-paid utility costs, and this program type is currently required to submit a utility analysis and documentation for review and approval prior to implementing changes in utility allowance levels. PHA-administered programs do not require utility allowance review and verification. Implementing reviews is essential to improving accountability in updating allowances in a timely manner, with respect to utility rate changes, and is likely a key factor in reducing subsidy error.
4. **Create Utility Database.** HUD should consider developing a utility database to systematically collect utility information, such as unit characteristics, location, and utility consumption from PHAs/Projects. Data collected could be used to inform HUSM modifications, accessed by PHAs/Projects to calculate utility allowances via their preferred method, and analyzed to estimate conservative use thresholds. HUD may also consider forming relationships with Federal and State agencies, organizations, and utility companies to capture data not easily obtained from PHAs/Projects in order to develop a comprehensive and robust utility database. The development of the database should mitigate, to the extent possible, the burden placed on PHAs/Projects and tenants in supplying utility information and should consider biases that may exist by partnering with external entities (e.g., the largest utility companies) that are not completely representative of providers nationwide. The development should also be coupled with policies aimed at addressing utility allowance subsidy error.

In addition to providing general program recommendations, we seek to improve the UAC Study that provides estimates related to utility allowances and utility expenditures. The current methodology used by ICF to conduct the study is contained within the parameters of current study objectives and the coupling of the study with the HUDQC Study. The following recommendations serve to expand the usefulness of the data collected, support HUD's research goals, and improve the overall efficiency of ongoing studies.

5. **Expand Methodology to Mitigate Nonresponse by Utility Companies.** Twenty-seven percent of the households sampled were used to produce analytical estimates (respondents); the remaining 73 percent had missing data that prevented the calculation of a utility metric (nonrespondents). For the majority of nonrespondents, data were unavailable for Utility Expenditure calculations. To improve data quality and increase response rates, the current data collection methodology could be expanded to include incentives to tenants to provide accurate and complete information during the household interview. An incentive initiative may improve the availability and accuracy of information needed for utility companies to fulfill data requests, such as utility provider, account number, and account holder name. Higher incentive levels could also be implemented to ask households to obtain the required consumption and rate information by accessing their online utility account in advance of the interview, alleviating the need for a study headquarters request.

To help mitigate instances where utility companies do not provide a response to requests for data to calculate the Utility Expenditure, study methodology could be expanded to include targeted, initial outreach to the largest utility companies servicing sampled households prior to field data collection. Outreach may include fact sheets detailing the types of data that will be requested, the use of the requested data, and the impact and benefit of subsequent study findings. Additionally, HUD could establish relationships with the largest utility companies to help in outreach efforts. Obtaining buy-in from larger entities would likely increase response rates, as well as likely decrease the length of time it takes to obtain complete consumption data among those that are already responders.

6. **Incorporate Additional Objectives in the UAC Study.** The current study research questions sought to understand which methods PHAs/Projects used to set their utility allowance levels, as well as to determine the amount of subsidy error associated with current allowances compared to tenant-paid expenditures. HUD should expand these objectives to include a cost-benefit analysis of the endorsed methods. The current methodology could be leveraged to determine the benefit (i.e., reduction in subsidy error) of each method, and current data collection efforts could be expanded to obtain information on the cost to the PHA/Project or HUD in calculating utility allowances for a given year. This analysis would better detect the best models for balancing accuracy and administration burden to inform policy changes.

   HUD may also consider expanding the objectives of the study to include an analysis of assisted households' level of utility consumption. Because utility allowances are intended to help cover utility use of an energy-conservative household, it is important to understand whether subsidy errors are a result of households consuming more in utilities than what is deemed conservative or rather an unrealistically low utility allowance. The investigation could draw upon current study methodology, but may require either access to conservative use thresholds or the development of assumptions to define the conservative use threshold.

7. **Conduct the UAC Study as a Separate Task From the HUDQC Study.** HUD may consider conducting the UAC Study as an investigation separate from the HUDQC Study. Decoupling the two studies would have the following advantages:

   - A separate sampling methodology could be designed to more directly target the population of interest, or those households that receive a utility allowance. This would have the impact of providing a more efficient sample to address HUD's research questions and to achieve a specific level of statistical precision. The methodology could include an analysis of the propensity for nonresponse, or missing data, prior to sample selection to proactively mitigate low response rates.
   - The length of the household interview and associated tenant burden would be decreased because tenants would not be asked questions about their household income, assets, expenses, and composition in addition to utility questions.

I. Introduction

The U.S. Department of Housing and Urban Development (HUD) provides housing subsidies to Multifamily project owners and Public Housing Authorities (PHAs) to administer housing assistance primarily to low-income households. The Office of Public and Indian Housing (PIH) and the Office of Housing provide funding for rental subsidies and utility allowances through Public Housing, PHA-administered Section 8 Housing Choice Voucher and Moderate Rehabilitation programs (PHA-administered Section 8), and the Owner-administered Section 8 project-based programs. Collectively, these programs are part of HUD's Rental Housing Assistance Programs (RHAP). They are administered by more than 4,000 intermediary agencies and provide affordable housing for approximately 4.97 million households (i.e., 1.1 million though Public Housing, 2.2 million through the PHA-administered Section 8 program, and 1.6 million through project-based programs).[5]

An estimated 3.43 million households that were enrolled in HUD's RHAP in Federal Fiscal Year (FY) 2015 received or should have received a utility allowance. Approximately, 2.05 million of these households received assistance through PHA-administered Section 8, and 0.48 million and 0.90 million received assistance through Public Housing and Owner-administered programs, respectively.

Under the Improper Payments Elimination and Recovery Act (IPERA), signed into law in 2010, and the guidance of the Office of Management and Budget (OMB), agencies assess all programs they administer and identify those that may be susceptible to improper payments. An improper payment is any payment that should not have been made or that was made in an incorrect amount. In FY 2014, $32 billion of HUD's total payments were attributed to HUD's rental assistance programs. These programs constitute a significant amount of HUD's total payments and continue to be assessed as being at high risk of significant improper payments.[6]

ICF International (ICF) was contracted to perform the Improper Payment for Quality Control for Rental Subsidy Determination Studies to support HUD's continued dedication to reducing the amount of annual improper payments in its programs and to comply with the reporting and administrative requirements under IPERA. To expand upon the work previously conducted under these studies and include new research objectives to establish priorities for future corrective action, ICF and The Nelrod Company (Nelrod)[7] were contracted to perform the inception Utility Allowance Comparison (UAC) Study in conjunction with the Quality Control (HUDQC) Study.

The UAC Study seeks to ascertain whether utility allowances that were provided to households receiving assistance through PHA-administered (i.e., Public Housing, Section 8 Housing Choice Voucher, and Section 8 Moderate Rehabilitation) and Owner-administered programs in FY 2015 were reasonably accurate relative to actual tenant-paid utility costs. In addition, it aims to determine the usefulness and accuracy of the HUD Utility Schedule Model (HUSM) in setting utility allowance schedules. To fulfill these objectives, we collected data to determine and compare the three main metrics defined in Exhibit I-1.

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[5] U.S. Department of Housing and Urban Development. *Annual Report: FY 2015 Agency Financial Report*. Washington, DC: U.S. Department of Housing and Urban Development, 2015. pg. 12

[6] U.S. Department of Housing and Urban Development. *Annual Report: FY 2015 Agency Financial Report*. Washington, DC: U.S. Department of Housing and Urban Development, 2015. pg. 213

[7] Staff from ICF and from Nelrod herein are collectively referred to as study headquarters.

Exhibit I-1
Definition of Main Utility Metrics Relevant to the UAC Study

Utility Metric	Definition
Actual Utility Allowance	The monthly utility allowance amount on Forms HUD-50058/50059
Utility Expenditure	The average monthly utility cost incurred by the household
HUSM Utility Allowance	The monthly utility allowance amount estimated by the HUSM

This report examines a total of five research questions and outlines them in more detail in *Section III: Research Questions and Analytic Methods*. The sampling, data collection, data review and calculation activities all served to address these research questions. The main focus of this work commenced in September 2015, and involved collecting data in multiple stages and from multiple data sources and analyzing information that pertained to the main utility metrics to identify subsidy error and possible causes of error.

A. Organization of the Report

This report contains the following sections:

- Section I: Introduction
- Section II: Methodology
- Section III: Research Questions and Analytic Methods
- Section IV: Findings
- Section V: Recommendations
- Appendices
  - Appendix A: Nonresponse Considerations and Analysis
  - Appendix B: Weighting Procedures and Reliability of Estimates

II. Methodology

A. Study Standards

The UAC Study provides nationally representative estimates of the differences between utility allowances and actual utility costs incurred by assisted households during FY 2015. This study:

- Determined the actual allowances received by sampled households,
- Calculated the utility expenditures incurred by households, and
- Calculated the allowance the household would have received, according to the HUSM.

Standardized concepts and rules were established to ensure that the identification of information used to determine and calculate the utility metrics for the UAC Study were handled consistently across all households.

To ensure that the study objectives were fulfilled, a defined set of rules, or standards, were established to describe the procedures that would be followed, the rationale for the rules devised (where applicable), and the methodology for correctly implementing the standards. The standards used for the UAC Study can be found in the *Final FY 2015 Utility Allowance Comparison Study Methodology Report, Section II: Standards.*[8]

Key Terms. In order to calculate and compare utility metrics consistently, we defined three key concepts—*utilities*, *unit of interest*, and *financial responsibility*.

- **Utilities.** Utility components included in the definition of utilities are: electric, natural gas, fuel oil, propane/bottled gas, kerosene, coal, wood/wood pellets, water, sewer, and trash. Components not included in the definition are cable television, satellite television, subscription streaming services (e.g., Netflix, Hulu), Internet connection, and wireless cell phone costs. Other specialized components included the renting or financing of a range, microwave, or refrigerator, and other fees determined to be covered by utility allowances (e.g., city fees). Utility elements that were used when determining the average monthly allowance and expenditure for each utility include consumption, per unit consumed or flat cost rates, monthly/service fees, extra/surcharges, and taxes. Elements assessed on a household-specific level—such as late fees and activation fees—were not included; only those fees that apply to all households serviced by the utility company were included.
- **Unit of Interest.** Unlike earnings and held assets, utility allowances and expenses are tied to the characteristics of the rented unit and not to the household members residing in the unit. The level of subsidy and out-of-pocket costs may depend on the unit's geographic location; the structure type of the unit's building; the number of bedrooms in the unit; and the energy-efficiency of the unit on the basis of age, structural features, and appliances. The physical *unit of interest* was defined as the property occupied by the household according to the Forms HUD-50058/50059 (re)certification action selected for the HUDQC Study.[9]

[8] ICF International unpublished report to HUD dated November 25, 2015.

[9] For more information about the selection of the HUDQC Study Forms HUD-50058/50059 action, see the Final FY 2015 HUDQC Study Data Collection Standards, an ICF International unpublished report to HUD dated September 18, 2015.

- **Financial Responsibility.** *Financial responsibility* was defined as the utility component expenses incurred by the unit that either the household or someone outside of the household pays for, including the Low Income Energy Assistance Program (known as LIEAP) and/or Federal- and State-based utility assistance ICF International unpublished report to HUD dated November 25, 2015. programs, but excluding the PHA/Project.

Key Timeframes. Because the study required reviewing and comparing utility allowances and expenses that occurred in the past, it was necessary to use a consistent method for identifying the reference point on which to base the utility metrics' rate calculations. Furthermore, a time frame was established to produce reasonably accurate monthly averages of utility consumption since utility consumption can vary throughout the year due to seasonal variations.

- **Utility Rates Reference Date.** PHAs/Projects establish utility allowance amounts based on the utility rates at the time of the utility allowance initial determination or annual review. Therefore, it was important to select rates for the HUSM Utility Allowance and the Utility Expenditure calculations that replicate (to the extent possible) the rates used by the PHA/Project when determining Actual Utility Allowance amounts.

  The Utility Rates Reference Date was the point in time we used to select utility rates. The date was based on the following hierarchy:

  1. The effective date of the household's Form HUD-52667 (Allowances for Tenant-Furnished Utilities) or utility allowance worksheet, if it falls within FY 2015.
  2. The Forms HUD-50058/50059 effective date of the HUDQC Study selected action (or the date that the household's Actual Utility Allowance went into effect), if it falls within FY 2015.
  3. The effective date of the household's Form HUD-52667 (Allowances for Tenant-Furnished Utilities) or utility allowance worksheet that falls prior to October 1, 2014, but has been adjusted to fall within FY 2015.
  4. The Forms HUD-50058/50059 effective date of the HUDQC Study selected action (or the date that the household's Actual Utility Allowance went into effect) that falls prior to October 1, 2014, but has been adjusted to fall within FY 2015.

  If only current rates were available, we accepted them to mitigate nonresponse and adjusted the resulting average monthly HUSM Utility Allowance and the Utility Expenditure for the utility component accordingly. For utility components in which only current rates were available, we multiplied the utility component's average monthly allowance or cost by the inverse of the FY 2016 utility component by State-level factors[10] to account for changes between current rates and FY 2015 rates.

[10] HUD annually publishes Utility Allowance Factors for utility components by State for applicable Owner-administered properties to use to adjust their utility allowance level. These Utility Allowance Factors are intended to adjust allowances forward into FY 2016, relative to the changes in rates between fiscal years. By taking the mathematical inverse of the factor, we were able to adjust the calculations backward to FY 2015.

- **Utility Consumption Time Frame.** A year's worth of consumption data allowed the average monthly consumption used in Utility Expenditure calculations to reflect, to the extent possible, the ebbs and flows of utility use due to seasonal climate variations. We reviewed data sources for monthly consumption data from October 2014 to May 2016 to yield 12 months of information. If we were still not able to obtain a full 12 months of consumption data, we implemented procedures to approximate 12 months of consumption data. A minimum of eight months of actual consumption data were required for all utility components for a given household to be considered a respondent.

B. Sample and Subgroup

The UAC Study households were a subgroup of the HUDQC Study sample and included only those HUDQC Study households that had financial responsibility to pay for utilities in their unit. Households were considered as respondents or nonrespondents depending on whether the data that were needed to calculate the three utility metrics of interest (Actual Utility Allowance, Utility Expenditure, and the HUSM Utility Allowance) were complete or missing. Considerations related to project sampling, UAC Study subgroup, nonresponse considerations and analysis, and weighting are discussed in this subsection.

Project Sampling. The universe from which study headquarters drew the HUDQC Study sample included all assisted housing projects and households located in the continental United States, Alaska, Hawaii, and Puerto Rico. The sampling design required approximately equal allocations for the following three major program types and we sampled 200 projects from each:[11] Public Housing, PHA administered Section 8 (Vouchers and Moderate Rehabilitation), and Owner-administered Section 8 (including Section 202 Project Rental Assistance Contracts [PRAC], Section 202/162 Project Assistance Contracts [PAC], and Section 811 PRAC).[12] We selected projects with probabilities proportional to size, but more households were selected from larger projects whose size exceeded the sampling interval; these were counted as more than one project for the purpose of determining the sample size.

Household Sampling. The initial HUDQC sampling design called for a nationally representative sample with 4 households randomly selected from each of the 600 projects, equaling 2,400 households. We selected households using HUD-provided PIH Information Center/Tenant Rental Assistance Certification System (PIC/TRACS) data. Where reliable PIC/TRACS data did not exist for a project (e.g., Moving to Work projects with biennial or triennial recertification cycles), we collected a tenant roster from the individual project and selected the sample using simple random sampling techniques. A random sample of 4 households was selected from most projects, with some larger Voucher projects having a selection of multiples of 4 households (8, 12, or more households). An equal number of "replacement" households were identified at each selected project as potential substitutes, in the event that a selected household did not meet the study requirements or was unavailable to be interviewed.

[11] For the purpose of this study, a "project" for the Section 8 Voucher program was defined as the administration of the program in one county/township. Therefore, if a PHA administered vouchers in more than one county/township, the PHA could be represented in this study by more than one "project."

[12] Due to different eligibility and rent calculation rules, Owner-administered Rental Assistance Payment or Rental Supplement Program (RAP/SUP) project and Owner-administered project conversions under the Rental Assistance Demonstration (RAD) were excluded from the study.

Study Subgroup. Households in the HUDQC Study sample were assessed on two conditions to determine whether they should be a part of the UAC Study subgroup. These two conditions were:

1. Flat rent status
2. Verified status of tenant-furnished utilities

Tenants in the Public Housing program that pay flat rent do not receive an official utility allowance on Form HUD-50058, and the HUDQC Study methodology does not require household interviews with flat rent households (preventing the collection of out-of-pocket utility cost information). Because these households were in the HUDQC Study sample but were not relevant to the UAC Study, we neither replaced these households nor collected additional data from other households solely for use in the UAC Study. Public Housing households paying a flat rent were not included in the UAC Study subgroup.

In addition to a household's flat rent status, households that did not pay for utilities out of pocket and did not receive a utility allowance were excluded from the UAC Study subgroup. We established three criteria to identify these households:

1. The household selected in the HUDQC Study did not receive a utility allowance on Forms HUD-50058/50059, and where missing on the form, an allowance amount could not be identified from other sources in the household file;
2. Utility allowance determination documents found in the household file (including Form HUD-52667: Allowances for Tenant-Furnished Utilities; Form HUD-52641: Housing Assistance Payment Contract; Form HUD-52517: Request for Tenancy Approval; and other utility allowance worksheets or lease agreements) indicated that the household was not responsible for utilities and an allowance should not be assessed; and
3. The household indicated that it was not financially responsible for utility consumption and costs during the household interview.

If all three criteria were met, then the household was excluded from the UAC Study subgroup. Otherwise, the household was included (i.e., if none, one, or two of the criteria were met).

Nonresponse. The UAC Study's main research questions required that the three utility metrics of interest be compared for subgroup households. We designated each subgroup household as respondent or nonrespondent on the basis of whether the data needed to calculate all three utility metrics of interest were complete. To ensure consistent findings across responses to all main research questions, we analyzed only the data of respondent households.

Nonresponse Designation and Dispositions

In order to make a nonresponse designation, we evaluated the category of the data for each of the three utility metrics, which are presented in Exhibit II-1.

Exhibit II-1
Utility Metrics' Categories

Actual Utility Allowance	Utility Expenditure	HUSM Utility Allowance
• Amount Equal to $0 • Amount Greater Than $0	• Amount Equal to $0 • Amount Greater Than $0 and Could be Calculated • Amount Greater Than $0 and Could Not be Calculated	• Amount Equal to $0 • Amount Greater Than $0 and Could be Calculated • Amount Greater Than $0 and Could Not be Calculated

Given the two categories for Actual Utility Allowance and three categories for Utility Expenditure and HUSM Utility Allowance, a household can have one of 18 possible combinations of data across the three utility metrics. Households where all three utility metrics are equal to $0, as discussed previously under Study Subgroup, were excluded from the UAC Study subgroup.

Nonrespondent designations were further classified into a nonresponse disposition, or reason why a utility metric amount could not be calculated. Nonresponse dispositions were coded separately for incomplete Utility Expenditure data and for incomplete HUSM Utility Allowance data, and were related to household/unit characteristics and utility company characteristics. Unweighted rates of nonresponse dispositions are presented in Section IV: Findings, B. Response Rates.

Nonresponse Analysis

ICF conducted a nonresponse analysis on the UAC Study subgroup to determine if respondent households differed from nonrespondent households. The results of this analysis informed additional weighting considerations for the UAC Study analysis (see Weighting below).

In order to accomplish the main objective of the nonresponse analysis, we first conducted a series of bivariate analyses (i.e., significance testing on cross-tabulations) that looked at how response rates may vary across different groups of households, and whether any differences were statistically significant. The variables determined to be statistically significant were:

- The number of tenant-paid utilities, according to the household
- HUD region
- The number of units administered by the household's project
- Certification type
- Program type

The bivariate analyses were followed by a multivariate analysis (i.e., logistical regression). Variables that were found to be significant predictors of response in the bivariate analyses (or explanatory variables) were included in the multivariate analysis. The multivariate analysis assessed the independent association of each explanatory variable with the response designation while adjusting for the other variables.

The multivariate analysis showed that two of five explanatory variables should be used to adjust the HUDQC Study weights to reduce nonresponse bias. All else being equal, there was a 54 percent increase in the odds of being a nonrespondent for Public Housing households when compared to PHA-administered Section 8 households ($p < 0.05$). Furthermore, the decrease from two or more tenant-paid utilities to zero or one tenant-paid utilities resulted in a decrease in the odds that the household would be a nonrespondent by 31 percent ($p < 0.001$), net of all other factors.

More information on the nonresponse analysis can be found in *Appendix A: Nonresponse Considerations and Analysis*.

Weighting. The procedure to determine final weights for the UAC Study subgroup leveraged the weighting procedures for the HUDQC Study. The sum of the HUDQC Study weights among the UAC Study subgroup represents those in the HUD-assisted population who have utility allowances or actual utility costs. Exhibit II-2 displays the population totals used for HUDQC Study weighting and the estimated UAC Study population.

Exhibit II-2
HUDQC Study Population Totals vs. Estimated UAC Study Population Totals by Program Type

Administration Type	HUDQC Study Population	Estimated UAC Study Population	
		Count	% of HUDQC Study Population
Public Housing	1,061,690	479,910	45%
PHA-administered Section 8	2,209,296	2,051,239	93%
Owner-administered	1,382,453	903,634	65%
Total	**4,653,439**	**3,434,783**	**74%**

In order to mitigate nonresponse bias, the HUDQC Study weights were adjusted to account for UAC Study nonresponse. The significant predictors of nonresponse, program type and the number of tenant-paid utilities, found during the nonresponse analysis were used to classify UAC Study subgroup households into adjustment cells. Within each defined cell, nonrespondent households were given a weight of 0 and their HUDQC Study weight was redistributed to the respondent households in the cell. This procedure ensured that the sum of final UAC Study weights equaled the sum of the final HUDQC Study weights for the subgroup. More details on weighting steps and formulas for the UAC Study can be found in *Appendix B: Weighting Procedures and Reliability of Estimates*.

C. Data Collection

This study used a multistage data collection process to obtain information from projects, tenants and utility companies. Information obtained from projects included a Web-based survey and a review of tenant-level files at the project site. Tenants provided information and completed tenant consent forms during household interviews. Upon request, data related to utility rates and consumption were provided from third-party utility companies. To support this data collection process, both field interviewers and study headquarters staff were trained in the appropriate methods and policies to ensure consistency of procedures and accuracy of data. All information was collected using HUD-sanctioned data collection procedures, and quality control and assurance procedures were put in place to review obtained data.

Projects. We contacted PHAs/Projects multiple times and at various stages during the study period, including: to introduce the study, to introduce the specific field interviewer, to request specific project information, and to follow up in the event of missing or incomplete information. We obtained initial PHA/Project contact names from HUD headquarters staff and emailed PHA/Project contacts to notify them of the study and request participation. Prior to the field interviewer training and data collection, each project in the study was sent a Web survey, the Project Specific Information (PSI) questionnaire, requesting background information essential to

the data collection process. The survey also asked for data on how projects determined their utility allowance schedule and other key pieces of information related to utility allowances, including:

- The method used to determine utility allowance schedules in FY 2015
- The document that the data collector should review to determine the utilities for which the household is responsible
- The utilities that are master-metered, check-metered, and tenant-paid (for project-based program types only)
- The structure type of the project's building(s) and the ENERGY STAR® certification status of their units (for project

Additionally, while at the project site, field interviewers used computer-assisted data collection technology to review and extract information contained in each household's file. The main focus of the review was to identify and collect the following documents from the tenant file: Form HUD-52667 (Allowances for Tenant-Furnished Utilities), Form HUD-52641 (Housing Assistance Payment Contract), Form HUD-52517 (Request for Tenancy Approval), lease agreements, and other utility allowance schedule/worksheet documents. The documents were then photocopied and mailed to study headquarters. Study headquarters staff used these documents to determine characteristics of the unit (e.g., bedroom size, ENERGY STAR® certification status, and fuel sources for heating, cooking, and water heating), the specific utilities for which the household received a utility allowance, and the itemized allowance amount for each specific utility.

Households. An adult household member (preferably the head of household) participated in a detailed interview that investigated all potential utility costs incurred by the household, including those that may not have been stated in the household file. Field interviewers used computer-assisted personal interviewing (CAPI) software to obtain the information and transfer the data electronically to study headquarters. The CAPI software instructed the field interviewer to request and review any documentation of out-of-pocket utility costs, such as utility bills. Documents that contained the same address as the unit of interest were scanned and electronically transferred to study headquarters.

Adult household members were asked to sign standardized release authorization forms that permitted study headquarters staff to obtain additional information from relevant third-party utility companies for all utility items. Although we developed a standardized consent form for the release of information, research prior to field data collection indicated that some utility companies required the use of their proprietary form(s) for authorizing and requesting the release of historical utility consumption and rate data. These proprietary release forms were obtained in advance of field data collection, when possible, and provided to field interviewers as needed. During the course of the study, approximately 700 proprietary forms were signed by tenants during the household interview, in addition to the standardized release, from a total of 12 utility companies.[13] The hard-copy version of these forms were returned to study headquarters via FedEx, and were scanned and transferred electronically to study headquarters for processing.

[13] Of the 12 utility companies that had proprietary release forms, one serviced households in four of the sampled geographic areas and another serviced households in five of the sampled geographic areas.

Utility Companies. When adequate historical utility consumption and/or rate information was not available from documentation provided during the household interview, additional information and verification from third-party utility companies was requested. In addition to a signed release authorization form, we included a data request form in our request to utility companies. The form references the specific time period, property address, and account number for which data were needed. Although most packages were sent to the appropriate third-party utility companies via fax, certain requests were sent via secure email. Utility companies were asked to complete the bottom portion of the request form and include a copy when returning the requested data reports.

Follow-up requests were made to third-party utility companies that did not return the requested data, which included reminder fax, email, and telephone communications. Phone calls were also made to these third parties regarding clarification of data that were received, when necessary.

D. Utility Metric Calculations

To fulfill the goals of the UAC Study, ICF produced national estimates based on the nationally representative subgroup discussed in subsection B. Sample and Subgroup. Specifically, national estimates of the Actual Utility Allowance, Utility Expenditure, and HUSM Utility Allowance in FY 2015 were determined.

Actual Utility Allowance. If the cost of utilities for an assisted unit is not included in the tenant rent but is the responsibility of the family occupying the unit, a utility allowance is provided to the household. This allowance is approved by the PHA/Project to be an estimate of the monthly cost of reasonable consumption of utilities for the unit by an energy-conservative household of modest circumstances, consistent with the requirements of a safe, sanitary, and healthful living environment.

The Actual Utility Allowance used for analysis was the monthly utility allowance amount on Forms HUD-50058/50059, or if missing from the form, the amount of utility allowance found on other sources in the household's file. Where appropriate, the Actual Utility Allowance was chosen from the prorated rent calculation section of the Form HUD-50058 for households with ineligible noncitizens prior to selecting the amount from other sources. This amount was the monthly household utility allowance for the year, following the most recent (re)certification selected for use in the HUDQC Study. In some cases, this allowance included a portion intended to cover other, unspecified expenses. The Actual Utility Allowance was decreased by this amount. This occurred for a total of three respondent households.

In addition to the total Actual Utility Allowance received by a household, the utility components and associated itemized allowances were determined to support utility component level comparisons between utility metrics. These itemized component amounts were identified using documentation from both project staff and tenant files.

Utility Expenditure. Utility Expenditure was the average monthly utility cost incurred by the household in the unit of interest during FY 2015, or the sum of the monthly costs among each utility component. This average was determined by first selecting the utility components, then calculating consumption and utility rate, fees, and taxes.

The selection of utility components that were considered for the Utility Expenditure was based on financial responsibility according to the household, as stated verbally during the household interview or as listed on tenant-provided documentation of out-of-pocket utility costs, such as utility bills.

The review of tenant file documents and project-provided allowance documentation was not used to inform which components were used to calculate the Utility Expenditure.

Each selected utility component's consumption was based on tenant-provided utility bills, or similar documentation, and data returned from third-party utility company requests. We reviewed these data sources for monthly consumption data from October 2014 to May 2016 to yield a minimum of eight months of actual consumption. If eight to eleven months of actual consumption data were obtained, we implemented procedures to obtain a full 12 months of consumption data. An average monthly consumption amount was then calculated. This average monthly consumption was weighted to account for differential utility use in winter and summer months; it was the average of the average winter consumption and the average summer consumption. Winter and summer month designations were defined by the utility company's policy, if available. If not available, winter months were November through April, and summer was May through October.

The selected utility components' specific charges, including rates, fees, and taxes, were based on the returned data from third-party utility company requests; information supplied in project-provided allowance documentation data; or from tenant-provided documentation of out-of-pocket utility costs, such as utility bills. An average monthly rate was also calculated based on a weighted average to account for seasonal variations in cost, using the same winter and summer month designations as used for consumption. A weighted average rate was calculated for each rate block, where applicable. Other total charges/fees and total taxes were also assessed.

In general, the average monthly cost of each utility component was calculated by:

1. Multiplying the weighted average consumption by each of following, where applicable:
    a. The weighted average rate for each rate block
    b. The total charges/fees assessed based on consumption
    c. The total tax rate assessed based on consumption
2. Summing the products of (1) and any flat rates or charges/fees
3. Assessing any flat tax rates

The resulting average monthly cost for a household's utility component was adjusted when current rates were used to estimate the cost. These utility component costs were multiplied by the inverse of the FY 2016 utility component by State level factors to account for changes between current rates and FY 2015 rates.

For each household, the Utility Expenditure was then calculated as the sum of their utility components' average monthly costs. If applicable, this sum also included in the allowance amounts received by the household for renting or financing a range, microwave, or refrigerator, and other fees determined to be covered by utility allowances (e.g., city fees).

HUSM Utility Allowance. The HUSM Utility Allowance was the sum of HUSM estimated itemized, monthly allowances associated with the utility components for which the household was financially responsible. The HUSM is a Microsoft Excel workbook designed to produce consistent Utility Allowance Schedules (or Form HUD-52667 Allowances for Tenant-Furnished Utilities and Other Services) for PHAs/Projects relative to energy-conservative households of modest circumstances consistent with the requirements of a safe, sanitary, and healthful living environment. This workbook

required data entry of the location of the project to populate climate data and rates/charges for a range of utilities to generate a utility allowance schedule.

Study headquarters calculated a HUSM Utility Allowance using version 13 of the HUSM (revised as of August 27, 2013) for each household whose project did not use the HUSM to create their utility allowance schedule, and for 50 percent of households from those projects who did use the HUSM to create their utility allowance schedule.[14] The procedures outlined in HUD's HUSM Instruction document were followed to complete the data entry of the "Location," "Tariffs," and "Utility Allowance Computation" tabs.

Data that were entered into the model were identified from various sources. The selection of utility component rates/charges, including range/microwave, refrigerator, and other fees, (for the "Tariffs" tab) and the utility and fuel source (for the "Utility Allowance Computation" worksheet) for each household was based on the review of tenant file documents and project-provided allowance documentation. Financial responsibility for utility components according to the household, as stated during the household interview, was not used to inform which components were used to calculate the HUSM Utility Allowance. The specific utility rates, fees, and taxes data entered into the "Tariffs" tab were based on the data from tenant-provided documentation of out-of-pocket utility costs, such as utility bills, returned data from third-party utility company requests, or information supplied in project-provided allowance documentation. Other required data were identified as follows:

- Unit Type: The structure type of the unit's building was determined from the Form HUD-50058 (for PHA-administered Section 8 households), project responses to the PSI questionnaire, or review of tenant file documents.
- ENERGY STAR® Status: The ENERGY STAR® certification status of the unit was determined from project responses to the PSI questionnaire and the review of tenant file documents.
- Unit Size: The number of bedrooms in the unit was determined from the review of tenant file documents, the Forms HUD-50058/50059, or based on HUD occupancy standards.

The resulting monthly allowance for a household was adjusted when current rates were used to estimate the itemized allowance for at least one utility component. The utility component estimated using current rates was multiplied by the inverse of the FY 2016 utility component by State level factors to account for changes between current rates and FY 2015 rates. The HUSM Utility Allowance total was recalculated by summing all itemized amounts for all households.

E. Utility Metric Comparisons

Comparisons of the three key utility metrics were used to answer UAC Study research questions. These differences have several dimensions and definitions, which served as the primary dependent variables. On a basic level, the term difference in this study referred to a utility allowance that did not accurately reflect the utility expenses incurred by a household, based on the verified information.

[14] A 50 percent sample of households from those projects who did use the HUSM was drawn according to requirements of the Statement of Work (SOW). For the 50 percent sample of households who were not selected for a HUSM recalculation, the Forms HUD-50058/50059 total and component amounts were used as the HUSM Utility Allowance amounts for analysis purposes.

Study research questions require that several definitions of difference be estimated based on data collected in the study:

Dollar Difference. The dollar amount of the utility allowance (either Actual or HUSM) minus the Utility Expenditure for an individual household. A negative number indicates an under subsidy, meaning the household received an allowance lower than the actual costs incurred. A positive number indicates an over subsidy, meaning the household received an allowance greater than the actual costs incurred.

Total Gross Difference. The weighted sum of the absolute values of the positive and negative individual household dollar difference. Gross differences represent the dollars associated with the difference between utility metrics, or the magnitude of the difference.

Total Net Difference. The arithmetic value of the weighted sum of the individual household dollar difference. Net differences represent the cost of the difference found between utility metrics.

Over/Under Subsidy. Over subsidy is reflected by a positive dollar difference, indicating a household's actual utility costs were below the allowance the household received. In this instance, HUD's subsidy was too high. Under subsidy is reflected by a negative dollar difference, indicating a household's actual utility costs were above the allowance the household received. In this instance, HUD's subsidy was too low. To account for rounding, dollar differences within ±$2 were considered a matching subsidy.

Mean Square Error. The mean square error (MSE) is the average squared difference of the estimated utility allowance (either Actual or HUSM) and the Utility Expenditure, and is a measure of allowance's accuracy in predicting out-of-pocket costs.

Ideally, the MSE would be zero, indicating that the estimated utility allowance predicts the Utility Expenditure exactly. We calculated the MSE for each of the utility allowance metrics: the Actual Utility Allowance and the HUSM Utility Allowance. The smaller the MSE, the closer the utility allowance metric is to the actual utility costs incurred by the household.

$$MSE = \frac{\sum_{i=1}^{n}(Allowance - Expenditure)^2}{n}$$

Ideally, the MSE would be zero, indicating that the estimated utility allowance predicts the Utility Expenditure exactly. We calculated the MSE for each of the utility allowance metrics: the Actual Utility Allowance and the HUSM Utility Allowance. The smaller the MSE, the closer the utility allowance metric is to the actual utility costs incurred by the household.

III. Research Questions and Analytic Methods

This section identifies the five main research questions of the study and a brief description of the methodology that was used to address each question.

These research questions required that the three utility metrics of interest be compared, and thus, all three must be present to ensure consistent findings across responses to all main research questions. For the UAC Study, households were considered as respondents or nonrespondents depending on whether the data that were needed to calculate all three utility metrics of interest were complete or missing. We analyzed only the data of respondent households for the study.

Actual findings and analytic exhibits and tables are provided in Section IV: Findings. Throughout these findings, information is reported for the three major housing programs separately and in combination.

Question 1: What was the actual cost of utilities paid by households participating in the Public Housing, PHA-administered Section 8 Voucher and Moderate Rehabilitation, and Owner-administered Section 8, Section 202 PRAC, Section 202/162 PAC, Section 811 PRAC programs?

During household interviews, we determined the utilities for which the household was financially responsible and collected detailed information about each utility that was tenant-paid in FY 2015. We also collected signed third-party release forms and utility bills from tenants. If utility bills were not obtained or were incomplete, we sent third-party requests to utility companies for consumption and rate information. This data, combined with utility rate information from project-provided documentation of utility allowances, was used to calculate the average monthly Utility Expenditure for respondent households. Exhibit IV-12: Monthly Utility Expenditure provides national estimates for average monthly Utility Expenditure by program type, or the actual cost of utilities paid by households receiving housing assistance under the three major program types.

Question 2: For each program separately and in combination, what was the average utility allowance based upon the Forms HUD-50058/50059? What are the gross and net differences between Forms HUD-50058/50059 utility allowances and actual utility expenditures?

Study headquarters obtained documentation of the actual utility allowance received by respondent households in FY 2015 from the Forms HUD-50058/50059 and, where missing, from tenant files. Exhibit IV-10: Monthly Actual Utility Allowance provides the national estimate for average monthly Forms HUD-50058/50059 utility allowance by program type.

The monthly Actual Utility Allowance and Utility Expenditure (estimated via Question 1), were then compared to determine differences. The dollar difference was the dollar amount of the Actual Utility Allowance minus the Utility Expenditure for an individual respondent household. To account for rounding, dollar differences within ±$2 were set to a $0 difference. Gross difference was considered the weighted sum of the absolute values of the positive and negative differences, and net difference was the arithmetic value of the weighted sum of dollar difference. Exhibit IV-18: Gross and Net Differences (Monthly) Between Actual Utility Allowance and Utility Expenditure depict these estimated differences.

Question 3: For each program separately and in combination, what was the average utility allowance based on the HUSM? What are the gross and net differences between HUSM utility allowances for the unit and actual utility expenditures?

We collected project utility allowance schedules and documentation during the project-level questionnaire, tenant file documentation from the project sites, and utility bills during household interviews to obtain utility rates/charges information for each respondent household. Utility rates/charges information and unit characteristics were used to estimate the average monthly HUSM Utility Allowance. Exhibit IV-14: Monthly HUSM Utility Allowance provides the national estimate for average monthly utility allowance based on the HUSM by program type.

The monthly HUSM Utility Allowance and Utility Expenditure (estimated via Question 1) were then compared to determine differences. The dollar difference was the dollar amount of the HUSM Utility Allowance minus the Utility Expenditure for an individual respondent household. To account for rounding, dollar differences within ±$2 were set to a $0 difference. Gross difference was considered the weighted sum of the absolute values of the positive and negative differences, and net difference was the arithmetic value of the weighted sum of dollar difference. Exhibit IV-23: Gross and Net Differences (Monthly) Between HUSM Utility Allowance and Utility Expenditure depict these estimated differences.

Question 4: For each program separately and in combination, were there statistically significant differences between the two forms of utility allowances and actual utility expenses? Does either method of utility allowance determination produce allowances that are statistically significantly closer to actual utility expenses than the other?

Using the average estimated amounts for the utility metrics estimated via Questions 1, 2, and 3, we performed two-tailed t-tests to determine the statistical significance of the differences between the utility allowance (either Actual or HUSM) and Utility Expenditure, for programs separately and in combination. Results are depicted in Exhibit IV-27: Monthly Actual Utility Allowance and Utility Expenditure and Exhibit IV-28: Monthly HUSM Utility Allowance and Utility Expenditure.

We then calculated the MSE of each difference to assess the accuracy of the utility allowance (either Actual or HUSM) in predicting Utility Expenditures. The confidence intervals of the calculated MSEs were compared to discern whether one allowance performs better at predicting expenditures. Exhibit IV-29: Difference (Monthly) Between Utility Allowance Metrics and Utility Expenditures: MSEs displays these results.

Question 5: How did PHAs and owners calculate utility allowances? Did they calculate utility allowances themselves or outsource? If they outsourced, to what company did they outsource? Did they use HUSM to calculate the utility allowances? If they did not use the HUSM, is there another model that they used? If they did not use the HUSM or alternate model, how were utility allowances determined?

We collected data about utility allowance methods and the use of the HUSM during the project-level questionnaire. Data are presented in Section IV. Findings: A. Overview of Utility Allowances using unweighted descriptive statistics of survey responses and qualitative coding to summarize open-ended responses.

Beyond the scope of the main research questions, additional analyses depict the estimated subsidy status rate (i.e., under, over, or matching subsidy) of the Actual and HUSM Utility Allowance and the estimated dollar difference of under and over subsidy. At a more granular level, the composition of the three utility metrics and differences between the metrics at the utility component level are described. Furthermore, insights into challenges in obtaining utility data and an analysis as to how respondent and nonrespondent households differ are provided.

IV. Findings

The discussion contained in this section addresses the main research questions of the UAC Study. Data are presented by the three program types that were the basis for the sampling design: PHA-administered Public Housing; PHA-administered Section 8 Housing Choice Voucher and Moderate Rehabilitation programs (PHA-administered Section 8); and Office of Housing-administered Section 8, Section 202 PRAC, Section 811 PRAC, and Section 202/162 PAC programs (Owner-administered).

Our discussion is divided into six subsections:

A. Overview of Utility Allowances

B. Response Rates

C. Utility Metrics

D. Actual Utility Allowance Subsidy Error

E. HUSM Utility Allowance Subsidy Error

F. Statistical Comparisons of Utility Metrics

The first subsection presents unweighted findings of project responses to the Project Specific Information (PSI) questionnaire about how utility allowances were established in FY 2015. The second subsection details the study subgroup and provides unweighted rates of respondent and nonrespondent households. The remaining subsections present the analyses that describe the relationship among the Actual Utility Allowance, Utility Expenditure, and HUSM Utility Allowance using the nationally weighted sample data for the 436 responding UAC Study subgroup households.[15]

A. Overview of Utility Allowances

To provide background and context to the relationships between utility allowances and out-of-pocket utility costs, this subsection discusses how utility allowances were established by projects in FY 2015 for each program separately and combination.

Findings presented were derived from responses to the PSI questionnaire, which had a 99 percent response rate (526 of 531 projects completed the survey). Sixty-six of these projects (12 percent) indicated that they did not provide utility allowances in FY 2015 and were excluded from the tables presented. Analytical findings are based on 177 Public Housing projects, 96 PHA-administered Section 8 projects, and 192 Owner-administered projects to yield a total of 465 projects, or 88 percent of completed questionnaires.

Establishing Utility Allowances. Project staff have a variety of options to calculate and set utility allowances, including the HUSM and other models, and may leverage more than one model. Exhibit IV-1 displays the percentage of projects, among those surveyed, that used specific methods to determine their allowances in FY 2015.

[15] Despite the low response rate, the weighted estimates provided in subsections C. through F. are reliable. *Appendix B: Weighting Procedures and Reliability of Estimates* details an additional analysis that tested the reliability of presented estimates.

- Three percent of surveyed projects used the new HUSM (version 13) in FY 2015, whereas four percent used a version of HUSM older than version 13. PHA-administered Section 8 projects were most likely to use a version of the HUSM (19 percent).
- Approximations of average utility costs from local utility companies was most likely to be used (31 percent), followed by engineering/consumption models and average tenant costs/usage based on actual utility bills (26 percent, each).
- PHA-administered Section 8 projects were most likely to use approximations of average utility costs from local utility companies (71 percent), whereas Public Housing was most likely to use an engineering/consumption model (48 percent) and Owner-administered was most likely to use average tenant costs/usage based on utility bills (46 percent).
- Twenty-four percent of surveyed projects used a different method for setting their FY 2015 utility allowances, but did not specify what this method was. No PHA-administered Section 8 projects indicated a different, unspecified method.

Exhibit IV-1
Development of FY 2015 Utility Allowance Schedule(s): Methods and Models

Methods and Models Used to Develop Utility Allowance Schedule(s)	Public Housing	PHA-administered Section 8	Total PHA-administered	Owner-administered	Total
Approximations of Average Utility Costs From Local Utility Companies	21.5%	70.8%	*38.8%*	19.8%	**31.0%**
Engineering/Consumption Model	48.0%	31.3%	*42.1%*	2.6%	**25.8%**
Average Tenant Costs/Usage Based on Actual Utility Bills	11.3%	11.5%	*11.4%*	46.4%	**25.8%**
Other—Not Specified	26.0%	0.0%	*16.8%*	33.9%	**23.9%**
Old HUSM (older than version 13)	3.4%	10.4%	*5.9%*	1.0%	**3.9%**
New HUSM (version 13)	2.3%	8.3%	*4.4%*	0.5%	**2.8%**
Collection of Average Expenditure Using a Phone Survey of Local Area Tenants	1.7%	4.2%	*2.6%*	0.0%	**1.5%**

Data in this exhibit are not weighted.

Projects have the option to employ these methods themselves or to contract out this work. Exhibit IV-2 reports the percentage of projects that did and did not contract out the development of utility allowance schedules, as well as the organizations that were contracted.

- Thirty-three percent of projects did not contract with external organizations to develop their FY 2015 utility allowance schedules. PHA-administered Section 8 projects were most likely to perform this task in-house (57 percent).
- Thirty-nine percent of projects indicated that outside organizations were contracted to set FY 2015 utility allowances. Public Housing projects were most likely to contract out this activity (46 percent).

- Contract administrators or HUD were most likely to be under contract to develop utility allowance schedules (30 percent). Ninety percent of Owner-administered projects that contracted out used contract administrators or HUD.
- Forty-six percent of Public Housing projects that contracted out utility allowance activities did so to EME Group. EME Group constituted 21 percent of the organizations contracted among all program types.
- PHA-administered Section 8 was most likely to contract out to The Nelrod Company and Happy Software, Inc (18 percent, each).

Exhibit IV-2
Development of FY 2015 Utility Allowance Schedule(s): Contracted Organizations

Contracting Status	Public Housing	PHA-administered Section 8	Total PHA-administered	Owner-administered	Total
PHA/Project Does Not Contract Out	21.5%	57.3%	*34.1%*	32.3%	**33.3%**
PHA/Project Does Contract Out	46.3%	40.6%	*44.3%*	31.3%	**38.9%**
PHA/Project Does Not Know	32.2%	2.1%	*21.6%*	36.5%	**27.7%**
Organizations Contracted*					
Contract Administrator/HUD	-	-	-	90.0%	**29.8%**
EME Group	46.3%	-	*31.4%*	-	**21.0%**
The Nelrod Company	6.1%	17.9%	*9.9%*	-	**6.6%**
Happy Software, Inc.	1.2%	17.9%	*6.6%*	-	**4.4%**
Energy Consultants, Inc.	7.3%	2.6%	*5.8%*	-	**3.9%**
2rw Contractors, Inc	3.7%	10.3%	*5.8%*	-	**3.9%**
R. Christopher Goodwin & Associates	4.9%	5.1%	*5.0%*	-	**3.3%**
Management Resources Group, Inc.	2.4%	10.3%	*5.0%*	-	**3.3%**
National Facility Consultants, Inc.	6.1%	-	*4.1%*	-	**2.8%**
Siemens	4.9%	-	*3.3%*	-	**2.2%**
Other Contractors/Vendors	8.5%	25.6%	*14.0%*	6.7%	**11.0%**
Not Provided	8.5%	10.3%	*9.1%*	3.3%	**7.2%**

Data in this exhibit are not weighted.
Note: Column totals may not add up to 100% due to rounding.
* The rates presented only apply to those projects that indicated that they contracted out.

Updating Utility Allowances. Projects establish utility allowance amounts based on the utility rates during annual reviews, but the annual review may not result in a change in utility allowance levels. They may also revise their allowances for tenant-paid utilities between annual reviews if there is a rate change; in fact, they are required to do so if the change results in an increase of 10 percent or more. Exhibit IV-3 presents how frequently projects updated their utility allowances within the past five years.

- Forty-two percent of projects updated their utility allowance levels five or more times in the past five years. PHA-administered Section 8 projects were most likely to update at this frequency (66 percent).

- Public Housing projects were most likely to have no utility allowance update or one update in the past five years (10 percent and 7 percent, respectively), whereas Owner-administered projects were most likely to have two or three updates in this timeframe (7 percent and 9 percent, respectively).

Exhibit IV-3
Frequency of Utility Allowance Schedule(s) Updates

Contracting Status	Public Housing	PHA-administered Section 8	Total PHA-administered	Owner-administered	Total
No Updates in Past 5 Years	9.6%	2.1%	*7.0%*	3.1%	**5.4%**
1 Update in Past 5 Years	7.3%	3.1%	*5.9%*	3.1%	**4.7%**
2 Updates in Past 5 Years	5.1%	6.3%	*5.5%*	6.8%	**6.0%**
3 Updates in Past 5 Years	3.4%	8.3%	*5.1%*	9.4%	**6.9%**
4 Updates in Past 5 Years	4.5%	13.5%	*7.7%*	9.9%	**8.6%**
5 or More Updates in Past 5 Years	40.1%	65.6%	*49.1%*	31.8%	**41.9%**
Unknown	29.9%	1.0%	*19.8%*	35.9%	**26.5%**

Data in this exhibit are not weighted.
Note: Column totals may not add up to 100% due to rounding.

B. Response Rates

Overview. The UAC Study methodology required that, first, the study subgroup be defined from the HUDQC Study sample and, second, that subgroup households be designated as respondents and nonrespondents on the basis of complete data to fulfill study objectives. This subsection details these classifications with unweighted results.

Study Subgroup. Exhibit IV-4 shows the number and percentage of households in the UAC Study subgroup for each program separately and in combination. The exhibit also provides the reasons why households in the HUDQC Study were excluded from the UAC Study subgroup.

- Of the possible 2,400 HUDQC Study households, 1,628 (68 percent) had either a utility allowance or out-of-pocket utility costs in FY 2015 and were included in the UAC Study subgroup.
- Ninety-three percent of PHA-administered Section 8 households were included in the subgroup, as opposed to 66 percent and 45 percent of households in Owner-administered and Public Housing programs, respectively.
- Of the 772 households excluded from the study subgroup, 78 (10 percent) were excluded because of flat rent status and 694 (90 percent) were excluded for verified absence of tenant-furnished utilities (i.e., the household did not receive a utility allowance and did not pay for utilities out of pocket).

Exhibit IV-4
UAC Study Subgroup: Count and Percentage of Households

Subgroup Rates and Conditions	Public Housing		PHA-administered Section 8		Total PHA-administered		Owner-administered		Total	
	n	%	n	%	n	%	n	%	n	%
Included Households	359	45%	742	93%	*1,101*	*69%*	527	66%	**1,628**	**68%**
Excluded Households	446	55%	57	7%	*503*	*31%*	269	34%	**772**	**32%**
Excluded Conditions*										
Flat Rent Households	78	17%	-	-	*78*	*16%*	-	-	**78**	**10%**
Verified Absence of Tenant-Furnished Utilities	368	83%	57	100%	*425*	*84%*	269	100.0%	**694**	**90%**

Data in this exhibit are not weighted.
* The condition rates presented are for those households excluded from the UAC Study subgroup.

Responding Households. In order to designate subgroup households as respondent or nonrespondent, UAC Study methodology required the assessment of the availability of data used to determine each of the three key utility metrics (i.e., Actual Utility Allowance, HUSM Utility Allowance, and Utility Expenditure).

Exhibit IV-5 provides the number and percentage of households in the UAC Study subgroup that had an Actual Utility Allowance equal to or greater than $0. This utility metric could be determined for all subgroup households and did not impact response designation.

- One percent of households in the UAC Study subgroup had a $0 Actual Utility Allowance in FY 2015. These cases are retained in the subgroup because they had non-zero Utility Expenditures.
- Public Housing had the largest percentage (4 percent) of households with a $0 utility allowance on their Form HUD-50058.

Exhibit IV-5
Count and Percentage of Households With an Actual Utility Allowance

Response Categories	Public Housing		PHA-administered Section 8		Total PHA-administered		Owner-administered		Total	
	n	%	n	%	n	%	n	%	n	%
Households With an Actual Utility Allowance = $0	14	4%	6	1%	*20*	*2%*	2	< 1%	**22**	**1%**
Households With an Actual Utility Allowance > $0	345	96%	736	99%	*1,081*	*98%*	525	100%	**1,606**	**99%**

Data in this exhibit are not weighted.

Exhibit IV-6 displays the number and percentage of households in the UAC Study subgroup with a HUSM Utility Allowance, those with available data to calculate this metric, and the reasons for missing calculations for each program separately and in combination.

- One percent of households in the UAC Study subgroup had a $0 HUSM Utility Allowance in FY 2015 and are considered as having the utility metric calculated. These cases are retained in the subgroup because they had non-zero out-of-pocket utility costs.
- Of the 1,628 subgroup households, 86 percent had a non-zero HUSM Utility Allowance that could be calculated. Conversely, 12 percent had a non-zero allowance that could not be calculated due to missing data.
- Public Housing had the largest percentage (29 percent) of households where the non-zero allowance could not be calculated, and PHA-administered Section 8 had the smallest percentage (7 percent).
- The HUSM Utility Allowance was not calculated for 81 percent of households because fuel sources (e.g., electric, natural gas) for space heating, cooking, and/or water heating were unknown. This was the primary reason among Public Housing households (95 percent) and Owner-administered households (80 percent).
- Unknown or incorrect utility providers prevented the allowance from being calculated for 12 percent of households. Valid utility providers were required to gather and enter rates into the HUSM.

Exhibit IV-6
Count and Percentage of Households With a HUSM Utility Allowance

Response Categories	Public Housing		PHA-administered Section 8		Total PHA-administered		Owner-administered		Total	
	n	%	n	%	n	%	n	%	n	%
Households Not Requiring a HUSM Utility Allowance (= $0)	14	4%	6	1%	*20*	*2%*	2	< 1%	**22**	**1%**
Households Requiring a HUSM Utility Allowance and Calculated	241	67%	684	92%	*925*	*84%*	479	91%	**1,404**	**86%**
Households Requiring a HUSM Utility Allowance and Not Calculated	104	29%	52	7%	*156*	*14%*	46	9%	**202**	**12%**
Reasons for No Calculation*										
Unknown Fuel Sources	99	95%	28	54%	*127*	*81%*	37	80%	**164**	**81%**
Unknown or Incorrect Providers	0	0%	19	37%	*19*	*12%*	5	11%	**24**	**12%**
Could Not Obtain Rates/Charges	1	1%	2	4%	*3*	*2%*	4	9%	**7**	**3%**
Unknown Utility Components	3	3%	2	4%	*5*	*3%*	0	0%	**5**	**2%**
Other	1	1%	1	2%	*2*	*1%*	0	0%	**2**	**1%**

Data in this exhibit are not weighted.
Note: Column totals may not add up to 100% due to rounding.
* The reason rates presented are for those households where a HUSM Utility Allowance could not be calculated.

Exhibit IV-7 displays the number and percentage of households in the UAC Study subgroup with a Utility Expenditure, those with available data to calculate this metric, and the reasons for missing calculations for each program separately and in combination. Households where a calculation could not be performed were assigned more than one reason, if applicable, to accurately capture where multiple barriers existed. Two hundred seventy households (24 percent of those where calculation could not be completed) had more than one reason, of which 67 were Public Housing, 169 were PHA-administered Section 8, and 34 were Owner-administered, respectively.

- One percent of households in the UAC Study subgroup had a $0 Utility Expenditure in FY 2015 and are considered as having the utility metric calculated. These cases are retained in the subgroup because they have a non-zero utility allowance.
- Of the 1,628 subgroup households, 29 percent had a non-zero Utility Expenditure that could be calculated. Conversely, 70 percent had a non-zero expenditure that could not be calculated due to missing data.
- PHA-administered Section 8 had the largest percentage (73 percent) of households where the non-zero expenditure could not be calculated, and Owner-administered had the smallest percentage (66 percent).

- Utility providers not responding to requests for data required to calculate the Utility Expenditure was the most common reason for no calculation (34 percent), followed by less than eight months of consumption being available to calculate a reliable monthly average (17 percent), utility company policies that only provided the required data to the serviced customer (16 percent), and an account number being required by the utility company to fulfill the request when it was not provided by the household (13 percent).

Exhibit IV-7
Count and Percentage of Households With Utility Expenditures

Response Categories	Public Housing		PHA-administered Section 8		Total PHA-administered		Owner-administered		Total	
	n	%	n	%	n	%	n	%	n	%
Households Without Utility Expenditures (= $0)	1	< 1%	9	1%	*10*	*1%*	8	2%	**18**	**1%**
Households With Utility Expenditures and Calculated	106	30%	190	26%	*296*	*27%*	169	32%	**465**	**29%**
Households With Utility Expenditures and Not Calculated	252	70%	543	73%	*795*	*72%*	350	66%	**1,145**	**70%**
Reasons for No Calculation*										
Utility Provider Did Not Respond	80	32%	206	38%	*286*	*36%*	104	30%	**390**	**34%**
Reliable Monthly Average Cost Could Not Be Calculated Because Less Than 8 Months of Consumption Data Were Available	50	20%	97	18%	*147*	*19%*	43	12%	**190**	**17%**
Utility Company Only Provides Data to the Serviced Customer	30	12%	86	16%	*116*	*15%*	64	18%	**180**	**16%**
Account Number Was Required by the Utility Company to Fulfill Data Requests and Was Not Provided by the Household	27	11%	71	13%	*98*	*12%*	47	13%	**145**	**13%**
Consumption Data Were Not Provided/Available, Only Monthly Cost Information Was Available	38	15%	66	12%	*104*	*13%*	18	5%	**122**	**11%**

Exhibit IV-7 cont.
Count and Percentage of Households With Utility Expenditures

Response Categories	Public Housing		PHA-administered Section 8		Total PHA-administered		Owner-administered		Total	
	n	%	n	%	n	%	n	%	n	%
Additional Restrictions Existed that Related to the Company's Proprietary Release Form	8	3%	56	10%	*64*	*8%*	29	8%	**93**	**8%**
Correct Utility Company Provider Name or Contact Information Was Not Provided by the Household	26	10%	39	7%	*65*	*8%*	27	8%	**92**	**8%**
Other	70	28%	121	22%	*191*	*24%*	53	15%	**244**	**21%**

Data in this exhibit are not weighted.
* The reason rates presented are for those households where a HUSM Utility Allowance could not be calculated.

The availability of data to calculate the three utility metrics informed the final response designation. Both the HUSM Utility Allowance and the Utility Expenditure had to be considered calculated for key difference calculations to be completed and for a given household to be designated as a respondent. Exhibit IV-8 displays rates with which the HUSM Utility Allowance and Utility Expenditure could be calculated among subgroup households for each program type separately and in combination. Shaded cells indicate the percentage of households that were considered final respondents.

- Across all program types, the lack of data available to calculate the Utility Expenditure was the major limiting factor in response rates. Only 30 percent of households had a calculated Utility Expenditure.
- Comparing the 27 percent of households that had both the HUSM Utility Allowance and Utility Expenditure calculated to the 30 percent of households who had the Utility Expenditure calculated, indicates that 3 percent of households had unavailable data only for the HUSM Utility Allowance. In these households, the calculation of the HUSM Utility Allowance was the limiting factor to response.

Exhibit IV-8
Percentage of Households With Utility Metric Calculations: Response Rates

Administration Type	HUSM Utility	PHA-administered Section 8	Total PHA-administered
Public Housing	71%	30%	23%
PHA-administered Section 8	93%	27%	25%
Total PHA-administered	*91%*	*28%*	*25%*
Owner-administered	88%	34%	31%
Total	**86%**	**30%**	**27%**

Data in this exhibit are not weighted.

Analytical Impact. Exhibit IV-9 presents the number and percentage of households in the UAC Study subgroup who were respondents and nonrespondents for each program separately and in combination.

- Respondents comprised 27 percent of the UAC Study subgroup.
- Owner-administered had the largest percentage of respondents within program type (31 percent), followed by PHA-administered Section 8 (25 percent) and Public Housing (23 percent).

Exhibit IV-9
Response and Nonresponse for the UAC Study Subgroup: Count and Percentage of Households

	Public Housing		PHA-administered Section 8		*Total PHA-administered*		Owner-administered		Total	
Response Rates	n	%	n	%	n	%	n	%	n	%
Respondent Households	81	23%	189	25%	*270*	*25%*	166	31%	**436**	**27%**
Nonrespondent Households	278	77%	553	75%	*831*	*75%*	361	69%	**1,192**	**73%**

Data in this exhibit are not weighted.

Only those households designated as respondents were used to generate the findings presented in the following subsections. Unless otherwise stated, these analyses were conducted using nationally weighted sample data for the 436 responding households. Despite this low response rate, weighted estimates provided are reliable.[16]

C. Utility Metrics

Overview. This subsection provides national estimates of the average monthly utility allowance based on the Form HUD-50058/50059 (Actual Utility Allowance) and the HUSM (HUSM Utility Allowance), as well as the average monthly cost of utilities paid by assisted households (Utility Expenditure).

[16] *Appendix B: Weighting Procedures and Reliability of Estimates* details the weighting methodology and an additional analysis that tested the reliability of presented estimates.

In addition, analyses of the utility components (e.g., electric, natural gas) for each utility metric are displayed. For these analyses, the dollar amounts associated with each component that comprised the Utility Expenditure and HUSM Utility Allowance were known for all responding households. The dollar amounts associated with each component of the Actual Utility Allowance were not known for 40 of the 436 responding households (9 percent), equating to approximately 390,000 households when weighted. Six of these households were PHA-administered Section 8, and the documentation provided to support the Actual Utility Allowance did not contain component amounts that added up to the reported Form HUD-50058/50059 amount. Public Housing had eight households where itemized component information was unavailable because documentation to support the Actual Utility Allowance was incomplete. Twenty-six households were Owner-administered and their projects did not use an itemized component approach to set utility allowances. Rather, the projects averaged sampled households' total out-of-pocket costs, typically across electric and natural gas.

Actual Utility Allowance. Exhibit IV-10 displays the average monthly Actual Utility Allowance provided to households in FY 2015 for each program type separately and in combination, along with their associated 95 percent confidence intervals.

- On average, households received an Actual Utility Allowance of $105 on a monthly basis.
- PHA-administered program types provided higher allowances ($116) than Owner-administered programs ($76).

Exhibit IV-10
Monthly Actual Utility Allowance

Administration Type	Average Dollar Amount	95% Confidence Interval
Public Housing	$113	±$22
PHA-administered Section 8	$117	±$14
Total PHA-administered	*$116*	*±$11*
Owner-administered	$76	±$12
Total	**$105**	**±$9**

Data in this exhibit are weighted.

Exhibit IV-11 provides a breakdown of the Actual Utility Allowance into the four utility components: electric, natural gas, other fuels (i.e., fuel oil, propane, kerosene, coal, and wood), and nonfuels (i.e., water, sewer, and trash). The percentage of households receiving an allowance for the component and the average monthly amount associated with the component are reported. Weighted estimates are provided for those households that had complete component-level data.

- Nearly all households received an allowance for electricity, with an average monthly value of $66.
- Forty-five percent of all households received an allowance for natural gas, with an average monthly value of $48. Households in Owner-administered programs received less of an allowance for this component ($31), compared to those households in PHA-administered programs ($48).

- Owner-administered programs provided an allowance for nonfuels for only 4 percent of households, compared to 28 percent and 29 percent in Public Housing and PHA-administered Section 8 programs, respectively. Despite this, the average dollars provided for nonfuels was similar across all program types, ranging from $54 to $60.

Exhibit IV-11
Actual Utility Allowance - Utility Components:
Percentage of Households and Average Monthly Dollar Amount

Administration Type	Electric		Natural Gas		*Other Fuels**		Nonfuels**	
	%	Avg. $	%	Avg. $	*%*	*Avg. $*	%	Avg. $
Public Housing	98%	$77	41%	$51	*0%*	-	28%	$60
PHA-administered Section 8	100%	$64	53%	$48	*4%*	*$195*	29%	$57
Total PHA-administered	*100%*	*$67*	*51%*	*$48*	*3%*	*$195*	*29%*	*$58*
Owner-administered	99%	$64	27%	$31	*0%*	-	4%	$54
Total	**99%**	**$66**	**45%**	**$48**	**2%**	**$195**	**22%**	**$58**

Data in this exhibit are weighted.
* Other fuels include fuel oil, propane, kerosene, coal, and wood. Cell sizes for these estimates are small; therefore, these estimates may not be reliable.
** Nonfuels include water, sewer, and trash. Cell size for the Owner-administered estimates is small; therefore, these estimates may not be reliable.

Utility Expenditures. Exhibit IV-12 displays the average monthly Utility Expenditure, or the estimated cost of out-of-pocket utilities, for households in FY 2015 for each program separately and in combination, along with their associated 95 percent confidence intervals.

- On average, households had a monthly Utility Expenditure of $116.
- Households in Public Housing had the highest out-of-pocket utility costs ($131), followed by PHA-administered Section 8 ($130) and Owner-administered ($75).

Exhibit IV-12
Monthly Utility Expenditure

Administration Type	Average Dollar Amount	95% Confidence Interval
Public Housing	$131	±$40
PHA-administered Section 8	$130	±$15
Total PHA-administered	*$130*	*±$14*
Owner-administered	$75	±$13
Total	**$116**	**±$10**

Data in this exhibit are weighted.

Exhibit IV-13 provides a breakdown of the Utility Expenditure into the four main utility components. The percentage of households who paid out of pocket for the component and the average monthly amount associated with the component, among payers, are reported.

- Nearly all households were financially responsible for electricity payments, with an average monthly cost of $86. Public Housing households paid an average of $104 for electricity and PHA-administered Section 8 households paid $89.

- Forty-three percent all households paid for natural gas out of pocket, with an average monthly cost of $52. PHA-administered Section 8 households paid the most for natural gas on a monthly basis ($56), followed by Public Housing and Owner-administered households ($49 and $35, respectively).
- Owner-administered households were responsible for nonfuels only one percent of the time, compared to 30 percent and 25 percent for Public Housing and PHA-administered Section 8 households, respectively. Despite this, the average dollars paid for nonfuels was similar across all program types, ranging from $37 to $46.

Exhibit IV-13
Utility Expenditure - Utility Components:
Percentage of Households and Average Monthly Dollar Amount

Administration Type	Electric		Natural Gas		*Other Fuels**		Nonfuels**	
	%	Avg. $	%	Avg. $	*%*	*Avg. $*	%	Avg. $
Public Housing	97%	$104	37%	$49	*0%*	-	30%	$40
PHA-administered Section 8	97%	$89	51%	$56	1%	$106	25%	$46
Total PHA-administered	*97%*	*$92*	*48%*	*$55*	*1%*	*$106*	*26%*	*$45*
Owner-administered	96%	$68	26%	$35	*0%*	-	1%	$37
Total	**97%**	**$86**	**43%**	**$52**	**1%**	**$106**	**19%**	**$44**

Data in this exhibit are weighted.
* Other fuels include fuel oil, propane, kerosene, coal, and wood. Cell sizes for these estimates are small; therefore, these estimates may not be reliable.
** Nonfuels include water, sewer, and trash. Cell sizes for the Owner-administered estimates are small; therefore, these estimates may not be reliable.

HUSM Utility Allowance. Exhibit IV-14 presents what the HUSM Utility Allowance would have been for households in FY 2015 for each of the programs separately and in combination, along with their associated 95 percent confidence intervals.

- On average, households would have received a monthly HUSM Utility Allowance of $113.
- Households in Owner-administered programs would have received a smaller allowance according to the HUSM ($75), than households in PHA-administered Section 8 and Public Housing programs ($128 and $120, respectively).

Exhibit IV-14
Monthly HUSM Utility Allowance

Administration Type	Average Dollar Amount	95% Confidence Interval
Public Housing	$120	±$31
PHA-administered Section 8	$128	±$11
Total PHA-administered	*$127*	*±$11*
Owner-administered	$75	±$11
Total	**$113**	**±$7**

Data in this exhibit are weighted.

Exhibit IV-15 provides a breakdown of the HUSM Utility Allowance into the four main utility components. The percentage of households who would have received an allowance for the component and the average monthly amount associated with the component, among receivers, are reported.

- Nearly all households would have received an allowance to cover electricity costs, with an average monthly cost of $75.
- Forty-two percent of all households would have received a HUSM allowance for natural gas, with an average monthly cost of $49. Owner-administered households would have received an allowance amount of $34 for this component, while Public Housing and PHA-administered Section 8 households would have received $75 and $49, respectively.
- Owner-administered programs would have provided a HUSM allowance for nonfuels for only 4 percent of households, compared to 25 percent and 27 percent in Public Housing and PHA-administered Section 8 programs, respectively. Despite this, the average dollars provided for nonfuels was similar across all program types, ranging from $63 to $78.

Exhibit IV-15
HUSM Utility Allowance - Utility Components:
Percentage of Households and Average Monthly Dollar Amount

Administration Type	Electric		Natural Gas		Other Fuels*		Nonfuels**	
	%	Avg. $	%	Avg. $	%	Avg. $	%	Avg. $
Public Housing	98%	$84	28%	$75	0%	-	25%	$63
PHA-administered Section 8	100%	$77	53%	$49	4%	$98	27%	$71
Total PHA-administered	*100%*	*$79*	*48%*	*$52*	*3%*	*$98*	*27%*	*$70*
Owner-administered	99%	$65	24%	$34	0%	-	4%	$78
Total	**99%**	**$75**	**42%**	**$49**	**2%**	**$98**	**21%**	**$70**

Data in this exhibit are weighted.
* Other fuels include fuel oil, propane, kerosene, coal, and wood. Cell sizes for these estimates are small; therefore, these estimates may not be reliable.
** Nonfuels include water, sewer, and trash. Cell sizes for the Owner-administered estimates are small; therefore, these estimates may not be reliable.

D. Actual Utility Allowance Subsidy Error

Overview. This subsection provides national estimates of gross and net differences, or subsidy errors, between the Actual Utility Allowance and the Utility Expenditure. The gross differences are the sum of the absolute values of the positive and negative individual household dollar difference, while the net differences are the arithmetic value of the sum of the individual household dollar difference. To provide additional context to these differences, under, over, and matching subsidy rates and dollar errors are first discussed.

In addition, component-level comparisons between the Actual Utility Allowance and Utility Expenditure are presented.

Subsidy Error. Exhibit IV-16 shows the percentage of households who received a matching Actual Utility Allowance subsidy, within $2, when compared to the Utility Expenditure. This exhibit also displays the percentage of households who received an under subsidy and an over subsidy.

- For all program types, the majority of households did not receive a matching Actual Utility Allowance subsidy. Only six percent of households received a matching subsidy.
- Fifty-one percent of all households received a monthly allowance in excess of $2 less than their Utility Expenditure.
- Forty-three percent of all households received a monthly allowance in excess of $2 more than their Utility Expenditure.

Exhibit IV-16
Percentage of Households With Actual Utility Allowance and Utility Expenditure Match

Administration Type	Households With Under Subsidy		Households With Matching Subsidy (Within $2)		Households With Over Subsidy	
	Percentage	Standard Error	Percentage	Standard Error	Percentage	Standard Error
Public Housing	56%	6.2%	5%	2.8%	39%	6.2%
PHA-administered Section 8	54%	4.7%	6%	1.4%	40%	4.7%
Total PHA-administered	*55%*	*3.7%*	*6%*	*1.2%*	*40%*	*3.8%*
Owner-administered	41%	4.6%	6%	2.0%	53%	4.4%
Total	**51%**	**2.5%**	**6%**	**1.2%**	**43%**	**2.8%**

Data in this exhibit are weighted.
Note: Row totals may not add up to 100% due to rounding.

Exhibits IV-17a and IV-17b expand on the incidence of under and over subsidy to also show the average dollar amount of difference for all households when errors of $2 or less are excluded from the calculations; these exhibits present the difference for under subsidy and over subsidy households by the Actual Utility Allowance, respectively.

- The average monthly under subsidy difference was $53 overall.
- Public Housing had the highest rate of under subsidy by the Actual Utility Allowance (56 percent) and the largest average monthly under subsidy ($61).

Exhibit IV-17a
Under-Subsidized Households (Actual Utility Allowance):
Percentage of Households and Average Monthly Dollar Amount of Difference

Administration Type	Percentage of Households With Under Subsidy	Average Dollar Amount of Difference between Actual Utility Allowance and Utility Expenditure	
		For Under-Subsidized Households	For All Households
Public Housing	56%	$61	$34
PHA-administered Section 8	54%	$57	$31
Total PHA-administered	*55%*	*$58*	*$31*
Owner-administered	41%	$37	$15
Total	**51%**	**$53**	**$27**

Data in this exhibit are weighted.

- The average monthly over subsidy difference was $39 overall.
- Owner-administered had the highest rate of over subsidy by the Actual Utility Allowance (53 percent), but the smallest average monthly over subsidy ($30).

Exhibit IV-17b
Over-Subsidized Households (Actual Utility Allowance): Percentage of Households and Average Monthly Dollar Amount of Difference

Administration Type	Percentage of Households With Over Subsidy	Average Dollar Amount of Difference Between Actual Utility Allowance and Utility Expenditure	
		For Over-Subsidized Households	For All Households
Public Housing	39%	$39	$15
PHA-administered Section 8	40%	$45	$18
Total PHA-administered	*40%*	*$44*	*$17*
Owner-administered	53%	$30	$16
Total	**43%**	**$39**	**$17**

Data in this exhibit are weighted.

Exhibit IV-18 presents the average gross and net monthly dollar differences between Actual Utility Allowance and Utility Expenditure and their associated standard errors. To obtain the differences, the dollar amount of over subsidies was added to the dollar amount of under subsidies, first using the absolute values for the Gross Difference and then the arithmetic values for the Net Difference.

- The net difference was -$10 overall (indicating an average monthly under subsidy by the Actual Utility Allowance); the average gross difference was $44 overall.
- Both PHA-administered program types had the largest gross dollar difference of $49 between the Actual Utility Allowance and Utility Expenditure. Public Housing also showed the largest net difference of -$18 (under subsidy).
- The smallest average monthly gross difference of $31 was found in Owner-administered programs. The Owner-administered program also had $0.45 net difference, indicating a slight over subsidy, on average, of the FY 2015 Actual Utility Allowance when compared to the out-of-pocket Utility Expenditure.

Exhibit IV-18
Gross and Net Differences (Monthly) Between Actual Utility Allowance and Utility Expenditure

Administration Type	Gross Difference		Net Difference	
	Average Dollar Difference	Standard Error	Average Dollar Difference	Standard Error
Public Housing	$49	$13.85	-$18	$14.36
PHA-administered Section 8	$49	$5.34	-$13	$6.38
Total PHA-administered	*$49*	*$4.77*	*-$14*	*$5.87*
Owner-administered	$31	$3.38	$0.45	$4.60
Total	**$44**	**$3.22**	**-$10**	**$4.11**

Data in this exhibit are weighted.

Component Error. Component-level analyses are presented to indicate for which utilities the Actual Utility Allowance[17] was most erroneous in covering households' Utility Expenditures.[18] Components analyzed include electric, natural gas, other fuels (i.e., fuel oil, propane, kerosene, coal, and wood), and nonfuels (i.e., water, sewer, and trash).

Exhibit IV-19 provides the percentage of households who received an itemized Actual Utility Allowance and were financially responsible for the Utility Expenditure for each utility component. This exhibit also displays the rate with which each utility component was a portion of allowance when the household was not financially responsible, as well as the rate with which the component was not a portion of the allowance when the household was financially responsible.

- Nearly all of the electric component dollars were correctly received by households as a portion of the allowance and paid by households as an out-of-pocket cost (97 percent).
- Ninety percent of households had natural gas component dollars that were correctly a portion of both utility metrics, compared to seven percent who only received a natural gas allowance portion of the Actual Utility Allowance and three percent who were financially responsible but did not receive an allowance.
- Nonfuel utilities had the largest discrepancy between the utility metrics. Twenty-three percent of households received a nonfuel allowance but did not have financial responsibility for nonfuel utility bills. An Actual Utility Allowance was not received for nonfuels, despite out-of-pocket expenditures, for 12 percent of households.

[17] The utilities for which a household received a utility allowance was determined from tenant file documents and project-provided documentation of utility allowances.

[18] The utilities for which a household was financially responsible was determined from information gathered during the household interview.

Exhibit IV-19
Percentage of Households With Mismatched Receipt of Actual Utility Allowance and Financial Responsibility, by Utility Component

Utility Component	Does Receive Allowance and Is Financially Responsible	Does Receive Allowance and Is Not Financially Responsible	Does Not Receive Allowance and Is Financially Responsible
Electric	97%	3%	< 1%
Natural Gas	90%	7%	3%
Other Fuels*	23%	77%	0%
Nonfuels**	65%	23%	12%

Data in this exhibit are weighted.
* Other fuels include fuel oil, propane, kerosene, coal, and wood. Cell sizes for these estimates are small; therefore, these estimates may not be reliable.
** Nonfuels include water, sewer, and trash. Row total may not add up to 100% due to rounding.

Exhibits IV-20a through IV-20c expand on these utility component rates to provide the average monthly dollar amounts and gross and net differences for the electric, natural gas, and nonfuel utility components for program types separately and in combination.[19] Households who did not receive an Actual Utility Allowance and did not have a Utility Expenditure for a given component were excluded from the component's exhibit. Further, average dollar, gross difference, and net difference amounts are only provided for those households where itemized Actual Utility Allowance amounts could be identified (see subsection *C. Utility Metrics* for more information).

- PHA-administered Section 8 shows the largest gross difference of $44 and largest net difference of -$24 (under subsidy) between the Actual Utility Allowance and Utility Expenditure for electricity.
- Public Housing households also received an average under subsidy of their electric Utility Expenditures, with a -$14 net difference. Conversely, Owner-administered households received an average over subsidy for electric costs, with a net difference of $5.
- Owner-administered and Public Housing households had similar gross differences of $24 and $29, respectively.

[19] Due to small cell sizes, an Exhibit for other fuels (i.e., fuel oil, propane, kerosene, coal, and wood) is not presented.

Exhibit IV-20a
Average Monthly Electric Actual Allowance and Expenditure for All Program Types

Administration Type	Actual Utility Allowance		Utility Expenditure		Gross Difference	Net Difference
	Percentage of Households	Average Dollar Amount	Percentage of Households	Average Dollar Amount		
Public Housing	100%	$77	99%	$91	$29	-$14
PHA-administered Section 8	100%	$64	98%	$88	*$44*	*-$24*
Total PHA-administered	*100%*	*$67*	*98%*	*$88*	*$41*	*-$22*
Owner-administered	99%	$63	96%	$58	$24	$5
Total	**100%**	**$66**	**98%**	**$82**	**$37**	**-$16**

Data in this exhibit are weighted.

- Overall, households received a slight under subsidy for their natural gas costs with a net difference of -$3.
- PHA-administered Section 8 households had an under subsidy for the natural gas component (-$5 net difference), whereas Owner-administered and Public Housing households had over subsidies ($16 and $7 net differences, respectively).
- Owner-administered and Public Housing had similar gross differences for natural gas with differences ranging from $16 to $18. PHA-administered Section 8 showed a $31 gross difference.

Exhibit IV-20b
Average Monthly Natural Gas Actual Allowance and Expenditure for All Program Types

Administration Type	Actual Utility Allowance		Utility Expenditure		Gross Difference	Net Difference
	Percentage of Households	Average Dollar Amount	Percentage of Households	Average Dollar Amount		
Public Housing	100%	$51	92%	$44	$18	$7
PHA-administered Section 8	96%	$46	92%	$51	$31	-$5
Total PHA-administered	*97%*	*$47*	*92%*	*$50*	*$30*	*-$3*
Owner-administered	100%	$31	96%	$15	$16	$16
Total	**97%**	**$46**	**93%**	**$49**	**$29**	**-$3**

Data in this exhibit are weighted.

- Overall, households received an over subsidy in their Actual Utility Allowance to help cover nonfuel (i.e., water, sewer, and trash) Utility Expenditures with a net difference of $15.
- Public Housing and PHA-administered Section 8 households had the same gross difference of $35.
- Public Housing households had a slightly smaller average over subsidy ($13 net difference), than PHA-administered Section 8 households ($15 net difference).

Exhibit IV-20c
Average Monthly Nonfuel Actual Allowance and Expenditure for All Program Types

Administration Type	Actual Utility Allowance		Utility Expenditure		Gross Difference	Net Difference
	Percentage of Households	Average Dollar Amount	Percentage of Households	Average Dollar Amount		
Public Housing	93%	$55	100%	$42	$35	$13
PHA-administered Section 8	86%	$50	75%	$34	*$35*	$15
Total PHA-administered	*88%*	*$50*	*79%*	*$35*	*$35*	*$15*
Owner-administered*						
Total	**88%**	**$50**	**77%**	**$35**	**$35**	**$15**

Data in this exhibit are weighted.
Note: Nonfuel includes water, sewer, and trash.
* Data are not presented for Owner-administered because availability of this data resulted in unweighted cell sizes too small for estimation.

E. HUSM Utility Allowance Subsidy Error

Overview. This subsection provides national estimates of gross and net differences, or subsidy errors, between the HUSM Utility Allowance and the Utility Expenditure. The gross differences are the sum of the absolute values of the positive and negative individual household dollar difference, while the net differences are the arithmetic value of the sum of the individual household dollar difference. To provide additional context to these differences, under, over, and matching subsidy rates and dollar errors are first discussed.

In addition, component-level comparisons between the HUSM Utility Allowance and Utility Expenditure and a discussion of the HUSM's usability and accuracy are presented.

Subsidy Error. Exhibit IV-21 shows the percentage of households who would have received a matching HUSM Utility Allowance subsidy, within $2, when compared to the Utility Expenditure. This exhibit also displays the percentage of households who would have received an under subsidy and an over subsidy.

- For all program types, the majority of households would not have received a matching HUSM Utility Allowance subsidy. Only four percent of households would have received a matching subsidy.
- Forty-two percent of all households would have received a monthly allowance according to the HUSM in excess of $2 less than their Utility Expenditure.
- Fifty-four percent of all households would have received a monthly allowance according to the HUSM in excess of $2 more than their Utility Expenditure.

Exhibit IV-21
Percentage of Households With HUSM Utility Allowance and Utility Expenditure Match

Administration Type	Households With Under Subsidy		Households With Matching Subsidy (Within $2)		Households With Over Subsidy	
	%	Avg. $	%	Avg. $	%	Avg. $
Public Housing	46%	5.9%	5%	3.5%	49%	6.5%
PHA-administered Section 8	43%	4.6%	3%	0.9%	54%	4.4%
Total PHA-administered	*43%*	*4.0%*	*3%*	*1.1%*	*53%*	*4.0%*
Owner-administered	38%	4.7%	6%	2.5%	55%	4.7%
Total	**42%**	**2.9%**	**4%**	**1.0%**	**54%**	**2.7%**

Data in this exhibit are weighted.
Note: Row totals may not add up to 100% due to rounding.

Exhibits IV-22a and IV-22b expand on the incidence of under and over subsidy to also show the average dollar amount of difference for all households when errors of $2 or less are excluded from the calculations; these exhibits present the difference for under subsidy and over subsidy households by the HUSM Utility Allowance, respectively.

- The average monthly under subsidy difference was $58 overall.
- Public Housing had the highest rate of under subsidy by the HUSM Utility Allowance (46 percent) and the largest average monthly under subsidy ($73).

Exhibit IV-22a
Under-Subsidized Households (HUSM Utility Allowance):
Percentage of Households and Average Monthly Dollar Amount of Difference

Administration Type	Percentage of Households With Under Subsidy	Average Dollar Amount of Difference Between HUSM Utility Allowance and Utility Expenditure	
		For Under-Subsidized Households	For All Households
Public Housing	46%	$73	$33
PHA-administered Section 8	43%	$61	$26
Total PHA-administered	*43%*	*$63*	*$27*
Owner-administered	38%	$41	$16
Total	**42%**	**$58**	**$24**

Data in this exhibit are weighted.

- The average monthly over subsidy difference was $41 overall.
- Owner-administered had the highest rate of over subsidy by the HUSM Utility Allowance (55 percent), but the smallest average monthly over subsidy ($29).

Exhibit IV-22b
Over-Subsidized Households (HUSM Utility Allowance):
Percentage of Households and Average Monthly Dollar Amount of Difference

Administration Type	Percentage of Households With Over Subsidy	Average Dollar Amount of Difference Between HUSM Utility Allowance and Utility Expenditure	
		For Over-Subsidized Households	For All Households
Public Housing	49%	$44	$22
PHA-administered Section 8	54%	$46	$25
Total PHA-administered	*53%*	*$46*	*$24*
Owner-administered	55%	$29	$16
Total	**54%**	**$41**	**$22**

Data in this exhibit are weighted.

Exhibit IV-23 presents the average gross and net monthly dollar differences between HUSM Utility Allowance and Utility Expenditure and their associated standard errors. To obtain the differences, the dollar amount of over subsidies was added to the dollar amount of under subsidies, first using the absolute values for the Gross Difference and then the arithmetic values for the Net Difference.

- The net difference was -$2 overall (indicating an average monthly under subsidy by the HUSM Utility Allowance); the average gross difference was $47 overall.
- Public Housing HUSM Utility Allowances would have provided the largest under subsidy, with a net difference of -$11. This program type also shows the largest gross dollar difference of $55.
- A slight over subsidy would have been provided to households in the Owner-administered program, according to the HUSM, with a net difference of $0.05. Owner-administered also had the smallest average monthly gross difference of $32.

Exhibit IV-23
Gross and Net Differences (Monthly) Between HUSM Utility Allowance and Utility Expenditure

Administration Type	Gross Difference		Net Difference	
	Average Dollar Difference	Standard Error	Average Dollar Difference	Standard Error
Public Housing	$55	$14.15	-$11	$7.83
PHA-administered Section 8	$51	$5.80	-$1	$5.35
Total PHA-administered	*$52*	*$4.78*	*-$3*	*$4.23*
Owner-administered	$32	$2.30	$0.05	$4.95
Total	**$47**	**$3.37**	**-$2**	**$2.73**

Data in this exhibit are weighted.

Component Error. Component-level analyses are presented to indicate for which utilities the HUSM Utility Allowance[20] was most erroneous in producing allowances to cover households' Utility Expenditures.[21] Components analyzed include electric, natural gas, other fuels (i.e., fuel oil, propane, kerosene, coal, and wood), and nonfuels (i.e., water, sewer, and trash).

Exhibit IV-24 provides the percentage of households who would have received an itemized HUSM Utility Allowance and had a Utility Expenditure for each utility component. This exhibit also displays the rate with which each utility component was a portion of the allowance when the household was not financially responsible, as well as the rate with which the component was not a portion of the allowance when the household was financially responsible.

- Nearly all of the electric component dollars would have been correctly received by households as a portion of the allowance and were paid by households as an out-of-pocket cost (97 percent).
- Eighty-four percent of households had natural gas component dollars that were correctly a portion of both utility metrics, compared to seven percent who would have only received a natural gas allowance portion of the HUSM Utility Allowance and nine percent who were financially responsible but would not have received an allowance.
- Nonfuel utilities (i.e., water, sewer, and trash) had the largest discrepancy between the utility metrics. Twenty percent of households would have received a nonfuel allowance, but did not have financial responsibility for nonfuel utility bills. A HUSM Utility Allowance would not have been received for nonfuels, despite out-of-pocket expenditures, for 14 percent of households.

Exhibit IV-24
Percentage of Households With Mismatched Receipt of HUSM Utility Allowance and Financial Responsibility, by Utility Component

Utility Component	Does Receive Allowance and Is Financially Responsible	Does Receive Allowance and Is Not Financially Responsible	Does Not Receive Allowance and Is Financially Responsible
Electric	97%	3%	< 1%
Natural Gas	84%	7%	9%
Other Fuels*	23%	77%	0%
Nonfuels**	66%	20%	14%

Data in this exhibit are weighted.
* Other fuels include fuel oil, propane, kerosene, coal, and wood. Cell sizes for these estimates are small; therefore, these estimates may not be reliable.
** Nonfuels include water, sewer, and trash.

[20] The utilities for which a household would have received a HUSM Utility Allowance was determined from tenant file documents and project-provided documentation of utility allowances.

[21] The utilities for which a household was financially responsible was determined from information gathered during the household interview.

Exhibits IV-25a through IV-25c expand on these utility component rates to provide the average monthly dollar amounts and gross and net differences for the electric, natural gas, and nonfuels utility components for program types separately and in combination.[22] Households who would not have received a HUSM Utility Allowance and did not have a Utility Expenditure for a given component were excluded from the component's exhibit.

- Public Housing showed the largest differences between the HUSM Utility Allowance and Utility Expenditure for electricity, with a $42 of gross difference and -$18 of net difference (under subsidy).
- Owner-administered and PHA-administered Section 8 households also would have received an under subsidy for the utility component via the HUSM (-$2 and -$10 net difference, respectively). Further, these programs had similar gross differences of $29 and $34, respectively.

Exhibit IV-25a
Average Monthly Electric HUSM Allowance and Expenditure for All Program Types

Administration Type	HUSM Utility Allowance		Utility Expenditure		Gross Difference	Net Difference
	Percentage of Households	Average Dollar Amount	Percentage of Households	Average Dollar Amount		
Public Housing	100%	$84	99%	$103	$42	-$18
PHA-administered Section 8	100%	$77	98%	$87	$34	-$10
Total PHA-administered	*100%*	*$79*	*98%*	*$90*	*$36*	*-$11*
Owner-administered	99%	$64	96%	$66	$29	-$2
Total	**100%**	**$75**	**98%**	**$84**	$34	-$9

Data in this exhibit are weighted.

- Overall, households would have received an under subsidy for their natural gas costs according to the HUSM, with a net difference of -$3.
- PHA-administered Section 8 and Owner-administered households would have had an average under subsidy for the natural gas component (-$4 net difference for both), whereas Public Housing households would have had over subsidies ($7 net difference).
- Owner-administered would have had the smallest gross difference of $21, whereas the other program types had similar gross differences ranging from $32 to $39.

[22] Due to small cell sizes, an Exhibit for other fuels (i.e., fuel oil, propane, kerosene, coal, and wood) is not presented.

Exhibit IV-25b
Average Monthly Natural Gas HUSM Allowance and Expenditure for All Program Types

Administration Type	HUSM Utility Allowance		Utility Expenditure		Gross Difference	Net Difference
	Percentage of Households	Average Dollar Amount	Percentage of Households	Average Dollar Amount		
Public Housing	75%	$56	100%	$49	$39	$7
PHA-administered Section 8	96%	$47	91%	$51	$32	-$4
Total PHA-administered	*92%*	*$48*	*92%*	*$51*	*$33*	*-$3*
Owner-administered	86%	$29	96%	$34	*$21*	-$4
Total	**91%**	**$45**	**93%**	**$48**	**$31**	-$3

Data in this exhibit are weighted.

- Overall households would have received an over subsidy via the HUSM Utility Allowance to help cover nonfuel (i.e., water, sewer, and trash) Utility Expenditures, with a net difference of $24.
- Public Housing and PHA-administered Section 8 households had similar gross differences of $40 and $42, respectively.
- Public Housing households had a smaller average over subsidy cost ($13 net difference), than PHA-administered Section 8 households ($25 net difference).

Exhibit IV-25c
Average Monthly Nonfuel HUSM Allowance and Expenditure for All Program Types

Administration Type	HUSM Utility Allowance		Utility Expenditure		Gross Difference	Net Difference
	Percentage of Households	Average Dollar Amount	Percentage of Households	Average Dollar Amount		
Public Housing	84%	$53	100%	$40	$40	$13
PHA-administered Section 8	86%	$61	79%	$36	$42	$25
Total PHA-administered	*85%*	*$59*	*83%*	*$37*	*$42*	*$22*
Owner-administered*	100%	$78	32%	$12	*$67*	*$67*
Total	**86%**	**$60**	**80%**	**$36**	**$43**	**$24**

Data in this exhibit are weighted.
Note: Nonfuel includes water, sewer, and trash.
* Cell sizes for these estimates are small; therefore, these estimates may not be reliable.

HUSM Usefulness and Accuracy. In addition to comparing the HUSM Utility Allowance to the Utility Expenditure to estimate subsidy error, the following issues related to HUSM usability were identified:

- HUSM contains incorrect fuel source options for calculating the water heating allowance
- HUSM erroneously excludes other fees allowance when applicable

- HUSM has a restricted tariff structure that complicated rate data entry for electric, natural gas, water, and sewer
- HUSM has limited consumption unit options for water, sewer, and propane that did not align with industry norms
- HUSM has limited availability of utilities and bedroom sizes for which HUSM utility allowances were available

While the UAC Study implemented specific procedures to handle these restrictions and produce accurate HUSM Utility Allowances and associated estimates, it is possible that project staff using the HUSM may not have used similar methods and may have calculated incorrect utility allowance amounts.

HUSM Recalculation. An analysis was conducted to compare the Actual Utility Allowance and HUSM Utility Allowance amounts among the 38 responding households whose project stated they used the HUSM to set their actual allowances in FY 2015 and who were sampled for a HUSM recalculation; six of these households received assistance through Public Housing and the remaining 32 through PHA-administered Section 8. For these households it was expected that the Actual and HUSM Utility Allowances were equal, because the HUSM tool was used by the project staff to set the Actual Utility Allowances, and any discrepancies found between the metrics may have been tied to the HUSM usability issues previously stated. Exhibit IV-26 displays the unweighted percentage of households where the Actual Utility Allowance was less than, within ±$2 of, and greater than the recalculated HUSM Utility Allowance, as well as the associated average monthly dollar difference.

- All Public Housing HUSM recalculation households had an Actual Utility Allowance in FY 2015 that was less than the recalculated HUSM Utility Allowance, with an average dollar difference of $14.
- Nineteen percent of PHA-administered Section 8 HUSM recalculation households had an Actual Utility Allowance that was more than the recalculated HUSM Utility Allowance, with an average dollar difference of $26. Sixty-nine percent of these households had an Actual amount that was less than the recalculated HUSM amount, with an average dollar difference of $55.
- Thirteen percent of PHA-administered Section 8 HUSM recalculation households had an Actual Utility Allowance that was within ±$2 of their recalculated HUSM Utility Allowance.

Exhibit IV-26
Actual Utility Allowance Accuracy Among HUSM Recalculation Households

Administration Type	HUSM Utility Allowance		Utility Expenditure		Actual Utility Allowance is Greater Than HUSM Utility Allowance
	Percentage	Average Dollar Difference*	Percentage	Percentage	Average Dollar Difference*
Public Housing	100%	$14	0%	0%	-
PHA-administered Section 8**	69%	$55	13%	19%	$26
Total	74%	$46	11%	16%	$26

Data in this exhibit are not weighted.
Note: Owner-administered is not represented in the table, because Owner-administered households were not sampled for HUSM recalculation.
* Average Dollar Differences presented are among those households in the difference category, not among all HUSM recalculation households.
** Row totals may not add up to 100% due to rounding.

F. Statistical Comparisons of Utility Metrics

This subsection discusses whether statistically significant differences were found between the utility allowances—either Actual or HUSM—and the Utility Expenditure, as well as whether dollar differences found between the two forms of allowances and out-of-pocket costs were statistically different from one another.

Exhibit IV-27 displays the average monthly Actual Utility Allowance and Utility Expenditure for each of the program types of interest separately and in combination, along with their associated 95 percent confidence intervals.

- No statistically significant results were found between the Actual Utility Allowance and Utility Expenditure for each program type separately and in combination. On average, the allowances received by assisted households in FY 2015 were not statistically different in value from the amount paid out of pocket for utility costs.

Exhibit IV-27
Monthly Actual Utility Allowance and Utility Expenditure

Administration Type	Actual Utility Allowance		Utility Expenditure	
	Average Dollar Amount	95% Confidence Interval	Average Dollar Amount	95% Confidence Interval
Public Housing	$113	±$22	$131	±$40
PHA-administered Section 8	$117	±$14	$130	±$15
Total PHA-administered	*$116*	*±$11*	*$130*	*±$14*
Owner-administered	$76	±$12	$75	±$13
Total	**$105**	**±$9**	**$116**	**±$10**

Data in this exhibit are weighted.
Note: Table results combine Exhibits IV-12 and IV-14 for the convenience of the reader.

Exhibit IV-28 displays the average monthly HUSM Utility Allowance and Utility Expenditure for each of the program types of interest separately and in combination, along with their associated 95 percent confidence intervals.

- No statistically significant results were found between the HUSM Utility Allowance and Utility Expenditure for each program type separately and in combination. On average, the allowances that would have been received by assisted households in FY 2015, according to the HUSM, were not statistically different in value from the amount paid out of pocket for utility costs.

Exhibit IV-28
Monthly HUSM Utility Allowance and Utility Expenditure

Administration Type	HUSM Utility Allowance		Utility Expenditure	
	Average Dollar Amount	95% Confidence Interval	Average Dollar Amount	95% Confidence Interval
Public Housing	$120	±$31	$131	±$40
PHA-administered Section 8	$128	±$11	$130	±$15
Total PHA-administered	*$127*	*±$11*	*$130*	*±$14*
Owner-administered	$75	±$11	$75	±$13
Total	**$113**	**±$7**	**$116**	**±$10**

Data in this exhibit are weighted.
Note: Table results combine Exhibits IV-12 and IV-14 for the convenience of the reader.

Exhibit IV-29 presents the unweighted mean square error (MSE) for the Actual Utility Allowance when compared to the Utility Expenditure and the HUSM Utility Allowance when compared to the Utility Expenditure for each program separately and in combination. The MSE is the average squared difference of the utility allowance (either Actual or HUSM) and the Utility Expenditure, and is a measure of allowance's accuracy in predicting out-of-pocket costs. Ideally, the MSE would be zero, indicating that the utility allowance predicts, or matches, the Utility Expenditure exactly. The smaller the MSE, the closer the utility allowance metric is to the utility costs incurred by the household.[23]

- No statistically significant results were found between the Actual Utility Allowance MSE and the HUSM Utility Allowance MSE for each program type separately and in combination. Neither form of utility allowance produced subsidies closer to households' out-of-pocket costs than the other.
- Owner-administered had the smallest MSEs, indicating that allowances provided to households in this program type—either Actual or HUSM—are closest to the Utility Expenditure.

[23] MSE data presented in Exhibit IV-29 are not weighted. MSEs are used to assess the accuracy of an estimate (i.e., allowance) in predicting a true value (i.e., tenant-paid utility costs) on a case by case basis. In order to understand whether an allowance model performs better than the other at predicting tenant-paid utility costs, the case by case, unweighted comparison of the MSEs was required.

- Public Housing had the largest MSEs, indicating that allowances provided to households in this program type—either Actual or HUSM—are furthest from the Utility Expenditure.

Exhibit IV-29
Difference (Monthly) Between Utility Allowance Metrics and Utility Expenditure: MSEs

Administration Type	Actual Utility Allowance vs. Utility Expenditure		HUSM Utility Allowance vs. Utility Expenditure	
	MSE	95% Confidence Interval	MSE	95% Confidence Interval
Public Housing	7,654	±10,823	5,851	±7,235
PHA-administered Section 8	4,585	±2,024	4,553	±1,914
Total PHA-administered	*5,506*	*±3,307*	*4,943*	*±2,261*
Owner-administered	1,430	±582	1,558	±417
Total	**3,954**	**±1,986**	**3,654**	**±1,364**

Data in this exhibit are not weighted.

Although statistically significant differences were not found when comparing the allowances, certain trends were evident. Exhibit IV-30 reiterates the average gross and net differences between the two forms of allowances and the Utility Expenditure to support these trends.

- Overall, the Actual Utility Allowance provided an under subsidy on average (-$10 net difference). The HUSM Utility Allowance also provided an under subsidy on average, but to a lesser extent (-$2 net difference).
- Overall, the Actual Utility Allowance and HUSM Utility Allowance provided comparable average gross differences ($44 and $47, respectively).
- On average, HUSM Utility Allowances were associated with larger gross differences, but Actual Utility Allowances were associated with larger net differences.
- Owner-administered households had a slight over subsidy on average for both the Actual and HUSM Utility Allowance, with $0.45 and $0.05 net differences, respectively.

Exhibit IV-30
Gross and Net Differences (Monthly) Between Utility Allowance Metrics and Utility Expenditure

Administration Type	Actual Utility Allowance vs. Utility Expenditure		HUSM Utility Allowance vs. Utility Expenditure	
	Gross Difference	Net Difference	Gross Difference	Net Difference
Public Housing	$49	-$18	$55	-$11
PHA-administered Section 8	$49	-$13	$51	-$1
Total PHA-administered	*$49*	*-$14*	*$52*	*-$3*
Owner-administered	$31	$0.45	$32	$0.05
Total	**$44**	**-$10**	**$47**	**-$2**

Data in this exhibit are weighted.
Note: Table results combine Exhibits IV-18 and IV-23 for the convenience of the reader.

V. Recommendations

The inception UAC Study sought to ascertain whether utility allowances being used by HUD's RHAP were reasonably accurate relative to actual tenant-paid utility costs. In addition, it aimed to determine the usefulness and accuracy of the HUSM tool in setting utility allowance schedules. Findings to fulfill these objectives suggest general actions or policies that should be considered with respect to utility allowances. In subsection A. Policy Actions, we present recommendations that may decrease utility allowance subsidy error rates in HUD programs, based on insights we have gathered during this study.

In addition to program recommendations, we examined how the UAC Study can be improved. Any changes and improvements that would be made in the execution of the study would help to achieve increased efficiency, reduced burden on project staff and households, and a better understanding of utility allowance determinations and subsidy error. In subsection B. Future Research, we provide recommendations for improving the data collection process and the quality of the data used in the analysis of utility allowance subsidy error.

A. Policy Actions

It should be noted that the study was not designed to provide recommendations on program policies and procedures in determining and setting utility allowances. However, findings from the study suggest general actions or policies that should be considered to maintain or improve PHA/Project performance in utility allowance calculations. In the following, we present recommendations that may decrease subsidy error rates in HUD programs, based on insights we have gathered during this study.

1. **Focus Utility Allowance Modification Efforts on Electricity.** If HUD would like to have more alignment between utility allowances and out-of-pocket utility expenses, resources should be dedicated to aligning electricity subsidies. The majority of households with a utility allowance have an allowance to cover tenant-paid electric costs, and the electric component showed large gross differences and net differences as an under subsidy overall. HUD should focus on implementing changes to electric utility allowance levels, in either the HUSM tool or in regulations that surround other utility allowance determination methods, prior to evaluating allowances for other utilities. HUD should also consider implementing these changes on a program-specific basis. Owner-administered properties are typically newer structures built under modern and stringent energy codes, and those households may not consume as much electricity. Conversely, Public Housing properties were typically built prior to stringent energy codes and may consume more electricity. Also, HUD regulations prevent Public Housing households from receiving an allowance to cover air conditioning, but tenants may be required to pay out of pocket for the electricity to fuel the air conditioning. By providing assisted households with electric utility allowance levels that better reflect out-of-pocket expenses, the amount of subsidy error associated with utility allowances will likely decrease.
2. **Implement HUSM Improvements and Trainings.** Study findings showed that current HUSM users are producing incorrect allowances via the tool. HUD should consider making improvements to the HUSM tool to increase the accuracy of data entry and calculated utility allowances. Improvements may include:

- Updating the tool to better align with utility rate industry norms
- Updating the tool to include currently excluded characteristics of units (e.g., six bedrooms or larger) rented by the assisted housing population
- Developing location options that are site-specific for Public Housing and Owner-administered properties

In addition, HUD should consider providing HUSM technical training and assistance to PHA/Project staff to supplement the HUSM instruction document already available. Web-based forums and interactive trainings focused on best practices and troubleshooting to accurately use the HUSM to produce allowances would provide comprehensive support to HUSM users and potentially increase the use of the tool. Accurate and increased use of an improved HUSM tool would result in more consistent and transparent allowances being provided to households nationally.

3. **Perform Project-level Reviews and Approvals of Utility Allowance Levels.** HUD should consider requiring review and approval of utility allowance levels by HUD-contracted compliance agencies for all HUD-assisted programs. In addition, PHAs/Projects should be held accountable for supplying concrete documentation of utility allowance determination methods and data. Analytical findings showed that Owner-administered programs provided allowances to households that were closest to actual tenant-paid utility costs, and this program type is currently required to submit a utility analysis and documentation for review and approval prior to implementing changes in utility allowance levels. PHA-administered programs do not require utility allowance review and verification. Implementing reviews is essential to improving accountability in updating allowances in a timely manner, with respect to utility rate changes, and is likely a key factor in reducing subsidy error.
4. **Create Utility Database.** HUD should consider developing a utility database to systematically collect utility information, such as unit characteristics, location, and utility consumption, from PHAs/Projects. Data collected could be used to inform HUSM modifications, accessed by PHAs/Projects to calculate utility allowances via their preferred method, and analyzed to estimate conservative use thresholds. HUD may also consider forming relationships with Federal and State agencies, organizations, and utility companies to capture data not easily obtained from PHAs/Projects in order to develop a comprehensive and robust utility database. The development of the database should mitigate, to the extent possible, the burden placed on PHAs/Projects and tenants in supplying utility information and should consider biases that may exist by partnering with external entities (e.g., the largest utility companies) that are not completely representative of providers nationwide. The development should also be coupled with policies aimed at addressing utility allowance subsidy error.

B. Future Research

In addition to providing general program recommendations to improve subsidy error rates, we offer suggestions to improve the UAC Study that provides the estimates of these subsidy error rates. The current methodology used by ICF to conduct the study is contained within the parameters of current study objectives and the coupling of the study with the HUDQC Study. The following

recommendations serve to expand the utility of the data collected, support HUD's research goals, and improve the overall efficiency of ongoing quality control studies.

5. **Expand Methodology to Mitigate Nonresponse by Utility Companies.** Twenty-seven percent of the households sampled were used to produce analytical estimates (respondents); the remaining 73 percent had missing data that prevented the calculation of a utility metric (nonrespondents). For the majority of nonrespondents, data were unavailable for Utility Expenditure calculations. To improve data quality and increase response rates, the current data collection methodology could be expanded to include incentives to tenants to provide accurate and complete information during the household interview. An incentive initiative may improve the availability and accuracy of information needed for utility companies to fulfill data requests, such as utility provider, account number, and account holder name. Higher incentive levels could also be implemented to ask households to obtain the required consumption and rate information by accessing their online utility account in advance of the interview, alleviating the need for a study headquarters request.

   To help mitigate instances where utility companies do not provide a response to requests for data to calculate the Utility Expenditure, study methodology could be expanded to include targeted, initial outreach to the largest utility companies servicing sampled households prior to field data collection. Outreach may include fact sheets detailing the types of data that will be requested, the use of the requested data, and the impact and benefit of subsequent study findings. Additionally, HUD could establish relationships with the largest utility companies to help in outreach efforts. Obtaining buy-in from larger entities would likely increase response rates, as well as likely decrease the length of time it takes to obtain complete consumption data among those that are already responders.

6. **Incorporate Additional Objectives in the UAC Study.** The current study research questions sought to understand which methods PHAs/Projects used to set their utility allowance levels, as well as to determine the amount of subsidy error associated with current allowances compared to tenant-paid expenditures. HUD should expand these objectives to include a cost-benefit analysis of the endorsed methods. The current methodology could be leveraged to determine the benefit (i.e., reduction in subsidy error) of each method, and current data collection efforts could be expanded to obtain information on the cost to the PHA/Project or HUD in calculating utility allowances for a given year. This analysis would better detect the best models for balancing accuracy and administration burden to inform policy changes.

   HUD may also consider expanding the objectives of the study to include an analysis of assisted households' level of utility consumption. Because utility allowances are intended to help cover utility use of an energy-conservative household, it is important to understand whether subsidy errors are a result of households consuming more in utilities than what is deemed conservative or rather an unrealistically low utility allowance. The investigation could draw upon current study methodology, but may require either access to conservative use thresholds or the development of assumptions to define the conservative use threshold.

7. **Conduct the UAC Study as a Separate Task From the HUDQC Study.** HUD may consider conducting the UAC Study as an investigation separate from the HUDQC Study. Decoupling the two studies would have the following advantages:

- A separate sampling methodology could be designed to more directly target the population of interest, or those households that receive a utility allowance. This would have the impact of providing a more efficient sample to address HUD's research questions and to achieve a specific level of statistical precision. The methodology could include an analysis of the propensity for nonresponse, or missing data, prior to sample selection to proactively mitigate low response rates.
- The length of the household interview and associated tenant burden would be decreased because tenants would not be asked questions about their household income, assets, expenses, and composition in addition to utility questions.

Appendix A: Nonresponse Considerations and Analysis

Appendix A: Nonresponse Considerations and Analysis

This appendix details nonresponse considerations and describes the nonresponse analysis that was performed for the UAC Study. Households in the UAC Study subgroup were first classified as respondents and nonrespondents on the basis of the availability of data to calculate the three main utility metrics (i.e., Actual Utility Allowance, Utility Expenditure, and HUSM Utility Allowance). Then, an analysis was completed to determine if respondent households differed from nonrespondent households to inform additional weighting procedures.

Nonresponse Considerations. The UAC Study's main research questions, as presented in *Section III: Research Questions and Analytical Methods*, required that the three utility metrics of interest be compared, and thus all three had to be present for each household. Specifically, Research Question 4 required ICF to answer whether or not the difference found between the Actual Utility Allowance and the Utility Expenditure was statistically different from the difference found between the HUSM Utility Allowance and the Utility Expenditure. To make this determination, we needed to analyze only those households with amounts for all three utility metrics.

Response Designation

ICF designated each subgroup household as respondent or nonrespondent based on the presence of data that were needed to calculate the utility metrics of interest were complete. The three utility metrics of interest are:

- **Actual Utility Allowance.** This utility metric was derived from Forms HUD-50058/50059 or, if missing, was obtained from other sources in the household's file. The categories that ICF assigned for this metric were:
  - *Amount equal to $0*—Household did not receive a utility allowance.
  - *Amount greater than $0*—Household received a utility allowance.

  The assignment of a household to these categories did not affect its overall response designation.
- **Utility Expenditure.** The actual utility costs incurred by a household was a calculated average monthly amount, derived from data collected directly from the household or project and from third-party utility companies. ICF could determine whether a household had actual financial responsibility to furnish the utilities for their unit (i.e., the calculated amount was greater than $0); however, barriers existed in collecting all the data needed to complete this calculation (see Nonresponse Dispositions that follows for a discussion of these barriers). Therefore, the categories that ICF assigned for this metric were:
  - *Amount equal to $0*—Household was not financially responsible for utilities.
  - *Amount greater than $0 and could be calculated*—Household was financially responsible for utilities, and the explicit average monthly amount could be determined.
  - *Amount would be greater than $0 but could not be calculated*—Household was financially responsible for utilities, but the average monthly amount could not be determined.

  The assignment of a household to these categories did affect overall response designation. If a household was assigned to the *amount would be greater than $0 but could not be*

calculated category, then this utility metric was not available for the household and was designated as a nonrespondent household for all analyses.

- **HUSM Utility Allowance.** This utility metric was calculated using HUD's HUSM Microsoft Excel workbook, which required entering information from the household's file and third-party utility companies. ICF could determine whether a PHA/Project had given actual financial responsibility for the utilities in the unit to the household (i.e., the calculated allowance will be greater than $0), but barriers existed in collecting all the data needed to complete this calculation (see *Nonresponse Dispositions* that follows for a discussion of these barriers). Therefore, the categories that ICF assigned for this metric were:
  - *Amount equal to $0*—Household was not financially responsible for utilities according to the PHA/Project.
  - *Amount greater than $0 and could be calculated*—Household was financially responsible for utilities according to the PHA/Project, and the explicit average monthly amount could be determined.
  - *Amount would be greater than $0 but could not be calculated*—Household was financially responsible for utilities according to the PHA/Project, but the average monthly amount could not be determined.

  The assignment of a household to these categories did affect overall response designation. If a household was assigned to the *amount would be greater than $0 but could not be calculated* category, then the household did not have this utility metric and was designated as a nonrespondent household for all analyses.

There were multiple combinations of categories across the three utility metrics given the two categories for Actual Utility Allowance and three categories for Utility Expenditure and HUSM Utility Allowance Households. Households with an Actual Utility Allowance, Utility Expenditure, and HUSM Utility Allowance all equal $0 were excluded from the UAC Study subgroup, as discussed in *Section II: Methodology*.

Subgroup households with complete data for all three utility metrics were designated as respondents and were included in the analyses. Households that had an *amount equal to $0* category on one or two of the utility metrics were still included as respondents, if the other utility metric(s) had a category of *amount greater than $0 and could be calculated*. Households in this situation were included to accurately capture under and over subsidies of utility allowances. It is possible that a household was not receiving a utility allowance, either Actual or HUSM, but did have actual utility costs. Similarly, a household could have received an allowance, although they had no Utility Expenditure for their unit.

Households with incomplete data for at least one utility metric, where the amount would be greater than $0, were designated as nonrespondents and were not included in the analyses.

Nonresponse Dispositions

The 10 combinations of utility metrics' categories that yielded a nonrespondent designation were further classified into a nonresponse disposition, or reason why utility metric amount(s) could not

be calculated. Nonresponse dispositions were coded separately for incomplete Utility Expenditure data and for incomplete HUSM Utility Allowance data, and were related to household/unit characteristics and utility company characteristics. Unweighted rates of nonresponse dispositions are presented in *Section IV: Findings, B. Response Rates*. Nonresponse dispositions are as follows.

- Utility Expenditure Nonresponse Dispositions
  - Utility company only provides data to the serviced customer
  - Additional restrictions existed that related to the company's proprietary release form
  - Correct utility company provider name or contact information was not provided by the household
  - Account number was required by the utility company to fulfill data request and was not provided by the household
  - Reliable monthly average cost could not be calculated because less than eight months of data were available
  - Consumption data were not provided/available, only monthly cost information was available
  - Utility provider did not respond
  - Other (e.g., no or an unsigned generic release letter, information needed to request data from the utility provider did not match the utility provider's records, rate data were not provided
- HUSM Utility Allowance Nonresponse Dispositions
  - Unknown utility components
  - Unknown or incorrect providers
  - Could not obtain rates/charges
  - Unknown fuel sources
  - Other (e.g., HUSM tariff structure did not conform with utility rate structure, other unknown building/unit characteristics)

Nonresponse Analysis. A nonresponse analysis on the UAC Study subgroup was conducted to evaluate whether households who were designated as respondents differ from those designated as nonrespondents. The results of this analysis were used to inform additional weighting processes for the UAC Study, including the creation of nonresponse adjustment cells used in the weighting described in *Appendix B: Weighting Procedures and Reliability of Estimates*.

We first conducted a series of bivariate analyses (i.e., significance testing on cross-tabulations) that looked at how response rates may have varied across different characteristics, and whether any differences were statistically significant. The characteristics used in the nonresponse analysis were limited to information we have for both responding and nonresponding households. The characteristics were defined by the variable categories presented in Exhibit A-1. This exhibit also provides the chi-squared value and statistical significance for each variable when crossed with response designation.

- Program type was found to have a statistically significant relationship with response designation ($x^2 = 9.89$; $p < 0.01$).

- Number of tenant-paid utilities, HUD region, number of units administered by the household's project, and certification type were also found to have statistically significant relationships with response designation (x^2 = 96.18, 54.86, 24.42, and 23.77, respectively; $p < 0.001$).

Exhibit A-1
Nonresponse Bivariate Analysis Household Definitions

Characteristics	Categories	Chi-Squared
Number of Tenant-paid Utilities[24]	0 or 1 Utility 2 or More Utilities	96.18***
HUD Region[25]	1: CT, VT, MA, ME, NH, and RI 2: NY and NJ 3: PA, VA, WV, MD, DE, and Washington, DC 4: AL, FL, GA, KY, MS, NC, SC, TN, and PR 5: IL, IN, MI, MN, OH, and WI 6: AR, LA, NM, OK, and TX 7: KS, IA, MO, and NE 8: CO, MT, ND, SD, UT, and WY 9: CA, AR, HI, and NV 10: WA, AK, ID, and OR	54.86***
Number of Units Administered by the Household's Project	First Quantile: 12 to 96 Units Second Quantile: 97 to 168 Units Third Quantile: 169 to 571 Units Fourth Quantile: 572 to 3,974 Units Fifth Quantile: 3,975 to 42,544 Units	24.42***
Certification Type	New Admission Annual Reexamination	23.77***
Program Type	New Admission Annual Reexamination Public Housing PHA-administered Section 8 Owner-administered	9.89**
Moving to Work Status	Moving to Work Household Non-Moving to Work Household	0.99
Number of Adult Household Members[26]	1 Adult Household Member 2 or More Adult Household Members	0.45

* Chi-squared is statistically significant at $p < 0.05$.
** Chi-squared is statistically significant at $p < 0.01$.
*** Chi-squared is statistically significant at $p < 0.001$.

Bivariate analyses were followed by a multivariate logistical regression analysis. All variables that were found to be significant predictors of response designation—number of tenant-paid utilities, HUD region, number of units administered by the household's project, certification type, and

[24] Number of tenant-paid utilities was according to the household.

[25] Other geographic variables, such as household's state, were considered for the bivariate analyses. However, cross-tabulations resulted in cell sizes too small in some geographic categories (e.g., states) to produce reliable chi-squared values. As such, the larger classification of households into HUD regions was used.

[26] Adult household members was defined as any member was either 18 years of age or older or who had a relationship status of head, co-head, or spouse.

program type—were included in the multivariate analysis. The multivariate analysis assessed the independent association of each explanatory variable with the response designation while adjusting for the other variables.

Final model specifications included a logistic model predicting the outcome of nonresponse, with a reference group[27] among the explanatory variables of PHA-administered Section 8 households residing in HUD region 10 in a project with units in the fifth quantile who had an annual reexamination and two or more tenant-paid utilities in FY 2015. Exhibit A-2 presents the log odds (β) and odds ratios (e^{β}) coefficients of the final multivariate logistic model, as well as statistical significance of the explanatory variables predicting nonresponse.

Exhibit A-2
Nonresponse Multivariate Analysis: Logistic Regression Results

Predictor of Nonresponse	Log Odds (β)	Odds Ratio (e^{β})
Number of Tenant-paid Utilities (Reference Group: 2 or More Utilities)		
0 or 1 Utility***	-1.159	0.314
HUD Region (Reference Group: Region 10)		
Region 1	-0.109	0.896
Region 2	0.139	1.149
Region 3	0.439	1.551
Region 4	0.556	1.744
Region 5	0.544	1.723
Region 6	-0.081	0.923
Region 7	0.433	1.541
Region 8**	2.198	9.010
Region 9	0.103	1.108
Number of Units Administered by the Household's Project (Reference Group: Fifth Quantile)		
First Quantile	-0.204	0.816
Second Quantile	0.276	1.318
Third Quantile	-0.355	0.701
Fourth Quantile	0.353	1.423
Certification Type (Reference Group: Annual Reexamination)		
New Admissions***	1.115	3.050
Program Type (Reference Group: PHA-administered Section 8)		
Public Housing*	0.432	1.541
Owner-administered	0.195	1.215
Constant**	1.126	3.083

* Coefficient is statistically significant at $p < 0.05$.
** Coefficient is statistically significant at $p < 0.01$.
*** Coefficient is statistically significant at $p < 0.001$.

[27] The reference group is represented by the *Constant* in Exhibit A-2, or the intercept of the logistic regression equation. The statistical software automatically sorted the explanatory variables by their value levels, either numeric or alphanumeric, and selected the last level as the reference group. The selection of the reference group has no impact on the overall significance found.

In the multivariate logistic regression, the regression coefficient estimates are typically evaluated in terms of odds ratios. The odds ratio represents the odds that an event (e.g., nonresponse) will occur given a particular characteristic (e.g., new admission certification type), relative to the odds of the event occurring in the absence or opposite of that characteristic. The odds ratio is simply the probability of the event occurring divided by the probability of the event not occurring: $e^{\beta} = p/(1-p)$. For example, if the probability of nonresponse among annual reexamination households is 25 percent, the odds of the event are *25%/75%*, or 1 to 3. If having a new admission certification type increases the probability of nonresponse to 50 percent, the odds are 1 to 1. The odds ratio is the odds of nonresponse with a new admission certification type relative to the odds of nonresponse with an annual reexamination certification type, or:

$$e^{\beta} = {(50\%/50\%)}\Big/{(25\%/75\%)} = 3$$

The odds ratio was estimated as the given predictor's relationship with nonresponse, net of other predictor effects (hereafter, statements to interpret regression coefficient estimates are all qualified such that the estimated effect exists while holding other effects constant).

- The decrease from two or more tenant-paid utilities to zero or one tenant-paid utilities resulted in a decrease in the odds that the household would be a nonrespondent by 31 percent ($e^{\beta} = 0.314$; $p < 0.001$).
- Residing in HUD Region 8, when compared to HUD Region 10, resulted in an increase in the odds of being a nonrespondent by 9.010 times ($p < 0.01$).
- A new admission household had 3.050 times greater odds of being a nonrespondent than an annual reexamination household ($p < 0.001$).
- There was a 54 percent increase in the odds ($e^{\beta} = 1.541$) of being a nonrespondent for Public Housing households when compared to PHA-administered Section 8 households ($p < 0.05$).

Bivariate and multivariate analyses showed that HUD region, program type, certification type, and the number of tenant-paid utilities were significant predictors of nonresponse. These findings were used to inform household classifications, or adjustment cells, for UAC Study nonresponse weight adjustments. A discussion of these adjustment cells and subsequent weight adjustments can be found in *Appendix B: Weighting Procedures and Reliability of Estimates*.

Appendix B: Weighting Procedures and Reliability of Estimates

Appendix B: Weighting Procedures and Reliability of Estimates

This appendix describes the procedures followed to generate the final UAC Study household weights. The UAC Study weights were created by first weighting the HUDQC Study project sample, and then adjusting these weights for the UAC Study subgroup to account for UAC Study nonresponse. Following the weighting methodology, a discussion of the reliability of the national estimates reported in *Section IV: Findings* is presented.

HUDQC Study Population. The universe of the HUDQC Study included all projects and households located in the continental United States, Alaska, Hawaii, and Puerto Rico. In FY 2015, Moving to Work (MTW) Public Housing Authorities (PHAs) were included in the study population.

The following programs were included in the sample:

- PHA-administered Public Housing (Public Housing)
- PHA-administered Section 8
  - Moderate Rehabilitation
  - Housing Choice Voucher (HCV) program
- Office of Housing-administered projects (Owner-administered)
  - Section 8 New Construction/Substantial Rehabilitation
  - Section 8 Loan Management
  - Section 8 Property Disposition
  - Section 202 Project Rental Assistance Contracts (PRAC)
  - Section 202/162 Project Assistance Contracts (PAC)
  - Section 811 PRAC

The initial universe files used to draw the sample occasionally reflected out-of-date or incorrect information, including out-of-scope projects such as demolished projects, projects undergoing renovation, projects that were no longer assisted, projects that had merged or split, and other special circumstances. Many of these projects were identified prior to drawing the sample. For example, in FY 2015, at the request of HUD, projects newly converted to Owner-administered assistance through the Rental Assistance Demonstration (RAD) program were excluded from the sampling frame, due to unique rent calculation rules while households phase into the new program type. However, other out-of-scope projects were identified later during data collection. Depending on the circumstance of those identified during data collection, sampling decisions were made to either replace the project, to subselect the project, or to make adjustments during weighting. The use of replacement projects for out of-scope projects complicated the sample weight calculations. The determination of an actual probability of selection for these replacements was impossible to make. A sampling weight that is proportional to what the probability would have been had the project been selected originally was used as a reasonable estimate.

HUDQC Study Weighting. This subsection details the population totals and methodology that were used to produce the HUDQC Study weights. As the UAC Study shared the same sample as the HUDQC Study, HUDQC Study weights were required to be calculated first, prior to any weight adjustments that related specifically to the UAC Study.

Population Totals

ICF used the population totals which were derived from universe files provided by HUD in July 2015. As programs may grow or shrink over time, it is desirable to update population counts for each study. Estimates of total dollar amounts and estimates of the proportion of the population represented by each program type run the risk of not being representative of the current population if the population changes significantly. However, the use of the same population counts from year to year has the advantage of increasing comparability of gross dollar estimates; any change from year to year would not have been due to a change in the number of households in the program, but due to an actual change in the average gross dollar error or percentage of households. Estimates of averages and percentages within program types have the advantage of being comparable regardless of changes in population counts from year to year.

Exhibit B-1 provides the population totals by program type for the FY 2015 HUDQC Study.

Exhibit B-1
Population Totals Used for HUDQC Study Weighting by Program Type

Administration Type	FY 2015 HUDQC Study Population
Public Housing	1,061,690
PHA-administered Section 8	2,209,296
Owner-administered	1,382,453
Total	**4,653,439**

Methodology

The procedure to determine the HUDQC Study weights involved several steps, including: 1) calculating the project weight (w_1); 2) calculating the household weight (w_3); 3) accounting for HUDQC Study nonresponding households (f_n); 4) poststratifying (f_p); and finally, 5) trimming the weights.

1. **Calculating the Project Weight (w_1).** The first step to determine the HUDQC Study weights was calculating the project weight by compiling the sampling probabilities calculated during the cluster and project sampling and the initial data collection process. These probabilities were then used to calculate each project's probability of selection. The probability of selection of a project was the product of the following:

   1) The probability of selection of the cluster (p_1)

   2) The probability of selection of the subcluster if the cluster was divided (p_2)

   3) The probability of selection of the project from its respective cluster (p_3)

   Each cluster was sampled with probabilities proportional to size. The measure of size used was the number of households adjusted to obtain equal expectation for the three major types of programs in the study. The number of households of each program in a cluster was multiplied by an inflation factor to make all three numbers equal. The probability of selection of the cluster (p_1) was calculated in three steps. First, the proportion of the households in each of the three programs in a particular cluster was obtained. These proportions were defined as the number of households in each program within a cluster divided by the number nationwide (program's population count). Next, the three proportions in each cluster were averaged; and finally, the proportions were multiplied by 60, the number of clusters to be selected nationwide.

In some instances, clusters were geographically too large to collect data in a cost-effective manner. To accommodate this logistical problem, clusters were divided into two or more subclusters or smaller geographic areas. A subcluster was then sampled from the group of subclusters using probabilities proportional to size. This resulted in the same probability that would have ensued had the division taken place before drawing the sample, or the probability of selection of the subcluster (p_2). If the cluster was not divided into smaller clusters, then the subcluster probability of selection was one. The formula to calculate the project weight was:

$$\left(w_1 = \frac{1}{minimum[p_1, 1] \times minimum[p_2, 1] \times minimum[p_3, 1]}\right)$$

Clusters with probabilities greater than one could have been selected more than once (Sampling With Minimal Replacement). These clusters were certainty clusters, meaning that their selection into the sample was guaranteed. For the purposes of calculating the project weight, the certainty clusters' probability of selection was set to one.

The probability of selection of a project from its respective cluster (p3) was calculated in two steps. First, the number of households in a program type within a project was divided by the total number of households in a program type within the project's cluster. This proportion was then multiplied by the number of projects in a program type to be selected from the cluster. The PHA administered Section 8 projects could have had a probability greater than one for sampling purposes (meaning they could be sampled more than once). However, for the other two major program types, if the calculated probability exceeded one, it was set to one and all the other probabilities were readjusted so that they added to the allocation for the program in the cluster. For weighting purposes, probabilities greater than one among PHA-administered Section 8 projects were set to one.

2. **Calculating the Household Weight (w_3).** The second step to determine the HUDQC Study weights was to calculate the household weight. To calculate the household weight, the number of households in the project (N_p) and the number of households sampled from the project (n_p) were identified. The household probability of selection within the sampled project was the number of sampled households divided by the number of households in the project (p_4):

$$\left(p_4 = \left(\frac{n_p}{N_p}\right)\right)$$

The household within project weight (w_2) was the inverse of the probability of selecting the household within the sampled project:

$$\left(w_2 = \frac{1}{p_4}\right)$$

The household base weight (w_3) was the product of the project weight and the household within project weight:

$$(w_3 = w_1 \times w_2)$$

3. **Accounting for HUDQC Study Nonresponding Households (f_n).** The third step in the HUDQC Study weighting process was to account for nonresponding households to the HUDQC Study within the sampled project. To do this, the number of eligible sampled households (n_{pe}), the number of HUDQC Study responding households (n_{pr}) and the eligibility adjusted household weight were needed. The sum of the eligibility-adjusted household weights for all eligible households in the project and the sum of eligibility-adjusted household weights for only the HUDQC Study responding households in a project was then calculated. A HUDQC Study nonresponse adjustment factor (f_n) was calculated as:

$$f_n = \frac{\sum_{n_{pe}} w_3}{\sum_{n_{pr}} w_3}$$

The HUDQC nonresponse, adjusted household weight (w_4) was the eligibility-adjusted household weight multiplied by the nonresponse adjustment factor:

$$(w_4 = w_3 \times f_n)$$

4. **Poststratifying (f_p).** The fourth step in the HUDQC Study weighting process was poststratification. The sample was designed to obtain similar numbers of households in each of the following three program types:

   1) Public Housing projects

   2) PHA-administered Section 8 projects

   3) Owner-administered projects

   Population totals for each of the programs were obtained from the FY 2015 sampling frame. The population estimates after weighting did not correspond exactly to these FY 2015 population totals and required adjustments. The weights were adjusted to sum to the known external population totals, so the sum of the weights would have been the same had a different sample been selected.

   To poststratify the weights, the HUDQC nonresponse adjusted household weights within program type were summed to estimate the population totals from the HUD sample. For example, the sum of weights for all Owner-administered households in the sample is an estimate of the total number of Owner-administered households in the nation. A poststratification factor (f_p) was calculated by dividing the known external population totals ($N_{program\ type}$) by the estimated population totals from the HUD sample ($\sum_{program\ type} w_4$):

$$f_p = \frac{N_{program\ type}}{\sum_{program\ type} w_4}$$

A poststratification factor was calculated for each program type. This factor was then multiplied to the HUDQC nonresponse adjusted household weight within each program type to obtain the poststratified weight (w_5), ensuring that the sum of the household weights by program type was the same as the external population totals.

$$(w_5 = w_4 \times f_p)$$

5. **Trimming the Weights.** The final HUDQC Study step was the trimming of the weights. Weights more than three times the median weight were set to three times the median weight, and all the weights were readjusted. Large weights usually resulted from incorrect frame information.

UAC Study Weighting. This subsection discusses the UAC Study subgroup, in brief, and the corresponding estimated UAC Study population. Additionally, procedures related to generating UAC Study weights that reduce bias related to nonresponse to the study are presented. Estimated population totals and UAC Study weighting methodology both leveraged the final HUDQC Study household weights described above.

Population Totals

The UAC Study households were a subgroup of the HUDQC Study sample. Households excluded from the UAC Study subgroup included flat rent households in Public Housing and any household who did not receive an Actual Utility Allowance, according to both the Form HUD-50058/50059 and household file documentation, and did not pay for out-of-pocket utility expenses in FY 2015. The sum of the HUDQC Study weights among the UAC Study subgroup represents those in the HUD-assisted population who had utility allowances or actual utility costs, or the estimated UAC Study population.

Exhibit B-2 presents the estimated UAC Study population totals as derived from the UAC Study subgroup, as well as the HUDQC Study population totals for comparison.

- Approximately 3.4 million assisted households received a utility allowance or incurred utility expenses in FY 2015. This represents 74 percent of the HUDQC Study population.
- Forty-five percent of Public Housing households received a utility allowance or incurred utility expenses, compared to 93 percent of PHA-administered Section 8 households.

Exhibit B-2
HUDQC Study Population Totals vs. Estimated UAC Study Population Totals by Program Type

Administration Type	HUDQC Study Population	Estimated UAC Study Population	
		Count	% of HUDQC Study Population
Public Housing	1,061,690	479,910	45%
PHA-administered Section 8	2,209,296	2,051,239	93%
Owner-administered	1,382,453	903,634	65%
Total	**4,653,439**	**3,434,783**	**74%**

Methodology

From the final HUDQC Study household weights, procedures were followed to adjust the weights for nonresponse to the UAC Study. The primary goal of the nonresponse adjustment was to reduce bias. Nonresponse bias occurs when (a) nonrespondents differ from respondents and (b) nonrespondents account for a large enough proportion of the population, resulting in differences in survey estimates.

While nonresponse adjustments reduce bias, they usually introduce added variation to the weights. A balance between bias reduction and the increase in variance was considered when implementing the nonresponse adjustment. Nonresponse adjustments used information available for the sampled subgroup households. In general, the adjustment distributed the final HUDQC Study weights of the nonrespondents to the respondents so that the sum of the final UAC Study weights equaled the sum of the final HUDQC Study weights for the UAC Study subgroup.

The procedure to determine the UAC Study weights from the HUDQC Study weights involved two steps: 1) defining nonresponse adjustment cells based on the nonresponse analysis; and 2) accounting for UAC Study nonresponding households within the defined cells.

1. **Defining Nonresponse Adjustment Cells.** A nonresponse weight adjustment cell is a subclass in which the nonresponse adjustments were applied. For example, if program type is a significant predictor of response, the nonresponse adjustment will be calculated within different "cells" or categories of program type.

   The results of the nonresponse analysis detailed in *Appendix A: Nonresponse Consideration and Analysis* were used to classify UAC Study subgroup households into nonresponse adjustment cells. The nonresponse analysis found that HUD region, program type, certification type, and the number of tenant-paid utilities were significant predictors of nonresponse. However, limiting the number of explanatory variables used to define nonresponse adjustment cells is advantageous to create meaningful cells with a sufficient number of households to produce stable weight adjustments.

   HUD region was not considered for classifying households into nonresponse adjustment cells because only one region was found to be significant. Furthermore, as HUD region has 10 different levels, the likelihood of having adequate cell sizes was low, especially when used in conjunction with other significant predictors of nonresponse.

   Program type, certification type, and the number of tenant-paid utilities were initially considered for defining subgroup households into nonresponse adjustment cells. Using these three explanatory variables for classification purposes resulted in some cell sizes being too small, particularly among the cells with a new admission status for certification type. As such, certification type was removed from the set of variables used to classify subgroup households. The final nonresponse adjustment cells that UAC Study subgroup households were classified into were based on program type and number of tenant-paid utilities and included:

   - Public Housing households with zero or one utility
   - Public Housing households with two or more utilities
   - PHA-administered Section 8 households with zero or one utility
   - PHA-administered Section 8 households with two or more utilities
   - Owner-administered households with zero or one utility
   - Owner-administered households with two or more utilities.

2. **Accounting for UAC Study Nonresponding Households (f_{un}).** The second step in the UAC Study weighting process was to account for nonresponding households to the UAC Study within the defined nonresponse adjustment cells, in order to mitigate bias. To do this, the number of subgroup households (n_{cs}), the number of UAC Study responding households (n_{cr}) and the final HUDQC Study household weight (w_{qc}) were needed. The sum of the final HUDQC Study household weights for all UAC Study subgroup households in the defined adjustment cell and the sum of final HUDQC Study household

weights for only the UAC Study responding households in a defined adjustment cell was then calculated. A UAC Study nonresponse adjustment factor (f_{un}) was calculated as:

$$f_{un} = \frac{\sum_{n_{c_s}} w_{qc}}{\sum_{n_{c_r}} w_{qc}}$$

UAC Study nonresponding households had their final UAC Study weight set to 0. UAC Study responding households had their final UAC Study weight (w_{uac}) calculated as their final HUDQC Study weight multiplied by the UAC Study nonresponse adjustment factor for their cell:

$$(w_{uac} = w_{qc} \times f_{un})$$

Exhibit B-3 provides details on the sample counts, weighted population count estimates, and the nonresponse adjustment factors by the nonresponse adjustment cell definitions.

Exhibit B-3
UAC Study Nonresponse Adjustment Factors by Defined Adjustment Cells

Adjustment Cells		Response Designation	Sampled Number of Households (n)	Estimated Population Count (N)	Adjustment Factor (f_{un})
Program Type	Number of Tenant-paid Utilities				
Public Housing	0 or 1 Utility	Respondent	56	76,419	2.987
Public Housing	0 or 1 Utility	Nonrespondent	119	151,855	
Public Housing	2 or More Utilities	Respondent	25	35,619	7.065
Public Housing	2 or More Utilities	Nonrespondent	159	216,017	
PHA-administered Section 8	0 or 1 Utility	Respondent	112	308,668	2.551
PHA-administered Section 8	0 or 1 Utility	Nonrespondent	173	478,892	
PHA-administered Section 8	2 or More Utilities	Respondent	77	208,403	6.064
PHA-administered Section 8	2 or More Utilities	Nonrespondent	380	1,055,276	
Owner-administered	0 or 1 Utility	Respondent	144	246,887	2.646
Owner-administered	0 or 1 Utility	Nonrespondent	234	406,258	
Owner-administered	2 or More Utilities	Respondent	22	36,692	6.827
Owner-administered	2 or More Utilities	Nonrespondent	127	213,796	

Variance Estimation. Standard errors were obtained for a number of estimates using a delete a group Jackknife procedure. This was implemented by using 20 replicate groups and creating 20 sets of replicate weights. This procedure is available starting with SAS 9.4, and is considered more robust with respect to design characteristics than the Taylor Series method.[28]

Reliability of Estimates. Survey estimates are said to be statistically reliable if they are consistent, or if similar results are found under similar conditions. Historically, the HUDQC Study weights have produced survey estimates to fulfill the HUDQC Study objectives that are reliable from year to year. Given that the HUDQC Study weights were adjusted to mitigate UAC Study nonresponse and

[28] Kott, P. S. (1998). Using the Delete-a-Group Jackknife Variance Estimator in Practice. *Proceedings of the Annual Meeting of the American Statistical Association, Section on Survey Research Methods* (pp. 763–768). Alexandria, VA: American Statistical Association.

the estimates provided in *Section IV: Findings* do not have historical comparisons, ICF completed an additional analysis to understand the reliability of the UAC Study estimates.

The analysis included several steps, including: 1) estimating the Actual Utility Allowance among UAC Study respondents using the UAC Study weights (Test Estimates); 2) estimating the Actual Utility Allowance among UAC Study subgroup households using the HUDQC Study weights (Reference Estimates); and 3) comparing the estimates for statistical significance using two-tailed *t*-tests.

1. **Calculating the Test Estimates.** The monthly average Actual Utility Allowance and the annual Actual Utility Allowance sum for each program type separately and in combination was estimated among the UAC Study respondents using the final UAC Study weights. These estimates are those reported in *Section IV: Findings* and the *Executive Summary* and those for which reliability is unknown and must be tested. Exhibit B-4 presents these findings with their associated standard errors.

Exhibit B-4
Actual Utility Allowance Test Estimates: UAC Study Respondents and UAC Study Weights

Administration Type	Monthly Average		Annual Sum (in $1,000s)	
	Estimate	Standard Error	Estimate	Standard Error
Public Housing	$113	$10.58	$650,815	$60,945.39
PHA-administered Section 8	*$117*	*$6.50*	*$2,870,330*	*$160,086.65*
Total PHA-administered	*$116*	*$5.31*	*$3,521,146*	*$161,194.39*
Owner-administered	$76	$5.95	$822,283	$64,501.18
Total	**$105**	**$4.18**	**$4,343,429**	**$172,375.93**

2. **Calculating the Reference Estimates.** As the Actual Utility Allowance for the UAC Study was obtained from the Form HUD-50058/50059 that was selected for use in the HUDQC Study, this metric is known for all UAC Study subgroup households regardless of response designation. Therefore, an estimate of the Actual Utility Allowance among the UAC Study subgroup is possible. HUDQC Study weights can be used to produce these estimates as response designation was not dependent upon the availability of the Actual Utility Allowance (all data were available) and nonresponse biases do not need to be mitigated for this metric via the UAC Study weighting procedures. Using HUDQC Study weights produces estimates with known reliability, as these weights have produced survey estimates that are historically reliable to fulfill HUDQC Study objectives. The reference estimates are the monthly average Actual Utility Allowance and the annual Actual Utility Allowance sum for each program type separately and in combination among the UAC Study subgroup using the final HUDQC Study weights. Exhibit B-5 presents these findings with their associated standard errors.

Exhibit B-5
Actual Utility Allowance Reference Estimates: UAC Study Subgroup and HUDQC Study Weights

Administration Type	Monthly Average		Annual Sum (in $1,000s)	
	Estimate	Standard Error	Estimate	Standard Error
Public Housing	$93	$9.66	$537,110	$76,284.81
PHA-administered Section 8	$126	$5.80	$3,113,316	$134,619.33
Total PHA-administered	*$120*	*$4.60*	*$3,650,426*	*$147,774.42*
Owner-administered	$72	$5.07	$778,863	$63,998.58
Total	**$107**	**$4.35**	**$4,429,289**	**$148,524.92**

3. **Comparing the Test Estimates to the Reference Estimates.** Two-tailed t-tests for each program separately and in combination were performed for the monthly average and annual estimates to determine whether the Test Estimates presented as main findings to the UAC Study were statistically different from the Reference Estimates with known reliability. Figures B-1 and B-2 combine the Test and Reference Estimates (plotted open circle) and their corresponding 95 percent confidence intervals (shaded rectangles surrounding the plotted open circle) as a visual representation of the t-tests for monthly average Actual Utility Allowance and annual Actual Utility Allowance sum, respectively.

- No statistical differences were found between the Test and Reference Estimates.
- The main findings presented in the *Executive Summary and Section IV: Findings* to fulfill UAC Study research questions are reliable.

Figure B-1
Monthly Average Actual Utility Allowance: Reference and Test Estimates

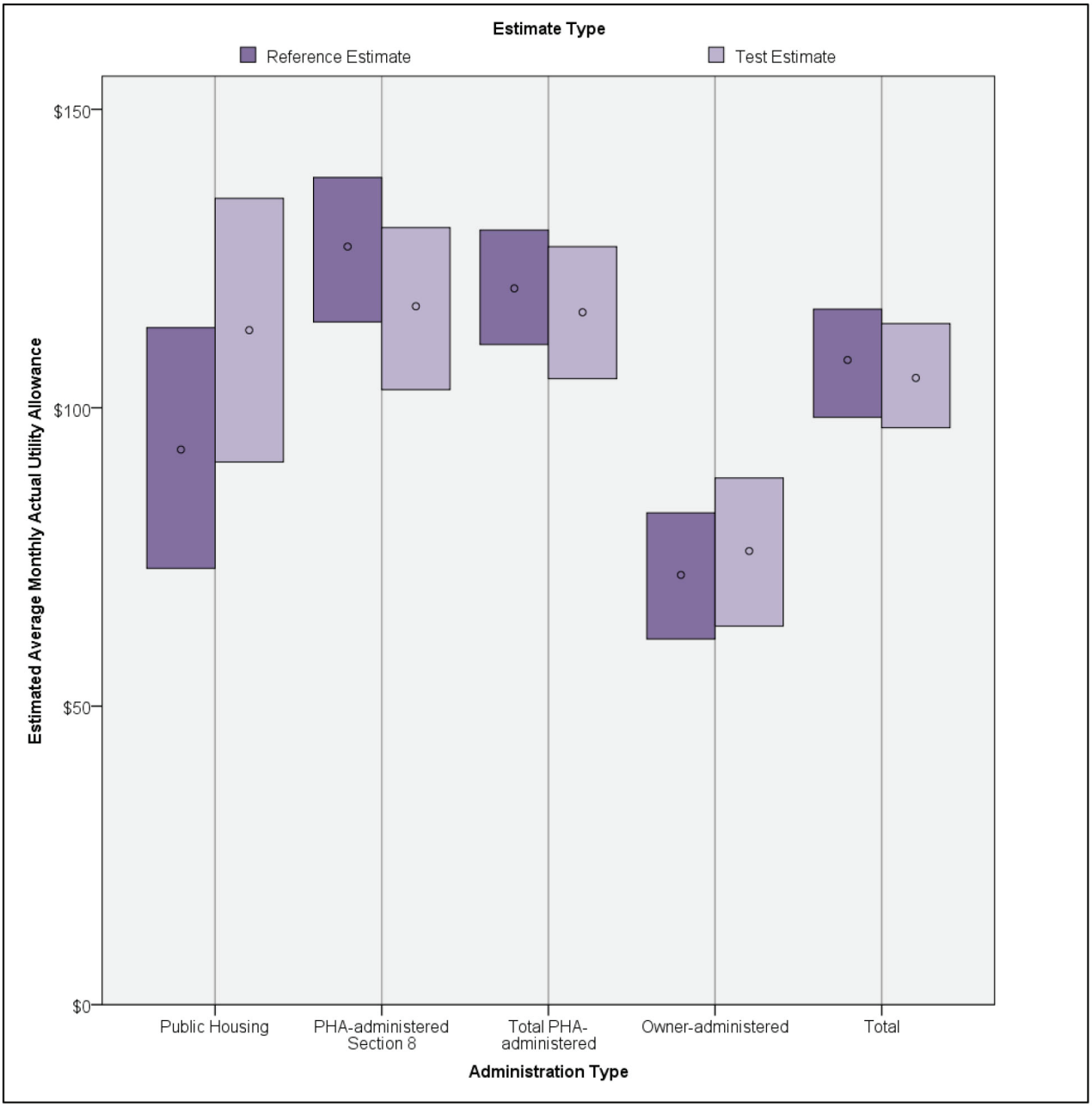

Figure B-2
Annual Actual Utility Allowance Sum: Reference and Test Estimates