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MONTEREY, CALIFORNIA

THESIS

**AN ALTERNATIVE UTILITY FUNDING MODEL FOR
THE DEPARTMENT OF THE ARMY**

by

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March 2019

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**AN ALTERNATIVE UTILITY FUNDING MODEL FOR THE DEPARTMENT
OF THE ARMY**

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Submitted in partial fulfillment of the
requirements for the degree of

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from the

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ABSTRACT

This thesis examines the development of a requirements-based utility funding model for the U.S. Army. The inputs to the model would be real property information such as building category codes, square footage, and climate zone information. Using industry-accepted energy use intensity (EUI) standards, the model would provide energy usage levels. Using local energy cost information, the model would provide utility budgets for each building or for an entire garrison. Through the use of an objective funding model as opposed to using historical usages and costs, Army leadership could make better decisions, incentivize savings more directly, and hold facility managers more accountable. Additionally, the model could allow energy savings to be retained by those garrisons that achieve savings instead of those garrisons simply receiving less funding in future years.

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LIST OF ACRONYMS AND ABBREVIATIONS

ACSIM	Assistant Chief of Staff Installation Management
AEWRS	Army Energy & Water Reporting System
ASHRAE	American Society of Heating, Refrigeration, & Air-conditioning Engineers
BOS	Base Operations Support
BRM	Budget Requirements Model
CATCD	Category Code
CBECS	Commercial Building Energy Consumption Survey
CERL	Construction Engineering Research Laboratory
DLA	Defense Logistics Agency
DOD	Department of Defense
EISA	Energy Independence Security Act
EPACT	Energy Policy Act
ESPC	Energy Savings Performance Contract
EUI	Energy Use Intensity
FY	Fiscal Year
GFEBs	General Fund Enterprise Business System
HQDA	Headquarters Department of the Army
HVAC	Heating Ventilation & Air Conditioning
IMCOM	Installation Management Command
kBtu	kilo British Thermal Units
LEED	Leadership in Energy and Environmental Design
MDEP	Management Decision Execution Package
MWh	Mega-Watt Hour
MMBtu	Million British Thermal Unit
NZP	Net Zero Planner
OMA	Operations & Maintenance Army
ORNL	Oak Ridge National Lab
PG&E	Pacific Gas & Electric
POM	Presidio of Monterey

PPA	Power Purchase Agreement
PV	Photo-voltaic
QDPW	Cost code for Directorate of Public Works
QUTM	Cost code for Utilities and Energy Management
QUTS	Cost code for Utilities Commodities
RECS	Residential Energy Consumption Survey
SAG	Sub Activity Group
SATCOM	Satellite Command
SDD	Sustainable Design & Development
SRM	Sustainment, Restoration & Modernization
UEPH	Unaccompanied Enlisted Personnel Housing
UESC	Utility Energy Service Contract
USC	United States Code

EXECUTIVE SUMMARY

The origin of this thesis was the goal of developing a process to reward garrisons that saved energy by allowing them to retain funding. As an Army installation energy manager for the past eight years, I was tasked with saving energy by implementing projects, refining existing systems, or enacting human behavior campaigns. During those years, I had numerous discussions with multiple garrison commanders and budget staff and saw genuine support for energy savings. However, it was clear that a key lever for getting things done at a garrison was money, and the existing utilities-funding process did not provide effective incentives. Primarily, there was no clear way to retain the saved costs. Even worse, the garrison was penalized by receiving lower funding the next year.

After more research, the objective of the thesis shifted to a broader and more proactive approach of funding utilities which could address more foundational issues. Despite an increased percentage of onsite power from renewables or cogeneration, the vast majority of energy still comes from traditional sources, either produced on-site or bought from utility companies providing power as a commodity. Therefore, funding of utilities could be a key lever, as a carrot or a stick, to further the goals of energy and cost savings. But due to the current method of utility funding, that lever does not exist. Unlike most of a garrison's annual budget request, utility commodity costs are not based on quantitative requirements. Instead, the utility budget of a garrison is based simply on prior years' costs, plus an escalation factor. In addition, since utilities are a "must fund," there is very little questioning of any overruns above the budgeted amount. This removes any incentive to delve into cost drivers or look for better business practices. So, the challenge of this thesis is to develop a requirements-based model for funding garrisons' utilities. The basic idea is quite simple: use real property information (facility square footage, construction type, category code, and age), geographical climate data, and regional energy rates to produce a utility budget.

The proposed process would still accomplish the goal of letting garrisons retain funding but would do so within a broader perspective that would also push for energy and cost savings from a programmatic standpoint. It my assertion that shifting the funding

method from a backward-looking, historical approach to a requirements-driven method may fundamentally change the paradigm for energy decision-making at garrisons. In essence, the approach would go from “how much did it cost?” to “how much *should* it cost?” This thesis develops a model and methodology for how this process could be established.

The basic idea is to build a utility-funding model based on real property data, including square footage and building data such as age and category code, and climate data. This will be coupled with the Army’s Sustainable Design and Development Policy, which has energy utility intensities (EUI) per facility Category Code (CATCD) to develop an energy profile of an installation. This will be combined with regional energy-cost data to develop a “should cost” utility budget. By changing the budget model to a requirements-driven model, the same kind of scrutiny that currently exists for custodial contracts, grounds maintenance, and other service contracts would become standard for utility-funding outlays.

The objective is to show a proof of concept of a model that could be implemented. While this thesis shows only one garrison (the Presidio of Monterey [POM]), the process could be used across the Army. It is unlikely that most garrisons are using less energy, and requiring less utility funding, than is possible if systems were running efficiently. This study includes a discussion of how to implement the proposed alternative utility funding process for the Army. Challenges and opportunities are reviewed, and the study provides conclusions and recommendations on how to move the process forward. The proposed process would be a transparent budgeting approach to funding utilities based on the actual facilities within that garrison.

The potential benefits of a requirements-based model are numerous, namely an objective target budget, based on actual real-property assets instead of a budget based on just historical usage. This target budget would allow a comparison of what garrisons spend versus what they *should* spend, which could lead to greater accountability for usage. A detailed model could highlight which category codes or even which specific buildings are outside the expected range. By holding garrisons accountable to deviations from the target

budget, this requirements-based model would encourage conservation and may allow garrisons to retain funding for what they save.

In fact, this model could assist with a long-standing goal for the Army: In December of 2010 the Department of the Army Headquarters (HQDA) issued Letter 420-10-1 (referencing 10 USC 2912 among other documents) with the subject line “Identifying, Retaining, and Using Energy Savings at Army Installations.” The letter’s purpose statement reads: “This letter prescribes Army’s policy and procedures for identifying savings from an installation’s conservation efforts, for retaining those savings within an extended year account, and for using the savings captured in this account. This policy will be incorporated into the next revision of the AR 420-1, chapter 22” (Casey, 2010). The letter expired in December of 2012 following the August 2012 revision of the AR 420-1. That revision had no revised policy on retained energy savings. There was no follow-on guidance or explanation of why the letter was allowed to expire without defining a process. Changing from a backward-looking process to a requirements-based approach could provide a way forward on this goal.

There are challenges with this approach, namely building an accurate model. This thesis includes a conceptual model, done simply in Microsoft Excel. It is meant to serve as a proof of concept, from which a more sophisticated model could be built. The model has three main components: Army building categories with their associated EUIs for the climate zone of the Presidio; real property data (building types, age, and square footage) and energy and cost data for these buildings; and the combining of the first two components to develop projected energy usage and costs for the facilities at the Presidio. The results of the model yielded a budget significantly lower than what was actual spent. This means that either the model was too aggressive, the base did not perform as well as it should have, or some combination of the two. Looking at a building by building comparison of projected versus actual, most of the facilities are not performing nearly as well as they need to. The positive take-away from this is that we can begin to develop a clear picture of how the individual facilities perform and how that aggregates to an overall garrison energy usage.

If a requirement-based model was developed, it would not be advised to simply toss out the current system. Instead, the recommendation would be to run the current system

alongside a requirements-based model for a few years to see how they compare and to alert garrisons of how they are doing. This would phase the program in slowly to avoid pushback from the negatively affected Army installations.

Reference

Casey, G. (December 13, 2010). *Identifying, retaining, and using energy savings at army installations*. [Letter]. Washington, DC: Department of the Army.

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I. INTRODUCTION

This thesis is an analysis of the current utility funding process within the U.S. Army's Installation Management Command (IMCOM) and the impact that process has on utility costs, energy-conservation programs, and the ability to retain energy cost savings. It proposes an alternative method to fund utilities at Army installations more appropriately for their real property portfolio and could allow garrisons to retain energy cost savings. While existing Army policies mandate reductions in energy intensity, measured in energy consumption per square foot (Executive Order No. 13693, 2015), the utilities budgeting methodology does not actually encourage garrison commanders to reduce energy costs. Additionally, energy intensity, the metric used to track progress, can fluctuate widely based on factors outside the control of local garrison commanders, namely, square-footage allocations. Together, these factors are stifling the Army's overall progress toward its stated energy-conservation goals and toward true energy cost savings. This thesis aims to demonstrate an alternative that would overcome these factors.

A. BACKGROUND

As in the rest of society, energy supports everything the Army does. Without it, lights would go out, communications would cease, and operations would grind to a halt. Therefore, the funding of utilities such as electricity and natural gas is foundational to the mission of the Army. In fact, the funding of these utilities is such a given that it is called a "must-fund" in the budget (Valine, 2017). But, as will be seen in this thesis, the development of the funding model relies almost totally on prior year costs instead of a forward-looking model.

1. Energy Significance

The U.S. Army spends over \$1 billion (B) on utilities every year at their installations around the world, including payments for electricity, natural gas, coal, water, and, to a lesser degree, other utility commodities such as propane (S. Mandes, email to author, April 3, 2018). Over the past decade, there has been a strong push in the Army to reduce energy intensity at Army installations. Additionally, the Army, along with all

federal entities, is mandated by various policies to reduce energy intensity of its facilities (Executive Order No. 13693, 2015). The primary strategy used by the Army has been to implement energy-conservation measures and renewable-energy projects to reduce energy intensity. In addition to specified energy-intensity-reduction goals, there is also a desire for cost savings (Installation Management Command [IMCOM], 2018), although with no corresponding mandates. Additionally, climate change has been identified as a security threat due to sea-level rise, mass migrations, and possible geopolitical instability (Office of the Under Secretary of Defense [OUSD], 2015). Based on a broad consensus of the benefits of energy savings, it is likely that there will be continued pressure to reduce energy usage. The premise of this thesis is that the proposed budgetary method used by the Army, may be an effective way to induce energy and cost savings.

2. Federal Legislation and Executive Orders

There has been an abundance of federal legislation and executive guidance regarding energy conservation over the past 20 years, most significantly the Energy Policy Act of 2005, the Energy Independence Security Act of 2007, and Executive Orders 13423 (2007) and 13693 (2015). Much of this legislation deals with energy-reduction goals and renewable-energy production. While these laws specify energy-intensity-reduction goals, they do not require cost-saving reductions. A deeper analysis of the legislation will be provided in the literature review of this paper.

3. Army Regulations and Guidance

Federal legislation and executive orders flow down to the Department of Defense, resulting in Army regulations and guidance. Among many memoranda, guidance letters, and directives on energy reductions, from various levels of Army leadership, two documents are most relevant for this thesis: The Department of the Army Headquarters (HQDA) Letter of December 2010 and the 2017 Sustainable Design and Development (SDD) Policy Memo. Both of these documents are summarized in the Literature Review section of this thesis.

4. Energy Savings Metrics

The primary metric used by the federal government, and therefore the Army, is Energy Use Intensity (EUI) (Energy Independence Security Act [EISA], 2007). EUI is a measure of energy per facility area, typically in kilo-British thermal units (kBtu) per square foot. The rationale for EUI instead of total energy consumption is likely to provide a relative metric not dependent on required facility expansion or reduction. Like any metric, EUI poses challenges and has ways to be manipulated. While garrisons must report their energy usage (the numerator) each year, they have little control over their square footage (the denominator) because it is loaded from a central database. Base Realignment and Closure (BRAC) can cause the denominator of this metric to fluctuate from year to year, skewing the data. EUI can also be skewed by high-energy facilities and equipment, such as data centers or radar dishes, or low-consumption facilities, such as unconditioned warehouses or barracks that are empty for long periods of time due to troop deployments. The government has used this metric to assess progress relative to the installation's individual baseline, not from an absolute benchmark.

Focusing on EUI reductions also introduces a disconnect between energy and costs. The Army guidance driven by EISA, Executive Order 13423, and Executive Order 13693 required a 3-percent EUI reduction per year over 10 years (2005–2015) and a 2.5-percent EUI reduction from 2015 to 2025. However, since there is no penalty if cost savings are not achieved, cost-saving strategies may be neglected. This has led to a situation where energy savings, which are measured, are decoupled from energy costs.

The Army's energy goals and targets are reductions from a baseline year (Executive Order No. 13493, 2007, and Executive Order No. 13693, 2015). The baseline is simply where that garrison's EUI was at the baseline year. However, the baseline does not consider where the garrison energy usage should be. So, if the baseline year is high, it may be easy to make large reductions at the facilities. So, a garrison may look like it is doing really well in reducing energy when, in reality, it is simply getting closer to the level of energy use at which it should be.

The point is not that EUI is a bad metric, but that it does not present a complete picture. EUI can be a problematic metric since the denominator (square footage) can skew the data for reasons having nothing to do with energy usage. For example, empty warehouses or vacant buildings can bring the EUI down.

Therefore, it would also be beneficial to track the total energy consumed. This would be easy, given that total energy is just the numerator in the EUI metric. But, at this time, it's not a number that is given any emphasis by the Army. In order to incent garrisons to reduce their overall energy usage there should be some type of benefit. This would offset the current incentive for a garrison to "game the system," for example, by keeping empty warehouses. It is vital to take into account incentives and metrics that the Army uses and how they affect the way energy managers approach their jobs. If energy intensity is measured but costs are not, there can be a tendency to focus on energy reduction but not cost reduction. With limited time and resources, an energy manager has to prioritize projects and efforts. However, these distorted incentives do not help the army achieve its energy and cost goals.

5. Army Utility Funding

The Army uses a Budget Requirements Model (BRM) to determine maintenance funding levels at installations (Beskow & McCarthy, 2014). This model takes into account the physical properties and actual quantities at a garrison, such as building square footage or number of employees, as the basis of requirements to establish funding levels. The model also considers variables such as building type. As an example, a Sustainment, Restoration, Modernization (SRM) budget should be calculated based on facility square footage and facility types. For example, a garrison receives an allocation of annual maintenance funds for storm drains based on the type and linear footage of pipe on the installation.

Utility funding is done differently. Instead of being driven by requirements including facility square footage and building type utilities, budgets are developed based on historical costs (G. Kish, email to author, March 14, 2018). As noted in the executive summary, the current utility-funding process is backward looking. As such, funding is

based on the average of the previous four years of utility costs, plus an escalation factor based on estimated utility cost trends. During the literature review, no written explanation was found as to why utilities funding is not treated as a BRM. In my opinion, it is done for the following reasons.

First, the current process is fairly simple, while developing a model based on requirements is challenging. Unless there are major changes to facility square footage or weather, using historical costs—with a nominal escalation factor—to estimate the current year's utility costs should result in a relatively accurate budget. Due to the relative stability of an installation's facility portfolio, population, and mission function, this funded amount will typically be quite close to what is needed. It should be noted that exceptions can occur for years of drastically different weather, large-scale troop deployments, or a large percentage of demolished or constructed facility square footage. So, the increased accuracy ends up discouraging energy cost and usage reductions.

Second, utilities are considered a “must fund” account due to the necessity of keeping the power on. As the term implies, these funds are required for facility operations and will take precedence over other budgeted items. This differs from maintenance costs, which can be deferred. The garrison can prioritize certain repair projects and postpone others to a future year. However, this is not the case with utilities. The Army has to pay utility bills as they come in. And in the event that utility costs are more than anticipated, funding from other areas would be moved to pay for the utilities, or additional funding would be requested from headquarters.

Another aspect of the traditional funding model is that the broad and diffuse nature of energy costs makes it challenging to identify an exact reason why the costs are what they are. In addition to actual energy usage, other factors cause costs go up and down, including utility rates, weather, occupant behavior, operational demands, occupancy levels of buildings, and a multitude of other reasons. Since it is difficult to pinpoint the exact cause of cost fluctuations, it is difficult for funding agencies to develop programs to reward savings retroactively. Therefore, it makes more sense to fund utilities with an objective target as proposed in this thesis, and let installations work within that constraint instead of trying to ask installations to prove savings after the fact and ask for funding rewards.

Even if utility costs do come in under the projections, the excess funds are difficult to utilize for anything else. This is because the funding type of utility costs uses the funding code QUTS and cannot be used for energy efficiency projects, which use the funding code QUTM (IMCOM, 2018). Difficulty is compounded because total savings would not be known until the end of the year, when executing projects is challenging.

A final reason that utility contracts may escape some of the cost-cutting budget drills that other services, such as custodial or landscaping contracts, go through is that they are not fixed-price, regular contracts. So, it is not possible to negotiate an exact monthly price. Month-to-month utility costs are typically dynamic. Natural gas prices can fluctuate from month to month, electric tariffs are often based on time-of-use rates that vary depending on the season and the time of day. Thus, utility costs are typically not possible to set exactly in advance.

Despite the obvious need to keep the power on to maintain the Army's mission, there are some downsides to classifying utilities as "must fund." First, it goes against the idea of a requirements-based model, which is the basis of budget funding throughout the government. Second, it allows utility budgets to avoid cost-cutting drills that are common across other services in a garrison's budget. Without budgetary pressure, there is little scrutiny on utility costs or incentive to look for ways to reduce costs.

These factors result in little need for installation commanders to make the difficult choices on how to use energy funding. Historical inefficiencies which led to higher costs in previous years allow inefficiencies to perpetuate in future years. And since energy cost savings mean that future utility budgets will decrease, garrison commanders understand that there is no incentive to save energy costs. Furthermore, the utility budgeting process does not force the Army to ask whether the budget is appropriate.

This thesis will explore how the Army can use its budgeting processes to support its energy conservation and financial goals. This would require a multi-pronged approach. The Army already uses central funding to support garrisons to execute energy conservation projects (IMCOM, 2018). This is a tried and true method of lowering energy usage and has had considerable success. This thesis will explore a more direct route using the utility

budget itself. A proactive utility funding process could correct the lack of incentives in the current process by using a “carrot and stick” approach. The Army would benefit from a process that would incentivize energy savings through behavior, projects, and maintenance. This could be done by basing the funding projections on real property inventory, population, climate zone, and regional utility costs. Note that this approach is in line with the BOS (Base Operations Support) Requirements Model (BRM) already in effect for funding a garrison. The BRM develops a “should cost” funding model based on actual conditions and resources. Because this basic methodology already exists within Army funding methods, it just needs to be adopted to fund utilities. This process could also more easily allow local commands to retain cost savings they achieve, which provides an incentive for them to take the initiative in saving both energy and costs. IMCOM could provide clear methodology to retain two-thirds of the savings described in 10 USC §2865. By providing more local control, garrison commanders would be more motivated to direct changes.

One encouraging note is that in FY18 a new Management Decision Execution Package (MDEP), which is essentially an accounting code, labeled QUTS, was developed to track utility costs separately. With QUTS, it became possible to isolate the costs of utilities from the other public works costs.

6. Retaining Energy Cost Savings

As will be discussed in detail in the literature review, there is statutory policy that allows U.S. Department of Defense (DOD) facilities to retain most of the savings from decreased energy costs each year. Title 10 USC §2865 describes how the savings will go toward energy conservation, energy security, quality of life, morale, welfare, recreation, or housing projects. The amount retained does not expire at the end of the fiscal year.

There is a lack of current guidance on the process for retaining funds at the garrison level. The last the most recent, but expired, guidance noted that garrisons should prove that their energy-conservation efforts have resulted in a certain cost savings and that those funds are eligible to be retained (Casey, 2010). This is challenging to do for several reasons: At most installations, one year’s worth of energy projects won’t lead to a huge reduction in

energy costs from the previous year; most energy projects take more than a year to go from development, to funding, through project completion; it is difficult to correlate projects with savings quickly since it normally takes a year to know the effects of a project; and energy costs typically go up every year, so it is challenging to just look at the cost side and know whether a program is saving money based on projects. Another challenge is that, once the money is spent, it puts the onus on the installation commanders to prove that they deserve to be given back funding. It takes time to assemble reports and data analysis to make the case that retained earnings are deserved. This takes well into the next fiscal year. So, at that point, where is the funding going to come from? The previous fiscal year? The current fiscal year? Given these challenges, it is not surprising that there is no process developed for retaining funds and, thus, no financial incentive for army installations to save energy.

This thesis will propose a more proactive method for retaining funds. The basic idea is that an objectively developed energy budget is allocated to a garrison each year. Whatever isn't spent in a fiscal year would be saved and then allocated to both energy and quality-of-life projects at the garrison per the Title 10 USC §2865 legislation. To succeed, cost savings must not penalize the garrison by giving it less funds the next year, as the current system does.

B. SCOPE OF STUDY

This study is limited to one Army Garrison, the Presidio of Monterey. However, the methodology could be replicated for any Army installation. The study is limited to a time period of fiscal year 2015 to determine how the actual funding compared with the modeled funding. This study will only consider energy use, e.g., gas and electric, not water. Finally, the study will only include the buildings for which the Army pays the utility bill. Therefore, family housing and reimbursable tenant spaces will be excluded.

C. ORGANIZATION OF THIS STUDY

This thesis contains six chapters. Chapter I contains background, objective, research questions, and scope of investigation. Chapter II presents a review of relevant documents. Chapter III presents an analysis of the real property at the Presidio of Monterey

and the current utility funding process, and describes the methodology and set-up of the proposed model. Chapter IV analyzes the results of the proposed funding model. Chapter V is a discussion of challenges and opportunities associated with using the proposed funding model. It also summarizes the results and provides final recommendations.

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II. LITERATURE REVIEW

The literature review will cover the history of efforts at encouraging energy savings through retaining cost savings. This includes congressional legislation, executive orders, and DOD policies and financial procedures. Additionally, it will cover governmental and commercial methodologies of developing energy usage and cost benchmarks and models.

A. FEDERAL LEGISLATION AND EXECUTIVE ORDERS

Energy guidance in the Army typically flows down from the Department of Defense, which is normally influenced by a combination of Executive Orders and Federal Law. The following are some of the primary influences over the past 20 years.

1. Energy Policy Act (2005)

The Energy Policy Act (EPACT) of 2005 provides guidance on a number of energy-related areas including energy-savings performance contracts, greenhouse gas intensity-reducing technology strategies, procurement of energy-efficient products, requirements for energy metering at federal buildings, and daylight savings calendar adjustments. But the most relevant aspects of the legislation for this thesis are in Section 109, Federal Building Performance Standards. This section amends the Energy Conservation and Production Act, 42 U.S.C. 6834(a) by adding mandated energy-intensity reductions of 2 percent per year for ten years resulting in 20 percent reductions by 2015; and more stringent energy-efficiency design standards for new buildings, requiring that, if life cycle cost-effective, federal buildings “be designed to achieve energy consumption levels that are 30 percent below the levels established in the version of the ASHRAE Standard or the International Energy Conservation Code.”

2. Executive Order 13423 (2007)

Executive Order 13423, “Strengthening Federal Environmental, Energy, and Transportation Management,” was signed on January 24, 2007, and establishes energy efficiency and renewable energy targets. The order requires annual reductions of 3 percent energy intensity, resulting in a 30 percent reduction over a ten-year period from 2005-2015.

3. Energy Independence and Security Act (2007)

Among other things, the Energy Independence and Security Act (EISA) of 2007 amended the National Energy Conservation Policy Act by increasing the energy intensity-reduction requirements from 20 percent to 30 percent from 2005 to 2015. The introduction of the act outlines the goal:

To move the United States toward greater energy independence and security, to increase the production of clean renewable fuels, to protect consumers, to increase the efficiency of products, buildings, and vehicles, to promote research on and deploy greenhouse gas capture and storage options, and to improve the energy performance of the Federal Government, and for other purposes. (EISA, 2007)

4. Executive Order 13693 (2015)

Executive Order 13693, “Planning for Federal Sustainability in the Next Decade” was signed on March 19, 2015, and, among other things, requires agencies to reduce energy intensity by 2.5 percent per year for 10 years, resulting in 25 percent reductions by 2025. In the text, it also sets requirements on efficiency of new buildings:

Federal Agencies shall, where life-cycle cost-effective, beginning in fiscal year 2016, unless otherwise specified, promote building energy conservation, efficiency, and management by reducing agency building energy intensity measured in British thermal units per gross square foot by 2.5 percent annually through the end of fiscal year 2025, relative to the baseline of the agency’s building energy use in fiscal year 2015 and taking into account agency progress to date.

5. National Defense Authorization Act (1991)

But well before the quantitative goals from EPACT 2005, EISA 2007, and the Executive Orders 13423 and 13693 were set, there had been legislative attempts to use the incentive of retaining energy cost savings as a way to encourage energy conservation. The first mention of retaining energy savings is found in the National Defense Authorization Act for Fiscal Year 1991:

PUBLIC LAW 101-510—NOV. 5, 1990 104 STAT. 1803, cited as the “National Defense Authorization Act for Fiscal Year 1991.” Title XXVIII General Provisions, Part D, Department of Defense Energy Savings Sec. 2851 Department of Defense Energy Savings Program

The law states:

(a) IN GENERAL.—Subchapter III of chapter 169 of title 10, United States Code, is amended by adding at the end the following:

“§ 2865. Energy savings at military installations:

“(b)(1) The Secretary shall provide that two-thirds of the portion of the funds appropriated to the Department of Defense for a fiscal year that is equal to the amount of energy cost savings realized by the Department, including financial benefits resulting from shared energy savings contracts and financial incentives described in paragraph (3)(B), for any fiscal year beginning after fiscal year 1990 shall remain available for obligation under paragraph (2) through the end of the fiscal year following the fiscal year for which the funds were appropriated, without additional authorization or appropriation.

“(2) The amount that remains available for obligation under paragraph (1) shall be utilized as follows:

“(A) One-half of the amount shall be used for the implementation of additional energy conservation measures at such buildings, facilities, or installations of the Department of Defense as the head of the department, agency, or instrumentality that realized the savings may designate in accordance with regulations prescribed by the Secretary of Defense.

“(B) One-half of the amount shall be used at the installation at which the savings were realized, as determined by the commanding officer of such installation consistent with applicable law and regulations, for—

“(i) improvements to existing military family housing units;

“(ii) any unspecified minor construction project that will enhance the quality of life of personnel; or

“(iii) any morale, welfare, or recreation facility or service.”

This portion of the law provides more detail in how energy cost savings may be used. Specifically, it outlines “that two-thirds of the energy cost savings realized by the Department...shall remain available for obligation...through the end of the fiscal year following the fiscal year for which the funds were appropriated, without additional authorization or appropriation.” Furthermore, half of the saved amount (the two-thirds portion) shall be used “for the implementation of additional energy conservation measures” although it is not completely clear where these savings are to be spent. The other half “shall

be used at the installation at which the savings were realized...for improvements to existing military family housing units; any unspecified minor construction projects that will enhance the quality of life of personnel; or morale, welfare, or recreation facility or service.”

6. Energy Savings at Military Installations (1994)

In 1994, the U.S. Code was amended with respect to retaining energy savings. One major change was that the stipulation of the two-thirds amount is gone as shown in this section. The law now appears to allow for the DOD to retain all the savings. The full law is titled

1994 U.S. Code, Title 10—ARMED FORCES, Subtitle A—General Military Law
PART IV—SERVICE, SUPPLY, AND PROCUREMENT
Chapter 169—Military Construction and Military Family Housing
Subchapter III—Administration of Military Construction and Military Family Housing.
§2865. Energy savings at military installations

The law states the following:

Availability and use of energy cost savings

(a) AVAILABILITY

An amount of the funds appropriated to the Department of Defense for a fiscal year that is equal to the amount of energy cost savings realized by the Department, including financial benefits resulting from shared energy savings contracts entered into under section 2913 of this title, shall remain available for obligation under subsection (b) until expended, without additional authorization or appropriation.

(b) USE

The Secretary of Defense shall provide that the amount that remains available for obligation under subsection (a) and the funds made available under section 2916(b)(2) of this title shall be used as follows:

(1) One-half of the amount shall be used for the implementation of additional energy conservation and energy security measures at buildings, facilities, or installations of the Department of Defense or related to vehicles and equipment of the Department, which are designated, in accordance with regulations prescribed by the Secretary of Defense, by the head of the department, agency, or instrumentality that realized the savings referred to in subsection (a).

(2) One-half of the amount shall be used at the installation at which the savings were realized, as determined by the commanding officer of such installation consistent with applicable law and regulations, for

(A) improvements to existing military family housing units;

(B) any unspecified minor construction project that will enhance the quality of life of personnel; or

(C) any morale, welfare, or recreation facility or service.

This section was repealed in 2006 but the exact verbiage was simply moved to Chapter 173—Energy Security, Subchapter I—Energy Security Activities, Section 2912—Availability and use of energy cost savings, which is still in place as of 2017.

Through these iterations of law, it is clear that there has remained an intent to allow the Department of Defense to retain an amount of funds equal to the amount of savings realized from multiple methods, and that the funding is allowed to exist until expended. There is still some ambiguity as to where the saved amount should be spent. However, it appears to give enough room for interpretation that the DOD could determine how the savings should be used. It is surprising that no formal processes have been set in place to institutionalize this intent. This has broad implications as will be described in the literature review.

B. ARMY REGULATIONS AND GUIDANCE

The following regulations and guidance are how the Army implements the guidance and laws from the federal level, and which ultimately govern how the Presidio of Monterey executes utility funding.

1. Army Regulation 420-1, Department of the Army (2012)

Army Regulation 420-1 is the primary guide that sets requirements on how to manage Army facilities. This includes the design, construction, and operation of facilities and addresses the management of utilities and energy. Part 5 addresses Utilities and Energy Management, and includes Chapter 22—Army Energy and Water Management Program and Chapter 23—Utility Services. In chapter 22 of the AR 420-1, the following items of interest to this thesis are noted:

- Chapter 22-4.e.10 notes that the Army Chief of Staff, Installation Management (ACSIM) will “Participate in the planning, programming, and budget process for all Army energy and water matters. Participation will include the following: (a) Development of utilities budget allocations.”
- Chapter 22-11.d notes that “Savings realized from implementation of energy management initiatives will be used to invest in additional energy saving measures such as the purchase of renewable energy systems and renewable energy sources.” However, there is no guidance on how to do this.
- Chapter 22-14.b notes that “Utility dollars saved as a result of energy reduction efforts will be reprogrammed during the execution year to finance other energy conservation projects. Any energy improvement project may be funded with these savings subject to the normal statutory limits.” However, there is no process provided for how this should be done. At what point in the year is there confidence that there will be savings? It would likely be at the very end of the fiscal year. By that point, it would be too late to reprogram the funds for use.

2. Department of the Army Headquarters Letter 420-10-1, Casey (2010)

Letter 420-10-1 is the most direct reference found during the literature review that indicates the Army’s attempt to develop a policy to retain energy savings. The Department of the Army Headquarters (HQDA) issued Letter 420-10-1 (referencing 10 U.S.C. 2912 among other documents) in December of 2010, with the subject line “Identifying, Retaining, and Using Energy Savings at Army Installations.” The letter’s purpose statement reads:

This letter prescribes Army’s policy and procedures for identifying savings from an installation’s conservation efforts, for retaining those savings within an extended year account, and for using the savings captured in this account. This policy will be incorporated into the next revision of the AR

420-1, chapter 22. The letter expired in December of 2012 without revisions made to the AR 420-1.

The next revision of AR 420-1 was released on August 24, 2012, with no revised policy on retained energy savings. There was no official explanation of why this letter was allowed to expire without defining a process. It is my theory that it was simply a very challenging problem and that no viable solution could be found. The challenge may be due in part to the current funding process, which will be explored later in this thesis.

The Department of the Army's letter outlines a reactive, rather than a proactive approach, in that it requires Army installations to prove that savings were from energy-conservation programs. This implies an assumption that the process should be backward looking. In other words, it says that garrisons should prove the savings after the fact and petition for the retained funding. This is a challenging task as will be explained later in the thesis.

3. Sustainable Design and Development Policy Update, Hammack (2017)

The Sustainable Design and Development (SDD) policy update, dated January 17, 2017, updated the SDD policy from 2013. It is a broad policy memo with guidance on many areas of energy and sustainable design. Most relevant to this thesis, the policy sets design requirements for EUI targets in new and older buildings, by building type and climate zone. This is significant because it is the first Army policy that does this so specifically. This is a novel approach and one that potentially has great merit. Additionally, the policy uses the EUI targets set forth by the American Society of Heating and Refrigeration Engineers (ASHRAE) to set the Army's EUI targets. And the policy sets EUI targets for many facility category codes in all U.S. climate zones. By doing so, it helps provide the foundation for a requirements-based funding model that could be developed. It therefore provides the technical basis for the funding model explored in this thesis. Appendix B provides the three tables included in this policy update.

The SDD Policy Update is written to steer the Army toward more efficient new and renovated buildings. As such, it is not meant to provide EUI targets for older buildings,

which comprise much of the Army's facility portfolio. But the more aggressive targets it sets out could be viewed as a goal that could be reached within a decade or so.

4. Department of the Army Budget Estimates, Department of Army (2017)

The full title of this document is the *Department of the Army, Fiscal Year (FY) 2018 Budget Estimates, May 2017 Volume I—Operation and Maintenance, Army—Justification of Estimates*. This annually issued document details the costs of Operations and Maintenance in the Army (OMA). This thesis only looks at numbers from the most current year, FY18.

The OMA budget in FY18 was \$38.945B. The OMA budget is broken down into various levels. At the highest level, the OMA budget is divided into four budget activities: 1) operating forces, 2) mobilizations, 3) training, and 4) recruiting. Budget activity 1 is \$23.752B and is the largest budget activity. It contains the activity group 13 “Land Forces Readiness Support,” which contains the subactivity groups (SAG) 131 and 132 that are relevant to this study.

SAG 131, Base Operations Support (BOS) covers utility costs. SAG 132 covers sustainment, restoration, and modernization, which is where energy-savings projects are typically funded, unless the projects are financed through third-party programs. SAG 131 was funded in FY18 for \$8.080B. This is the largest SAG in the OMA budget. SAG 132 was funded in FY18 for \$3.401B.

A full breakdown of SAG 131 begins on page 167. The budget estimates a program growth in energy from FY17 of \$7.143M from a baseline of \$20.384M (p. 177). These costs are for “Energy Program Strategic Initiatives, which will increase the Army's ability to assess the cost-effectiveness of energy saving efforts, and to coordinate for private partnerships for onsite renewable energy generation projects for improved security and resiliency of energy resources to support installation mission requirements” (p. 177). This does not appear to be for utilities, but it is also not for direct SRM projects because those would be funded from SAG 132. SAG 131 does allow for the funding of studies and other non-construction energy programs.

The detail of SAG 131 includes a “Performance Criteria and Evaluation Summary” beginning on page 181. This includes the justifying data behind the dollar budgets. On page 182, there is the breakdown of the utilities for FY16, FY17, and FY18, as seen in Table 1. The budget lists electricity in megawatt Hours (MWh), heating in million British thermal units (MMBtu), water and sewage in thousands of gallons per day, and air conditioning in tons. On a positive note, the document shows a decrease in each of the metrics from FY16 to FY17 and again from FY17 to FY18. This may indicate that conservation programs are working, or it may be a result of the decreases in personnel over the same time period, or it could be a combination of the two. It is not clear where these numbers come from, but it is likely they are aggregated from Army installations around the world.

Table 1. Utility Metrics for FY 2016–2018.
Source: Department of Army (2017).

Utilities:	<u>FY 2016</u>	<u>FY 2017</u>	<u>FY 2018</u>
Electricity (megawatt hours)	9,317,856	9,038,320	8,767,170
Heating (million British Thermal Units)	33,328,204	32,328,358	31,358,507
Water, Plants, Systems (000 gallons per day)	79,410	75,439	73,865
Sewage & Waste Systems (000 gallons per day)	78,699	74,764	73,203
Air Conditioning & Refrigeration (tons)	177,533	168,656	165,136

Table 1 shows that there is some tracking of energy units. Although they are likely simply tabulated from historical usage, they still may provide a basis for a requirements-driven approach. One challenge is then to convert these units to dollar costs, given that energy costs differ widely across geographies, and then to divide them up appropriately across installations across the world.

Starting on page 186, a detail of SAG 131, line item 0913 is Purchased utilities (nonfund). The budget shows it growing from \$598M in FY16 to \$861M in FY17 to a \$917M budget request in FY18. This number does not match the costs seen in the budget documents provided by Installation Management Command that show energy costs above \$1B in 2017.

The breakdown of SAG 132 (SRM) begins on page 189. While this SAG does not directly prescribe how utilities are purchased, it does address energy programs. It describes the maintenance and upgrade of facilities and the energy-consuming equipment on an installation.

On page 194, the budget estimate describes the restoration and modernization funding for energy and utilities, which support energy projects:

5) Restoration and Modernization-Energy and Utilities Program.....\$56,098

Funds the upgrade of Army facilities to improve energy efficiency and reduce utilities costs, preserve water, develop on-site renewable energy generation to reduce consumption and cost of purchased energy, and improve reliability and efficiency of Army-owned installation utilities distribution systems and central plans as well as to meet Department of Defense facility energy reductions. (Baseline: \$75,170)

5. IMCOM FY18 Narrative Funding Guidance, Installation Management Command (2018)

The Installation Management Command (IMCOM) FY18 Narrative Funding Guidance, Version 1, 27 September 2017, lists utilities and utilities-privatization contracts as the number two priority, following civilian pay.

In the overview, paragraph I.C.3 provides guidance on the restrictions on migrating funds between categories, which is one reason it is difficult to use energy savings for energy projects:

Garrisons will not migrate funds into or out of BOS or Sustainment, Restoration and Modernization (SRM). Migration of these funds by the Garrison could result in an Anti-Deficiency Act (ADA) violation. As mentioned in the G8 Introduction, pay continues to be fenced in FY18. Garrisons can realign funding within Sub Activity Groups (SAGs) among Management Decision Packages (MDEPs).

Paragraph IV.C.2.c describes energy and utilities. There are two separate management decision packages (MDEPs) related to this thesis: QUTS, the cost code for utilities services and commodities, and QUTM, which is for energy and utilities modernization, such as energy projects.

Paragraph IV.C.2.c.1 describes the repayment of Energy Savings Performance Contracts (ESPCs and Utility Energy Services Contracts (UESCs) that utilize financing for doing energy-savings projects. These contracts are to be executed against commitment item 233L (OpEx/Pgm Costs—Other Utility Payments to Other).

This allows the data to be captured properly, so that the information can be used later. This is significant because ESPC and UESC payments must come out of the same funding source as utility commodities payments. Therefore, it is important to accurately capture the costs. Surprisingly, there is nothing in the Narrative Funding Guidance that describes how funded amounts are set. Similarly, there is nothing that discusses retention of funds. There does not appear to be any guidance on this at the command level.

In FY18, IMCOM started classifying utilities costs separately from other public works costs. The MDEP for utilities is designated with the cost code QUTS. This development strengthens the approach suggested in this thesis because it identifies utility costs separately. Previously, utilities were combined in the QDPW MDEP, which obscured the cost of utilities. Separating them should facilitate tracking of cost growth or savings.

C. OTHER AGENCIES AND COMMERCIAL RESOURCES

In addition to Army guidance, the author explored other federal agencies and commercial sources that could be applied as a template for the Army.

1. Defense Logistics Agency Instruction (DLAI) 4170.01

The only documented process for retaining cost savings from energy reductions at the federal level that I found was the Defense Logistics Agency (DLA) Instruction DLAI 4170.01, Retained Energy Savings. Through email correspondence with Mr. Don Juhauz, the primary author of DLAI 4170.01 (though now retired from civil service), and Mr. Michael Van Dam, an engineer at the DLA, I received a copy of DLAI 4170.01 and a summary of the genesis and success of DLA's program. The following is excerpted from a September 7, 2018 email from Mr. Van Dam:

- The DLA implementation of the 10 USC 2912 authority has been updated since 2013 and was formally implemented as DLAI 4170.01, a DLA

Instruction for Retained Savings in 2017. The program has been implemented in stages, but is a current DLA finance (J8) supported account:

- Initial stage was to set-up an interim policy memo (Retained Savings DTM dated March 11, 2013) that implemented the foundational elements of the 10 USC 2912 authority. The basic process and accounting procedures were exercised with gas and electric utility rebate checks. The more challenging aspect, the data and formulas for calculating energy utility budget savings were developed and calculated each year but not financially implemented. In the interim the calculation's formula, data call process and data validation were analyzed, scrubbed and refined.

- The retained savings policy memo was updated as DLA Instruction (DLAI) 4170.01 and formally signed into effect June 6, 2017. This policy included the lessons learned from the prior year's efforts and set the stage, policy wise, for the next step in the retained savings implementation, to capture into the retained savings account the calculated yearly energy utility budget savings.

- This full policy implementation could be realized as soon as this FY but depends on several factors including: HQ level staffing assignments and field site support for the policy under a reduced oversight scenario.

- Since the initial policy implementation in 2013 \$2.3M has been received into the account. Primarily the funds transacted into and disbursed out of the account are from utility company rebates checks. The DLA Retained Savings account is open, current and active.

- Lessons learned over the 2013 to 2018 period: using the authority solely for energy rebates is not optimal since rebates vary significantly year to year due to local, state, and utility company policy, current finance procedure requires rolling account funds over year to year rather than as a true multi-year fund until expended, MHA staffing reductions resulted in reduced DLA Retained Savings oversight, field site staff reductions impacted the level of support and experience level of supporting staff, some field sites are reluctant to give up budget flexibility of using their savings "as needed" to primarily for promoting or executing energy saving projects, ongoing delays in smart metering connectivity due to cyber security concerns negatively impact the timeliness and accuracy of field site utility data that underpins the savings calculations.

- The calculations need more granular data to separate baseload from weather driven load. We currently only have quarterly data calls with monthly resolution data. Department of energy has a different method for weather normalization, that is an extrapolated "baseload." There are other factors that affect the calculation like added shifts, change in OPTEMPO,

occupancy increases etc. Some of these we suspect are higher order effects but since we don't have data on these factors, we are left estimating their true effect.

2. ASHRAE Standard 100, American Society of Heating, Refrigerating and Air-Conditioning Engineers (2016)

ANSI/ASHRAE/IES Standard 100-2015, *Energy Efficiency in Existing Buildings*, commonly known as ASHRAE 100, supersedes the 2006 version of the same name. The purpose of the standard is spelled out in section 1.

This standard provides criteria that will result in energy efficiency in existing buildings. This standard is directed toward providing procedures and programs essential to energy efficient operation, maintenance, management, and monitoring; increasing the energy efficiency of the energy-using systems and components; and upgrading the thermal performance of the building envelope.

While many ASHRAE standards focus on how to design new buildings, ASHRAE 100 focuses on existing buildings. This is important to the Army—indeed, the entire DOD—due to the large stock of existing buildings. ASHRAE 100 also provides guidance on retrofits, which is a key strategy within the Army.

Another important aspect of ASHRAE 100 is that it links 53 building types to the Commercial Buildings Energy Consumption Survey (CBECS) and the Residential Energy Consumption Survey (RECS) which are surveys done by the U.S. Energy Information Administration that benchmark commercial and residential buildings by climate zone. This broadens the dataset of buildings to help set energy targets among similar building types. The 53 building types are seen in Table 2.

Table 2. Commercial and Residential Building Types/
Activities. Source: ASHRAE (2015, Table 7-1).

No.	Commercial Building Type	No.	Commercial Building Type
1	Admin/professional office	28	Preschool/daycare
2	Bank/other financial	29	Other classroom education
3	Government office	30	Fast food
4	Medical office (nondiagnostic)	31	Restaurant/cafeteria
5	Mixed-use office	32	Other food service
6	Other office	33	Hospital/inpatient health
7	Laboratory	34	Nursing home/assisted living
8	Distribution/ship center	35	Dormitory/fraternity/sorority
9	Nonrefrigerated warehouse	36	Hotel
10	Convenience store	37	Motel or inn
11	Convenience store + gas	38	Other lodging
12	Grocery/food market	39	Vehicle dealership/showroom
13	Other food sales	40	Retail store
14	Fire/police station	41	Other retail
15	Other public order/safety	42	Post office/postal center
16	Medical office (diagnostic)	43	Repair shop
17	Clinic/other outpatient health	44	Vehicle service/repair shop
18	Refrigerated warehouse	45	Vehicle storage/maintenance
19	Religious worship	46	Other service
20	Entertainment/culture	47	Strip shopping mall
21	Library	48	Enclosed mall
22	Recreation	No. Residential Building Type	
23	Social/meeting	49	Mobile home
24	Other public assembly	50	Single-family detached
25	College/university	51	Single-family attached
26	Elementary/middle school	52	Apartment building (2–4 units)
27	High school	53	Apartment building (5+ units)

Notes: Apartments with units where all utilities are submetered are considered as single-family attached residences, and those with at least one type of utility not submetered (i.e., hot water, steam) are considered as nonresidence (#53). Examples: social housing, leased condos.

The reason that this standard is so important to this thesis is that it provides a recognized standard for energy targets by climate zone for different building types. This standard is referenced by the Army’s SDD policy as noted previously.

Section 7 of ASHRAE 100, “energy-use analysis and target requirements” describes the procedure for using the EUI targets to develop weighted targets for particular buildings. This includes accounting for buildings with multiple Category Codes (CATCDs)

and for buildings that are partially vacant. The procedures noted in this section form the basis for the EUI target development in the energy model proposed in this thesis.

3. ASHRAE 90.1, American Society of Heating, Refrigerating and Air-Conditioning Engineers (2016)

ASHRAE 90.1-2016 Chapter 11 Energy Cost Budget, commonly referred to as ASHRAE 90.1, is well known in the engineering design community. It provides guidance on many aspects of energy design codes. Chapter 11 provides an alternative method of showing design compliance by using an energy cost budget. This method could be used to help develop detailed energy budgets for specific buildings but is likely too specific to use as a broad EUI tool for developing a portfolio-wide energy budget. While it appears to develop a cost budget for energy, it actually does not. Per chapter 11.4:

Informative Note: The energy cost budget and the design energy cost calculations are applicable only for determining compliance with this standard. They are not predictions of actual energy consumption or costs of the proposed design after construction. Actual experience will differ from these calculations due to variations such as occupancy, building operation and maintenance, weather, energy use not covered by this standard, changes in energy rates between design of the building and occupancy, and precision of the calculation tool.

4. ASHRAE 105-2014, American Society of Heating, Refrigerating and Air-Conditioning Engineers (2014)

ASHRAE 105 could also be used in developing an energy budget model because it provides a method for energy performance comparisons across buildings. It does not provide specific energy targets, as does ASHRAE 100. However, it could support an Army-wide energy cost model by clarifying how to address site and source energy, renewable energy, and other relevant variables.

5. CBECS, U.S. Energy Information Administration (2017a)

The Commercial Buildings Energy Consumption Survey (CBECS), is a database of energy data for commercial buildings compiled by the U.S. Energy Information Administration (EIA). As stated on the EIA website, the CBECS is

a national sample survey that collects information on the stock of U.S. commercial buildings, including their energy-related building characteristics and energy usage data (consumption and expenditures). Commercial buildings include all buildings in which at least half of the floor space is used for a purpose that is not residential, industrial, or agricultural. By this definition, CBECS includes building types that might not traditionally be considered commercial, such as schools, hospitals, correctional institutions, and buildings used for religious worship, in addition to traditional commercial buildings such as stores, restaurants, warehouses, and office buildings...BECS interviewers collect building characteristics and energy usage data (consumption and costs) from a respondent at the building. If the building respondent cannot supply the required energy usage data during the interview.

This thesis does not make direct use of CBECS. However, if the energy model in this thesis were to be further developed, the energy data in CBECS could be used to assist in the development of benchmarks for Army buildings.

6. RECS, U.S. Energy Information Administration (2017b)

Residential Energy Consumption Survey (RECS): As it does for commercial buildings with CBECS, the EIA collects data on residential buildings. This database could be used in conjunction with CBECS to assist the Army with developing benchmarks for the residential buildings on an installation. Because these are databases of actual energy usage, they could provide more realistic EUI targets than the aggressive numbers found in ASHRAE 100.

III. METHODOLOGY AND RESEARCH APPROACH

A. INTRODUCTION

The approach taken with this study is to use real property data for the Presidio and couple it with the EUI targets from the SDD policy to develop a target energy-consumption budget. From there, an energy-cost budget could be developed using local energy rates.

The Army, like the entire DOD, categorizes its real property into category codes (CATCDs), which provide a standardized profile of the different types of facilities on an Army base. While some CATCDs are unique to the military, such as tank maintenance facilities, most CATCDs have parallels in the civilian sectors, which would allow us to compare them to commercial or industrial facilities. This comparison would allow the Army to benchmark their buildings against properties in the private sector.

In in the 2017 Sustainable Design and Development (SDD) policy update the Army has done just this, linking its CATCDs to similar facility types identified by the American Society of Heating, Refrigeration, and Air-conditioning Engineers (ASHRAE). ASHRAE is a recognized professional organization of facilities-related mechanical engineering and has published many recognized journals and guidelines focused on energy efficiency. ASHRAE 100 provides updated EUIs by building type and by climate zone. As shown in Table 3.

Table 3. Building Activity Energy Use Intensity Targets. Source: ASHRAE (2015, Table 7-2).

No.	Commercial Building Type	EUIs by Building Type by Climate Zone (kBtu/ft²·yr)																
		ASHRAE Climate Zone																
		1A	2A	2B	3A	3B Coast	3B Other	3C	4A	4B	4C	5A	5B	5C²	6A	6B	7	8
1	Admin/professional office	39	40	39	42	33	39	33	46	40	40	48	42	39	54	47	58	81
2	Bank/other financial	55	57	56	59	46	55	47	65	56	57	68	59	56	76	67	82	115
3	Government office	49	50	49	52	41	48	42	57	49	50	60	52	49	67	59	72	101
4	Medical office (nondiagnostic)	33	34	33	35	28	33	28	39	34	34	41	36	33	46	40	49	69
5	Mixed-use office	45	46	45	48	38	45	39	53	46	47	56	48	45	62	55	67	94
6	Other office	38	39	38	40	32	37	32	44	38	39	47	40	38	52	46	56	78
7	Laboratory	178	176	171	175	147	165	159	194	173	179	209	187	181	232	211	249	331
8	Distribution/shipping center	12	16	16	20	11	18	14	27	23	22	36	30	24	49	40	60	113
9	Nonrefrigerated warehouse	6	8	8	10	5	9	7	13	11	11	17	14	12	24	19	29	54
10	Convenience store	135	146	135	152	127	139	141	166	150	157	178	162	167	193	179	208	263
11	Convenience store with gas	108	118	109	122	102	112	114	133	121	126	144	130	135	156	144	168	212
12	Grocery/food market	112	122	113	127	106	116	118	138	125	131	149	135	139	161	149	174	219
13	Other food sales	34	37	34	38	32	35	36	42	38	40	45	41	42	49	45	53	66
14	Fire/police station	66	65	63	64	54	61	59	71	64	66	77	69	67	85	78	92	122
15	Other public order and safety	60	59	57	59	49	55	53	65	58	60	70	63	61	78	71	84	111
16	Medical office (diagnostic)	33	32	32	32	30	32	27	32	30	28	30	30	28	31	30	31	35
17	Clinic/other outpatient health	50	48	49	48	45	48	40	48	46	42	46	45	42	47	45	46	52
18	Refrigerated warehouse	69	68	66	68	57	64	62	75	67	69	81	72	70	90	82	96	128
19	Religious worship	23	23	22	23	19	22	21	25	23	23	27	25	24	30	28	33	43
20	Entertainment/culture	23	23	22	23	19	21	21	25	23	23	27	24	24	30	28	32	43
21	Library	61	61	59	60	50	57	55	67	60	61	72	64	62	80	73	86	114
22	Recreation	26	26	25	26	22	24	24	29	26	26	31	28	27	34	31	37	49
23	Social/meeting	28	27	26	27	23	26	25	30	27	28	32	29	28	36	33	39	51
24	Other public assembly	28	28	27	28	23	26	25	31	27	28	33	30	29	37	33	39	52
25	College/university	62	61	60	62	45	58	50	72	60	65	78	65	65	90	78	99	147
26	Elementary/middle school	38	37	36	37	30	35	32	41	36	36	42	37	35	46	41	49	72
27	High school	45	45	44	46	33	42	37	52	44	47	57	48	47	66	57	72	107
28	Preschool/daycare	49	48	46	48	39	45	41	52	46	47	54	47	46	60	53	63	93
29	Other classroom education	25	25	25	25	18	24	21	29	25	26	32	27	27	37	32	40	60
30	Fast food	261	268	263	277	237	266	253	305	280	284	332	301	295	364	333	393	497
31	Restaurant/cafeteria	141	145	141	150	126	143	137	166	151	156	179	163	166	195	181	213	268
32	Other food service	77	79	77	82	69	78	75	91	83	85	98	89	91	107	99	116	146
33	Hospital/inpatient health	142	143	140	141	134	138	130	143	129	135	139	126	135	142	130	144	166
34	Nursing home/assisted living	84	83	81	83	69	78	75	91	82	84	99	88	85	109	100	118	156
35	Dormitory/fraternity/sorority	40	43	42	47	31	43	40	58	48	54	65	55	52	75	66	85	119
36	Hotel	50	51	48	52	47	49	48	55	52	52	57	55	53	61	59	65	75
37	Motel or inn	55	53	52	51	48	50	46	52	50	48	53	50	49	56	52	57	69

No.	Commercial Building Type	EUIs by Building Type by Climate Zone (kBtu/ft ² ·yr)																
		ASHRAE Climate Zone																
		1A	2A	2B	3A	3B Coast	3B Other	3C	4A	4B	4C	5A	5B	5C ²	6A	6B	7	8
38	Other lodging	53	50	50	49	46	48	44	49	48	46	50	48	47	53	50	55	66
39	Vehicle dealership/showroom	49	50	49	53	38	48	42	60	52	52	68	58	58	78	69	87	124
40	Retail store	28	29	28	30	21	27	24	34	30	30	39	33	33	45	40	50	71
41	Other retail	49	50	49	52	37	48	42	59	52	52	67	58	57	78	69	86	124
42	Post office/postal center	43	42	41	42	35	39	38	46	41	43	50	45	43	56	51	60	79
43	Repair shop	28	28	27	28	23	26	25	31	28	28	33	30	29	37	34	40	53
44	Vehicle service/repair shop	33	33	32	32	27	31	29	36	32	33	39	35	33	43	39	46	61
45	Vehicle storage/maintenance	14	14	14	14	12	13	13	16	14	14	17	15	15	19	17	20	27
46	Other service	60	60	58	59	50	56	54	65	59	60	71	63	61	78	71	84	112
47	Strip shopping mall	59	59	58	62	46	57	51	71	62	63	82	70	71	94	84	106	151
48	Enclosed mall	56	56	55	59	44	54	49	68	59	60	78	67	68	90	80	101	144
No.	Residential Building Type	ASHRAE Climate Zone																
		1A	2A	2B	3A	3B Coast	3B Other	3C	4A	4B	4C	5A	5B	5C ²	6A	6B	7	8
49	Mobile/manufactured home	38	40	40	45	30	41	38	54	45	51	62	52	49	71	62	80	112
50	Single-family detached	28	30	30	33	22	30	28	40	34	38	46	38	36	52	46	60	83
51	Single-family attached	32	34	34	38	25	35	32	46	39	43	53	44	42	60	53	69	96
52	Apartment (in 2-4 unit building)	47	50	50	56	37	51	47	68	57	64	77	65	61	89	78	101	140
53	Apartment (in 5+ unit building)	32	34	34	38	25	35	32	46	39	43	53	44	42	60	53	68	96

The 2017 SDD policy update correlates Army CATCDs with ASHRAE Standard 100 facility types, as seen in Appendix B, Table 11.

The 2017 SDD policy update provides these EUIs as design targets for new and newly renovated facilities. However, because large capital projects affect only a small percentage of a facility's inventory, this will yield limited energy savings across a military installation. The SDD policy recognizes that older buildings will typically not meet these standards. But these EUIs can provide long-term goals for the facility portfolio. Using CATCDs, building age, or other relevant variables, broad energy-planning goals could be established to assist with long-range capital-improvement planning. In this way, the SDD policy update is useful for planning purposes.

The thrust of this thesis is to utilize the aggressive EUI targets in the SDD policy update to assess how existing buildings compare. By looking at specific buildings and the facility portfolio broadly, a military base may develop an installation-wide model based on EUI goals. Based on target energy levels, target funding levels could also be set, thus

providing financial information to analyze which renovation projects may make buildings more energy and cost efficient.

To develop this model as part of this thesis, the following steps were taken:

1. Use the Army real-property database to identify each energy-consuming facility.
2. Correlate each property with a facility type identified in the Army's new policy, which references ASHRAE 100.
3. Develop an EUI target for each facility, in energy per square foot.
4. Develop gas/electricity ratios for each building to set total gas and electricity usage.
5. Determine blended utility rates for gas and electricity to charge per EUI based on the local utility company's tariffs.
6. Multiply the blended rates by the annual EUIs to generate an annual utility cost per building
7. Sum the annual utility cost for the entire installation.

B. REAL PROPERTY ANALYSIS AT THE PRESIDIO OF MONTEREY

The U.S. Army Garrison Presidio of Monterey comprises three main locations: Presidio of Monterey, Ord Military Community, and the Army Satellite Activity known as SATCOM. Most of the square footage is at the Presidio, which is primarily an instructional campus similar to a small college or university. The total square footage of the three areas is approximately 2.5M SF. The breakdown of that square footage by facility type is 32 percent instructional, 25 percent barracks, and 43 percent administrative and support facilities.

Appendix A, Table 5 lists all the buildings on the Presidio and Ord Military Community with attributes that include square footage, CATCD, and age. Appendix A, Table 6, also lists the annual energy intensity for the buildings in FY 2015. Developing this

annual EUI relied on gas meter data, which was available for every building on the Presidio, and electrical meter data where available. Because about half of the buildings on the Presidio do not have electric meters, developing this annual EUI required several assumptions. By using the buildings that have electric meters, EUIs were set for facility types and age groups, which allowed estimated EUIs for buildings without meters. A correlation of Electric EUI and Gas EUI versus age is seen in the scatter plots in Figures 1 and 2. As evidenced by the scatter plots, there is virtually no correlation solely between age or building and EUI for electric and a slight negative correlation for gas, likely due to the central air systems. A more detailed look at EUI compared to age while isolating for building type yielded similar results, likely due to the small sample size at Presidio. It would be beneficial for this type of study to be done across the whole Army.

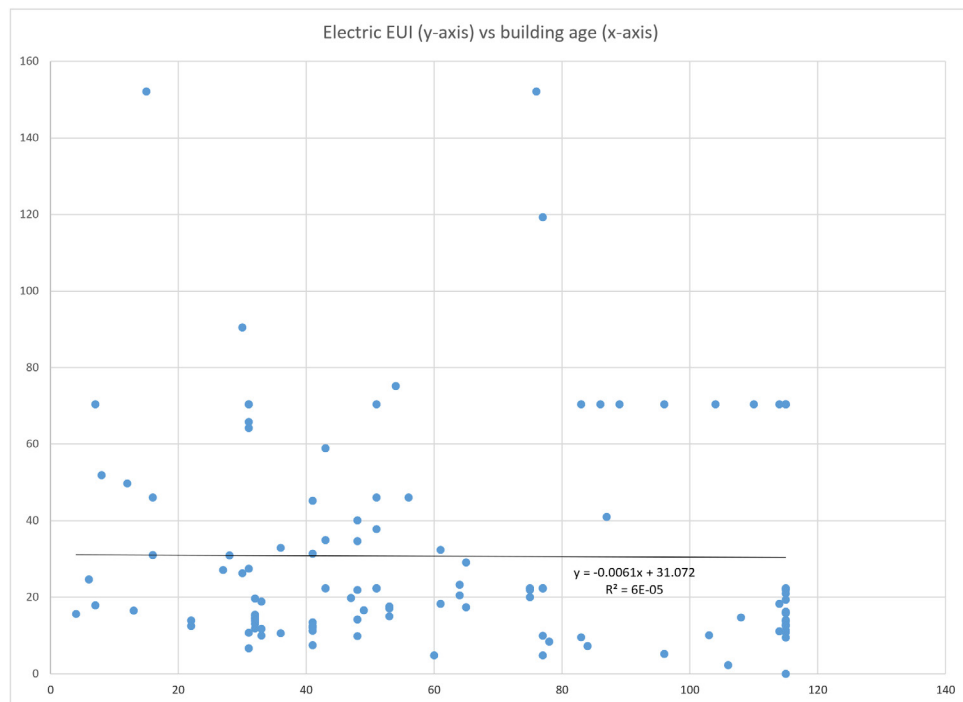


Figure 1. Scatter Plot of Electric EUI against Building Age.

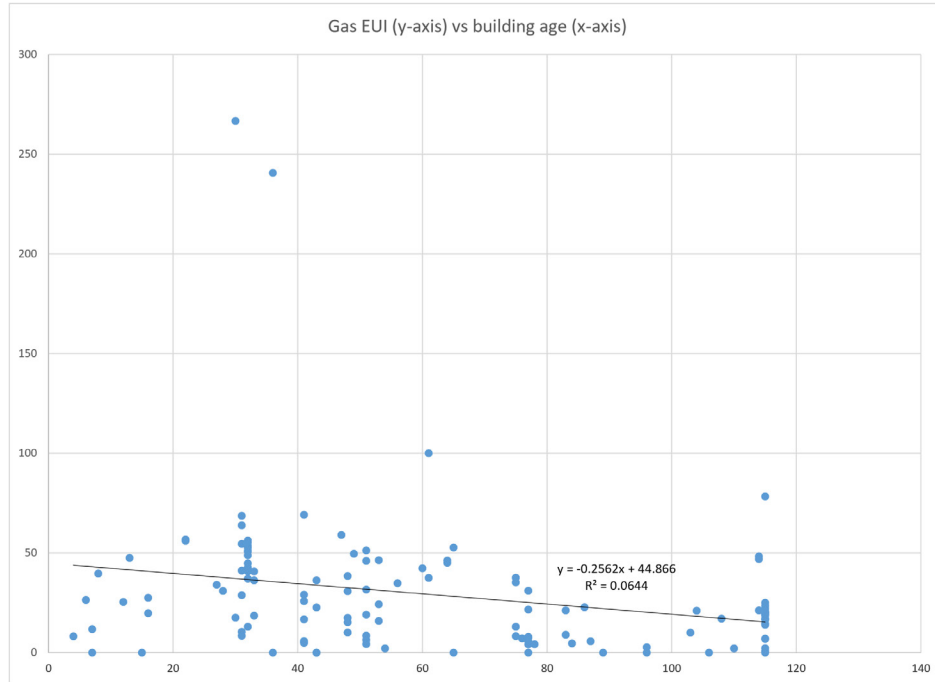


Figure 2. Scatter Plot of Gas EUI against Building Age.

C. CORRELATION OF PRESIDIO REAL PROPERTY WITH ASHRAE STANDARDS

The next step was to assign an ASHRAE code to each facility on the Presidio. The Presidio has 138 facilities that can be grouped into 61 CATCDS. Some facilities have CATCDS that were already associated with an ASHRAE building code in the SDD Policy. However, because the SDD Policy only associated 17 CATCDS from the 61 CATCDS at the Presidio, the remaining facilities- at the Presidio were classified with ASHRAE building codes that were most comparable. This introduced an additional set of assumptions in the development of the model. The comparison to commercial buildings was fairly direct because most of the buildings have corollaries to buildings in the commercial sector. While this may not be the case for all military facilities, such as jet airplane simulators, there should typically be a similar facility that could be compared. However, for the 44 CATCDS at Presidio that did not have a corollary a best-fit match was made. Of note, four CATCDS (Exchange Service Outlet, Information Systems Facility, Communications Center, and Terminal Equipment Facility), did not have an applicable ASHRAE building code, so, new ASHRAE building codes were created with an estimated

EUI. This introduced another assumption into the model. Appendix A, Table 5 shows the buildings with category codes that have been correlated directly with ASHRAE codes.

D. DEVELOP EUI TARGETS

The next step was to obtain an EUI target for each facility. First, the facilities with multiple CATCDS were broken up by component, and the square footage for each portion was tagged by CATCD. Next, the ASHRAE code that had been correlated from the CATCD was applied to each facility or portion of a facility. Then, these multiple components were aggregated by using a pivot table to come up with a weighted EUI for each building. These steps resulted in a spreadsheet that had a target EUI for every facility on the Presidio.

The age of each facility was used to determine if the age factor applied. The SDD policy sets newer buildings with an EUI 20 percent lower than the EUI set in ASHRAE 100. Age can have an impact on energy usage, and the assumption is that new facilities will use less energy, although that may not always be true. Counterintuitively, many of the older buildings at the Presidio have the lowest energy usage per square foot. This is primarily due to the lack of centralized HVAC systems with large forced-air systems, air conditioning, or other variables. These buildings were designed in an era in which centralized systems were rare, so they simply relied on windows for ventilation and cooling.

E. DEVELOP ENERGY RATIOS AND BLENDED UTILITY RATE

Once the EUI targets were set for each building, two more factors were needed to develop a utility cost budget for each building: estimated ratio of electricity and gas, and utility costs of electricity and gas. Actual data were used from the buildings on the Presidio that had both gas and electricity data to develop standard gas/electricity ratios. These known ratios were used for similar buildings that did not have both meters. For buildings without meters that match other buildings, an estimate based on knowledge of the facility was used to develop the gas/electricity ratio. This introduced a third set of assumptions into the model.

For the utility costs, the model was simplified by using one average cost for gas and electric. This blended rate only approximates the actual rates for three reasons: 1) the Presidio has different utility rates based on the meter size of the building, or if the building is connected to the master 4 kilovolt (kV) distribution system; 2) the cost of the Presidio's electricity has three components, which are a) energy cost per kilowatt-hour (kWh), b) demand charge, which uses a monthly ratchet that charges per kW for the highest kW seen each month, and c) various taxes, transmission charges, or other fees; and 3) natural gas rates vary by month based on commodity prices. The annual blended rate for each utility was done for the ease of the model, thus introducing the fourth major assumption.

F. REVIEW ENERGY USAGE AND UTILITY COSTS COMPARED TO CURRENT PROCESS

After inserting the blended utility rates and the estimated energy ratios, the spreadsheet model calculates an estimated energy usage for gas and electric, and the associated utility costs. The total energy usage and cost can then be compared against actual usage and cost. Additionally, many individual buildings can be compared. By comparing the model's projected usage and cost against actual data, it was possible to determine the differences between the model's predicted energy costs and actuals. As previously noted, a variance may suggest that either the model is poorly calibrated or the building is performing better or worse than expected.

G. NOTES ON THE PRESIDIO MODEL

- The U.S. Army Garrison, Presidio of Monterey (POM), has multiple sites in different cities. However, the majority of the facilities are located at two sites, the actual POM, in Monterey, California and Ord Military Community (OMC) in Seaside, California with 138 buildings.
- A third site, the U.S. Army Satellite Activity Camp Roberts (SATCOM), is a small compound with little facility square footage but high energy usage due to the data center and equipment. The building is not metered, so only the total energy usage, and cost are known. If we were to analyze only facility square footage and energy usage, the EUI would appear very

high. Because it is a distinct area, the usage and costs can be isolated. This example of high EUI equipment is one of the variables that can make the requirements-based approach challenging. And for installations that do not have the ability to isolate the costs, it is even more challenging. The model in this thesis keeps the costs and data in place but noted them as such, so that they can be isolated. Because there are no comparable buildings in the ASHRAE tables, it is an example of a component in which relying simply on historical usage and cost is likely the best path forward. However, in the future, submetering is critical to be able to isolate the energy usage of this facility.

- A similar compound at the Presidio is the DOD Center, a large building at OMC with its own gas and electric meters, as well as a large parking-lot solar array. The solar array makes developing an accurate cost challenging because the reported usage is 2 percent below the actual usage. Because this building is funded separately by the tenant organization, it will not be included in the model. However, the EUI data for the building will still be analyzed to assess the accuracy of the proposed data center code.
- The model excludes privatized housing and metered tenant spaces because they pay their own costs and since the Presidio does not report their usage in the Army Energy and Water Reporting System (AEWRS). In most cases, usage and cost can be isolated through separate meters and bills, but in the case of the 35 privatized houses on the Presidio, it requires some EUI estimating because the housing does not have electric meters.
- Another challenge on the Presidio is the mix of electrical metering. While every building that uses gas has a revenue meter billed by the local utility company, that is not the case with electric. There are two broad categories for facilities with electric metering: those with revenue meters billed by Pacific Gas and Electric (PG&E) that provide energy consumption and cost, and those under a large master revenue meter billed by PG&E. The

total usage and cost for this meter is known, so it is possible to use this data to further refine the estimated usage of the buildings that do not have individual electric meters. Additionally, some of the facilities in the second category are sub-metered for energy consumption by the Army. SATCOM is a final category. There is one meter for the compound. This includes the buildings and equipment at the site. At the Presidio, 130 buildings have PG&E revenue gas meters, 62 facilities have PG&E revenue electric meters, and 46 of the 93 buildings on the master meter have Army-owned submeters. And of those, many only provide sporadic data. Therefore, several buildings cannot be validated in that the EUI, usage, and cost calculated by the model cannot be compared to actual numbers. Fortunately, there are enough buildings of similar age, construction type, and usage, that reasonable EUIs can be estimated.

In sum, the mix of metering actually allows for a fairly accurate “actual” energy usage to compare to the spreadsheet model for almost all of the Presidio buildings. This helps to validate and calibrate the spreadsheet model.

IV. DATA ANALYSIS

A. INTRODUCTION

This project creates a method to develop energy-usage estimates and utility cost budgets for an Army installation based on real property data, local utility rates, climate zone, and energy use intensity (EUI) targets. The analysis should consider 1) how close the usage estimate and cost budget come to actual numbers, and 2) factors that account for any variances. To do this, a more complete explanation of the EUI tables in the SDD Policy Update Memo is needed.

B. ASSUMPTIONS AND INPUTS

The following notes help understand how the Presidio data match up with the SDD memo and the ASHRAE 100 standard that underlies it:

- Table 3 (table 7-2 from ASHRAE 100) is the foundation for the EUI targets in the Army's SDD Policy Update Memo and, therefore, for this thesis. Table 3 has EUI targets for 53 building types (48 commercial building types and 5 residential building types), each with EUI's for the 17 ASHRAE climate zones.
- The SDD Memo cross references the ASHRAE 100 EUI facility types with Army CATCDS. Six CATCDS have been validated as seen in Appendix B, Tables 9 and 10 (tables 1 and 2 from the SDD Policy Update). However, the memo notes that for the CATCDS not validated, the most relevant ASHRAE building types can be correlated as seen in Appendix B, Table 11 (table 3 from the SDD Policy Update). which lists 146 distinct CATCDS and correlates these with 31 CATCDS.
- The Presidio has 61 distinct CATCDS, of which only 22 had corresponding ASHRAE codes listed in the SDD memo and could therefore be directly assigned EUIs. The SDD policy includes only codes that account for a large proportion of square footage on most garrisons.

These 22 CATCDS accounted for 83 percent of the square footage at POM.

- Still, this left 39 CATCDS that needed to be assigned an ASHRAE code. Once assigned, the CATCDS at POM that did not have corresponding ASHRAE codes were linked with a CATCD with a similar ASHRAE code. These assumptions will lead to variances in the model since some correlations will not be correct.
- Army currently has a total of 970 CATCDS. There are many variations of similar buildings, such as repair shops, laboratories, and warehouses. While these may be necessary for real property tracking, they are not material to this thesis. An easy fix would be to group many of them within larger ASHRAE codes.

C. CURRENT UTILITY FUNDING AT THE PRESIDIO

Utility funding at the POM has been fairly steady over the past four years, despite high increases in utility rates. Table 4 shows utility funding levels over the past four years, with an anomalous blip in FY15. Note that these levels are for the entire garrison including tenant organizations not captured in the model developed for this thesis.

Table 4. Electric and Gas Costs at Presidio FY13–16.

	FY13	FY14	FY15	FY16
Electric	\$ 2,839,177	\$ 2,865,302	\$ 3,723,278	\$ 3,226,975
Gas	\$ 895,788	\$ 859,399	\$ 705,804	594,378
Total	\$ 3,734,964	\$ 3,724,700	\$ 4,429,082	\$ 3,821,353

D. COMPARISON OF THE MODEL WITH ACTUAL DATA

The model projected energy usage and total utility costs 45 percent lower than the actual numbers in FY15. The variance is likely due to many of the following factors:

The EUI targets are too aggressive, especially for the aging building stock on the Presidio, where the average age was 83 years in 2015. Many of these buildings were built

with no insulation and with highly inefficient systems. Although some buildings compare favorably with the EUI target, most do not.

Even the newer buildings are not performing up to the EUI targets. For example, the three newest buildings on campus (buildings 417, 607, and 613) were designed to the US Green Building Council's Leadership in Energy & Environmental Design (LEED) "Silver" standards. These three are all instructional buildings (CATCD 17120) which, according to the SDD memo, correspond with ASHRAE 100 code 29, "Other Classroom Education." The target EUI in the Presidio's climate zone for ASHRAE 100 code 29 is 21 kBTU/SF. However, because the three buildings were built after 2008, they must take the 20 percent reduction, taking the target EUI to 17. This is a very difficult target to reach, and the three buildings on the Presidio do not come close with EUIs of 62, 51, and 39. Of note, for these buildings ASHRAE codes other than 29 could have been selected: ASHRAE 100 code 25 (College/University) has a base EUI of 50, and code 27 (High School) has a base EUI of 37. With the 20 percent reduction for newer buildings, the target EUIs would have been 40 and 29.6, respectively, which would have resulted in the Presidio's buildings comparing more favorably, although still notably higher than the target.

The real-property data could be inaccurate and out of date. This is likely a systemic issue across the Army's real-property records, presenting both a challenge and an opportunity. Still, it could have local impacts on the model. Errors of square footage, outdated CATCDS, and missing data could impact the projections. An example can be found by looking at Presidio buildings 214, 215, and 216, which are all classroom buildings, so the model used the same EUI. These are almost identical buildings. But owing to differing basement spaces, the square footage of the three buildings range from 6,131 SF to 9,020 SF. This difference in square footage allowed Building 215 to be allotted more energy consumption and utility cost, making it look like a well-performing building. This points to the large impact of accurate real-property data on the modelling approach used here. If the Presidio is any example, there are many potential errors—or simply nuances—in real-property data.

The EUI targets in the model are set for buildings built after 2008 with a 10 percent adjustment for buildings built before 2008. But most of the building stock at the Presidio

were built well before 2008, as far back as 1903 so the model does not fit well with the actual EUIs. This will not be uncommon at many Army installations. So that the budgeting model does not over-penalize for variables out of the control of the garrison, an age-factor corrector could be applied to account for older buildings. For example, for every year older than 2008, a percent could be added to the EUI. However, it should be noted that age does not always positively correlate to EUI. A regression analysis was done for total 2015 EUI and an overall negative correlation was found. This is due to the relatively simple mechanical systems in the very old buildings. The highest EUIs were from buildings built in the 1960s through the 1980s. The regression line has a low R² value, though this may be in part due to the relatively low sample size.

It is notable that even for the Presidio, an Army installation recognized for energy efficient practices and a quality O&M system, the model predicted significantly lower usage and costs than the actual numbers. If this is the case for the Presidio, it is likely to be the case for many of the Army's sites. This implies that either the model is too aggressive, or the installation is too wasteful. Or perhaps it is due to a combination of both. This leads to the question of how the model could be calibrated and used, which will be addressed in the recommendations in Section V.

E. BROADER ANALYSIS

In addition to the narrow analysis of how the model corresponds to reality, there is a benefit to taking a broader perspective of how a model like this could work. First, we can look at the physical attributes that become inputs to a model. As noted previously, a major element of this model is accurate real-property data. Ensuring that the quantitative data (square footage, age, etc.) and the qualitative data (alignment of the CATCD with the actual usage of the building) are correct is imperative to make the model work. Validating real-property data can be an expensive task. If the sole rationale for this effort was a utility-funding model, it would probably not be worth the effort of validating the data. Still, there are many reasons the Army would want accurate real-property data, and there are ongoing efforts to improve the accuracy of the data. Therefore, the work involved in this effort would not be only for utility budgeting.

A further step could be to go deeper than just real-property data, that is, to analyze building systems and construction type, including components such as insulation values of the exterior envelope, window glazing, and HVAC efficiency. These clues could provide a better understanding of why the EUI is what it is. In fact, there are already Army tools, such as SMS Builder and the Net Zero Planner (NZP), developed by the Army Corps of Engineers, that provide information that is beneficial to aspects of facilities management.

Instead of using ASHRAE 100, the model could have used the CBECS/RECS database. As a normative comparison, Oak Ridge National Labs (ORNL) and the Department of Energy (DOE) took data from these two databases and created a table in the same format as the tables developed for ASHRAE 100. As noted in the Literature Review, the CBECS/RECS databases reflect actual usage, so the averages are higher than the EUI targets from ASHRAE 100. So, ORNL and the DOE took the 40th percentile and then extrapolated for the 17 climate zones to derive the “normative EUI targets.” This would mean that, if the target EUIs came from the CBECS/RECS database, the usage and costs would have matched up more closely. If this spreadsheet model is too aggressive in its targets, the CBECS/RECS database could be used as a baseline, with a 10-year glide-slope toward the ASHRAE 100 targets. This comparison could be done as part of a follow-on study.

A key part of the analysis is whether this requirements-based approach would save the Army money. There is an argument that, even if this approach does not provide cost savings but changes the incentive basis and therefore encourages conservation, it would yield a positive outcome, especially if targets for energy use were to be slowly ratcheted up over time. Based on experience, the author believes that there is likely a very large upside to energy savings in the DOD, with potentially huge savings possible. Although this study only has a sample size of 1, the 45 percent cost overage implies that there could be massive energy savings possible across DOD.

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V. DISCUSSION OF RESULTS

This thesis presents a simple idea: fund utilities based on what buildings should cost instead of what they have historically cost. And while this idea presents many challenges, it also allows numerous opportunities, as described in the following text.

A. HURDLES TO OVERCOME

As with many entrenched bureaucratic processes, vestigial inertia and an existing mindset would have to be overcome. Given that the existing system yields relatively accurate budgets, any new budgeting process will likely face resistance by those at Headquarters responsible for developing current budgets. Also, a requirements-based budgeting system will undoubtedly be more complicated than the current system because the current system uses only historical data. Building a robust model such as this for large installations, or for the entire Army, will be challenging but is entirely feasible. The model that was built for this thesis was for the Presidio, a relatively small installation, and one with which the author is very familiar. To replicate this model on an Army-wide scale would require appropriate resourcing.

In addition to the technical challenges, there may be complaints that the model is flawed or that certain operations cannot be modelled with sufficient accuracy. This would especially be the case if the model caused pressure to cuts to the utility budget, and this argument would not be without merit. No model can reflect reality exactly, and in this case, there are assumptions made because many facilities do not fit well with the ASHRAE codes. But any complaints about funding levels could yield positive results for the Army as it would force scrutiny over where the energy costs are coming from. And across the large population set of the Army, the law of large numbers should average out highs and lows to allow a reasonable overall budget.

One of the most difficult parts of the model is converting energy usage to cost. Even if the model fit the energy usage exactly, predicting a utility budget may still be challenging. This is because utility rates are complicated and not based solely on energy usage. Most rates also include demand charges, transmission costs, taxes and, often, more

complicated factors such as different time of use, and/or time of season rates. For simplicity, at least at the outset, a blended rate would be used across the board. This rate would incorporate taxes, transmission fees, demand charges, and others as deemed appropriate. This would also encourage a garrison to enroll in programs such as demand-reduction programs that save money.

Another issue is building into the model an accurate energy ratio—gas versus electric—for each building. The EUI given in Table 6 is the estimated overall energy (electric and gas) used per square foot. Most facilities use electricity and natural gas. And because the costs per unit of energy for electricity and gas typically differ widely, it is necessary to have an idea of how much of the total EUI is for electricity versus gas. Significantly, different buildings have different gas-to-electricity ratios. For example, at Building 344, the data center at the POM, there is no gas service, so the building is heated with electricity, which is a more expensive way to heat. The model may accurately project the energy usage but therefore underestimate the cost for buildings where the energy type is not known exactly.

As with any budgeting system, incentives may arise for “gaming the system.” For example, this method would incentivize the practice of keeping properties on the books, even if they are mothballed, to obtain utility funding. But there is already an incentive for this practice because maintenance funding is based on the current square footage as well. Therefore, this “gaming the system” should be addressed regardless of using this utilities-budgeting model.

An important challenge is calibrating the spreadsheet model. The goal of the model is to develop a budget for an entire installation. Because each installation is unique, it is challenging to calibrate the model in a systematic way. If we were to compare this to a company like Walmart or Home Depot that has the same type of building across the country, we would likely find that they have a good idea of what each building should cost. The solution to that seems to be using as much building-specific data as possible. Any individual building that has an individual meter, either a utility revenue meter or an Army submeter, should be analyzed to determine the accuracy of the model. By using refined, building-specific data, a relative degree of accuracy may be developed for entire garrisons.

Another challenge, although it would be a good problem to have, is how to deal with installations that cost less than the projected amount, not due to efficient buildings but because of large investments in photovoltaic (PV) projects. These solar projects could make it look like an installation is performing really well. In the most extreme case, consider an installation designed with ample solar power as to have virtually no electric bill. Based on the budgeting method proposed, the installation would get to keep the extra utility budget for quality-of-life or other energy projects. One might ask whether this is fair or appropriate, given that Army funding paid for the solar projects up front with the expectation of savings? This may not be a frequent problem but it does bring up questions of how to handle the savings on bases that have been funded for large solar or wind projects.

Similarly, adjustments would need to be made to the model for a garrison where a large percentage of the base was supplied with electric power from a solar power purchase agreement (PPA) that has a lower rate than the local electric rate. Should the model use the higher rate and then let the installation keep the delta?

A final related example is repayment of third-party financed projects in which the Army essentially takes a loan to pay for energy projects and repays it over 10 or 20 years. The repayments are paid out of the BOS utility budget and must be accounted for in that MDEP. But the utility-funding model would not take these costs into account. These financed projects are often a good deal for the Army because they allow for much-needed work to be done at no upfront cost. As long as proper maintenance is accomplished and the savings continue as planned, they can make economic sense. But they present a different strategy to a project that is funded upfront and the savings go to the Army every year. It would be necessary to factor into the model the different way the repayments are paid.

B. OPPORTUNITIES PRESENTED BY THIS THESIS

The primary opportunity presented by this thesis is for the Army to reduce utility costs. This would be done by using the model to set objective energy-consumption and utility-cost targets and, then, by applying pressure to garrisons to meet those targets. Even if Army headquarters simply conveyed to the installations that they were not meeting the

energy-consumption targets, there would be external pressure from oversight that may lead to opportunities for savings.

The second opportunity would be for the Army to more accurately assess the actual progress of the energy program. Because the measure of success has been a relative gauge to this point, there hasn't been an objective measurement of how the Army is performing. By comparing energy usage to real benchmarks, a more objective analysis could be performed. Realistically, this may not be of interest to the Army headquarters because simply meeting the current reduction goals is challenging.

Another opportunity is a forward-looking way to utilize the recent investments in meters and the wealth of existing data to develop aggressive energy targets and energy savings. Historically, many installations had one electric meter for the entire installation, so granular data was challenging to obtain. But in recent years thousands of buildings throughout the Army have been metered through the Army Metering Program. These meters provide an opportunity for calibration of EUI data for many different CATCDS across all climate zones. While the funding model proposed in this thesis would have been possible to develop 10 years ago, it would have been virtually impossible to evaluate with any granularity. Now the opportunity for a large database similar to CBECS is possible across the Army.

Another opportunity is that this model provides further impetus to clean up CATCDS at Army garrisons. CATCDS should be verified because buildings have changed functions over time. Most garrisons probably need to go through this process. Accurate property data are crucial to effective facilities management, and many other benefits can be realized by putting attention to Army real-property records, namely inventory of category codes, building data, and equipment.

There is a real opportunity for learning across the Army energy management community. A database of energy intensities across CATCDS in different climate zones would allow energy managers and engineers to compare and benchmark their own facilities. It also would allow a data set for deeper investigations and to assess opportunities for more savings. This data set would serve as a tool that would become more robust over

time. And the actual data would inform future designs on what EUI's are possible for particular CATCDS. Additionally, the increased scrutiny by building an energy budget from the ground up would give energy managers information on where to focus their energy.

Lastly, a major opportunity from this model is to develop a system that allows garrisons to retain savings from implementing energy projects. By using an objective budgeting methodology, there is a fair way to provide savings to garrisons doing well. This method could provide a solution to the vexing question of what to do if energy is saved but costs still rise due to higher rates. By tying retained funding to the modeled energy usage, the higher rates are considered, so that garrisons are not penalized. This works the other way as well; that is, if energy is not saved but costs go down due to lower rates, there would not be a cause for retained savings.

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VI. CLOSING SUMMARY

A. CONCLUSIONS

1. The requirements-based modeling approach used in this thesis is a valid method with potential benefits. The model provides a baseline for future work on this topic.
2. Although the Presidio example yielded predicted results quite far from the actual amounts, this does not invalidate the conceptual approach used. It could mean that the EUI targets used in the model were too stringent or that Presidio's buildings are not as energy efficient as they should be. It is probably a combination of the two.
3. If nothing else, the model shows that the process of using EUI targets across a real-property database is useful in developing EUI portfolio targets.
4. A requirements-based approach can fundamentally shift the way we analyze our progress on energy and cost saving. The Army needs to be able to have targets based on an absolute benchmark, not just a relative one, in order to make its building stock more efficient and cost effective.
5. One challenging aspect of the model is converting energy usage to dollars. A more systematic method than the one used in this thesis would have to be developed.
6. A more sophisticated model, using EUI data from across the Army, would provide insight into how our facilities compare with the commercial sector. Also, aggregating the data across facilities Army-wide would provide for a more accurate model.

B. RECOMMENDATIONS

1. Test the model at pilot sites: work with the Construction Engineering Research Laboratory (CERL) or a contractor, to develop a better tool than the Excel model created for this thesis.
2. Create a process to allow garrison energy managers to benefit from this modelling approach- namely retaining energy savings.
3. Modify the model to include age and equipment factors, so the EUI target is shifted to account for older buildings or buildings that do not have HVAC equipment.
4. Phase in the process through a voluntary system: Some garrisons may not think it is worth the effort, in which case it may not be worth forcing them to use it. For those that do make the effort, the model should be used as a carrot, which could be the chance of retaining funds.
5. Continue to improve real-property data: A key benefit will be a validation of the Army real-property data. This is something that hampers the Army on many levels. Presently, there is little incentive to identify errors and make corrections. A formalized validation of the data would be a prerequisite to using this system. Also, do random audits to hold real-property record holders accountable.
6. Even if garrisons do not volunteer to use the model, Army HQ could use this model to provide them with a “should cost” number. This would let them know how far off they are from the target.
7. Determine if this EUI budget tool is to be used like a cudgel or a nudge. This will determine how aggressive the requirements would be to meet the targets. A severe approach may aim to save more money but could hurt the way this technique is received by garrisons. Perhaps, an initial approach

would be to use the budget tool for information at first, and after a few years, begin to use it as an influencing tool.

8. Due to the challenges of building an accurate model, there should be built-in allowances or “fudge factors” to account for modeling inaccuracies. The goal is to refine the model over time. Now that many buildings are metered, it should be possible to isolate where discrepancies occur. For example, we may be able to isolate energy-intensive infrastructure like radar towers that are not common or have no corollary in the commercial sector database.
9. Use new QUTS MDEP to begin to track utility costs at each garrison; even if it’s not used to change funding levels, make the data visible.
10. Make improvements to AEWRs to analyze not just EUI but also total energy and total cost; make progress graphs; attempt to align the numbers that Resource Management (RM) uses in the General Fund Enterprise Business System (GFEBS) with the numbers that energy managers input into AEWRs.

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APPENDIX A. UTILITY FUNDING MODEL

Table 5. Real Property Data and ASHRAE Codes Used.

FY	Installation Name	Site Name	Facility Number	Year Built	Cat. Code	Cat. Desc.	Broad Building Type	KSF	ASHRAE 100 equivalent	Proposed ASHRAE 100 Equivalent	Non-ASHRAE 100 proposed code	Code used
2016	Presidio Of Monterey	Ord Military Community	4220	1964	74052	EXCHANGE AUTOMOTIVE SERVICE STATION	Support	8.973	0	44	0	44
2016	Presidio Of Monterey	Ord Military Community	4227	1982	74056	EXCHANGE SERVICE OUTLET	Support	2.497	0	0	101	101
2016	Presidio Of Monterey	Ord Military Community	4235	1970	74053	EXCHANGE MAIN RETAIL STORE	Support	75.0	40	0	0	40
2016	Presidio Of Monterey	Ord Military Community	4250	1953	13120	COMMUNICATIONS CENTER	Support	1.85	0	0	100	100
2016	Presidio Of Monterey	Ord Military Community	4250	1953	61050	ADMINISTRATION BUILDING, GENERAL PURPOSE	Support	6.5	1	0	0	1
2016	Presidio Of Monterey	Ord Military Community	4251	1977	44220	STORAGE BUILDING, GENERAL PURPOSE, INSTALLATION	Support	3.43	9	0	0	9
2016	Presidio Of Monterey	Ord Military Community	4251	1977	61050	ADMINISTRATION BUILDING, GENERAL PURPOSE	Support	3.07	1	0	0	1
2016	Presidio Of Monterey	Ord Military Community	4260	1965	74046	CONSOLIDATED OPEN DINING FACILITY	Support	30.339	0	31	0	31
2016	Presidio Of Monterey	Ord Military Community	4260	1965	74033	ARMY COMMUNITY SERVICES CENTER	Support	5.273	0	46	0	46
2016	Presidio Of Monterey	Ord Military Community	4260	1965	61050	ADMINISTRATION BUILDING, GENERAL PURPOSE	Support	35.973	1	0	0	1
2016	Presidio Of Monterey	Ord Military Community	4260	1965	74065	RECREATIONAL EQUIPMENT CHECKOUT	Support	0.0	0	40	0	40
2016	Presidio Of Monterey	Ord Military Community	4275	1970	74041	LIBRARY MAIN	Instruction	14.4	0	21	0	21
2016	Presidio Of Monterey	Ord Military Community	4280	1958	73017	CHAPEL	Support	26.666	0	19	0	19
2016	Presidio Of Monterey	Ord Military Community	4283	1991	74066	YOUTH CENTER	Support	15.0	0	28	0	28
2016	Presidio Of Monterey	Ord Military Community	4283C	1997	44220	STORAGE BUILDING, GENERAL PURPOSE, INSTALLATION	Support	0.2	9	0	0	9
2016	Presidio Of Monterey	Ord Military Community	4380	1954	53040	VETERINARY FACILITY	Support	5.627	0	17	0	17
2016	Presidio Of Monterey	Ord Military Community	4390	1954	53060	MEDICAL WAREHOUSE	Support	5.697	0	18	0	18
2016	Presidio Of Monterey	Ord Military Community	4396	2010	73075	SEPARATE TOILET/SHOWER BUILDING	Support	1.848	0	53	0	53
2016	Presidio Of Monterey	Ord Military Community	4397	2010	17120	GENERAL INSTRUCTION BUILDING	Instruction	1.848	29	0	0	29
2016	Presidio Of Monterey	Ord Military Community	4398	2010	17120	GENERAL INSTRUCTION BUILDING	Instruction	1.848	29	0	0	29
2016	Presidio Of Monterey	Ord Military Community	4399	1977	53020	LABORATORY	Support	1.5	0	7	0	7
2016	Presidio Of Monterey	Ord Military Community	4399	1977	17120	GENERAL INSTRUCTION BUILDING	Instruction	14.024	29	0	0	29
2016	Presidio Of Monterey	Ord Military Community	portables			Portable Barracks	Barracks					
2016	Presidio Of Monterey	Ord Military Community	4400	1953	73010	FIRE STATION	Support	6.906	14	0	0	14
2016	Presidio Of Monterey	Ord Military Community	4403	1982	73010	FIRE STATION	Support	3.75	14	0	0	14
2016	Presidio Of Monterey	Ord Military Community	4455	1970	61050	ADMINISTRATION BUILDING, GENERAL PURPOSE	Support	11.399	1	0	0	1
2016	Presidio Of Monterey	Ord Military Community	4463	1970	61050	ADMINISTRATION BUILDING, GENERAL PURPOSE	Support	9.797	1	0	0	1
2016	Presidio Of Monterey	Ord Military Community	4468	1970	73016	POLICE/MP STATION	Support	11.399	0	14	0	14
2016	Presidio Of Monterey	Ord Military Community	4495	1977	44228	HAZARDOUS MATERIAL STORAGE BUILDING, INSTALLATION	Support	5.197	0	9	0	9

FY	Installation Name	Site Name	Facility Number	Year Built	Cat. Code	Cat. Desc.	Broad Building Type	KSF	ASHRAE 100 equivalent	Proposed ASHRAE 100 Equivalent	Non-ASHRAE 100 proposed code	Code used
2016	Presidio Of Monterey	Ord Military Community	4495	1977	61050	ADMINISTRATION BUILDING, GENERAL PURPOSE	Support	3.485	1	0	0	1
2016	Presidio Of Monterey	Ord Military Community	4497	1977	44220	STORAGE BUILDING, GENERAL PURPOSE, INSTALLATION	Support	0.707	9	0	0	9
2016	Presidio Of Monterey	Ord Military Community	4499	1977	21845	ADMINISTRATION AND SHOP CONTROL, DOL/DPW/IMMA/IMMD	Support	7.268	43	0	0	43
2016	Presidio Of Monterey	Ord Military Community	4499	1977	44220	STORAGE BUILDING, GENERAL PURPOSE, INSTALLATION	Support	7.267	9	0	0	9
2016	Presidio Of Monterey	Ord Military Community	4499A	1985	44220	STORAGE BUILDING, GENERAL PURPOSE, INSTALLATION	Support	1.652	9	0	0	9
2016	Presidio Of Monterey	Ord Military Community	4499B	1985	44220	STORAGE BUILDING, GENERAL PURPOSE, INSTALLATION	Support	1.652	9	0	0	9
2016	Presidio Of Monterey	Ord Military Community	4503	1977	44220	STORAGE BUILDING, GENERAL PURPOSE, INSTALLATION	Support	0.363	9	0	0	9
2016	Presidio Of Monterey	Ord Military Community	4506	1977	21885	MAINTENANCE SHOP, GENERAL PURPOSE	Support	14.52	43	0	0	43
2016	Presidio Of Monterey	Ord Military Community	4506A	1985	44220	STORAGE BUILDING, GENERAL PURPOSE, INSTALLATION	Support	1.652	9	0	0	9
2016	Presidio Of Monterey	Ord Military Community	4506B	1985	44220	STORAGE BUILDING, GENERAL PURPOSE, INSTALLATION	Support	1.652	9	0	0	9
2016	Presidio Of Monterey	Ord Military Community	4512	1977	44220	STORAGE BUILDING, GENERAL PURPOSE, INSTALLATION	Support	14.517	9	0	0	9
2016	Presidio Of Monterey	Ord Military Community	4512A	1985	44220	STORAGE BUILDING, GENERAL PURPOSE, INSTALLATION	Support	1.652	9	0	0	9
2016	Presidio Of Monterey	Ord Military Community	4512B	1985	44220	STORAGE BUILDING, GENERAL PURPOSE, INSTALLATION	Support	1.652	9	0	0	9
2016	Presidio Of Monterey	Ord Military Community	4516	1977	44220	STORAGE BUILDING, GENERAL PURPOSE, INSTALLATION	Support	0.37	9	0	0	9
2016	Presidio Of Monterey	Ord Military Community	4522	1980	21910	ENGINEERING/HOUSING MAINTENANCE SHOP	Support	7.783	43	0	0	43
2016	Presidio Of Monterey	Ord Military Community	4522A	1985	44220	STORAGE BUILDING, GENERAL PURPOSE, INSTALLATION	Support	1.888	9	0	0	9
2016	Presidio Of Monterey	Ord Military Community	7693	1990	74017	CHILD DEVELOPMENT CENTER-UNDER 6 YEARS OF AGE	Support	23.8	28	0	0	28
2016	Presidio Of Monterey	Presidio of Monterey	0343G	2002	89111	POWER PLANT BUILDING	Support	0.36	0	9	0	9
2016	Presidio Of Monterey	Presidio of Monterey	0614G	2002	89111	POWER PLANT BUILDING	Support	0.432	0	9	0	9
2016	Presidio Of Monterey	Presidio of Monterey	0620A	2002	13181	TERMINAL EQUIPMENT FACILITY	Support	0.222	0	0	100	100
2016	Presidio Of Monterey	Presidio of Monterey	0622A	1996	44224	ORGANIZATIONAL STORAGE BUILDING	Support	0.1	9	0	0	9
2016	Presidio Of Monterey	Presidio of Monterey	0622B	1996	44224	ORGANIZATIONAL STORAGE BUILDING	Support	0.1	9	0	0	9
2016	Presidio Of Monterey	Presidio of Monterey	0622C	2002	44224	ORGANIZATIONAL STORAGE BUILDING	Support	0.24	9	0	0	9
2016	Presidio Of Monterey	Presidio of Monterey	0627A	1996	44224	ORGANIZATIONAL STORAGE BUILDING	Support	0.2	9	0	0	9
2016	Presidio Of Monterey	Presidio of Monterey	0627B	1996	44224	ORGANIZATIONAL STORAGE BUILDING	Support	0.1	9	0	0	9
2016	Presidio Of Monterey	Presidio of Monterey	0627C		89111	POWER PLANT BUILDING	Support	0.432	0	9	0	9
2016	Presidio Of Monterey	Presidio of Monterey	0629A	1996	44224	ORGANIZATIONAL STORAGE BUILDING	Support	0.1	9	0	0	9
2016	Presidio Of Monterey	Presidio of Monterey	0629B	1996	44224	ORGANIZATIONAL STORAGE BUILDING	Support	0.1	9	0	0	9
2016	Presidio Of Monterey	Presidio of Monterey	0630A	1996	44224	ORGANIZATIONAL STORAGE BUILDING	Support	0.1	9	0	0	9

FY	Installation Name	Site Name	Facility Number	Year Built	Cat. Code	Cat. Desc.	Broad Building Type	KSF	ASHRAE 100 equivalent	Proposed ASHRAE 100 Equivalent	Non-ASHRAE 100 proposed code	Code used
2016	Presidio Of Monterey	Presidio of Monterey	0630B	1996	44224	ORGANIZATIONAL STORAGE BUILDING	Support	0.1	9	0	0	9
2016	Presidio Of Monterey	Presidio of Monterey	0634G	2002	89111	POWER PLANT BUILDING	Support	0.215	0	9	0	9
2016	Presidio Of Monterey	Presidio of Monterey	0830G	2002	89111	POWER PLANT BUILDING	Support	0.234	0	9	0	9
2016	Presidio Of Monterey	Presidio of Monterey	0831A	1996	44224	ORGANIZATIONAL STORAGE BUILDING	Support	0.1	9	0	0	9
2016	Presidio Of Monterey	Presidio of Monterey	0840A	1996	44224	ORGANIZATIONAL STORAGE BUILDING	Support	0.1	9	0	0	9
2016	Presidio Of Monterey	Presidio of Monterey	105	1922	44224	ORGANIZATIONAL STORAGE BUILDING	Support	4.906	9	0	0	9
2016	Presidio Of Monterey	Presidio of Monterey	112	1924	73075	SEPARATE TOILET/SHOWER BUILDING	Support	0.257	0	53	0	53
2016	Presidio Of Monterey	Presidio of Monterey	113	1908	76010	MUSEUM	Support	1.813	0	41	0	41
2016	Presidio Of Monterey	Presidio of Monterey	115	0	14113	ACCESS CONTROL FACILITY	Support	1.35	6	0	0	6
2016	Presidio Of Monterey	Presidio of Monterey	203	0	14113	ACCESS CONTROL FACILITY	Support	0.8	6	0	0	6
2016	Presidio Of Monterey	Presidio of Monterey	204	1941	17120	GENERAL INSTRUCTION BUILDING	Instruction	4.78	29	0	0	29
2016	Presidio Of Monterey	Presidio of Monterey	205	1941	17120	GENERAL INSTRUCTION BUILDING	Instruction	4.78	29	0	0	29
2016	Presidio Of Monterey	Presidio of Monterey	206	1941	17120	GENERAL INSTRUCTION BUILDING	Instruction	4.78	29	0	0	29
2016	Presidio Of Monterey	Presidio of Monterey	207	1941	17120	GENERAL INSTRUCTION BUILDING	Instruction	4.78	29	0	0	29
2016	Presidio Of Monterey	Presidio of Monterey	208	1910	74010	AUDITORIUM, GENERAL PURPOSE	Instruction	4.46	0	24	0	24
2016	Presidio Of Monterey	Presidio of Monterey	209	1903	17136	AUTOMATION-AIDED INSTRUCTIONAL BUILDING	Instruction	0.503	0	29	0	29
2016	Presidio Of Monterey	Presidio of Monterey	209	1903	17120	GENERAL INSTRUCTION BUILDING	Instruction	8.996	29	0	0	29
2016	Presidio Of Monterey	Presidio of Monterey	210	1903	17120	GENERAL INSTRUCTION BUILDING	Instruction	6.825	29	0	0	29
2016	Presidio Of Monterey	Presidio of Monterey	211	1903	17120	GENERAL INSTRUCTION BUILDING	Instruction	8.707	29	0	0	29
2016	Presidio Of Monterey	Presidio of Monterey	211	1903	17136	AUTOMATION-AIDED INSTRUCTIONAL BUILDING	Instruction	0.727	0	29	0	29
2016	Presidio Of Monterey	Presidio of Monterey	212	1903	17120	GENERAL INSTRUCTION BUILDING	Instruction	4.908	29	0	0	29
2016	Presidio Of Monterey	Presidio of Monterey	212	1903	74062	FAST FOOD/SNACK BAR	Support	5.214	0	30	0	30
2016	Presidio Of Monterey	Presidio of Monterey	213	1903	17120	GENERAL INSTRUCTION BUILDING	Instruction	9.472	29	0	0	29
2016	Presidio Of Monterey	Presidio of Monterey	214	1903	17120	GENERAL INSTRUCTION BUILDING	Instruction	4.663	29	0	0	29
2016	Presidio Of Monterey	Presidio of Monterey	214	1903	17136	AUTOMATION-AIDED INSTRUCTIONAL BUILDING	Instruction	1.498	0	29	0	29
2016	Presidio Of Monterey	Presidio of Monterey	215	1903	17120	GENERAL INSTRUCTION BUILDING	Instruction	3.491	29	0	0	29
2016	Presidio Of Monterey	Presidio of Monterey	215	1903	17136	AUTOMATION-AIDED INSTRUCTIONAL BUILDING	Instruction	5.529	0	29	0	29
2016	Presidio Of Monterey	Presidio of Monterey	216	1903	17120	GENERAL INSTRUCTION BUILDING	Instruction	8.326	29	0	0	29
2016	Presidio Of Monterey	Presidio of Monterey	218	1903	17120	GENERAL INSTRUCTION BUILDING	Instruction	3.875	29	0	0	29

FY	Installation Name	Site Name	Facility Number	Year Built	Cat. Code	Cat. Desc.	Broad Building Type	KSF	ASHRAE 100 equivalent	Proposed ASHRAE 100 Equivalent	Non-ASHRAE 100 proposed code	Code used
2016	Presidio Of Monterey	Presidio of Monterey	218	1903	17136	AUTOMATION-AIDED INSTRUCTIONAL BUILDING	Instruction	2.256	0	29	0	29
2016	Presidio Of Monterey	Presidio of Monterey	219	1904	73016	POLICE/MP STATION	Support	0.659	0	14	0	14
2016	Presidio Of Monterey	Presidio of Monterey	220	1908	61050	ADMINISTRATION BUILDING, GENERAL PURPOSE	Support	3.714	1	0	0	1
2016	Presidio Of Monterey	Presidio of Monterey	221	1904	17120	GENERAL INSTRUCTION BUILDING	Instruction	8.754	29	0	0	29
2016	Presidio Of Monterey	Presidio of Monterey	228	1934	74065	RECREATIONAL EQUIPMENT CHECKOUT	Support	20.501	0	40	0	40
2016	Presidio Of Monterey	Presidio of Monterey	230	1941	74052	EXCHANGE AUTOMOTIVE SERVICE STATION	Support	1.184	0	44	0	44
2016	Presidio Of Monterey	Presidio of Monterey	233	1943	13185	PRINT PLANT BUILDING	Support	9.348	0	43	0	43
2016	Presidio Of Monterey	Presidio of Monterey	235	1987	44220	STORAGE BUILDING, GENERAL PURPOSE, INSTALLATION	Support	34.008	9	0	0	9
2016	Presidio Of Monterey	Presidio of Monterey	254	1929	61050	ADMINISTRATION BUILDING, GENERAL PURPOSE	Support	0.911	1	0	0	1
2016	Presidio Of Monterey	Presidio of Monterey	257	1932	61070	RED CROSS BUILDING	Support	2.262	6	0	0	6
2016	Presidio Of Monterey	Presidio of Monterey	261	1903	44220	STORAGE BUILDING, GENERAL PURPOSE, INSTALLATION	Support	3.73	9	0	0	9
2016	Presidio Of Monterey	Presidio of Monterey	263	1915	44224	ORGANIZATIONAL STORAGE BUILDING	Support	4.306	9	0	0	9
2016	Presidio Of Monterey	Presidio of Monterey	263	1915	17120	GENERAL INSTRUCTION BUILDING	Instruction	3.086	29	0	0	29
2016	Presidio Of Monterey	Presidio of Monterey	263	1915	61050	ADMINISTRATION BUILDING, GENERAL PURPOSE	Support	1.62	1	0	0	1
2016	Presidio Of Monterey	Presidio of Monterey	267	1903	17120	GENERAL INSTRUCTION BUILDING	Instruction	4.58	29	0	0	29
2016	Presidio Of Monterey	Presidio of Monterey	268	1903	21910	ENGINEERING/HOUSING MAINTENANCE SHOP	Support	4.745	43	0	0	43
2016	Presidio Of Monterey	Presidio of Monterey	269	1912	44220	STORAGE BUILDING, GENERAL PURPOSE, INSTALLATION	Support	3.308	9	0	0	9
2016	Presidio Of Monterey	Presidio of Monterey	271	1940	21910	ENGINEERING/HOUSING MAINTENANCE SHOP	Support	1.113	43	0	0	43
2016	Presidio Of Monterey	Presidio of Monterey	272	1922	17120	GENERAL INSTRUCTION BUILDING	Instruction	2.758	29	0	0	29
2016	Presidio Of Monterey	Presidio of Monterey	272	1922	61050	ADMINISTRATION BUILDING, GENERAL PURPOSE	Support	2.9	1	0	0	1
2016	Presidio Of Monterey	Presidio of Monterey	273	1903	17120	GENERAL INSTRUCTION BUILDING	Instruction	9.258	29	0	0	29
2016	Presidio Of Monterey	Presidio of Monterey	274	1903	61050	ADMINISTRATION BUILDING, GENERAL PURPOSE	Support	2.866	1	0	0	1
2016	Presidio Of Monterey	Presidio of Monterey	274	1903	17120	GENERAL INSTRUCTION BUILDING	Instruction	3.784	29	0	0	29
2016	Presidio Of Monterey	Presidio of Monterey	275	1903	61050	ADMINISTRATION BUILDING, GENERAL PURPOSE	Support	6.743	1	0	0	1
2016	Presidio Of Monterey	Presidio of Monterey	275	1903	61065	TECHNICAL LIBRARY	Support	1.0	21	0	0	21
2016	Presidio Of Monterey	Presidio of Monterey	275	1903	61075	COURTROOM	Support	1.1	3	0	0	3
2016	Presidio Of Monterey	Presidio of Monterey	276	1903	61050	ADMINISTRATION BUILDING, GENERAL PURPOSE	Support	8.558	1	0	0	1
2016	Presidio Of Monterey	Presidio of Monterey	276	1903	73028	DRUG AND ALCOHOL ABUSE COUNSELING CENTER	Support	1.168	0	46	0	46
2016	Presidio Of Monterey	Presidio of Monterey	277	1935	61050	ADMINISTRATION BUILDING, GENERAL PURPOSE	Support	9.062	1	0	0	1

FY	Installation Name	Site Name	Facility Number	Year Built	Cat. Code	Cat. Desc.	Broad Building Type	KSF	ASHRAE 100 equivalent	Proposed ASHRAE 100 Equivalent	Non-ASHRAE 100 proposed code	Code used
2016	Presidio Of Monterey	Presidio of Monterey	278	1914	61050	ADMINISTRATION BUILDING, GENERAL PURPOSE	Support	0.571	1	0	0	1
2016	Presidio Of Monterey	Presidio of Monterey	281	1921	44220	STORAGE BUILDING, GENERAL PURPOSE, INSTALLATION	Support	5.152	9	0	0	9
2016	Presidio Of Monterey	Presidio of Monterey	282	1903	44220	STORAGE BUILDING, GENERAL PURPOSE, INSTALLATION	Support	0.78	9	0	0	9
2016	Presidio Of Monterey	Presidio of Monterey	324	1941	73018	RELIGIOUS EDUCATION FACILITY	Support	8.34	0	23	0	23
2016	Presidio Of Monterey	Presidio of Monterey	325	1941	73017	CHAPEL	Support	3.341	0	19	0	19
2016	Presidio Of Monterey	Presidio of Monterey	326	1904	17120	GENERAL INSTRUCTION BUILDING	Instruction	18.403	29	0	0	29
2016	Presidio Of Monterey	Presidio of Monterey	339	1943	17120	GENERAL INSTRUCTION BUILDING	Instruction	5.654	29	0	0	29
2016	Presidio Of Monterey	Presidio of Monterey	340	1943	17120	GENERAL INSTRUCTION BUILDING	Instruction	5.654	29	0	0	29
2016	Presidio Of Monterey	Presidio of Monterey	343	1942	13120	COMMUNICATIONS CENTER	Support	2.279	0	0	100	100
2016	Presidio Of Monterey	Presidio of Monterey	344	2003	13115	INFORMATION SYSTEMS FACILITY	Support	6.577	0	0	100	100
2016	Presidio Of Monterey	Presidio of Monterey	354	1903	72010	ARMY LODGING	Support	2.46	52	0	0	52
2016	Presidio Of Monterey	Presidio of Monterey	356	1903	72010	ARMY LODGING	Support	2.033	52	0	0	52
2016	Presidio Of Monterey	Presidio of Monterey	358	1903	72010	ARMY LODGING	Support	2.252	52	0	0	52
2016	Presidio Of Monterey	Presidio of Monterey	359	1903	72010	ARMY LODGING	Support	1.563	52	0	0	52
2016	Presidio Of Monterey	Presidio of Monterey	364	1903	72010	ARMY LODGING	Support	1.314	52	0	0	52
2016	Presidio Of Monterey	Presidio of Monterey	417	2011	14129	TRAINING AIDS CENTER	Support	38.247	0	29	0	29
2016	Presidio Of Monterey	Presidio of Monterey	418	1962	13175	TELEVIDEO CENTER	Support	5.853	0	46	0	46
2016	Presidio Of Monterey	Presidio of Monterey	419	1996	44220	STORAGE BUILDING, GENERAL PURPOSE, INSTALLATION	Support	0.32	9	0	0	9
2016	Presidio Of Monterey	Presidio of Monterey	420	2002	13175	TELEVIDEO CENTER	Support	5.5	0	46	0	46
2016	Presidio Of Monterey	Presidio of Monterey	421	2011	14113	ACCESS CONTROL FACILITY	Support	0.69	6	0	0	6
2016	Presidio Of Monterey	Presidio of Monterey	422	1977	54010	HEALTH CLINIC	Support	8.208	0	17	0	17
2016	Presidio Of Monterey	Presidio of Monterey	422	1977	55010	HEALTH CLINIC	Support	16.416	17	0	0	17
2016	Presidio Of Monterey	Presidio of Monterey	423	2006	54010	DENTAL CLINIC	Support	11.0	0	17	0	17
2016	Presidio Of Monterey	Presidio of Monterey	450	1903	17120	GENERAL INSTRUCTION BUILDING	Instruction	9.496	29	0	0	29
2016	Presidio Of Monterey	Presidio of Monterey	450	1903	17136	AUTOMATION-AIDED INSTRUCTIONAL BUILDING	Instruction	0.739	0	29	0	29
2016	Presidio Of Monterey	Presidio of Monterey	451	1903	17120	GENERAL INSTRUCTION BUILDING	Instruction	7.6	29	0	0	29
2016	Presidio Of Monterey	Presidio of Monterey	452	1903	17136	AUTOMATION-AIDED INSTRUCTIONAL BUILDING	Instruction	1.024	0	29	0	29
2016	Presidio Of Monterey	Presidio of Monterey	452	1903	17120	GENERAL INSTRUCTION BUILDING	Instruction	7.424	29	0	0	29
2016	Presidio Of Monterey	Presidio of Monterey	453	1903	17120	GENERAL INSTRUCTION BUILDING	Instruction	9.733	29	0	0	29

FY	Installation Name	Site Name	Facility Number	Year Built	Cat. Code	Cat. Desc.	Broad Building Type	KSF	ASHRAE 100 equivalent	Proposed ASHRAE 100 Equivalent	Non-ASHRAE 100 proposed code	Code used
2016	Presidio Of Monterey	Presidio of Monterey	453	1903	17136	AUTOMATION-AIDED INSTRUCTIONAL BUILDING	Instruction	0.601	0	29	0	29
2016	Presidio Of Monterey	Presidio of Monterey	454	1943	55010	HEALTH CLINIC	Support	3.041	17	0	0	17
2016	Presidio Of Monterey	Presidio of Monterey	517	1931	44224	ORGANIZATIONAL STORAGE BUILDING	Support	3.781	9	0	0	9
2016	Presidio Of Monterey	Presidio of Monterey	517	1931	61050	ADMINISTRATION BUILDING, GENERAL PURPOSE	Support	4.291	1	0	0	1
2016	Presidio Of Monterey	Presidio of Monterey	517	1931	74062	FAST FOOD/SNACK BAR	Support	1.325	0	30	0	30
2016	Presidio Of Monterey	Presidio of Monterey	517	1931	73072	POST OFFICE BRANCH	Support	1.553	0	42	0	42
2016	Presidio Of Monterey	Presidio of Monterey	518	1935	44224	ORGANIZATIONAL STORAGE BUILDING	Support	2.618	9	0	0	9
2016	Presidio Of Monterey	Presidio of Monterey	518	1935	61050	ADMINISTRATION BUILDING, GENERAL PURPOSE	Support	2.547	1	0	0	1
2016	Presidio Of Monterey	Presidio of Monterey	518	1935	74010	AUDITORIUM, GENERAL PURPOSE	Support	7.479	0	24	0	24
2016	Presidio Of Monterey	Presidio of Monterey	566	1986	74017	CHILD DEVELOPMENT CENTER-UNDER 6 YEARS OF AGE	Support	12.382	28	0	0	28
2016	Presidio Of Monterey	Presidio of Monterey	569	1986	44224	ORGANIZATIONAL STORAGE BUILDING	Support	0.082	9	0	0	9
2016	Presidio Of Monterey	Presidio of Monterey	570	1986	44224	ORGANIZATIONAL STORAGE BUILDING	Support	0.082	9	0	0	9
2016	Presidio Of Monterey	Presidio of Monterey	571	1986	44224	ORGANIZATIONAL STORAGE BUILDING	Support	0.082	9	0	0	9
2016	Presidio Of Monterey	Presidio of Monterey	572	1986	44224	ORGANIZATIONAL STORAGE BUILDING	Support	0.082	9	0	0	9
2016	Presidio Of Monterey	Presidio of Monterey	607	2012	17120	GENERAL INSTRUCTION BUILDING	Instruction	47.0	29	0	0	29
2016	Presidio Of Monterey	Presidio of Monterey	609	2003	14113	ACCESS CONTROL FACILITY	Support	0.058	6	0	0	6
2016	Presidio Of Monterey	Presidio of Monterey	610	1985	17120	GENERAL INSTRUCTION BUILDING	Instruction	74.658	29	0	0	29
2016	Presidio Of Monterey	Presidio of Monterey	610	1985	17136	AUTOMATION-AIDED INSTRUCTIONAL BUILDING	Instruction	6.235	0	29	0	29
2016	Presidio Of Monterey	Presidio of Monterey	611	2002	17120	GENERAL INSTRUCTION BUILDING	Instruction	27.894	29	0	0	29
2016	Presidio Of Monterey	Presidio of Monterey	611	2002	17136	AUTOMATION-AIDED INSTRUCTIONAL BUILDING	Instruction	2.706	0	29	0	29
2016	Presidio Of Monterey	Presidio of Monterey	612	0	14113	ACCESS CONTROL FACILITY	Support	0.8	6	0	0	6
2016	Presidio Of Monterey	Presidio of Monterey	613	2014	17120	GENERAL INSTRUCTION BUILDING	Instruction	66.791	29	0	0	29
2016	Presidio Of Monterey	Presidio of Monterey	614	1977	61050	ADMINISTRATION BUILDING, GENERAL PURPOSE	Support	27.941	1	0	0	1
2016	Presidio Of Monterey	Presidio of Monterey	615	1983	44224	ORGANIZATIONAL STORAGE BUILDING	Support	0.072	9	0	0	9
2016	Presidio Of Monterey	Presidio of Monterey	616	1988	14183	BATTALION HEADQUARTERS BUILDING	Support	5.123 3B		0	0 3B	
2016	Presidio Of Monterey	Presidio of Monterey	616	1988	61050	ADMINISTRATION BUILDING, GENERAL PURPOSE	Support	15.369	1	0	0	1
2016	Presidio Of Monterey	Presidio of Monterey	617	1987	17120	GENERAL INSTRUCTION BUILDING	Instruction	18.958	29	0	0	29
2016	Presidio Of Monterey	Presidio of Monterey	618	1975	17120	GENERAL INSTRUCTION BUILDING	Instruction	15.463	29	0	0	29
2016	Presidio Of Monterey	Presidio of Monterey	618	1975	13135	PHOTO LAB	Support	1.092	0	43	0	43

FY	Installation Name	Site Name	Facility Number	Year Built	Cat. Code	Cat. Desc.	Broad Building Type	KSF	ASHRAE 100 equivalent	Proposed ASHRAE 100 Equivalent	Non-ASHRAE 100 proposed code	Code used
2016	Presidio Of Monterey	Presidio of Monterey	619	1975	17120	GENERAL INSTRUCTION BUILDING	Instruction	19.979	29	0	0	29
2016	Presidio Of Monterey	Presidio of Monterey	619	1975	17136	AUTOMATION-AIDED INSTRUCTIONAL BUILDING	Instruction	2.939	0	29	0	29
2016	Presidio Of Monterey	Presidio of Monterey	620	1965	17120	GENERAL INSTRUCTION BUILDING	Instruction	37.138	29	0	0	29
2016	Presidio Of Monterey	Presidio of Monterey	620	1965	17136	AUTOMATION-AIDED INSTRUCTIONAL BUILDING	Instruction	2.599	0	29	0	29
2016	Presidio Of Monterey	Presidio of Monterey	621	1975	17120	GENERAL INSTRUCTION BUILDING	Instruction	28.361	29	0	0	29
2016	Presidio Of Monterey	Presidio of Monterey	621	1975	17136	AUTOMATION-AIDED INSTRUCTIONAL BUILDING	Instruction	3.629	0	29	0	29
2016	Presidio Of Monterey	Presidio of Monterey	622	1971	72111	ENLISTED UNACCOMPANIED PERSONNEL HOUSING	Barracks	61.07	35A	0	0	35A
2016	Presidio Of Monterey	Presidio of Monterey	622	1971	14185	COMPANY HEADQUARTERS BUIDLING	Support	7.411	1A	0	0	1A
2016	Presidio Of Monterey	Presidio of Monterey	622	1971	14183	BATTALION HEADQUARTERS BUILDING	Support	7.411	3B	0	0	3B
2016	Presidio Of Monterey	Presidio of Monterey	623	1975	17120	GENERAL INSTRUCTION BUILDING	Instruction	20.412	29	0	0	29
2016	Presidio Of Monterey	Presidio of Monterey	624	1957	17120	GENERAL INSTRUCTION BUILDING	Instruction	35.858	29	0	0	29
2016	Presidio Of Monterey	Presidio of Monterey	624	1957	17136	AUTOMATION-AIDED INSTRUCTIONAL BUILDING	Instruction	1.039	0	29	0	29
2016	Presidio Of Monterey	Presidio of Monterey	627	1957	72111	ENLISTED UNACCOMPANIED PERSONNEL HOUSING	Barracks	53.573	35A	0	0	35A
2016	Presidio Of Monterey	Presidio of Monterey	627	1957	14185	COMPANY HEADQUARTERS BUIDLING	Support	10.973	1A	0	0	1A
2016	Presidio Of Monterey	Presidio of Monterey	627	1957	72210	DINING FACILITY	Support	10.494	30A	0	0	30A
2016	Presidio Of Monterey	Presidio of Monterey	627	1957	14183	BATTALION HEADQUARTERS BUILDING	Support	5.246	3B	0	0	3B
2016	Presidio Of Monterey	Presidio of Monterey	629	1965	73032	LAUNDRY/DRY CLEANING PICK-UP POINT	Support	3.855	0	9	0	9
2016	Presidio Of Monterey	Presidio of Monterey	629	1965	72111	ENLISTED UNACCOMPANIED PERSONNEL HOUSING	Barracks	47.563	35A	0	0	35A
2016	Presidio Of Monterey	Presidio of Monterey	629	1965	14185	COMPANY HEADQUARTERS BUIDLING	Support	24.624	1A	0	0	1A
2016	Presidio Of Monterey	Presidio of Monterey	629	1965	17119	ORGANIZATIONAL CLASSROOM	Support	7.656	0	29	0	29
2016	Presidio Of Monterey	Presidio of Monterey	630	1969	14185	COMPANY HEADQUARTERS BUIDLING	Support	11.58	1A	0	0	1A
2016	Presidio Of Monterey	Presidio of Monterey	630	1969	17136	AUTOMATION-AIDED INSTRUCTIONAL BUILDING	Instruction	1.156	0	29	0	29
2016	Presidio Of Monterey	Presidio of Monterey	630	1969	74025	ARMY CONTINUEING EDUCATION SYSTEM FACILITY	Support	9.003	0	29	0	29
2016	Presidio Of Monterey	Presidio of Monterey	630	1969	72111	ENLISTED UNACCOMPANIED PERSONNEL HOUSING	Barracks	60.854	35A	0	0	35A
2016	Presidio Of Monterey	Presidio of Monterey	631	1967	17120	GENERAL INSTRUCTION BUILDING	Instruction	3.646	29	0	0	29
2016	Presidio Of Monterey	Presidio of Monterey	631	1967	17136	AUTOMATION-AIDED INSTRUCTIONAL BUILDING	Instruction	2.036	0	29	0	29
2016	Presidio Of Monterey	Presidio of Monterey	632	1967	17120	GENERAL INSTRUCTION BUILDING	Instruction	5.533	29	0	0	29
2016	Presidio Of Monterey	Presidio of Monterey	633	1967	61050	ADMINISTRATION BUILDING, GENERAL PURPOSE	Support	3.287	1	0	0	1
2016	Presidio Of Monterey	Presidio of Monterey	634	1967	17120	GENERAL INSTRUCTION BUILDING	Instruction	7.185	29	0	0	29

FY	Installation Name	Site Name	Facility Number	Year Built	Cat. Code	Cat. Desc.	Broad Building Type	KSF	ASHRAE 100 equivalent	Proposed ASHRAE 100 Equivalent	Non-ASHRAE 100 proposed code	Code used
2016	Presidio Of Monterey	Presidio of Monterey	635	1967	17136	AUTOMATION-AIDED INSTRUCTIONAL BUILDING	Instruction	0.992	0	29	0	29
2016	Presidio Of Monterey	Presidio of Monterey	635	1967	13175	TELEVIDEO CENTER	Support	4.69	0	46	0	46
2016	Presidio Of Monterey	Presidio of Monterey	636	1967	17120	GENERAL INSTRUCTION BUILDING	Instruction	5.682	29	0	0	29
2016	Presidio Of Monterey	Presidio of Monterey	637	1967	17136	AUTOMATION-AIDED INSTRUCTIONAL BUILDING	Instruction	5.682	0	29	0	29
2016	Presidio Of Monterey	Presidio of Monterey	645	1985	72111	ENLISTED UNACCOMPANIED PERSONNEL HOUSING	Barracks	23.746 35A		0	0 35A	
2016	Presidio Of Monterey	Presidio of Monterey	646	1985	72111	ENLISTED UNACCOMPANIED PERSONNEL HOUSING	Barracks	23.746 35A		0	0 35A	
2016	Presidio Of Monterey	Presidio of Monterey	647	1986	72111	ENLISTED UNACCOMPANIED PERSONNEL HOUSING	Barracks	23.533 35A		0	0 35A	
2016	Presidio Of Monterey	Presidio of Monterey	648	1986	72111	ENLISTED UNACCOMPANIED PERSONNEL HOUSING	Barracks	23.676 35A		0	0 35A	
2016	Presidio Of Monterey	Presidio of Monterey	649	1986	72111	ENLISTED UNACCOMPANIED PERSONNEL HOUSING	Barracks	23.533 35A		0	0 35A	
2016	Presidio Of Monterey	Presidio of Monterey	650	1986	72111	ENLISTED UNACCOMPANIED PERSONNEL HOUSING	Barracks	23.676 35A		0	0 35A	
2016	Presidio Of Monterey	Presidio of Monterey	651	1986	72111	ENLISTED UNACCOMPANIED PERSONNEL HOUSING	Barracks	23.533 35A		0	0 35A	
2016	Presidio Of Monterey	Presidio of Monterey	652	1986	72111	ENLISTED UNACCOMPANIED PERSONNEL HOUSING	Barracks	23.533 35A		0	0 35A	
2016	Presidio Of Monterey	Presidio of Monterey	660	1987	89121	HEATING PLANT BUILDING	Support	2.23	0	9	0	9
2016	Presidio Of Monterey	Presidio of Monterey	660	1987	74062	FAST FOOD/SNACK BAR	Support	1.905	0	30	0	30
2016	Presidio Of Monterey	Presidio of Monterey	660	1987	74056	EXCHANGE SERVICE OUTLET	Support	6.9	0	40	0	40
2016	Presidio Of Monterey	Presidio of Monterey	660	1987	74055	EXCHANGE WAREHOUSE	Support	4.865	0	9	0	9
2016	Presidio Of Monterey	Presidio of Monterey	660	1987	74053	EXCHANGE MAIN RETAIL STORE	Support	16.3	40	0	0	40
2016	Presidio Of Monterey	Presidio of Monterey	824	1985	13170	RECEIVER BUILDING	Support	0.053	0	9	0	9
2016	Presidio Of Monterey	Presidio of Monterey	829	2005	72111	ENLISTED UNACCOMPANIED PERSONNEL HOUSING	Support	23.1 35A		0	0 35A	
2016	Presidio Of Monterey	Presidio of Monterey	830	1987	14185	COMPANY HEADQUARTERS BUIDLING	Support	7.698 1A		0	0 1A	
2016	Presidio Of Monterey	Presidio of Monterey	831	1986	72111	ENLISTED UNACCOMPANIED PERSONNEL HOUSING	Barracks	23.032 35A		0	0 35A	
2016	Presidio Of Monterey	Presidio of Monterey	832	1986	72111	ENLISTED UNACCOMPANIED PERSONNEL HOUSING	Barracks	23.032 35A		0	0 35A	
2016	Presidio Of Monterey	Presidio of Monterey	833	1986	72111	ENLISTED UNACCOMPANIED PERSONNEL HOUSING	Barracks	23.032 35A		0	0 35A	
2016	Presidio Of Monterey	Presidio of Monterey	834	1987	14185	COMPANY HEADQUARTERS BUIDLING	Support	7.698 1A		0	0 1A	
2016	Presidio Of Monterey	Presidio of Monterey	835	1996	72111	ENLISTED UNACCOMPANIED PERSONNEL HOUSING	Barracks	23.032 35A		0	0 35A	
2016	Presidio Of Monterey	Presidio of Monterey	836	1996	72111	ENLISTED UNACCOMPANIED PERSONNEL HOUSING	Barracks	23.46 35A		0	0 35A	
2016	Presidio Of Monterey	Presidio of Monterey	838	1988	72210	DINING FACILITY	Support	11.565 30A		0	0 30A	
2016	Presidio Of Monterey	Presidio of Monterey	840	1986	72111	ENLISTED UNACCOMPANIED PERSONNEL HOUSING	Barracks	23.032 35A		0	0 35A	
2016	Presidio Of Monterey	Presidio of Monterey	841	1986	72111	ENLISTED UNACCOMPANIED PERSONNEL HOUSING	Barracks	23.032 35A		0	0 35A	

FY	Installation Name	Site Name	Facility Number	Year Built	Cat. Code	Cat. Desc.	Broad Building Type	KSF	ASHRAE 100	Proposed ASHRAE 100	Non-ASHRAE 100 proposed code	Code used
									equivalent	Equivalent		
2016	Presidio Of Monterey	Presidio of Monterey	842	1987	74028	PHYSICAL FITNESS CENTER	Support	72.759	22	0	0	22
2016	Presidio Of Monterey	Presidio of Monterey	843	1987	74068	RECREATION CENTER	Support	8.431	0	22	0	22
2016	Presidio Of Monterey	Presidio of Monterey	848	1986	17120	GENERAL INSTRUCTION BUILDING	Instruction	69.878	29	0	0	29
2016	Presidio Of Monterey	Presidio of Monterey	848L	1986	17136	AUTOMATION-AIDED INSTRUCTIONAL BUILDING	Instruction	8.099	0	29	0	29

Data compiled from sources outlined in Chapter III.

Table 6. Facility Numbers and Modeled Energy Usage and Costs.

						89,470,332	38,337,616	51,132,716	89,470	\$ 2,134,774	\$ 510,985	\$ 2,645,759
FY	Installation Name	Site Name	Facility Number	Base case EUI (kBtu/SF*year)	Adjusted building EUI	Modeled Energy /year (kBtu)	Modeled Electrical kBtu/year	Modeled Gas kBtu/year	Modeled Total Annual Energy (MBtu)	Modeled Annual Electric Cost	Modeled Annual Gas Cost	Modeled Annual cost
2016	Presidio Of Monterey	Ord Military Community	4220	29	29	260,217	256,598	3,619	260	\$ 14,288	\$ 36	\$ 14,324
2016	Presidio Of Monterey	Ord Military Community	4227	270	270	674,190	81,050	593,140	674	\$ 4,513	\$ 5,927	\$ 10,441
2016	Presidio Of Monterey	Ord Military Community	4235	24	24	1,800,000	1,132,095	667,905	1,800	\$ 63,039	\$ 6,675	\$ 69,714
2016	Presidio Of Monterey	Ord Military Community	4250	160	160	296,000	291,621	4,379	296	\$ 16,239	\$ 44	\$ 16,282
2016	Presidio Of Monterey	Ord Military Community	4250	33	33	214,500	153,733	60,767	215	\$ 8,560	\$ 607	\$ 9,168
2016	Presidio Of Monterey	Ord Military Community	4251	7	7	24,010	17,207	6,803	24	\$ 958	\$ 68	\$ 1,026
2016	Presidio Of Monterey	Ord Military Community	4251	33	33	101,310	72,609	28,701	101	\$ 4,043	\$ 287	\$ 4,330
2016	Presidio Of Monterey	Ord Military Community	4260	137	137	4,156,443	2,184,232	1,972,211	4,156	\$ 121,626	\$ 19,709	\$ 141,335
2016	Presidio Of Monterey	Ord Military Community	4260	54	54	284,742	237,011	47,731	285	\$ 13,198	\$ 477	\$ 13,675
2016	Presidio Of Monterey	Ord Military Community	4260	33	33	1,187,109	850,804	336,305	1,187	\$ 47,376	\$ 3,361	\$ 50,737
2016	Presidio Of Monterey	Ord Military Community	4260	24	24	-	-	-	-	\$ -	\$ -	\$ -
2016	Presidio Of Monterey	Ord Military Community	4275	55	55	792,000	249,883	542,117	792	\$ 13,914	\$ 5,418	\$ 19,332
2016	Presidio Of Monterey	Ord Military Community	4280	21	21	559,986	66,257	493,729	560	\$ 3,689	\$ 4,934	\$ 8,623
2016	Presidio Of Monterey	Ord Military Community	4283	41	41	615,000	398,306	216,694	615	\$ 22,179	\$ 2,165	\$ 24,345
2016	Presidio Of Monterey	Ord Military Community	4283C	7	7	1,400	1,003	397	1	\$ 56	\$ 4	\$ 60
2016	Presidio Of Monterey	Ord Military Community	4380	40	40	225,080	128,140	96,940	225	\$ 7,135	\$ 969	\$ 8,104
2016	Presidio Of Monterey	Ord Military Community	4390	62	62	353,214	108,520	244,694	353	\$ 6,043	\$ 2,445	\$ 8,488
2016	Presidio Of Monterey	Ord Military Community	4396	32	25.6	47,309	23,654	23,654	47	\$ 1,317	\$ 236	\$ 1,554
2016	Presidio Of Monterey	Ord Military Community	4397	21	16.8	31,046	17,624	13,422	31	\$ 981	\$ 134	\$ 1,116
2016	Presidio Of Monterey	Ord Military Community	4398	21	16.8	31,046	17,624	13,422	31	\$ 981	\$ 134	\$ 1,116
2016	Presidio Of Monterey	Ord Military Community	4399	159	159	238,500	119,250	119,250	239	\$ 6,640	\$ 1,192	\$ 7,832
2016	Presidio Of Monterey	Ord Military Community	4399	21	21	294,504	167,184	127,320	295	\$ 9,309	\$ 1,272	\$ 10,582
2016	Presidio Of Monterey	Ord Military Community	4399 portables									
2016	Presidio Of Monterey	Ord Military Community	4400	59	59	407,454	273,038	134,416	407	\$ 15,204	\$ 1,343	\$ 16,547
2016	Presidio Of Monterey	Ord Military Community	4403	59	59	221,250	148,261	72,989	221	\$ 8,256	\$ 729	\$ 8,985

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2016	Presidio Of Monterey	Ord Military Community	4455	33	33	376,167	269,600	106,567	376	\$ 15,012	\$ 1,065	\$ 16,077
2016	Presidio Of Monterey	Ord Military Community	4463	33	33	323,301	231,711	91,590	323	\$ 12,902	\$ 915	\$ 13,818
2016	Presidio Of Monterey	Ord Military Community	4468	59	59	672,541	450,674	221,867	673	\$ 25,095	\$ 2,217	\$ 27,312
2016	Presidio Of Monterey	Ord Military Community	4495	7	7	36,379	26,071	10,308	36	\$ 1,452	\$ 103	\$ 1,555
2016	Presidio Of Monterey	Ord Military Community	4495	33	33	115,005	82,424	32,581	115	\$ 4,590	\$ 326	\$ 4,915
2016	Presidio Of Monterey	Ord Military Community	4497	7	7	4,949	3,547	1,402	5	\$ 197	\$ 14	\$ 212
2016	Presidio Of Monterey	Ord Military Community	4499	25	25	181,700	93,468	88,232	182	\$ 5,205	\$ 882	\$ 6,086
2016	Presidio Of Monterey	Ord Military Community	4499	7	7	50,869	36,456	14,413	51	\$ 2,030	\$ 144	\$ 2,174
2016	Presidio Of Monterey	Ord Military Community	4499A	7	7	11,564	8,287	3,277	12	\$ 461	\$ 33	\$ 494
2016	Presidio Of Monterey	Ord Military Community	4499B	7	7	11,564	8,287	3,277	12	\$ 461	\$ 33	\$ 494
2016	Presidio Of Monterey	Ord Military Community	4503	7	7	2,541	1,821	720	3	\$ 101	\$ 7	\$ 109
2016	Presidio Of Monterey	Ord Military Community	4506	25	25	363,000	186,731	176,269	363	\$ 10,398	\$ 1,762	\$ 12,159
2016	Presidio Of Monterey	Ord Military Community	4506A	7	7	11,564	8,287	3,277	12	\$ 461	\$ 33	\$ 494
2016	Presidio Of Monterey	Ord Military Community	4506B	7	7	11,564	8,287	3,277	12	\$ 461	\$ 33	\$ 494
2016	Presidio Of Monterey	Ord Military Community	4512	7	7	101,619	72,827	28,792	102	\$ 4,055	\$ 288	\$ 4,343
2016	Presidio Of Monterey	Ord Military Community	4512A	7	7	11,564	8,287	3,277	12	\$ 461	\$ 33	\$ 494
2016	Presidio Of Monterey	Ord Military Community	4512B	7	7	11,564	8,287	3,277	12	\$ 461	\$ 33	\$ 494
2016	Presidio Of Monterey	Ord Military Community	4516	7	7	2,590	1,856	734	3	\$ 103	\$ 7	\$ 111
2016	Presidio Of Monterey	Ord Military Community	4522	25	25	194,575	100,091	94,484	195	\$ 5,573	\$ 944	\$ 6,518
2016	Presidio Of Monterey	Ord Military Community	4522A	7	7	13,216	9,471	3,745	13	\$ 527	\$ 37	\$ 565
2016	Presidio Of Monterey	Ord Military Community	7693	41	41	975,800	631,979	343,821	976	\$ 35,191	\$ 3,436	\$ 38,627
2016	Presidio Of Monterey	Presidio of Monterey	0343G	7	7	2,520	1,806	714	3	\$ 101	\$ 7	\$ 108
2016	Presidio Of Monterey	Presidio of Monterey	0614G	7	7	3,024	2,167	857	3	\$ 121	\$ 9	\$ 129
2016	Presidio Of Monterey	Presidio of Monterey	0620A	160	160	35,520	34,995	525	36	\$ 1,949	\$ 5	\$ 1,954
2016	Presidio Of Monterey	Presidio of Monterey	0622A	7	7	700	502	198	1	\$ 28	\$ 2	\$ 30
2016	Presidio Of Monterey	Presidio of Monterey	0622B	7	7	700	502	198	1	\$ 28	\$ 2	\$ 30

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2016	Presidio Of Monterey	Presidio of Monterey	0622C	7	7	1,680	1,204	476	2 \$	67 \$	5 \$	72
2016	Presidio Of Monterey	Presidio of Monterey	0627A	7	7	1,400	1,003	397	1 \$	56 \$	4 \$	60
2016	Presidio Of Monterey	Presidio of Monterey	0627B	7	7	700	502	198	1 \$	28 \$	2 \$	30
2016	Presidio Of Monterey	Presidio of Monterey	0627C	7	7	3,024	2,167	857	3 \$	121 \$	9 \$	129
2016	Presidio Of Monterey	Presidio of Monterey	0629A	7	7	700	502	198	1 \$	28 \$	2 \$	30
2016	Presidio Of Monterey	Presidio of Monterey	0629B	7	7	700	502	198	1 \$	28 \$	2 \$	30
2016	Presidio Of Monterey	Presidio of Monterey	0630A	7	7	700	502	198	1 \$	28 \$	2 \$	30
2016	Presidio Of Monterey	Presidio of Monterey	0630B	7	7	700	502	198	1 \$	28 \$	2 \$	30
2016	Presidio Of Monterey	Presidio of Monterey	0634G	7	7	1,505	1,079	426	2 \$	60 \$	4 \$	64
2016	Presidio Of Monterey	Presidio of Monterey	0830G	7	7	1,638	1,174	464	2 \$	65 \$	5 \$	70
2016	Presidio Of Monterey	Presidio of Monterey	0831A	7	7	700	502	198	1 \$	28 \$	2 \$	30
2016	Presidio Of Monterey	Presidio of Monterey	0840A	7	7	700	502	198	1 \$	28 \$	2 \$	30
2016	Presidio Of Monterey	Presidio of Monterey	105	7	7	34,342	24,612	9,730	34 \$	1,370 \$	97 \$	1,468
2016	Presidio Of Monterey	Presidio of Monterey	112	32	32	8,224	4,112	4,112	8 \$	229 \$	41 \$	270
2016	Presidio Of Monterey	Presidio of Monterey	113	42	42	76,146	38,073	38,073	76 \$	2,120 \$	380 \$	2,501
2016	Presidio Of Monterey	Presidio of Monterey	115	32	32	43,200	21,600	21,600	43 \$	1,203 \$	216 \$	1,419
2016	Presidio Of Monterey	Presidio of Monterey	203	32	32	25,600	12,800	12,800	26 \$	713 \$	128 \$	841
2016	Presidio Of Monterey	Presidio of Monterey	204	21	21	100,380	56,984	43,396	100 \$	3,173 \$	434 \$	3,607
2016	Presidio Of Monterey	Presidio of Monterey	205	21	21	100,380	56,984	43,396	100 \$	3,173 \$	434 \$	3,607
2016	Presidio Of Monterey	Presidio of Monterey	206	21	21	100,380	56,984	43,396	100 \$	3,173 \$	434 \$	3,607
2016	Presidio Of Monterey	Presidio of Monterey	207	21	21	100,380	56,984	43,396	100 \$	3,173 \$	434 \$	3,607
2016	Presidio Of Monterey	Presidio of Monterey	208	25	25	111,500	51,607	59,893	112 \$	2,874 \$	599 \$	3,472
2016	Presidio Of Monterey	Presidio of Monterey	209	21	21	10,563	5,996	4,567	11 \$	334 \$	46 \$	380
2016	Presidio Of Monterey	Presidio of Monterey	209	21	21	188,916	107,244	81,672	189 \$	5,972 \$	816 \$	6,788
2016	Presidio Of Monterey	Presidio of Monterey	210	21	21	143,325	81,363	61,962	143 \$	4,531 \$	619 \$	5,150
2016	Presidio Of Monterey	Presidio of Monterey	211	21	21	182,847	103,798	79,049	183 \$	5,780 \$	790 \$	6,570

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2016	Presidio Of Monterey	Presidio of Monterey	211	21	21	15,267	8,667	6,600	15	\$ 483	\$ 66	\$ 549
2016	Presidio Of Monterey	Presidio of Monterey	212	21	21	103,068	58,510	44,558	103	\$ 3,258	\$ 445	\$ 3,703
2016	Presidio Of Monterey	Presidio of Monterey	212	253	253	1,319,142	659,571	659,571	1,319	\$ 36,727	\$ 6,591	\$ 43,319
2016	Presidio Of Monterey	Presidio of Monterey	213	21	21	198,912	112,918	85,994	199	\$ 6,288	\$ 859	\$ 7,147
2016	Presidio Of Monterey	Presidio of Monterey	214	21	21	97,923	55,589	42,334	98	\$ 3,095	\$ 423	\$ 3,518
2016	Presidio Of Monterey	Presidio of Monterey	214	21	21	31,458	17,858	13,600	31	\$ 994	\$ 136	\$ 1,130
2016	Presidio Of Monterey	Presidio of Monterey	215	21	21	73,311	41,617	31,694	73	\$ 2,317	\$ 317	\$ 2,634
2016	Presidio Of Monterey	Presidio of Monterey	215	21	21	116,109	65,913	50,196	116	\$ 3,670	\$ 502	\$ 4,172
2016	Presidio Of Monterey	Presidio of Monterey	216	21	21	174,846	99,256	75,590	175	\$ 5,527	\$ 755	\$ 6,282
2016	Presidio Of Monterey	Presidio of Monterey	218	21	21	81,375	46,195	35,180	81	\$ 2,572	\$ 352	\$ 2,924
2016	Presidio Of Monterey	Presidio of Monterey	218	21	21	47,376	26,894	20,482	47	\$ 1,498	\$ 205	\$ 1,702
2016	Presidio Of Monterey	Presidio of Monterey	219	59	59	38,881	26,054	12,827	39	\$ 1,451	\$ 128	\$ 1,579
2016	Presidio Of Monterey	Presidio of Monterey	220	33	33	122,562	87,840	34,722	123	\$ 4,891	\$ 347	\$ 5,238
2016	Presidio Of Monterey	Presidio of Monterey	221	21	21	183,834	104,359	79,475	184	\$ 5,811	\$ 794	\$ 6,605
2016	Presidio Of Monterey	Presidio of Monterey	228	24	24	492,024	309,455	182,569	492	\$ 17,232	\$ 1,824	\$ 19,056
2016	Presidio Of Monterey	Presidio of Monterey	230	29	29	34,336	33,858	478	34	\$ 1,885	\$ 5	\$ 1,890
2016	Presidio Of Monterey	Presidio of Monterey	233	25	25	233,700	120,218	113,482	234	\$ 6,694	\$ 1,134	\$ 7,828
2016	Presidio Of Monterey	Presidio of Monterey	235	7	7	238,056	170,606	67,450	238	\$ 9,500	\$ 674	\$ 10,174
2016	Presidio Of Monterey	Presidio of Monterey	254	33	33	30,063	21,546	8,517	30	\$ 1,200	\$ 85	\$ 1,285
2016	Presidio Of Monterey	Presidio of Monterey	257	32	32	72,384	36,192	36,192	72	\$ 2,015	\$ 362	\$ 2,377
2016	Presidio Of Monterey	Presidio of Monterey	261	7	7	26,110	18,712	7,398	26	\$ 1,042	\$ 74	\$ 1,116
2016	Presidio Of Monterey	Presidio of Monterey	263	7	7	30,142	21,602	8,540	30	\$ 1,203	\$ 85	\$ 1,288
2016	Presidio Of Monterey	Presidio of Monterey	263	21	21	64,806	36,789	28,017	65	\$ 2,049	\$ 280	\$ 2,329
2016	Presidio Of Monterey	Presidio of Monterey	263	33	33	53,460	38,315	15,145	53	\$ 2,134	\$ 151	\$ 2,285
2016	Presidio Of Monterey	Presidio of Monterey	267	21	21	96,180	54,599	41,581	96	\$ 3,040	\$ 416	\$ 3,456
2016	Presidio Of Monterey	Presidio of Monterey	268	25	25	118,625	61,022	57,603	119	\$ 3,398	\$ 576	\$ 3,974

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2016	Presidio Of Monterey	Presidio of Monterey	269	7	7	23,156	16,595	6,561	23	\$ 924	\$ 66	\$ 990
2016	Presidio Of Monterey	Presidio of Monterey	271	25	25	27,825	14,313	13,512	28	\$ 797	\$ 135	\$ 932
2016	Presidio Of Monterey	Presidio of Monterey	272	21	21	57,918	32,879	25,039	58	\$ 1,831	\$ 250	\$ 2,081
2016	Presidio Of Monterey	Presidio of Monterey	272	33	33	95,700	68,588	27,112	96	\$ 3,819	\$ 271	\$ 4,090
2016	Presidio Of Monterey	Presidio of Monterey	273	21	21	194,418	110,367	84,051	194	\$ 6,146	\$ 840	\$ 6,986
2016	Presidio Of Monterey	Presidio of Monterey	274	33	33	94,578	67,784	26,794	95	\$ 3,774	\$ 268	\$ 4,042
2016	Presidio Of Monterey	Presidio of Monterey	274	21	21	79,464	45,110	34,354	79	\$ 2,512	\$ 343	\$ 2,855
2016	Presidio Of Monterey	Presidio of Monterey	275	33	33	222,519	159,480	63,039	223	\$ 8,880	\$ 630	\$ 9,510
2016	Presidio Of Monterey	Presidio of Monterey	275	55	55	55,000	17,353	37,647	55	\$ 966	\$ 376	\$ 1,342
2016	Presidio Of Monterey	Presidio of Monterey	275	42	42	46,200	23,100	23,100	46	\$ 1,286	\$ 231	\$ 1,517
2016	Presidio Of Monterey	Presidio of Monterey	276	33	33	282,414	202,407	80,007	282	\$ 11,271	\$ 800	\$ 12,070
2016	Presidio Of Monterey	Presidio of Monterey	276	54	54	63,072	52,499	10,573	63	\$ 2,923	\$ 106	\$ 3,029
2016	Presidio Of Monterey	Presidio of Monterey	277	33	33	299,046	214,327	84,719	299	\$ 11,934	\$ 847	\$ 12,781
2016	Presidio Of Monterey	Presidio of Monterey	278	33	33	18,843	13,505	5,338	19	\$ 752	\$ 53	\$ 805
2016	Presidio Of Monterey	Presidio of Monterey	281	7	7	36,064	25,846	10,218	36	\$ 1,439	\$ 102	\$ 1,541
2016	Presidio Of Monterey	Presidio of Monterey	282	7	7	5,460	3,913	1,547	5	\$ 218	\$ 15	\$ 233
2016	Presidio Of Monterey	Presidio of Monterey	324	25	25	208,500	65,497	143,003	209	\$ 3,647	\$ 1,429	\$ 5,076
2016	Presidio Of Monterey	Presidio of Monterey	325	21	21	70,161	8,301	61,860	70	\$ 462	\$ 618	\$ 1,080
2016	Presidio Of Monterey	Presidio of Monterey	326	21	21	386,463	219,387	167,076	386	\$ 12,216	\$ 1,670	\$ 13,886
2016	Presidio Of Monterey	Presidio of Monterey	339	21	21	118,734	67,403	51,331	119	\$ 3,753	\$ 513	\$ 4,266
2016	Presidio Of Monterey	Presidio of Monterey	340	21	21	118,734	67,403	51,331	119	\$ 3,753	\$ 513	\$ 4,266
2016	Presidio Of Monterey	Presidio of Monterey	343	160	160	364,640	359,246	5,394	365	\$ 20,004	\$ 54	\$ 20,058
2016	Presidio Of Monterey	Presidio of Monterey	344	160	160	1,052,320	1,036,754	15,566	1,052	\$ 57,730	\$ 156	\$ 57,886
2016	Presidio Of Monterey	Presidio of Monterey	354	47	47	115,620	105,381	10,239	116	\$ 5,868	\$ 102	\$ 5,970
2016	Presidio Of Monterey	Presidio of Monterey	356	47	47	95,551	87,089	8,462	96	\$ 4,849	\$ 85	\$ 4,934
2016	Presidio Of Monterey	Presidio of Monterey	358	47	47	105,844	96,470	9,374	106	\$ 5,372	\$ 94	\$ 5,465

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2016	Presidio Of Monterey	Presidio of Monterey	359	47	47	73,461	66,955	6,506	73	\$ 3,728	\$ 65	\$ 3,793
2016	Presidio Of Monterey	Presidio of Monterey	364	47	47	61,758	56,289	5,469	62	\$ 3,134	\$ 55	\$ 3,189
2016	Presidio Of Monterey	Presidio of Monterey	417	21	16.8	642,550	364,762	277,788	643	\$ 20,311	\$ 2,776	\$ 23,087
2016	Presidio Of Monterey	Presidio of Monterey	418	54	54	316,062	263,081	52,981	316	\$ 14,649	\$ 529	\$ 15,179
2016	Presidio Of Monterey	Presidio of Monterey	419	7	7	2,240	1,605	635	2	\$ 89	\$ 6	\$ 96
2016	Presidio Of Monterey	Presidio of Monterey	420	54	54	297,000	247,215	49,785	297	\$ 13,766	\$ 498	\$ 14,263
2016	Presidio Of Monterey	Presidio of Monterey	421	32	25.6	17,664	8,832	8,832	18	\$ 492	\$ 88	\$ 580
2016	Presidio Of Monterey	Presidio of Monterey	422	40	40	328,320	186,915	141,405	328	\$ 10,408	\$ 1,413	\$ 11,821
2016	Presidio Of Monterey	Presidio of Monterey	422	40	40	656,640	373,830	282,810	657	\$ 20,816	\$ 2,826	\$ 23,642
2016	Presidio Of Monterey	Presidio of Monterey	423	40	40	440,000	250,495	189,505	440	\$ 13,948	\$ 1,894	\$ 15,842
2016	Presidio Of Monterey	Presidio of Monterey	450	21	21	199,416	113,204	86,212	199	\$ 6,304	\$ 862	\$ 7,165
2016	Presidio Of Monterey	Presidio of Monterey	450	21	21	15,519	8,810	6,709	16	\$ 491	\$ 67	\$ 558
2016	Presidio Of Monterey	Presidio of Monterey	451	21	21	159,600	90,602	68,998	160	\$ 5,045	\$ 690	\$ 5,735
2016	Presidio Of Monterey	Presidio of Monterey	452	21	21	21,504	12,207	9,297	22	\$ 680	\$ 93	\$ 773
2016	Presidio Of Monterey	Presidio of Monterey	452	21	21	155,904	88,503	67,401	156	\$ 4,928	\$ 674	\$ 5,602
2016	Presidio Of Monterey	Presidio of Monterey	453	21	21	204,393	116,030	88,363	204	\$ 6,461	\$ 883	\$ 7,344
2016	Presidio Of Monterey	Presidio of Monterey	453	21	21	12,621	7,165	5,456	13	\$ 399	\$ 55	\$ 453
2016	Presidio Of Monterey	Presidio of Monterey	454	40	40	121,640	69,251	52,389	122	\$ 3,856	\$ 524	\$ 4,380
2016	Presidio Of Monterey	Presidio of Monterey	517	7	7	26,467	18,968	7,499	26	\$ 1,056	\$ 75	\$ 1,131
2016	Presidio Of Monterey	Presidio of Monterey	517	33	33	141,603	101,487	40,116	142	\$ 5,651	\$ 401	\$ 6,052
2016	Presidio Of Monterey	Presidio of Monterey	517	253	253	335,225	167,613	167,613	335	\$ 9,333	\$ 1,675	\$ 11,008
2016	Presidio Of Monterey	Presidio of Monterey	517	38	38	59,014	29,507	29,507	59	\$ 1,643	\$ 295	\$ 1,938
2016	Presidio Of Monterey	Presidio of Monterey	518	7	7	18,326	13,134	5,192	18	\$ 731	\$ 52	\$ 783
2016	Presidio Of Monterey	Presidio of Monterey	518	33	33	84,051	60,240	23,811	84	\$ 3,354	\$ 238	\$ 3,592
2016	Presidio Of Monterey	Presidio of Monterey	518	25	25	186,975	86,541	100,434	187	\$ 4,819	\$ 1,004	\$ 5,823
2016	Presidio Of Monterey	Presidio of Monterey	566	41	41	507,662	328,789	178,873	508	\$ 18,308	\$ 1,788	\$ 20,096

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2016	Presidio Of Monterey	Presidio of Monterey	569	7	7	574	411	163	1 \$	23 \$	2 \$	25
2016	Presidio Of Monterey	Presidio of Monterey	570	7	7	574	411	163	1 \$	23 \$	2 \$	25
2016	Presidio Of Monterey	Presidio of Monterey	571	7	7	574	411	163	1 \$	23 \$	2 \$	25
2016	Presidio Of Monterey	Presidio of Monterey	572	7	7	574	411	163	1 \$	23 \$	2 \$	25
2016	Presidio Of Monterey	Presidio of Monterey	607	21	16.8	789,600	448,239	341,361	790 \$	24,960 \$	3,411 \$	28,371
2016	Presidio Of Monterey	Presidio of Monterey	609	32	32	1,856	928	928	2 \$	52 \$	9 \$	61
2016	Presidio Of Monterey	Presidio of Monterey	610	21	21	1,567,818	890,018	677,800	1,568 \$	49,559 \$	6,773 \$	56,333
2016	Presidio Of Monterey	Presidio of Monterey	610	21	21	130,935	74,329	56,606	131 \$	4,139 \$	566 \$	4,705
2016	Presidio Of Monterey	Presidio of Monterey	611	21	21	585,774	332,532	253,242	586 \$	18,517 \$	2,531 \$	21,047
2016	Presidio Of Monterey	Presidio of Monterey	611	21	21	56,826	32,259	24,567	57 \$	1,796 \$	246 \$	2,042
2016	Presidio Of Monterey	Presidio of Monterey	612	32	32	25,600	12,800	12,800	26 \$	713 \$	128 \$	841
2016	Presidio Of Monterey	Presidio of Monterey	613	21	16.8	1,122,089	636,986	485,102	1,122 \$	35,470 \$	4,848 \$	40,317
2016	Presidio Of Monterey	Presidio of Monterey	614	33	33	922,053	660,838	261,215	922 \$	36,798 \$	2,610 \$	39,408
2016	Presidio Of Monterey	Presidio of Monterey	615	7	7	504	361	143	1 \$	20 \$	1 \$	22
2016	Presidio Of Monterey	Presidio of Monterey	616	39	39	199,797	99,899	99,899	200 \$	5,563 \$	998 \$	6,561
2016	Presidio Of Monterey	Presidio of Monterey	616	33	33	507,177	363,495	143,682	507 \$	20,241 \$	1,436 \$	21,677
2016	Presidio Of Monterey	Presidio of Monterey	617	21	21	398,118	226,003	172,115	398 \$	12,585 \$	1,720 \$	14,305
2016	Presidio Of Monterey	Presidio of Monterey	618	21	21	324,723	184,338	140,385	325 \$	10,265 \$	1,403 \$	11,668
2016	Presidio Of Monterey	Presidio of Monterey	618	25	25	27,300	14,043	13,257	27 \$	782 \$	132 \$	914
2016	Presidio Of Monterey	Presidio of Monterey	619	21	21	419,559	238,175	181,384	420 \$	13,262 \$	1,813 \$	15,075
2016	Presidio Of Monterey	Presidio of Monterey	619	21	21	61,719	35,037	26,682	62 \$	1,951 \$	267 \$	2,218
2016	Presidio Of Monterey	Presidio of Monterey	620	21	21	779,898	442,732	337,166	780 \$	24,653 \$	3,369 \$	28,022
2016	Presidio Of Monterey	Presidio of Monterey	620	21	21	54,579	30,983	23,596	55 \$	1,725 \$	236 \$	1,961
2016	Presidio Of Monterey	Presidio of Monterey	621	21	21	595,581	338,099	257,482	596 \$	18,827 \$	2,573 \$	21,400
2016	Presidio Of Monterey	Presidio of Monterey	621	21	21	76,209	43,262	32,947	76 \$	2,409 \$	329 \$	2,738
2016	Presidio Of Monterey	Presidio of Monterey	622	54	54	3,297,780	755,764	2,542,016	3,298 \$	42,084 \$	25,403 \$	67,487

FY	Installation Name	Site Name	Facility Number	Base case EUI (kBTU/SF*year)	Adjusted building EUI	Modeled Energy /year (kBTU)	Modeled Electrical kBTU/year	Modeled Gas kBTU/year	Modeled Total Annual Energy (MBTU)	Modeled Annual Electric Cost	Modeled Annual Gas Cost	Modeled Annual cost
2016	Presidio Of Monterey	Presidio of Monterey	622	28	28	207,494	110,969	96,525	207	\$ 6,179	\$ 965	\$ 7,144
2016	Presidio Of Monterey	Presidio of Monterey	622	39	39	289,010	144,505	144,505	289	\$ 8,047	\$ 1,444	\$ 9,491
2016	Presidio Of Monterey	Presidio of Monterey	623	21	21	428,652	243,337	185,315	429	\$ 13,550	\$ 1,852	\$ 15,402
2016	Presidio Of Monterey	Presidio of Monterey	624	21	21	753,018	427,473	325,545	753	\$ 23,803	\$ 3,253	\$ 27,056
2016	Presidio Of Monterey	Presidio of Monterey	624	21	21	21,819	12,386	9,433	22	\$ 690	\$ 94	\$ 784
2016	Presidio Of Monterey	Presidio of Monterey	627	54	54	2,892,942	662,986	2,229,956	2,893	\$ 36,917	\$ 22,285	\$ 59,202
2016	Presidio Of Monterey	Presidio of Monterey	627	28	28	307,244	164,316	142,928	307	\$ 9,150	\$ 1,428	\$ 10,578
2016	Presidio Of Monterey	Presidio of Monterey	627	356	356	3,735,864	946,321	2,789,543	3,736	\$ 52,694	\$ 27,877	\$ 80,571
2016	Presidio Of Monterey	Presidio of Monterey	627	39	39	204,594	102,297	102,297	205	\$ 5,696	\$ 1,022	\$ 6,719
2016	Presidio Of Monterey	Presidio of Monterey	629	7	7	26,985	19,339	7,646	27	\$ 1,077	\$ 76	\$ 1,153
2016	Presidio Of Monterey	Presidio of Monterey	629	54	54	2,568,402	588,610	1,979,792	2,568	\$ 32,776	\$ 19,785	\$ 52,561
2016	Presidio Of Monterey	Presidio of Monterey	629	28	28	689,472	368,735	320,737	689	\$ 20,532	\$ 3,205	\$ 23,738
2016	Presidio Of Monterey	Presidio of Monterey	629	21	21	160,776	91,269	69,507	161	\$ 5,082	\$ 695	\$ 5,777
2016	Presidio Of Monterey	Presidio of Monterey	630	28	28	324,240	173,406	150,834	324	\$ 9,656	\$ 1,507	\$ 11,163
2016	Presidio Of Monterey	Presidio of Monterey	630	21	21	24,276	13,781	10,495	24	\$ 767	\$ 105	\$ 872
2016	Presidio Of Monterey	Presidio of Monterey	630	21	21	189,063	107,327	81,736	189	\$ 5,976	\$ 817	\$ 6,793
2016	Presidio Of Monterey	Presidio of Monterey	630	54	54	3,286,116	753,091	2,533,025	3,286	\$ 41,935	\$ 25,313	\$ 67,248
2016	Presidio Of Monterey	Presidio of Monterey	631	21	21	76,566	43,465	33,101	77	\$ 2,420	\$ 331	\$ 2,751
2016	Presidio Of Monterey	Presidio of Monterey	631	21	21	42,756	24,272	18,484	43	\$ 1,352	\$ 185	\$ 1,536
2016	Presidio Of Monterey	Presidio of Monterey	632	21	21	116,193	65,960	50,233	116	\$ 3,673	\$ 502	\$ 4,175
2016	Presidio Of Monterey	Presidio of Monterey	633	33	33	108,471	77,741	30,730	108	\$ 4,329	\$ 307	\$ 4,636
2016	Presidio Of Monterey	Presidio of Monterey	634	21	21	150,885	85,654	65,231	151	\$ 4,770	\$ 652	\$ 5,421
2016	Presidio Of Monterey	Presidio of Monterey	635	21	21	20,832	11,826	9,006	21	\$ 659	\$ 90	\$ 749
2016	Presidio Of Monterey	Presidio of Monterey	635	54	54	253,260	210,807	42,453	253	\$ 11,738	\$ 424	\$ 12,163
2016	Presidio Of Monterey	Presidio of Monterey	636	21	21	119,322	67,737	51,585	119	\$ 3,772	\$ 516	\$ 4,287
2016	Presidio Of Monterey	Presidio of Monterey	637	21	21	119,322	67,737	51,585	119	\$ 3,772	\$ 516	\$ 4,287

FY	Installation Name	Site Name	Facility Number	Base case EUI (kBTU/SF*year)	Adjusted building EUI	Modeled Energy /year (kBTU)	Modeled Electrical kBTU/year	Modeled Gas kBTU/year	Modeled Total Annual Energy (MBTU)	Modeled Annual Electric Cost	Modeled Annual Gas Cost	Modeled Annual cost
2016	Presidio Of Monterey	Presidio of Monterey	645	54	54	1,282,284	293,865	988,419	1,282	\$ 16,363	\$ 9,878	\$ 26,241
2016	Presidio Of Monterey	Presidio of Monterey	646	54	54	1,282,284	293,865	988,419	1,282	\$ 16,363	\$ 9,878	\$ 26,241
2016	Presidio Of Monterey	Presidio of Monterey	647	54	54	1,270,782	291,230	979,552	1,271	\$ 16,217	\$ 9,789	\$ 26,006
2016	Presidio Of Monterey	Presidio of Monterey	648	54	54	1,278,504	292,999	985,505	1,279	\$ 16,315	\$ 9,848	\$ 26,164
2016	Presidio Of Monterey	Presidio of Monterey	649	54	54	1,270,782	291,230	979,552	1,271	\$ 16,217	\$ 9,789	\$ 26,006
2016	Presidio Of Monterey	Presidio of Monterey	650	54	54	1,278,504	292,999	985,505	1,279	\$ 16,315	\$ 9,848	\$ 26,164
2016	Presidio Of Monterey	Presidio of Monterey	651	54	54	1,270,782	291,230	979,552	1,271	\$ 16,217	\$ 9,789	\$ 26,006
2016	Presidio Of Monterey	Presidio of Monterey	652	54	54	1,270,782	291,230	979,552	1,271	\$ 16,217	\$ 9,789	\$ 26,006
2016	Presidio Of Monterey	Presidio of Monterey	660	7	7	15,610	11,187	4,423	16	\$ 623	\$ 44	\$ 667
2016	Presidio Of Monterey	Presidio of Monterey	660	253	253	481,965	240,983	240,983	482	\$ 13,419	\$ 2,408	\$ 15,827
2016	Presidio Of Monterey	Presidio of Monterey	660	24	24	165,600	104,153	61,447	166	\$ 5,800	\$ 614	\$ 6,414
2016	Presidio Of Monterey	Presidio of Monterey	660	7	7	34,055	24,406	9,649	34	\$ 1,359	\$ 96	\$ 1,455
2016	Presidio Of Monterey	Presidio of Monterey	660	24	24	391,200	246,042	145,158	391	\$ 13,700	\$ 1,451	\$ 15,151
2016	Presidio Of Monterey	Presidio of Monterey	824	7	7	371	266	105	0	\$ 15	\$ 1	\$ 16
2016	Presidio Of Monterey	Presidio of Monterey	829	54	54	1,247,400	285,871	961,529	1,247	\$ 15,918	\$ 9,609	\$ 25,527
2016	Presidio Of Monterey	Presidio of Monterey	830	28	28	215,544	115,274	100,270	216	\$ 6,419	\$ 1,002	\$ 7,421
2016	Presidio Of Monterey	Presidio of Monterey	831	54	54	1,243,728	285,029	958,699	1,244	\$ 15,871	\$ 9,581	\$ 25,452
2016	Presidio Of Monterey	Presidio of Monterey	832	54	54	1,243,728	285,029	958,699	1,244	\$ 15,871	\$ 9,581	\$ 25,452
2016	Presidio Of Monterey	Presidio of Monterey	833	54	54	1,243,728	285,029	958,699	1,244	\$ 15,871	\$ 9,581	\$ 25,452
2016	Presidio Of Monterey	Presidio of Monterey	834	28	28	215,544	115,274	100,270	216	\$ 6,419	\$ 1,002	\$ 7,421
2016	Presidio Of Monterey	Presidio of Monterey	835	54	54	1,243,728	285,029	958,699	1,244	\$ 15,871	\$ 9,581	\$ 25,452
2016	Presidio Of Monterey	Presidio of Monterey	836	54	54	1,266,840	290,326	976,514	1,267	\$ 16,166	\$ 9,759	\$ 25,925
2016	Presidio Of Monterey	Presidio of Monterey	838	356	356	4,117,140	1,042,901	3,074,239	4,117	\$ 58,072	\$ 30,722	\$ 88,794
2016	Presidio Of Monterey	Presidio of Monterey	840	54	54	1,243,728	285,029	958,699	1,244	\$ 15,871	\$ 9,581	\$ 25,452
2016	Presidio Of Monterey	Presidio of Monterey	841	54	54	1,243,728	285,029	958,699	1,244	\$ 15,871	\$ 9,581	\$ 25,452
2016	Presidio Of Monterey	Presidio of Monterey	842	24	24	1,746,216	729,313	1,016,903	1,746	\$ 40,611	\$ 10,162	\$ 50,773

FY	Installation Name	Site Name	Facility Number	Base case EUI (kBTU/SF*year)	Adjusted building EUI	Modeled Energy /year (kBTU)	Modeled Electrical kBTU/year	Modeled Gas kBTU/year	Modeled Total Annual Energy (MBTU)	Modeled Annual Electric Cost	Modeled Annual Gas Cost	Modeled Annual cost
2016	Presidio Of Monterey	Presidio of Monterey	843	24	24	202,344	84,510	117,834	202	\$ 4,706	\$ 1,178	\$ 5,883
2016	Presidio Of Monterey	Presidio of Monterey	848	21	21	1,467,438	833,034	634,404	1,467	\$ 46,386	\$ 6,340	\$ 52,726
2016	Presidio Of Monterey	Presidio of Monterey	848L	21	21	170,079	96,550	73,529	170	\$ 5,376	\$ 735	\$ 6,111

Data compiled from sources outlined in Chapter III.

Table 7. Comparison of Actual Energy Usage and the Variation from Modeled Usage

Actuals energy usage and variations from model									
Totals	2,314	54,815,643	75,120,900	129,936,543	56	147%	143%	145%	145%
Facility Number	Sum of KSF	2015 Actual Electric kBTU	2015 Actual Gas kBTU	2015 Actual Total kBTU	2015 Actual total EUI (kBTU/SF)	Actual Gas MMBTU Variation from model	Actual Electric MMBTU Variation from model	Total MMBTU variation from model	EUI variation from model
105	4.906	25,546	-	25,546	5.21	0%	104%	74%	74%
112	0.257	-	-	-	-	0%	0%	0%	0%
113	1.813	-	-	-	-	0%	0%	0%	0%
115	1.35	128,714	-	128,714	95.34	0%	596%	298%	298%
203	0.8	42,616	-	42,616	53.27	0%	333%	166%	166%
204	4.78	106,702	19,800	126,502	26.46	46%	187%	126%	126%
205	4.78	106,702	26,900	133,602	27.95	62%	187%	133%	133%
206	4.78	106,702	37,700	144,402	30.21	87%	187%	144%	144%
207	4.78	106,702	35,400	142,102	29.73	82%	187%	142%	142%
208	4.46	65,573	76,100	141,673	31.77	127%	127%	127%	127%
209	9.499	150,147	187,400	337,547	35.53	217%	133%	169%	169%
210	6.825	152,352	139,000	291,352	42.69	224%	187%	203%	203%
211	9.434	107,446	194,400	301,846	32.00	227%	96%	152%	152%
212	10.122	245,370	194,000	439,370	43.41	28%	34%	31%	31%
213	9.472	89,460	208,800	298,260	31.49	243%	79%	150%	150%
214	6.161	84,385	154,100	238,485	38.71	276%	115%	184%	184%
215	9.02	115,410	63,500	178,910	19.83	78%	107%	94%	94%
216	8.326	116,892	155,800	272,692	32.75	206%	118%	156%	156%
218	6.131	136,860	13,700	150,560	24.56	25%	187%	117%	117%
219	0.659	46,390	30,900	77,290	117.28	241%	178%	199%	199%
220	3.714	261,448	7,800	269,248	72.50	22%	298%	220%	220%
221	8.754	97,381	422,400	519,781	59.38	531%	93%	283%	283%
228	20.501	148,272	94,600	242,872	11.85	52%	48%	49%	49%
230	1.184	141,228	-	141,228	119.28	0%	417%	411%	411%
233	9.348	205,257	121,300	326,557	34.93	107%	171%	140%	140%
235	34.008	363,995	287,200	651,195	19.15	426%	213%	274%	274%
254	0.911	64,130	-	64,130	70.40	0%	298%	213%	213%
257	2.262	159,234	51,500	210,734	93.16	142%	440%	291%	291%
261	3.73	47,187	-	47,187	12.65	0%	252%	181%	181%
263	9.012	90,598	89,800	180,398	20.02	174%	94%	122%	122%
267	4.58	-	235,000	235,000	51.31	565%	0%	244%	244%
268	4.745	77,149	94,800	171,949	36.24	165%	126%	145%	145%
269	3.308	7,373	-	7,373	2.23	0%	44%	32%	32%
271	1.113	9,308	4,700	14,008	12.59	35%	65%	50%	50%
272	5.658	398,296	15,400	413,696	73.12	30%	393%	269%	269%
273	9.258	116,199	176,300	292,499	31.59	210%	105%	150%	150%
274	6.65	468,128	127,500	595,628	89.57	209%	415%	342%	342%
275	8.843	622,505	60,500	683,005	77.24	49%	311%	211%	211%
276	9.726	684,664	197,400	882,064	90.69	218%	269%	255%	255%
277	9.062	637,921	80,800	718,721	79.31	95%	298%	240%	240%
278	0.571	40,196	12,000	52,196	91.41	225%	298%	277%	277%
281	5.152	-	-	-	-	0%	0%	0%	0%
282	0.78	-	-	-	-	0%	0%	0%	0%
324	8.34	82,579	180,300	262,879	31.52	126%	126%	126%	126%
325	3.341	16,093	103,600	119,693	35.83	167%	194%	171%	171%
326	18.403	335,941	389,100	725,041	39.40	233%	153%	188%	188%
339	5.654	126,212	212,300	338,512	59.87	414%	187%	285%	285%
340	5.654	126,212	199,400	325,612	57.59	388%	187%	274%	274%
343	2.279	346,701	16,100	362,801	159.19	298%	97%	99%	99%
344	6.577	1,000,550	-	1,000,550	152.13	0%	97%	95%	95%
354	2.46	-	-	-	-	0%	0%	0%	0%
356	2.033	-	-	-	-	0%	0%	0%	0%

Actuals energy usage and variations from model									
Totals	2,314	54,815,643	75,120,900	129,936,543	56	147%	143%	145%	145%
Facility Number	Sum of KSF	2015 Actual Electric kBTU	2015 Actual Gas kBTU	2015 Actual Total kBTU	2015 Actual total EUI (kBTU/SF)	Actual Gas MMBTU Variation from model	Actual Electric MMBTU Variation from model	Total MMBTU variation from model	EUI variation from model
358	2.252	-	-	-	-	0%	0%	0%	0%
359	1.563	110,028	21,800	131,828	84.34	335%	164%	179%	179%
364	1.314	92,499	1,100	93,599	71.23	20%	164%	152%	152%
417	38.247	1,422,650	934,700	2,357,350	61.63	336%	390%	367%	367%
418	5.853	269,634	204,000	473,634	80.92	385%	102%	150%	150%
419	0.32	-	-	-	-	0%	0%	0%	0%
420	5.5	253,372	150,900	404,272	73.50	303%	102%	136%	136%
421	0.69	48,573	-	48,573	70.40	0%	550%	275%	275%
422	24.624	1,277,207	976,200	2,253,407	91.51	230%	228%	229%	229%
423	11	546,841	279,200	826,041	75.09	147%	218%	188%	188%
450	10.235	224,729	173,500	398,229	38.91	187%	184%	185%	185%
451	7.6	147,001	178,600	325,601	42.84	259%	162%	204%	204%
452	8.448	135,290	142,000	277,290	32.82	185%	134%	156%	156%
453	10.334	111,474	149,700	261,174	25.27	160%	90%	120%	120%
454	3.041	60,777	25,100	85,877	28.24	48%	88%	71%	71%
517	10.95	448,453	62,100	510,553	46.63	25%	141%	91%	91%
518	12.644	120,523	267,800	388,323	30.71	207%	75%	134%	134%
566	12.382	-	-	-	-	0%	0%	0%	0%
569	0.082	-	-	-	-	0%	0%	0%	0%
570	0.082	-	-	-	-	0%	0%	0%	0%
571	0.082	-	-	-	-	0%	0%	0%	0%
572	0.082	-	-	-	-	0%	0%	0%	0%
607	47	1,158,173	1,239,900	2,398,073	51.02	363%	258%	304%	304%
609	0.058	-	-	-	-	0%	0%	0%	0%
610	80.893	1,525,486	1,499,600	3,025,086	37.40	204%	158%	178%	178%
611	30.6	948,351	606,100	1,554,451	50.80	218%	260%	242%	242%
612	0.8	30,125	-	30,125	37.66	0%	235%	118%	118%
613	66.791	1,719,648	895,000	2,614,648	39.15	184%	270%	233%	233%
614	27.941	875,783	465,700	1,341,483	48.01	178%	133%	145%	145%
615	0.072	-	-	-	-	0%	0%	0%	0%
616	20.492	538,374	359,400	897,774	43.81	148%	116%	127%	127%
617	18.958	520,658	196,600	717,258	37.83	114%	230%	180%	180%
618	16.555	578,129	374,700	952,829	57.56	244%	291%	271%	271%
619	22.918	511,591	-	511,591	22.32	0%	187%	106%	106%
620	39.737	678,617	962,300	1,640,917	41.29	267%	143%	197%	197%
621	31.99	1,883,745	1,158,700	3,042,445	95.11	399%	494%	453%	453%
622	75.891	1,500,576	4,480,300	5,980,876	78.81	161%	148%	158%	158%
623	20.412	455,650	-	455,650	22.32	0%	187%	106%	106%
624	36.897	674,861	1,383,500	2,058,361	55.79	413%	153%	266%	266%
627	80.286	2,599,690	8,027,800	10,627,490	132.37	152%	139%	149%	149%
629	83.698	1,254,419	3,880,400	5,134,819	61.35	163%	117%	149%	149%
630	82.593	1,369,787	4,095,900	5,465,687	66.18	148%	131%	143%	143%
631	5.682	126,837	261,300	388,137	68.31	507%	187%	325%	325%
632	5.533	123,511	23,500	147,011	26.57	47%	187%	127%	127%
633	3.287	231,389	20,900	252,289	76.75	68%	298%	233%	233%
634	7.185	271,483	61,200	332,683	46.30	94%	317%	220%	220%
635	5.682	261,756	108,300	370,056	65.13	210%	118%	135%	135%
636	5.682	126,837	290,900	417,737	73.52	564%	187%	350%	350%
637	5.682	126,837	179,600	306,437	53.93	348%	187%	257%	257%
645	23.746	278,402	859,800	1,138,202	47.93	87%	95%	89%	89%
646	23.746	237,046	967,200	1,204,246	50.71	98%	81%	94%	94%
647	23.533	341,818	1,002,500	1,344,318	57.12	102%	117%	106%	106%

Actuals energy usage and variations from model									
Totals	2,314	54,815,643	75,120,900	129,936,543	56	147%	143%	145%	145%
Facility Number	Sum of KSF	2015 Actual Electric kBTU	2015 Actual Gas kBTU	2015 Actual Total kBTU	2015 Actual total EUI (kBTU/SF)	Actual Gas MMBTU Variation from model	Actual Electric MMBTU Variation from model	Total MMBTU variation from model	EUI variation from model
648	23.676	281,305	878,300	1,159,605	48.98	89%	96%	91%	91%
649	23.533	307,591	1,238,300	1,545,891	65.69	126%	106%	122%	122%
650	23.676	365,695	1,311,800	1,677,495	70.85	133%	125%	131%	131%
651	23.533	339,247	1,196,200	1,535,447	65.25	122%	116%	121%	121%
652	23.533	334,491	1,323,600	1,658,091	70.46	135%	115%	130%	130%
660	32.2	2,067,995	2,054,300	4,122,295	128.02	445%	330%	379%	379%
824	0.053	-	-	-	-	0%	0%	0%	0%
829	23.1	380,124	1,094,400	1,474,524	63.83	114%	133%	118%	118%
830	7.698	541,902	420,100	962,002	124.97	419%	470%	446%	446%
831	23.032	318,546	1,031,700	1,350,246	58.62	108%	112%	109%	109%
832	23.032	349,361	1,172,900	1,522,261	66.09	122%	123%	122%	122%
833	23.032	353,854	1,235,800	1,589,654	69.02	129%	124%	128%	128%
834	7.698	541,902	528,400	1,070,302	139.04	527%	470%	497%	497%
835	23.032	320,276	1,306,400	1,626,676	70.63	136%	112%	131%	131%
836	23.46	292,683	1,316,700	1,609,383	68.60	135%	101%	127%	127%
838	11.565	1,046,314	3,084,300	4,130,614	357.17	100%	100%	100%	100%
840	23.032	334,544	939,500	1,274,044	55.32	98%	117%	102%	102%
841	23.032	332,221	1,125,200	1,457,421	63.28	117%	117%	117%	117%
842	72.759	485,685	2,992,200	3,477,885	47.80	294%	67%	199%	199%
843	8.431	554,757	242,700	797,457	94.59	206%	656%	394%	394%
848	69.878	1,530,995	1,013,900	2,544,895	36.42	160%	184%	173%	173%
4220	8.973	674,587	19,300	693,887	77.33	533%	263%	267%	267%
4227	2.497	82,096	600,800	682,896	273.49	101%	101%	101%	101%
4235	75	3,069,056	892,700	3,961,756	52.82	134%	271%	220%	220%
4250	8.35	227,331	-	227,331	27.23	0%	51%	45%	45%
4251	6.5	25,600	237,200	262,800	40.43	668%	29%	210%	210%
4260	71.585	625,519	564,800	1,190,319	16.63	24%	19%	21%	21%
4275	14.4	204,150	442,900	647,050	44.93	82%	82%	82%	82%
4280	26.666	128,448	1,128,600	1,257,048	47.14	229%	194%	224%	224%
4283	15	521,060	654,600	1,175,660	78.38	302%	131%	191%	191%
4380	5.627	130,854	253,200	384,054	68.25	261%	102%	171%	171%
4390	5.697	116,595	262,900	379,495	66.61	107%	107%	107%	107%
4396	1.848	-	-	-	-	0%	0%	0%	0%
4397	1.848	-	-	-	-	0%	0%	0%	0%
4398	1.848	-	-	-	-	0%	0%	0%	0%
4399	15.524	702,053	401,200	1,103,253	71.07	163%	245%	207%	207%
4400	6.906	200,912	364,000	564,912	81.80	271%	74%	139%	139%
4403	3.75	39,695	-	39,695	10.59	0%	27%	18%	18%
4455	11.399	112,187	198,800	310,987	27.28	187%	42%	83%	83%
4463	9.797	214,355	376,100	590,455	60.27	411%	93%	183%	183%
4468	11.399	456,942	173,700	630,642	55.32	78%	101%	94%	94%
4495	8.682	108,543	45,600	154,143	17.75	106%	100%	102%	102%
4497	0.707	-	-	-	-	0%	0%	0%	0%
4499	14.535	163,489	83,500	246,989	16.99	81%	126%	106%	106%
4503	0.363	-	-	-	-	0%	0%	0%	0%
4506	14.52	194,678	421,500	616,178	42.44	239%	104%	170%	170%
4512	14.517	174,776	71,100	245,876	16.94	247%	240%	242%	242%
4516	0.37	-	-	-	-	0%	0%	0%	0%
4522	7.783	-	-	-	-	0%	0%	0%	0%
7693	23.8	735,866	736,600	1,472,466	61.87	214%	116%	151%	151%
0343G	0.36	-	-	-	-	0%	0%	0%	0%
0614G	0.432	-	-	-	-	0%	0%	0%	0%

Actuals energy usage and variations from model									
Totals	2,314	54,815,643	75,120,900	129,936,543	56	147%	143%	145%	145%
Facility Number	Sum of KSF	2015 Actual Electric kBTU	2015 Actual Gas kBTU	2015 Actual Total kBTU	2015 Actual total EUI (kBTU/SF)	Actual Gas MMBTU Variation from model	Actual Electric MMBTU Variation from model	Total MMBTU variation from model	EUI variation from model
0620A	0.222	-	-	-	-	0%	0%	0%	0%
0622A	0.1	-	-	-	-	0%	0%	0%	0%
0622B	0.1	-	-	-	-	0%	0%	0%	0%
0622C	0.24	-	-	-	-	0%	0%	0%	0%
0627A	0.2	-	-	-	-	0%	0%	0%	0%
0627B	0.1	-	-	-	-	0%	0%	0%	0%
0627C	0.432	-	-	-	-	0%	0%	0%	0%
0629A	0.1	-	-	-	-	0%	0%	0%	0%
0629B	0.1	-	-	-	-	0%	0%	0%	0%
0630A	0.1	-	-	-	-	0%	0%	0%	0%
0630B	0.1	-	-	-	-	0%	0%	0%	0%
0634G	0.215	-	-	-	-	0%	0%	0%	0%
0830G	0.234	-	-	-	-	0%	0%	0%	0%
0831A	0.1	-	-	-	-	0%	0%	0%	0%
0840A	0.1	-	-	-	-	0%	0%	0%	0%
4283C	0.2	-	-	-	-	0%	0%	0%	0%
4499A	1.652	-	-	-	-	0%	0%	0%	0%
4499B	1.652	-	-	-	-	0%	0%	0%	0%
4506A	1.652	-	-	-	-	0%	0%	0%	0%
4506B	1.652	-	-	-	-	0%	0%	0%	0%
4512A	1.652	-	-	-	-	0%	0%	0%	0%
4512B	1.652	-	-	-	-	0%	0%	0%	0%
4522A	1.888	-	-	-	-	0%	0%	0%	0%
848L	8.099	-	-	-	-	0%	0%	0%	0%

Data compiled from sources outlined in Chapter III.

Table 8. Comparison of Actual Energy Cost and the Variation from Modeled Cost.

Actuals energy cost and variations from model								
Totals	2,314	\$3,100,157	\$ 735,615	\$3,835,772	145%	144%	145%	
Facility Number	Sum of KSF	Actual Electric Cost	Actual Gas Cost	Actual Total Cost	Actual Electric Cost Variation from Model	Actual Gas Cost Variation from Model	Actual Total Cost Variation from Model	
105	5	1,435	-	1,435	105%	0%	98%	
112	0	-	-	-	0%	0%	0%	
113	2	-	-	-	0%	0%	0%	
115	1	7,688	-	7,688	639%	0%	542%	
203	1	2,710	-	2,710	380%	0%	322%	
204	5	5,942	297	6,238	187%	68%	173%	
205	5	5,942	364	6,306	187%	84%	175%	
206	5	5,942	485	6,427	187%	112%	178%	
207	5	5,942	452	6,393	187%	104%	177%	
208	4	3,651	964	4,615	127%	161%	133%	
209	9	8,361	1,984	10,345	133%	230%	144%	
210	7	8,484	1,525	10,009	187%	246%	194%	
211	9	5,983	2,051	8,034	96%	240%	113%	
212	10	13,663	2,039	15,702	34%	29%	33%	
213	9	4,981	2,184	7,166	79%	254%	100%	
214	6	4,699	1,664	6,363	115%	298%	137%	
215	9	6,426	734	7,161	107%	90%	105%	
216	8	6,509	1,690	8,199	118%	224%	131%	
218	6	7,621	230	7,851	187%	41%	170%	
219	1	2,583	400	2,983	178%	312%	189%	
220	4	14,558	186	14,744	298%	54%	281%	
221	9	5,423	4,336	9,759	93%	546%	148%	
228	21	8,256	1,144	9,400	48%	63%	49%	
230	1	7,864	-	7,864	417%	0%	416%	
233	9	11,429	1,427	12,857	171%	126%	164%	
235	34	20,269	2,937	23,206	213%	436%	228%	
254	1	3,571	-	3,571	298%	0%	278%	
257	2	8,867	594	9,461	440%	164%	398%	
261	4	2,628	103	2,731	252%	140%	245%	
263	9	5,045	1,115	6,160	94%	216%	104%	
267	5	-	2,667	2,667	0%	642%	77%	
268	5	4,630	1,067	5,697	136%	185%	143%	
269	3	654	-	654	71%	0%	66%	
271	1	776	150	926	97%	111%	99%	
272	6	22,179	250	22,428	393%	48%	363%	
273	9	6,470	1,874	8,344	105%	223%	119%	
274	7	26,067	1,423	27,490	415%	233%	399%	
275	9	34,663	740	35,403	311%	60%	286%	
276	10	38,124	2,072	40,196	269%	229%	266%	
277	9	35,522	979	36,501	298%	116%	286%	
278	1	2,238	221	2,459	298%	414%	305%	
281	5	-	-	-	0%	0%	0%	
282	1	-	-	-	0%	0%	0%	
324	8	4,598	1,958	6,557	126%	137%	129%	
325	3	896	1,274	2,170	194%	206%	201%	
326	18	18,706	4,182	22,889	153%	250%	165%	
339	6	7,028	2,252	9,280	187%	439%	218%	

Actuals energy cost and variations from model							
Totals	2,314	\$3,100,157	\$ 735,615	\$3,835,772	145%	144%	145%
Facility Number	Sum of KSF	Actual Electric Cost	Actual Gas Cost	Actual Total Cost	Actual Electric Cost Variation from Model	Actual Gas Cost Variation from Model	Actual Total Cost Variation from Model
340	6	7,028	2,116	9,144	187%	413%	214%
343	2	19,306	253	19,559	97%	470%	98%
344	7	55,714	-	55,714	97%	0%	96%
354	2	-	-	-	0%	0%	0%
356	2	-	-	-	0%	0%	0%
358	2	-	-	-	0%	0%	0%
359	2	6,127	311	6,437	164%	478%	170%
364	1	5,151	103	5,254	164%	189%	165%
417	38	93,522	9,582	103,103	460%	345%	447%
418	6	15,014	2,143	17,158	102%	405%	113%
419	0	-	-	-	0%	0%	0%
420	6	14,109	1,663	15,772	102%	334%	111%
421	1	2,705	-	2,705	550%	0%	466%
422	25	74,151	9,622	83,773	237%	227%	236%
423	11	34,238	2,910	37,148	245%	154%	234%
450	10	12,514	1,847	14,361	184%	199%	186%
451	8	8,186	1,906	10,091	162%	276%	176%
452	8	7,533	1,541	9,074	134%	201%	142%
453	10	6,207	1,617	7,825	90%	173%	100%
454	3	3,384	351	3,735	88%	67%	85%
517	11	24,971	747	25,718	141%	31%	128%
518	13	6,711	2,993	9,704	75%	231%	95%
566	12	-	-	-	0%	0%	0%
569	0	-	-	-	0%	0%	0%
570	0	-	-	-	0%	0%	0%
571	0	-	-	-	0%	0%	0%
572	0	-	-	-	0%	0%	0%
607	47	65,267	12,776	78,043	261%	375%	275%
609	0	-	-	-	0%	0%	0%
610	81	84,944	14,853	99,798	158%	202%	164%
611	31	52,808	6,311	59,119	260%	227%	256%
612	1	1,962	-	1,962	275%	0%	233%
613	67	106,512	8,832	115,344	300%	182%	286%
614	28	48,767	4,757	53,524	133%	182%	136%
615	0	-	-	-	0%	0%	0%
616	20	29,979	3,593	33,571	116%	148%	119%
617	19	28,992	2,070	31,062	230%	120%	217%
618	17	35,561	3,720	39,281	322%	242%	312%
619	23	28,487	-	28,487	187%	0%	165%
620	40	37,788	9,658	47,446	143%	268%	158%
621	32	104,894	11,719	116,613	494%	404%	483%
622	76	83,557	42,396	125,954	148%	152%	150%
623	20	25,372	-	25,372	187%	0%	165%
624	37	37,579	13,741	51,320	153%	410%	184%
627	80	144,760	66,993	211,753	139%	127%	135%
629	84	69,850	35,940	105,791	117%	151%	127%
630	83	76,275	39,354	115,629	131%	142%	134%

Actuals energy cost and variations from model							
Totals	2,314	\$3,100,157	\$ 735,615	\$3,835,772	145%	144%	145%
Facility Number	Sum of KSF	Actual Electric Cost	Actual Gas Cost	Actual Total Cost	Actual Electric Cost Variation from Model	Actual Gas Cost Variation from Model	Actual Total Cost Variation from Model
631	6	7,063	3,031	10,094	187%	588%	235%
632	6	6,878	323	7,200	187%	64%	172%
633	3	12,885	300	13,185	298%	98%	284%
634	7	15,117	810	15,927	317%	124%	294%
635	6	14,576	1,208	15,783	118%	235%	122%
636	6	7,063	2,895	9,958	187%	562%	232%
637	6	7,063	1,885	8,947	187%	366%	209%
645	24	15,502	8,493	23,996	95%	86%	91%
646	24	13,200	9,469	22,669	81%	96%	86%
647	24	19,034	9,893	28,927	117%	101%	111%
648	24	15,664	8,652	24,316	96%	88%	93%
649	24	17,128	12,179	29,307	106%	124%	113%
650	24	20,363	12,960	33,323	125%	132%	127%
651	24	18,890	11,738	30,628	116%	120%	118%
652	24	18,626	13,082	31,708	115%	134%	122%
660	32	115,153	19,762	134,915	330%	428%	341%
824	0	-	-	-	0%	0%	0%
829	23	21,808	11,031	32,839	137%	115%	129%
830	8	30,175	4,334	34,509	470%	432%	465%
831	23	17,738	10,167	27,905	112%	106%	110%
832	23	19,454	11,554	31,007	123%	121%	122%
833	23	19,704	12,362	32,066	124%	129%	126%
834	8	30,175	5,296	35,472	470%	529%	478%
835	23	17,834	12,888	30,722	112%	135%	121%
836	23	16,298	12,980	29,278	101%	133%	113%
838	12	55,234	29,803	85,036	95%	97%	96%
840	23	18,629	9,152	27,781	117%	96%	109%
841	23	18,499	11,001	29,500	117%	115%	116%
842	73	51,571	29,514	81,086	127%	290%	160%
843	8	30,840	2,859	33,699	655%	243%	573%
848	70	85,926	9,966	95,892	185%	157%	182%
4220	9	36,120	282	36,402	253%	780%	254%
4227	2	5,265	6,050	11,314	117%	102%	108%
4235	75	154,599	8,762	163,360	245%	131%	234%
4250	8	12,877	-	12,877	52%	0%	51%
4251	7	1,533	2,386	3,919	31%	672%	73%
4260	72	32,459	5,734	38,193	18%	24%	19%
4275	14	12,774	4,540	17,315	92%	84%	90%
4280	27	8,781	11,014	19,796	238%	223%	230%
4283	15	28,055	6,253	34,308	126%	289%	141%
4380	6	8,145	2,699	10,844	114%	279%	134%
4390	6	7,178	2,790	9,967	119%	114%	117%
4396	2	-	-	-	0%	0%	0%
4397	2	-	-	-	0%	0%	0%
4398	2	-	-	-	0%	0%	0%
4399	16	42,520	4,333	46,853	267%	176%	254%
4400	7	10,927	3,631	14,558	72%	270%	88%

Actuals energy cost and variations from model							
Totals	2,314	\$3,100,157	\$ 735,615	\$3,835,772	145%	144%	145%
Facility Number	Sum of KSF	Actual Electric Cost	Actual Gas Cost	Actual Total Cost	Actual Electric Cost Variation from Model	Actual Gas Cost Variation from Model	Actual Total Cost Variation from Model
4403	4	2,488	-	2,488	30%	0%	28%
4455	11	7,659	2,058	9,717	51%	193%	60%
4463	10	11,708	3,687	15,394	91%	403%	111%
4468	11	23,050	1,855	24,905	92%	84%	91%
4495	9	7,109	551	7,659	118%	128%	118%
4497	1	-	-	-	0%	0%	0%
4499	15	9,554	941	10,495	132%	92%	127%
4503	0	-	-	-	0%	0%	0%
4506	15	10,856	4,232	15,088	104%	240%	124%
4512	15	10,071	860	10,931	248%	299%	252%
4516	0	-	-	-	0%	0%	0%
4522	8	-	-	-	0%	0%	0%
7693	24	39,396	6,936	46,333	112%	202%	120%
0343G	0	-	-	-	0%	0%	0%
0614G	0	-	-	-	0%	0%	0%
0620A	0	-	-	-	0%	0%	0%
0622A	0	-	-	-	0%	0%	0%
0622B	0	-	-	-	0%	0%	0%
0622C	0	-	-	-	0%	0%	0%
0627A	0	-	-	-	0%	0%	0%
0627B	0	-	-	-	0%	0%	0%
0627C	0	-	-	-	0%	0%	0%
0629A	0	-	-	-	0%	0%	0%
0629B	0	-	-	-	0%	0%	0%
0630A	0	-	-	-	0%	0%	0%
0630B	0	-	-	-	0%	0%	0%
0634G	0	-	-	-	0%	0%	0%
0830G	0	-	-	-	0%	0%	0%
0831A	0	-	-	-	0%	0%	0%
0840A	0	-	-	-	0%	0%	0%
4283C	0	-	-	-	0%	0%	0%
4499A	2	-	-	-	0%	0%	0%
4499B	2	-	-	-	0%	0%	0%
4506A	2	-	-	-	0%	0%	0%
4506B	2	-	-	-	0%	0%	0%
4512A	2	-	-	-	0%	0%	0%
4512B	2	-	-	-	0%	0%	0%
4522A	2	-	-	-	0%	0%	0%
848L	8	-	-	-	0%	0%	0%
0	-	-	-	-			

Data compiled from sources outlined in Chapter III.

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APPENDIX B. TABLES FROM THE SDD POLICY UPDATE

Table 9. Energy Use Intensity Targets for Buildings Built After 2008. Source: Hammack (2017, Table 1).

EUIs by Building Type by Climate Zone (kBtu/ft2-yr)																			
ASHRAE 100 #	Commercial Building Type	Army Building Type	ASHRAE Climate Zone																
			1A	2A	2B	3A	3B Coast	3B Other	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
1	Admin/professional office		31	32	31	34	26	31	26	37	32	32	38	34	31	43	38	46	65
1A	Company Operations Facility	14185	28	31	29	33	22	29	23	41	32	33	47	34	35	57	48	63	76
3	Government Office		39	40	39	42	33	38	34	46	39	40	48	42	39	54	47	58	81
3A	Brigade Headquarters	14182	59	58	55	57	50	54	50	61	55	53	66	58	53	74	65	79	90
3B	Battalion Headquarters	14183	36	37	36	38	30	35	31	42	36	37	44	38	36	50	44	53	76
5	Mixed-use office		36	37	36	38	30	36	31	42	37	38	45	38	36	50	44	54	75
6	Other Office		30	31	30	32	26	30	26	35	30	31	38	32	30	42	37	45	62
7	Laboratory		142	141	137	140	118	132	127	155	138	143	167	150	145	186	169	199	265
8	Distribution / shipping center		10	13	13	16	9	14	11	22	18	18	29	24	19	39	32	48	90
9	Non-refrigerated warehouse		5	6	6	8	4	7	6	10	9	9	14	11	10	19	15	23	43
29	Other classroom education		20	20	20	20	14	19	17	23	20	21	26	22	22	30	26	32	48
30	Fast Food		235	241	237	249	213	239	228	275	252	256	299	271	266	328	300	354	447
30A	Dining Facility	72210	351	361	351	362	311	350	321	384	361	354	410	365	362	452	417	492	571
31	Restaurant/cafeteria		127	131	127	135	113	129	123	149	136	140	161	147	149	176	163	192	241
32	Other food services		69	71	69	74	62	70	68	82	75	77	88	80	82	96	89	104	131
34	Dormitory/fraternity/sorority		36	39	38	42	28	39	36	52	43	49	59	50	47	68	59	77	107
35A	Unaccompanied Enlisted Personnel Housing	72111	59	61	63	61	48	58	49	61	56	52	65	62	53	74	67	80	97
36	Hotel		45	46	43	47	42	44	43	50	47	47	51	50	48	55	53	59	68
37	Motel or inn		50	48	47	46	43	45	41	47	45	43	48	45	44	50	47	51	62
38	Other lodging		48	45	45	44	41	43	40	44	43	41	45	43	42	48	45	50	59
46	Other Service		48	48	46	47	40	45	43	52	47	48	57	50	49	62	57	67	90
46A	Tactical Equipment Maintenance Facility	21410	37	41	44	64	37	54	39	92	68	74	119	99	79	158	128	180	239
43	Repair shop		22	22	22	22	18	21	20	25	22	22	26	24	23	30	27	32	42
44	Vehicle service/repair shop		26	26	26	26	22	25	23	29	26	26	31	28	26	34	31	37	49
45	Vehicle storage/maintenance		11	11	11	11	10	10	10	13	11	11	14	12	12	15	14	16	22
50	Single family, detached		22	24	24	26	18	24	22	32	27	30	37	30	29	42	37	48	66
51	Single family, attached		26	27	27	30	20	28	26	37	31	34	42	35	34	48	42	54	77
52	Apartment, 2-4 units		38	40	40	45	30	41	38	54	46	51	62	52	49	71	62	81	112
53	Apartment, 5 or more units		26	27	27	30	20	28	26	37	31	34	42	35	34	48	42	54	77

Table 10. Energy Use Intensity Targets for Existing Buildings Undergoing Major Renovation.
Source: Hammack (2017, Table 2).

EUIs by Building Type by Climate Zone (kBtu/ft2-yr)																			
ASHRAE 100 #	Commercial/Army Building Type	Army Category Code	ASHRAE Climate Zone																
			1A	2A	2B	3A	3B Coast	3B Other	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
1	Admin/professional office		39	40	39	42	33	39	33	46	40	40	48	42	39	54	47	58	81
1A	Company Operations Facility	14185	35	39	36	41	27	36	28	51	40	42	59	42	44	71	60	79	95
3	Government Office		49	50	49	52	41	48	42	57	49	50	60	52	49	67	59	72	101
3A	Brigade Headquarters	14182	74	72	69	71	63	68	63	76	69	66	82	73	66	93	82	99	112
3B	Battalion Headquarters	14183	45	46	45	48	37	44	39	52	45	46	55	48	45	62	55	67	94
5	Mixed-use office		45	46	45	48	38	45	39	53	46	47	56	48	45	62	55	67	94
6	Other Office		38	39	38	40	32	37	32	44	38	39	47	40	38	52	46	56	78
7	Laboratory		178	176	171	175	147	165	159	194	173	179	209	187	181	232	211	249	331
8	Distribution / shipping center		12	16	16	20	11	18	14	27	23	22	36	30	24	49	40	60	113
9	Non-refrigerated warehouse		6	8	8	10	5	9	7	13	11	11	17	14	12	24	19	29	54
29	Other classroom education		25	25	25	25	18	24	21	29	25	26	32	27	27	37	32	40	60
30	Fast Food		261	268	263	277	237	266	253	305	280	284	332	301	295	364	333	393	497
30A	Dining Facility	72210	390	401	390	402	346	388	356	427	401	393	456	405	403	502	463	547	635
31	Restaurant/cafeteria		141	145	141	150	126	143	137	166	151	156	179	163	166	195	181	213	268
32	Other food services		77	79	77	82	69	78	75	91	83	85	98	89	91	107	99	116	146
35	Dormitory/fraternity/sorority		40	43	42	47	31	43	40	58	48	54	65	55	52	75	66	85	119
35A	Unaccompanied Enlisted Personnel Housing	72111	65	67	70	68	53	65	54	68	62	57	73	69	58	83	74	89	107
36	Hotel		50	51	48	52	47	49	48	55	52	52	57	55	53	61	59	65	75
37	Motel or inn		55	53	52	51	48	50	46	52	50	48	53	50	49	56	52	57	69
38	Other lodging		53	50	50	49	46	48	44	49	48	46	50	48	47	53	50	55	66
46	Other Service		60	60	58	59	50	56	54	65	59	60	71	63	61	78	71	84	112
46A	Tactical Equipment Maintenance Facility	21410	47	52	55	80	46	67	49	116	85	92	149	124	99	197	160	225	299
43	Repair shop		28	28	27	28	23	26	25	31	28	28	33	30	29	37	34	40	53
44	Vehicle service/repair shop		33	33	32	32	27	31	29	36	32	33	39	35	33	43	39	46	61
45	Vehicle storage/maintenance		14	14	14	14	12	13	13	16	14	14	17	15	15	19	17	20	27
50	Single family, detached		28	30	30	33	22	30	28	40	34	38	46	38	36	52	46	60	83
51	Single family, attached		32	34	34	38	25	35	32	46	39	43	53	44	42	60	53	68	96
52	Apartment, 2-4 units		47	50	50	56	37	51	47	68	57	64	77	65	61	89	78	101	140
53	Apartment, 5 or more units		32	34	34	38	25	35	32	46	39	43	53	44	42	60	53	68	96

Table 11. Correlation of Army CATCDs to ASHRAE 100 Facility Types.
Source: Hammack (2017, Table 3).

Army CAT Code	CAT Code Description	Army Mapping Building Type	ASHRAE Std 100 Facility type	ASHRAE Std 100 ID #
14113	ACCESS CONTROL FAC		Other office	6
14133	SHIP/RECV FAC		Distribution/shipping center	8
14140	CARE/PRESS SHOP		Vehicle storage/maintenance	45
14160	BLOCK/BAND FAC		Distribution/shipping center	8
14182	BDE HQ BLDG	BDEHQ	<-- Use this Facility Type	3A
14183	BN HQ BLDG	BnHQ	<-- Use this Facility Type	3B
14185	CO HQ BLDG	COF	<-- Use this Facility Type	1A
14190	EAB C2F		Government office	3
17120	GEN INST BLDG		Other classroom education	29
17140	USAR CENTER		Mixed-use office	5
17141	ARM FORCE CTR		Mixed-use office	5
17142	ARNG/USAR CTR		Mixed-use office	5
17180	ARNG ARMORY		Mixed-use office	5
21110	AC MAINT HGR		Repair shop	43
21113	AC PARTS STR		Nonrefrigerated warehouse	9
21116	HGR SHOP SPACE		Repair shop	43
21117	AVION MNT SHP I		Vehicle service/repair	44
21120	AC COMP MAINT		Vehicle service/repair	44
21130	AC PAINT SHOP		Repair shop	43
21140	AC ENG TST FAC		Vehicle service/repair	44
21210	GM MNT FAC DEP		Vehicle service/repair	44
21220	GM LCH EQ DEP		Vehicle service/repair	44
21407	ARNG VEH MAINT	TEMF	<-- Use this Facility Type	46A
21408	COMPT CLNG FAC		Vehicle service/repair	44
21409	USAR VEH MAINT	TEMF	<-- Use this Facility Type	46A
21410	VEH MAINT SHOP	TEMF	<-- Use this Facility Type	46A
21413	ADMIN / SHOP CONT		Mixed-use office	5
21414	GEN ITEM REPAIR		Vehicle service/repair	44
21415	COMP ITEM REP		Vehicle service/repair	44
21416	MSL MAINT FAC		Vehicle service/repair	44
21417	VEH PNT/PREP SH		Vehicle service/repair	44
21418	AMSA / ECS		Vehicle service/repair	44
21419	CSMS/MATES	TEMF	<-- Use this Facility Type	46A
21435	MAJ END ITM REB	TEMF	<-- Use this Facility Type	46A
21440	COMP REB DEPOT	TEMF	<-- Use this Facility Type	46A
21441	VEH MNT FAC DEP	TEMF	<-- Use this Facility Type	46A
21445	T/A PTS STR DEP		Vehicle storage/maintenance	45
21458	STM CLN BLD DEP		Vehicle service/repair	
21462	STM CLN FAC DEP		Vehicle service/repair	44
21465	DRUM RECON PLT		Vehicle service/repair	44
21470	OIL STR BLDG		Vehicle storage/maintenance	45
21510	SM ARMS REP DEP		Repair shop	43
21512	WEAP DEMIL DEP		Repair shop	43

Army CAT Code	CAT Code Description	Army Mapping Building Type	ASHRAE Std 100 Facility type	ASHRAE Std 100 ID #
21520	LT GUN DEPOT		Repair shop	43
21522	WPN QA / CAL DEP		Repair shop	43
21530	HVY GUN DEPOT		Repair shop	43
21540	SP WEAP DEPOT		Repair shop	43
21545	WPNS REPAIR FAC		Repair shop	43
21610	AMMO RENO DEPOT		Repair shop	43
21612	AMMO SURV DEP		Repair shop	43
21620	RKT OHUAL DEPOT		Repair shop	43
21622	EXP REC / SER DEP		Repair shop	43
21630	AMMO DEMIL DEP		Repair shop	43
21640	DUN BLDG DEPOT		Repair shop	43
21642	COMP CLEAN DEP		Repair shop	43
21650	AMMO QA/CAL DEP		Repair shop	43
21660	AMMO MNT FAC		Repair shop	43
21670	AMMO REPAIR, IN		Repair shop	43
21710	ELE MAINT DEPOT		Other service	46
21712	C-E QA / CAL DEP		Other service	46
21722	C-E COMP CN DEP		Other service	46
21730	RDR MAINT DEPOT		Other service	46
21740	AVION MAINT DEP		Other service	46
21840	RR EQ / EN MAINT		Other service	46
21845	ADMIN / SHOP DOL		Repair shop	43
21850	BATTERY SHOP		Repair shop	43
21855	VEH PNT / PREP DL		Vehicle service/repair	44
21865	OIL STR BLD DOL		Vehicle storage/maintenance	45
21870	MNT STORAGE DOL		Repair shop	43
21872	QA / CAL GEN PURP		Repair shop	43
21879	PROC MAINT FAC		Repair shop	43
21881	ABN EQ / PARA REP		Repair shop	43
21882	GEN ITM REP DOL		Repair shop	43
21885	MNT GEN PURPOSE		Repair shop	43
21887	COM ITM REP DOL		Repair shop	43
21910	ENG/HOUSING MNT		Repair shop	43
21922	ENTOMOLOGY FAC		Other service	46
21925	ENGR MAINT FAC		Other service	46
31010	CHEMISTRY LAB		Laboratory	7
31015	GREENHOUSE R&D		Laboratory	7
31020	METALLURGY LAB		Laboratory	7
31030	NUC PHY/CHM LAB		Laboratory	7
31040	PHYSICS LAB		Laboratory	7
31050	HUMAN ENG LAB		Laboratory	7
31060	MED RES LAB		Laboratory	7
31061	MED LAB AN SHLT		Laboratory	7
31062	DENTAL RESEARCH		Laboratory	7
31063	WILDLIFE OBS BD		Laboratory	7
31065	CLIMATIC CHAMBR		Laboratory	7

Army CAT Code	CAT Code Description	Army Mapping Building Type	ASHRAE Std 100 Facility type	ASHRAE Std 100 ID #
31066	BIO LAB LEVEL 3		Laboratory	7
31067	BIO LAB LEVEL 4		Laboratory	7
31071	ENGINEER R&D		Laboratory	7
31210	ASTRO/GEO BLDG		Laboratory	7
31220	GM BLDG		Other services	46
31610	CHM EQ/MAT BLDG		Laboratory	7
31620	AMMO/EXPL/TX BD		Laboratory	7
31710	COMMO EQ BLDG		Laboratory	7
31720	DETECT EQ BLDG		Laboratory	7
31730	ELECTL EQ BLDG		Laboratory	7
31740	ELCTR EQ BLDG		Laboratory	7
31810	NUC PROP BLDG		Laboratory	7
31820	PROPUL SYS BLDG		Laboratory	7
31910	NONMTL MAT FAC		Laboratory	7
31920	LAB/TST BLDG GP		Other services	46
31930	VIB TEST LAB		Laboratory	7
32110	PREC MACH SHOP		Repair shop	43
42120	HE MAG DEPOT		Non-refrigerated warehouse	9
42180	IGLOO STR DEPOT		Non-refrigerated warehouse	9
42280	IGLOO STR INST		Non-refrigerated warehouse	9
43210	COLD STR DEPOT		Refrigerated Warehouse	18
43211	COLD STR INST		Refrigerated Warehouse	18
44110	STORAGE GP DEP		Non-refrigerated warehouse	9
44130	CONT HUM WH DEP		Refrigerated Warehouse	18
44220	STORAGE GP INST		Non-refrigerated warehouse	9
44224	ORG STR BLDG		Non-refrigerated warehouse	9
44230	CONTR HUM WH IN		Refrigerated Warehouse	18
44288	INST STR OTHER		Non-refrigerated warehouse	9
51010	MED CTR/HOSP		Hospital/inpatient health	33
55010	HEALTH CLINIC		Clinic other/outpatient health	17
61001	MEPS		Other office	6
61002	RECRUITING STA		Other office	6
61050	ADMIN GEN PURP		Admin	1
61055	WAITING AREA		Other public assembly	24
61065	TECH LIBRARY		Library	21
61070	RED CROSS BLDG		Other office	6
61075	COURTROOM		Government office	3
71112	FH COL		Apartment (2-4)	52
71113	FH LTC/MAJ		Apartment (2-4)	52
71114	FH CO/WO		Apartment (2-4)	52
71115	FH SR NCO		Apartment (2-4)	52
71116	FH JR NCO/ENL		Apartment (2-4)	52
72010	ARMY LODGING		Apartment (2-4)	52
72111	ENLISTED UPH	UEPH	<-- Use this Facility Type	35A
72114	TT ENL BARRACKS	UEPH	Apartment (+5)	53
72121	TRANS UPH AIT	UEPH	Apartment (+5)	53

Army CAT Code	CAT Code Description	Army Mapping Building Type	ASHRAE Std 100 Facility type	ASHRAE Std 100 ID #
72122	TRANS UPH AST	UEPH	Apartment (+5)	53
72181	TRAINEE BKS	UEPH	Apartment (+5)	53
72210	DINING FACILITY	DFAC	<-- Use this Facility Type	30A
72410	UOQ MILITARY		Apartment (2-4)	52
73010	FIRE STATION		Fire/police station	14
73011	DET FIRE STATION SPT		Fire/police station	14
73046	DEPENDENT SCH		Elementary School	26
74017	CDC UNDER 6 YRS		Preschool/daycare	28
74021	COMMISSARY		Grocery/food market	12
74028	PHYS FIT CTR		Recreation	22
74053	EXCH MAIN STORE		Retail store	40

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