U.S. Department Housing and Urban Development

Utility Allowance Guidebook

Exhibit B

Utility Allowance Guidebook

For Optional Use By Public Housing Agencies

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Prepared for

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Exhibit 1

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CONTENTS

INTRODUCTION

What is the Purpose of This Guidebook?

The purpose of this guidebook is to provide assistance to Public Housing Agencies (which will be referred to as "HAs" throughout this guidebook) in ***establishing utility allowances for residents***. The guidebook focuses on utility allowances for federally subsidized public housing units where ***either:***

(a) the HA resident pays the utility bills directly to the utility supplier (for example, a local gas or electric company); or

(b) the HA provides the utilities to its residents but also meters each household (known as "checkmetering") to determine if any household has "excess consumption."

> *A 1991 study of assisted housing by the U.S. General Accounting Office found that the majority of public housing households (approximately 61 percent) receive a utility allowance.*

In addressing the issue of utility allowances, this guidebook has several related objectives:

- ***To provide the reader (whether an HA administrator, a public housing resident, or some other interested party) with an overview of the federal rules governing how utility allowances are set and put into effect.***

- ***To offer clear definitions of the common terminology used in connection with utility allowances, as well as "user-friendly" discussion of the basic principles that should be followed in designing such allowances.***

- ***To present some of the different methods available to HAs for calculating utility allowances, along with a description of the merits of each and information on how these methods can be employed.***

- ***To provide HAs that use consultants or contractors in developing their utility allowances with the information that the HAs need to write specifications for, evaluate the proposals from, and oversee the work of such consultants/contractors.***

The ultimate goal of the guidance provided here is to enable HAs to calculate allowances that will be in compliance with the regulations of the U.S. Department of Housing and Urban Development (HUD)—including the requirement that a resident's rent burden should equal 30 percent of the adjusted household income—and that will create reasonable incentives for energy conservation by residents.

> While the use of this guidebook is optional, it offers valuable technical advice on sound methods for establishing utility allowances. The "best" method among the options presented will depend on a housing authority's particular circumstances.

The use of this guidebook by HAs is optional. Each HA is allowed the discretion to develop its own approach to calculating its utility allowances, as long as the method used is consistent with the HUD regulations found in Part 965 in Title 24 of the Code of Federal Regulations (abbreviated 24 CFR 965). This guidebook suggests a number of permissible methods for satisfying these requirements, but other approaches may also be acceptable.

This guidebook is intended to help HAs to implement the general requirements found in the regulations. The reader should keep in mind that the recommendations found in this document are meant to supplement—not replace—the formal regulations. In areas of doubt, readers are advised to consult the regulations directly.

The Indian Housing Block Grant (IHBG) program for tribes and tribally designated housing entities (TDHEs) authorized by the Native American Housing Assistance and Self-Determination Act of 1996 replaces the 1937 Housing Act programs previously applicable to Indian Housing Authorities. In accordance with 24 CFR 1000.132, tribes or TDHEs decide whether or not to include utilities in rent calculations. For those tribes or TDHEs which elect to include utilities in the calculation of rent, this guidebook will be a valuable source of information.

How This Guidebook is Organized

The guidebook is organized into two primary parts.

Part One provides essential background information about the regulations governing utility allowances for public housing residents, offers some basic principles that contribute to a sound allowance methodology, and presents the different methodologies that may be used in calculating allowances.

Part Two guides the reader through the processes of choosing a suitable methodology and calculating the utility allowances.

Each part contains several chapters:

Part One

- *Primer on Key Utility Allowance Principles and Terms* (Chapter 1)
- *The Federal Regulations* (Chapter 2)
- *Methodologies to Establish Utility Allowances* (Chapter 3)

Part Two

- *Choosing a Methodology* (Chapter 4)
- *Establishing Utility Allowances Using the Engineering Methdology* (Chapter 5)
- *Establishing Utility Allowances Using Consumption Data* (Chapter 6)
- *Annual Review of Allowances* (Chapter 7)

Part One is indispensable for developing a basic familiarity with the key concepts involved in setting utility allowances. **Chapter 1** provides an overview of utility allowances in public housing and defines the technical terms used throughout the guidebook. **Chapter 2** summarizes the HUD regulations governing utility allowances in public housing. It highlights the key elements of the regulations and provides guidance in interpreting them. **Chapter 3** describes different methodologies that can be used to calculate utility allowances. The advantages and disadvantages of each methodology are discussed.

Part Two provides detailed guidance on choosing a methodology for a particular HA and for establishing the allowances for all relevant utilities. The focal point of the process of choosing a methodology is the "Decision Tree" in **Chapter 4, "*Choosing a Methodology*."** The Decision Tree navigates the user through a series of questions about the HA and its current utility allowances. The Decision Tree is intended to direct the user to an appropriate methodology for establishing the allowances, given that particular HA's characteristics. The Decision Tree will guide the user either to **Chapter 5** or **Chapter 6**, depending on the HA's characteristics. **Chapter 7** provides guidance on reviewing utility allowances every year, a process required for each HA by the regulations.

This guidebook also includes appendices that provide supplementary information that may be useful to HAs in calculating allowances:

Appendix A contains the full text of the regulations that govern the establishment of utility allowances in public housing (24 CFR 965).

Appendix B lists resources that HAs may consult for additional assistance. These resources include utility associations and research organizations.

Appendix C contains a ***sample*** table of consumption levels for various electrical appliances. This table is intended to demonstrate the type of information that HAs are encouraged to obtain from their local utility. This type of information is necessary when calculating allowances based on engineering calculations.

Appendix C also provides weather data for various parts of the country. Thirty-year average annual ***heating degree days, cooling degree days*** and the ***outdoor design temperatures*** in winter are provided for regions throughout the United States. The 30-year average heating degree days and winter outdoor design temperature are used to calculate the allowance for ***space heating*** when using the engineering-based methodology. The 30-year average heating degree days and cooling degree days are used for the process of ***normalizing*** consumption data for weather, an optional approach when using the consumption-based methodology. (The terms in *italics* are fully explained in Chapter 1.)

How to Use This Guidebook

This guidebook is designed to provide assistance to HA staff and residents of ***varying degrees of technical proficiency and experience*** with utility allowances. Users are encouraged to focus on those chapters that are most useful for their particular needs.

Many readers will find it helpful to review the background information in ***Part One*** to ensure that they are familiar with the basic principles and terminology relating to utility allowances. HA staff should then proceed to Chapter 4 and use the Decision Tree to determine which methodology may be best for their particular HA.

All readers should become familiar with Chapter 7, because of the importance of reviewing utility allowances on an annual basis.

> *The U.S. General Accounting Office found that, during the period of 1985 through 1989, fewer than half the HAs were reviewing their utility allowances yearly, despite the federal requirement for an annual review.*

In addition to the appendices containing additional reference and resource information, a number of other features have been included to increase the guidebook's value as a working tool:

- ***Notations in the left-hand column*** and ***highlighted summary statements*** throughout the guidebook ***identify important issues***, which are discussed in more detail in the right-hand text.

- When options are presented, the text offers a summary of the ***advantages and disadvantages*** of each alternative, to help guide local decision-making.

- At the end of many of the chapters, a ***"Question & Answer"*** section is included so that readers can test their level of comprehension of the written material before moving to the next chapter.

Finally, readers are encouraged to make use of the blank space in the left-hand column to jot down notes, ideas, telephones numbers of contact persons, or whatever else will make this document more useful to them.

PART ONE

CHAPTER 1: PRIMER ON KEY UTILITY ALLOWANCE PRINCIPLES AND TERMS

This chapter provides a basic overview of some of the key principles underlying the establishment of utility allowances.[1] The chapter:

- explains where the concept of utility allowances for public housing residents comes from;
- identifies the types of utilities and utility uses for which an allowance may be granted;
- discusses some of the features that may be involved in determining whether a public housing resident is provided a utility allowance; and
- presents definitions of common technical terms associated with utility allowance calculations.

This chapter should be a good starting point for readers who have not previously had any experience with the technical aspects of utility allowances. All readers should review the definition of terms so that they will understand how these terms will be used in the remainder of this handbook.

The Basis for Utility Allowances in Public Housing

Under the provisions of the U.S. Housing Act of 1937, as amended, HUD provides housing assistance to approximately 1.3 million households living in public housing across the country. This assistance is provided through approximately 3,100 Public Housing Agencies. HUD has responsibility for the oversight of federally assisted public housing and establishes regulations to guide these HAs in how they implement the federal housing assistance.

[1] In preparation of parts of this chapter, the authors relied heavily on the excellent overview of utility allowances provided in the U.S. General Accounting Office's March 1991 *Report to Congressional Committees: Assisted Housing—Utility Allowances Often Fall Short of Actual Utility Expenses*, GAO/RCED-91-40A.

In order to keep assisted housing affordable for lower-income households, federal housing law directs that the resident's share of rent in federally assisted public housing should equal 30 percent of the household's adjusted monthly income. In interpreting the federal housing law, HUD has defined the ***Total Resident Payment*** for "rent" to include both shelter costs ***and the costs for reasonable amounts of utilities***. The amount that an HA determines is necessary to cover the resident's reasonable utility costs is the ***utility allowance***.

Such allowances are ***estimates*** of the expenses associated with different types of utilities and different utility uses. The ***utilities*** for which allowances may be provided include electricity, natural gas, propane, fuel oil, wood or coal, and water and sewage service, as well as trash and garbage collection. The ***functions***, or ***end-uses***, covered by an allowance may include space heating, water heating, cooking, refrigeration, lighting, or appliances. Note that ***allowances are not provided for telephone service***.

Utility allowances can be small or large, and at various HAs across the country, they range from less than $10 to over $200 for a resident household per month, depending on the number of utilities covered, their use, and the dwelling unit and/or household size.

How Allowances Are Provided Depends on the Metering of the Utility

Whether a household receives an allowance for a given utility service generally depends on the way the utilities are metered. Utilities can be metered in one of three ways: master-metered, checkmetered, and individually metered. Allowances are provided for checkmetered or individually metered utilities, but not for master-metered utilities.

Master-Metered Utilities. A master meter measures consumption for the building as a whole, rather than for individual dwelling units or households. Master meters are owned by the local utility company. Where utilities are master-metered, the HA pays the utility bills to the utility company. In such instances, the utility costs are included in the basic rent levels established by the HA, and no separate allowance is provided. (The HA, however, may establish a "surcharge"—an extra resident fee—for utility consumption for major appliances not seen as essential or consistent with local custom, such as a food freezer.)

Checkmetered Utilities. Some HAs install separate sub-meters (called "checkmeters"), in addition to the utility-owned master meter, to measure consumption by individual dwelling units. These checkmeters are owned by the HA. As with master-metered utilities, the HA pays the utility bills to the utility company. With checkmetered utilities, however, the HA provides each household a utility allowance in the form of a maximum level of consumption that it may consume without a surcharge. When a household exceeds this level, a surcharge must be paid.

Individually Metered Utilities. Where utilities are individually metered, each household has a separate account with the utility company and pays the bill directly to that company. (For this reason, individually metered utilities are also called "resident-paid" or "resident-purchased" utilities.) The HA provides a utility allowance to the household, in the form of a reduction in the monthly amount for rent that the household must pay to the HA.[2]

Many buildings have different metering systems for different utilities ("mixed metering"). For example, electricity may be individually metered, gas may be master-metered, and water may be checkmetered.

An allowance may also be provided to residents for some non-metered utilities, because the residents pay for these services directly. Trash pickup and sewer services are examples of utilities that are non-metered in some areas.

For most utilities, individual meters are generally more prevalent than checkmeters in public housing. However, metering configuration varies widely by region. For example, in the Northwest section of the country, individual metering is more prevalent; in the South, however, checkmetering is very common.

The following are some estimates of metering configurations by type of utilities[3]:

Electricity. About 39 percent of public housing dwelling units are individually metered for electricity, whereas 17 percent are checkmetered. The other 44 percent have master-metered electricity.

Natural Gas. About 20 percent of public housing units are individually metered for natural gas, whereas 14 percent are

[2] It should also be noted that in some cases public housing residents with very low or zero rents actually receive a credited adjustment from the HA to pay utilities.

[3] These figures were derived from the HA questionnaire results in the GAO's 1991 *Report on Utility Allowances, Volume II.*

checkmetered. The remaining 66 percent have master-metered gas or do not have gas service at all.

Water and Sewer. About 8 percent of public housing dwelling units are individually metered for water and sewer, whereas 3 percent are checkmetered. About 89 percent of the units have master-metered water.

These figures allow an estimation of the numbers of public housing households that receive a utility allowance.

> *According to the 1991 U.S. General Accounting Office report, 56 percent of public housing households receive an allowance for electricity, 34 percent receive an allowance for natural gas, 11 percent receive one for water and sewer, and 4 percent receive one for trash pickup. Fewer than 1 percent of public housing households receive an allowance for propane, fuel oil, water only or sewer only.*[4]

Allowances Are Calculated for Categories of Units

Utility consumption tends to vary according to certain characteristics of units, such as building construction type and size. To account for such factors, HAs group dwelling units with similar characteristics into categories and calculate distinct allowances for each category. Each category (group) of dwelling units is called an ***allowance category***.

How Allowances Are Calculated: HAs Can Choose Between Two Basic Methodologies

The regulations governing calculation of utility allowances (discussed in detail in Chapter 2) specify the factors that HAs should consider in establishing allowance categories. It is left to the HA, however, to decide which methodology to use in establishing allowances, as long as the required factors and appropriate data sources are used.

There are two basic methodologies that can be used to develop reasonable allowances. HAs may establish allowances on the basis of either (1) engineering calculations or (2) consumption data. These two methodologies are described in Chapter 3. Chapter 4 provides assistance to HAs in determining which methodology may be most appropriate, given the particular HA's characteristics. Regardless of the methodology used to calculate the allowances, however, the HA must maintain a record

[4] These figures were derived from the HA questionnaire results in the GAO's 1991 *Report on Utility Allowances, Volume II.*

that documents the basis on which the allowances were established. This record must be made available to the residents.

Key Terms Used Throughout This Guidebook: A Glossary

There are a number of key terms commonly used in talking about utility allowances. The terms and their definitions, as used in this guidebook, are set out in the rest of this chapter. Words that appear in italics are defined elsewhere in this glossary.

British Thermal Unit (Btu). The amount of energy required to heat a pound of water 1 degree Fahrenheit (1°F). The Btu is the unit commonly used in calculating energy requirements. (It can apply to any energy use, not just heating water; for example, air conditioners are often rated by their Btu capacity.)

Calibration. The process of checking or adjusting a measuring instrument, such as a checkmeter. Checkmeters need to be calibrated periodically to ensure accurate measurement.

Central Tendency. A measure of the "typical" value in a collection of numbers or a ***data set***. The ***mean*** (average) and the ***median*** are two different measures of central tendency.

Consumption-Based Methodology. One of two suggested methods that can be used to establish utility allowances. (See also ***engineering-based methodology***.) This method is based on actual consumption data from utility bills or checkmeter readings. These data are used to estimate the amount of energy or water a household should reasonably require.

Consumption Data. Records obtained from the utility company or from checkmeter readings that show how much energy or water was consumed within a given period of time.

Cooling Degree Days. Cooling degree days are a measure of the severity of the summer in a given locality: the more cooling degree days, the hotter the summers. Cooling degree days are the difference between 65°F and the daily ***mean*** (average) temperature when the latter is more than 65°F. Data on the 30-year average cooling degree days are provided in Appendix C of this guidebook.

Data Set. A set of consumption records for individual dwelling units used to establish an allowance for a given allowance category.

Design Temperature Differential. The design temperature differential, or design range, is the difference between the indoor temperature in winter and the ***outdoor design temperature*** in winter. The design temperature differential is used in calculating the space heating requirements of a dwelling unit under the engineering-based methodology.

End-Use. The functional application or use of a utility, such as space heating, water heating, cooking, lighting, operating appliances, or air conditioning.

Engineering-Based Methodology. One of two suggested methods that can be used to establish utility allowances. (See also ***consumption-based methodology***.) This method is based on engineering calculations and other technical information that is used to estimate the amount of energy or water a household should reasonably require.

Equal Payments Plan. A payment plan offered by the local utility company to the resident whereby the seasonal variation in monthly bills is eliminated. A resident on an "equal payments plan" pays twelve equal monthly bills every year, even though utility use may go up or down with the seasons.

Heat Loss. The heat loss, or design heat loss, is the rate of heat transfer, in ***Btus*** per hour, from occupied space to the outdoors. Losses occur through walls, ceilings and floors of a structure, and through cracks around windows, doors, etc. The heat loss depends on the dwelling unit size, construction and design of the housing development, the physical condition of the development, amount of insulation in the walls and ceilings, the assumed indoor temperature, and various other factors.

Heating Degree Days. Heating degree days are a measure of the severity of the winter in a given locality: the more heating degree days, the colder the winters. Heating degree days are the difference between 65°F and the daily ***mean*** (average) temperature when the latter is less than 65°F. Data on the 30-year average heating degree days are provided in Appendix C of this guidebook.

Hundred Cubic Feet (ccf). A common unit of measurement for natural gas and water. One ccf of natural gas is approximately equal to one ***therm*** of natural gas. One ccf of water is equal to 748 gallons of water.

Kilowatt-Hour (kWh). The common unit of measurement for electricity. One kWh is 1,000 watt-hours, or the amount of electricity consumed by a 100-watt lamp in ten hours. One kWh is equal to 3,413 ***Btus***.

Mean. A measure of the ***central tendency*** of a ***data set***, the mean is the average value in a data set. It is determined by adding all the values and dividing the sum by the number of values in the data set.

Median. A measure of the ***central tendency*** of a ***data set***, the median is the middle value in a data set, when the values are ranked from lowest to highest.

Non-Allowable End-Use. An ***end-use*** whose consumption is excluded from the utility allowance because the HA considers this use to be a luxury rather than a necessity. It is left to the discretion of individual HAs to distinguish between luxuries and necessities based on local custom and usage patterns. For example, in some regions ceiling fans are seen as an allowable use because of the local climate, whereas in other regions such fans are viewed as luxuries.

Normalization. A mathematical process that adjusts for differences among data from varying sources in order to create a common basis for comparison. In the context of utility allowances, under the consumption-based methodology, an HA may use a fixed set of data on consumption for one or more years, with this data normalized (adjusted) using 30-year weather averages. The normalization corrects for the fluctuations in weather from year to year so that the allowances are calculated on more typical weather patterns.

Outdoor Design Temperature. The lowest outdoor winter temperature that could occur in a given location, based on a 99 percent confidence level. This temperature is used to determine the ***design temperature differential***, which is used in calculating the space heating requirements of a dwelling unit using the engineering-based methodology.

Space Heating. "Space heating" refers to the warming of a dwelling unit to a reasonable temperature in the wintertime. Space heating can be provided by any type of heating system; it is not limited to heating provided by portable space heaters.

Statistically Valid Sample. A data set that contains enough data to obtain a reasonable representation of the typical consumption for a given allowance category. The number of records (or sample size) required to make a sample statistically valid depends on how widely the consumption data vary among dwelling units within an allowance category.

Surcharge. The amount an HA charges a household, in addition to ***Resident Rent***, for consumption of checkmetered utilities in excess of the utility allowance, or for non-allowable end-uses.

Resident Rent. The amount paid monthly by the household as rent to the HA. Where all utilities are supplied by the HA, Resident Rent equals ***Total Resident Payment***. Where some or all of the utilities are paid directly by the resident to the utility company, then the Resident Rent equals Total Resident Payment minus the allowance for resident-purchased utilities.

Therm. A common unit of measurement of natural gas is equal to 100,000 ***Btus*** of energy. Depending on its quality, natural gas typically contains approximately 1,000 Btu per cubic foot. Therefore, a therm of natural gas is usually equal to about 100 cubic feet.

Total Resident Payment. Generally 30 percent of a resident's adjusted income. (See Chapter 2 for a more complete discussion of Total Resident Payment.)

Utility. Electricity, gas, propane, oil, water and sewer service, and trash and garbage collection. ***Telephone service is not considered a utility for the purposes of this guidebook.***

Wattage. A measure of the electric power required by a device such as a light bulb or appliance.

* * * * *

Now that the reader has acquired some basic familiarity with the principles and technical terminology associated with utility allowances, the next chapter will examine in greater detail the specific federal requirements that HAs must meet in setting utility allowances for their residents.

CHAPTER 2: THE FEDERAL REGULATIONS

Overview

This chapter summarizes the federal regulations that govern the setting of utility allowances in public and Indian housing. These regulations, which are found at 24 CFR Part 965, apply to allowances for all applicable types of utilities, regardless of the methodology used to calculate the allowances.

The regulations do not require that any particular method be used to establish allowances. They do, however, contain guidelines regarding which utilities should be covered by allowances, the factors that must be considered in calculating allowances, and the period for which an allowance should be established (for example, monthly, bi-monthly, or quarterly).

In addition, the federal regulations require HAs to inform their residents of any changes being made in the allowance schedule, and of the availability of individual relief in case of special needs. Finally, the regulations require that HAs review their allowances annually to ensure that they continue to be consistent with the regulations.

The Standard: "An Energy Conservative Household"

The regulations set forth the following basic standard for allowances for both HA-furnished and resident-purchased utilities. The objective of a HA in establishing allowances for each dwelling unit category and unit size must be:

> "... to approximate a ***reasonable consumption*** of utilities by an ***energy-conservative household*** of modest circumstances consistent with the requirements of a safe, sanitary, and healthful living environment." [emphasis added].[1]

Because HUD does not specifically define "reasonable" or "energy conservative household," it is left to the HA to interpret these terms, in light of the HA's particular location and other characteristics. The following points should be kept in mind when considering the meaning of "reasonable" and "energy conservative household."

[1] 24 CFR 965.505(a).

- **"Energy-conservative household" refers to the consumption of a household**, and not to factors outside the control of the residents, such as the physical condition of the public housing development or the energy efficiency of HA-provided appliances and equipment.

- **The level of reasonable consumption may vary depending on differences in local custom and usage patterns.** For example, a HA in Georgia might consider ceiling fans part of reasonable energy usage, whereas a HA in Oregon might not.

- **The level of reasonable consumption may differ between two households that have identical dwelling units and appliances, depending on the occupants' lifestyles and schedules.** For example, a two-person household in which both residents are at work or school all day can be expected to have lower consumption than a two-person household that consists of a person who stays home all day to care for a live-in elderly parent. Both households may have reasonable energy consumption, even if the actual amounts of consumption differ, because of the differences in their lifestyles and needs.

What Consumption is Within the Resident's Control?

Any amount of consumption above the allowance ought to be reasonably within the control of the household to avoid. But what does it mean to be within the control of the household to avoid? For most end-uses, there are many factors that affect consumption. Usually, some of these factors can be controlled by the resident and others cannot.

For example, the consumption requirements for space heating depend on various factors, including climate, the efficiency of the heating system, the level of insulation in the dwelling unit, how the thermostat is used, and whether the resident opens the windows in the winter. In this example, only the last two factors are within the ability of the resident to control. And sometimes, a resident may feel compelled to open the window because of factors not within his or her control, such as overheating or poor ventilation in the apartment, in which case, the HA should examine the need for adjustment or maintenance of the heating system.

Therefore, it is important to keep in mind that consumption may be high due to factors that are beyond the control of the resident. Where energy or water consumption is high, the HA should take measures to improve energy and water efficiency of developments, as well as to provide energy and water conservation education to the residents.

What Allowances Should Include

Utility allowances should be provided for reasonable consumption of checkmetered or individually metered utilities. Allowances for both HA-furnished[2] and resident-purchased utilities should be designed to reflect reasonable utility consumption for ***major equipment or for utility functions furnished by the HA***, ***essential equipment*** whether or not furnished by the HA, and ***minor items of equipment*** furnished by the

[2] For HA-furnished utilities, the allowance sets the level of consumption above which a surcharge will be assessed against a resident household.

residents.[3] These categories of equipment can be broken down into the following end-uses:

- space heating
- domestic hot water
- cooking
- food refrigeration
- lighting
- appliances
- water and sewer
- trash/garbage disposal

Where HAs provide an allowance for a "fixed price utility," it should cover the entire cost of that service.

In addition, for Public Housing Agencies, allowances should include the entire cost of any "fixed price" (non-metered) utilities. Fixed price utilities are those utilities that cost the same amount, regardless of how much of the utility is used. For example, garbage collection services are usually a fixed price utility.

Factors to Take into Account in Calculating Utility Allowances

The regulations require that HAs "take into account relevant factors" when calculating utility allowances.[4] In addition to the types of equipment and functions to be covered by the allowance, these factors include:

- climatic conditions
- dwelling unit size
- number of occupants
- type of construction and design of the housing development
- energy efficiency of appliances and equipment
- physical condition of the development
- indoor temperature
- hot water temperature

What does it mean "to take into account" these factors? In essence, the HA must consider each factor separately and decide whether it would

[3] 24 CFR 965.505(b).

[4] 24 CFR 965.505(d).

A note on appliances. All HA-supplied appliances should be covered by allowances. In addition, reasonable consumption due to resident-owned appliances that are considered necessities should be included in allowances. The HA should determine which appliances are necessities and which are luxuries. In making this determination, the HA must consider local custom and usage patterns. (Many appliances that were considered luxuries a decade or two ago may be considered necessities in today's world. For example, today many HAs consider television a necessity because this appliance provides necessary news and information.) If, after considering local custom and usage and local climate, the HA determines that the use of a certain appliance is a luxury, then this appliance may be termed a ***non-allowable end-use****, and consumption attributable to that end-use is not covered by the allowance.*

make a substantial difference in the allowance. If it would, then the HA should incorporate the factor into the calculation of the allowance. In some cases, incorporating a factor into the allowance calculation means making it a criterion for establishing ***allowance categories*** (see next section). Here is how these factors may be taken into account:

Equipment and Functions to be Covered by the Allowance. This factor involves determining which functions or end-uses are to be covered by an allowance. As noted above, the most common end-uses to consider are space heating, domestic hot water, cooking, lighting, food refrigeration, electrical appliances, water and sewer, and trash/garbage disposal. The energy usage can also depend on what kind of equipment is furnished for space heating, cooking, or heating water.

Climatic Conditions. Climatic conditions play a key role in the energy needs of a household. Local climate should be taken into account in determining if appliances used for cooling should be considered luxuries or necessities. The distinction between luxuries and necessities is used to determine whether these end-uses are considered non-allowable or allowable. With some methodologies (see Chapter 3), actual weather data are factored into the calculation of allowances.

Dwelling Unit Size and Number of Occupants. The utility needs of a household also depend on the dwelling unit size. Larger units

A note on cooling. It is important to note that air conditioning and cooling are not synonymous. Cooling refers to air conditioning as well as other end-uses used to improve comfort in the summer, such as dehumidifiers and fans.

Energy used for air conditioning is generally not included in utility allowances. Some limited exceptions are authorized by the regulations at 24 CFR 965.505(e):

- *For example, if an air conditioning system installed by a PHA does not give residents the option of choosing to use air conditioning, the residents are not to be charged. (Such systems are to be avoided whenever possible.)*
- *For air conditioning systems installed by the PHA that offer residents the option of choosing to use air conditioning and include retail meters or checkmeters, the residents must pay for such use and the PHA cannot include the air conditioning in its utility allowance.*
- *For air conditioning systems that provide for resident option but cannot be checkmetered, residents are to be surcharged per 24 CFR 965.506.*

require more energy to heat them. In addition, larger dwelling units tend to have more occupants.

The number of occupants in a household affects the consumption requirements of hot water and water/sewer services. To a lesser extent, the consumption requirements for lighting and appliances may also be affected by the number of people living in this unit. If an HA's allowances are set by dwelling unit size (number of bedrooms), separate consideration of the number of persons in the household may not be necessary except in the largest dwelling unit category. However, if there is significant variation in the number of legal occupants in dwelling units of the same size, then the number of authorized occupants in each dwelling unit should be considered in establishing allowances.

Construction and Configuration of the Public Housing Development. The construction and design of a housing development are two of the primary factors for determining allowances. Two public housing developments of different construction and design have different overall utility needs, and therefore require different allowances. In addition, the construction and design of a development, or the location of a unit, may also produce variation in utility needs within a given building. For example, a top-floor corner apartment most likely has different heating needs than a first-floor apartment with only one exterior wall.

Energy Efficiency of Appliances and Equipment. The energy efficiency of HA-supplied appliances and equipment greatly affects the utility needs of a household. For example, because of energy efficiency improvements in equipment, a unit in a recently modernized building with a new heating system and newly-replaced appliances will have much lower utility requirements (all else being equal) than a unit with an 8-year old refrigerator in a building that has a 30-year old heating system.

Physical Condition of the Development. The utility needs of a household also depend on the physical condition of the development. For example, leaky faucets increase water use, and loose-fitting windows and lack of insulation increase heating requirements.

Indoor Temperature. The energy requirement for heating a dwelling unit depends on the standard established for indoor temperature in winter. (The indoor temperature is an input to calculate the energy required for space heating when using the engineering-based methodology, described in Chapter 5.)

Hot Water Temperature. The standard for the temperature of domestic hot water is a factor in the energy requirements of a household. It takes more energy to heat water to 130°F than to 115°F. (The hot water temperature is an input to calculate the energy required for hot water when using the engineering-based methodology, described in Chapter 5.)

Developing the Allowance Categories

Because different types and sizes of dwelling units have different energy and water needs, the amount of utility consumption that could be considered to be reasonable varies among different dwelling units. ***Allowance categories*** are used to group together units with similar characteristics. Allowance categories are differentiated by factors that affect the reasonable consumption requirements of a household. In developing categories of allowances, the HA should take into account the factors outlined above. If a factor would make a significant difference on the allowance, it should be a criterion for an allowance category.

At a minimum, categories of allowances should generally be differentiated by the following:

Equipment and Functions Covered by the Allowance. Dwelling units that have different types of equipment and/or utility functions included in the allowance should be grouped in separate allowance categories. For example, one dwelling unit may have a gas stove, whereas a similar dwelling unit may have an electric stove. In such cases, the two dwelling units should be in separate allowance categories.

Dwelling Unit Size and Number of Occupants. Dwelling units of different sizes should be grouped in different allowance categories. Dwelling unit size is often expressed in terms of number of bedrooms. In some cases, the number of occupants may not need to be considered separately from dwelling unit size. In the largest size category of unit, however, separate consideration of number of occupants should occur. In addition, if there is significant variation in occupancy among dwelling units of the same size, then number of legal occupants should be considered in establishing allowances.

Construction and Design of the Housing Development. Dwelling units in developments of different construction and design should be grouped in separate allowance categories. For example, a high-rise development should be in a different allowance category than a townhouse-style development. Developments with exterior brick walls should be a different category than developments with wood siding.

It is also recommended that a dwelling unit's location within a building (for example, the number of exterior walls the unit has, or whether the unit is on the top or bottom floor) be a criterion in developing the allowance categories.

In addition, the following factors should be assessed to determine whether any of them make a significant difference in energy usage and therefore need to be used as criteria in developing allowance categories:

Energy Efficiency of Appliances. If the energy efficiency of HA-supplied appliances (such as refrigerators) and equipment (such as heating and hot water systems) varies significantly among developments of similar construction and design, then separate allowance categories should be developed for those different developments by appliance efficiency level.

Physical Condition of the Development. If the physical condition (for example, whether a development has been weatherized or modernized) varies significantly among developments of similar construction and design, then separate allowance categories should be developed for those developments.

Indoor Temperature. The indoor temperature of a dwelling unit should be a criterion in forming the allowance categories if two developments of similar construction and physical condition have different indoor temperatures, where an allowance is provided for space heating. For example, if one development that houses elderly people has an indoor temperature of 75°F, whereas a similar development that houses families has an indoor temperature of 72°F, then separate allowance categories are needed for the two developments.

A note on allowance categories: *The selection of allowance categories is one of the most critical steps in developing utility allowances, in terms of its effect both on the number of separate calculations that the HA will need to do, and on the fairness of the allowance.*

The total number of ***allowance categories*** *that an HA will need to establish will vary depending on the number of developments, their comparative ages and utility configurations, the nature of the resident population, etc.*

Within a development, an HA will most certainly want to have separate allowance categories for dwelling units of different sizes. For each development, the HA should also consider whether it is appropriate to have separate allowance categories by household size for the largest size category of units, or for under-housed or over-housed residents. The location of a unit within the building is an appropriate factor for differentiating allowance categories for space heating allowances.

In general, within a development, the utility configuration and equipment, construction materials/design, energy efficiency of equipment, indoor temperature, and physical condition should not vary greatly, and therefore these characteristics will ***not*** *require separate allowance categories.*

Period for Which Allowances Are Established

According to the federal regulations, the period of time for which allowances are established depends on whether the utilities are checkmetered (HA-furnished) or individually metered (resident-paid).

Checkmetered Utilities. Where utilities are checkmetered, the HA may establish allowances on a quarterly or monthly basis. Residents may be surcharged on a monthly basis.[5] If a checkmetered utility's consumption is used for heating or cooling, the allowances should provide for seasonal variations. If an HA's allowances for season-sensitive utilities (i.e., space heating) do not themselves vary seasonally, then that HA should provide residents with credits for the

[5] 24 CFR 965.504(a).

months in which the level of utilities consumed is less than the uniform allowance.

Individually Metered Utilities. Where utilities are individually metered, allowances are generally established by the HA at a uniform monthly amount. If the utility company does not offer residents an "equal payments plan," however, the HA should consider providing for seasonal variations in its allowances.[6]

Individual Relief

Because setting allowances involves estimation, HAs should expect that some residents who have excess consumption do not have the ability to control this consumption. The excess consumption may be caused by one of a number of factors. HUD regulations permit HAs to grant individual relief when the circumstances are beyond the resident's control. When granting individual relief, the regulations require HAs to develop criteria and notify the residents. The HA should consider the following as valid reasons when developing its criteria:[7]

- The resident's consumption was mistakenly portrayed as excessive due to defects in the meter or errors in the meter reading.

- The resident's excessive consumption is caused by a characteristic of the dwelling unit or HA-supplied equipment that is beyond the control of the resident. For example, the unit may have a particularly inefficient refrigerator or inadequate insulation. The allowance should be adjusted to reflect the higher consumption needs associated with the unit until the situation is remedied. The resident should be granted individual relief until the allowance is adjusted.

- The resident's excessive consumption is due to special needs of the resident and is not within his or her ability to control. For example, elderly, ill or handicapped residents may have special needs that justify higher energy or water consumption.[8] The allowance should be adjusted to reflect the higher consumption needs associated with the household's special circumstances.

[6] 24 CFR 965.504(b).

[7] 24 CFR 965.508.

[8] It should be noted that the state of being elderly, ill, or handicapped is not a sufficient condition for receiving individual relief. Rather, individual relief should be granted only under extraordinary circumstances.

If the resident's consumption is high because of a factor that is within the ability of the resident to control, then no relief should be granted.

The HA must inform its residents of the availability of individual relief, the procedures for seeking relief, and the HA's criteria for granting such relief. This information should be given to residents as part of the notice on proposed allowances and scheduled surcharges and revisions thereof. In addition, all new residents should be given this information when they move in.

If an HA surcharges a large percentage of its residents, it should consider analyzing the factors that are responsible for the high incidence of surcharging to determine if the excess consumption is within the control of most residents to avoid. If the high incidence of surcharging is due to factors that are not within the control of the residents, then the allowances should be recalculated. If the high incidence of surcharging is due to factors within the control of the resident, such as a large number of residents using non-allowable end-uses or engaging in wasteful consumption, then the allowances may be reasonable, but the HA should provide energy or water conservation education services to help the residents lower their consumption.[9]

Notice to Residents

The HA must maintain a record that documents the basis on which allowances and surcharges are established and revised. This record must be made available to residents.[10] In addition, the HA must give notice to all residents of ***proposed*** allowances and surcharges or ***revisions*** to allowances and surcharges at least 60 days before the allowances are scheduled to go into effect.[11]

The notice to residents must include the following:

- A description of the basis on which the allowances and surcharges were established or revised, including specification of which equipment and functions are included in the allowance.

[9] Information about effective programs for consumer energy education can be obtained through the Professional Association for Consumer Energy Education, P. O. Box 151147, Columbus, OH 43215-8147.

[10] 24 CFR 965.502(b).

[11] 24 CFR 965.502(c); however, according to 24 CFR 965.508(a) and 965.507(b), changes in allowances and the dollar amount of surcharges due to changes in the PHA's average utility rate are not subject to this advance notice requirement.

- Information on the availability of individual relief.

- Disclosure of where residents can find the records that document how the allowances and surcharges were calculated.

- Notification to the residents of their right to submit written comments on the allowances and surcharges. The period for submitting written comments must extend at least 30 days before the allowances or surcharges are to take effect.

Although not required by the regulations, the notice should also include:

- Information on the availability of special low-income or "lifeline" rates offered by the local utility company.

- Information on any "equal payments plan" offered by the local utility company.

HUD Review of Allowances

For federally assisted public housing, utility allowances do not have to be approved by HUD before they go into effect. However, HUD may review the allowances and surcharges in the course of audits or reviews of HA operations.[12]

Annual HA Review of Allowances

The federal regulations require that HAs review their utility allowances every year to determine whether the allowances need to be revised in order to remain consistent with the regulations.[13] The extent of the review process depends on the methodology that was used to calculate the allowances in the first place. (See Chapter 7 for more detail.)

Regardless of how the allowances were calculated, the general review process should include an examination of changes in utility rates. If the utility rates change by 10 percent or more, the HA must revise its allowances accordingly.[14] In addition, if the allowances were established based on engineering calculations or a fixed set of consumption data, the

[12] 24 CFR 965.502(d). The schedule of allowances and scheduled surcharges for IHAs also are not subject to approval by HUD before becoming effective, but are reviewed in the course of audits or reviews of IHA operations.

[13] 24 CFR 965.507(a).

[14] 24 CFR 965.507(b); in fact, the regulations at 24 CFR 965.507(b) indicates that a PHA may revise its allowances for resident-purchased utilities ***between*** annual revisions if there is a rate change of 10 percent or more.

review process should also include a review of whether major changes were made to the buildings, equipment, and appliances that would affect consumption requirements. If the allowances were calculated using a rolling base of consumption data, then the annual review process involves recalculating the allowances every year as an old year's data are dropped and the most recent year's data are added. ***Chapter 7, Annual Review of Allowances***, provides further guidance on the review process.

Question and Answer Exercise for Chapter 2

Questions

1. **Which of the following statements is *false*?**

   (a) Allowances should be set so that any amount above the allowance is within the ability of the resident to control.
   (b) The establishment of utility allowances is a complex task.
   (c) The reasonable consumption requirements of an energy conservative household are the same for all HAs.
   (d) The level of reasonable consumption may differ between two households living in identical dwelling units, depending on the occupants' lifestyles and schedules.
   (e) none of the above.

2. **In which of the following situations should an allowance be provided?**

   (a) where utilities are checkmetered
   (b) where utilities are individually metered
   (c) where the resident pays for garbage pickup as a fixed-price utility
   (d) a and b
   (e) all of the above

3. **Which of the following utilities is never covered by an allowance?**

   (a) natural gas
   (b) electricity
   (c) water
   (d) telephone
   (e) oil

4. **Which of the following factors is *not* listed in the regulations as a required factor to take into account when establishing allowances?**

   (a) dwelling unit size
   (b) consumption data from meter readings or utility bills of the dwelling units
   (c) physical condition of the development
   (d) energy efficiency of appliances and equipment
   (e) none of the above

5. **Which of the following items should the notice to residents include?**

   (a) a description of the basis on which the allowances were established and disclosure of where residents can see documentation of how the allowances were calculated
   (b) information on the availability of individual relief for special needs
   (c) information on low-income rates offered by the utility
   (d) notification of residents' rights to submit comments on the allowances
   (e) all of the above

Question and Answer Exercise for Chapter 2

Answers

1. (c) This statement is false. The reasonable consumption requirements of an energy conservative household are ***not*** the same for all HAs. Consumption requirements vary due to regional differences and other factors.

2. (e) All of the above. An allowance should be provided for checkmetered utilities, individually metered utilities, and for fixed-price utilities paid for by the residents.

3. (d) Telephone. Utility allowances do not include telephone services.

4. (b) Consumption data from meter readings or utility bills of the dwelling units. The regulations do not require HAs to take into account consumption data when calculating allowances. HAs may establish legitimate allowances based on engineering calculations, without using consumption data (this approach is discussed in Chapter 3). However, consumption data can provide valuable insight into actual energy and water usage in a development.

5. (e) All of the above. The notice to residents should include all of this information.

CHAPTER 3: METHODOLOGIES TO ESTABLISH UTILITY ALLOWANCES

Overview

HUD gives HAs wide latitude in how they develop utility allowances for their public housing units. Although the federal regulations state the various factors that should be taken into account (see Chapter 2 for a discussion of these factors), they do not require than any particular methodology be used to calculate allowances. Instead, it is left to the HA to decide which methodology to use in establishing allowances.

There are two basic ways to calculate allowances:

(1) **Engineering-Based Methodology**. Allowances are based on engineering calculations, standardized consumption tables, and/or in-house information; or

(2) **Consumption-Based Methodology**. Allowances are developed using actual consumption data from dwelling units in the HA's portfolio.

This chapter describes these two methodologies and discusses the advantages and disadvantages of each. The most appropriate methodology to choose depends on an HA's particular characteristics and resources. ***Chapter 4, Choosing a Methodology***, provides guidance in determining which approach may be most suitable for a particular HA. Chapters 5 and 6 detail the process of establishing allowances based on engineering calculations or consumption data, respectively.

Engineering-Based Methodology

With the engineering-based methodology, the HA uses engineering calculations and technical data to estimate reasonable energy and water consumption for a particular type of dwelling unit or household. The reasonableness of allowances set using the engineering-based methodology depends on assumptions made in the calculations. This guidebook provides help in developing the allowance categories and gives recommendations on these important assumptions.

The first step in establishing allowances with the engineering-based methodology is to develop allowance categories that group dwelling units according to factors that affect consumption requirements. Then, the consumption requirements for the various end-uses to be covered by the allowance—space heating, hot water, cooking, lighting, refrigeration, appliances, and/or water—are each determined separately. In some cases, not all of these end-uses are included in an allowance. For example, when a utility is master-metered, it is not included.

Applying the Engineering Methodology to Utility Functions and End-Uses

Depending on the end-use, the consumption requirement may be estimated based on engineering formulas, standardized consumption tables, or in-house information on equipment used or the physical condition of the developments. Below is a brief description of how the consumption requirements for various end-uses are commonly estimated under the engineering methodology. A more complete, step-by-step description of this method can be found in Chapter 5.

Space Heating. The energy requirement for space heating is estimated using an engineering calculation. One calculation is done for each ***allowance category***. The following inputs are needed:

- the ***heat loss*** of a dwelling unit,
- the 30-year average ***heating degree days*** for the region,
- the ***efficiency*** of the heating system,
- the ***Btus per fuel unit***,
- the ***indoor temperature***, and
- the ***outdoor design temperature*** in winter.

The heat loss calculation for each unit category will be either already on file or can be performed by the local utility, a consultant, or an in-house engineer. Data on heating degree days and outdoor design temperature are provided in Appendix C of this guidebook. The efficiency of the heating system can be estimated based on the age and type of system.[1] Information on the Btus per fuel unit is provided in Chapter 5. Although there is no standard specified by the regulations, HAs frequently establish an indoor temperature of 72°F for family units and 75°F for elderly units.

Hot Water. The energy requirement for hot water is estimated using an engineering calculation. One calculation is done for each allowance category. The following inputs are needed:

[1] If the HA is in a region of more than 2,500 heating degree days, the heating system efficiency should be estimated by a licensed professional engineer.

- the ***temperature of the cold water***,
- the ***temperature of the hot water***,
- the ***number of gallons per month*** reasonably consumed by a household,
- the ***efficiency*** of the hot water heating system, and
- the ***Btus per fuel unit***.

The temperature of the cold water can be estimated based on the geographical region, and using information provided in Chapter 5. The temperature of the hot water at the tap can be measured by maintenance staff. If the temperature at the tap is lower than the temperature in the hot water heater because of storage or distribution losses, this difference will be accounted for in an accurate estimate of the system efficiency. The number of gallons per month can be based on standard consumption levels, which are suggested in Chapter 5. The efficiency of the hot water heating system depends on the age and type of system. If the hot water heating system involves an extensive distribution system or a storage tank, estimating the system efficiency is a more complicated task because of storage and distribution heat losses and should be performed by a licensed professional engineer. Data on the Btus per fuel unit are provided in Chapter 5.

Cooking. The energy requirement for cooking is estimated using standard consumption levels. Chapter 5 provides recommended consumption amounts for cooking, by household size.

Lighting. The energy requirement for lighting is estimated by multiplying the wattage of each light bulb by the number of hours the average household would have the lights on. Chapter 5 provides typical ranges of consumption for lighting, by household size.

Refrigeration. The energy requirement for refrigeration is determined using in-house information on the annual energy consumption of the refrigerators provided in the dwelling units. Refrigerators manufactured during the last decade have labels that provide this information.

Miscellaneous Appliances. The energy requirement of miscellaneous appliances can be estimated using standard consumption tables available from the local utility. Chapter 5 provides typical ranges of consumption for appliances, by household size.

Laundry. Some HAs provide an allowance to cover the reasonable utility requirements of laundry. For example, the energy requirements of clothes washers are estimated based on the wattage of the washer and how often it is used. Chapter 5 provides data on standard consumption levels for washers and dryers, by household size.

Air Conditioning. Some HAs provide an allowance to cover the reasonable utility requirements of air conditioning.[2] The energy requirement for air conditioning is determined based on the wattage of the air conditioner and how often it is used.

Water. A household's water consumption requirement depends on whether water-saving devices have been installed and is determined using standard consumption levels. Chapter 5 provides data on standard consumption levels for water, by household size.

Because the utility allowances derived from the engineering methodology are not linked to past patterns of resident consumption, an HA that switched to this method from the consumption-based methodology might experience a significant increase or decrease in the percentage of resident households whose actual consumption exceeds their allowance.

If an HA finds that a large percentage of its residents have consumption levels that exceed the allowance developed under the engineering-based methodology, the HA will want to re-examine its assumptions about consumption levels to make sure that they are not too strict and that any excess consumption is within the residents' control to avoid. As one approach to evaluating the reasonableness of the allowances, HAs can compare the allowances derived under the engineering method with those calculated under the consumption-based method. (This is fairly straightforward if the HA was previously using the consumption-based method).

If the re-examination suggests that the engineering-based allowances that were initially calculated are too low, the HA can go back and make adjustments in the assumptions used for calculating the individual utility/end-use consumption levels (such as in the number of loads of laundry per week, etc.) to provide more reasonable allowances for residents. Chapter 5 discusses this adjustment process in more detail.

[2] See regulations governing air conditioning at 24 CFR 965.505(e).

Advantages of the Engineering-Based Methodology

- *The energy requirements of an "energy-conservative household" can be estimated using this methodology. By focusing on what consumption levels should be, this method promotes energy-conservative behavior.*

- *Allowances do not need to be recalculated every year.[3] Allowances should be recalculated periodically, however, to account for gradual changes in equipment and appliance use and efficiency. They should also be recalculated whenever major changes are made to the developments.*

- *The HA does not need to obtain actual consumption data for its residents to use this methodology.*

Disadvantages of the Engineering-Based Methodology

- *HAs must have certain technical information available, such as heat loss calculations, efficiency of appliances and equipment, and weather data.*

- *HAs must make assumptions about what is reasonable consumption.*

- *The allowances are not linked to actual consumption and may be far off from actual consumption patterns.*

Consumption-Based Methodology

With the consumption-based methodology, the HA uses actual utility data on past consumption by its residents to establish utility allowances. These data are in the form of billing records (where utilities are individually metered) or checkmeter records (where utilities are checkmetered). The first step in establishing allowances with the consumption-based methodology is to specify the allowable and non-allowable end-uses. The HA then needs to decide on the timeframe that its historic consumption data will span.

This guidebook will describe two different approaches that an HA can take in defining the timeframe of its consumption data:

[3] Allowances still must be ***reviewed*** annually to account for changes in utility rates, occupancy and other factors that may affect the allowance.

Three-Year Rolling Base. Many HAs use a three-year rolling base of data to calculate allowances. Every year, new consumption records are added to the database, and consumption records from the oldest year are removed. ***With this approach, the HA must recalculate allowances every year.***

Fixed Database, Normalized for Weather. An alternative approach, which may be used when an allowance is provided for space heating,[4] is to use a fixed database of consumption information from one or more years, adjusted for the effects of weather using local weather information. ***When this approach is taken, the HA does not need to obtain consumption data every year.***

Next, the HA needs to develop allowance categories that group dwelling units according to factors that affect consumption requirements.

Allowances are then established through the following process:

- collecting the consumption data
- grouping the data into allowance categories
- cleaning the data and checking the statistical validity of the data sets
- determining the "typical" consumption for each allowance category
- adjusting the data for any non-allowable end-uses (if such consumption has not already been removed from the data)
- converting consumption allowances to dollar allowances.

Collecting the Consumption Data. The first step in establishing allowances with the consumption-based methodology is to collect the consumption data. In the case of individually metered utilities, HAs obtain consumption records from the local utility. Generally, HAs must present a release form signed by the resident for each billing record. Where utilities are checkmetered, the consumption data are records of checkmeter readings that the HA makes on a routine basis. HAs that provide allowances for more than one utility (for example, electricity, gas, and water) must collect consumption data for each of those utilities.

[4] This approach should only be used if space heating represents a substantial portion of the utility consumption. This is generally the case, even when the utility is used for other end-uses, such as hot water heating and cooking. However, where the heating load does not represent a substantial portion of the consumption, such as may be the case in regions with extremely mild winters, then the weather-normalization approach should not be used.

Grouping the Data into Allowance Categories. Consumption data are then grouped according to the allowance categories developed by the HA. Each allowance category should have one data set.

Cleaning the Data and Checking for Statistical Validity. These are two distinct but related activities, which are both concerned with ensuring that the data set (i.e., the sample of consumption records) can provide a good approximation of the typical utility consumption experience of all units within the allowance category being studied. This is a critical step in the use of the consumption-based method.

To improve the quality of the consumption data being used for its calculations, an HA will generally want to "clean" the data by deleting dwelling unit utility records that are atypical or inaccurate because of vacancies, estimated readings that are not corrected for by subsequent actual meter readings, and/or non-allowable end-uses.

If the variation in the levels of consumption among units in an allowance category is high, however, a large sample size (i.e., data on a lot of the units in the allowance category) may be necessary in order to achieve statistical validity. If this is the case, then the HA may not have enough extra data available to be able to drop the units with vacancies or non-allowable end-uses, etc., entirely from its sample; instead, the HA may need to make adjustments in these data to allow their inclusion as part of the allowance calculations. Chapter 6 looks at this adjustment process in detail.

Determining the Typical Consumption for Each Allowance Category. Once statistical validity is confirmed, the HA determines the "typical" usage for each allowance category. The typical usage is determined by finding ***the point of central tendency***. Both the mean and the median are points of central tendency. The mean and the median are discussed in Chapter 6.

The reasonableness of the calculation of typical consumption using the consumption-based methodology depends on the selection of proper allowance categories, the quality of the consumption data, and on whether the data set (the sample of consumption records for units) was statistically valid.

Even after an HA has derived an accurate estimate of a typical (whether mean or median) consumption level, however, the HA must still decide whether the standard for the "energy-conservative household" should be set at that level. For example, if the mean (average) is used as the standard, then in all probability a sizable percentage of resident households will have consumption above this level; the HA needs to ask itself whether the "excess consumption" of these other households was actually wasteful and within the residents' ability to control. If the answer to either part of this question is "no," then the HA should consider establishing the allowances at some level above the mean (average) consumption figure. Chapter 6 provides guidance in how to go about this process.

Advantages of the Consumption-Based Methodology

- *This methodology is familiar to most HAs.*
- *For smaller HAs with a homogeneous housing stock and readily-available consumption data, this methodology may be simpler than the engineering-based methodology.*
- *The allowances have a direct link to actual consumption.*

Disadvantages of the Consumption-Based Methodology

- *This methodology does not provide insight into what proportion of usage may be attributed to wasteful consumption, so there is no guarantee that the average consumption for a given allowance category is representative of an "energy-conservative household."*
- *When the three-year rolling base approach is used, consumption data must be obtained every year and allowances must be recalculated annually.*
- *Where utilities are individually metered (resident-paid), obtaining the consumption data from the local utility can be a burdensome process.*

Question & Answer Exercise for Chapter 3

Questions

1. **Which of the following is an acceptable basis for establishing allowances?**

   (a) a three-year rolling base of consumption data
   (b) a fixed data base of consumption data, normalized for weather
   (c) engineering calculations
   (d) all of the above

2. **When using the engineering-based methodology, which of the following is necessary to determine the energy consumption requirements for space heating?**

   (a) standard consumption tables
   (b) utility billing records
   (c) a heat loss calculation
   (d) checkmeter readings
   (e) all of the above

3. **Which of the following statements about the engineering-based methodology is true?**

   (a) Allowances must be recalculated every year.
   (b) Accurate consumption data must be obtained.
   (c) Allowances have a direct link to actual consumption.
   (d) The reasonableness of the allowances depends on the assumptions made in establishing the allowances.
   (e) All of the above are true.

4. **Which of the following should be done when using the consumption-based methodology?**

   (a) adjust the data for vacancy
   (b) group the data into allowance categories
   (c) determine the mean or median for each allowance category
   (d) check the statistical validity of the data sets
   (e) all of the above

5. ***TRUE OR FALSE:*** **Three years of consumption data must be used when using the consumption-based methodology.**

Question & Answer Exercise for Chapter 3

Answers

1. (d) All of the above. All of these alternative approaches are acceptable.

2. (c) Heat loss calculation. Standard consumption tables, billing records, and checkmeter readings are not necessary when calculating consumption requirements for space heating using the engineering-based methodology.

3. (d) The reasonableness of the allowances depends on the assumptions made in establishing the allowances.

4. (e) All of the above. Each of these steps should be included when using the consumption-based methodology.

5. ***FALSE.*** Three years of consumption data are required when the three-year rolling base approach is used; when the weather-normalization approach is used, however, as little as one year of data may be used (although data from more than one year is recommended).

PART TWO

CHAPTER 4: CHOOSING A METHODOLOGY

Overview

Each HA has the discretion to choose the method it wants to establish its utility allowances, so long as the method is consistent with the standards specified in 24 CFR Part 965. Which methodology is the most appropriate for a particular agency depends on the HA's particular characteristics and resources. This chapter provides guidance to HAs in choosing the most suitable methodology. The key component of this chapter is the ***Decision Tree***, which is found in Exhibit 4.1. The Decision Tree guides an HA through a series of questions about the following information:

- the utility functions for which an allowance is necessary
- the HA's assessment of the reasonableness of the current utility allowances
- the features of the HA's current allowance methodology
- the availability and quality of consumption data
- the ability of the HA to obtain data on heat loss and heating system efficiency, if relevant
- the occurrence of resident complaints or legal challenges.

Depending on the HA's answers to these questions, the Decision Tree will provide a recommendation regarding the most appropriate methodology.

Questions Posed in the Decision Tree

This section walks the reader through the central questions posed in the Decision Tree, explaining key concepts and providing guidance in answering the questions.

Does the HA feel that its current allowances are reasonable, based on the standards set by the federal regulations?

The reasonableness of allowances depends on several factors. Reasonable allowances meet the following conditions:

- the allowances include utilities that are checkmetered and/ or individually metered
- the allowances approximate the consumption of an "energy-conservative household"
- any amount over the consumption allowance that is established is within the ability of the resident to control

Exhibit 4.1
Decision Tree for Selecting a Utility Allowance Method

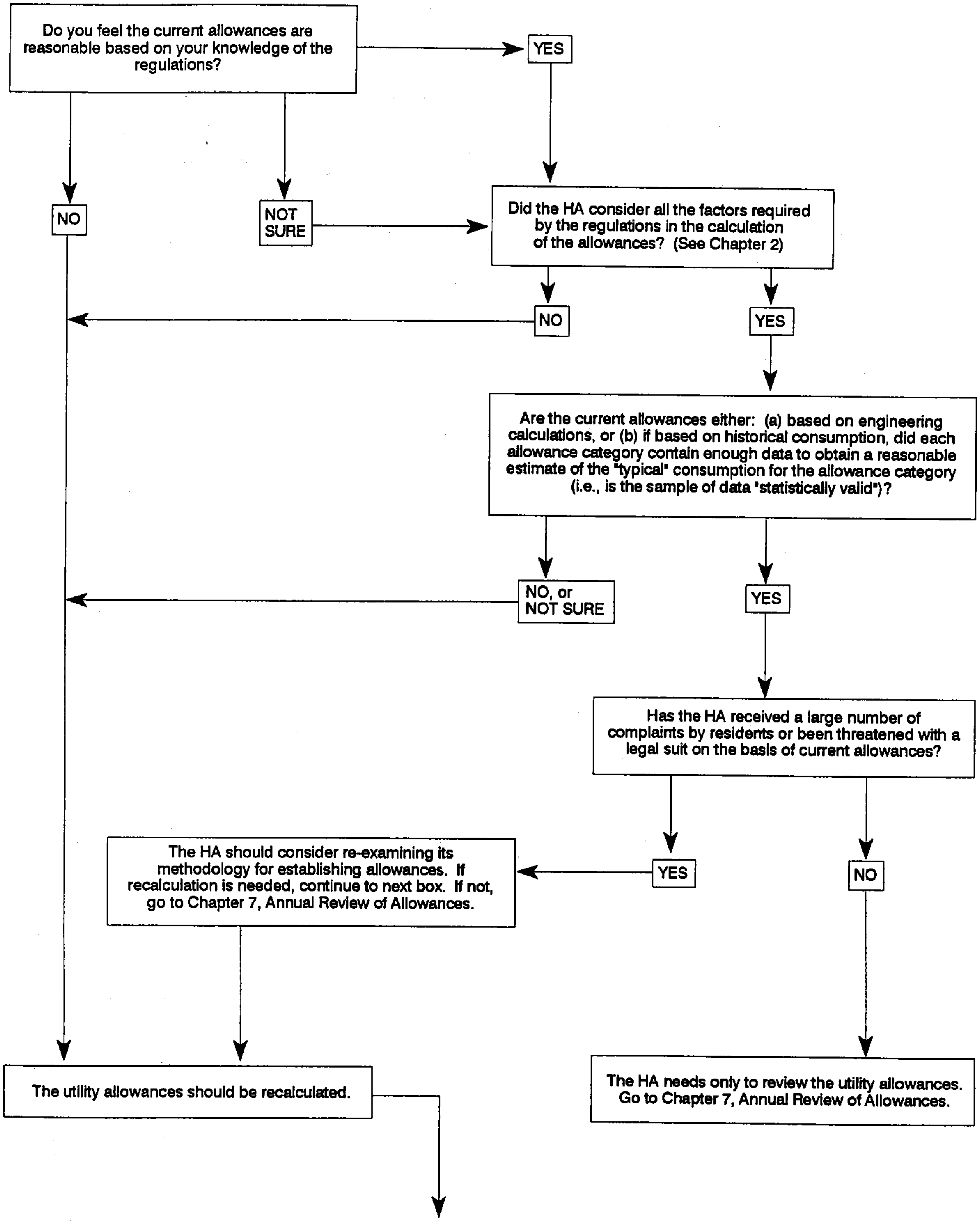

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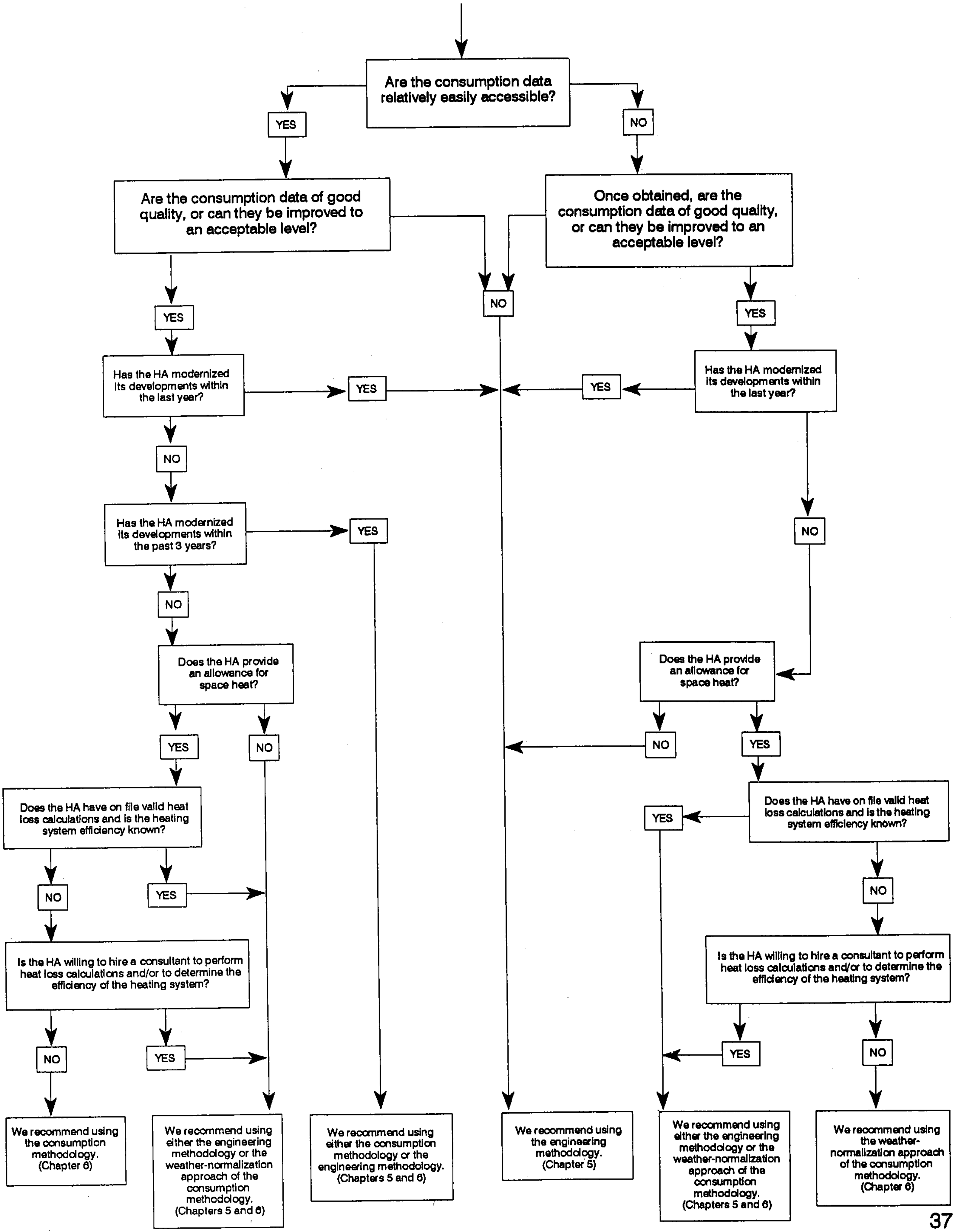
Exhibit 4.1 (cont.)
Decision Tree for Selecting a Utility Allowance Method



- the allowances take into account the factors outlined in the regulations
- the allowances are reviewed annually.

If one or more of these conditions is not met, then the allowances should not be considered reasonable.

Did the HA consider all the factors required by the regulations in the calculation of the allowances?

As explained in Chapter 2, the regulations require that the following factors be taken into account when establishing allowances:

- equipment and functions to be covered by the allowance
- climatic conditions
- dwelling unit size and number of occupants
- construction and design of the housing development
- energy efficiency of appliances and equipment
- physical condition of the development
- indoor temperature
- hot water temperature.

"Taking into account each factor" means considering each factor and determining whether it would make a substantial difference to the allowance. Factors that would make a significant difference to the allowance should be incorporated into the calculation of the allowance. How a factor is incorporated into the calculation depends on which methodology is being used.

> With the ***consumption-based methodology***, incorporating a factor means using it as a criterion for forming ***allowance categories***. For example, if one development has a new, efficient heating system, and a neighboring development has an old, inefficient heating system, then the two developments should have separate allowance schedules for space heating.
>
> With the ***engineering-based methodology***, a factor can be incorporated into the calculation of the allowance in one of two ways, depending on the factor and the end-use. First, it may be used as a criterion for forming allowance categories. Alternatively, it may be plugged into an equation to develop the figure for allowed usage. For example, the energy efficiency of heating equipment is an input to the formula used to determine energy requirements for space heating.

Are the current allowances either: (a) based on engineering calculations, or (b) if based on historical consumption, did each allowance category contain enough data to obtain a reasonable estimate of the "typical" consumption for the allowance category?[1]

Under the consumption-based methodology, in order to develop a reasonable idea of the "typical" consumption for an allowance category, there should be enough records (separate pieces of information or examples) in the data set to make the data set "statistically valid." Statistical validity is concerned with the level of certainty or confidence one can have that the data being examined truly reflect the actual phenomenon being studied. The number of records needed to make a data set statistically valid depends on how much variation there is among the data. The problems caused by variation in the data can often be reduced by including more data in the sample, such as when weather data from multiple years are used to offset year-by-year variation in weather patterns.

The concept of statistical validity is a complex one, but achieving such validity (within reasonable limits) is critical if the consumption methodology is being used. Chapter 6 provides guidelines about how to determine how much information is required for a statistically valid data set. As a rough rule of thumb, if an HA is unable to use a 100% sample for an allowance category, it should construct a sample that includes "clean" data from at least 20 randomly selected units for each allowance category (see Chapter 6 for details). If an HA does not think that it can achieve this standard for sample size, HA staff should carefully read Chapter 6 to determine whether the consumption methodology is actually appropriate for its use.

Has the HA received a large number of complaints by residents or been threatened with a legal suit on the basis of the current allowances?

If many residents have complained about the current allowances, or if the HA has been threatened with a legal suit, then it is particularly important for the HA to review carefully whether its method for calculating allowances is consistent with the regulations. Although complaints by residents do not necessarily mean that the allowances are unreasonable, it is suggested that the HA check whether its method and allowances are defensible; if there is some doubt about this, the HA should consider upgrading the method through use of the guidance in this guidebook.

[1] If HA staff are not sure of how the current allowances were calculated, this question should be answered "no."

Even if there have not been many formal complaints about the allowances, if a significant percentage of resident households are currently paying surcharges, it would also be advisable for the HA to review its allowances to determine the portion of these surcharges that are due to non-allowable uses as opposed to "excess consumption." If many surcharges are due to the latter, the HA needs to ensure that any consumption above the current allowance levels are within the ability of the residents to control.

Are the utility records relatively easily accessible, given HA staff resources?

When using the consumption methodology, where utilities are individually metered, the HA must obtain individual consumption records from the local utility. Typically, utilities will not release a record to an HA unless the resident whose name is on the account has signed a release form giving the utility permission to release the data. Some utilities are more willing than others to supply large quantities of consumption records.

Are the consumption data of good quality?

Good quality data must satisfy the following conditions:

- All consumption data should be adjusted for vacancy.
- Where utilities are individually metered, there should not be more than two months in a row of consumption data based on estimated reads.
- Where utilities are checkmetered, the consumption data should be from routine and regularly scheduled readings of properly calibrated checkmeters.

Can the quality of the consumption data be improved to an acceptable level?

Whether or not the quality of the data can be improved depends on the reason they are not of good quality in the first place:

- If the consumption data have not been adjusted for vacancy, then the data can be improved by making this adjustment or by removing units that have been vacant from the database. If the data are removed, then the HA must determine whether data from sufficient numbers of units remains to be able to achieve statistical validity.

- If utility records contain more than two months in a row of consumption data based on estimated reads, these records should be removed from the database. If, after removing the data based on estimated reads, enough data remain for the data sets to be statistically valid, then the consumption data may be acceptable.

- If checkmeter readings have not been made routinely and consistently, or the checkmeters were not properly calibrated during the period covered by the data, then the data cannot be improved to an acceptable level.

Has the HA modernized any developments during the past year?

If the HA has modernized any developments during the past year, then the pre-modernization consumption data for those developments will not accurately reflect the utility requirements of the dwelling units in those developments, and the HA will have less than one year's worth of post-modernization consumption data. Therefore, the engineering methodology should be used for those developments.

Has the HA modernized any developments within the past three years?

If the HA has modernized any developments within the past three years, then the pre-modernization consumption data for those developments will not accurately reflect the utility requirements of the dwelling units in those developments, and the HA will have less than three years' worth of post-modernization consumption data. Therefore, the three-year rolling base approach of the consumption methodology is inappropriate for those developments. The HA should use the engineering methodology, or alternatively, if an allowance is provided for space heat, the weather-normalization approach of the consumption methodology may be used.

If an allowance for space heat is provided, does the HA have on file (or have the capacity to secure a consultant to provide) valid heat loss calculations and heating efficiency ratings?

For the engineering-based method to be used to calculate allowances for space heat, accurate information on heat loss and heating efficiency for the HA's buildings is essential. Without such data on file, or the ability to hire consultants to provide this information, the consumption-based methodology is probably the most appropriate approach for the HA to use.

Based on the reader's responses to the questions posed in Exhibit 4.1, the Decision Tree will provide a recommended course of action to (a) maintain the HA's current methodology and conduct an annual review; (b) recalculate the allowances using an improved version of the HA's current methodology; or (c) adopt a new methodology.

If you are using (or planning to use) the ***engineering methodology***, Chapter 5 provides additional guidance. If you are using the ***consumption methodology***, then Chapter 6 should be consulted.

CHAPTER 5: ESTABLISHING ALLOWANCES USING THE ENGINEERING METHODOLOGY

Overview

The engineering-based methodology is an approach that uses technical calculations of utility requirements, rather than historical consumption data on dwelling units, to set allowances. That is, the engineering approach focuses on ***what consumption ought to be for the dwelling unit***, rather than concentrating on what it actually has been. Under the engineering approach, the ***energy*** and ***water*** consumption requirements of a dwelling unit are estimated using engineering calculations, building-specific information, and standardized consumption tables. Consumption requirements (i.e., consumption allowances) are determined ***separately*** for each allowable end-use, such as space heating, domestic hot water (DHW), cooking, refrigeration, lighting, miscellaneous end-uses, and water.

This chapter is divided into two main sections. The first section describes each of the steps in the process of establishing allowances using the engineering-based methodology. The second section provides a series of examples that lead the reader through each step of the process.

The following process is used to establish allowances under the engineering-based methodology:

Step #1: Specify allowable and non-allowable end-uses to determine which end-uses should be included in the allowances.

Step #2: Create the allowance categories.

Steps #3-#12: Estimate the consumption requirements for each end-use for each allowance category. These steps determine consumption requirements in terms of consumption units, such as therms, ccf, kWh, or gallons. HAs that do not provide an allowance for a particular end-use should skip the step for that end-use and continue to the next one.

Step #13: Aggregate the consumption requirements from the component end-uses (from Steps 3-12) to obtain the consumption allowance for each utility (e.g., electricity or gas) for each allowance category.

It is a good idea to compare these with available consumption data, to see if the results are similar.

Step #14: Convert the consumption allowances from Step 13 into dollar allowances. At this point, HAs with individually metered utilities will convert the dollar allowances into equal monthly amounts (unless the local utility does not provide an equal payments plan and the HA provides seasonally adjusted allowances).

Step #15: Publish the allowances and provide an opportunity for the residents to comment.

Exhibit 5.1 provides a schematic representation of these steps.

Step #1: Specifying Allowable and Non-Allowable End-Uses

The first step in establishing allowances with the engineering-based methodology is to determine which end-uses are to be covered by the allowances—that is, which end-uses are considered allowable end-uses. Following are examples of end-uses that may be included in allowances:

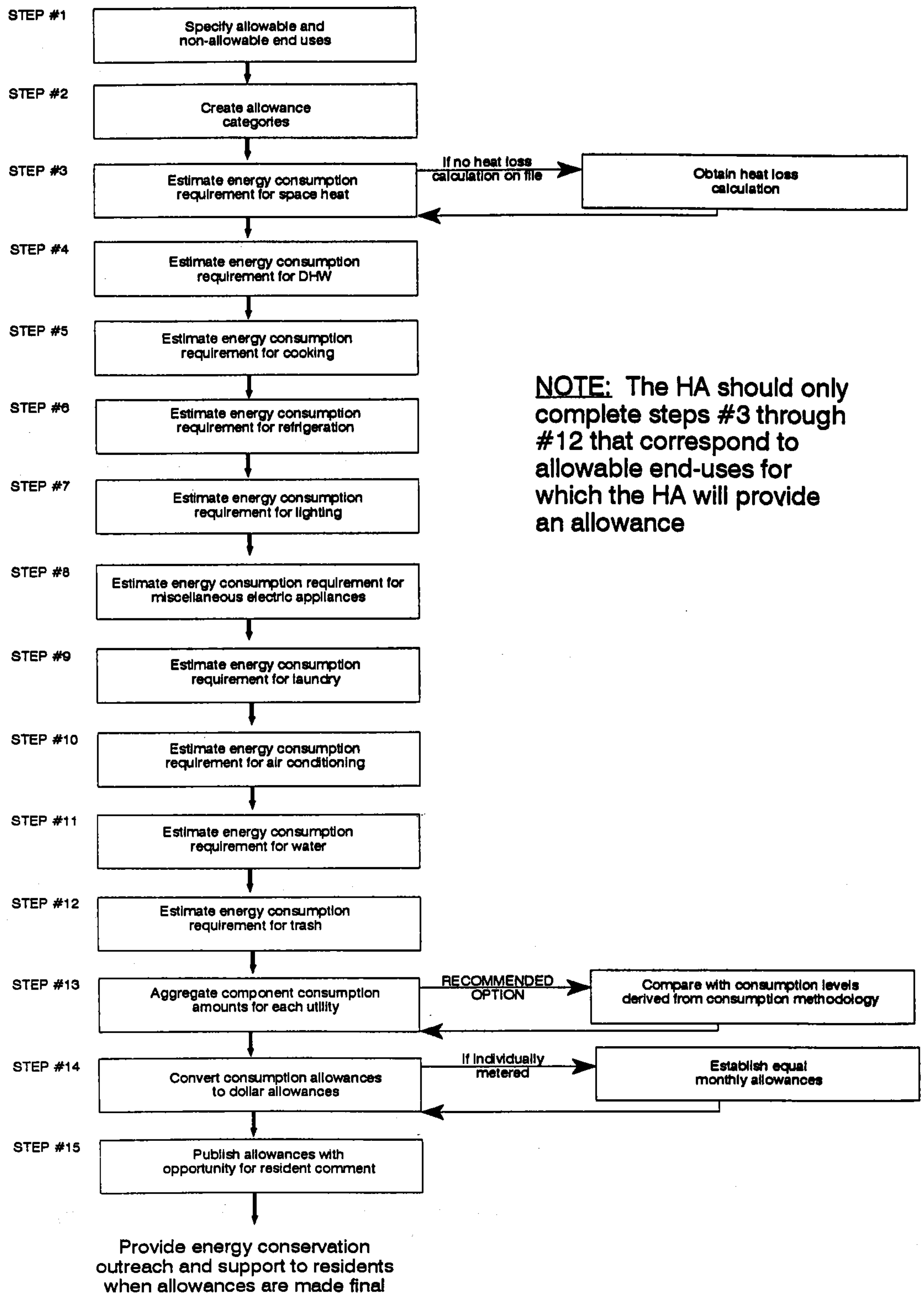
- space heating
- domestic hot water
- cooking
- refrigeration
- lighting
- miscellaneous electrical appliances
- laundry
- air conditioning
- water/sewer
- trash/garbage pickup.

In determining which end-uses should be included in the allowances, the HA should consider: (a) how the utility is metered, and (b) whether there are any end-uses that the HA specifically ***excludes*** from allowances.

As discussed in Chapter 2, an allowance should be provided for any utility that is checkmetered or individually metered, or for non-metered utilities that the residents pay for directly, such as trash/garbage pickup. Therefore, the allowances should include end-uses that are associated with those utilities.

End-uses that are specifically excluded from allowances are called ***non-allowable end-uses***. Some end-uses may be considered allowable end-uses by one HA but non-allowable by another HA. Even within one HA's

Exhibit 5.1
Steps in the Engineering-Based Methodology



portfolio, some end-uses may be considered allowable for some units, but non-allowable for others. Such decisions are left to the HA to make, based on local custom and usage as well as the local climate. ***(Please refer to Chapter 2 for a discussion of air conditioning.)***

Step #2: Creating the Allowance Categories

Allowance categories are the groups of units for which the allowances are specified. As noted in Chapter 2, different allowance categories are necessary because different types of dwelling units have varying consumption requirements. Allowance categories should be distinguished by characteristics that significantly affect the consumption requirements of a household. These characteristics may include any of the following factors:

- equipment and functions to be covered by the allowance
- climatic conditions
- dwelling unit size
- number of occupants
- type of construction and design of the housing development
- energy efficiency of appliances and equipment
- physical condition of the development
- indoor temperature.
- hot water temperature

At a minimum, categories of allowances should be differentiated by ***equipment and functions*** covered by the allowance, ***dwelling unit size and number of occupants per dwelling unit***, and ***construction and design*** of the housing development. To differentiate allowance categories by equipment and functions covered by the allowance means to group together only units that have the same types of equipment and functions. For example, a unit with gas cooking should not be grouped with a unit that has electric cooking.

Further, where the ***energy efficiency of HA-supplied appliances and equipment*** varies significantly among developments, separate allowance categories should be developed. For example, developments with original furnaces or refrigerators should be considered separately from developments with new heating systems and new refrigerators.

Where the allowance covers space heating, the allowance categories should also take into account the ***physical condition*** of the housing development. In other words, two developments of the same construction and design but in different physical condition should not be grouped together in forming allowance categories. In addition, ***dwelling unit configuration or location within a building*** (for example, the number of exterior walls the unit has, or whether the unit is on the top floor or bottom) and ***indoor temperature*** should also be criteria in developing the allowance categories where the allowance covers space heat. A heat loss calculation should take into account all of these factors. ***There should be a separate heat loss calculation for each allowance category.***

It is important to note that each factor may affect the consumption requirements of ***some*** end-uses but not others. Therefore, the number of allowance categories that are required will depend on which end-uses are covered by the allowances. An HA that provides allowances for electric end-uses that do not include space heating might have only a few allowance categories, distinguished by dwelling unit size and number of occupants, for each type of development. On the other hand, an HA that provides allowances for space heating will tend to need more allowance categories.

Step #3: Estimating the Energy Consumption Requirements for Space Heating

In public housing, space heat is generally provided by electricity or gas, and less frequently, by propane or oil. The space heating requirements of a dwelling unit depend on various factors, including dwelling unit size and configuration within the building, the construction and design of the housing development, the physical condition of the development, the local climate, the energy efficiency of the heating system, and the indoor temperature. These factors are taken into account in the following formula, which is used to determine annual energy requirements for space heating for a given dwelling unit type:

$$\text{Annual Energy Consumption} = \frac{\text{heat loss (in Btu/hr)} \times \text{heating degree days} \times \text{24 hours/day}}{\text{system efficiency} \times \text{Btu/fuel unit} \times \text{design temperature differential}}$$

Much of the information required for this formula, such as the heating degree days and the Btu per fuel unit, is provided in this guidebook. Other information, such as the heat loss calculations and the system efficiency, are site-specific and must be obtained by the HA. In some cases, professional consultation may be required. The inputs to the formula are described below:

Annual Energy Consumption. The formula determines the annual space heating energy requirements in terms of appropriate fuel units (kWh, therms, ccf, or gallons).

Heat Loss. The heat loss, or design heat loss, is the rate of heat transfer, in Btus per hour, from occupied space to the outdoors. Losses occur through walls, ceilings and floors of a structure, and though cracks around windows, doors, etc. The heat loss depends on the dwelling unit size and configuration within the building, the construction and design of the housing development, the physical condition of the development, amount of insulation in the walls and ceilings, the assumed indoor temperature, and various other factors. ***See section below on Obtaining Heat Loss Calculations.***

Heating Degree Days. Heating degree days are a measure of the severity of the winter in a given locality: the more degree days, the harsher the winters. Heating degree-days represent the difference between 65 degrees Fahrenheit (65°F) and the daily mean temperature when the latter is less than 65°F. Appendix C provides a list of the 30-year average heating degree days for various geographical areas throughout the country.

System Efficiency. The efficiency of the heating system depends on its type and age. Non-ducted electric heating systems have an efficiency of 100 percent. For other types of heating systems, the system efficiency generally ranges from 50 to 85 percent. Heating systems installed before 1975 generally have efficiencies of 70 percent or less. Systems installed from 1975 to present typically fall into the range of 75 to 85 percent. ***Note: The system efficiency is generally lower than the furnace or boiler efficiency because of distribution losses. If the HA is in a region where there are more than 2,500 heating degree days per year on average, it is especially important that the HA have an accurate estimate of the efficiency of the heating system for each allowance category.***

Btus per Fuel Unit. This factor is the heating value of the fuel used for space heat. The heating value of the fuel is plugged into the formula to convert Btus into other units, such as ccf or therms for gas, or kWh for electricity. The Btu per fuel unit conversion factors are as follows:

1 kWh	=	3,413	Btus
1 ccf natural gas[1]	=	100,000	Btus
1 therm natural gas	=	100,000	Btus
1 gallon No. 1 oil	=	134,950	Btus
1 gallon No. 2 oil	=	139,400	Btus
1 gallon No. 4 oil	=	145,600	Btus
1 gallon propane =		91,600	Btus

[1] The actual Btus per ccf gas may vary. The local gas company can provide the Btu content of the gas in its service area. For the purposes of this guidebook, we assume 100,000 Btus per ccf gas.

Design Temperature Differential (Indoor Temperature - Outdoor Design Temperature in Winter). The design temperature differential, also called "Delta T" or the design range, is the difference between the presumed indoor temperature in winter and the outdoor design temperature in winter. The ***maximum*** indoor winter temperature in public housing is typically 72°F for family developments and 75°F for elderly developments. The actual indoor temperature may be lower. The outdoor design temperature is the lowest outdoor winter temperature that could occur in a given location, based on a certain confidence level. Appendix C provides the outdoor design temperatures for various localities in each state.

Obtaining Heat Loss Calculations

There are several ways to obtain heat loss calculations, and following is a list of options. The most appropriate option depends on the circumstances of the development. HAs in regions with 2,500 or more heating degree days per year are strongly encouraged to have a licensed professional engineer perform the heat loss calculations.

Note: There should be one heat loss calculation for each space heating allowance category. Allowance categories should take into account dwelling size and location within the building.

Option 1: **Check the files.** Many HAs have already had heat loss calculations done on dwelling units, often during an energy audit performed by the local utility or a consulting engineering firm. If the heat loss calculations have been performed within five years, and no major changes (for example, new heating equipment, windows, or insulation) have been made to the development since these calculations were performed, then they may be used to establish allowances. Otherwise, new heat loss calculations should be performed.

Option 2: **Have staff engineer perform heat loss calculation.** Some HAs may have a staff engineer who knows how to perform heat loss calculations.

Option 3: **Ask the local utility.** If there is no engineer on staff who knows how to perform heat loss calculations, the HA may be able to request that the local utility perform the heat loss calculations as part of an energy audit. The HA should be prepared to provide the utility with architectural drawings of the buildings.

Option 4: **Hire a consultant or heating system service company.** If the local utility is not able to perform the heat loss calculations within a reasonable timeframe, then the HA may choose to hire an engineering consultant or heating system service company to perform the heat loss calculation. The HA should be prepared to provide the consultant or service company with architectural drawings of the buildings.

Once the HA has obtained a heat loss calculation for each allowance category and has gathered the other necessary information, it can calculate the annual energy requirement for space heating for each allowance category by using the formula shown on p. 47.

This formula yields the ***annual*** consumption requirement for space heating. The next step is to determine the ***monthly*** requirement for space heating. The monthly space heating requirements are determined through the following process. ***(Note: Monthly requirements should <u>not</u> be determined by simply dividing the annual consumption requirement by 12 months, because the energy requirement for space heating is concentrated in the winter months and is generally non-existent in the summer months, and because many utilities charge rates that vary seasonally.)***

To calculate monthly space heating allowances:

1) **Find the 30-year average heating degree days *for each month*.** The 30-year average heating degree days for each of the 12 months are provided in Appendix C of this guidebook.

2) **Find the 30-year average *annual* heating degree days.** The 30-year average annual heating degree days are provided in Appendix C of this guidebook. ***Note: The sum of the 30-year average heating degree days for the 12 months is equal to the 30-year average annual heating degree days.***

3) **For each month, divide the 30-year average heating degree days *for that month* (from #1) by the *annual* 30-year average heating degree days (from #2).** These calculations will yield the percent of annual heating demand for each month.

4) **For each month, multiply the percentage obtained in #3 by the annual consumption requirement for space heating.** These calculations will yield the monthly space heating consumption requirements.

Step #4: Estimating the Energy Consumption Requirements for Domestic Hot Water

Domestic hot water is heated using natural gas, electricity, propane, or oil. The monthly energy requirements for domestic hot water are calculated using a formula that determines the amount of energy it takes to heat a certain number of gallons to a certain temperature. The formula is as follows:

$$\text{Monthly Energy Consumption} = \frac{\text{temperature rise (in degrees) x 8.33 lb/gal x gal/month/unit}}{\text{system efficiency x Btu/fuel unit}}$$

The inputs to the formula are described below:

Temperature Rise. The temperature rise is the difference between the cold water temperature and the hot water temperature. The cold water temperature depends on the geographical location and tends to vary seasonally. Most water utilities can provide the average temperature of the water in their service area. Alternatively, the following average temperatures (in degrees Fahrenheit) may be used:

Northern localities:	40 degrees
North Central localities:	50 degrees
Central localities:	60 degrees
Southern localities:	70 degrees

(Note: these temperatures are consistent with HUD's Life Cycle Cost Analysis Handbook, 7418.1 CHG-1. These temperatures are average temperatures—actual cold water temperatures may vary substantially from season to season.)

The hot water temperature at the tap may range from 115°F to 140°F. The suggested temperature for hot water at the tap in public housing is 120°F.

8.33 Pounds/Gallon. There are 8.33 pounds per gallon of water. This figure is a constant used to convert the units from gallons to pounds, to be consistent with Btus.

Gallons/month/unit. The number of gallons of hot water per unit per month depends on the number of people per unit and on whether the dwellings have water-saving devices such as low-flow showerheads or faucet aerators. In addition, the presence of certain water-using appliances affects hot water requirements. On average, a person requires roughly 20 gallons of hot water per day if the unit has low-flow faucets and aerators. Gallons per month per unit are calculated by multiplying the gallons per person per day by the number of persons in the household times 31 days. For example, if each person in a two-person household is allowed 20 gallons per day, the gallons per month per unit would be 20 gallons x 2 people x 31 days, which equals 1,240 gallons. ***Note: Actual hot water usage may vary widely depending on the age and lifestyle of the residents. If the units are not equipped with water-saving devices, or if there are hot water leaks in some of the apartments, hot water requirements may be higher. In addition, if laundry is deemed an allowable end-use, 20 gallons per person per day may not be sufficient to cover reasonable hot water usage. A conventional washer uses about 30-50 gallons per load,[2] so if a household does just one load of hot-water laundry (or two loads of warm-water laundry) per person per week, then the per-person hot water requirement increases to 25 gallons per day.***

System Efficiency. The efficiency of the hot water heating system depends on the fuel type, and on the age and type of the system. Electric water heaters have an efficiency of 100 percent, and the efficiency of gas water heaters is typically in the range of 50 to 60 percent, with newer water heaters tending to have higher efficiency ratings. However, especially in cases where the water heating system has a lengthy distribution system or a separate storage tank, the *system* efficiency is lower than that of the water heater itself because of storage and distribution heat losses, and the temperature at the tap is lower than the temperature at the hot water heater. In such cases, it is advised that a licensed professional engineer estimate the efficiency of the system.

Btu Per Fuel Unit. This factor is the heating value of the fuel used for water heating. The heating value of the fuel is plugged into the formula to convert Btus into other units, such as ccf or therms for gas, or kWh for electricity. The Btu per fuel unit conversion factors were listed in Step #3, above.

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[2] Per *Home Water Conservation Guide*, Massachusetts Water Authority, 1989.

Note: Tables 5.1 through 5.5 in this chapter assume an occupancy of two people per bedroom. A 0-bedroom unit is assumed to have one person. HAs with different occupancy patterns should adjust the consumption amounts accordingly. It is important to note that in public housing for the elderly, 1-bedroom units generally have only one occupant. In this case, the consumption amounts listed for 0-bedroom may be more appropriate.

Step #5: Estimating the Energy Consumption Requirements for Cooking

Cooking is powered by electricity, gas, or propane. Energy requirements for cooking depend on household size. Table 5.1 provides monthly consumption amounts generally considered reasonable for HAs. Actual consumption requirements vary according to the energy efficiency of the appliance and the amount it is used, which is a function of household size.

Table 5.1. Suggested Monthly Energy Consumption Requirements for Cooking[a]

	0 BR	1 BR	2 BR	3 BR	4 BR	5 BR
Electric (kWh)	47 kWh	52 kWh	62 kWh	71 kWh	77 kWh	84 kWh
Gas (therms)	4.8 thm	5.4 thm	6.5 thm	7.4 thm	8.1 thm	8.8 thm
Propane (gal)	5.2 gal	5.9 gal	7.1 gal	8.1 gal	8.8 gal	9.6 gal

[a] The gas consumption levels shown in this table are found in HUD's Lifecycle Cost Analysis Handbook. The electric consumption level for the 0-bedroom dwelling unit was derived using standard consumption tables from various utilities; the electric consumption levels for all other dwelling units were derived using the percent differential among usage for dwelling units as found in the Handbook. The propane consumption levels were derived from the gas amounts, assuming 91,600 Btus per gallon propane.

Step #6: Estimating the Energy Consumption Requirements for Refrigeration

Energy consumption of refrigerators can vary from about 500 kWh per year to over 2,000 kWh per year, depending on the age, size, and type of the refrigerator. Because of this high level of variation, it is important that HAs use information specific to particular buildings or developments. If there is significant variation of refrigerator efficiency within a given development, the allowance should take this fact into account. The monthly requirement for refrigeration is the annual energy consumption divided by 12 months.

Step #7: Estimating the Energy Consumption Requirements for Lighting

The energy requirements for lighting depend on the number and wattage of the light bulbs in a dwelling unit and on the number of hours the lights are on. Generally, the larger the household, the more light bulbs there are in the dwelling unit and the more hours the lights are on. The HA must make assumptions about how many light bulbs there are in each dwelling unit type and how many hours are considered reasonable consumption for households of various sizes. The lighting requirements can be determined as follows:

1) For each room in the dwelling unit (e.g., living room, kitchen, pantry, hall, bathroom and bedrooms and porch), add together the wattage of the light bulbs to obtain the total ***Watts for each room.***

2) Multiply the Watts for each room (from #1) by the number of hours the lights are on per day in that particular room to get ***daily Watt-hours for each room.***

3) Add together the daily Watt-hours for each room (from #2) to get ***daily Watt-hours for the dwelling unit.***

4) Divide the daily Watt-hours for the dwelling unit (from #3) by 1000 to convert the Watt-hours into ***daily kiloWatt-hours (kWh) for the dwelling unit.***

5) Multiply the daily kWh for the dwelling unit (from #4) by 31 days to determine ***monthly kWh for the dwelling unit.***

Energy consumption requirements for lighting in public housing typically fall into the ranges indicated in Table 5.2.

Table 5.2. Monthly Electric Consumption Requirements for Lighting, Typical Ranges[a]

	0-1 Bedroom	2 Bedrooms	3 Bedrooms	4+ Bedrooms
Range	70-90 kWh	90-135 kWh	105-185 kWh	120-235 kWh

[a] These ranges are based on consumption levels that various HAs, HUD field offices, and national consulting firms have used to calculate allowances.

Step #8: Estimating the Energy Consumption Requirements for Miscellaneous Electric Appliances

Miscellaneous appliances include various tenant-owned electric appliances used by an energy-conservative household of modest means. Examples of electrical appliances that may fall into this category are clocks, televisions, radios, toasters, microwave ovens, blenders, coffee makers, irons, vacuum cleaners, and fans.

The energy consumption requirements of small electrical appliances vary depending on the energy efficiency of the appliances and on how many hours they are used every day. Because these are tenant-owned appliances, it would be impractical to determine these factors. Instead, the HA can make assumptions about the appliances being used in the dwelling units and use standard consumption tables available from the local utility to estimate reasonable consumption levels. A sample of such a table, from the Edison Electric Institute, is included in Appendix C. The energy requirement for miscellaneous electric appliances increases with household size—a good rule of thumb is an increase of about 20 to 30 percent for each additional bedroom.

Energy consumption requirements of miscellaneous electric appliances in public housing typically fall into the ranges indicated in Table 5.3.

Table 5.3. Monthly Electric Consumption Requirements of Miscellaneous Appliances, Typical Ranges[a]

	0-1 Bedroom	2 Bedrooms	3 Bedrooms	4+ Bedrooms
Range	50-135 kWh	65-170 kWh	80-205 kWh	100-240 kWh

[a] As was the case in Table 5.2, these ranges are based on consumption levels that various HAs, HUD field offices, and national consulting firms have used to calculate allowances.

Many HAs find that providing an allowance for "miscellaneous" electrical items can be a fair and practical alternative to listing all the items covered by the allowance.

Step #9: Estimating the Energy Consumption Requirements for Laundry

Where clothes washer and/or clothes dryer hook-ups are provided by the HA, an allowance may be provided for the energy used by those appliances. HAs that do not provide an allowance for clothes washers or dryers should skip this section and continue to Step #10.

Clothes Washers. The electricity consumption requirement of a clothes washer depends on the wattage of the clothes washer, the number of loads per dwelling unit per month, and the length of an average wash cycle.

$$\text{Monthly Electricity Requirement} = \frac{\text{Watts x loads/month x length of load (in hours)}}{1000}$$

Table 5.4 provides monthly electric consumption requirements of a typical clothes washer, assuming eight half-hour (0.5 hr) loads per person per month and two persons per bedroom. ***Note: These assumptions may vary from HA to HA.***

Table 5.4. Monthly Electric Consumption Requirements of a Typical Clothes Washer

	0 BR	1 BR	2 BR	3 BR	4 BR	5 BR
Clothes washer (600 W)	2.5 kWh	5 kWh	10 kWh	15 kWh	20 kWh	25 kWh

Clothes Dryers. The energy (gas or electricity) consumption requirement of a clothes dryer depends on the wattage or gas usage of the dryer, the number of loads per dwelling unit per month, and the length of an average drying time.

A typical electric clothes dryer is 5000 Watts.[3] A typical gas clothes dryer uses about 0.22 therms per hour.[4] Assuming eight 45-minute loads per person per month and two persons per bedroom, the consumption requirements for typical clothes dryers are described in Table 5.5. ***Note: These assumptions may vary from HA to HA.***

[3] Based on standard consumption tables from Edison Electric Institute (1994), Philadelphia Electric Company (1990), and Pacific Gas & Electric Company (1993).

[4] Based on standard consumption tables from Pacific Gas & Electric Company (1993) and the U.S. Department of Energy (Test and Evaluation Branch, Conservation and Renewable Energy).

Table 5.5. Monthly Energy Consumption Requirements of Typical Clothes Dryers

	0 BR	1 BR	2 BR	3 BR	4 BR	5 BR
Electric dryer (5000 W)	30 kWh	60 kWh	120 kWh	180 kWh	240 kWh	300 kWh
Gas dryer (.22 therms/hr)	1.5 thms	3 thms	6 thms	8 thms	11 thms	13 thms

Step #10: Estimating the Energy Consumption Requirements for Air Conditioning

Some HAs provide an allowance for air conditioning. (Refer to Chapter 2 for a discussion of air conditioning.) HAs that do not provide an allowance for air conditioning should skip this section.

Where an allowance is provided for air conditioning, the air conditioning unit is typically a room unit air conditioner. The monthly energy consumption requirements of a room air conditioner depend on the wattage of the air conditioner and on the number of hours per day it is used. As with miscellaneous electrical appliances, this information is often impractical to obtain, therefore, the HA must make assumptions about the wattage and use of the air conditioners. The number of hours per day that air conditioning is needed depends on the regional climate and local custom and usage.

The monthly energy consumption requirements of an air conditioner may be estimated with the following formula:

$$\text{Monthly Electrical Consumption} = \frac{\text{Watts x hours in use/day x 31 days/month}}{1000}$$

Table 5.6 provides the monthly consumption amounts for typical air conditioners using various usage assumptions. According to the Edison Electric Institute table in Appendix C, the average room air conditioner is 670 Watts. The average energy-efficient air conditioner is 500 Watts.

Table 5.6. Monthly Electric Consumption Requirements for Typical Air Conditioners (kWh)

	3 hours/day	6 hours/day
Energy-efficient (500 Watts)	47 kWh	93 kWh
Average efficiency (670 Watts)	62 kWh	125 kWh

Step #11: Estimating the Consumption Requirements for Water

The level of water consumption that is reasonable depends on the number of occupants in a dwelling unit and on whether the dwelling unit has low-volume toilets, faucet aerators, and low-flow showerheads. For units where these water-saving measures have been installed, 60 gallons per person per day can generally be considered a reasonable amount. (This amount is consistent with literature from several utilities. The 60 gallons includes water used for laundry.) If these water-saving measures are not in place, the allowable amount should be higher. In addition, where outdoor watering by residents is permitted, the allowance should account for this additional usage. The per-person per-day amount must then be multiplied by the number of legal occupants in the unit and by 31 days to get a per-unit per-month figure.

Many water utilities charge per hundred cubic feet (ccf) rather than per gallon. In such cases, the HA should covert the consumption amount estimated in this step from gallons to ccf before changing the consumption allowance into a dollar allowance. Gallons are converted to ccf using the following conversion factor:

1 gallon = .001337 ccf

Checking for Leaks or Meter Calibration Problems

Before calculating the allowance for water, the HA should check the consumption on the master meter and compare it to the total consumption measured by the checkmeters. If these two amounts differ by more than 2 percent, the following steps should be taken:

> ***Step 1: Check the calibration of the checkmeters.*** *Where water is checkmetered, examine 3 or 4 percent of the checkmeters for calibration problems. This sample size should provide a good indication of whether the checkmeters are calibrated properly.*
>
> ***Step 2: Check the distribution and service lines.*** *Check the distribution lines on the street and the service lines on the property. Check the valve between the distribution line and the service line.*
>
> ***Step 3: Check for leaks in the apartments.*** *Distribute a notice to residents asking them to notify the HA of any leaks from faucets, showers, tubs, toilets, or garden hoses.*

Step #12: Estimating the Consumption Requirements for Trash/Garbage

Where trash/garbage pickup is not metered but is charged as a flat rate, this flat rate should be the amount of the trash allowance. Where trash/garbage pickup is metered according to the volume of trash (typically in terms of number of 30-gallon cans), then one trash can per household per week is generally sufficient.

HAs should schedule several times during the year when residents may exceed the trash allowance to accommodate greater disposal needs due to certain circumstances, such as residents moving in or out, spring cleaning, and the holidays. HAs are advised to take measures to ensure that the trash services are used solely by the public housing community.

Reducing Trash Pickup Costs Through Recycling

In many areas of the country, HAs that pay private haulers for trash/garbage pickup services can reduce the cost of trash pickup by up to one-third by starting a recycling program in the housing developments. The markets for recyclable goods such as paper (which includes newspaper, paper bags, and junk mail), glass, aluminum and other metals, and plastics are growing stronger in many regions. For this reason, recyclable goods can often be hauled away at a much lower cost than generic trash. In many regions, the recycling company will pay for the materials on a per-ton basis. Check local listings for recycling companies in your area.

Step #13: Aggregating Component Consumption Amounts for Each Utility

The monthly consumption requirements of various end-uses, such as space heating, hot water, cooking, lighting, etc, have now been determined for each allowance category. The next step is to establish a ***total consumption allowance for each utility*** (e.g., gas, electricity) within each allowance category, by adding the component consumption amounts for that utility. For example, if space heating, cooking, and hot water are all provided by gas, then the consumption amounts for space heating, hot water and cooking should be aggregated to get a total gas consumption allowance.

This process of adding up all the component allowances of each utility must be completed for each allowance category.

Step #14: Converting Consumption Allowances to Dollar Allowances

For each allowance category, each of the 12 monthly consumption amounts must be converted into a dollar amount.

Electricity. Consumption amounts of electricity are in kWh. The kWh amounts are converted to dollar amounts by multiplying the kWh by the utility rate, which is the price per kWh, and adding the base charge or consumer charge and any other charges levied by the utility. Some utilities charge one rate for usage up to a certain level and another rate for usage beyond this level. If the local utility has seasonal rates, the HA should multiply the consumption amounts by the rate appropriate to that particular season or even the particular month. For example, if the utility has one rate for September through May, and another rate for June through August, then the consumption amounts in June, July, and August should be multiplied by the summer rate, and the consumption amounts in the other months should be multiplied by the off-season rate. In some cases, the utility also levies a demand charge for part or all of the year.

Gas. Consumption amounts for gas are in ccf or therms. The consumption amounts for gas in terms of ccf or therms are converted to dollar amounts by multiplying them by the price per ccf or therm and adding any customer charges or adjustments. As with electricity, if the gas company has seasonal rates, these rates should be used for the appropriate months.

Water. The consumption amounts for water in terms of gallons or ccf are converted to dollar amounts by multiplying them by the price per ccf or gallon. Frequently, this per-volume charge varies according to the amount of water used. In most areas, there is an additional charge for sewer service, which may be a flat fee or a per-volume amount. If the sewer charge is a rate charged per ccf or gallon, then this fee should be multiplied by the ccf or gallons, and added to the dollar amount for water. Where the sewer rates vary seasonally, the rate appropriate for each month should be used. Where water is individually metered, if a monthly flat fee is charged, this amount should be added to the dollar allowance.

Propane or Oil. Consumption amounts for propane and oil are in gallons. The consumption amounts for propane or oil in terms of gallons are converted to dollar amounts by multiplying the consumption amounts by the average price per gallon of propane or oil.

HAs with individually metered utilities generally provide equal monthly allowances for those utilities. (However, if the utility supplier does not offer residents a uniform payment plan, the HA may provide for seasonal variations in its allowances.) Where equal monthly allowances are provided, the monthly dollar allowances for each allowance category should be added together to get an annual dollar amount for each allowance category. This amount should then be divided by 12 to get equal monthly allowances.

Recommended Option: Comparing Engineering Calculations to Actual Consumption

If at all possible, it is a good idea to check the consumption allowances developed using the engineering-based methodology against actual consumption records. This process provides insight into how actual consumption compares to "reasonable consumption" as determined using the engineering-based methodology. It is particularly important if the HA is switching to the engineering-based methodology from another one.

Moreover, when using the engineering methodology, the assumptions regarding overall system efficiency and loads for typical equipment and end uses require that considerable judgment be exercised. This is particularly true for the space heating calculations. By using actual consumption data to inform and/or cross-check the assumptions regarding system efficiency and loads, the HA can "fine-tune" its allowance calculations developed with the engineering methodology.

To make the comparison, use billing data or checkmeter information to determine the mean consumption for each unit category. (See Chapter 6 for guidance on this process). Make sure the consumption data have been adjusted for vacancy. If the engineering-based amount is lower than the actual consumption, then one of two explanations may apply:

1) The mean consumption is higher than that of an energy conservative household, and the difference between mean consumption and the allowance is within the ability of the residents to control. This "excess" consumption may be due to use of appliances considered non-allowable by the HA, or to energy consumption habits that are not conservative.

2) The difference between the mean and the allowance is due to factors beyond the control of the residents, and assumptions in the engineering calculations may be inaccurate.

If the allowances calculated by the engineering-based method are more than 10 percent lower than the mean for actual consumption for each allowance category, the following steps should be taken:

1) ***Check the technical assumptions*** in the engineering calculations, such as the heat loss, the efficiency of the system, the heating degree days, design temperature differential, hot water temperature, etc.

2) ***Check for leaks and metering problems***. Check for leaks in gas and water lines. Check the calibration of gas, water, and electricity meters. Verify that vacancy time has been excluded.

3) ***Survey households with the highest and lowest usage*** to evaluate consumption behavior patterns.

Step #15: Publish Allowances and Provide Residents an Opportunity to Comment

As indicated in Chapter 2, the HA must not only maintain a record that documents the basis upon which the utility allowances were established, but also must give notice to ***all*** residents of proposed allowances or revisions to allowances at least 60 days prior to the date the allowances are to become effective.

The notice to residents must include a description of the method for calculating the allowances, the specifics on where residents can obtain access to full documentation of the allowance methodology and calculations, notification of the residents' right to submit written comments, and information on the availability of individual relief for residents with special circumstances or needs.

Outreach Campaign on Energy Conservation

HAs should recognize the importance of an ongoing energy conservation education effort, particularly aimed at residents whose consumption exceeds their allowance. Such outreach and education efforts that result in more energy conservation by residents will not only benefit the individual households experiencing surcharges, but will also tend to reduce the HA's overall utility use and costs.

In addition, the HA should remain alert to weatherization measures and equipment upgrading that the agency could undertake that would reduce resident utility consumption.

USING THE ENGINEERING-BASED METHODOLOGY: EXAMPLES

This section of Chapter 5 illustrates each step of the methodology by guiding the reader through a series of examples. In each example, a fictitious housing development, Riverside Apartments, is used. For the steps that involve estimating the consumption requirements of an end-use (Steps #3 through #12), this section provides an example of how the HA calculates the consumption requirement for one allowance category ***(one-bedroom, end unit on the top floor)*** and explains how the process would differ for determining the consumption requirements for other allowance categories. The following examples are intended only as illustrations and that each HA must consider its own unique circumstances in establishing utility allowances for its developments.

Riverside Apartments, a fictitious site located in a region of moderate climate, is a 48-unit housing development consisting of six two-story buildings. Each building has eight apartments for families and has the following configuration:

1 BR Top End	2 BR Top Middle	1 BR Top Middle	2 BR Top End
1 BR Bottom End	2 BR Bottom Middle	1 BR Bottom Middle	2 BR Bottom End

All six buildings are of identical design and construction and are in the same physical condition. All the buildings have gas heat, hot water, and cooking. Refrigeration, lighting, and appliances are electric, and the apartments have hookups for electric clothes washers and dryers. Gas, electricity, and water are checkmetered. The HA provides trash pickup services, which are non-metered.

Step #1: Determining Which End-Uses Should Be Included in the Allowances

In determining which end-uses should be included in the allowances, the HA takes into account two items: (1) the metering configuration of the utilities, and (2) whether there are any end-uses that it considers non-allowable.

> **Metering Configuration.** Because gas, electricity, and water are checkmetered at Riverside Apartments, allowances are provided for all three of these utilities. Because the HA provides trash pickup as a non-metered service, no allowance is provided for trash.
>
> **Non-allowable End-uses.** The HA considers air conditioning a non-allowable end-use. Cooling fans, however, which the HA categorizes as a component of miscellaneous appliances, are considered allowable.

Therefore, the following end-uses are included in allowances at Riverside Apartments:

- space heating
- domestic hot water
- cooking
- refrigeration
- lighting
- miscellaneous electrical appliances (including fans)
- laundry
- water/sewer

Step #2: Developing the Allowance Categories

In developing the allowances categories, the HA considers the various factors outlined earlier in this chapter, which include:

- equipment and functions to be covered by the allowance
- dwelling unit size and number of occupants per dwelling unit
- construction and design of the housing development
- energy efficiency of HA-supplied appliances and equipment
- physical condition of the development
- indoor temperature

Following is a description of how the HA considers each factor and develops its allowance categories:

> **Equipment and Functions to be Covered by the Allowance.** All six of the buildings of Riverside Apartments have the same types of utilities and equipment, so this factor does not affect the allowance categories. If some buildings had gas cooking, however, whereas others had electric cooking, or if some buildings had laundry hookups and others did not, then the HA would have to develop separate allowance categories for these buildings.
>
> **Dwelling Unit Size and Number of Occupants per Dwelling Unit.** All of the apartments are either one-bedroom or two-bedroom. The HA assigns families to housing based on family size, and assumes two people per bedroom. Therefore, the HA bases its allowance categories on dwelling unit size in terms of number of bedrooms.
>
> **Construction and Design of the Housing Development.** Riverside Apartments is the only development of this particular construction and design in the HA's portfolio; therefore, the HA does not group Riverside Apartments with any other development in establishing allowances. Further, all the buildings ***within*** Riverside Apartments are of the same construction and design, and therefore can be considered together in determining allowance categories. Because an allowance is provided for space heat, however, the HA also considers a ***unit's location within the building*** in developing allowance categories. Therefore, the HA forms categories that reflect whether the

dwelling unit is on the top floor or bottom floor, or if the apartment is an end unit or a middle unit. The HA has a heat loss calculation for each of these allowance categories.

Energy Efficiency of HA-supplied Appliances and Equipment. The heating and hot water systems and HA-supplied appliances are identical in each of the six buildings. Therefore, this factor is not a criterion in forming the allowance categories. If the efficiency of the heating or hot water systems or appliances differed significantly, however, then separate allowance categories would be required. For example, if the refrigerators in some of the buildings were significantly older or larger than refrigerators in other buildings, then separate allowance categories would be required.

Physical Condition of the Development. Because an allowance is provided for space heat at Riverside Apartments, the HA must consider the physical condition of the development. All the buildings were built at the same time, and they have all been modernized. Therefore, physical condition is not a criterion in forming the allowance categories. If some of the buildings had been modernized but others had not, however, then separate allowance categories based on building condition would be necessary.

Indoor Temperature. The indoor temperature is the same in all six of the buildings, so this factor is not a criterion in distinguishing allowance categories. If some of the buildings maintained a higher temperature in the winter, however, because their occupants were elderly or had special needs, then separate allowance categories would be required.

Allowance categories at Riverside Apartments are therefore distinguished by household size (in terms of number of bedrooms) and by a unit's location within the building. ***The unit's location within the building is only a consideration when calculating space heating energy consumption requirements. For other end-uses, consumption requirements can be calculated based on household size.***

The allowance categories at Riverside Apartments are therefore as follows:

1 BR End Top
1 BR End Bottom
1 BR Mid Top
1 BR Mid Bottom
2 BR End Top
2 BR End Bottom
2 BR Mid Top
2 BR Mid Bottom

Step #3: Estimating the Energy Consumption Requirements for Space Heating

Heat loss calculations were performed at Riverside Apartments five years ago, and no significant changes have been made to the buildings since then. Heat loss calculations are on file for the following categories of units:

Heat Loss Factors (Btus per Hour)

1 BR End Top	17,000
1 BR End Bottom	21,400
1 BR Mid Top	13,600
1 BR Mid Bottom	15,300
2 BR End Top	23,600
2 BR End Bottom	29,500
2 BR Mid Top	18,900
2 BR Mid Bottom	21,200

To calculate the space heating energy requirement for a 1 BR End Top unit, the following information is used:

- The heat loss is 17,000 Btu/hour (from the table above).
- The 30-year annual heating degree days are 5,003 (derived from Appendix C).
- The estimated efficiency of the heating system is 70 percent (derived from an energy audit of Riverside Apartments).
- The fuel type is gas and the fuel units are therms, so the Btu per fuel unit is 100,000 (from the table below).

1 kWh	=	3,413	Btus
1 ccf natural gas	=	100,000	Btus
1 thm natural gas	=	100,000	Btus
1 gallon No. 1 oil	=	134,950	Btus
1 gallon No. 2 oil	=	139,400	Btus
1 gallon No. 4 oil	=	145,600	Btus
1 gallon propane	=	91,600	Btus

- The indoor temperature in winter is 72°F and the outdoor design temperature is 10°F (derived from Appendix C), so the design temperature differential is 62°F.

$$\text{Annual Energy Consumption} = \frac{17{,}000 \text{ Btu/hr} \times 5003 \times 24 \text{ hrs}}{.70 \times 100{,}000 \text{ Btu/thm} \times 62°}$$

$$= \frac{2{,}041{,}224{,}000 \text{ Btu}}{4{,}340{,}000 \text{ Btu/thm}}$$

$$= 470 \text{ thm}$$

The annual space heating energy consumption requirement for a unit in the ***1 BR End Top*** category is therefore ***470 therms***. The annual space heating energy consumption requirements for other allowance categories are calculated in exactly the same way, changing only the heat loss factor.

Once the ***annual*** space heating consumption requirement is determined for an allowance category, the next step is to determine the ***monthly*** space heating consumption requirements for that allowance category. The ***monthly*** consumption requirements for this allowance category are calculated in the following table. The 30-year average ***monthly*** heating degree days (HDD) are divided by the 30-year average ***annual*** heating degree days to get the percent heating demand for each month. This percentage is then applied to the annual consumption requirement for heating to get the monthly consumption requirements.

Monthly Space Heating Energy Consumption Requirements, 1 BR End Top

Month	30-Year Average Monthly HDD	Divided by 30-Year Average Annual HDD	= Percent of Annual Heating Demand	x Annual Consump. (therms)	= Monthly Consump. (therms)
January	1150	5003	23%	470	108.1
February	901	5003	18%	470	84.6
March	652	5003	13%	470	61.1
April	250	5003	5%	470	23.5
May	85	5003	2%	470	9.4
June	0	5003	0%	470	0
July	0	5003	0%	470	0
August	0	5003	0%	470	0
September	40	5003	1%	470	4.7
October	253	5003	5%	470	23.5
November	654	5003	13%	470	61.1
December	1018	5003	20%	470	94.0

The monthly space heating energy consumption requirements for the 1 BR End Top allowance category are as follows:

Monthly Space Heating Energy Consumption Requirements (therms)

Riverside Apts.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1 BR End Top	108.1	84.6	61.1	23.5	9.4	0	0	0	4.7	23.5	61.1	94.0

The monthly space heating requirements for other allowance categories can be determined simply by using the same table, changing only the annual consumption amount (which must be specifically calculated for each allowance category).

Step #4: Estimating the Energy Consumption Requirements for Domestic Hot Water

The monthly hot water energy consumption requirement for a 1 BR End Top unit at Riverside Apartments is the same as it is for other one-bedroom units in the development. The following information is used to determine the monthly hot water energy consumption requirement for a one-bedroom unit at Riverside Apartments:

- The cold water temperature is 60°F (derived from the table below), and the hot water temperature is 120°F, so the temperature rise is 60°F.

Northern localities:	40 degrees
North Central localities:	50 degrees
Central localities:	60 degrees
Southern localities:	70 degrees

- There are low-flow showerheads and faucet aerators in all the units.

- The HA allows 25 gallons of hot water per person per day, and there are two people per unit, so a one-bedroom unit is allowed 50 gallons per day. This is equal to 1,550 gallons per month.

- The efficiency of the water heating equipment is 60 percent (based on an HA audit).

- The fuel type is gas and the fuel units are therms, so the Btu per fuel unit is 100,000 (from the table below).

1 kWh	=	3,413	Btus
1 ccf natural gas	=	100,000	Btus
1 thm natural gas	=	100,000	Btus
1 gallon No. 1 oil	=	134,950	Btus
1 gallon No. 2 oil	=	139,400	Btus
1 gallon No. 4 oil	=	145,600	Btus
1 gallon propane	=	91,600	Btus

$$\text{Monthly Energy Consumption} = \frac{60° \times 8.33 \text{ lbs/gal} \times 1550 \text{ gal}}{.6 \times 100{,}000 \text{ Btu/thm}}$$

$$= \frac{774{,}690 \text{ Btu}}{60{,}000 \text{ Btu/thm}}$$

$$= 12.9 \text{ thm}$$

The monthly hot water energy consumption requirement for all one-bedroom allowance categories at Riverside is 12.9 therms. This amount is the same for every month.

Monthly Domestic Hot Water Energy Consumption Requirements (therms)

Riverside Apts.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1 BR allowance categories	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9

The hot water energy consumption requirements for two-bedroom apartments are calculated in exactly the same way, changing only the number of gallons per apartment, which would be 100 gallons per day, or 3,100 gallons per month.

Step #5: Estimating the Energy Consumption Requirements for Cooking

Cooking at Riverside Apartments is provided by gas. The monthly cooking energy consumption requirement for a 1 BR End Top unit at Riverside Apartments is the same as it is for other one-bedroom units in the development. From the table below, the HA derives 5.4 therms as a monthly consumption amount for 1 BR apartments at Riverside.

Suggested Monthly Energy Consumption Requirements for Cooking

	0 BR	1 BR	2 BR	3 BR	4 BR	5 BR
Electric (kWh)	47 kWh	52 kWh	62 kWh	71 kWh	77 kWh	84 kWh
Gas (therms)	4.8 thm	5.4 thm	6.5 thm	7.4 thm	8.1 thm	8.8 thm
Propane (gal)	5.2 gal	5.9 gal	7.1 gal	8.1 gal	8.8 gal	9.6 gal

The monthly cooking energy consumption requirement for all one-bedroom allowance categories at Riverside is 5.4 therms. This amount is the same for every month.

Monthly Cooking Energy Consumption Requirements (therms)

Riverside Apts.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1 BR allowance categories	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4

The cooking energy consumption requirements for two-bedroom apartments are derived using the same table.

Step #6: Estimating the Energy Consumption Requirements for Refrigeration

All of the refrigerators at Riverside Apartments are 14 cubic foot refrigerators with a rated energy usage of 850 kWh per year (from procurement files). Therefore, the monthly refrigeration energy consumption requirement for a 1 BR End Top unit at Riverside Apartments is the same as it is for all other units in the development. The monthly energy requirement is simply the annual requirement (850 kWh) divided by 12 months, which is 71 kWh.

The monthly refrigeration energy consumption requirement for all allowance categories at Riverside is 71 kWh. This amount is the same for every month.

Monthly Refrigeration Energy Consumption Requirements (kWh)

Riverside Apts.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
All allowance categories	71	71	71	71	71	71	71	71	71	71	71	71

Step #7: Estimating the Energy Consumption Requirements for Lighting

The monthly lighting energy consumption requirement for a 1 BR End Top apartment is the same as it is for other one-bedroom apartments at Riverside. To calculate the electricity requirements for lighting for a one-bedroom unit at Riverside Apartments, the HA uses the following assumptions, based on information it has on the lighting in the apartments, and on what it considers to be a reasonable number of hours for lights to be on every day in each room:

- The living room has two 75-Watt bulbs; these lights are on an average of five hours/day.
- The kitchen has two 75-Watt bulbs; these lights are on an average of four hours/day.
- The pantry has one 60-Watt bulb; this light is on an average of one hour/day.
- The hall has one 75-Watt bulb; this light is on an average of two hours/day.
- The bathroom has one 50-Watt bulb (fluorescent); this light is on an average of three hours/day.
- The bedroom has two 75-Watt bulbs; these lights are on an average of four hours/day.

- The porch has two 75-Watt bulbs; these lights are on an average of three hours/day.

1) For each room in the dwelling unit, add together the wattage of the light bulbs to obtain the total ***Watts (W) for each room.***

Living room	75 W + 75 W	=	150 W
Kitchen	75 W + 75 W	=	150 W
Pantry	60 W	=	60 W
Hall	75 W	=	75 W
Bathroom	50 W	=	50 W
Bedroom	75 W + 75 W	=	150 W
Porch	75 W + 75 W	=	150 W

2) Multiply the Watts for each room by the number of hours the lights are on per day in that particular room to get ***daily Watt-hours (Wh) for each room.***

Living room	150 W	x	5 hrs/day	=	750 Wh
Kitchen	150 W	x	4 hrs/day	=	600 Wh
Pantry	60 W	x	1 hr/day	=	60 Wh
Hall	75 W	x	2 hr/day	=	150 Wh
Bathroom	50 W	x	3 hr/day	=	150 Wh
Bedroom	150 W	x	4 hr/day	=	600 Wh
Porch	150 W	x	3 hr/day	=	450 Wh

3) Add together the Watt-hours for each room to get ***daily Watt-hours for the dwelling unit.***

Living room	750 Wh/day
Kitchen	600 Wh/day
Pantry	60 Wh/day
Hall	150 Wh/day
Bathroom	150 Wh/day
Bedroom	600 Wh/day
Porch	450 Wh/day
Total for Dwelling Unit	2,760 Wh/day

4) Divide the total Watt-hours by 1000 to convert the Watt-hours into ***daily kiloWatt-hours (kWh) for the dwelling unit.***

2,760 Wh/day ÷ 1000 Wh/kWh = 2.76 kWh/day

5) Multiply the kWh calculated in Step 3 by 31 to determine ***monthly kWh for the dwelling unit.***

2.76 kWh/day × 31 days/month = 86 kWh/month

The monthly lighting energy consumption requirement for all one-bedroom allowance categories is 86 kWh. This amount is the same for every month.

Monthly Lighting Energy Consumption Requirements (kWh)

Riverside Apts.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1 BR allowance categories	86	86	86	86	86	86	86	86	86	86	86	86

The lighting energy consumption requirements for two-bedroom apartments are calculated in the same way, but with increased wattages for the bedrooms (because there are two bedrooms rather than one) and increased burn times for some of the rooms, in particular the living room, kitchen and bathroom.

Step #8: Estimating Energy Consumption Requirements for Miscellaneous Electric Appliances

At Riverside Apartments, clocks, televisions, radios, toasters, microwave ovens, blenders, coffee makers, irons, vacuum cleaners, cooling fans, and other small appliances are considered legitimate end-uses and are included in the miscellaneous allowance category. The HA recognizes that there may be other legitimate end-uses that it has not listed.

The monthly energy consumption requirement for miscellaneous electric appliances for a 1 BR End Top apartment is the same as it is for other one-bedroom apartments at Riverside. ***Using a table of standard consumption levels, which the HA obtained from the local utility***, the HA estimates that all the items listed above use roughly 900 kWh per year for a household living in a one-bedroom apartment. An additional 300 kWh per year is added to cover the use of other small appliances that are not listed but that are legitimate uses of electricity for an energy-conservative household of modest means. The total annual consumption requirement is therefore 1200 kWh, which is ***100 kWh*** per month.

The monthly energy consumption requirement for miscellaneous electric appliances for all one-bedroom allowance categories is 100 kWh. This amount is the same for every month.

Monthly Energy Consumption Requirements for Miscellaneous Electric Appliances (kWh)

Riverside Apts.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1 BR allowance categories	100	100	100	100	100	100	100	100	100	100	100	100

The consumption requirements for two-bedroom apartments are calculated in the same way, but with increased assumptions of usage.

Step #9: Estimating the Energy Consumption Requirements for Laundry

The monthly laundry energy consumption requirement for a 1 BR End Top apartment is the same as it is for other one-bedroom apartments at Riverside. To estimate the electricity requirements for clothes washers and dryers for one-bedroom units of Riverside Apartments, the HA uses the tables below:

Monthly Electric Consumption Requirements of a Typical Clothes Washer

	0 BR	1 BR	2 BR	3 BR	4 BR	5 BR
Clothes washer (600-Watt)	2.5 kWh	5 kWh	10 kWh	15 kWh	20 kWh	25 kWh

Monthly Energy Consumption Requirements of Clothes Dryers

	0 BR	1 BR	2 BR	3 BR	4 BR	5 BR
Electric dryer (5000 Watts)	30 kWh	60 kWh	120 kWh	180 kWh	240 kWh	300 kWh
Gas dryer (.22 therms/hr)	1.5 thms	3 thms	6 thms	8 thms	11 thms	13 thms

The monthly energy consumption requirement for laundry for all one-bedroom allowance categories is 5 kWh plus 60 kWh, which totals 65 kWh. This amount is the same for every month.

Monthly Laundry Energy Consumption Requirements (kWh)

Riverside Apts.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1 BR allowance categories	65	65	65	65	65	65	65	65	65	65	65	65

The consumption requirements for two-bedroom apartments are derived using the same tables.

Step #10: Estimating the Energy Consumption Requirements for Air Conditioning

Because the HA does not provide an allowance for air conditioning, the HA skips this step. The energy consumption requirement for cooling fans, which are allowable, are determined in Step #8, which estimates the consumption requirements for miscellaneous electric appliances.

Step #11: Estimating the Consumption Requirements for Water

The monthly consumption requirement for water for a 1 BR End Top apartment is the same as it is for other one-bedroom apartments at Riverside. The dwelling units at Riverside Apartments have low-flow showerheads and low-volume flush toilets. The HA considers 60 gallons per person per day a reasonable amount. One-bedroom units are allowed 120 gallons per day, because the HA assumes two persons per one-bedroom apartment. The HA then multiplies this daily amount by 31 days to get the monthly amount, which is 3,720 gallons per one-bedroom unit.

Because the water utility charges per hundred cubic feet (ccf) rather than per gallon, the HA must convert the gallon consumption requirement into ccf. This conversion is done by multiplying the gallons by 0.001337:

$$3{,}720 \text{ gallons} \times 0.001337 = 4.97 \text{ ccf}$$

The monthly consumption requirement for water for all one-bedroom allowance categories is 4.97 ccf. This amount is the same for every month.

Monthly Water Consumption Requirements (ccf)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1 BR allow. categories	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97

The consumption requirements for two-bedroom apartments are derived in the same way, changing the daily per-unit amount to 240 gallons because there are assumed to be four people per dwelling unit. This amount is then multiplied by 31 days to get a monthly amount, which in then converted into ccf.

Step #12: Estimating the Consumption Requirements for Trash/Garbage

Because the HA does not provide an allowance for trash pickup, the HA skips this step.

Step #13: Aggregating Component Consumption Amounts for Each Utility

The HA has now calculated all the component monthly consumption allowances of one allowance category (1 BR End Top apartment) for Riverside Apartments. The next step is to aggregate the component consumption amounts for each utility.

For the total gas consumption allowance, the HA adds together the monthly component consumption requirements for gas end-uses: space heating, domestic hot water, and cooking.

Monthly Gas Allowances (therms), 1 BR End Top

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat	108.1	84.6	61.1	23.5	9.4	0	0	0	4.7	23.5	61.1	91.0
DHW	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9
Cooking	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Total	126.4	102.9	79.4	41.8	27.7	18.3	18.3	18.3	23.0	41.8	79.4	109.3

For the total electricity allowance, the HA adds together the monthly component consumption requirements for refrigeration, lighting, miscellaneous electric appliances, and laundry.

Monthly Electricity Allowances (kWh), 1 BR

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Refrig.	71	71	71	71	71	71	71	71	71	71	71	71
Lighting	86	86	86	86	86	86	86	86	86	86	86	86
Misc. appl.	100	100	100	100	100	100	100	100	100	100	100	100
Laundry	65	65	65	65	65	65	65	65	65	65	65	65
Total	322	322	322	322	322	322	322	322	322	322	322	322

Because there is only one component to the water allowance, the HA needs only to transfer the amounts derived in Step #11 to the table.

Monthly Water Allowances, 1 BR

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
ccf	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97

Step #14: Converting Consumption Allowances to Dollar Allowances

At this point, the HA has determined the monthly consumption allowances for gas, electricity, and water for one allowance category. The HA must then convert the consumption allowances for each utility by multiplying the consumption allowance by the rate that is applicable for that particular month.

Gas. The current gas rate is $0.65/therm for December through March, and $0.55/therm for April through November.

Monthly Gas Allowances, 1 BR End Top

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Consump. allow. (therms)	126.4	102.9	79.4	41.8	27.7	18.3	18.3	18.3	23.0	41.8	79.4	109.3
× rate ($/therm)	.65	.65	.65	.55	.55	.55	.55	.55	.55	.55	.55	.65
Dollar allow. ($)	$82	$67	$52	$23	$15	$10	$10	$10	$13	$23	$44	$71

Electricity. The current electric rate is $0.10/kWh for June through September, and $0.085/kWh for October through May. There is no demand charge.

Monthly Electricity Allowances, 1 BR End Top (same for all 1 BR allowance categories at Riverside Apartments)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Consump. allow. (kWh)	322	322	322	322	322	322	322	322	322	322	322	322
× rate ($/kWh)	.085	.085	.085	.085	.085	.10	.10	.10	.10	.085	.085	.085
Dollar allow. ($)	$27	$27	$27	$27	$27	$32	$32	$32	$32	$27	$27	$27

Water. The current water rate is $2.00 per ccf for water, and $1.00 per ccf for sewer. These rates do not vary seasonally. The HA adds these together for a rate of $3.00/ccf.

Monthly Water/Sewer Allowances, 1 BR (same for all 1 BR allowance categories at Riverside Apartments)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Consump. allow. (ccf)	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97
× rate (water + sewer) ($/ccf)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Dollar allow. for water	$15	$15	$15	$15	$15	$15	$15	$15	$15	$15	$15	$15

To finish the utility allowance calculation in dollars, the HA now adds together the dollar allowances for all the covered utilities, for the 1BR End Top apartments.

Total Monthly Utility Allowances, 1 BR End Top

Riverside Apts. 1 BR End Top	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
$ Allowance —Gas	$82	$67	$52	$23	$15	$10	$10	$10	$13	$23	$44	$71
$ Allowance —Electric	$27	$27	$27	$27	$27	$32	$32	$32	$32	$27	$27	$27
$ Allowance —Water/ Sewer	$15	$15	$15	$15	$15	$15	$15	$15	$15	$15	$15	$15
$ Allowance —All Utilities	$124	$109	$94	$65	$57	$57	$57	$57	$60	$65	$86	$113

OPTION: COMPARING THE OLD AND NEW UTILITY ALLOWANCES

Most HAs going through the process of calculating utility allowances will be replacing an old allowance schedule with a new one. When all the calculations are completed, it is important to look at the new allowance schedule as compared to the old one and consider the effect of the changes. This is a particularly vital step if the HA is changing the methodology being used, because it is possible that the engineering methodology will produce quite different allowances than the consumption methodology.

As a rule of thumb, if the allowances are more than 10 percent lower, the engineering calculations should be re-examined. See pages 61-62 of this chapter for steps to take.

Making this comparison between old and new allowance is of ***limited value*** when there have been significant changes made to the buildings (rehab or repairs, weatherization) or the HA-supplied equipment, or when the allowable end-uses have been changed, but it is still a useful step for the HA, because large changes in the allowances are more likely to bring resident comments, questions, or challenges.

The larger the dollar changes—even though the calculations are correctly done and fully documented—the more care the HA will want to put into explaining the new allowances and helping residents adjust to them. Particularly if the allowances are decreasing, the HA might want to take advantage of conservation materials available from a local utility company or weatherization program and conduct an education campaign for residents about how they can conserve energy and avoid or minimize surcharges.

If the HA is switching for the first time to individual metering or checkmetering (after paying all or nearly all utilities in the past), it is especially important to inform the residents about the changes and explain the changes in rent as they relate to the allowances.

Question & Answer Exercise for Chapter 5

Questions

1. **Which of the following items is required to calculate the consumption requirements for space heat, using the engineering-based methodology?**

   (a) heating degree days
   (b) heat loss calculation for each category of dwelling unit
   (c) information on the efficiency of the heating system
   (d) design temperature differential
   (e) all of the above

2. **Which of the following factors affect a household's energy requirement for domestic hot water?**

   (a) the temperature of the water before and after it is heated
   (b) whether the dwelling unit has water-saving devices installed
   (c) the number of persons in the household
   (d) the efficiency of the hot water heater
   (e) all of the above

3. **Which of the following factors affect a household's electricity requirements for lighting?**

   (a) the number of light bulbs in a dwelling unit
   (b) the wattage of the light bulbs in a dwelling unit
   (c) how many hours the lights are on every day
   (d) all of the above

4. **How should an HA estimate the consumption requirement for refrigeration?**

   (a) using standard consumption tables
   (b) with a formula
   (c) using in-house information from procurement records or refrigerator labels
   (d) contacting the local utility
   (e) all of the above

Question & Answer Exercise for Chapter 5

Answers

1. (e) all of the above. All of these pieces of information are required to estimate the consumption requirements for space heating.

2. (e) all of the above. Energy requirements for hot water depend on the temperature of the water before and after it is heated, on whether there are water-saving devices installed in the dwelling units, on the number of persons in the household, and on the efficiency of the water heating system.

3. (d) all of the above. Electricity requirements for lighting depend on the number of light bulbs in a dwelling unit, the wattage of those light bulbs, and how many hours they are on.

4. (c) using in-house information from procurement records or refrigerator labels. Because the consumption requirements for refrigeration range widely, depending on the age and size of the refrigerator, HAs should use in-house information, rather than relying on standard consumption tables.

CHAPTER 6: ESTABLISHING ALLOWANCES USING CONSUMPTION DATA

Overview

With the consumption-based methodology, HAs use actual historic consumption data from dwelling units to establish utility allowances. These data are in the form of utility billing records (where utilities are individually metered) or checkmeter records (where utilities are check-metered). Allowances are calculated separately for each utility for which an HA provides an allowance.

Because it focuses on recent experience at the HA, the consumption-based methodology generally reflects changes in the condition of the dwelling units, in equipment operation and in resident population and behavior more readily than does the engineering methodology. However, by focusing on actual resident utility consumption rather than on recommended standards for utility use, the consumption methodology also tends to give less emphasis on energy-conservation. In order words, if there is a trade-off between minimizing resident utility surcharges and maximizing energy conservation by residents, the consumption methodology will tend to favor the former over the latter.

There is sometimes a perception that the consumption-based methodology is less complicated for HAs to use (or less dependent on outside technical assistance) than the engineering methodology. This may be true in some cases, if the historical utility data are readily available, the HA has a very homogeneous resident population, and most of the HA's units are very similar in terms of construction type, utility configuration, and age of equipment and materials. However, as the reader will see as we proceed through this chapter, the consumption-based methodology can also prove to be quite complex at times, particularly around the issue of selecting a sample of units which will provide ***statistically valid*** utility consumption data.

"Statistically valid" means that the data for the sample provide a good approximation of the experience of all the units in the category being studied. One straightforward approach to satisfying this sampling issue is to include the data from all the HA's units ("100 percent sampling"). However, if the HA does not have the capacity (or desire) to include all units in its calculations, then the HA will need to determine what is an acceptable sample size for each allowance category, and how to achieve these sample sizes. As will be discussed in this chapter, in cases where the amount of consumption data available to the HA is limited, the HA will often be required to make mathematical adjustments in the data for units with vacancies or unallowable end uses, etc., in order to be able to reach the sample size necessary for statistical validity.

As described in this chapter, the process for calculating utility allowances using actual consumption data involves the following steps:

- specifying allowable and non-allowable end-uses
- determining the timeframe covered by the historic consumption data
- defining allowance categories
- collecting the consumption data and grouping the data by allowance categories
- cleaning the data and checking for statistical validity
- calculating typical consumption levels
- establishing the standards for "energy-conservative households"
- converting the consumption allowances into dollar allowances

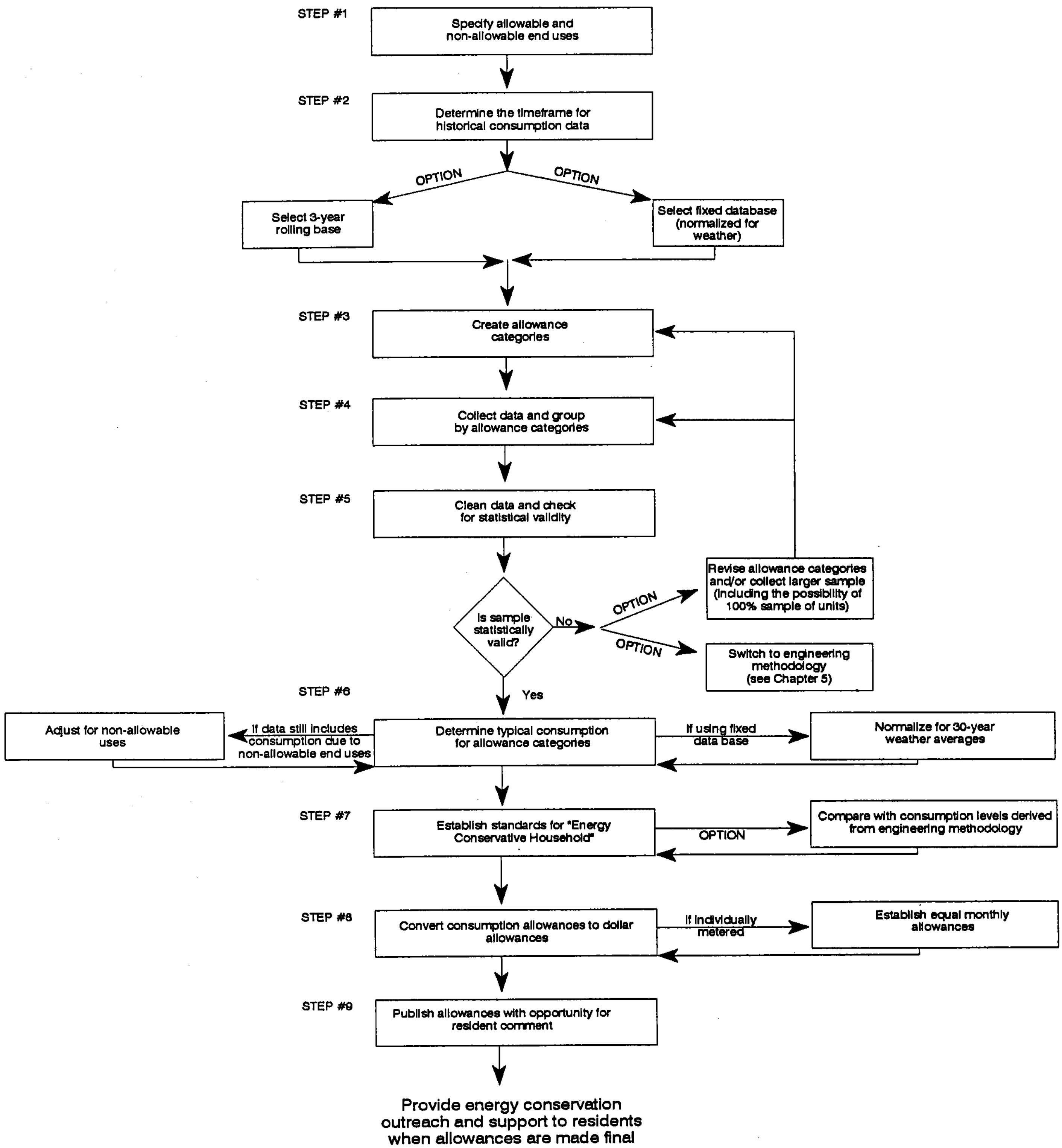
Exhibit 6.1 presents a schematic representation of this process. ***Note: It is important for the HA to recognize from the exhibit that the outlined steps are interdependent and not purely sequential. For example, in order to achieve statistical validity (see Step #5 in the exhibit), the HA may need to go back and revise allowance categories (Step #3) or sample more units (Step #4).***

After describing these individual steps, the chapter presents an example in which the utility allowances for a fictitious public housing development, ***Elm Street Apartments***, are calculated using the consumption based methodology.

Again, it is important for the reader to keep in mind that the specific approach to the consumption-based method described in this chapter is recommended, and not mandated. The federal regulations are quite clear in indicating that ***the complexity and elaborateness of the method chosen by an HA should be a reflection of the data available to the agency and the extent of administrative resources reasonably available*** to the HA to be devoted to the calculation of the allowances.

However, this chapter provides the rationale for each step in the process recommended, and attempts to demonstrate how the overall approach being presented represents a "best practice" for establishing allowances based on consumption records.

Exhibit 6.1
Steps in the Consumption-Based Methodology



Step #1: Defining Allowable and Non-Allowable End-Uses

Before establishing allowances, an HA must determine if there are any end-uses it will specifically exclude from the utility allowances, thereby considering them ***non-allowable end-uses.*** Some end-uses, may be considered allowable by one HA but non-allowable by another HA. Even within one HA's portfolio, some end-uses may be considered allowable for some units but non-allowable for others. This decision is left to the HA to make, based on local custom and usage patterns as well as local climate. ***(Please refer to Chapter 2 for a discussion of air conditioning.)***[1]

If an HA considers any end-uses to be non-allowable, then the consumption data should be adjusted to reflect this fact. This adjustment process is described later in this chapter. Where an end-use is allowable for some dwelling units but not for others, separate allowance categories should be developed for each grouping of units.

Step #2. Determining the Time Frame of the Historic Consumption Data

Within the consumption-based methodology, ***an HA has several different options*** relative to defining the time period covered by the historic consumption data that are used. This chapter will consider two options: the ***three-year rolling base*** approach and the ***weather-normalization*** approach.

Option #1: Three-Year Rolling Base. A common approach to calculate allowances is to use a three-year "rolling base" of consumption data. Allowances are calculated using data from three successive years; by using data from multiple years in the calculation, the impact on the allowance of single-year fluctuations in weather patterns is reduced. The term "rolling base" means that every year the oldest year's data are thrown out, and the most recent year's data are added to the database.

Advantages of the three-year rolling base:

- With three years of data, it may be easier to attain a sufficient sample size necessary for statistical validity.
- A rolling base will incorporate changes in consumption patterns over time that result from resident turnover, gradual changes in the number and type of appliances, and physical changes to the buildings.

[1] It is important to note that air conditioning and cooling are not synonymous. Cooling includes air conditioning and fans. In some cases, fans may be allowable where air conditioning is not.

Disadvantages of the three-year rolling base approach:

- The HA must obtain consumption data every year.
- The HA must recalculate the allowances every year.

Option #2: Fixed Database Normalized for Weather. An alternative way to calculate allowances is to use a fixed base of consumption data from one or more years,[2] adjusted (or "normalized") for the effects of weather. This approach is appropriate only where an allowance is provided for space heat.[3] The process of "weather normalization" can be performed using weather data from the years in which the consumption data are taken as well as the 30-year weather data averages. The weather data for the relevant years can be obtained from the local weather station, as can the 30-year weather data. Appendix C also provides 30-year average weather data for various locations throughout the country.

To use this approach, follow the instructions throughout this chapter as for the three-year rolling base method. Then follow the process for normalizing the weather data described at the end of the chapter.

Advantages of the normalized fixed database approach:

- It goes much further than the rolling-base approach in ensuring that the allowances are based on typical weather patterns, rather than reflecting short-term variations in the weather.
- The HA may not have to obtain consumption data every year.
- The HA does ***not*** need to recalculate allowances every year, and the annual review process is relatively simple.

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[2] If this approach is used to calculate allowances for individually metered propane or oil, three years of data should be used for the fixed base.

[3] This approach should only be used if space heating represents a substantial portion of the utility consumption. This is generally the case, even when the utility is used for other end-uses, such as hot water heating and cooking. However, where the heating load does not represent a substantial portion of the consumption, such as may be the case in regions with extremely mild winters, then the weather-normalization approach should not be used.

Disadvantages of the normalized fixed database approach:

- The HA must obtain weather data for the year(s) in which the consumption data were taken.

- A fixed database does not reflect changes in consumption over time that result from resident turnover, gradual changes in the number and type of appliances, or physical changes to the buildings. ***Therefore, the HA should recalculate the allowances every five years or so, using new data, to account for these changes.***

Step #3: Developing the Appropriate Allowance Categories

As noted in Chapter 2, different categories of allowances are necessary because different types of dwelling units have varying consumption requirements. ***Allowance categories*** should be distinguished by characteristics that significantly affect the consumption requirements of a dwelling unit. These characteristics may include any of the following factors:

- equipment and functions to be covered by the allowance
- climatic conditions
- dwelling unit size
- number of occupants
- type of construction and design of the housing development
- energy efficiency of appliances and equipment
- physical condition of the development
- indoor temperature
- hot water temperature

The establishment of the allowance categories is one of the most critical steps in the consumption-based methodology, because these decisions will significantly influence not only the fairness of the allowances which are generated, but also the amount of work that the HA will need to perform in calculating them.

How Many Allowance Categories Must an HA Establish?

The federal regulations require that a broad range of factors be examined to determine their potential bearing on the allowances, and whether separate categories should be established which distinguish among these factors. However, each allowance category which is created requires a separate set of calculations to be performed. Thus, the process of defining the allowance categories involves finding a proper balance between the administrative burden of large numbers of categories and the inequities which might result from the failure to recognize appropriate factors accounting for significantly different consumption requirements among households.

There is no "magic number" which represents the ideal number of allowance categories for all HAs. The appropriate number will vary according to the characteristics of an HA's residents, physical stock, and utility configurations, and the amount of variation within each of these elements.

As suggested previously, some of the factors which could be expected to affect consumption requirements are the ***characteristics of residents*** (for example, seniors versus families), ***construction and design*** of the housing development, ***energy efficiency*** of appliances and equipment provided, and (where the allowance covers space heating) the ***physical condition*** of the development. However, ***within a single public housing development***, these characteristics could be expected to be fairly consistent across all units. Therefore, the allowance categories established for an individual development may not need to distinguish among these factors.

On the other hand, even within a single public housing development, there are a number of factors which can be expected to account for considerable variation in reasonable consumption requirements among households. At a minimum, for each utility function, separate allowance categories should be established that distinguish between ***dwelling units of different sizes*** (in terms of number of bedrooms). For space heating or cooling allowances in multi-unit buildings, allowance categories should also be created that differentiate the ***configuration or location*** of a unit within the building (for example, the number of exterior walls the unit has, or whether the unit is on the top floor or bottom). The HA should also examine whether it may be appropriate to develop separate allowance categories based on ***numbers of occupants per unit***, particularly for the largest sized units, or for households which are either over-housed or under-housed in terms of number of bedrooms.

Thus, at the level of the individual housing development, the number of separate allowance categories which are necessary may prove to be reasonably limited, while still meeting the federal requirements.

Step #4: Collecting the Consumption Data and Grouping the Data by Allowance Categories

Consumption data are obtained from checkmeter records or utility billing records that show the number of units of energy (kWh of electricity, therms or ccf of gas, gallons of oil or propane) or water (gallons or ccf) consumed over a given period of time. Each piece of consumption data depicts the amount of energy or water that a dwelling unit consumed during a certain period.

HAs that provide allowances for more than one utility (for example, electricity, gas, and water) must collect consumption data for each of those utilities. Three years of data should be collected, unless the "weather normalization" approach is taken, in which case one or more years of data is needed.

Individually metered utilities. For individually metered utilities, the HA must obtain consumption records from the local utility. Each record shows the total amount of energy or water consumed by the household during a monthly or, in some cases, a bi-monthly period.

Generally, utilities require that the HA present a release form that has been signed by the resident before releasing that resident's record. For oil or propane (non-checkmetered), consumption data may be obtained from the residents or from the fuel company. Because oil and propane are delivered at irregular intervals, the data for each dwelling unit in a given year should be totaled to obtain an annual amount for each dwelling unit.

Checkmetered utilities. Where utilities are checkmetered, checkmeters should be read by the HA routinely at regular intervals, preferably every month, although some HAs read checkmeters bi-monthly or quarterly. The records of these periodic checkmeter readings provide the consumption data. Each record shows the total amount of energy or water consumed by the dwelling unit during that particular period.

The next step is to group the consumption data according to the ***allowance categories*** that have been established. Consumption data for all the dwelling units in a given allowance category should be grouped together. If the consumption records are on paper, such as copies of utility bills, then the HA should group the consumption records together by hand according to allowance category.

The consumption amount from each checkmeter or billing record in a given allowance category should be entered onto a separate table or spreadsheet. There should be one table for each allowance category for each utility allowance being calculated. Within each table, there should be a separate column for each month, bi-monthly period, or quarter, whichever is the appropriate billing period. (For non-checkmetered oil or propane, there should be only one column in each table because the amounts are annual.) The data records from the dwelling units in an allowance category for a given time period represents the ***data set*** or sample for that allowance category.

The following table shows how the data in a sample might be organized for a single allowance category:

Elm Street Apartments: 2-BR, Top Floor, End Units
kWh

Yr	Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Monthly Average for Year
1993	A-7													
	A-9													
	B-7													
	B-9													
	C-7													
	C-9													
1994	A-7													
	A-9													
	B-7													
	B-9													
	C-7													
	C-9													
1995	A-7													
	A-9													
	B-7													
	B-9													
	C-7													
	C-9													
Measure of central tendency														

NOTE: For this example, there are only 6 units in this particular allowance category.

Where possible and practical, data from all the dwelling units in an allowance category should be obtained (known as a "100% sample"). In some cases, however, a smaller, ***representative sample*** of data may be used for each allowance category. If a smaller sample is used, there should be enough data in each allowance category to render the data set ***statistically valid***.

Step #5: Cleaning the Consumption Data and Checking the Statistical Validity of the Sample

Overview: This section discusses the distinct but inter-related activities of ***cleaning the collected data*** and assessing the overall ***statistical validity*** of the sample. The former activity is concerned with trying to ensure that the consumption data for each dwelling unit included in the sample do not reflect features that might make the unit an inappropriate example of consumption levels, or provide inaccurate information. The latter activity (assessing statistical validity) is concerned with the dependability of the overall sample in depicting consumption typical of all units in the allowance category.

Problems regarding the accuracy or appropriateness of consumption data for a particular dwelling unit can derive from a number of sources, including ***vacancies***, ***estimated readings***, ***non-allowable end-uses*** and ***inaccurate meters***. There are basically two ways to deal with, or "clean", such data problems. The easiest approach is for the HA to eliminate from the sample any dwelling units which have such data problems. For example, the HA might want to exclude from the sample any units which have "estimated" (rather than actual) readings that are not corrected by subsequent actual meter readings, in order to ensure that the consumption data for the period examined as much as possible represents actual experience and not just an approximation.

However, it can be seen that this approach could significantly reduce the HA's overall sample size for an allowance category. As will be discussed in more detail later in this chapter, the statistical validity of the sample is dependent on achieving a final sample size that is sufficiently large in relation to the overall number of units in the allowance category. Therefore, it may not be possible to simply discard all units having apparent data problems and still be able to achieve a statistically valid sample for the allowance category. For example, in considering their data cleaning strategy, the following provides HAs with a rough "rule of thumb" for valid sample sizes:

Estimate of Valid Sample Sizes for Number of Units After Cleaning

If the sample size for an allowance category after cleaning is:

less than 6 units	->	*add those units to another similar category*
6 - 25 units	->	*use all of the units in calculations*
more than 25 units	->	*select a random sample of at least 26 units, sort the units by usage, and then drop the top three units and the bottom three units. The remaining sample of units can then be used to calculate "typical" consumption for the category.*

The dependability of this "rule of thumb" approach is improved if the HA has removed units containing unallowable end-uses from the sample.

Note: This table provides a rough estimate of the minimum sample size which could be expected to generate a valid sample when the allowance categories are relatively small. It is primarily meant to serve as a tool to help HAs in planning their data cleaning strategy, particularly when the amount of data available is limited. For a precise assessment of statistical validity, especially for larger allowance categories, the HA should use the formulas for sample size and variance found later in this chapter.

From this it can be seen that if the sample size is too small, the only way to achieve statistical validity is to merge allowance categories, which might create some inequities in the resulting allowances (for example, if the categories for modernized units were merged with units not yet upgraded).

To achieve larger sample sizes, the alternative approach to data cleaning is to delete or adjust the data ***for just those time periods in which the data problems occur,*** in order to permit the rest of the data for a dwelling unit to remain in the sample.

As can be seen from this discussion, under the consumption-based methodology, all data cleaning must proceed with an eye to the ultimate impact on final sample size. The following provides some additional discussion of this data cleaning process. At the end of the discussion of data cleaning, details on the assessment of statistical validity are presented.

Data Cleaning

The elements of data cleaning in part depend on how the utilities are metered:

Individually metered utilities. For individually metered utilities, if there are more than two months in a row of "estimated" reads for a particular dwelling unit, and these estimated reads are not corrected by subsequent actual meter readings, then the records for this unit should be removed from the database.

In addition, any monthly or bi-monthly utility record from a dwelling unit that was unoccupied during the time period covered by the monthly or bi-monthly record should be removed from the database. Obviously, a period of vacancy will reduce utility use for a unit. Including data from vacant units would likely result in overall consumption figures for the time period examined that are not typical of the occupied units. Therefore, such records should be excluded from the allowance calculation.

Similarly, for oil or propane, if any dwelling unit was vacant for more than two of the months of the heating season covered by consumption data within a given year, the whole year of data should be excluded from the database, because the two months could constitute a significant portion of the annual total.

If a unit has non-allowable end-uses, and the sample of dwelling units in an allowance category is large enough, the HA may simply want to delete all data on those units with such end-uses. If the HA feels that it needs to maintain these units in its sample, it should follow the directions regarding adjustments for non-allowable end-uses that appears at the end of the description of Step #6.

Checkmetered utilities. Checkmeter reading records should reflect readings made at regular intervals. If readings were made sporadically or at irregular intervals, the records from these readings should not be used or should be adjusted to reflect consistent time periods. This adjustment can often be accomplished by dividing the reading by the number of days between readings to get average use per day, and multiplying that number by a standard number of days.

As with individually metered utilities, consumption records from dwelling units that were vacant during the period covered by the data should be removed from the database. Non-allowable end-uses should also be addressed as described in the previous section on individually metered utilities.

Finally, to ensure the quality of checkmetered data, the total of all the checkmetered consumption data should be checked against the master-metered total, and:

- If the master-metered total is higher or lower than the checkmetered total ***by more than two percent***, then a sample of the checkmeters should be checked for calibration problems. Any miscalibrated checkmeters should be recalibrated. If it is found that the checkmeters are calibrated properly, gas or water lines should be checked for leaks, and electricity distribution lines should be checked for power losses.

- If the master-metered total is higher or lower than the checkmetered total ***by more than ten percent***, then the consumption records are of unacceptable quality and the HA should not use the consumption-based methodology. Instead, the engineering methodology should be used.

Following is a more detailed discussion of statistical validity and the elements which affect it.

Statistical Validity

A statistically-valid data set for an allowance category has enough data in it to derive a reasonably accurate measure of the typical utility consumption experience for that category of dwelling units. In other words, statistical validity is an indication of the level of confidence that any average calculated for the sample (data set) is a close approximation of the true average for all the units in the allowance category.

The most important thing to remember is that ***unless the sample of data used for an allowance category is statistically valid***, the results of the calculations using such data cannot be trusted, and ***the consumption method should not be used.***

Note: If an HA is using all the units from the allowance category as part of its sample (i.e., a 100% sample), there is no need to check for statistical validity.

Assume that the standard for statistical validity is that there must be a ***95 percent probability*** that the average from the sample is ***within 10 percent*** of the true average for the allowance category; that is, there is a high degree of confidence that the estimate of the typical consumption is accurate to within 10 percent of the actual average consumption across the units in the allowance category. To determine how large a sample is needed to meet this standard, the following formula would be used:

$$\text{valid sample size} = \frac{3.84 * Var}{(0.10 * Avg)^2}$$

where *Var* stands for ***variance*** and *Avg* stands for the ***average monthly consumption across the dwelling units in the sample.***

For present purposes, the ***variance*** is a measure of the extent to which the values of the annual average consumption of the ***individual dwelling units*** in the sample differs from the average consumption computed ***for the overall sample.***

It is essential to understand that if the variability in the average consumption between household units is large, then the overall average computed for a small sample of units may be very sensitive to the particular units selected for the sample. Therefore, the larger the variability in consumption patterns across dwelling units, the larger the number of units that need to be included in the data set to get a reliable or statistically valid overall average. Conversely, because this valid sample size is directly proportional to variance, if the variance of a data set can be reduced, the sample size that is required can be decreased as well.

Variance in utility consumption patterns across dwelling units can be the result of a variety of causes, and how to deal with the variability depends on its source. For example, if variability in the data is due to differences in ***family size*** or differences in the ***physical condition of the units***, then the most appropriate approach is to construct separate allowance categories according to these factors (see discussion in Step #3, above).

Other significant sources of variability are vacancies and non-allowable end-uses. Variability due to these sources should be addressed as described in the section on data cleaning, either through deleting the units from the sample or by just dropping the months or quarters in which these factors appeared, keeping the dwelling unit(s) in the sample for the other time periods during which the reading were valid. Under the first approach, it becomes a tradeoff of reduced variability *versus* a smaller number of units left in the sample with which to achieve statistical validity.

For larger HAs, or larger allowance categories in any sized HA, there are more options regarding approaches to sampling to reduce unrepresentative variance. For example, after having "cleaned" the data for vacancies, ineligible end-uses and the like, the HA can then drop out the top 10 percent and bottom 10 percent of the units based on consumption levels. The resulting sample will have less variability because the extreme values have been dropped.

Once the HA has done what it can to reduce the unrepresentative variability in the sample for an allowance category, then the remaining variance must be calculated to determine whether the sample size is sufficient to ensure statistical validity. When the variance has been calculated,[4] the figure for variance can be plugged into the earlier formula for valid sample size to determine how many units need to be included from the allowance category.

If the planned sample size is smaller than the size recommended by this calculation, then the HA should include data from more units. If additional units are not available from the allowable category, the HA should consider combining similar allowance categories (e.g., combine studio and one-bedroom units) to create a new allowance category with a larger sample size. The critical issue, of course, is finding allowance categories that are reasonably comparable, so that units with significantly dissimilar consumption requirements are not lumped together. If the sample sizes for an allowance category are too small to satisfy the test of statistical validity, and the HA cannot identify categories that are similar enough to combine, then the HA should reconsider its use of the consumption methodology.

When ***checkmeters*** are utilized, the HA is more likely to have access to data on 100% of the units in any allowance category. Such HAs can use 100% samples, and this eliminates the need to check for statistical validity.

When residents pay directly to a utility, however, it may be much more difficult for the HA to obtain complete data for a sufficient number of units to ensure the statistical validity of the samples used for its allowance categories. In such cases, the HA should consider using the engineering methodology instead (see Chapter 5).

[4] In the example at the end of this chapter showing the allowance calculations for the fictitious Elm Street Apartments development, the complete formula for computing variance is presented in an illustrative application. Although the formula for variance may appear somewhat complex, most software spreadsheets and many scientific calculators have a function which performs this calculation. Again, if the HA uses a 100% sample of units from an allowance category, these calculations are not necessary.

Step #6: Determining the Point of Central Tendency for Each Data Set

Once the statistical validity of the sample for an allowance category is verified, the next step is to determine the "typical" consumption of a given monthly, bi-monthly, quarterly, or (in the case of non-checkmetered oil or propane) annual data set. The ***point of central tendency*** is the number that represents the typical or average consumption for a data set. There are two basic measures of central tendency: the median and the mean. The HA can choose to use either the mean or the median to represent the typical consumption within an allowance category.

Mean. The ***mean*** is, technically speaking, the average of a data set. The mean of a data set is determined by adding up all the records or values in the data set and dividing the total by the number of records in the data set. The mean is an appropriate measure of central tendency when the data are normally distributed and not skewed toward either extreme.

Median. The ***median*** is the point in a data set that is found in the middle of all the records, that is, exactly half the values of the records are higher than the median and half the values of the records are lower. The median may be the most appropriate point of central tendency if the data set contains extremely high or low consumption levels.[5]

After the HA has selected the mean or the median as its measure of central tendency for its calculation for each ***allowance category***, the HA should calculate one "average" consumption amount across all units in the sample for ***each*** of 12 monthly data sets, six bi-monthly data sets, or four quarterly data sets that have been collected. (In the case of non-checkmetered propane or oil, each allowance category should have ***one*** average value, based on an annual data set.) Next, where averages are for periods other than monthly, these averages should be converted to monthly amounts:

- If the averages are based on ***bi-monthly*** data sets, each bi-monthly average should be broken down into two monthly averages by dividing the bi-monthly average by two.

- If the averages are based on ***quarterly*** data sets, each quarterly average should be broken down into three monthly averages by dividing the quarterly average by three.

[5] Ferrey, Steven, "In From the Cold: Energy Efficiency and the Reform of HUD's Utility Allowance System," *Harvard Journal on Legislation*, vol. 32, no. 1, Winter 1995, pp. 187-188.

- If the averages are based on ***annual*** data sets, as is the case with non-checkmetered propane or oil, each annual average should be broken down into 12 equal monthly averages by dividing it by 12.

Adjusting for Non-Allowable End-Uses

Once the point of central tendency (the "typical consumption") is determined for each data set, that level of consumption should be adjusted for any end-uses that the HA considers non-allowable end-uses, if such consumption has not already been deleted from the data. Air conditioning is an example of an end-use that many HAs will determine to be non-allowable for some or all of their units. HAs that do not have any non-allowable end-uses may wish to skip this section.

To adjust the mean or median for non-allowable end-uses, the HA needs to have a fairly accurate idea of the percentage of households in each allowance category that have the non-allowable end-use. In addition, the HA should also have some idea about the energy rating of the appliances involved (for example, the wattage), as well as an estimate of how many hours the appliances are used per day. Much of this information can be obtained by inspecting the apartments. If the HA is large, a representative sample of apartments can be inspected. Alternatively, the HA can issue surveys to the residents.

The mean or median cannot be adjusted for non-allowable end-uses unless the following information is available:

- *the percentage of households within an allowance category that have the non-allowable end-use;*
- *the average energy rating of the appliances; and*
- *an estimate of how many hours the appliances are used.*

With this information, the HA can estimate the amount of energy the non-allowable end-use consumes every month. This can be done in one of two ways:

Method #1: Using mathematics. If the non-allowable end-use is electric, then the monthly consumption amount may be estimated as follows:

(a) multiply the average wattage of the non-allowable appliance by the hours in use per day to get watt-hours per day;

(b) multiply the watt-hours per day by 31 days to get watt-hours per month;
(c) divide the watt-hours per month by 1000 to get kilowatt-hours (kWh) per month.

The following table provides consumption information for air conditioners. These consumption amounts were determined using the process described above.

Monthly Electric Consumption Requirements for a Typical Air Conditioner[6]

	3 hours/day	6 hours/day
Energy-efficient (500 Watts)	47 kWh	93 kWh
Average efficiency (670 Watts)	62 kWh	125 kWh

Method #2: Using standard consumption tables. The HA could also use standard consumption tables to determine the monthly consumption requirement of a given non-allowable end-use.

These tables usually depict average ***annual*** consumption, rather than monthly, and the amounts must be adjusted accordingly.

Furthermore, if standard consumption tables are used, the HA should make sure the assumptions in the table are consistent with the information the HA has on hours of usage and energy ratings.

Once the HA determines the amount of energy the non-allowable appliance uses per month, the following process should be followed to determine the amount by which the mean or median should be adjusted for such non-allowable end-uses:

(A) For each allowance category that includes dwelling units that have the non-allowable end-use, multiply the consumption amount attributable to the non-allowable end-use by the percentage of dwelling units in the allowance category that have the non-allowable end-use; then

(B) Subtract the amount obtained in Step (A) from the point of central tendency (mean or median) for each allowance category. ***For seasonal non-allowable end-uses, this amount should be***

[6] The hours of usage depend on the regional climate. The typical wattage of an air conditioner is 670 Watts (Edison Electric Institute).

subtracted only in those months that the appliance is normally used.

Optional Approach: Normalizing for the Effects of Weather

As indicated in the beginning of this chapter, an alternative to establishing allowances based on a three-year rolling database is to establish allowances based on one or more years' worth of consumption data that have been normalized for weather, based on 30-year averages. This approach is only appropriate for utilities used for ***heating***.

If allowances are based on "normalized" consumption data, the HA does not need to obtain new consumption data every year. This approach may be especially attractive for HAs that have individually metered utilities.

Normalizing the data requires the following information:

- **One or more years' worth of consumption data.** Data from at least one year are required. If the HA has not obtained actual consumption data in the last two years, then the HA should obtain more recent data. If the HA has been using a three-year rolling database, then this database may be used as well for this alternative approach. By doing so, the HA can simplify what needs to be done annually as part of the review of allowances.

- **Total heating degree days.** This information must be obtained ***for the year or years from which the consumption data were taken***. This information may be obtained from a local weather station. In many cases, the local utility also has this information. These data should be from the same weather station as the 30-year average degree days used in this process (see below).

- **Thirty-year average annual heating degree days.** The 30-year average annual degree days should be from the same weather station as the degree days for the year in which the consumption data were recorded. ***Appendix C provides 30-year average annual degree days for several weather stations in each state.***

- **Thirty-year average monthly heating degree days.** Thirty-year average ***monthly*** degree days are required only for ***checkmetered utilities***, or for ***individually metered utilities for which the HA provides seasonally adjusted allowances***. The 30-year average monthly degree days should be from the same weather station as the degree days for the year in which the consumption data were recorded. ***Appendix C provides 30-year average monthly degree days for several weather stations in each state.***

An example of normalization is presented later in this chapter.

STEP #7: Establish Standards for the "Energy-Conservative Household"

After having calculated the "typical" consumption level for a utility, the HA is still faced with the choice of the standard for consumption that it will establish for an "energy-conservative household."

It is logical to assume that a sizable percentage of resident households will have consumption levels above the "point of central tendency" (the average). Therefore, the HA must decide to what extent the utility use above the calculated average represents wasteful consumption which was within the ability of the residents to control.

For example, it would be difficult to justify the statement that a two-bedroom household using a single kWh per month more than the average for that category of units was actually "wasting" electricity (except in the instance where the average itself was found to be exceptionally high). Unless there is strong evidence to the contrary (e.g., see next section on comparison with engineering-based allowances), the HA probably should assume that most of its lower income residents engage in reasonably energy-conservative behavior. Consequently, if a large percentage of resident households have consumption above the average and the HA has made diligent efforts to provide conservation education, then it is generally proper to conclude that much of the consumption above the average was not within the power of the residents to control. In such circumstances, the HA should provide a range above the average consumption that will still be considered non-excessive.

There are a variety of ways for the HA to establish such a range. One way is to set the consumption allowance at the level of the ***mean plus one standard deviation***. The standard deviation, which is the square root of the variance, provides a measure of the typical variation in consumption by dwelling units within a category from the average consumption for that category. By adding the standard deviation to the mean, the HA would ensure that the consumption of most residents households would fall within the allowance standard.

A second approach to determining an acceptable range above the average is to divide the dwelling unit consumption data into ***percentiles***, and then selecting the level (e.g., the 85th percentile) above which the HA feels that consumption is clearly excessive based on its familiarity with utility use patterns across the agency over time.

A third alternative, particularly for HAs desiring to limit the complexity of their calculations, is to simply ***multiply the average by a coefficient greater than 1.0*** to provide for a fixed percentage of consumption above the average which will be considered permissible. For example, if the coefficient 1.25 is used, the allowance level permits consumption 25 percent above the average without a surcharge being incurred by the resident household.

Option: Comparing With Consumption Levels Derived from Engineering Method

For those HAs with the capacity, an excellent approach for checking the reasonableness of the allowance levels derived from the consumption-based methodology is to check them against the comparable levels that the engineering-based method would suggest.

Since the engineering method emphasizes theoretical norms for utility use rather than actual past consumption experience, it can be expected that the allowance levels suggested by this alternative methodology will be somewhat different from those derived under the consumption-based method. However, by comparing the average consumption calculated under the consumption-based method with what the engineering method suggests the typical consumption should be, the HA will be able to make a better judgment about whether a range above the average is appropriate in setting the standard for an "energy-conservative household," and how large that range should be.

Step #8: Converting Consumption Allowances to Dollar Allowances

For each allowance category, each of the 12 monthly consumption amounts established as a result of Step #7 should be converted into a dollar amount.

Electricity. Consumption amounts of electricity are in kWh. The kWh amounts are converted to dollar amounts by multiplying the kWh by the utility rate, which is the price per kWh, and adding the base charge or customer charge and any other charges levied by the utility. Some utilities charge one rate for usage up to a certain level and another rate for usage beyond this level. If the utility has seasonal rates, the HA should multiply the consumption amounts by the rate appropriate to that particular season. For example, if the utility has one rate for September through May, and another rate for June through August, then the consumption amounts in June, July, and August should be multiplied by the summer rate, and the consumption amounts in the other months should be multiplied by the off-season rate.

Gas. Consumption amounts for gas are in hundred cubic feet (ccf) or therms. The consumption amounts for gas in terms of ccf or therms are converted to dollar amounts by multiplying them by the price per ccf or therm and adding any customer charges or adjustments. As with electricity, if the gas company has seasonal rates, these rates should be used.

Water. Consumption amounts for water are usually in ccf or gallons. The consumption amounts for water in terms of ccf or gallons are converted to dollar amounts by multiplying them by the price per ccf or gallon.

In many areas, there is an additional charge for sewer service. If the sewer charge is a rate charged per ccf or gallon, then this fee should be multiplied by the ccf or gallons, and added to the dollar amount for water. Where the sewer rates vary seasonally, the rate appropriate for each month should be used.

Where water is individually metered, if a monthly flat fee is charged, this amount should be added to the dollar allowance.

Propane or Oil. Consumption amounts for propane and oil are in gallons. The consumption amounts for propane or oil in terms of gallons are converted to dollar amounts by multiplying the consumption amounts by the average price per gallon of propane or oil.

Individually Metered Utilities: Establishing Equal Monthly Allowances

HAs with individually metered utilities generally provide ***equal monthly allowances*** for those utilities. (However, if the utility supplier does not offer residents a uniform payment plan, the HA may provide for seasonal variations in its allowances.) Where equal monthly allowances are to be provided, the monthly dollar allowances calculated for each allowance category should be added together to get an annual dollar amount for each allowance category. This amount should then be divided by 12 to get equal monthly allowances.

STEP #9: Publish Allowances with Opportunity for Resident Comment

As indicated in Chapter 2, the HA must not only maintain a record which documents the basis upon which the utility allowances were established, but also must give notice to ***all*** residents of proposed allowances or revisions to allowances at least 60 days prior to the date the allowances are to become effective. (The exceptions to this rule are when changes in allowances or the dollar amount of surcharges are directly due to changes in the HA's average utility rate; such rate changes are not subject to the 60-day notice requirement. See 24 CFR 965.506(a).

The notice to residents must include a description of the method for calculating the allowances, the specifics on where residents can obtain access to full documentation of the allowance methodology and calculations, notification of the residents' right to submit written comments, and information on the availability of individual relief for residents with special circumstances or needs.

A Final Note: Energy-Conservation Outreach and Support to Residents

HAs should recognize the importance of an on-going energy-conservation education effort, particularly aimed at residents whose consumption exceeds their allowance. Such outreach and education efforts that result in more energy-conservation by residents will not only benefit the individual households experiencing surcharges, but will also tend to reduce the HA's overall utility use and costs.

In addition, the HA should remain alert to weatherization measures and equipment upgrading which the agency could undertake that would reduce resident utility consumption.

THE APPLICATION OF THE CONSUMPTION-BASED METHODOLOGY: EXAMPLES

This section of Chapter 6 illustrates each step of the consumption-based methodology by guiding the reader through a series of examples involving a fictitious housing development, ***Elm Street Apartments***. The section demonstrates how to follow the steps to generate the consumption allowances for a single allowance category (three-bedroom units on the top floor) and explains how the process would differ for determining the consumption allowance for other allowance categories and utilities.

Elm Street Apartments, a fictitious site located in a moderate climate, is a 96-unit family development consisting of four three-story buildings containing 24 units apiece. Each building has the following configuration:

2 2-BR Top End	2 3-BR Top Middle	2 4-BR Top Middle	2 2-BR Top End
2 2-BR Middle End	2 3-BR Middle Middle	2 4-BR Middle Middle	2 2-BR Middle End
2 2-BR Bottom End	2 3-BR Bottom Middle	2 4-BR Bottom Middle	2 2-BR Bottom End

All four buildings are of identical design and construction, and are in essentially the same physical condition. All the buildings have gas heat, hot water, and cooking. Refrigeration, lighting, and appliances are electric. The apartments have hook-ups for electric clothes washers and dryers. Gas, electricity and water are checkmetered. The HA provides trash pick-up services, which are non-metered.

We will now proceed through each of the steps in the consumption-based methodology.

Step #1: Specifying the Allowable and Non-Allowable End Uses

In determining which end-uses should be included in the allowances, the HA takes into account two items: (1) the metering configuration of the utilities, and (2) whether there are any end-uses which it considers non-allowable.

Metering configuration: Because gas, electricity and water are checkmetered at Elm Street Apartments, allowances are provided for all three of these utilities.

Because the HA provides the trash pick-up and this utility is not metered, the HA assumes all the costs for this service and no separate allowance is established for it.

Non-allowable end-uses: Although the HA permits air conditioning as an allowable end-use in its elderly developments, in the family developments air conditioning is a non-allowable end-use. However, the HA does permit cooling fans in the family developments.

Therefore, the following end-uses are allowable for the family units, and allowances must be established for each category of utilities identified:

Gas

- space heating
- domestic hot water
- cooking

Electricity

- refrigeration
- lighting
- appliances (including washer/dryers and ceiling fans)

Water/sewer

Step #2: Determining the time frame for historical consumption data

In deciding between a ***three-year rolling base*** of consumption data and a ***fixed data base normalized for weather***, there are a number of considerations. The three-year rolling base requires data collection and allowance recalculations every year; the annual data collection may be a particular problem if the HA must go to the utility for such records (after obtaining permission from the residents). The fixed data base approach avoids these annual data collection and recalculation functions, but to use this approach the HA must have good data on 30-year weather averages for the locality and perform somewhat more complex calculations.

Because Elm Street Apartments is checkmetered, the HA does not need to worry about the problem of obtaining consumption records from utility companies. Therefore, for this example, the three-year rolling base will be used. However, Step #6 will demonstrate how the data could be normalized for 30-year weather averages.

Step #3: Selecting the proper allowance categories

In developing allowance categories, the HA needs to consider all the factors specified in the federal requirements (see Chapter 2) that might make a difference in the consumption requirements among units. Then the HA should classify the dwelling units into separate groupings according to the characteristics which can be expected to significantly affect consumption requirements.

In looking at Elm Street Apartments, it can be seen that all the units will have certain characteristics in common, including:

- **the local climate**
- **equipment and functions to be covered by the allowances**

- **construction and design of the housing development**
- **energy-efficiency of HA-supplied appliances and equipment**
- **physical condition of the development**
- **indoor temperature**

Therefore, the allowance categories for each utility do not need to make distinctions among units according to these factors.

However, there are several factors affecting consumption where the characteristics of the Elm Street Apartments units vary among each other. These include:

- **dwelling unit size/number of occupants**
- **location of unit within the building (for space heat and cooling)**

Accordingly, these factors should be used as the criteria for developing separate allowance categories. Applying these factors, ***the following six allowance categories are generated for Elm Street Apartments:***

2-BR Top End Units (16 units)
2-BR Middle End and 2-BR Bottom End Units (32 units)
3-BR Top Middle Units (8 units)
3-BR Middle/Middle and 3-BR Bottom Middle Units (16 units)
4-BR Top Middle Units (8 units)
4-BR Middle/Middle and 4-BR Bottom Middle Units (16 units)

The remainder of this illustrative application of the consumption-based methodology will focus on the third allowance category -- 3-bedroom units on the top floor.

Step #4: Collecting the data and grouping by allowance categories

Since gas, electricity and water/sewer are checkmetered at Elm Street Apartments, and the checkmeter readings are routinely recorded every quarter, the data needed for the three-year rolling base are readily available. The following table presents how data on ***gas consumption*** might be organized for the 3-bedroom top floor units at Elm Street Apartments; note that this consumption is related to three end-uses -- space heating, domestic hot water and cooking.

Elm Street Apartments
Allowance Category: 3-BR Top Floor
Quarterly Natural Gas Consumption (Measured in Therms)

Year	Unit	Jan - Mar	Apr - Jun	Jul - Sep	Oct - Dec	Monthly Average
1992	A-18	260	73	49	197	49
	A-23	284	79	54	214	53
	B-18	218	61	41	165	40
	B-23	392	109	74	296	73
	C-18	263	85	46	199	49
	C-23	241	70	55	201	47
	D-18	310	90	61	230	58
	D-23	275	89	47	188	50
1993	A-18	256	65	48	199	47
	A-23	292	83	50	201	52
	B-18	200	63	44	171	40
	B-23	378	111	***23***	290	67
	C-18	268	79	41	187	48
	C-23	251	75	60	214	50
	D-18	289	78	59	213	53
	D-23	268	83	46	192	49
1994	A-18	240	66	45	183	45
	A-23	269	80	54	211	51
	B-18	207	59	45	185	41
	B-23	351	102	71	299	69
	C-18	271	81	43	173	47
	C-23	***163***	77	63	220	44
	D-18	294	82	62	218	55
	D-23	260	78	50	188	48

The seasonal variation in consumption levels is a reflection that most of the consumption for space heat is limited to the period of January through March and October through December.

Similar tables can be constructed for ***electricity*** and ***water/sewer*** utility consumption using the checkmeter records.

Step #5: Cleaning the data and checking for statistical validity

Example of data cleaning

Problems in the quality of consumption data can occur as a result of a number of factors, including ***estimated or missing readings***, ***vacancies***, ***non-allowable end uses***, and ***inaccurate meters***.

In the example of natural gas consumption for the 3-bedroom top floor units shown in the preceding table, the data are relatively complete and "clean," with no missing or estimated readings. The HA staff responsible for Elm Street Apartments also annually compare their total of checkmeter readings against mastermeter readings for accuracy, and have found the former to be within 1 percent of the latter. There are also no non-allowable end-uses. (Note: As part of the discussion of Step #6, an example of adjustment for non-allowable end-uses will be presented.)

In this illustration, however, there are two examples of ***vacancies*** in the table: Unit B-23 was vacant for almost 2 months during the period of July - September 1993, and Unit C-23 was vacant for a month in the period of January - March 1994.

One option for "cleaning" the data is to delete these two units from the sample. However, based on the "rough rule of thumb" for valid sample sizes noted earlier in this chapter, the remaining 6 units would leave the HA at the very lower limit of an acceptable sample size. Therefore, the HA should try to adjust for these vacancies to permit the inclusion of these units in a sample. By retaining these units through careful data cleaning, the HA can achieve a 100 percent sample.

There are several ways to adjust the data for these two vacancies to come up with an approximation of what the consumption would have been if the units had been occupied for the entire period. First, since the HA has three years of data, and assuming the residents in the units have not changed, the HA can simply substitute the consumption for that unit from the same 3-month period in another year. For example, for Unit B-23, the HA could replace the July - September 1993 figure (***23 therms***) with the figure from July - September 1992 (***74 therms***).

A second approach to data cleaning for the vacancies would be to take the consumption level shown for the calendar quarter in question, and extrapolate this figure to cover the entire 3-month period. For example, Unit C-23 consumed ***163 therms*** during two months' of occupancy in the first quarter of 1994; by multiplying this figure by 3/2 the HA can get an approximation of what the consumption would have been (***245 therms***) had the unit been occupied over the entire three-month period.

If the utility being examined generally exhibited little seasonal variation in consumption, the HA could also consider simply dropping the period with the vacancy, and calculate the average consumption based on the remaining months.

In any particular instance of data cleaning, the HA will need to make a judgment about which of the available approaches is likely to result in the best estimate, given the other data which is available and the HA's familiarity with its residents and historic patterns of consumption.

Example of assessing the statistical validity of the sample size

It has been noted that the ideal approach to ensuring statistical validity is to use a 100 percent sample, particularly for smaller allowance categories. However, there may be numerous instances where an HA does not have the data or desire to achieve a 100 percent sample; how can the HA determine that the sample which it is planning to use is large enough to be statistically valid?

In such cases, the HA can use the formula for valid sample sizes presented earlier in this chapter.

Assume that the standard for statistical validity that must be met is there must be a ***95 percent probability*** that the average from the sample is ***within 10 percent*** of the true average for the allowance category. To determine how large a sample is needed to meet this standard, the following formula would be used:

$$\text{valid sample size} = \frac{3.84 * Var}{(0.10 * Avg)^2}$$

where *Var* stands for ***variance*** and *Avg* stands for the ***average monthly consumption*** across the dwelling units in the sample.

For present purposes, the ***variance*** is a measure of the extent to which the values of the annual average consumption of the ***individual dwelling units*** in the sample differs from the average consumption computed ***for the overall sample.***

The variance should be calculated across units using the annual periodic average for each unit. Using the following table layout, the variance would be calculated for the last column of annual periodic (monthly) averages.

Elm Street Apartments: 2-BR Middle and Bottom Units
Consumption of electricity (kWh)

Year	Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Monthly Average for Year
1994	A-7													
	A-9													
	B-7													
	B-9													
	Etc.													
	Etc.													

Most spreadsheets and scientific calculators have a function that calculates variance. The formula for sample variance is:

$$Var(x) = \frac{(x_1 - Avg)^2 + \ldots + (x_N - Avg)^2}{(N-1)}$$

$$Avg = \frac{x_1 + \ldots + x_N}{N}$$

where N equals the number of dwelling units in the sample for which there is an annual periodic average, and where x_1 through x_n represent the individual annual periodic averages for the individual dwelling units (i.e., the last column of the table). The variance for the sample is the sum of the squared differences between each value and the average value divided by N-1.

Suppose the variance of the sample calculated using this formula is 225 and the mean (average) of the annual monthly averages is 65kWh. By plugging these numbers into the earlier formula for sample size, it is determined that the sample size needs to be at least 20 units (that is, $(3.84*225)/6.5^2 = 20.4$) to achieve the statistical precision sought. This means that with sample of 20 units that has a mean of 65kWh and a variance of 225, there is a 95 percent probability that the sample mean is within 10 percent (or 6.5) of the true mean.

If the current sample size is smaller than the size recommended by the formula to achieve statistical validity, the HA has three options:

1) Increase sample size by including more units from the allowance category;

2) Combine similar allowance categories to create a new category where there is a sufficiently large sample to achieve validity; or

3) Shift to the engineering-based methodology.

Step #6: Determine typical consumption for the allowance categories

Once the data have been cleaned and the statistical validity has been verified, the next step is to determine the ***point of central tendency*** -- the number which represents the "typical" consumption of a given monthly, bi-monthly, quarterly, or (in the case of non-checkmetered oil or propane) annual data set.

In the example of gas consumption for the three-bedroom top floor units at Elm Street Apartments (***see table for Step #4***), assume that the HA opts to use the ***mean*** (average) as the point of central tendency. To find the mean, the column for each calendar quarter is totalled and divided by 24, which is the number of separate records in each column. The result is the typical consumption for each month, as follows:

Elm Street Apartments: 3-BR Top Floor
Mean Natural Gas Consumption (in Therms)

Jan - Mar	Apr - Jun	Jul - Sep	Oct - Dec
274	80	58	210

Note: Consistent with the earlier discussion of data cleaning, for the Unit B-23 vacancy during July through September 1993 the figure 23 has been replaced with 74, and for the Unit C-23 vacancy during January through March 1994, the figure 163 has been replaced with 245.

Example of using fixed data base normalized for weather

The example of natural gas consumption has assumed the use of a three-year "rolling base" of consumption data, which means that every year consumption data from the most recent year are added to the sample and data from the earliest year in the previous set of three years are deleted.

Another option for calculating allowances for space heating end-uses, however, is to use a fixed data base normalized for weather using 30-year averages. This approach has the advantage that the database does not need to be updated every year.

To develop allowances based on the 30-year averages, the HA first completes Steps #1 through Step #6 described above. Then the HA must:

(1) Annualize the mean or median for each allowance category by adding together the 12 monthly figures, or 4 quarterly figures, etc.

(2) If consumption data from more than one year are used, then the heating degree days (HDD) from those years should be averaged. This is done by adding the HDD from those years and dividing the total by the number of years worth of data used. This average of HDD from the years in which the consumption data were taken is used in (3). If consumption data from just one year are used, then the HDD from that year is used in (3).

(3) For each allowance category, divide the annualized mean or median by the number of HDD from (2).

(4) For each allowance category, take the answer from (3) and multiply it by the ***30-year average annual*** HDD. This amount is the ***normalized annual consumption***.

The next two steps are only for checkmetered utilities, or for individually metered utilities where allowances provide for seasonal variation. (These steps should not be completed for utilities that are individually metered if the allowances do not provide for seasonal variation).

(5) For each month, divide the 30-year average HDD for ***that month*** by the 30-year average ***annual*** HDD. These calculations will yield the percent of annual heating demand for each month.

(6) For each month, multiply the percentage by the normalized annual consumption. These calculations will yield the ***monthly normalized consumption*** requirements for that utility.

To illustrate the weather-normalization approach, imagine a second fictitious housing development, ***Lincoln Apartments***, which has five buildings that use gas for space heating and cooking. In the case of Lincoln Apartments, the HA performs checkmeter readings every month. For this development, we shall normalize the space heating consumption for the allowance category of one-bedroom end apartments on the top floor.

The monthly means for a valid sample of the selected allowance category are:

Lincoln Apartments
Allowance Category: 1-BR End Top
Mean Monthly Space Heating Consumption in 1994 (in Therms)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
114	87	61	22	10	0	0	0	6	20	63	96

Following the directions described above, first, these monthly means are annualized by adding them together, to get an annual average of: ***479 therms.***

Next, since only one year of data is being looked at, only the figure for total heating degree days for 1994 is needed; this information is obtained from the local weather station: ***4,433 HDD Total.*** The figure for the annual mean is then divided by this number: ***0.108.***

The result of the above is then multiplied by the 30-year average annual HDD (***4,940***) to get the ***normalized annual consumption***: ***533 therms.***

Since the utility is checkmetered, the following calculations are performed to get the ***monthly normalized consumption***:

Lincoln Apartments
Allowance Category: 1-BR End Top
Monthly Normalized Space Heating Consumption (in Therms)

Month	30-Year Average Monthly HDD	Divided by 30-Year Average Annual HDD	= Percent of Annual Heating Demand	x Annual Consumption (Normalized)	= Monthly Normalized Consumption
January	1,023	4,940	21%	533	112
February	879	4,940	17%	533	90
March	725	4,940	14%	533	75
April	381	4,940	8%	533	43
May	128	4,940	3%	533	16
June	0	4,940	0	533	0
July	0	4,940	0	533	0
August	0	4,940	0	533	0
September	32	4,940	1%	533	5
October	254	4,940	5%	533	27
November	579	4,940	12%	533	64
December	939	4,940	19%	533	101

Example of adjusting for non-allowable end-uses

Elm Street Apartments is in a region of moderate climate. The HA considers air conditioning to be a luxury, and a non-allowable end-use.

Through inspections of the dwelling units, the HA estimates that 20 percent of the households in all allowance categories have functional air conditioners. The HA estimates that these air conditioners are of average efficiency and that they run an average of 3 hours per day during the months of June, July and August.

Based on industry data (see Appendix C), the HA calculates 62 kWh as the typical monthly electric consumption for air conditioning. The 62 kWh is then multiplied by 20 percent, which equals 12.4 kWh. This amount, 12.4 kWh, is then subtracted from the central tendency for the "typical" consumption which was calculated for the months of June, July and August. This adjustment removes the non-allowable end-use from the consumption allowance figures.

Step #7: Establish standards for the "energy-conservative household"

This is probably the most challenging step in using the consumption-based methodology: ***an HA will want to create a consumption standard which not only encourages conservation, but also is set at a level which clearly is within the ability of residents to achieve.***

Finding the "point of central tendency", whether using the mean or the median, in many cases is only the starting point. For example, looking at the natural gas consumption table for Elm Street Apartments in Step #4, it is seen that if the average consumption of 210 therms per unit for the period of October - December had been used as the consumption standard during the three-year period, in any single year between 38 percent and 50 percent of the households in the allowance category would have paid a surcharge. Under such circumstances an HA must seriously examine whether it believes that such a high percentage of its residents are actually engaging in "excessive consumption" that is within their ability to reduce.

One approach to get another perspective on standards for reasonable allowances is to ***look at the corresponding consumption levels which the engineering-based approach would suggest.*** It is not necessary for an HA to complete a full engineering analysis to accomplish this. For example, the HA could consult with other public housing agencies in their region (with similar development and resident characteristics) that use the engineering method; through such consultations, the HA should be able to get an initial sense of the comparable allowances that are generated by the engineering approach, and whether further exploration of engineering data would be productive. The HA could also decide to perform the engineering calculations only for the specific end-uses about which the agency has the most questions concerning the consumption data.

Because of the fundamental differences in the approach used, it is to be expected that the engineering method will frequently suggest allowance levels that vary from those generated by the consumption method. This should not be viewed as a problem, but instead as an opportunity for the HA, by comparing the two methods, to better understand the consumption patterns of its residents.

Unless engineering or other data strongly suggest otherwise, it is recommended that the HA assume that most resident households engage in reasonably energy-conservative behavior. It appears to be plausible to assume that, given their limited financial resources, the majority of public housing resident households would not engage in wasteful consumption that would result in a surcharge for any utilities within their control. Therefore, the HA should consider establishing a range above the point of central tendency that reflects this view.

Assume that for Elm Street Apartments, the HA has decided to establish its consumption allowance standards based on ***the mean plus the standard deviation*** (the latter is the square root of the variance). For the example of natural gas consumption, across the three years of data, ***the mean consumption of the allowance category for the fourth quarter of the calendar year was 210 therms, with a standard deviation of 36, which would result in a consumption allowance of 246 therms for this period.*** With this allowance, only 13 percent of the resident households from this allowance category would be assessed a surcharge for the fourth quarter of the calendar year.

There are other approaches which can be used to establish a fixed range above the point of central tendency as the allowance standard. The HA could decide to set its allowances at 25 percent above the mean; this would simply involve ***multiplying the mean by a coefficient*** (1.25).

The HA may alternatively decide to establish the consumption allowance standard based on ***percentiles***; for example, setting the allowance equal to the 85th percentile of past consumption across the sample for any allowance category.

Step #8: Convert the consumption allowances to dollar allowances

At this point, the HA has determined the monthly consumption allowances for the utility (in the example, gas consumption). The HA must then convert the consumption allowances for each utility by multiplying the consumption allowance by the applicable rate for each part of the year.

Example: The consumption allowance was established at the level of the mean plus one standard deviation. The current gas rate is $0.65/therm for October through March, and $0.55 for April through September.

Elm Street Apartments
Allowance category: 3-BR Top End
Gas Allowances

	Jan - Mar	Apr - Jun	Jul - Sep	Oct - Dec
Consumption Allowance (therms)	320	93	68	246
x Rate ($/therm)	.65	.55	.55	.65
Dollar Allowance ($)	$208	$51	$37	$160

If the HA wanted to implement the schedule of allowances and surcharges on a monthly basis, it would simply divide each of the dollar allowance figures by 3 to provide even monthly amounts within each quarter.

Question & Answer Exercise for Chapter 6

Questions

1. **Which of the following statements is true if the three-year rolling base approach is used?**
   (a) Allowances must be recalculated every year.
   (b) The HA must obtain new data every year.
   (c) The allowances reflect gradual changes in consumption over time.
   (d) All of the above.

2. **Regarding the process of collecting consumption data, which of the following statements is *FALSE*?**

   (a) Utilities generally require that the HA present a release form that has been signed by the resident before it will release consumption information for that household.
   (b) For oil or propane that is not checkmetered, the HA should collect consumption data from the fuel company or the resident, and then annualize it.
   (c) When the HA compares the checkmetered consumption total to the master-metered consumption total, if the two amounts are not equal, the data should not be used.
   (d) If checkmeter readings have not been made at regular intervals, the data are of unacceptable quality.
   (e) None of the above.

3. **Which of the following may be acceptable measures of the typical consumption of a data set, assuming the data set is statistically valid?**

   (a) The point of central tendency.
   (b) The mean value.
   (c) The median value.
   (d) All of the above.

4. **Which of the following sources of information should be available when adjusting for non-allowable end-uses?**

   (a) The percentage of dwelling units that have the non-allowable end-use.
   (b) The average energy rating of the non-allowable appliance.
   (c) An estimate of the number of hours the appliance is typically used per day.
   (d) All of the above.

5. **If the weather-normalization approach is taken, where might the HA obtain weather data for the year in which the consumption data were taken?**

   (a) In the appendix of this guidebook.
   (b) From the local weather station.
   (c) From the local utility.
   (d) All of the above.
   (e) (b) and (c).

Question & Answer Exercise for Chapter 6

Answers

1. (d) All of the above. All of these statements are true of the three-year rolling-base approach.

2. (c). If the checkmetered total does not equal the master-metered total, the data may still be of acceptable quality. If the two amounts differ by 10 percent or more, however, then the data should not be used.

3. (d) All of the above. The typical consumption in a data set may be determined using the mean or median. Both the mean and median are points of central tendency.

4. (d) All of the above. The HA should have all of this information before adjusting for non-allowable end-uses.

5. (e). Weather data for a given year may be obtained from the local weather station, and in many cases, from the local utility. The appendix provides 30-year average monthly and annual data, but does not provide data for particular years.

CHAPTER 7: ANNUAL REVIEW OF ALLOWANCES

Overview

Each HA is required by the regulations to ***review its utility allowances on an annual basis*** to ensure that the allowances continue to be reasonable. There are two types of changes that can affect the reasonableness of the allowances from year to year: (1) changes in utility rates, and (2) changes in consumption requirements of a household. These two factors should be checked every year in the annual review process.

The extent of the review process depends on how the allowances were calculated in the first place. If the allowances were calculated using the engineering-based methodology or the "weather-normalization" approach of the consumption-based methodology, then the review process is relatively simple and straightforward. In these cases, the review does not normally involve a great deal of work, unless there is a change in equipment or building condition, the HA decides to use a new fixed database, or a problem is discovered in the method previously used.

On the other hand, if the allowances were established using the three-year rolling base approach of the consumption-based methodology, then the review process is actually a process of recalculating the allowances after collecting one new year of data.

This chapter offers step-by-step guidance on the annual review process for allowances calculated using any of these specified approaches.

If the Engineering-Based Methodology is Used

When the engineering-based methodology is used (see Chapter 5), the HA estimates the reasonable consumption of various categories of dwelling units, based on assumptions about the structure of the units, the appliances and equipment, and various other factors that affect consumption requirements. Whenever there are major changes to the buildings, equipment or appliances, the assumptions may no longer be valid, and the allowances should be recalculated based on new assumptions.

Even when there are not major changes to any of these factors from year to year, gradual changes occur over the years, affecting the consumption requirements of a household. Examples of these changes include the settling of insulation, possible declines in efficiency of equipment, and gradual changes in resident-owned appliances as societal customs and usage patterns evolve. Because of these gradual changes, the HA should recalculate the allowances ***at least every five years*** to account for the effects of such changes on consumption requirements.

The annual review process for allowances calculated using the engineering-based methodology should therefore include the following steps:

Step #1: Since the time when the allowances were last calculated, review whether there have been any significant changes to buildings, equipment, or appliances that would affect the consumption requirements of the utility for which the allowance is provided. Examples of such changes include modernization or weatherization, replacement of the heating or hot water systems, or replacement of the refrigerators in a development. If there have been any significant changes that would affect the consumption requirements of dwelling units, then the allowance consumption amounts for the affected dwelling units should be recalculated.

Step #2: Check to see when the last time the allowance consumption amounts were recalculated. If the allowances have not been recalculated in the last five years, then they should be recalculated to take into account any changes over time that may have affected the consumption requirements of the dwelling units.

Step #3: Contact the local utility company to check the rates. If the rates have changed by 10 percent or more compared to the ones used when the allowances were calculated, then the regulations require the HA to recalculate the allowances based on the new rates.

If the Weather-Normalization Approach of the Consumption-Based Methodology is Used

When the weather normalization approach of the consumption-based methodology is used (see Chapter 6), the HA estimates the reasonable consumption of various categories of dwelling units based on a fixed set of consumption data from one or more years. It is generally acceptable to use data from only one year because these data are normalized for the effects of weather using 30-year averages. Normalizing the data for the effects of weather in this fashion "neutralizes" the data for weather effects, which can otherwise affect consumption requirements from year to year. When this approach is used, the HA does not have to obtain weather data every year (as it would have to do with the three-year rolling base approach).

Because new data are not obtained every year and integrated into the database, however, changes in consumption requirements over time are not reflected in the allowances. Consumption requirements may shift due to major alterations to the buildings, changes in equipment or appliances, or gradual changes occurring over the years (such as the settling of insulation and gradual changes in resident-owned appliances) that affect the utility consumption of a household.

Because the consumption requirements shift over time, a HA should recalculate the allowances whenever there are major changes to the buildings, equipment, or appliances. Even in the absence of major changes, the HA should recalculate the allowances every five years in order to account for gradual changes in consumption requirements.

The annual review process for allowances calculated using the weather normalization approach of the consumption-based methodology is the same as the review process for allowances calculated using the engineering-based methodology. The process should include the following steps:

Step #1: Since the time when the allowances were last calculated, review whether there have been any significant changes to buildings, equipment, or appliances that would affect the consumption requirements of the utility for which the allowance is provided. Examples of such changes include modernization or weatherization, the installation of heating or hot water systems, or replacement of a large portion of the refrigerators in a development. If there have been any significant changes that would affect the consumption requirements of dwelling units, then the allowance consumption amounts for the affected dwelling units should be recalculated.

Step #2: Check to see when the last time the allowance consumption amounts were recalculated. If the allowances have not been recalculated in the last five years, then they should be recalculated to take into account any changes over time that may have affected the consumption requirements of the dwelling units.

Step #3: Contact the local utility company to check the rates. If the rates have changed by 10 percent or more compared to the ones used when the allowances were calculated, then the regulations require the HA to recalculate the allowances based on the new rates.

If the Three-Year Rolling Base Approach of the Consumption-Based Methodology is Used

When the three-year rolling base approach of the consumption-based methodology is used (see Chapter 6), the HA estimates the reasonable consumption of various categories of dwelling units based on a set of three years of consumption data. This set of data is not fixed but changes ("rolls") every year, as data from the most recent year are added to the data set, and data from the oldest year are removed. By using a rolling database, gradual changes in consumption requirements over time are taken into account because the new data reflect these changes.[1]

This approach requires that new data be added to the database every year. Thus the annual review process for allowances calculated using a rolling base is actually a process of recalculating the allowances every year. The review process should include the following steps:

Step #1: Collect consumption data from the most recent year.

Step #2: Remove the oldest year's consumption data from the data set.

Step #3: Recalculate the allowances following the process described in Chapter 6.

In this chapter, we have discussed the process that a HA should follow in reviewing its utility allowances on an annual basis. The steps to be followed vary according to the utility allowance methodology that is being used. The amount of work that is entailed in these annual reviews also varies, not only according to the methodology used, but also based on the extent to which utility rates, the physical condition of the public housing units, the equipment or appliances involved, and/or the makeup of the resident population have changed. Conducting these annual reviews, however, is essential for maintaining appropriate utility allowance levels.

[1] Note that if recent modernization of developments has resulted in major, abrupt changes in consumption requirements, the HA probably should not be using the three-year rolling base approach (see Chapter 4).

Question & Answer Exercise for Chapter 7

Questions

1. **Regardless of how allowances were calculated in the first place, all HAs should do the following during the annual review process:**

   (a) examine current utility rates
   (b) obtain consumption data
   (c) interview households regarding consumption habits
   (d) perform a heat loss calculation
   (e) all of the above

2. **If allowances were calculated using the engineering-based methodology or the weather-normalization approach of the consumption-based methodology, allowances should be recalculated when the annual review process reveals that:**

   (a) some buildings were modernized since the allowances were last calculated
   (b) refrigerators were replaced in a large percentage of the dwelling units of one or more developments since the allowances were last calculated
   (c) new heating systems were installed at one of the developments since the allowances were calculated
   (d) it has been five years since the allowances were calculated
   (e) all of the above

3. ***TRUE OR FALSE:*** **If allowances were calculated using the weather-normalization approach of the consumption-based methodology, then the annual review process is actually a process of recalculating the allowances.**

4. **If the allowances were calculated using the three-year rolling base approach of the consumption-based methodology, allowances should be recalculated:**

   (a) when refrigerators were replaced at one of the developments
   (b) when some buildings were modernized
   (c) when new hot water systems were installed at a development
   (d) when the winter was especially harsh
   (e) every year, using the most recent year's consumption data

Question & Answer Exercise for Chapter 7

Answers

1. (a) examine current utility rates. Regardless of the approach used to calculate the allowances in the first place, all HAs should check with their local utility to see if rates changed from the previous year.

2. (e) all of the above. If allowances were calculated using the engineering-based methodology or the weather-normalization approach of the consumption-based methodology, allowances should be recalculated when the annual review process reveals any of these situations.

3. ***FALSE***. If allowances were calculated using the ***three-year rolling base*** approach of the consumption-based methodology, then the annual review process is actually a process of recalculating the allowances.

4. (e) every year. If the allowances were calculated using the three-year rolling base approach of the consumption-based methodology, allowances should be recalculated every year using the most recent year's consumption data.

Appendix A
Federal Regulations and HUD Notices

Subpart C—Energy Audits and Energy Conservation Measures

SOURCE: 61 FR 7969, Feb. 29, 1996, unless otherwise noted.

§965.301 Purpose and applicability.

(a) *Purpose*. The purpose of this subpart C is to implement HUD policies in support of national energy conservation goals by requiring PHAs to conduct energy audits and undertake certain cost-effective energy conservation measures.

(b) *Applicability*. The provisions of this subpart apply to all PHAs with PHA-owned housing, but they do not apply to Indian Housing Authorities. (For similar provisions applicable to Indian housing, see part 950 of this chapter.) No PHA-leased project or Section 8 Housing Assistance Payments Program project, including a PHA-owned Section 8 project, is covered by this subpart.

§965.302 Requirements for energy audits.

All PHAs shall complete an energy audit for each PHA-owned project under management, not less than once every five years. Standards for energy audits shall be equivalent to State standards for energy audits. Energy audits shall analyze all of the energy conservation measures, and the payback period for these measures, that are pertinent to the type of buildings and equipment operated by the PHA.

§965.303 [Reserved]

§965.304 Order of funding.

Within the funds available to a PHA, energy conservation measures should be accomplished with the shortest payback periods funded first. A PHA may make adjustments to this funding order because of insufficient funds to accomplish high-cost energy conservation measures (ECM) or where an ECM with a longer pay-back period can be more efficiently installed in conjunction with other planned modernization. A PHA may not install individual utility meters that measure the energy or fuel used for space heating in dwelling units that need substantial weatherization, when installation of meters would result in economic hardship for residents. In these cases, the ECMs related to weatherization shall be accomplished before the installation of individual utility meters.

§965.305 Funding.

(a) The cost of accomplishing cost-effective energy conservation measures, including the cost of performing energy audits, shall be funded from operating funds of the PHA to the extent feasible. When sufficient operating funds are not available for this purpose, such costs are eligible for inclusion in a modernization program, for funding from any available development funds in the case of projects still in development, or for other available funds that HUD may designate to be used for energy conservation.

(b) If a PHA finances energy conservation measures from sources other than modernization or operating reserves, such as a loan from a utility entity or a guaranteed savings agreement with a private energy service company, HUD may agree to provide adjustments in its calculation of the PHA's operating subsidy eligibility under the PFS for the project and utility involved based on a determination that payments can be funded from the reasonably anticipated energy cost savings (See §990.107(g) of this chapter).

§965.306 Energy conservation equipment and practices.

In purchasing original or, when needed, replacement equipment, PHAs shall acquire only equipment that meets or exceeds the minimum efficiency requirements established by the U.S. Department of Energy. In the operation of their facilities, PHAs shall follow operating practices directed to maximum energy conservation.

§965.307 Compliance schedule.

All energy conservation measures determined by energy audits to be cost effective shall be accomplished as funds are available.

§965.308 Energy performance contracts.

(a) *Method of procurement.* Energy performance contracting shall be conducted using one of the following methods of procurement:

(1) Competitive proposals (see 24 CFR 85.36(d)(3)). In identifying the evaluation factors and their relative importance, as required by §85.36(d)(3)(i) of this title, the solicitation shall state that technical factors are significantly more important than price (of the energy audit); or

(2) If the services are available only from a single source, noncompetitive proposals (see 24 CFR 85.36(d)(4)(i)(A)).

(b) *HUD Review.* Solicitations for energy performance contracting shall be submitted to the HUD Field Office for review and approval prior to issuance. Energy performance contracts shall be submitted to the HUD Field Office for review and approval before award.

Subpart D—Individual Metering of Utilities for Existing PHA-Owned Projects

SOURCE: 61 FR 7970, Feb. 29, 1996, unless otherwise noted.

§965.401 Individually metered utilities.

(a) All utility service shall be individually metered to residents, either through provision of retail service to the residents by the utility supplier or through the use of checkmeters, unless:

(1) Individual metering is impractical, such as in the case of a central heating system in an apartment building;

(2) Change from a mastermetering system to individual meters would not be financially justified based upon a benefit/cost analysis; or

(3) Checkmetering is not permissible under State or local law, or under the policies of the particular utility supplier or public service commission.

(b) If checkmetering is not permissible, retail service shall be considered. Where checkmetering is permissible, the type of individual metering offering the most savings to the PHA shall be selected.

§965.402 Benefit/cost analysis.

(a) A benefit/cost analysis shall be made to determine whether a change from a mastermetering system to individual meters will be cost effective, except as otherwise provided in §965.405.

(b) Proposed installation of checkmeters shall be justified on the basis that the cost of debt service (interest and amortization) of the estimated installation costs plus the operating costs of the checkmeters will be more than offset by reduction in future utilities expenditures to the PHA under the mastermeter system.

(c) Proposed conversion to retail service shall be justified on the basis of net savings to the PHA. This determination involves making a comparison between the reduction in utility expense obtained through eliminating the expense to the PHA for PHA-supplied utilities and the resultant allowance for resident-supplied utilities, based on the cost of utility service to the residents after conversion.

§965.403 Funding.

The cost to change mastermeter systems to individual metering of resident consumption, including the costs of benefit/cost analysis and complete installation of checkmeters, shall be funded from operating funds of the PHA to the extent feasible. When sufficient operating funds are not available for this purpose, such costs are eligible for inclusion in a modernization project or for funding from any available development funds.

§965.404 Order of conversion.

Conversions to individually metered utility service shall be accomplished in the following order when a PHA has projects of two or more of the designated categories, unless the PHA has a justifiable reason to do otherwise, which shall be documented in its files.

(a) In projects for which retail service is provided by the utility supplier and the PHA is paying all the individual utility bills, no benefit/cost analysis is necessary, and residents shall be billed directly after the PHA adopts revised payment schedules providing appropriate allowances for resident-supplied utilities.

(b) In projects for which checkmeters have been installed but are not being utilized as the basis for determining utility charges to the residents, no benefit/cost analysis is necessary. The checkmeters shall be used as the basis for utility charges, and residents shall be surcharged for excess utility use.

(c) Projects for which meter loops have been installed for utilization of checkmeters shall be analyzed both for the installation of checkmeters and for conversion to retail service.

(d) Low- or medium-rise family units with a mastermeter system should be analyzed for both checkmetering and conversion to retail service, because of their large potential for energy savings.

(e) Low- or medium-rise housing for the elderly should next be analyzed for both checkmetering and conversion to retail service, since the potential for energy saving is less than for family units.

(f) Electric service under mastermeters for high-rise buildings, including projects for the elderly, should be analyzed for both use of retail service and of checkmeters.

§965.405 Actions affecting residents.

(a) Before making any conversion to retail service, the PHA shall adopt revised payment schedules, providing appropriate allowances for the resident-supplied utilities resulting from the conversion.

(b) Before implementing any modifications to utility services arrangements with the residents or charges with respect thereto, the PHA shall make the requisite changes in resident dwelling leases in accordance with 24 CFR part 966.

(c) PHAs must work closely with resident organizations, to the extent practicable, in making plans for conversion of utility service to individual metering, explaining the national policy objectives of energy conservation, the changes in charges and rent structure that will result, and the goals of achieving an equitable structure that will be advantageous to residents who conserve energy.

(d) A transition period of at least six months shall be provided in the case of initiation of checkmeters, during which residents will be advised of the charges but during which no surcharge will be made based on the readings. This trial period will afford residents ample notice of the effects the checkmetering system will have on their individual utility charges and also afford a test period for the adequacy of the utility allowances established.

(e) During and after the transition period, PHAs shall advise and assist residents with high utility consumption on methods for reducing their usage. This advice and assistance may include counseling, installation of new energy conserving equipment or appliances, and corrective maintenance.

§965.406 Benefit/cost analysis for similar projects.

PHAs with more than one project of similar design and utilities service may prepare a benefit/cost analysis for a representative project. A finding that a change in metering is not cost effective for the representative project is sufficient reason for the PHA not to perform a benefit/cost analysis on the remaining similar projects.

§ 965.407 Reevaluations of mastermeter systems.

Because of changes in the cost of utility services and the periodic changes in utility regulations, PHAs with mastermeter systems are required to reevaluate mastermeter systems without checkmeters by making benefit/cost analyses at least every 5 years. These analyses may be omitted under the conditions specified in § 965.406.

Subpart E—Resident Allowances for Utilities

SOURCE: 61 FR 7971, Feb. 29, 1996, unless otherwise noted.

§ 965.501 Applicability.

(a) This subpart E applies to public housing, including the Turnkey III Homeownership Opportunities program. This subpart E also applies to units assisted under sections 10(c) and 23 of the U. S. Housing Act of 1937 (42 U.S.C. 1437 *et seq.*) as in effect before amendment by the Housing and Community Development Act of 1974 (12 U.S.C. 1706e) and to which 24 CFR part 900 is not applicable. This subpart E does not apply to Indian housing projects (see 24 CFR part 950).

(b) In rental units for which utilities are furnished by the PHA but there are no checkmeters to measure the actual utilities consumption of the individual units, residents shall be subject to charges for consumption by resident-owned major appliances, or for optional functions of PHA-furnished equipment, in accordance with § 965.502(e) and 965.506(b), but no utility allowance will be established.

§ 965.502 Establishment of utility allowances by PHAs.

(a) PHAs shall establish allowances for PHA-furnished utilities for all checkmetered utilities and allowances for resident-purchased utilities for all utilities purchased directly by residents from the utilities suppliers.

(b) The PHA shall maintain a record that documents the basis on which allowances and scheduled surcharges, and revisions thereof, are established and revised. Such record shall be available for inspection by residents.

(c) The PHA shall give notice to all residents of proposed allowances, scheduled surcharges, and revisions thereof. Such notice shall be given, in the manner provided in the lease or homebuyer agreement, not less than 60 days before the proposed effective date of the allowances or scheduled surcharges or revisions; shall describe with reasonable particularity the basis for determination of the allowances, scheduled surcharges, or revisions, including a statement of the specific items of equipment and function whose utility consumption requirements were included in determining the amounts of the allowances or scheduled surcharges; shall notify residents of the place where the PHA's record maintained in accordance with paragraph (b) of this section is available for inspection; and shall provide all residents an opportunity to submit written comments during a period expiring not less than 30 days before the proposed effective date of the allowances or scheduled surcharges or revisions. Such written comments shall be retained by the PHA and shall be available for inspection by residents.

(d) Schedules of allowances and scheduled surcharges shall not be subject to approval by HUD before becoming effective, but will be reviewed in the course of audits or reviews of PHA operations.

(e) The PHA's determinations of allowances, scheduled surcharges, and revisions thereof shall be final and valid unless found to be arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with the law.

§ 965.503 Categories for establishment of allowances.

Separate allowances shall be established for each utility and for each category of dwelling units determined by the PHA to be reasonably comparable as to factors affecting utility usage.

§ 965.504 Period for which allowances are established.

(a) *PHA-furnished utilities*. Allowances will normally be established on a quarterly basis; however, residents may be surcharged on a monthly basis. The allowances established may provide for seasonal variations.

(b) *Resident-purchased utilities.* Monthly allowances shall be established. The allowances established may provide for seasonal variations.

§ 965.505 Standards for allowances for utilities.

(a) The objective of a PHA in designing methods of establishing utility allowances for each dwelling unit category and unit size shall be to approximate a reasonable consumption of utilities by an energy-conservative household of modest circumstances consistent with the requirements of a safe, sanitary, and healthful living environment.

(b) Allowances for both PHA-furnished and resident-purchased utilities shall be designed to include such reasonable consumption for major equipment or for utility functions furnished by the PHA for all residents (e.g., heating furnace, hot water heater), for essential equipment whether or not furnished by the PHA (e.g., range and refrigerator), and for minor items of equipment (such as toasters and radios) furnished by residents.

(c) The complexity and elaborateness of the methods chosen by the PHA, in its discretion, to achieve the foregoing objective will depend upon the nature of the housing stock, data available to the PHA and the extent of the administrative resources reasonably available to the PHA to be devoted to the collection of such data, the formulation of methods of calculation, and actual calculation and monitoring of the allowances.

(d) In establishing allowances, the PHA shall take into account relevant factors affecting consumption requirements, including:

(1) The equipment and functions intended to be covered by the allowance for which the utility will be used. For instance, natural gas may be used for cooking, heating domestic water, or space heating, or any combination of the three;

(2) The climatic location of the housing projects;

(3) The size of the dwelling units and the number of occupants per dwelling unit;

(4) Type of construction and design of the housing project;

(5) The energy efficiency of PHA-supplied appliances and equipment;

(6) The utility consumption requirements of appliances and equipment whose reasonable consumption is intended to be covered by the total resident payment;

(7) The physical condition, including insulation and weatherization, of the housing project;

(8) Temperature levels intended to be maintained in the unit during the day and at night, and in cold and warm weather; and

(9) Temperature of domestic hot water.

(e) If a PHA installs air conditioning, it shall provide, to the maximum extent economically feasible, systems that give residents the option of choosing to use air conditioning in their units. The design of systems that offer each resident the option to choose air conditioning shall include retail meters or checkmeters, and residents shall pay for the energy used in its operation. For systems that offer residents the option to choose air conditioning, the PHA shall not include air conditioning in the utility allowances. For systems that offer residents the option to choose air conditioning but cannot be checkmetered, residents are to be surcharged in accordance with § 965.506. If an air conditioning system does not provide for resident option, residents are not to be charged, and these systems should be avoided whenever possible.

§ 965.506 Surcharges for excess consumption of PHA-furnished utilities.

(a) For dwelling units subject to allowances for PHA-furnished utilities where checkmeters have been installed, the PHA shall establish surcharges for utility consumption in excess of the allowances. Surcharges may be computed on a straight per unit of purchase basis (e.g., cents per kilowatt hour of electricity) or for stated blocks of excess consumption, and shall be based on the PHA's average utility rate. The basis for calculating such surcharges shall be described in the PHA's schedule of allowances. Changes in the dollar amounts of surcharges based directly on changes in the PHA's average utility rate shall not be subject to the advance notice requirements of this section.

(b) For dwelling units served by PHA-furnished utilities where checkmeters have not been installed, the PHA shall establish schedules of surcharges indicating additional dollar amounts residents will be required to pay by reason of estimated utility consumption attributable to resident-owned major appliances or to optional functions of PHA-furnished equipment. Such surcharge schedules shall state the resident-owned equipment (or functions of PHA-furnished equipment) for which surcharges shall be made and the amounts of such charges, which shall be based on the cost to the PHA of the utility consumption estimated to be attributable to reasonable usage of such equipment.

§965.507 Review and revision of allowances.

(a) *Annual review.* The PHA shall review at least annually the basis on which utility allowances have been established and, if reasonably required in order to continue adherence to the standards stated in §965.505, shall establish revised allowances. The review shall include all changes in circumstances (including completion of modernization and/or other energy conservation measures implemented by the PHA) indicating probability of a significant change in reasonable consumption requirements and changes in utility rates.

(b) *Revision as a result of rate changes.* The PHA may revise its allowances for resident-purchased utilities between annual reviews if there is a rate change (including fuel adjustments) and shall be required to do so if such change, by itself or together with prior rate changes not adjusted for, results in a change of 10 percent or more from the rates on which such allowances were based. Adjustments to resident payments as a result of such changes shall be retroactive to the first day of the month following the month in which the last rate change taken into account in such revision became effective. Such rate changes shall not be subject to the 60 day notice requirement of §965.502(c).

§965.508 Individual relief.

Requests for relief from surcharges for excess consumption of PHA-purchased utilities, or from payment of utility supplier billings in excess of the allowances for resident-purchased utilities, may be granted by the PHA on reasonable grounds, such as special needs of elderly, ill or disabled residents, or special factors affecting utility usage not within the control of the resident, as the PHA shall deem appropriate. The PHA's criteria for granting such relief, and procedures for requesting such relief, shall be adopted at the time the PHA adopts the methods and procedures for determining utility allowances. Notice of the availability of such procedures (including identification of the PHA representative with whom initial contact may be made by residents), and the PHA's criteria for granting such relief, shall be included in each notice to residents given in accordance with §965.502(c) and in the information given to new residents upon admission.

Special Attention of:

Housing Authorities; Resident Management Corporations; Public Housing Directors; Administrators, Offices of Native American Programs

Notice PIH 95-47 (HA)

Issued: July 6, 1995
Expires: July 31, 1996

Cross References:

Subject: Extension of Notice PIH 93-40 (PHA/IHA), Air-Conditioning in Public and Indian Housing

This Notice extends Notice PIH 93-40 (PHA/IHA), dated August 10, 1993, which expired August 31, 1994, until July 31, 1996.

Assistant Secretary for Public
and Indian Housing

IH : Distribution: W-3-1, W-2(H), R-3-1(PIH), R-6, R-7, R-9, 138-2, 138-7, RMC-2

Special Attention of:
Public Housing Agencies; Indian Housing Authorities; Regional Administrators; Regional Public Housing Directors; Field Office Managers; Public Housing Division Directors; Housing Development Division Directors; Office of Indian Programs Directors; Resident Management Corporations

Notice PIH 93-40 (PHA/IHA)

Issued: August 10, 1993
Expires: August 31, 1994

Cross References:

Subject: Air-Conditioning in Public and Indian Housing

1. Purpose. The purpose of this Notice is to announce a revision in the Department's existing policy regarding air-conditioning (AC) for the public and Indian housing programs.

2. Background. The Department of Housing and Urban Development (HUD) has historically considered AC to be inconsistent with the modest, non-luxury nature of public housing. As a result, HUD has limited the use of Federal funds for the installation of AC.

   One of the goals of the Secretary is to provide public housing agencies and Indian housing authorities (referred to as HAs) with the flexibility to meet local needs and design public housing that is consistent with community standards and custom. Pursuant to the Secretary's objective, the Department is modifying its policy to permit HAs and residents the choice of including AC in their developments within existing funding as outlined below.

3. Development.

   (a) AC systems are optional eligible costs in development. However, the total development cost (TDC) limits are not and will not be adjusted to reflect the cost of AC. If a HA chooses to include AC, development must be accomplished within the existing TDC limits.

(b) In designing AC systems, HAs are to provide, to the maximum extent economically feasible, systems that give residents the option of choosing to use AC in their units. When a system is designed so that each resident can choose AC, the design shall include individual (retail) meters or checkmeters for electricity and residents shall pay for the energy used in its operation in accordance with 24 CFR 965, Subparts D and E and 24 CFR 905, Subpart K. For systems that provide residents the option to choose AC but cannot be checkmetered, residents are to be surcharged as provided by HUD regulation 24 CFR 965.477(b) and 905.872(b). For AC systems that do not provide for resident option, residents are not to be charged for AC; these types of systems should be avoided whenever possible.

(c) Paragraph 3-147 of the Public Housing Development Handbook 7417.1 REV-1, regarding criteria for installing AC is superseded by this Notice.

4. Modernization.

(a) AC systems are optional eligible physical improvements under either the Comprehensive Improvement Assistance Program (CIAP) or the Comprehensive Grant Program (CGP). If AC is to be included, the same criteria identified in paragraph 3(b) above apply. No additional funds will be provided in CIAP or CGP where the HA and its residents choose AC.

(b) For previously approved CIAP developments where AC is desired but was not discussed at the time of approval, HAs shall consult with residents in the same manner as is required in 24 CFR 968.220 and 24 CFR 905.627. At that time, residents should be fully informed of the ramifications of choosing to have AC, including the degree to which other modernization needs will have to be deferred and the estimated energy costs to the resident associated with AC.

(b) Paragraph 4-19A of the CGP Handbook, 7485.3, regarding the installation of central AC or purchase of window or wall units is superseded by this Notice. The Department intends to issue changes to this Handbook to reflect this policy in the near future.

5. Utility Allowances. 24 CFR 965, Subpart E and 24 CFR 905.885 require the establishment of tenant allowances for utilities as well as surcharges for excess consumption for PHA-furnished utilities. HAs are expected to comply with these requirements. In establishing utility allowances pursuant to 24 CFR 965, Subpart E, it is noted that Section 965.472 defines a surcharge to be the amount charged by the HA to a tenant in addition to tenant rent, for consumption of utilities in excess of the allowances for HA-furnished utilities or for excess consumption attributable to tenant-owned major appliances or to optional functions, such as air conditioning, of HA-furnished equipment (also see Section 965.477(b) and 24 CFR 905.872(b)). These sections have been interpreted as not permitting the inclusion of AC in utility allowances. As a result, HAs choosing to install AC shall assure that the cost of utilities attributable to AC when the use is optional shall be borne by the residents.

6. Costs. As indicated above, the cost of the initial installation and replacement of AC systems must be accomplished within existing funding levels; that is, no additional amendment funds for development programs, or additional modernization funds will be requested or provided by the Department to cover the cost of AC. The cost of maintaining AC systems must be absorbed within a HA's existing Performance Funding System eligibility. Residents shall pay the cost of utility consumption in accordance with the regulations outlined in paragraph 5 above.

Assistant Secretary for Public
and Indian Housing

Appendix B
Additional Resources

Resources

Information on the consumption requirements of appliances may be obtained from the following organizations:

Local utility company

American Council for an Energy-Efficient Economy
1001 Connecticut Avenue, NW
Suite 801
Washington, DC 20036
(202) 429-8873

American Gas Association (AGA)
1515 Wilson Blvd.
Arlington, VA 22209
(703) 841-8660

Association of Home Appliance Manufacturers (AHAM)
20 North Wacker Drive
Chicago, IL 60606
(312) 984-5800

Edison Electric Institute (EEI)
701 Pennsylvania Avenue, NW
Washington, DC 20004-2696
(202) 508-5000

Technical assistance on energy or water conservation may be provided by the following organizations:

Local HUD field office

Local utility company

National Center for Appropriate Technology (NCAT)
Energy Efficiency Clearinghouse for Public Housing
3040 Continental Drive
P. O. Box 3838
Butte, MT 59702
(406) 494-4572
Toll free number: 1-800-Ask-NCAT

Local weather data may be obtained from the following organizations:

Local weather station

Local utility company

National Oceanographic and Atmospheric Administration (NOAA)
U. S. Department of Commerce
National Climatic Data Center
Federal Building
Asheville, NC 28801-2733
(704) 271-4800

Other important resources:

State energy offices

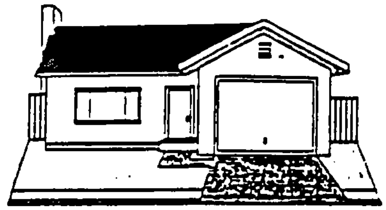
Local weatherization providers

American Society of Heating Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE)
1791 Tullie Circle, NE
Atlanta, GA 30329
(404) 235-0228

Energy Efficiency and Renewable Energy Clearinghouse (EREC)
P. O. Box 3048
Merrifield, VA 22116
(800) 363-3732

National Association of Energy Services Providers

Appendix A
Table of Consumption Levels and Weather Data



ANNUAL ENERGY REQUIREMENTS OF ELECTRIC HOUSEHOLD APPLIANCES

The estimated annual kilowatt-hour consumption of electric appliances listed in this handy reference are based on normal usage. When using these figures for projections, such factors as the size of the specific appliance, the geographical area of use and individual usage should be taken into consideration. Please note that the wattages are not additive since all units are not normally in operation at the same time.

	Average Wattage	Estimated kWh Consumed Annually
Laundry		
Clothes Dryer	5,000	770
Iron(hand)	1,100	50
Washing Machine[1]	-	145
Water Heater	3,800	1,000 - 4,500
-quick recovery	-	350
Comfort Conditioning		
Air Cleaner	45	216
Air Conditioner(room)[2]	670	330 - 1,330
-high efficiency[2]	500	250 - 1,000
Bed Covering	90	80 - 160
Dehumidifier	675	200 - 500
Fan(ceiling)	-	50
Fan(whole house)	-	80
Fan(rollaway)	-	60
Fan(window)	-	10 - 30
Furnace Fan	-	300 - 900
Heater(portable)	800	80 - 240
Heating Pad	70	10
Humidifier	175	50 - 200

[1]Excludes hot water consumption.
[2]Varies widely due to climatic location unit size.
-Amount varies widely.

	Average Wattage	Estimated kWh Consumed Annually
Food Preparation		
Blender	300	1 - 4
Broiler	1,350	33
Carving Knife	90	1
Coffee Maker	-	80
Deep Fryer	1,200	30 - 100
Dishwasher[1]	-	170
Egg Cooker	600	9
Frying Pan	1,100	100
Hot Plate	1,200	62
Mixer	150	1 - 5
Microwave	-	40 - 200
Range		
with oven	-	500 - 700
with self-cleaning	-	600 - 800
Roaster	850	40 - 100
Sandwich Grill	1,200	20 - 50
Toaster	1,200	20 - 50
Trash Compactor	-	6
Waffle Iron	650	10 - 20
Garbage Disposal	850	10
Freezer-manual defrost (20 cu ft)	-	790
-automatic defrost (27 cu ft)	-	990
Refrigerators/Freezers		
-manual defrost (14 cu ft)	-	710
-automatic defrost (20 cu ft)	-	800

	Average Wattage	Estimated kWh Consumed Annually
Health & Beauty		
Hair Dryer	1,200	20 - 70
Heat Lamp(infrared)	250	13
Shaver	15	1
Sun Lamp	800	49
Tooth Brush	10	1
Home Entertainment		
Compact Disc Player	-	24
Home Computer	150	80 - 170
Radio	-	20 - 50
Stereo	90	75
Television- b & w		
-solid state	45	90
Television- color		
-solid state	100	100 - 300
VCR	30	20 - 60
Video Games	-	120
Housewares		
Clock	2	17
Floor Polisher	500	6
Sewing Machine	75	12
Vacuum Cleaner		
-canister	-	20 - 60
-upright	-	15 - 40
Cordless Lawn Mower	-	40

EDISON ELECTRIC INSTITUTE

30-Year Average Monthly Heating Degree Days at Base 65 Deg F. (1941 - 1970)

Weather Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Heating Deg Day Total	Outdoor 99% Design Temperature Degree F
ALABAMA														
BIRMINGHAM FAA AP	654	517	389	116	20	0	0	0	6	137	391	614	2,844	17
HUNTSVILLE WSO AP	747	605	461	145	32	0	0	0	11	159	441	701	3,302	11
MOBILE WSO AP	451	337	221	40	0	0	0	0	0	39	211	385	1,684	25
MONTGOMERY WSO AP	556	419	299	76	8	0	0	0	0	93	306	512	2,269	22
MUSCLE SHOALS FAA AP	735	582	447	138	27	0	0	0	8	148	435	679	3,199	
TUSCALOOSA FAA AP	629	484	346	88	11	0	0	0	0	116	366	586	2,626	20
ALASKA														
ANCHORAGE WSCMO AP	1,649	1,322	1,280	891	583	312	220	282	507	936	1,317	1,612	10,911	-23
ANNETTE WSO AP	977	792	828	666	484	318	231	211	330	561	753	902	7,053	
BARROW WSO AP	2,471	2,341	2,486	1,977	1,423	960	815	849	1,041	1,541	1,965	2,396	20,265	-45
BETHEL WSO AP	1,857	1,590	1,662	1,215	772	402	319	394	600	1,079	1,434	1,879	13,203	
BETTLES FAA AP	2,424	2,038	1,969	1,335	722	270	231	406	750	1,395	1,992	2,393	15,925	
BIG DELTA FAA/AMOS AP	2,167	1,725	1,634	1,068	580	257	181	322	642	1,234	1,743	2,145	13,698	
COLD BAY WSO AP	1,141	1,030	1,116	957	791	588	462	425	531	787	921	1,116	9,865	
CORDOVA FAA FSS AP	1,302	1,072	1,110	870	660	438	360	372	510	787	1,032	1,252	9,765	
FAIRBANKS WSFO AP	2,384	1,890	1,721	1,083	549	211	148	304	618	1,234	1,866	2,337	14,345	-51
GULKANA FSS/AMOS	2,241	1,711	1,566	1,044	657	333	254	366	642	1,184	1,767	2,173	13,938	
HOMER WSO AP	1,352	1,123	1,159	900	704	489	394	391	540	856	1,104	1,352	10,364	
JUNEAU AP	1,287	1,036	1,026	783	564	354	288	332	474	719	975	1,169	9,007	-4
KETCHIKAN	955	773	812	654	468	303	217	205	321	552	738	887	6,885	
KING SALMON WSO AP	1,600	1,355	1,383	1,005	694	429	326	347	531	973	1,287	1,652	11,582	
KOTZEBUE WSO AP	2,130	1,940	2,031	1,560	1,060	645	375	443	717	1,283	1,719	2,136	16,039	
MC GRATH WSO AP	2,291	1,826	1,739	1,155	648	285	219	357	636	1,231	1,800	2,300	14,487	
NOME WSO AP	1,829	1,674	1,786	1,383	936	585	462	490	687	1,132	1,482	1,879	14,325	-31
NORTHWAY FAA AP	2,595	2,036	1,810	1,140	639	286	207	353	696	1,339	2,022	2,511	15,634	
ST PAUL ISLAND WSO AP	1,206	1,176	1,277	1,095	933	723	598	543	618	843	954	1,153	11,119	
TALKEETNA WSCMO AP	1,724	1,392	1,395	972	629	306	220	322	567	1,020	1,425	1,736	11,708	
TANANA FAA AP	2,356	1,954	1,845	1,218	645	258	203	372	702	1,302	1,908	2,353	15,116	
UNALAKLEET WSO AP	1,910	1,691	1,724	1,287	843	495	341	406	645	1,169	1,551	1,965	14,027	
VALDEZ WSO	1,463	1,193	1,184	882	657	414	363	403	555	853	1,167	1,411	10,545	
WRANGELL AIRPORT	1,138	913	905	702	505	325	264	290	417	645	861	1,045	8,010	
YAKUTAT WSO AP	1,265	1,036	1,076	867	673	459	360	375	498	753	984	1,187	9,533	
ARIZONA														
FLAGSTAFF WSO AP	1,150	966	955	687	462	219	52	93	231	558	858	1,091	7,322	-2
PHOENIX WSFO AP	428	292	185	60	0	0	0	0	0	17	182	388	1,552	31
TUCSON WSO AP	436	328	235	76	0	0	0	0	0	26	209	397	1,707	28
WINSLOW WSO AP	1,004	725	626	348	124	14	0	0	19	252	654	967	4,733	5
YUMA WSO AP	308	192	97	24	0	0	0	0	0	0	108	276	1,005	36
ARKANSAS														
EL DORADO FAA AP	636	488	361	98	11	0	0	0	0	117	351	583	2,645	18
FAYETTEVILLE EXP STN	865	669	559	203	63	0	0	0	16	182	504	778	3,839	7
FORT SMITH WSO AP	806	608	471	132	17	0	0	0	0	135	438	729	3,336	12
LITTLE ROCK FAA AP	791	619	470	139	21	0	0	0	5	143	441	725	3,354	15
CALIFORNIA														
BAKERSFIELD WSO AP	543	353	266	140	22	0	0	0	0	55	276	530	2,185	30
BISHOP WSO AP	865	655	580	337	145	38	0	5	44	256	579	809	4,313	
BLYTHE FAA AIRPORT	363	215	106	33	0	0	0	0	0	9	122	336	1,184	30
BURBANK VALLEY PMP PLT	356	273	247	159	80	36	0	0	9	53	168	320	1,701	37

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Weather Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Heating Deg Day Total	Outdoor 99% Design Temperature Degree F
DAGGETT FAA AIRPORT	549	371	271	118	14	0	0	0	0	57	296	527	2,203	
FRESNO WSO AP	611	423	344	182	51	9	0	0	0	90	345	595	2,650	28
IMPERIAL	325	195	105	23	0	0	0	0	0	6	118	288	1,060	
LONG BEACH WSO AP	339	273	247	148	71	23	0	0	7	48	155	295	1,606	41
LOS ANGELES WSO AP	331	270	267	195	114	71	19	15	23	77	158	279	1,819	41
LOS ANGELES CIVIC CTR	268	207	190	124	60	25	0	0	5	35	113	218	1,245	37
MODESTO	617	423	350	202	75	17	0	0	6	104	372	601	2,767	28
MOUNT SHASTA WSO CI	973	762	763	561	371	178	37	64	145	422	699	915	5,890	
NEEDLES FAA AIRPORT	421	261	150	42	0	0	0	0	0	10	163	381	1,428	30
OXNARD	351	297	304	242	180	116	68	51	56	109	202	310	2,286	34
PALM SPRINGS	341	224	141	51	0	0	0	0	0	12	161	310	1,240	33
RED BLUFF	614	420	366	218	64	8	0	0	0	82	339	577	2,688	
SACRAMENTO FAA AP	617	426	372	227	120	20	0	0	5	101	360	595	2,843	30
SALINAS FAA AP	465	364	372	296	214	139	102	96	72	136	275	428	2,959	30
SANDBERG WSMO	769	638	663	474	288	116	7	10	33	212	501	716	4,427	
SAN DIEGO WSO AP	314	237	219	144	79	52	6	0	16	43	140	257	1,507	42
SAN FRANCISCO WSO AP	518	386	372	291	210	120	93	84	66	137	291	474	3,042	35
SAN FRAN MISSION DOLORES	437	325	332	291	257	194	202	177	102	127	233	403	3,080	
SANTA BARBARA FAA AP	415	328	319	233	168	102	61	43	55	128	240	378	2,470	34
SANTA MARIA WSO AP	450	364	378	303	245	167	112	102	94	159	270	409	3,053	31
STOCKTON WSO AP	632	445	381	214	67	15	0	0	0	88	363	601	2,806	28
WATSONVILLE WATERWORKS	515	400	403	315	251	170	138	137	112	182	318	477	3,418	
COLORADO														
AKRON FAA AP	1,203	983	942	558	286	93	0	6	143	446	846	1,119	6,625	
ALAMOSA WSO AP	1,482	1,182	1,054	714	440	171	55	96	294	648	1,053	1,420	8,609	-21
BURLINGTON	1,085	882	828	462	210	54	0	0	102	363	741	1,011	5,738	
COLORADO SPRGS WSO AP	1,128	944	921	564	301	103	9	13	155	456	825	1,054	6,473	-3
DENVER WSFO AP	1,088	902	868	525	253	80	0	0	120	408	768	1,004	6,016	-5
EAGLE FAA AP	1,457	1,168	1,051	693	425	190	43	79	285	626	1,023	1,386	8,426	
GRAND JUNCTION WSO AP	1,190	879	738	404	133	20	0	0	60	324	756	1,101	5,605	2
PUEBLO WSO AP	1,082	848	775	405	148	28	0	0	55	335	726	992	5,394	-7
TRINIDAD FAA AP	1,054	868	822	471	212	58	0	0	81	364	732	980	5,642	-2
CONNECTICUT														
BRIDGEPORT WSO AP	1,079	955	840	498	225	24	0	0	42	261	570	967	5,461	6
HARTFORD WSO AP	1,246	1,070	911	519	226	24	0	12	106	384	711	1,141	6,350	3
DELAWARE														
WILMINGTON WSO AP	1,023	879	725	381	128	0	0	0	32	254	579	939	4,940	10
DISTRICT OF COLUMBIA														
WASH DULLES WSO AP	1,020	874	719	357	131	5	0	0	43	291	609	961	5,010	
WASH NATL WSCMO AP	911	776	617	265	72	0	0	0	14	190	510	856	4,211	14
FLORIDA														
APALACHICOLA WSO AP	368	290	175	30	0	0	0	0	0	22	158	318	1,361	
DAYTONA BEACH WSO AP	241	210	120	17	0	0	0	0	0	0	97	212	897	32
FORT LAUDERDALE	69	79	24	0	0	0	0	0	0	0	13	59	244	42
FORT MYERS FAA AP	128	125	48	0	0	0	0	0	0	0	44	112	457	41
JACKSONVILLE WSO AP	348	282	176	24	0	0	0	0	0	19	161	317	1,327	29
KEY WEST WSO AP	16	25	5	0	0	0	0	0	0	0	0	18	64	55
MELBOURNE	161	163	80	8	0	0	0	0	0	0	56	143	611	
MIAMI WSCMO AP	53	67	17	0	0	0	0	0	0	0	13	56	206	44

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PENSACOLA FAA AP	427	323	211	37	0	0	0	0	0	32	189	359	1,578	25
TALLAHASSEE WSO AP	408	323	187	34	0	0	0	0	0	31	204	376	1,563	27
TAMPA WSCMO AP	203	176	90	9	0	0	0	0	0	0	71	169	718	36
WEST PALM BEACH WSO AP	83	91	25	0	0	0	0	0	0	0	22	78	299	41
GEORGIA														
ALBANY 3 SE	468	371	243	42	0	0	0	0	0	54	247	447	1,872	25
ALMA FAA AP	467	367	245	58	0	0	0	0	0	61	255	447	1,900	
ATHENS WSO AP	670	543	423	131	20	0	0	0	6	132	402	648	2,975	18
ATLANTA WSO AP	701	560	443	144	27	0	0	0	8	137	408	667	3,095	17
AUGUSTA WSO AP	601	475	346	90	10	0	0	0	0	104	344	577	2,547	20
COLUMBUS WSO AP	571	448	323	89	6	0	0	0	0	81	324	536	2,378	21
MACON WSO AP	543	423	298	66	6	0	0	0	0	82	304	518	2,240	21
SAVANNAH WSO AP	483	379	256	63	0	0	0	0	0	60	253	458	1,952	24
HAWAII														
HILO WSO AP 87	0	0	0	0	0	0	0	0	0	0	0	0	0	61
HONOLULU WSFO AP 703	0	0	0	0	0	0	0	0	0	0	0	0	0	62
KAHULUI WSO 398 AP	0	0	0	0	0	0	0	0	0	0	0	0	0	
LIHUE WSO AP 1020.1	0	0	0	0	0	0	0	0	0	0	0	0	0	
IDAHO														
BOISE WSFO AP	1,116	826	741	480	252	97	0	12	127	406	756	1,020	5,833	3
BURLEY FAA AP	1,221	927	859	573	331	141	0	29	204	505	834	1,107	6,731	-3
IDAHO FALLS FAA AP	1,429	1,117	1,008	633	371	176	10	47	252	580	963	1,302	7,888	-11
LEWISTON WSO AP	1,048	753	685	441	232	84	0	17	124	409	735	936	5,464	-1
POCATELLO WSO AP	1,296	997	918	591	336	138	0	20	192	515	879	1,181	7,063	-8
ILLINOIS														
CHICAGO O'HARE WSO AP	1,305	1,089	908	486	240	45	7	18	90	360	774	1,175	6,497	-8
CHICAGO MIDWAY AP 3 SW	1,262	1,053	874	453	208	26	0	8	57	316	738	1,132	6,127	-5
MOLINE WSO AP	1,349	1,100	908	436	184	20	0	11	79	344	774	1,190	6,395	-9
MT VERNON 3 NE	1,020	823	661	264	93	0	0	0	32	222	597	930	4,642	0
PEORIA WSO AP	1,277	1,044	859	416	180	17	0	8	70	327	753	1,147	6,098	-8
ROCKFORD WSO AP	1,389	1,148	958	504	233	35	6	16	99	392	822	1,243	6,845	-9
SPRINGFIELD WSO AP	1,187	969	794	363	132	12	0	8	48	282	693	1,070	5,558	-3
INDIANA														
EVANSVILLE WSO AP	1,004	815	653	263	95	0	0	0	34	236	603	921	4,624	4
FORT WAYNE WSO AP	1,231	1,047	884	471	216	23	0	12	90	363	744	1,128	6,209	-4
INDIANAPOLIS WSFO	1,150	960	784	387	159	11	0	5	63	302	699	1,057	5,577	-2
SOUTH BEND WSO AP	1,271	1,084	921	507	245	35	6	24	98	368	762	1,141	6,462	-3
IOWA														
BURLINGTON RADIO KBUR	1,305	1,056	871	416	172	16	0	8	70	320	756	1,159	6,149	-7
DES MOINES WSFO AP	1,414	1,142	964	465	186	26	0	13	94	350	816	1,240	6,710	-10
DUBUQUE WSO AP	1,466	1,204	1,017	525	247	49	11	27	134	422	873	1,302	7,277	-12
MARSHALLTOWN	1,432	1,159	964	476	199	32	7	18	112	383	834	1,259	6,875	-12
MASON CITY FAA AP	1,575	1,302	1,116	579	265	64	13	31	165	457	942	1,392	7,901	-15
SIOUX CITY WSO AP	1,457	1,165	986	474	189	33	0	10	113	378	861	1,287	6,953	-11
SPENCER 1 N	1,559	1,274	1,085	564	251	59	11	25	161	453	945	1,383	7,770	
WATERLOO WSO AP	1,510	1,238	1,039	528	229	39	7	26	137	426	897	1,339	7,415	-15
KANSAS														
CHANUTE FAA AIRPORT	1,039	787	656	258	88	7	0	0	27	204	579	921	4,566	3
CONCORDIA WSO AP	1,197	938	803	379	152	22	0	5	68	275	708	1,076	5,623	

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DODGE CITY WSO AP	1,060	834	738	344	115	21	0	0	41	247	666	980	5,046	0
GARDEN CITY FAA AP	1,066	840	753	357	116	22	0	0	41	270	690	992	5,147	-1
GOODLAND WSO AP	1,159	938	890	489	216	55	0	0	108	387	795	1,082	6,119	-5
RUSSELL FAA AP	1,122	879	772	356	127	22	0	0	50	262	687	1,035	5,312	0
SALINA FAA AP	1,097	851	718	313	110	9	0	0	38	228	636	992	4,992	0
TOPEKA WSFO AP	1,147	885	745	329	118	13	0	0	55	259	663	1,029	5,243	0
WICHITA WSO AP	1,045	804	671	275	90	7	0	0	32	211	606	946	4,687	3
KENTUCKY														
BOWLING GREEN FAA AP	911	745	592	238	82	6	0	0	23	218	558	846	4,219	4
COVINGTON WSO AP	1,051	888	722	341	138	9	0	0	44	271	636	970	5,070	1
FRANKFORT LOCK 4	980	829	688	325	119	12	0	0	37	259	597	908	4,754	
HENDERSON 7 SSW	942	764	604	228	80	5	0	0	28	200	549	868	4,268	
LEXINGTON WSO AP	995	832	673	302	106	8	0	0	40	246	612	915	4,729	3
LOUISVILLE WSFO AP	983	818	661	286	105	0	0	0	35	241	600	911	4,640	5
LOUISIANA														
BATON ROUGE WSO AP	451	335	208	33	0	0	0	0	0	54	208	381	1,670	25
LAFAYETTE FAA AP	428	318	201	28	0	0	0	0	0	39	188	349	1,551	26
LAKE CHARLES WSO AP	415	306	200	26	0	0	0	0	0	36	177	338	1,498	27
MONROE FAA AP	574	434	311	71	6	0	0	0	0	90	307	518	2,311	20
NEW ORLEANS WSCMO AP	403	299	188	29	0	0	0	0	0	40	179	327	1,465	29
SHREVEPORT WSO AP	552	416	291	65	5	0	0	0	0	70	278	490	2,167	20
MAINE														
CARIBOU WSO AP	1,683	1,459	1,283	849	474	170	84	122	327	657	1,008	1,516	9,632	-18
PORTLAND WSMO AP	1,349	1,179	1,029	669	381	106	27	55	200	493	792	1,218	7,498	-6
WATERVILLE PMP STN	1,417	1,224	1,039	642	319	75	20	32	181	477	810	1,277	7,513	-8
MARYLAND														
BALTIMORE WSO AP	980	846	688	340	110	0	0	0	27	250	567	921	4,729	10
BALTIMORE WSO CI	896	773	617	270	71	0	0	0	16	162	474	822	4,101	14
MASSACHUSETTS														
BLUE HILL	1,203	1,050	924	561	271	54	6	14	111	366	681	1,094	6,335	
BOSTON WSO AP	1,110	969	834	492	218	27	0	8	76	301	594	992	5,621	6
NANTUCKET FAA AP	1,029	935	871	621	378	126	24	30	108	326	573	908	5,929	
WORCESTER WSO AP	1,283	1,117	983	591	295	61	10	24	144	415	753	1,172	6,848	0
MICHIGAN														
ALPENA WSO AP	1,463	1,308	1,203	747	455	150	75	110	265	549	903	1,290	8,518	-11
BENTON HARBOR AP	1,212	1,047	911	513	272	48	6	22	99	355	723	1,088	6,296	1
DETROIT METRO WSO AP	1,252	1,075	921	519	244	36	5	16	95	377	747	1,132	6,419	3
FLINT WSO AP	1,324	1,154	1,004	573	306	65	14	36	147	433	801	1,184	7,041	-4
GRAND RAPIDS WSO AP	1,296	1,134	989	555	270	44	8	27	114	409	789	1,166	6,801	1
HOLLAND	1,228	1,078	936	525	259	59	12	41	107	367	732	1,101	6,445	2
HOUGHTON LAKE WSO AP	1,476	1,310	1,187	693	389	120	59	94	248	539	918	1,314	8,347	
IRON MTN-KINGSFORD WWT	1,569	1,350	1,194	705	384	121	50	83	267	549	984	1,407	8,663	
JACKSON FAA AP	1,302	1,120	967	537	264	46	9	24	115	404	792	1,175	6,755	1
KALAMAZOO STATE HOSP	1,246	1,070	911	483	218	35	0	12	79	355	747	1,125	6,281	1
LANSING WSO AP	1,314	1,148	995	555	280	48	9	27	133	422	798	1,175	6,904	-3
MUSKEGON WSO AP	1,271	1,131	1,001	591	316	64	15	37	137	421	774	1,132	6,890	2
PELLSTON FAA AP	1,504	1,369	1,252	756	452	144	79	111	274	561	918	1,314	8,734	
SAGINAW FAA AP	1,352	1,184	1,029	588	303	52	10	36	143	436	810	1,200	7,143	0
SAULT STE MARIE WSO	1,575	1,394	1,271	804	496	200	96	125	291	583	966	1,392	9,193	-12

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TRAVERSE CITY FAA AP	1,370	1,240	1,125	669	387	104	33	66	178	471	843	1,212	7,698	-3
MINNESOTA														
ALEXANDRIA FAA AP	1,795	1,498	1,274	705	345	101	20	35	240	558	1,086	1,578	9,235	-22
DULUTH WSO AP	1,752	1,481	1,287	792	484	194	67	104	318	611	1,098	1,569	9,757	-21
GRAND RAPIDS FORESTRY	1,798	1,495	1,271	735	403	138	46	85	301	601	1,107	1,606	9,586	
INTERNL FALLS WSO AP	1,956	1,624	1,376	804	462	168	66	112	364	667	1,203	1,745	10,547	-29
MARSHALL	1,615	1,327	1,135	594	262	62	8	16	164	457	969	1,423	8,032	
MINN-ST PAUL WSO AP	1,649	1,366	1,147	612	286	75	14	26	195	496	993	1,451	8,310	-16
ROCHESTER WSO AP	1,615	1,347	1,153	615	292	78	21	35	185	485	972	1,429	8,227	-17
ST CLOUD WSO AP	1,739	1,448	1,212	663	324	85	18	37	228	539	1,050	1,525	8,868	-15
MISSISSIPPI														
GREENWOOD FAA AP	632	489	353	77	9	0	0	0	0	109	349	580	2,598	15
JACKSON WSFO AP	569	442	313	74	6	0	0	0	0	91	301	504	2,300	21
MERIDIAN WSO AP	575	443	312	79	7	0	0	0	0	111	331	530	2,388	19
TUPELO WSO AP	694	540	409	109	19	0	0	0	5	132	396	642	2,946	14
UNIVERSITY	719	570	432	120	26	0	0	0	11	154	399	654	3,085	
MISSOURI														
COLUMBIA WSO AP	1,107	879	730	314	117	11	0	0	42	247	633	998	5,078	-1
JOPLIN FAA AP	949	739	610	230	73	8	0	0	25	183	528	843	4,188	6
KANSAS CITY WSO AP	1,153	893	745	314	111	12	0	0	42	235	642	1,014	5,161	2
ST LOUIS WSCMO AP	1,045	837	682	272	103	10	0	0	35	224	600	942	4,750	2
SEDALIA WATER PLANT	1,039	812	666	262	94	8	0	0	26	203	579	924	4,613	-1
SPRINGFIELD WSO AP	995	784	660	275	94	10	0	6	35	227	585	899	4,570	3
MONTANA														
BILLINGS WSO AP	1,336	1,053	1,004	612	333	131	10	15	221	487	879	1,184	7,265	-15
BUTTE FAA AP	1,547	1,235	1,221	819	564	337	119	166	437	741	1,113	1,420	9,719	-24
CUT BANK FAA AP	1,513	1,193	1,184	765	477	267	82	125	368	648	1,059	1,352	9,033	-25
GLASGOW WSO AP	1,730	1,394	1,234	666	344	151	15	30	263	577	1,080	1,485	8,969	-22
GREAT FALLS WSCMO AP	1,380	1,075	1,070	648	367	162	18	42	260	524	912	1,194	7,652	-21
HAVRE WSO AP	1,646	1,316	1,197	675	358	168	21	47	292	608	1,077	1,448	8,853	-18
HELENA WSO AP	1,454	1,109	1,066	669	401	194	33	57	304	611	999	1,293	8,190	-21
KALISPELL WSO AP	1,423	1,120	1,070	690	437	249	72	126	360	698	1,029	1,280	8,554	-14
LEWISTOWN FAA AP	1,423	1,154	1,163	747	477	265	70	94	348	605	984	1,256	8,586	-22
LIVINGSTON FAA AP	1,246	1,019	1,042	681	432	215	40	53	301	551	894	1,119	7,593	-20
MILES CITY FAA AP	1,538	1,215	1,079	591	288	117	9	16	217	508	978	1,333	7,889	-20
MISSOULA WSO AP	1,370	1,058	983	633	397	201	39	71	301	648	981	1,249	7,931	-13
NEBRASKA														
CHADRON FAA AP	1,302	1,042	983	570	297	100	9	10	165	477	882	1,194	7,031	-8
GRAND ISLAND WSO AP	1,324	1,044	915	461	184	35	6	0	107	362	804	1,178	6,420	-8
LINCOLN WSO AP	1,327	1,039	884	419	166	22	0	0	83	329	780	1,169	6,218	-5
MC COOK	1,163	913	815	392	170	44	0	0	86	330	744	1,057	5,714	-6
NORFOLK WSO AP	1,429	1,151	998	500	203	37	6	11	123	397	861	1,265	6,981	-8
NORTH PLATTE WSO AP	1,290	1,033	952	522	238	65	7	8	141	439	864	1,184	6,743	-8
OMAHA (EPPLEY FIELD)	1,314	1,036	865	391	148	20	0	6	71	301	750	1,147	6,049	-8
OMAHA (NORTH) WSFO	1,389	1,106	942	456	186	33	7	10	99	342	813	1,218	6,601	
SCOTTSBLUFF WSO AP	1,243	994	952	564	280	91	0	8	160	459	864	1,159	6,774	-8
VALENTINE WSO AP	1,383	1,134	1,048	576	273	73	8	10	154	470	912	1,259	7,300	
NEVADA														
ELKO FAA AP	1,296	1,002	930	645	406	190	27	60	248	561	906	1,212	7,483	-8

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Weather Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Heating Deg Day Total	Outdoor 99% Design Temperature Degree F
ELY WSO AP	1,283	1,039	998	711	470	241	23	62	265	589	930	1,203	7,814	-10
LAS VEGAS WSO AP	645	451	324	126	10	0	0	0	0	74	357	614	2,601	25
LOVELOCK FAA AP	1,119	834	772	495	255	86	0	17	126	428	798	1,060	5,990	8
RENO WSFO AP	1,026	781	766	546	328	145	17	50	168	456	747	992	6,022	5
TONOPAH AP	1,079	851	787	512	269	92	0	13	108	407	756	1,026	5,900	5
WINNEMUCCA WSO AP	1,141	865	849	597	359	149	6	42	199	518	831	1,073	6,629	-1
NEW HAMPSHIRE														
CONCORD WSO AP	1,376	1,187	1,014	624	315	58	16	45	182	487	810	1,246	7,360	-8
MOUNT WASHINGTON	1,838	1,680	1,649	1,269	949	609	502	558	714	1,039	1,332	1,739	13,878	
NEW JERSEY														
ATLANTIC CITY WSO AP	1,001	871	741	399	131	9	0	0	35	262	570	927	4,946	10
NEWARK WSO AP	1,042	907	756	399	143	0	0	0	34	243	564	946	5,034	10
NEW MEXICO														
ALBUQUERQUE WSFO AP	924	700	595	282	58	0	0	0	7	218	615	893	4,292	12
CLAYTON WSO AP	989	809	763	431	172	38	0	0	73	324	681	927	5,207	
LAS VEGAS FAA AP	1,048	871	843	537	279	76	19	30	138	434	756	989	6,020	
TUCUMCARI 4 NE	825	650	549	242	46	0	0	0	10	177	525	784	3,808	8
NEW YORK														
ALBANY WSFO AP	1,349	1,162	980	543	253	39	9	22	135	422	762	1,212	6,888	-6
BINGHAMTON WSO AP	1,333	1,182	1,045	609	320	75	21	40	172	456	804	1,228	7,285	-2
BUFFALO WSCMO AP	1,280	1,137	1,020	603	321	58	12	33	138	419	756	1,150	6,927	2
MASSENA FAA AP	1,566	1,352	1,159	684	350	78	22	57	192	512	873	1,392	8,237	-13
N Y CENTRAL PK WSO CI	1,017	885	741	387	137	0	0	0	29	209	528	915	4,848	11
N Y KENNEDY WSO AP	1,042	918	797	453	188	9	0	0	42	247	555	933	5,184	12
N Y LAGUARDIA WSO AP	1,020	893	756	399	145	0	0	0	30	224	531	911	4,909	11
ROCHESTER WSO AP	1,271	1,126	992	567	285	46	9	26	126	398	735	1,138	6,719	1
SYRACUSE WSO AP	1,283	1,131	986	555	272	46	11	18	120	392	720	1,144	6,678	-3
NORTH CAROLINA														
ASHEVILLE WSO AP	840	717	592	279	100	14	0	0	50	269	561	815	4,237	10
CAPE HATTERAS WSO	611	538	458	188	47	0	0	0	0	76	277	536	2,731	
CHARLOTTE WSO AP	710	588	461	145	34	0	0	0	10	152	420	698	3,218	18
GREENSBORO WSO AP	815	683	544	203	59	0	0	0	24	209	501	787	3,825	14
RALEIGH-DURHAM WSFO AP	760	638	502	180	48	0	0	0	12	186	450	738	3,514	16
WILMINGTON WSO AP	586	478	354	97	7	0	0	0	0	80	288	543	2,433	23
NORTH DAKOTA														
BISMARCK WSFO AP	1,761	1,442	1,237	660	339	122	18	35	252	564	1,083	1,531	9,044	-23
DEVILS LAKE	1,885	1,565	1,345	747	396	134	22	56	291	614	1,167	1,668	9,890	-25
DICKINSON FAA AP	1,640	1,350	1,231	714	394	167	29	41	274	586	1,074	1,442	8,942	-21
FARGO WSO AP	1,832	1,520	1,265	681	334	97	13	33	234	558	1,092	1,612	9,271	-22
GRAND FORKS FAA AP	1,907	1,590	1,339	735	382	134	29	51	275	611	1,143	1,680	9,876	-26
JAMESTOWN FAA AP	1,810	1,492	1,274	711	378	127	21	39	272	589	1,116	1,593	9,422	-22
MINOT FAA AP	1,770	1,462	1,283	717	384	150	27	70	286	586	1,113	1,559	9,407	-24
WILLISTON WSO AP	1,758	1,422	1,249	678	345	135	22	35	274	598	1,107	1,538	9,161	-25
OHIO														
AKRON-CANTON WSO AP	1,200	1,044	893	495	231	33	9	16	101	369	729	1,104	6,224	1
CINCINNATI-ABBE WSO	1,020	857	692	307	118	7	0	0	37	245	612	949	4,844	1
CLEVELAND WSFO AP	1,181	1,039	896	501	244	40	9	17	95	354	702	1,076	6,154	1
COLUMBUS WSO AP	1,135	972	800	418	176	13	0	8	76	342	699	1,063	5,702	0
DAYTON WSCMO AP	1,144	969	806	413	166	13	0	7	63	307	696	1,057	5,641	1

30-Year Average Monthly Heating Degree Days at Base 65 Deg F. (1941 - 1970)

Weather Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Heating Deg Day Total	Outdoor 99% Design Temperature Degree F
MANSFIELD WSO AP	1,147	991	834	450	201	24	0	10	79	332	690	1,060	5,818	0
TOLEDO EXPRESS WSO AP	1,246	1,061	905	498	229	32	5	18	99	379	762	1,147	6,381	-3
YOUNGSTOWN WSO AP	1,218	1,072	921	519	258	42	9	22	118	384	741	1,122	6,426	-1
OKLAHOMA														
HOBART FAA AP	859	647	521	175	33	0	0	0	6	141	480	772	3,634	
MC ALESTER FAA AP	797	591	455	140	22	0	0	0	7	125	414	704	3,255	14
OKLAHOMA CITY WSFO AP	874	664	532	180	36	0	0	0	12	148	474	775	3,695	9
STILLWATER 2 W	865	644	517	174	38	0	0	0	10	146	465	772	3,631	8
TULSA WSO AP	880	666	528	176	28	0	0	0	10	143	468	781	3,680	8
OREGON														
ASTORIA WSO AP	756	599	639	516	394	255	163	151	201	378	555	688	5,295	25
EUGENE WSO AP	794	602	592	441	289	133	41	51	119	366	582	729	4,739	17
KLAMATH FALLS 2 SSW	1,094	846	812	591	386	187	42	67	186	484	789	1,032	6,516	4
MEDFORD WSO AP	880	664	626	444	250	94	11	21	89	360	645	846	4,930	19
NORTH BEND FAA AP	632	515	561	477	369	243	188	168	201	313	447	574	4,688	
PENDLETON WSO AP	1,023	731	657	423	220	70	6	13	97	384	708	908	5,240	-2
PORTLAND WSFO AP	834	622	598	432	264	128	48	56	119	347	591	753	4,792	17
REDMOND FAA AP	1,079	818	818	618	425	220	55	102	233	515	780	980	6,643	
ROSEBURG KQEN	747	571	561	411	256	115	31	33	100	319	543	698	4,385	18
SALEM WSO AP	812	619	614	456	295	133	43	53	120	366	594	747	4,852	18
SEXTON SUMMIT WSMO	946	776	843	666	481	292	97	115	179	450	714	871	6,430	
PENNSYLVANIA														
ALLENTOWN WSO AP	1,153	997	834	453	190	21	0	6	85	344	681	1,063	5,827	4
BRADFORD FAA AP	1,345	1,196	1,066	660	380	126	61	101	235	530	864	1,240	7,804	
ERIE WSO AP	1,237	1,114	995	606	336	80	24	43	141	415	747	1,113	6,851	4
HARRISBURG FAA AP	1,082	916	744	370	128	0	0	0	51	293	636	1,004	5,224	7
PHILADELPHIA WSCMO AP	1,014	871	716	367	122	0	0	0	38	249	564	924	4,865	10
PITTSBURGH WSCMO2 AP	1,144	1,000	834	444	208	26	7	16	98	372	711	1,070	5,930	1
WIL-BARRE-SRAN WSO AP	1,209	1,056	899	495	219	28	7	18	116	391	726	1,113	6,277	
WILLIAMSPORT WSO AP	1,172	1,019	853	456	195	23	0	14	96	369	705	1,079	5,981	2
RHODE ISLAND														
BLOCK ISLAND STATE AP	1,042	944	871	591	347	82	9	11	79	301	570	924	5,771	
PROVIDENCE WSO AP	1,135	997	871	531	259	36	0	10	93	350	651	1,039	5,972	5
SOUTH CAROLINA														
CHARLESTON WSO AP	521	419	300	69	5	0	0	0	0	74	271	487	2,146	24
CHARLESTON WSO CI	481	393	282	52	0	0	0	0	0	50	211	435	1,904	25
COLUMBIA WSFO AP	608	493	360	83	12	0	0	0	0	112	341	589	2,598	20
FLORENCE FAA AP	608	493	359	91	11	0	0	0	0	101	326	577	2,566	22
GRNVLE-SPARTBG WSO AP	704	577	450	144	29	0	0	0	9	145	420	685	3,163	18
SOUTH DAKOTA														
ABERDEEN WSO AP	1,721	1,397	1,172	624	303	93	12	21	202	530	1,038	1,504	8,617	-19
HURON WSO AP	1,628	1,319	1,116	576	273	72	9	13	169	482	978	1,420	8,055	-18
PIERRE FAA AP	1,531	1,249	1,091	561	267	74	6	10	152	451	936	1,349	7,677	-15
RAPID CITY WSO AP	1,336	1,098	1,048	612	319	134	13	17	191	474	888	1,194	7,324	-11
SIOUX FALLS WSFO AP	1,575	1,277	1,085	567	259	65	10	18	165	465	957	1,395	7,838	-15
WATERTOWN FAA AP	1,714	1,406	1,200	669	332	96	17	28	229	549	1,056	1,500	8,796	-19
TENNESSEE														
BRISTOL WSO AP	887	736	604	270	90	8	0	0	37	249	579	846	4,306	9
CHATTANOOGA WSO AP	769	625	483	165	51	0	0	0	9	182	483	738	3,505	13

30-Year Average Monthly Heating Degree Days at Base 65 Deg F. (1941 - 1970)

Weather Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Heating Deg Day Total	Outdoor 99% Design Temperature Degree F
KNOXVILLE WSO AP	756	630	484	173	47	0	0	0	10	175	474	729	3,478	13
MEMPHIS FAA AP	760	594	457	131	22	0	0	0	7	142	423	691	3,227	13
NASHVILLE WSO AP	828	672	524	176	45	0	0	0	10	180	498	763	3,696	9
OAK RIDGE ATDL	834	689	551	220	77	0	0	0	20	216	537	800	3,944	
TEXAS														
ABILENE WSO AP	660	479	354	104	11	0	0	0	0	89	336	577	2,610	15
ALICE	319	199	121	7	0	0	0	0	0	11	100	252	1,009	31
AMARILLO WSO AP	899	708	601	275	81	10	0	0	20	206	561	822	4,183	6
AUSTIN WSO AP	483	344	223	44	0	0	0	0	0	39	205	399	1,737	24
BROWNSVILLE WSO AP	225	151	89	0	0	0	0	0	0	5	35	145	650	35
CHILDRESS FAA AP	784	591	474	155	28	0	0	0	5	120	426	704	3,287	
COLLEGE STATION FAA AP	467	326	223	29	0	0	0	0	0	31	197	385	1,658	
CORPUS CHRISTI WSO AP	304	199	120	0	0	0	0	0	0	7	81	219	930	31
DALHART FAA AP	967	767	685	332	101	13	0	0	31	269	645	899	4,709	
DALLAS FAA AP	608	437	314	71	0	0	0	0	0	55	284	521	2,290	18
DEL RIO WSO AP	449	283	163	16	0	0	0	0	0	34	184	394	1,523	26
EL PASO WSO AP	663	465	328	89	0	0	0	0	0	92	402	639	2,678	20
GALVESTON WSO CI	365	273	187	20	0	0	0	0	0	12	105	262	1,224	31
HOUSTON WSCMO AP	416	294	189	23	0	0	0	0	0	24	155	333	1,434	27
LAREDO 2	299	177	87	0	0	0	0	0	0	8	74	231	876	32
LUBBOCK WSFO AP	803	624	508	190	29	0	0	0	8	162	486	735	3,545	10
LUFKIN FAA AP	509	371	256	56	0	0	0	0	0	52	256	440	1,940	25
LULING	482	334	215	38	0	0	0	0	0	36	189	395	1,689	
MIDLAND-ODESSA WSO AP	663	482	349	98	0	0	0	0	0	81	356	592	2,621	16
PORT ARTHUR WSO AP	420	302	202	33	0	0	0	0	0	35	184	342	1,518	27
SAN ANGELO WSO AP	577	413	287	74	0	0	0	0	0	73	298	518	2,240	18
SAN ANTONIO WSFO AP	451	310	194	31	0	0	0	0	0	32	179	373	1,570	25
VICTORIA WSO AP	372	258	159	15	0	0	0	0	0	15	123	285	1,227	29
WACO WSO AP	558	401	280	56	0	0	0	0	0	51	241	471	2,058	21
WICHITA FALLS WSO AP	729	535	409	112	13	0	0	0	0	92	369	645	2,904	14
UTAH														
CEDAR CITY FAA AP	1,125	893	825	537	281	86	0	6	114	424	786	1,060	6,137	-2
LOGAN UTAH STATE UNIV	1,271	1,011	896	543	283	114	0	8	146	449	849	1,163	6,733	-3
MILFORD WSMO	1,218	941	834	534	274	82	0	7	120	443	831	1,128	6,412	
SALT LAKE CITY NWSFO AP	1,147	885	787	474	237	88	0	5	105	402	777	1,076	5,983	3
VERNAL AIRPORT	1,516	1,168	958	585	319	136	12	33	199	546	957	1,358	7,787	-5
WENDOVER	1,166	862	741	431	168	36	0	0	86	384	792	1,094	5,760	
VERMONT														
BURLINGTON WSO AP	1,494	1,299	1,113	660	331	63	20	49	191	502	840	1,314	7,876	-12
VIRGINIA														
LYNCHBURG WSO AP	880	753	605	260	85	0	0	0	33	234	540	843	4,233	12
NORFOLK WSO AP	760	661	532	226	53	0	0	0	9	141	402	704	3,488	20
RICHMOND WSO AP	853	717	569	226	64	0	0	0	21	203	480	806	3,939	14
ROANOKE WSO AP	887	753	611	283	101	0	0	0	32	235	549	856	4,307	12
WASHINGTON														
DALLESPORT FAA AP	998	708	614	381	193	68	8	19	78	353	678	880	4,978	
OLYMPIA WSO AP	862	672	676	504	341	197	89	103	198	446	651	791	5,530	16
QUILLAYUTE WSCMO AP	815	661	710	576	434	294	194	195	246	443	627	756	5,951	
SEATTLE-TAC WSCMO AP	831	636	648	489	313	167	80	82	170	397	612	760	5,185	21

30-Year Average Monthly Heating Degree Days at Base 65 Deg F. (1941 - 1970)

Weather Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Heating Deg Day Total	Outdoor 99% Design Temperature Degree F
SPOKANE WSO AP	1,228	918	853	567	327	144	21	47	196	533	885	1,116	6,835	-6
YAKIMA WSO AP	1,163	820	719	465	239	94	20	37	147	462	798	1,045	6,009	-2
WEST VIRGINIA														
BECKLEY WSO AP	1,042	907	769	406	226	39	11	17	117	381	696	1,004	5,615	-2
CHARLESTON WSFO AP	946	798	642	287	113	10	0	0	46	267	588	893	4,590	7
ELKINS WSO AP	1,085	941	812	459	236	63	20	36	139	420	729	1,035	5,975	1
HUNTINGTON WSO AP	952	809	649	293	115	11	0	0	46	265	585	899	4,624	5
KEARNEYSVILLE WSO	1,020	868	710	358	142	11	0	0	58	307	618	967	5,059	
MARTINSBURG FAA AP	1,048	896	741	376	149	14	0	0	65	314	642	986	5,231	6
MORGANTOWN FAA AP	1,039	899	738	373	155	20	0	9	76	308	645	973	5,235	4
WISCONSIN														
ASHLAND EXP FARM	1,640	1,406	1,228	759	453	163	48	81	262	558	1,011	1,454	9,063	-21
EAU CLAIRE FAA AP	1,652	1,389	1,169	615	293	65	14	37	202	505	990	1,457	8,388	-15
FOND DU LAC	1,466	1,238	1,057	564	275	61	12	32	139	433	870	1,314	7,461	-12
GREEN BAY WSO AP	1,538	1,316	1,128	636	338	91	22	54	191	490	927	1,367	8,098	-13
LA CROSSE FAA AP	1,516	1,260	1,051	522	224	39	10	17	130	421	888	1,339	7,417	-13
MADISON WSO AP	1,494	1,252	1,079	591	297	72	14	39	173	474	909	1,336	7,730	-11
MANITOWOC	1,389	1,187	1,045	627	352	90	18	30	137	431	834	1,237	7,377	-11
MARSHFIELD EXP FARM	1,612	1,352	1,169	642	326	101	31	69	228	524	993	1,435	8,482	
MILWAUKEE WSO AP	1,414	1,190	1,042	609	348	90	15	36	140	440	855	1,265	7,444	-8
OSHKOSH	1,488	1,263	1,085	594	285	58	10	26	135	440	888	1,330	7,602	
WAUSAU FAA AP	1,631	1,392	1,190	660	333	95	22	56	227	533	996	1,451	8,586	-16
WEST BEND	1,426	1,207	1,042	585	306	70	13	33	130	425	852	1,280	7,369	
WISCONSIN RAPIDS	1,575	1,330	1,135	621	308	82	21	46	200	509	963	1,411	8,201	
WYOMING														
BIG PINEY	1,733	1,439	1,333	894	611	369	185	267	522	862	1,245	1,631	11,091	
CASPER WSO AP	1,296	1,070	1,054	669	388	147	13	17	229	536	933	1,203	7,555	-11
CHEYENNE WSFO AP	1,190	1,008	1,035	669	394	156	22	31	225	530	885	1,110	7,255	-9
CODY	1,259	1,011	995	633	378	186	32	47	269	517	906	1,153	7,386	-19
LANDER WSO AP	1,407	1,106	1,042	663	382	150	9	14	225	564	1,005	1,302	7,869	-16
LARAMIE FAA AP	1,373	1,170	1,175	816	533	258	71	100	345	673	1,038	1,287	8,839	-14
ROCK SPRINGS FAA AP	1,420	1,165	1,119	747	453	198	18	49	269	629	1,029	1,314	8,410	-9
SHERIDAN WSO AP	1,364	1,095	1,054	642	375	168	28	31	245	533	948	1,225	7,708	-14
WORLAND FAA AP	1,429	1,168	1,187	825	558	333	99	147	394	691	1,065	1,330	9,226	
US TERRITORIES														
SAN JUAN WSFO	0	0	0	0	0	0	0	0	0	0	0	0	0	
GUAM WSMO	0	0	0	0	0	0	0	0	0	0	0	0	0	
KOROR WSO	0	0	0	0	0	0	0	0	0	0	0	0	0	
KWAJALEIN MISSILE RNG	0	0	0	0	0	0	0	0	0	0	0	0	0	
MAJURO WSO AP	0	0	0	0	0	0	0	0	0	0	0	0	0	
PAGO PAGO WSO AP	0	0	0	0	0	0	0	0	0	0	0	0	0	
PONAPE WSO	0	0	0	0	0	0	0	0	0	0	0	0	0	
TRUK MOEN IS WSO AP	0	0	0	0	0	0	0	0	0	0	0	0	0	
WAKE ISLAND WSO AP	0	0	0	0	0	0	0	0	0	0	0	0	0	
YAP WSO AP	0	0	0	0	0	0	0	0	0	0	0	0	0	

30-Year Average Monthly Cooling Degree Days at Base 65 Deg F. (1941 - 1970)

Weather Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Cooling Deg Day Total	Coincident Wet Bulb Temperature Degree F
ALABAMA														
BIRMINGHAM FAA AP	9	10	26	62	190	372	462	440	273	84	0	0	1,928	94/75
HUNTSVILLE WSO AP	0	6	21	46	174	357	450	434	248	72	0	0	1,808	93/74
MOBILE WSO AP	23	29	47	127	304	459	515	512	375	160	16	10	2,577	93/77
MONTGOMERY WSO AP	14	16	35	82	237	417	496	487	330	118	6	0	2,238	95/76
MUSCLE SHOALS FAA AP	0	0	20	51	176	372	468	440	245	62	0	0	1,834	
TUSCALOOSA FAA AP	9	10	24	70	225	414	502	484	306	94	0	0	2,138	96/76
ALASKA														
ANCHORAGE WSCMO AP	0	0	0	0	0	0	0	0	0	0	0	0	0	68/58
ANNETTE WSO AP	0	0	0	0	0	6	8	0	0	0	0	0	14	
BARROW WSO AP	0	0	0	0	0	0	0	0	0	0	0	0	0	53/50
BETHEL WSO AP	0	0	0	0	0	0	0	0	0	0	0	0	0	
BETTLES FAA AP	0	0	0	0	0	6	11	0	0	0	0	0	17	
BIG DELTA FAA/AMOS AP	0	0	0	0	0	20	8	6	0	0	0	0	34	
COLD BAY WSO AP	0	0	0	0	0	0	0	0	0	0	0	0	0	
CORDOVA FAA FSS AP	0	0	0	0	0	0	0	0	0	0	0	0	0	
FAIRBANKS WSFO AP	0	0	0	0	0	31	15	6	0	0	0	0	52	78/60
GULKANA FSS/AMOS	0	0	0	0	0	9	0	0	0	0	0	0	9	
HOMER WSO AP	0	0	0	0	0	0	0	0	0	0	0	0	0	
JUNEAU AP	0	0	0	0	0	0	0	0	0	0	0	0	0	70/58
KETCHIKAN	0	0	0	0	0	6	10	6	0	0	0	0	22	
KING SALMON WSO AP	0	0	0	0	0	0	0	0	0	0	0	0	0	
KOTZEBUE WSO AP	0	0	0	0	0	0	0	0	0	0	0	0	0	
MC GRATH WSO AP	0	0	0	0	0	6	8	0	0	0	0	0	14	
NOME WSO AP	0	0	0	0	0	0	0	0	0	0	0	0	0	62/55
NORTHWAY FAA AP	0	0	0	0	0	13	6	0	0	0	0	0	19	
ST PAUL ISLAND WSO AP	0	0	0	0	0	0	0	0	0	0	0	0	0	
TALKEETNA WSCMO AP	0	0	0	0	0	6	0	0	0	0	0	0	6	
TANANA FAA AP	0	0	0	0	0	12	8	0	0	0	0	0	20	
UNALAKLEET WSO AP	0	0	0	0	0	0	0	0	0	0	0	0	0	
VALDEZ WSO	0	0	0	0	0	0	0	0	0	0	0	0	0	
WRANGELL AIRPORT	0	0	0	0	0	0	7	0	0	0	0	0	7	
YAKUTAT WSO AP	0	0	0	0	0	0	0	0	0	0	0	0	0	
ARIZONA														
FLAGSTAFF WSO AP	0	0	0	0	0	15	70	49	6	0	0	0	140	82/55
PHOENIX WSFO AP	0	14	21	141	355	588	812	747	564	240	26	0	3,508	107/71
TUCSON WSO AP	0	11	15	100	281	528	667	595	471	199	29	0	2,896	102/66
WINSLOW WSO AP	0	0	0	9	52	218	412	344	154	14	0	0	1,203	95/60
YUMA WSO AP	10	36	63	210	425	624	890	862	663	343	63	6	4,195	109/72
ARKANSAS														
EL DORADO FAA AP	0	6	27	80	219	420	530	505	306	105	6	0	2,204	96/76
FAYETTEVILLE EXP STN	0	0	13	35	110	287	422	394	181	45	0	0	1,487	94/73
FORT SMITH WSO AP	0	0	15	48	175	390	533	508	274	79	0	0	2,022	98/76
LITTLE ROCK FAA AP	0	0	14	40	169	393	508	484	254	63	0	0	1,925	96/77
CALIFORNIA														
BAKERSFIELD WSO AP	0	0	6	71	171	362	586	515	348	114	6	0	2,179	101/69
BISHOP WSO AP	0	0	0	19	58	179	360	287	119	15	0	0	1,037	
BLYTHE FAA AIRPORT	6	33	62	231	450	672	921	877	678	341	44	0	4,315	110/71
BURBANK VALLEY PMP PLT	5	10	12	30	52	123	289	301	240	99	18	0	1,179	91/68

30-Year Average Monthly Cooling Degree Days at Base 65 Deg F.
(1941 - 1970)

Weather Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Cooling Deg Day Total	Coincident Wet Bulb Temperature Degree F
DAGGETT FAA AIRPORT	0	7	14	97	241	453	691	636	426	153	11	0	2,729	
FRESNO WSO AP	0	0	0	41	125	276	484	412	267	66	0	0	1,671	100/69
IMPERIAL	9	27	52	185	388	594	825	806	633	326	64	0	3,909	
LONG BEACH WSO AP	0	7	0	16	43	92	226	260	211	107	23	0	985	80/68
LOS ANGELES WSO AP	5	7	0	9	17	56	127	154	134	83	23	0	615	80/68
LOS ANGELES CIVIC CTR	10	14	10	25	51	115	258	282	236	140	44	0	1,185	89/70
MODESTO	0	0	0	28	78	197	350	296	186	36	0	0	1,171	98/68
MOUNT SHASTA WSO CI	0	0	0	0	8	28	124	95	31	0	0	0	286	
NEEDLES FAA AIRPORT	5	23	44	204	453	699	942	877	657	299	34	0	4,237	110/71
OXNARD	0	6	0	0	0	14	74	69	53	38	10	0	264	80/64
PALM SPRINGS	10	39	54	180	338	537	800	760	576	301	86	0	3,681	110/70
RED BLUFF	0	0	0	53	139	323	536	462	309	82	0	0	1,904	
SACRAMENTO FAA AP	0	0	0	26	98	185	316	286	200	48	0	0	1,159	98/70
SALINAS FAA AP	0	0	0	0	0	7	6	16	30	15	0	0	74	70/60
SANDBERG WSMO	0	0	0	0	0	86	286	258	150	20	0	0	800	
SAN DIEGO WSO AP	10	0	0	15	26	67	149	201	163	77	14	0	722	80/69
SAN FRANCISCO WSO AP	0	0	0	0	0	18	16	22	39	13	0	0	108	77/63
SAN FRAN MISSION DOLORES	0	0	0	0	0	5	0	0	18	16	0	0	39	
SANTA BARBARA FAA AP	0	0	0	0	0	12	64	65	55	22	0	0	218	77/66
SANTA MARIA WSO AP	0	0	0	0	0	5	22	18	22	17	0	0	84	76/63
STOCKTON WSO AP	0	0	0	22	73	219	363	323	217	42	0	0	1,259	97/68
WATSONVILLE WATERWORKS	0	0	0	0	0	5	0	7	13	0	0	0	25	
COLORADO														
AKRON FAA AP	0	0	0	0	16	123	258	217	56	9	0	0	679	
ALAMOSA WSO AP	0	0	0	0	0	9	55	24	0	0	0	0	88	82/57
BURLINGTON	0	0	0	6	27	168	315	259	90	13	0	0	878	
COLORADO SPRGS WSO AP	0	0	0	0	6	91	186	140	32	6	0	0	461	88/57
DENVER WSFO AP	0	0	0	0	0	110	248	208	54	5	0	0	625	91/59
EAGLE FAA AP	0	0	0	0	0	7	71	39	0	0	0	0	117	
GRAND JUNCTION WSO AP	0	0	0	0	47	209	425	322	126	11	0	0	1,140	94/59
PUEBLO WSO AP	0	0	0	6	27	199	353	295	91	10	0	0	981	95/61
TRINIDAD FAA AP	0	0	0	0	14	145	263	213	63	7	0	0	705	91/61
CONNECTICUT														
BRIDGEPORT WSO AP	0	0	0	0	17	111	273	241	87	6	0	0	735	84/71
HARTFORD WSO AP	0	0	0	0	18	108	239	179	40	0	0	0	584	88/73
DELAWARE														
WILMINGTON WSO AP	0	0	0	0	48	196	335	282	119	12	0	0	992	89/74
DISTRICT OF COLUMBIA														
WASH DULLES WSO AP	0	0	0	0	57	188	319	267	100	9	0	0	940	
WASH NATL WSCMO AP	0	0	0	7	109	288	425	375	182	29	0	0	1,415	91/74
Florida														
APALACHICOLA WSO AP	18	32	42	129	307	450	508	512	408	202	41	14	2,663	
DAYTONA BEACH WSO AP	37	59	86	158	310	432	496	499	435	262	100	45	2,919	90/77
FORT LAUDERDALE	124	155	201	288	388	465	533	549	495	391	229	149	3,967	91/78
FORT MYERS FAA AP	81	116	156	253	394	483	543	552	498	353	176	106	3,711	92/78
JACKSONVILLE WSO AP	25	38	58	117	288	426	496	496	396	190	47	19	2,596	94/77
KEY WEST WSO AP	193	210	303	393	493	555	608	611	546	453	303	220	4,888	90/78
MELBOURNE	62	99	127	203	329	432	502	512	459	313	143	84	3,265	
MIAMI WSCMO AP	121	145	212	300	403	480	536	555	501	397	229	159	4,038	90/77

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Weather Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Cooling Deg Day Total	Coincident Wet Bulb Temperature Degree F
PENSACOLA FAA AP	27	37	53	130	316	468	521	521	399	187	24	12	2,695	93/77
TALLAHASSEE WSO AP	23	38	41	121	304	450	499	499	393	164	21	10	2,563	92/76
TAMPA WSCMO AP	60	87	121	219	378	480	524	533	474	301	125	64	3,366	91/77
WEST PALM BEACH WSO AP	98	122	174	270	388	465	524	536	495	378	202	134	3,786	91/78
GEORGIA														
ALBANY 3 SE	25	38	54	114	302	459	521	515	375	147	22	10	2,582	95/76
ALMA FAA AP	11	17	38	97	254	411	487	477	339	126	15	7	2,279	
ATHENS WSO AP	0	0	14	35	175	354	437	415	234	58	0	0	1,722	92/74
ATLANTA WSO AP	0	0	12	27	154	321	403	388	227	57	0	0	1,589	92/74
AUGUSTA WSO AP	6	8	23	54	218	396	477	453	279	76	5	0	1,995	95/76
COLUMBUS WSO AP	10	12	25	77	236	411	484	474	315	93	6	0	2,143	93/76
MACON WSO AP	10	14	35	90	269	438	508	493	324	103	10	0	2,294	93/76
SAVANNAH WSO AP	15	18	39	96	260	423	499	484	336	125	16	6	2,317	93/77
HAWAII														
HILO WSO AP 87	192	170	191	216	264	288	319	338	318	310	255	205	3,066	83/72
HONOLULU WSFO AP 703	226	204	248	294	369	417	468	487	462	431	345	270	4,221	86/73
KAHULUI WSO 398 AP	208	187	223	264	322	363	409	428	402	381	309	236	3,732	
LIHUE WSO AP 1020.1	196	176	211	249	326	375	415	437	414	381	306	233	3,719	
IDAHO														
BOISE WSFO AP	0	0	0	0	17	91	295	235	70	6	0	0	714	94/64
BURLEY FAA AP	0	0	0	0	9	42	187	134	27	0	0	0	399	95/61
IDAHO FALLS FAA AP	0	0	0	0	6	26	131	102	21	0	0	0	286	87/61
LEWISTON WSO AP	0	0	0	0	18	84	264	218	73	0	0	0	657	93/64
POCATELLO WSO AP	0	0	0	0	7	42	205	159	24	0	0	0	437	91/60
ILLINOIS														
CHICAGO O'HARE WSO AP	0	0	0	0	35	138	221	207	51	12	0	0	664	89/74
CHICAGO MIDWAY AP 3 SW	0	0	0	0	53	191	301	277	84	19	0	0	925	91/73
MOLINE WSO AP	0	0	0	0	63	194	298	255	67	16	0	0	893	91/75
MT VERNON 3 NE	0	0	10	15	118	295	403	360	167	30	0	0	1,398	92/75
PEORIA WSO AP	0	0	0	5	71	206	313	271	85	17	0	0	968	89/74
ROCKFORD WSO AP	0	0	0	0	41	149	247	218	48	11	0	0	714	89/73
SPRINGFIELD WSO AP	0	0	0	6	82	249	344	300	114	21	0	0	1,116	92/74
INDIANA														
EVANSVILLE WSO AP	0	0	11	14	117	296	397	347	157	25	0	0	1,364	93/75
FORT WAYNE WSO AP	0	0	0	0	48	158	251	207	75	9	0	0	748	89/72
INDIANAPOLIS WSFO	0	0	0	6	72	212	310	259	102	13	0	0	974	90/74
SOUTH BEND WSO AP	0	0	0	0	40	143	232	210	62	8	0	0	695	89/73
IOWA														
BURLINGTON RADIO KBUR	0	0	0	5	73	208	322	284	82	20	0	0	994	91/75
DES MOINES WSFO AP	0	0	0	0	59	191	317	270	73	18	0	0	928	91/74
DUBUQUE WSO AP	0	0	0	0	30	124	219	191	32	10	0	0	606	88/73
MARSHALLTOWN	0	0	0	0	56	173	280	238	46	14	0	0	807	90/75
MASON CITY FAA AP	0	0	0	0	30	130	208	183	21	8	0	0	580	88/74
SIOUX CITY WSO AP	0	0	0	6	62	192	324	274	65	9	0	0	932	92/74
SPENCER 1 N	0	0	0	0	37	143	234	198	23	6	0	0	641	
WATERLOO WSO AP	0	0	0	0	37	144	243	206	35	10	0	0	675	89/75
KANSAS														
CHANUTE FAA AIRPORT	0	0	8	24	125	307	456	434	192	49	0	0	1,595	97/74
CONCORDIA WSO AP	0	0	0	10	84	250	405	383	143	27	0	0	1,302	

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Weather Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Cooling Deg Day Total	Coincident Wet Bulb Temperature Degree F
DODGE CITY WSO AP	0	0	0	14	84	282	440	406	158	27	0	0	1,411	97/69
GARDEN CITY FAA AP	0	0	0	15	76	280	440	394	146	19	0	0	1,370	96/69
GOODLAND WSO AP	0	0	0	0	27	178	338	286	87	9	0	0	925	96/65
RUSSELL FAA AP	0	0	9	17	90	295	453	422	167	32	0	0	1,485	98/73
SALINA FAA AP	0	0	9	22	114	315	484	456	185	42	0	0	1,627	100/74
TOPEKA WSFO AP	0	0	8	14	103	268	409	378	151	30	0	0	1,361	96/75
WICHITA WSO AP	0	0	8	23	124	331	487	456	200	44	0	0	1,673	98/73
KENTUCKY														
BOWLING GREEN FAA AP	0	0	13	22	134	306	406	369	182	35	0	0	1,467	92/75
COVINGTON WSO AP	0	0	0	8	82	222	329	294	128	17	0	0	1,080	90/72
FRANKFORT LOCK 4	0	0	9	10	88	240	344	310	139	20	0	0	1,160	
HENDERSON 7 SSW	0	0	12	15	123	296	391	347	169	30	0	0	1,383	
LEXINGTON WSO AP	0	0	10	11	97	248	347	313	148	23	0	0	1,197	91/73
LOUISVILLE WSFO AP	0	0	10	13	99	254	369	338	158	27	0	0	1,268	93/74
LOUISIANA														
BATON ROUGE WSO AP	17	24	44	135	304	459	527	515	375	163	16	6	2,585	93/77
LAFAYETTE FAA AP	22	30	49	142	310	465	524	521	381	163	17	8	2,632	94/78
LAKE CHARLES WSO AP	21	29	54	143	316	471	539	533	402	191	33	7	2,739	93/77
MONROE FAA AP	6	9	35	98	263	453	536	518	327	115	7	0	2,367	96/76
NEW ORLEANS WSCMO AP	28	35	55	137	313	462	524	524	396	189	32	11	2,706	92/78
SHREVEPORT WSO AP	0	10	37	107	266	456	564	564	372	148	14	0	2,538	96/76
MAINE														
CARIBOU WSO AP	0	0	0	0	0	8	81	39	0	0	0	0	128	81/67
PORTLAND WSMO AP	0	0	0	0	0	22	120	99	11	0	0	0	252	84/71
WATERVILLE PMP STN	0	0	0	0	9	54	162	119	22	0	0	0	366	84/69
MARYLAND														
BALTIMORE WSO AP	0	0	0	0	70	225	360	307	132	14	0	0	1,108	91/75
BALTIMORE WSO CI	0	0	0	12	112	303	446	391	199	28	0	0	1,491	89/76
MASSACHUSETTS														
BLUE HILL	0	0	0	0	10	69	195	150	33	0	0	0	457	
BOSTON WSO AP	0	0	0	0	20	117	260	203	61	0	0	0	661	88/71
NANTUCKET FAA AP	0	0	0	0	0	21	117	113	33	0	0	0	284	
WORCESTER WSO AP	0	0	0	0	10	64	168	121	24	0	0	0	387	84/70
MICHIGAN														
ALPENA WSO AP	0	0	0	0	6	27	90	85	0	0	0	0	208	85/70
BENTON HARBOR AP	0	0	0	0	43	129	204	180	72	10	0	0	638	88/72
DETROIT METRO WSO AP	0	0	0	0	30	135	232	196	53	8	0	0	654	88/72
FLINT WSO AP	0	0	0	0	21	89	160	135	27	6	0	0	438	87/72
GRAND RAPIDS WSO AP	0	0	0	0	25	116	210	182	36	6	0	0	575	88/72
HOLLAND	0	0	0	0	32	128	210	199	59	8	0	0	636	86/71
HOUGHTON LAKE WSO AP	0	0	0	0	11	48	96	87	8	0	0	0	250	
IRON MTN-KINGSFORD WWT	0	0	0	0	9	49	109	83	0	0	0	0	250	
JACKSON FAA AP	0	0	0	0	34	127	217	186	43	7	0	0	614	88/72
KALAMAZOO STATE HOSP	0	0	0	0	50	158	249	223	64	11	0	0	755	88/72
LANSING WSO AP	0	0	0	0	26	111	192	166	34	6	0	0	535	87/72
MUSKEGON WSO AP	0	0	0	0	18	82	170	161	32	6	0	0	469	84/70
PELLSTON FAA AP	0	0	0	0	5	21	94	83	0	0	0	0	203	
SAGINAW FAA AP	0	0	0	0	17	100	184	157	29	0	0	0	487	87/72
SAULT STE MARIE WSO	0	0	0	0	0	11	59	69	0	0	0	0	139	81/69

30-Year Average Monthly Cooling Degree Days at Base 65 Deg F. (1941 - 1970)

Weather Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Cooling Deg Day Total	Coincident Wet Bulb Temperature Degree F
TRAVERSE CITY FAA AP	0	0	0	0	9	65	148	144	10	0	0	0	376	86/71
MINNESOTA														
ALEXANDRIA FAA AP	0	0	0	0	10	77	175	141	15	0	0	0	418	88/72
DULUTH WSO AP	0	0	0	0	0	14	86	76	0	0	0	0	176	82/68
GRAND RAPIDS FORESTRY	0	0	0	0	6	39	102	82	0	0	0	0	229	
INTERNL FALLS WSO AP	0	0	0	0	0	30	90	56	0	0	0	0	176	83/68
MARSHALL	0	0	0	0	27	137	247	202	35	8	0	0	656	
MINN-ST PAUL WSO AP	0	0	0	0	23	111	206	163	18	6	0	0	527	89/73
ROCHESTER WSO AP	0	0	0	0	19	108	179	147	14	7	0	0	474	87/72
ST CLOUD WSO AP	0	0	0	0	14	79	179	142	12	0	0	0	426	88/72
MISSISSIPPI														
GREENWOOD FAA AP	0	8	28	80	251	447	527	502	306	103	0	0	2,252	93/77
JACKSON WSFO AP	14	17	37	95	245	432	518	502	330	116	10	5	2,321	95/76
MERIDIAN WSO AP	14	17	37	91	236	426	502	487	309	105	7	0	2,231	95/76
TUPELO WSO AP	0	0	22	64	217	414	508	487	281	85	0	0	2,078	94/77
UNIVERSITY	0	10	29	63	184	372	471	450	266	98	0	0	1,943	
MISSOURI														
COLUMBIA WSO AP	0	0	8	14	98	251	381	346	141	30	0	0	1,269	94/74
JOPLIN FAA AP	0	0	12	35	129	323	462	439	208	62	0	0	1,670	97/73
KANSAS CITY WSO AP	0	0	7	14	111	279	428	388	156	37	0	0	1,420	96/74
ST LOUIS WSCMO AP	0	0	9	17	128	307	422	378	173	41	0	0	1,475	94/75
SEDALIA WATER PLANT	0	0	12	22	128	293	428	391	173	45	0	0	1,492	92/76
SPRINGFIELD WSO AP	0	0	9	20	98	268	401	381	164	41	0	0	1,382	93/74
MONTANA														
BILLINGS WSO AP	0	0	0	0	8	59	220	173	38	0	0	0	498	91/64
BUTTE FAA AP	0	0	0	0	0	0	32	21	5	0	0	0	58	83/56
CUT BANK FAA AP	0	0	0	0	0	12	64	50	14	0	0	0	140	85/61
GLASGOW WSO AP	0	0	0	0	9	61	185	154	29	0	0	0	438	89/63
GREAT FALLS WSCMO AP	0	0	0	0	0	36	151	116	29	7	0	0	339	88/60
HAVRE WSO AP	0	0	0	0	0	45	158	121	22	0	0	0	346	90/64
HELENA WSO AP	0	0	0	0	0	20	123	94	19	0	0	0	256	88/60
KALISPELL WSO AP	0	0	0	0	0	9	51	48	9	0	0	0	117	87/61
LEWISTOWN FAA AP	0	0	0	0	0	13	86	75	18	0	0	0	192	87/61
LIVINGSTON FAA AP	0	0	0	0	7	17	120	87	25	6	0	0	255	87/60
MILES CITY FAA AP	0	0	0	0	19	114	301	248	64	6	0	0	752	95/66
MISSOULA WSO AP	0	0	0	0	0	18	89	71	10	0	0	0	188	88/61
NEBRASKA														
CHADRON FAA AP	0	0	0	0	15	112	288	252	54	5	0	0	726	94/65
GRAND ISLAND WSO AP	0	0	0	8	51	206	356	315	89	11	0	0	1,036	94/71
LINCOLN WSO AP	0	0	0	8	73	232	386	333	101	15	0	0	1,148	95/74
MC COOK	0	0	0	11	77	230	382	335	122	20	0	0	1,177	95/69
NORFOLK WSO AP	0	0	0	0	48	184	331	283	69	10	0	0	925	93/74
NORTH PLATTE WSO AP	0	0	0	6	30	155	295	256	60	0	0	0	802	94/69
OMAHA (EPPLEY FIELD)	0	0	0	10	86	236	378	334	110	19	0	0	1,173	91/75
OMAHA (NORTH) WSFO	0	0	0	6	59	189	320	280	81	14	0	0	949	
SCOTTSBLUFF WSO AP	0	0	0	0	16	118	273	213	46	0	0	0	666	92/65
VALENTINE WSO AP	0	0	0	0	22	130	291	242	46	5	0	0	736	
NEVADA														
ELKO FAA AP	0	0	0	0	0	28	166	122	26	0	0	0	342	92/59

Weather Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Cooling Deg Day Total	Coincident Wet Bulb Temperature Degree F
					30-Year Average Monthly Cooling Degree Days at Base 65 Deg F. (1941 - 1970)									
ELY WSO AP	0	0	0	0	0	22	92	77	16	0	0	0	207	87/56
LAS VEGAS WSO AP	0	6	8	90	268	519	763	694	453	139	6	0	2,946	106/65
LOVELOCK FAA AP	0	0	0	0	23	104	288	212	57	0	0	0	684	96/63
RENO WSFO AP	0	0	0	0	6	40	150	109	24	0	0	0	329	92/60
TONOPAH AP	0	0	0	0	18	101	251	190	63	8	0	0	631	92/59
WINNEMUCCA WSO AP	0	0	0	0	11	50	192	129	25	0	0	0	407	94/60
NEW HAMPSHIRE														
CONCORD WSO AP	0	0	0	0	8	49	162	113	17	0	0	0	349	87/70
MOUNT WASHINGTON	0	0	0	0	0	0	0	0	0	0	0	0	0	
NEW JERSEY														
ATLANTIC CITY WSO AP	0	0	0	0	25	168	313	260	98	0	0	0	864	89/74
NEWARK WSO AP	0	0	0	0	47	197	353	298	118	11	0	0	1,024	91/73
NEW MEXICO														
ALBUQUERQUE WSFO AP	0	0	0	6	67	291	425	360	160	7	0	0	1,316	94/61
CLAYTON WSO AP	0	0	0	0	17	164	271	234	73	8	0	0	767	
LAS VEGAS FAA AP	0	0	0	0	0	64	121	86	12	0	0	0	283	
TUCUMCARI 4 NE	0	0	0	20	84	313	425	378	172	22	0	0	1,414	97/66
NEW YORK														
ALBANY WSFO AP	0	0	0	0	27	114	226	165	42	0	0	0	574	88/72
BINGHAMTON WSO AP	0	0	0	0	13	69	148	111	28	0	0	0	369	83/69
BUFFALO WSCMO AP	0	0	0	0	14	79	170	138	36	0	0	0	437	85/70
MASSENA FAA AP	0	0	0	0	12	57	146	110	18	0	0	0	343	83/69
N Y CENTRAL PK WSO CI	0	0	0	0	54	202	360	307	131	14	0	0	1,068	89/73
N Y KENNEDY WSO AP	0	0	0	0	27	144	313	267	102	8	0	0	861	87/72
N Y LAGUARDIA WSO AP	0	0	0	0	46	199	363	307	123	10	0	0	1,048	89/73
ROCHESTER WSO AP	0	0	0	0	22	103	202	159	45	0	0	0	531	88/71
SYRACUSE WSO AP	0	0	0	0	18	103	212	164	54	0	0	0	551	87/71
NORTH CAROLINA														
ASHEVILLE WSO AP	0	0	0	6	60	182	264	244	101	15	0	0	872	87/72
CAPE HATTERAS WSO	0	0	12	5	109	283	403	388	261	82	7	0	1,550	
CHARLOTTE WSO AP	0	0	15	19	152	327	419	394	220	50	0	0	1,596	93/74
GREENSBORO WSO AP	0	0	11	11	124	282	378	341	165	29	0	0	1,341	91/73
RALEIGH-DURHAM WSFO AP	0	0	12	15	123	282	388	357	180	37	0	0	1,394	92/75
WILMINGTON WSO AP	9	0	22	46	199	375	477	450	291	89	6	0	1,964	91/78
NORTH DAKOTA														
BISMARCK WSFO AP	0	0	0	0	11	86	198	165	27	0	0	0	487	91/68
DEVILS LAKE	0	0	0	0	5	59	143	128	15	0	0	0	350	88/68
DICKINSON FAA AP	0	0	0	0	7	62	162	140	22	6	0	0	399	90/66
FARGO WSO AP	0	0	0	0	11	88	190	163	21	0	0	0	473	89/71
GRAND FORKS FAA AP	0	0	0	0	10	80	157	126	11	0	0	0	384	87/70
JAMESTOWN FAA AP	0	0	0	0	6	67	154	132	17	0	0	0	376	90/69
MINOT FAA AP	0	0	0	0	6	60	144	138	22	0	0	0	370	89/67
WILLISTON WSO AP	0	0	0	0	7	66	180	144	25	0	0	0	422	88/67
OHIO														
AKRON-CANTON WSO AP	0	0	0	0	36	132	217	181	62	6	0	0	634	86/71
CINCINNATI-ABBE WSO	0	0	7	10	100	250	347	313	139	22	0	0	1,188	90/72
CLEVELAND WSFO AP	0	0	0	0	37	127	208	172	62	7	0	0	613	88/72
COLUMBUS WSO AP	0	0	0	0	55	175	267	222	82	8	0	0	809	90/73
DAYTON WSCMO AP	0	0	0	5	61	202	298	255	102	13	0	0	936	89/72

30-Year Average Monthly Cooling Degree Days at Base 65 Deg F. (1941 - 1970)

Weather Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Cooling Deg Day Total	Coincident Wet Bulb Temperature Degree F
MANSFIELD WSO AP	0	0	0	0	52	168	267	230	91	10	0	0	818	87/72
TOLEDO EXPRESS WSO AP	0	0	0	0	37	149	231	198	63	7	0	0	685	88/73
YOUNGSTOWN WSO AP	0	0	0	0	29	102	185	153	49	0	0	0	518	86/71
OKLAHOMA														
HOBART FAA AP	0	0	9	43	161	411	564	546	270	70	0	0	2,074	
MC ALESTER FAA AP	0	0	15	66	171	393	543	533	289	97	0	0	2,106	96/74
OKLAHOMA CITY WSFO AP	0	0	11	42	138	354	512	499	252	68	0	0	1,876	97/74
STILLWATER 2 W	0	0	15	57	149	363	521	505	256	81	0	0	1,947	96/74
TULSA WSO AP	0	0	10	50	145	369	530	508	259	78	0	0	1,949	98/75
OREGON														
ASTORIA WSO AP	0	0	0	0	0	0	8	5	0	0	0	0	13	71/62
EUGENE WSO AP	0	0	0	0	0	25	100	85	29	0	0	0	239	89/66
KLAMATH FALLS 2 SSW	0	0	0	0	7	22	132	95	30	0	0	0	286	87/60
MEDFORD WSO AP	0	0	0	0	11	73	218	189	71	0	0	0	562	94/67
NORTH BEND FAA AP	0	0	0	0	0	0	0	0	0	0	0	0	0	
PENDLETON WSO AP	0	0	0	0	18	88	269	214	67	0	0	0	656	93/64
PORTLAND WSFO AP	0	0	0	0	7	38	114	106	35	0	0	0	300	85/67
REDMOND FAA AP	0	0	0	0	0	16	76	64	14	0	0	0	170	
ROSEBURG KQEN	0	0	0	0	0	37	130	123	52	0	0	0	342	90/66
SALEM WSO AP	0	0	0	0	7	19	92	87	27	0	0	0	232	88/66
SEXTON SUMMIT WSMO	0	0	0	0	0	7	53	57	20	0	0	0	137	
PENNSYLVANIA														
ALLENTOWN WSO AP	0	0	0	0	38	156	282	214	76	6	0	0	772	88/72
BRADFORD FAA AP	0	0	0	0	8	30	64	58	10	0	0	0	170	
ERIE WSO AP	0	0	0	0	13	68	139	120	33	0	0	0	373	85/72
HARRISBURG FAA AP	0	0	0	0	69	214	344	279	111	8	0	0	1,025	91/74
PHILADELPHIA WSCMO AP	0	0	0	0	67	223	366	304	131	13	0	0	1,104	90/74
PITTSBURGH WSCMO2 AP	0	0	0	0	46	134	221	177	62	7	0	0	647	86/71
WIL-BARRE-SRAN WSO AP	0	0	0	0	30	115	230	173	53	7	0	0	608	
WILLIAMSPORT WSO AP	0	0	0	0	43	137	249	197	66	6	0	0	698	89/72
RHODE ISLAND														
BLOCK ISLAND STATE AP	0	0	0	0	0	25	149	142	43	0	0	0	359	
PROVIDENCE WSO AP	0	0	0	0	8	78	224	177	45	0	0	0	532	86/72
SOUTH CAROLINA														
CHARLESTON WSO AP	12	13	36	57	225	387	471	453	306	108	10	0	2,078	91/78
CHARLESTON WSO CI	16	15	37	76	263	426	508	493	348	143	22	7	2,354	92/78
COLUMBIA WSFO AP	0	5	25	56	233	414	502	471	289	87	5	0	2,087	95/75
FLORENCE FAA AP	7	6	25	49	212	384	474	443	273	79	0	0	1,952	92/77
GRNVLE-SPARTBG WSO AP	0	0	13	24	156	327	412	388	210	43	0	0	1,573	91/74
SOUTH DAKOTA														
ABERDEEN WSO AP	0	0	0	0	15	105	223	195	28	0	0	0	566	91/72
HURON WSO AP	0	0	0	0	25	135	278	233	40	5	0	0	716	93/72
PIERRE FAA AP	0	0	0	0	31	146	322	286	65	8	0	0	858	95/71
RAPID CITY WSO AP	0	0	0	0	15	110	249	222	56	9	0	0	661	92/65
SIOUX FALLS WSFO AP	0	0	0	0	32	143	267	229	42	6	0	0	719	91/72
WATERTOWN FAA AP	0	0	0	0	13	87	194	161	22	0	0	0	477	91/72
TENNESSEE														
BRISTOL WSO AP	0	0	9	9	87	230	316	285	142	29	0	0	1,107	89/72
CHATTANOOGA WSO AP	0	6	12	30	159	330	428	403	216	52	0	0	1,636	93/74

30-Year Average Monthly Cooling Degree Days at Base 65 Deg F. (1941 - 1970)

Weather Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Cooling Deg Day Total	Coincident Wet Bulb Temperature Degree F
KNOXVILLE WSO AP	0	8	16	32	152	315	409	381	208	48	0	0	1,569	92/73
MEMPHIS FAA AP	0	0	23	56	205	408	515	477	265	80	0	0	2,029	95/76
NASHVILLE WSO AP	0	0	19	29	153	348	453	419	220	53	0	0	1,694	94/74
OAK RIDGE ATDL	0	0	12	22	129	281	372	344	173	34	0	0	1,367	
TEXAS														
ABILENE WSO AP	0	0	29	110	240	459	586	577	333	123	9	0	2,466	99/71
ALICE	31	47	121	265	422	562	639	642	492	284	88	38	3,621	98/77
AMARILLO WSO AP	0	0	0	20	99	298	425	391	164	36	0	0	1,433	98/67
AUSTIN WSO AP	8	16	52	152	316	498	608	611	417	197	28	5	2,908	98/74
BROWNSVILLE WSO AP	79	106	173	297	443	534	601	601	498	337	128	77	3,874	93/77
CHILDRESS FAA AP	0	0	16	65	192	426	564	549	284	77	0	0	2,173	
COLLEGE STATION FAA AP	9	15	53	137	316	492	601	611	417	189	29	7	2,876	
CORPUS CHRISTI WSO AP	34	48	117	238	400	522	614	623	480	283	78	37	3,474	94/78
DALHART FAA AP	0	0	0	8	55	253	384	338	121	14	0	0	1,173	
DALLAS FAA AP	0	0	29	113	273	498	642	645	396	148	11	0	2,755	100/75
DEL RIO WSO AP	8	22	88	226	409	579	673	654	456	226	22	0	3,363	98/73
EL PASO WSO AP	0	0	6	56	223	459	536	481	276	61	0	0	2,098	98/64
GALVESTON WSO CI	20	27	63	146	338	489	564	567	450	263	60	17	3,004	89/79
HOUSTON WSCMO AP	16	22	59	155	335	483	567	570	426	207	38	11	2,889	94/77
LAREDO 2	36	62	168	339	505	630	710	704	537	334	80	32	4,137	101/73
LUBBOCK WSFO AP	0	0	9	40	138	363	456	415	188	38	0	0	1,647	96/69
LUFKIN FAA AP	7	13	39	125	282	459	558	561	375	151	22	0	2,592	97/76
LULING	7	12	51	152	326	501	598	614	426	198	21	7	2,913	
MIDLAND-ODESSA WSO AP	0	0	17	77	230	447	536	521	312	105	5	0	2,250	98/69
PORT ARTHUR WSO AP	17	25	51	150	310	474	558	561	417	187	40	8	2,798	93/78
SAN ANGELO WSO AP	0	0	42	140	298	498	611	605	354	141	13	0	2,702	99/71
SAN ANTONIO WSFO AP	8	16	64	169	341	516	611	611	429	202	20	7	2,994	97/73
VICTORIA WSO AP	16	28	76	186	360	510	601	605	453	239	51	15	3,140	96/77
WACO WSO AP	0	6	38	125	295	507	639	642	417	178	16	0	2,863	99/75
WICHITA FALLS WSO AP	0	0	22	91	239	489	645	636	360	123	6	0	2,611	101/73
UTAH														
CEDAR CITY FAA AP	0	0	0	0	8	66	254	201	60	6	0	0	615	91/60
LOGAN UTAH STATE UNIV	0	0	0	0	13	57	245	207	56	6	0	0	584	91/61
MILFORD WSMO	0	0	0	0	10	88	288	242	60	0	0	0	688	
SALT LAKE CITY NWSFO AP	0	0	0	0	30	124	363	300	99	11	0	0	927	95/62
VERNAL AIRPORT	0	0	0	0	6	52	155	113	16	0	0	0	342	89/60
WENDOVER	0	0	0	5	37	162	443	363	122	5	0	0	1,137	
VERMONT														
BURLINGTON WSO AP	0	0	0	0	15	69	169	123	20	0	0	0	396	85/70
VIRGINIA														
LYNCHBURG WSO AP	0	0	0	8	91	232	335	291	126	17	0	0	1,100	90/74
NORFOLK WSO AP	0	0	8	10	106	285	412	369	213	38	0	0	1,441	91/76
RICHMOND WSO AP	0	0	8	10	111	276	400	350	171	27	0	0	1,353	92/76
ROANOKE WSO AP	0	0	0	10	83	205	316	282	122	12	0	0	1,030	91/72
WASHINGTON														
DALLESPORT FAA AP	0	0	0	0	35	104	237	224	87	0	0	0	687	
OLYMPIA WSO AP	0	0	0	0	0	14	46	35	6	0	0	0	101	83/65
QUILLAYUTE WSCMO AP	0	0	0	0	0	0	8	0	0	0	0	0	8	
SEATTLE-TAC WSCMO AP	0	0	0	0	0	11	65	45	8	0	0	0	129	80/64

30-Year Average Monthly Cooling Degree Days at Base 65 Deg F.
(1941 - 1970)

Weather Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Cooling Deg Day Total	Coincident Wet Bulb Temperature Degree F
SPOKANE WSO AP	0	0	0	0	8	39	167	140	34	0	0	0	388	90/63
YAKIMA WSO AP	0	0	0	0	19	79	197	148	36	0	0	0	479	93/65
WEST VIRGINIA														
BECKLEY WSO AP	0	0	0	0	24	108	166	135	51	6	0	0	490	81/69
CHARLESTON WSFO AP	0	0	7	14	97	220	310	267	121	19	0	0	1,055	90/73
ELKINS WSO AP	0	0	0	0	25	84	135	111	34	0	0	0	389	84/70
HUNTINGTON WSO AP	0	0	7	14	99	233	319	279	127	20	0	0	1,098	91/74
KEARNEYSVILLE WSO	0	0	0	0	65	182	304	250	94	10	0	0	905	
MARTINSBURG FAA AP	0	0	0	0	66	188	310	257	95	7	0	0	922	90/74
MORGANTOWN FAA AP	0	0	0	7	68	179	256	217	94	13	0	0	833	87/73
WISCONSIN														
ASHLAND EXP FARM	0	0	0	0	0	25	107	93	0	0	0	0	225	82/68
EAU CLAIRE FAA AP	0	0	0	0	20	98	185	143	13	0	0	0	459	89/73
FOND DU LAC	0	0	0	0	24	109	195	171	19	8	0	0	526	86/72
GREEN BAY WSO AP	0	0	0	0	12	76	152	138	8	0	0	0	386	85/72
LA CROSSE FAA AP	0	0	0	0	38	144	252	215	34	12	0	0	695	88/73
MADISON WSO AP	0	0	0	0	18	96	172	154	14	6	0	0	460	88/73
MANITOWOC	0	0	0	0	0	63	173	166	14	0	0	0	416	86/72
MARSHFIELD EXP FARM	0	0	0	0	13	71	130	116	6	0	0	0	336	
MILWAUKEE WSO AP	0	0	0	0	13	75	167	166	23	6	0	0	450	87/73
OSHKOSH	0	0	0	0	22	109	205	181	21	9	0	0	547	
WAUSAU FAA AP	0	0	0	0	11	80	143	121	0	0	0	0	355	88/72
WEST BEND	0	0	0	0	21	97	184	175	25	7	0	0	509	
WISCONSIN RAPIDS	0	0	0	0	20	97	170	146	11	7	0	0	451	
WYOMING														
BIG PINEY	0	0	0	0	0	0	9	0	0	0	0	0	9	
CASPER WSO AP	0	0	0	0	6	54	199	159	40	0	0	0	458	90/57
CHEYENNE WSFO AP	0	0	0	0	0	45	149	112	21	0	0	0	327	86/58
CODY	0	0	0	0	9	57	168	134	35	5	0	0	408	86/60
LANDER WSO AP	0	0	0	0	0	36	182	138	27	0	0	0	383	88/61
LARAMIE FAA AP	0	0	0	0	0	9	49	26	6	0	0	0	90	81/56
ROCK SPRINGS FAA AP	0	0	0	0	0	15	117	84	11	0	0	0	227	84/55
SHERIDAN WSO AP	0	0	0	0	7	51	195	161	32	0	0	0	446	91/62
WORLAND FAA AP	0	0	0	0	0	6	34	29	7	0	0	0	76	
US TERRITORIES														
SAN JUAN WSFO	322	288	350	375	440	465	493	505	483	484	411	366	4,982	
GUAM WSMO	381	344	394	420	446	444	446	437	423	431	426	419	5,011	
KOROR WSO	502	440	499	507	527	498	499	502	498	524	507	505	6,008	
KWAJALEIN MISSILE RNG	502	459	518	504	521	507	530	543	525	539	501	515	6,164	
MAJURO WSO AP	490	454	502	483	505	480	496	512	492	505	486	499	5,904	
PAGO PAGO WSO AP	474	434	477	468	450	423	412	409	420	446	447	465	5,325	
PONAPE WSO	484	440	490	471	487	465	465	468	468	471	459	484	5,652	
TRUK MOEN IS WSO AP	496	451	505	489	505	489	487	493	480	499	489	505	5,888	
WAKE ISLAND WSO AP	372	336	394	399	459	495	527	546	528	515	462	422	5,455	
YAP WSO AP	477	434	496	501	521	501	502	496	489	508	495	496	5,916	