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Comprehensive Energy Assessment: EE and RE Project Optimization Modeling for United States Pacific Command (USPACOM)

American Recovery and Reinvestment Act (ARRA) FEMP Technical Assistance

RT Brigantic
A Papatyi
CJ Perkins

September 2010

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Richland, Washington 99352

Executive Summary

This study and corresponding model development was conducted in support of the United States Pacific Command (USPACOM) as part of the Federal Energy Management Program (FEMP) American Reinvestment and Recovery Act (ARRA). This research was aimed at developing a mathematical programming framework and accompanying optimization methodology in order to simultaneously evaluate energy efficiency (EE) *and* renewable energy (RE) opportunities. Once developed, this research then demonstrated this methodology at a USPACOM installation – Camp H.M. Smith, Hawaii. We believe this is the first time such an integrated, joint EE and RE optimization methodology has been constructed and demonstrated.

This effort drew from existing literature and two independent studies recently completed for USPACOM under FEMP ARRA sponsorship: 1) an EE focused assessment and recommendations conducted by the Pacific Northwest National Laboratory (PNNL) using the Facility Energy Decision System (FEDS) model and 2) a RE focused assessment and recommendations from the National Renewable Energy Laboratory (NREL) using the Renewable Energy Optimizer (REO) model.

The methodology and demonstration employed first examined output from these recently completed PNNL and NREL independent studies – both focused on Camp Smith, and then used the output from one as an input to the other. This backward and forward serial analysis confirmed our hypothesis that conducting independent EE and RE assessments may lead to a higher life cycle cost and a potentially confounding solution set. The second part of the methodology examined data input considerations necessary to formulate an optimization framework capable of ingesting and analyzing EE and RE opportunities. The third element of the methodology built the optimization framework and algorithm set using Excel and the add-in package Frontline Systems Risk Solver Platform. The mathematical programming formulation developed is called the Joint Energy Efficiency and Renewable Energy Optimizer (JERO). The fourth and final step demonstrated JERO by applying it to Camp Smith, as a test case.

Through this research effort, the authors concluded that a mathematical programming approach can be employed to simultaneously analyze EE and RE opportunities and account for interactions between the two opportunity families. Such an approach, which quantitatively considered performance and cost elements of both EE and RE opportunities, had not previously been documented in the literature. The real-world demonstration of the mathematical programming algorithm set on Camp Smith provided insights about the practicality and difficulty of simultaneously analyzing EE and RE opportunities. A summary of these insights follows:

- Input considerations such as building aggregation and life cycle duration (to name just a few) must be thoroughly analyzed and understood prior to ingesting the EE and RE parameters into the mathematical programming algorithms.

- Pre-screening opportunities – both EE and RE, is necessary in order to reduce the size and complexity of the overall optimization model. To do otherwise will likely yield intractable solution sets.

- Life cycle duration assumptions seem to have the largest influence on output recommendations.

- Assumed plant capacities seem to strongly influence optimization output.

It is clear that a properly assembled mathematical programming approach to simultaneously understanding EE and RE opportunities can provide an increased level of clarity and understanding for a decision maker faced with reducing energy consumption and renewable energy implementation goals. Making cost and performance trades between the EE and RE family of opportunities can lead to decreases in life cycle costs, compared to independent assessments. It is also clear that challenges to a mathematical programming formulation remain. Some of these challenges include:

- Acquiring high fidelity building input data, including hourly usage patterns.

- Model calibration, against known building and installation energy use.

- Hourly computations to account for EE and RE performance/availability.

- Incorporation of variability in model parameters.

- Accommodating cost and performance characteristics for numerous EE and RE technologies.

With focused and deliberate research efforts, it is likely that many of these challenges can be overcome. As such, the following recommendations for future research/development are offered:

- Incorporate known input parameter variability by building stochastic, rather than deterministic variable sets.

- Expand the goals constraints to include EE and carbon emissions.

- Develop decision variables that incorporate temporal, annual budget limitations.

- Expand the life cycle cost elements of the framework by incorporating more sophisticated and conventional costing algorithms.

- Migrate the formulation to a more sophisticated mathematical programming application such as the General Algebraic Modeling (GAMS) System and corresponding optimization solver routines.

- Expand the formulation and model implementation so that 8,760 hour time-steps are considered.

- Accomplish additional demonstrations and tests of the existing formulation to ensure its general applicability and overall value compared to independently completed EE and RE analyses and recommendations.

Finally, On 16 Sep 2010 a briefing on the joint optimization work reported in this report was presented to representatives from USPACOM. The briefing outlined the work completed under this joint EE/RE project and followed the general structure and headings of this report. We summarize the key discussion items from this briefing in Appendix A.

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Acronyms and Abbreviations

ARRA	American Reinvestment and Recovery Act
BTU	British thermal Unit
DoD	Department of Defense
DOE	Design of Experiments
EE	Energy efficiency
FATE2-P	Financial Analysis Tool for Electric Energy Projects
FEDS	Facility Energy Decision System
FEMP	Federal Energy Management Program
FRESA	Federal Renewable Energy Screening Assistant
HCEI	Hawaii Clean Energy Initiative
IC	Installed Cost
IMCOM-PAC	Installation Management Command - Pacific
JERO	Joint Energy Efficiency and Renewable Energy Optimizer
kW	kilowatt
kWh	kilowatt-hour
LCC	Life Cycle Cost
MMBTU	Million British Thermal Units
MP	Mathematical Programming
MW	Megawatt
NCO	Non-commissioned Officer
NPV	Net Present Value
NREL	National Renewable Energy Laboratory
O&M	Operations and Maintenance
PEPSC	PACOM Energy Partnership and Strategy Council
PNNL	Pacific Northwest National Laboratory
PV	Photovoltaic
RE	Renewable Energy

REAP	Renewable Energy Alternatives Planning
REO	Renewable Energy Optimizer
SEPS	Sustainable Energy Portfolio Standards
SIR	Savings-to-Investment ratio
SWH	Solar Water Heating
USPACOM	United States Pacific Command

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Section 1: Introduction

1.1 Background

In response to a consistent and continuing stream of National, State, and Department of Defense energy-related laws, strategies and plans, including the October, 2008 Hawaii Clean Energy Initiative (HCEI) agreement, the Director of Resources and Assessment at USPACOM formed a consortium from across DoD, DOE, and the State of Hawaii (Ka'iliwai and Roley 2009). The consortium, created in January, 2009 and nicknamed PEPSC (PACOM Energy Partnership and Strategy Council), laid the foundation for USPACOM's energy partnership strategy. This strategic partnership between the State of Hawaii and USPACOM was the catalyst to marshal existing energy efficiency (EE) and renewable energy (RE) activities and investigate new potential opportunities.

PEPSC's strategic goal is to, "match or exceed the State of Hawaii goals" (Ka'iliwai 2009), which center on reaching "70% clean energy by 2030 in the electricity and transportation sectors" (HCEI 2009). To do this USPACOM has embarked on numerous Joint Experiments including data center energy reduction efforts, military family housing incentives, spray foam insulation, etc. Additionally, USPACOM sought and received Federal Energy Management Program (FEMP) American Reinvestment and Recovery Act (ARRA) technical assistance funding to conduct a variety of assessments (EE and RE) and training, and a task to investigate building a framework to optimally analyze EE and RE opportunities. That investigation and framework was the focus of the research documented in this report.

1.2 Purpose

This study was chartered to develop an integrated framework capable of optimally selecting a *best mix* of EE *and* RE opportunities. This included developing a suitable objective function which incorporated economic constraints and opportunity goals (i.e., 70% clean by 2030). This also included demonstrating the integrated framework via a small-scale demonstration.

1.3 Scope

This research consisted of four components:

1) Literature review – Accomplished to better understand and document previous efforts associated with optimally selecting EE and RE opportunities.

2) Model investigation – Completed to understand state-of-the-art modeling tools used to evaluate EE and/or RE opportunities.

3) Framework development – Devised an analytic, Operations Research-focused modeling framework that can be used as a foundation for an integrated EE and RE assessment tool.

4) Small scale methodology demonstration – Accomplished to provide confidence in the structural integrity of the analytic framework

The term "framework" is meant to capture the essential ingredients necessary to build an application that considers EE and RE technology opportunities in an optimal fashion. The framework contains elements of approach and methodology, algorithm considerations, constraints, economic realities, environmental factors, and opportunity goals. The framework development accomplished in this study is analogous to the framework construction of a new house or building. Both require thorough thought, planning, and structural soundness *and* both require finishing work to be useful.

Section 2: Literature Review

This section provides a summary of some of the literature addressing the implementation of EE and RE opportunities[1]. The section also provides a review of models that are currently being used to conduct EE and RE assessments.

2.1 General Articles on Combined Approaches on EE and RE

Although there seems to be a slight growing trend in the number of articles that discuss combined EE and RE concepts and methods over the past couple of years, there is clearly not a plethora of articles on this topic. And, the articles that exist are strictly qualitative in nature; none provide any quantitative means/methods to consider a combined EE and RE approach.

Austin Energy, the 9th largest community-owned electric utility in the U.S. is widely credited with developing the first initiatives to consider the synergistic effects of EE and RE opportunities. Their initiatives, which began in the early 1980s as a way to keep Austin Texas separate from the proposed South Texas Nuclear Project, pioneered "green building initiatives." These green initiatives led to a structured synergistic approach to sustainability which contains the following "key synergies":

- Financial savings – targeted EE opportunities that provide savings for residential customers

- Improved reliability – implementing a broad portfolio of renewable and non-RE sources which limit outages from a single plant

- Electric grid benefits – consideration of time-of-day usage and its relationship to generation capabilities (i.e., targeted solar energy buy-back during peak demand hours)

- Reduced carbon emissions – increased emphasis on non-carbon emitting generation facilities

- Strategic planning – broad investments in EE and RE generates more community support and outreach for both (i.e., no single industry or product is favored over another)

- Magnified resource potential – use energy savings from EE investments to leverage funds for additional renewable investment

Today, Austin Energy's sustainability momentum continues to be a model for strategically implementing EE and RE opportunities (Prindle 2007 and Austin Energy 2010).

[1] This literature review should not be considered comprehensive.

Regarding sustainability, Albinger points out that there are clear advantages to combining EE and RE approaches, which include some significant cost savings and side benefits of carbon dioxide reductions (Albinger, 2008). He relates these advantages to improvements in an organizations "triple bottom line" consisting of financial, environmental, and social performance. These are achieved via lower energy costs, reduced emissions, and local economic development respectively. Of course the first two elements of this triple bottom line are evident in the USPACOM energy goals, the third element associated with local economic development is one that might be kept in mind in combined EE and RE approaches. This is because it would seem to favor RE development over EE. Albinger also discussed how EE measures can make RE efforts more affordable by "reducing the amount of energy renewables need to generate." This statement might be counterintuitive to some of the RE modeling methods that will be discussed later as related to lower costs per unit of power as the size of the renewable power generation capability increases (i.e., economies of scale). This discussion points to the need for combined approaches as the former comments by Albinger would indicate "do EE first" whereas the latter thoughts would indicate "not so fast" as doing EE might make the RE less attractive.

> Sustainable Energy: Effectively, the provision of energy such that it meets the needs of the future without compromising the ability of future generations to meet their own needs. Sustainable Energy has two key components; renewable energy and energy efficiency (Glossary, 2004).

> Some organizations have chosen energy efficiency as a path to sustainability. Others are using on-site renewable sources such as biomass, solar and wind to generate their own sustainable power supplies. However, those organizations that have adopted *both* approaches are accelerating their progress towards sustainability (Albinger, 2008).

Today, sustainable energy portfolios are receiving increased amounts of attention – at both the grassroots and legislative level. Much of this renewed attention began in 2004 when the state of Hawaii became the first to incorporate EE mandates with the existing RE laws[2]. Their legislative change triggered similar actions by other states, and as of April 2009, 34 states had adopted Sustainable Energy Portfolio Standards (SEPS) that detail a combination of temporally-based goals, targets, and mandates for both EE and RE technology insertions (Brown 2007 Chandler 2009). SEPS are generally written to require that some percentage of electricity sold by a generator be produced through renewable sources and efficiency improvements be made to reduce demand. Interestingly, according to Chandler, states adopt SEPS for a variety of reasons – some to avoid industry loss, others for altruistic purposes such as improving air quality. Regardless of the reason, the trend toward SEPS is clear. Despite this trendiness however, quantitative assessments that simultaneously compute trades between EE and RE opportunities have not been accomplished (or possibly not published).

2.2 Summary of Existing EE and RE Models

As discussed in Section 2.1, quantitative models which combine EE and RE opportunities simply do not exist. There are several quantitative models however that focus on either EE *or* RE opportunities. Of these, this research investigated the following ones[3]:

[2] Hawaii Senate Bill 2474 - http://www.capitol.hawaii.gov/session2004/bills/sb2474_hd2_.htm

[3] This list is not comprehensive. A multitude of models (both government and contractor owned) exist – they range from sophisticated stochastic simulations to simple spreadsheet-based models. The models investigated as part of this research were chosen because of their current or historical use and the quantitative treatment nature.

- Facility Energy Decision System (FEDS)
- Renewable Energy Optimization (REO)
- Renewable Energy Alternatives Planning (REAP)
- Federal Renewable Energy Screening Assistant (FRESA)
- Financial Analysis Tool for Electric Energy Projects (FATE2-P)

The FEDS model, developed by the Pacific Northwest National Laboratory (PNNL) is an energy analysis software system that ingests building data such as square footage, lighting devices, heating and cooling equipment characteristics, etc. and outputs a rank-ordered listing of EE retrofits that individually and collectively minimize the life-cycle cost of building energy service. All of the outputted retrofit recommendations have net present values (NPVs) that are greater than or equal to zero, and a savings-to-investment ratio (SIR) that are greater than or equal to one. This engineering model (i.e., the model uses building construction elements to estimate energy consumption) is used exclusively to investigate and recommend EE retrofits, not RE options (FEDS 2008). This model is actively being used by PNNL engineers and scientists.

The REO model, developed by the National Renewable Energy Laboratory (NREL), ingests building square footage, number of floors, location, and customer-provided energy use and cost information, and outputs RE technology recommendations that minimize total life cycle costs while meeting specific customer-provided RE constraints or requirements. The Microsoft Excel spreadsheet-based model uses data sets maintained at NREL and purchased data sets that provide utility rate and incentive information, by city/state/region. The model is used exclusively to investigate and recommend RE options, not EE retrofits (Lee 2008 and Walker 2009). This model is actively being used by NREL engineers and scientists.

The REAP model, developed by the Installation Management Command – Pacific (IMCOM-PAC), is a Microsoft Excel spreadsheet-based model built “to help installations screen renewable energy production alternatives and rank their importance based on mission, economic, environmental, social impact and other criteria” (REAP 2009). The model ingests energy density and land use compatibility information as well as decision maker weighting preferences for environmental, economic, social, and mission and outputs a prioritized list of candidate RE solutions. The model is envisioned to be used as a screening tool to discard non-viable RE opportunities. It has not been used for real-world studies.

The FRESA model, developed by NREL, is an application built to “quickly evaluate renewable energy conservation opportunities and renewable energy systems options for possible inclusion in a facility's energy program” (FRESA 2000). The model, which was a precursor to NREL’s REO model, provides an application for collecting and processing building/facility data to indicate cost effective opportunities for RE technologies. The program uses a two step process: Step 1 is a heuristic evaluation used to disqualify specific RE or efficiency technologies; Step 2 is a more sophisticated life cycle cost evaluation of the remaining technologies. The output is provided in terms of life cycle cost, savings-to-investment ratios, and payback periods. The model is not in use today (FRESA 2000).

The FATE2-P model is a Microsoft Excel-based finance model used to calculate the cost of energy or the internal rate of return for alternative energy projects and/or competing conventional energy projects. The tool, which is currently used by PNNL, allows for the analysis of several different types of RE technologies. The model is used to assess project feasibility by changing a multitude of input variables (FATE2-P 2004).

Each of these models serves to address a specific slice of the EE/RE problems set. None however, are robust or comprehensive enough to simultaneously investigate EE and RE opportunities in an optimal or near-optimal fashion. The idea that there must be trade-offs between buying $10 worth of EE opportunities and $10 worth of RE opportunities led to our hypothesis, discussed in the next section.

Section 3: Methodology and Conventional Modeling

Our methodology centers on the hypothesis that conducting independent EE *and* RE assessments leads to a less-than-optimal (from a life cycle cost perspective) and likely confounding solution set. To investigate and test our hypothesis, we analyzed output from recently conducted EE assessments (using FEDS) and (independently conducted) RE assessments (using REO) of Hickam Air Force Base and Camp Smith. We also conducted and analyzed results from serially executed modeling runs. That is, we used output from FEDS as an input to REO, and vice versa. These serial forward and backward model runs provided insight into the independent solution sets and led to an increased awareness of the need to simultaneously analyze both EE and RE opportunities.

3.1 Conventional Modeling Approach

Historically, because integrated EE and RE assessments have not been conducted, organizations have relied on separate investigations – analyze EE opportunities first, then independently analyze RE opportunities, or vice versa. This independent approach, depicted in Figure 3.1, leaves the decision maker with a bin full of EE opportunities, and another full of RE options.

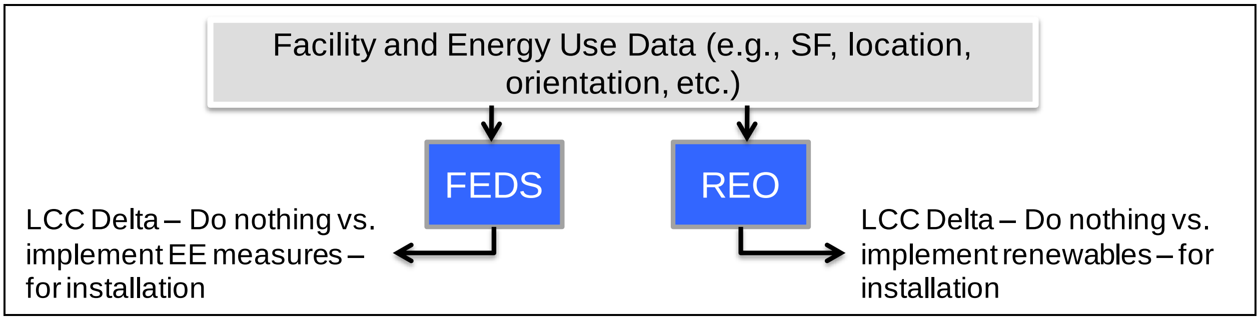

Figure 3.1 Conventional Modeling Approach

Optimally selecting from each bin however, has proven to be difficult, if not impossible. To confirm the suspicion (and previously stated hypothesis) that independently analyzing EE and RE opportunities (or vice versa) leads to a less-than-optimal set of decision opportunities, output from FEDS and REO assessments recently conducted for the Hickam Air Force Base (Chvala 2010b) and Camp Smith (Chvala 2010a) installations was analyzed[4]. The results of this mini-analysis are contained in Section 5.1.

3.2 FEDS then REO Approach

The next logical step is to use the EE output as an input to the RE assessment. This approach, depicted in Figure 3.2, follows the long-held convention that RE opportunity investments should be considered only

[4] These assessments were recently accomplished as part of the American Recovery and Reinvestment Act (ARRA) FEMP Technical Assistance work performed for USPACOM.

after all EE retrofits have been put in place (Prindle 2007). This approach allows the RE assessment to be conducted on a reduced energy consumption (reduced by implementing the recommended EE retrofits) load.

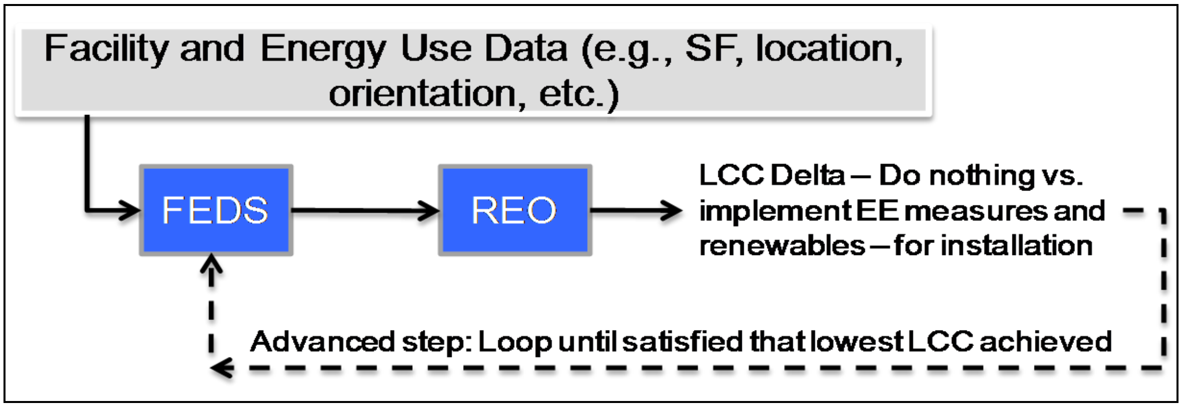

Figure 3.2 FEDS then REO Approach

This assessment scheme was used to evaluate Camp Smith only. NREL, using their REO tool, ingested the PNNL-generated FEDS output (the EE recommendations), and produced RE recommendations. The results of this analysis are presented in Section 5.2.

3.3 REO then FEDS Approach

To better understand how EE and RE recommendations are affected by the order that they are modeled, we used the NREL RE recommendations, as an input to the FEDS model. This modeling scheme is depicted in Figure 3.3.

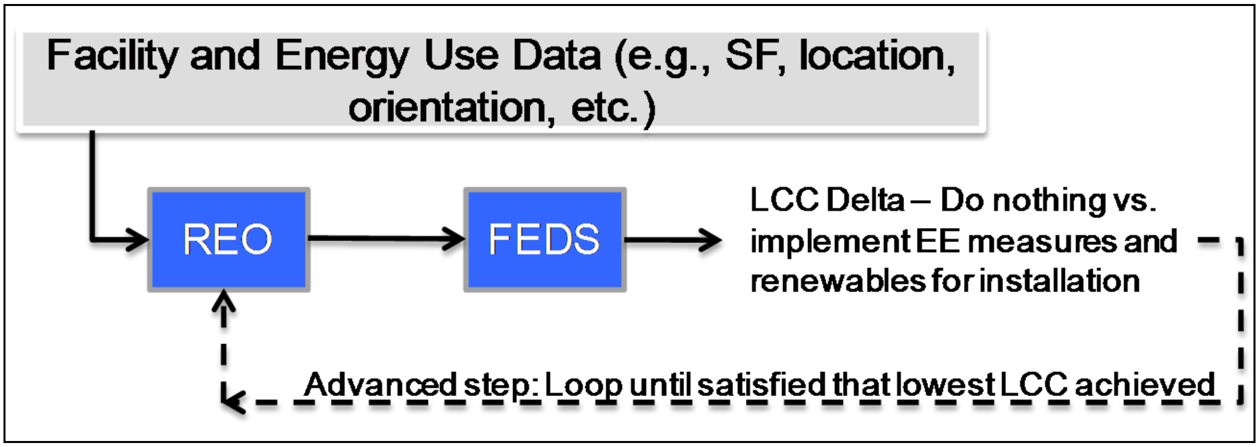

Figure 3.3 REO then FEDS Approach

This modeling scheme, which is not considered to be a conventional assessment order, forces the implementation of the recommended RE opportunities (as computed by REO) and then assesses the EE opportunities. Two scenarios were used to evaluate this modeling scheme – both for Camp Smith, only.

The first assumed that a 2.4 MW wind turbine and a 3.2 MW PV farm had been installed at Camp Smith. These renewable sources were assumed to produce 6,587,210 kWh/year, or 24.4% of the site's energy needs. By incorporating these renewables, the electric energy charge rate was estimated at $0.136/kWh (compare to $0.143/kWh used without RE technologies). The combined initial cost of these projects was assumed to be $27.9M; annual operating costs were assumed at $49,276.

The second scenario assumed that 3 solar hot water projects were installed on the Post. Collectors were assumed to be installed on the old hospital building 5, the NCO club, and the barracks (buildings 401-404). The initial cost of these projects was estimated at $336,188; annual operating costs were assumed to be $1,681. Results from each of these two scenarios are presented in Section 5.3.

3.4 Joint Optimization Approach

The final assessment modeling scheme is to consider EE and RE opportunities simultaneously. This approach focused on developing a mathematical programming framework (and algorithm set) to simultaneously assess EE and RE opportunities. If populated with appropriate data, the approach would provide decision makers a single prioritized list containing cost effective EE and RE opportunities. It is this approach that is depicted in Figure 3.4, and is the focus of the remainder of this report.

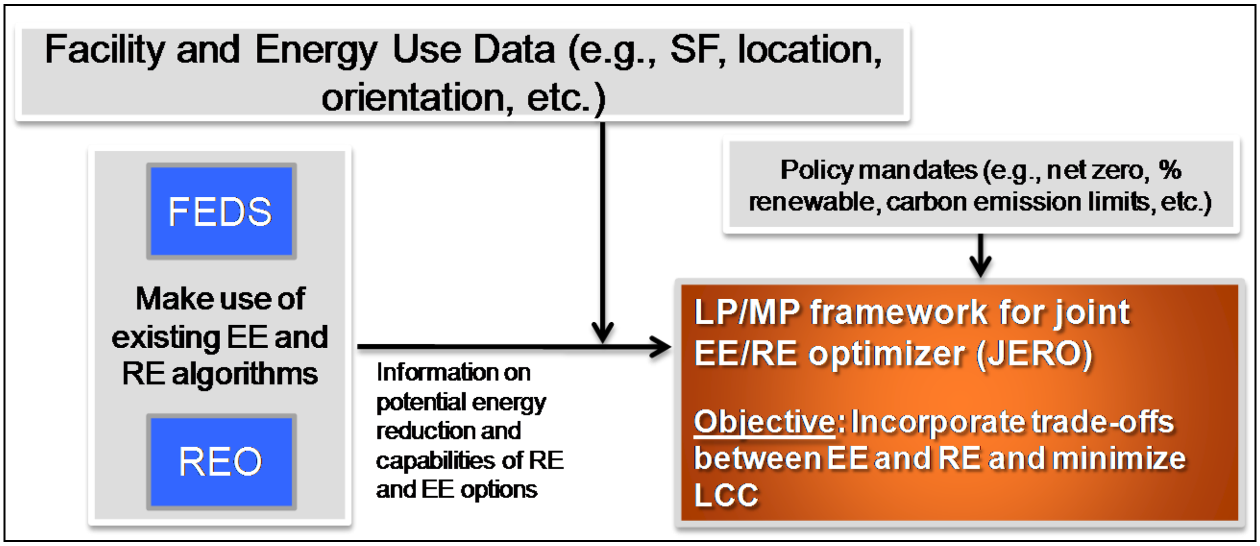

Figure 3.4 Joint Optimization Approach

The underlying approach depicted in Figure 3.4 is to first design a traditional linear programming optimization formulation for joint EE and RE optimization. A linear programming (LP) formulation implies we can construct equations in our model that are all linear. More likely than not, some of these functions will be non-linear. In this case a more generalized mathematical programming (MP) formulation can be constructed.

The basic aim then of our MP formulation is to construct an optimization model that is prescriptive in nature. That is, our formulation will strive to prescribe actions that will enable USPACOM to best meet its energy goals. The three basic components of our prescriptive model formulation include an objective function, decision variables, and constraints.[5] Each of these elements will be covered in more detail below, but at a high level the objective function involves a function that we will wish to minimize (e.g., minimize life cycle costs) or maximize (e.g., maximize renewable energy resources); decision variables are variables that we can control and that directly influence the overall performance of the system being studying; and finally constraints are limitations on resources and other restrictions imposed on our system. Given these elements, it is our premise that we can identify a combined EE and RE system optimal solution for a given installation that satisfies all specified constraints. Below we discuss the basic elements of the developed and implemented MP formulation.

Decision Variables

To construct our mathematical programming formulation, we start by identifying appropriate decision variables for both energy efficiency (EE) measures and renewable energy (RE) resources and their use in meeting the installation's energy demand. These decision variables will later be used to define an objective function and constraints that must be satisfied to provide a feasible solution.

[5] Winston and Venkataramanan, Operations Research: Volume One, Introduction to Mathematical Programming, 4th Edition, Brooks/Cole – Thomson Learning, Pacific Grove, CA, 2003.

EE Decision Variables. We will consider five basic EE decision variables for each building and/or aggregate building set on an installation. These EE decisions are whether or not to take the following individual actions on given building(s):

1) upgrade/replace existing service hot water systems

2) lighting retrofits (e.g., advanced T8 lighting)

3) envelope modifications (e.g., windows or insulation)

4) heating system upgrades/modifications

5) cooling system upgrades/modifications (e.g., central water-cooled chilled water plant)

Using these five basic EE measures, we also consider all combinations of these measures (31 in all). These 31 different combinations are shown later in Section 4, Figure 4.9.

For EE decisions, we will also consider the potential to aggregate buildings on an installation and use ε as in index for the EE aggregated buildings. The upper limit for the total EE aggregated buildings will be represented by B_E. Similarly, we use i as an index for the EE measure being considered and M_E will be the upper limit for the total number of EE decisions (M_E = 5 in this case). The decision then will be whether or not to implement a particular EE measure for each aggregated building on the installation. For $\varepsilon = 1, \ldots, B_E$ and $i = 1, \ldots, M_E$, this binary decision variable can be written as

$$E_{\varepsilon,i} = \begin{cases} 1 & \text{if EE measure } i \text{ is to be implemented on building } \varepsilon \\ 0 & \text{otherwise} \end{cases} \tag{3.1}$$

RE Decision Variables. We will consider 11 basic RE decision variables for each building and/or aggregate building set on an installation. These RE decisions are whether or not to acquire and install the following RE opportunities of a certain size (e.g., kilowatts) on a given building or aggregated set of building:

1) photovoltaics

2) wind power

3) solar water heating

4) solar vent air preheat

5) concentrating solar heat

6) concentrating solar power

7) biomass heat

8) biomass power

9) daylighting

10) ground source heat pump

11) landfill gas

As with EE decisions, we will again also consider the potential to aggregate buildings on an installation and use ρ as in index for the RE aggregated buildings. The upper limit for the total RE aggregated buildings will be represented by B_R. Similarly, we use j as an index for the RE measure being considered and M_R will be the upper limit for the total number of RE decisions ($M_R = 11$ in this case). The decision then will be to implement (or not) a particular RE opportunity of a certain size for each aggregated building set on the installation. For $\rho = 1, \ldots, B_R$ and $j = 1, \ldots, M_R$, this decision variable can be written as

$$R_{\rho,j} = \text{size of RE system } j \text{ on building } \rho \qquad (3.2)$$

Before leaving RE decision variables, we need to further discuss building aggregation considerations. Figure 3.5 shows an example small scale installation with a total of seven individual buildings. For evaluation of potential EE measures, these buildings were aggregated into four building sets as depicted. Hence, for this experimental building set, the EE aggregation index ε is 1 to 4. Now, for potential RE resources that might be employed, different building aggregations are possible, ranging from a complete aggregation at the installation level (e.g., a biomass power plant for the entire installation) so that only one aggregated building results, or aggregation down to the individual building level (e.g., individual photovolatics are installed separately on each of the seven buildings) so that seven aggregated buildings result. Moreover, it is possible that for some renewable energy resources aggregation is not applicable as the resource would not even be considered for use on certain buildings (e.g., assume because of space limitations solar water heating is not feasible for buildings 1 and 4). All of these different notional building aggregations are depicted in tabular form in Table 3.1. Therefore, as in these examples and based on other considerations such as collocation of buildings, distances to potential power plants, and related confounding issues, it is evident that different aggregation levels are possible for each RE opportunity. For now, in our JERO prototype we have devised the potential to consider only RE systems installed on individual aggregated buildings or a single plant for each RE alternative serving the entire installation. This RE building aggregation challenge needs further development and will be included in our recommendations for future research.

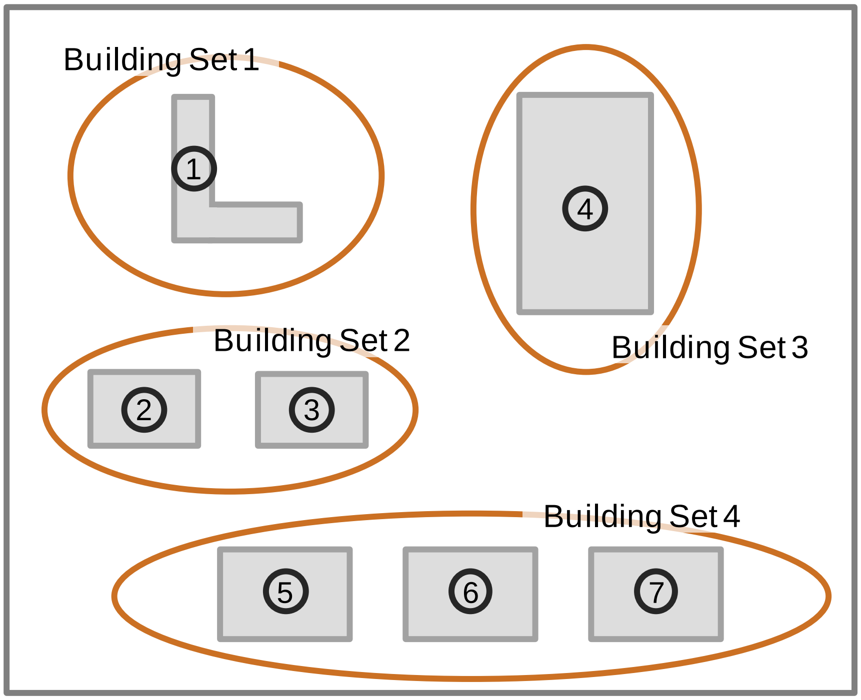

Figure 3.5 Example Building Set to Demonstrate Aggregation Concept

For now, in order to simplify our formulation, we will assume the same level of building aggregation for RE resources as for EE measures. Hence, the respective indices for EE and RE building aggregation will be equal to each other (i.e., $\varepsilon = \rho$). Likewise, under this assumption it follows that the upper limits for total EE and RE aggregated buildings are also equal to each other (i.e., $B_R = B_E$).

Table 3.1 Different Notional Building Aggregations for the Example Building Set

<table>
<tr><th>Installation Building Number</th><th>EE Aggregation Number</th><th>RE Aggregation Number for Biomass Power Plant</th><th>RE Aggregation Number for Photovoltaics</th><th>RE Aggregation Number for Solar Water Heating</th></tr>
<tr><td>1</td><td>1</td><td rowspan="7">1</td><td>1</td><td>N/A</td></tr>
<tr><td>2</td><td rowspan="2">2</td><td>2</td><td rowspan="2">1</td></tr>
<tr><td>3</td><td>3</td></tr>
<tr><td>4</td><td>3</td><td>4</td><td>N/A</td></tr>
<tr><td>5</td><td rowspan="3">4</td><td>5</td><td rowspan="3">1</td></tr>
<tr><td>6</td><td>6</td></tr>
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</table>

Objective Function

Our initial objective function will be to minimize the overall life cycle cost (*LCC*) of the EE/RE combined system for a specific USPACOM installation. In simple terms, this objective function is the sum of EE/RE total acquisition costs (*A*) and annual operations and maintenance costs (*O*) less any net annual revenue for the installation for selling back potential excess power to the local utility (*V*) for each year (*Y*) of the life cycle under consideration. Later in this report, we discuss life cycle duration several times – consider *Y* as this life cycle duration. In equation form,

$$LCC = A + Y(O - V) \quad (3.3)$$

This objective function now needs additional development through appropriate characterization of each of the cost components, *A*, *O*, and *V*. Note that we did not implement selling back excess power in our JERO demonstration.

Acquisition Costs. Acquisition costs are the costs to acquire, install, and/or upgrade EE retrofits and the costs to acquire and install, RE technologies. EE costs were derived from FEDS results (Chvala 2010a) and RE costs were derived from REO results using cost functions contained in that report for Camp Smith (Walker 2010). These specifics will be visited in more detail in Section 4.

Annual Operations and Maintenance Costs. The annual operations and maintenance costs for energy can be determined by computing the estimated hourly operations and maintenance costs for each aggregate building throughout the year and summing these over all hours of the year. For a single aggregated building, these costs can be allocated to the different energy sources that will be used to satisfy the building demand. It should be noted that the operations and maintenance costs are applied as a rate multiplier only to the energy sources (renewables or local utility). The operations and maintenance costs associated with EE retrofits are considered to be negligible. Furthermore, the maintenance part of the operations and maintenance costs are assumed to be negligible as well. Alternatively, a simple multiplier could be applied to each energy source to make certain that the maintenance element of the operations and maintenance costs is included. To determine the demand that must be supplied, we consider the reduction in the baseline energy demand for each aggregated building that could be achieved by energy efficiency retrofits implemented on that building (or aggregated building set).

Revenue. We consider the potential for revenue that might be generated for an installation by selling back excess power to the local utility when supply (from organically produced energy) exceeds demand. However, we did not implement this potential option in our Camp Smith demonstration.

Constraints.

The last element of our mathematical programming formulation is the delineation of appropriate constraints. Some of these constraints have been alluded to earlier, such as constraints to ensure the hourly energy demand for each aggregated building is met by a combination of renewable and/or local utility sources.

Energy Provided to Buildings. These are constraints designed to ensure that the individual demand of each aggregated building is satisfied at each hour of the day considered. In JERO, these constraints are met via the appropriate allocation of demand satisfied via energy provided by the local utility, individual building RE systems, and installation wide plant allocations proportionate to the need of each building. There is then a potential to generate excess power when total installation RE system production is greater than total installation demand. However, for now this excess power is not accounted for in life cycle costs.

Maximum Theoretical Power. In JERO, we express the total theoretical power available for use by an individual building and/or the installation by each type of energy source at each hour of the day. This variable can also be used as a constraint to ensure that the amount of power provided by the different sources (and discriminated by the RE aggregated buildings, ρ) do not exceed this limit. Likewise, size limits on installation wide plants are also included in JERO as capacity constraints.

Renewable Energy Goals. In this constraint, we define the total percent of renewable energy provided to an installation. Since the percent of renewable energy use can vary significantly throughout the day and/or year, this goal is best defined on an annual basis. This constraint will then ensure that optimal solutions meet or exceed the specified RE goal.

Nonnegativity Constraints. The last constraints needed to complete our mathematical programming formulation are nonnegativity constraints. In particular, we require that none of the decision variable be allowed to take on negative values.

Figures 3.6 and 3.6 provide a graphical portrayal of key elements involved in the joint optimization of EE and RE measures and a summary of the MP methodology respectively.

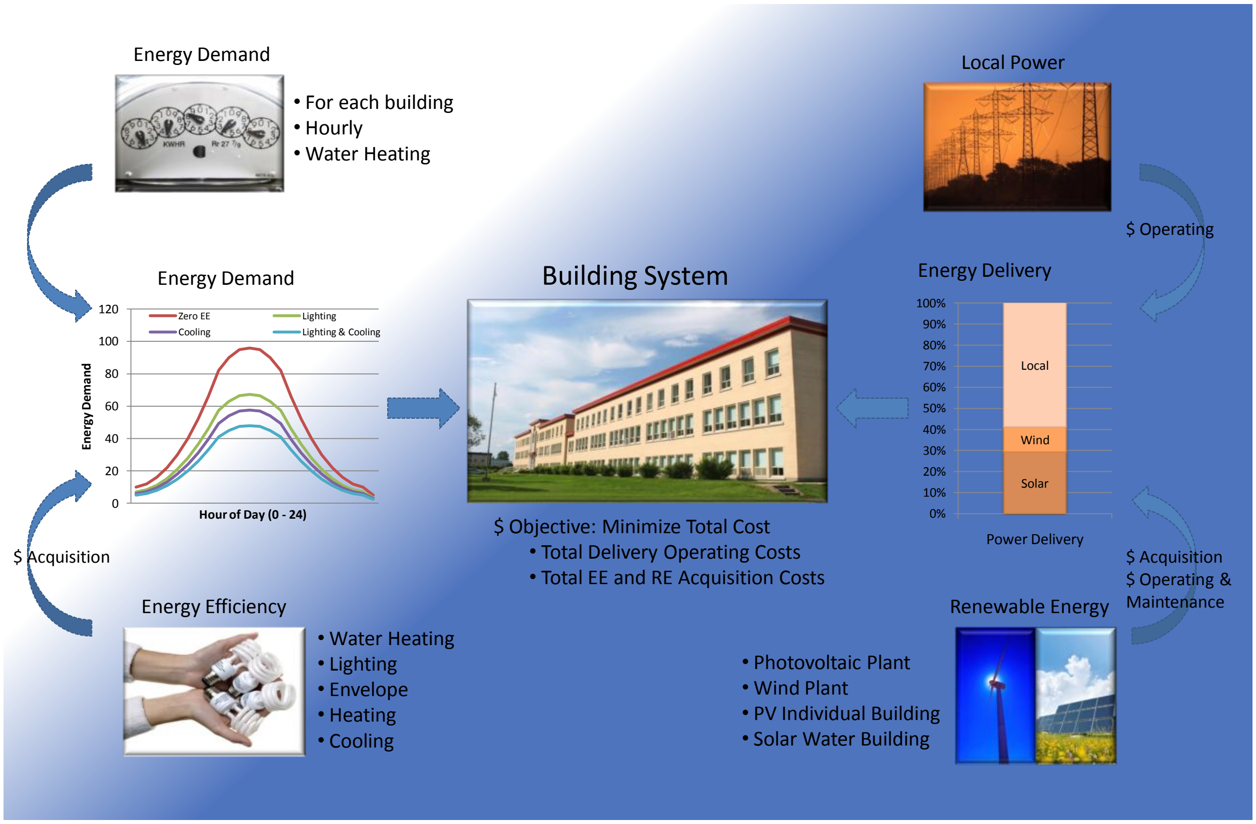


Figure 3.6 Elements Involved in Joint EE and RE Optimization

The elements shown in Figure 3.6 will be covered in more detail in Section 4. For now, we note that energy demand for each building and in turn the entire installation varies as a function of time. Various EE measures can help to reduce this demand. Such measures impose acquisition costs that are accounted for in the objective function that we are trying to minimize. The result energy demand can be satisfied via local utility or the implementation of RE resources. Such RE resources also impose acquisition costs that are accounted for in the objective function that we are trying to minimize. However, such RE resources may also lower life cycle costs via lower annual O&M costs that are also included in the objective function.

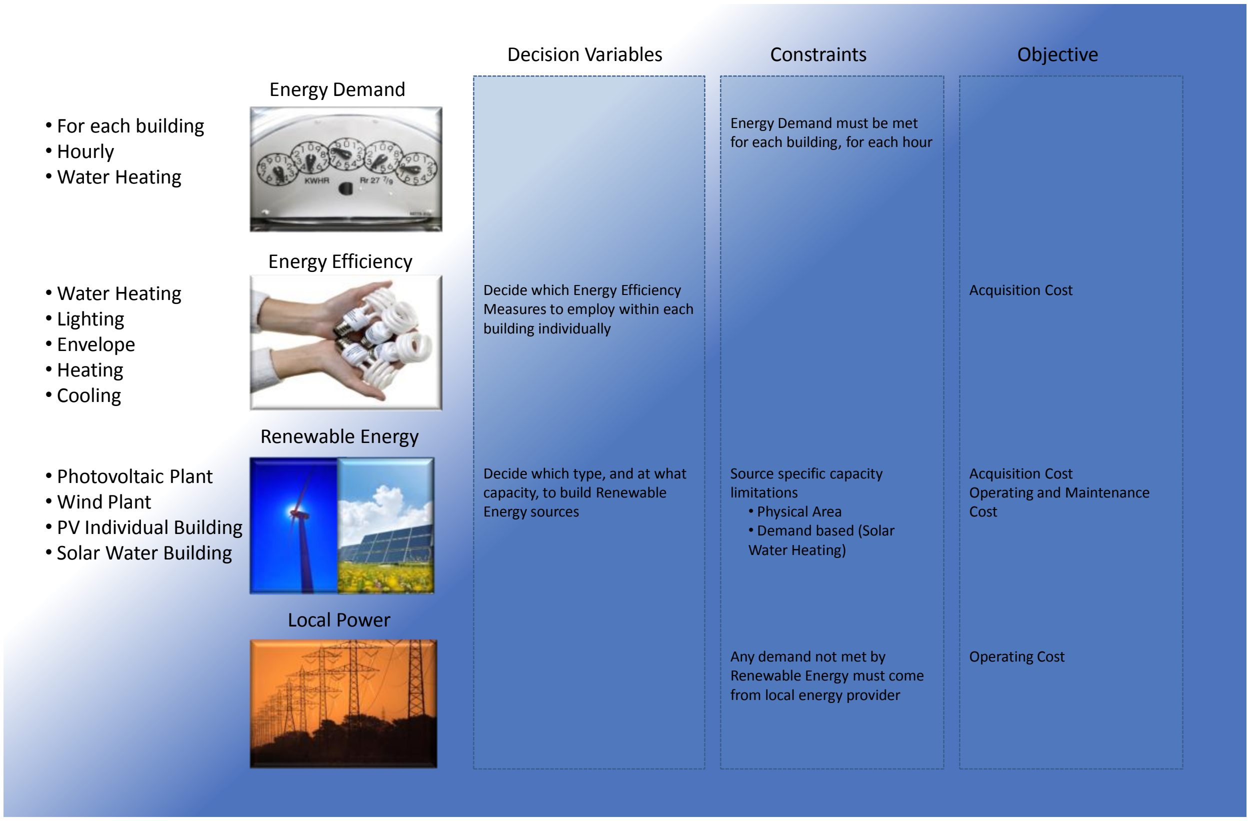


Figure 3.7 Joint EE and RE Optimization – MP Summary

Figure 3.6 summarizes the basic MP components of decision variables, constraints, and the objective function. The different joint EE and RE elements outlined in Figure 3.5 are shown as broken out into these MP components in Figure 3.7.

Section 4: EE and RE Modeling Input Considerations

In this section we discuss general energy efficiency and renewable energy data input considerations that are necessary for our joint modeling approach. These considerations are applicable in general for our approach to be employed to any installation, but as we progress through them we will apply special emphasis and specific reference to Camp Smith as we will use these input considerations and corresponding data components in our demonstration in Section 5. In this current section we consider 1) general big picture considerations, 2) building aggregation considerations, 3) EE specific considerations, 4) RE specific considerations, and 5) final parameters that should be considered in the joint optimization approach.

4.1 General Big Picture Modeling Considerations

Because of the potential quantity of variables and the unique geographic and environmental aspects of each installation, a *first cut* screening of potential EE and RE opportunities is recommended. Such a first cut, which should consider installation peculiarities (e.g., natural size limitations based on geographic area, political/legal limitations, resource availability and limitations, etc.), will help to minimize computation time and provide for a less cluttered analysis space. For instance, at Camp Smith, because of the limited open land availability, there are natural upper bounds on the potential wind energy and/or photovoltaic plant size. The REAP model, developed by IMCOM and discussed in Section 2.2, could be used to rapidly discard candidate opportunities that simply do not make sense for a given installation. As a different screening approach, in our demonstration on Camp Smith, we have applied some general considerations for RE technologies based on the NREL completed REO assessments and recommendations and we did not use the REAP tool as a screening mechanism. These considerations are discussed in more detail in Section 4.4 RE Modeling Input Considerations.

4.2 Building Aggregation Considerations

As discussed in the methodology section, our joint EE and RE optimization approach assumes a common set of buildings to be considered for energy efficiency and renewable energy systems. For our Camp Smith demonstration that will be presented later, we start our analysis by first distilling down the set of potential buildings to be analyzed to a set of aggregated buildings that are common to both EE and RE results as provided from FEDS and REO analyses respectively. Table 4.1 summarizes the Camp Smith aggregated buildings from FEDS. In this table, FEDS has started with a total of 59 individual buildings on Camp Smith and aggregated these into a set of 27 buildings. Table 4.2 summarizes the Camp Smith aggregated buildings used by REO. In this table, REO has considered only 21 aggregated buildings which are a subset of the FEDS buildings. Hence, to have a common set of aggregated buildings for our joint EE and RE optimization, we use this smaller set of 21 aggregated buildings in the remainder of our demonstration and results. A summary key with building numbers and names is provided in Table 4.3. Also, a graphical summary of the baseline energy use for these 21 aggregated buildings is provided in Figures 4.1 and 4.2. These data will be used further in Section 5 as part of the Camp Smith demonstration.

Table 4.1 Camp Smith Aggregated Buildings from FEDS Results (Chvala 2010a)

FEDS Facility Category Code	Facility Category Description	Proxy Facility No.	Facility Quantity	Category Area (sq. ft.)
1	Overhead Protection	N/A	11	10,136
10_a	Building 20, Admin	20	1	75,585
10_OldHosp_1	Old Hospital, Building 1	1	1	67,986
10_OldHosp_2c	Old Hospital, Building 2C, Admin + basement fitness center	2C	1	37,336
10_OldHosp_2D	Old Hospital, Building 2D	2D	1	37,336
10_OldHosp_3A	Old Hospital, Building 3A, Floors 1&2 admin, Floor 3 renovation	3A	1	31,582
10_OldHosp_3B	Old Hospital, Building 3B, Admin + 1st floor clinic	3B	1	30,165
10_OldHosp_4	Old Hospital, Building 4 Admin plus food service	4	1	72,129
10_OldHosp_PXAud	Old Hospital, Building 4/PX and Auditorium			12,000
10_OldHosp_5	Old Hospital, Building 5	5, 5A	2	24,125
10_OldHosp_80	Old Hospital, Building 80, Admin/Control Room/Computers	80	1	37,300
10_OldHosp_81	Old Hospital, Building 81 phones	81	1	3,299
10_OldHosp_Connectors	Old Hospital, Buildings 1A, 1B, 2AA, 3AA	1A, 1B, 3AA, 2AA	4	28,291
10_PACOM	Bldg 700 PACOM Center, 701, 705	700	3	284,658
10_PACOM_food	Bldg 700 PACOM Food Service	700 café		
10b	Building 20E, Admin/Training	20E	1	2,520
31_barracks	barracks complex (401-404)	402	4	43,596
40_Maint	Maintenance B600	600	1	20,900
50_GEN	Generator Buildings/Shelters	N/A	6	5,338
50_UPS	UPS Building 602	602	2	2,184
80_Fire	Fire Station B612	612	1	7,126
80_Misc	Everything else	366	10	12,887
80_NCO	NCO Club, B500	500	1	7,020
80_Police	B601 Police Station	601	1	3,888
80_RB	Courts	450, 451	2	3,322
80_Pool	Outdoor Pool	125	N/A	N/A
80_RecCntr	Bldg 501 Rec center	501	1	5,518
TOTAL			59	866,227

Table 4.2 Camp Smith Aggregated Buildings from REO Results (Walker 2010)

Name	Annual Electric Consumption (kWh)	Annual Electric Cost ($)	Annual Propane Consumption (therms)	Propane annual cost ($/year)
Total for Facility	21,563,187	3,767,687	36,511	81,238
Building 20, Admin	2,640,426	$461,356	0	0
Old Hospital, Building 1	1,139,598	$199,119	0	0
Old Hospital, Building 2C, Admin + basement fitness center	541,644	$94,640	0	0
Old Hospital, Building 2D	502,328	$87,771	0	0
Old Hospital, Building 3A, Floors 1&2 admin, Floor 3 renovation	487,044	$85,100	0	0
Old Hospital, Building 3B, Admin + 1st floor clinic	394,600	$68,948	0	0
Old Hospital, Building 4 Admin plus food service	1,256,773	$219,593	0	0
Old Hospital, Building 5	413,130	$72,185	7,114	15,830
Old Hospital, Building 80, Admin/Control Room/Computers	2,468,113	$431,248	0	0
Old Hospital, Building 81 phones	243,779	$42,595	0	0
Old Hospital, Buildings 1A, 1B, 2AA, 3AA	401,402	$70,136	0	0
Bldg 700 PACOM Center, 701, 705	7,112,806	$1,242,804	14,189	31,571
Barracks complex (401-404)	332,824	$58,154	11,462	25,503
Maintenance B600	144,713	$25,285	0	0
UPS Building 602	2,800,413	$489,310	0	0
Fire Station B612	109,966	$19,214	0	0
Everything else	140,028	$24,467	0	0
NCO Club, B500	172,115	$30,073	3,746	8,334
B601 Police Station	91,838	$16,047	0	0
Courts	16,557	$2,893	0	0
Bldg 501 Rec center	153,090	$26,749	0	0

Table 4.3 Summary Key for Camp Smith Aggregated Buildings Considered in Joint Optimization Approach

Aggregated Building Number	Aggregated Building Name
1	Building 20, Admin
2	Old Hospital, Building 1
3	Old Hospital, Building 2C, Admin + basement fitness center
4	Old Hospital, Building 2D
5	Old Hospital, Building 3A, Floors 1&2 admin, Floor 3 renovation
6	Old Hospital, Building 3B, Admin + 1st floor clinic
7	Old Hospital, Building 4 Admin plus food service
8	Old Hospital, Building 5
9	Old Hospital, Building 80, Admin/Control Room/Computers
10	Old Hospital, Building 81 phones
11	Old Hospital, Buildings 1A, 1B, 2AA, 3AA
12	Bldg 700 PACOM Center, 701, 705
13	barracks complex (401-404)
14	Maintenance B600
15	UPS Building 602
16	Fire Station B612
17	Everything else
18	NCO Club, B500
19	B601 Police Station
20	Courts
21	Bldg 501 Rec center

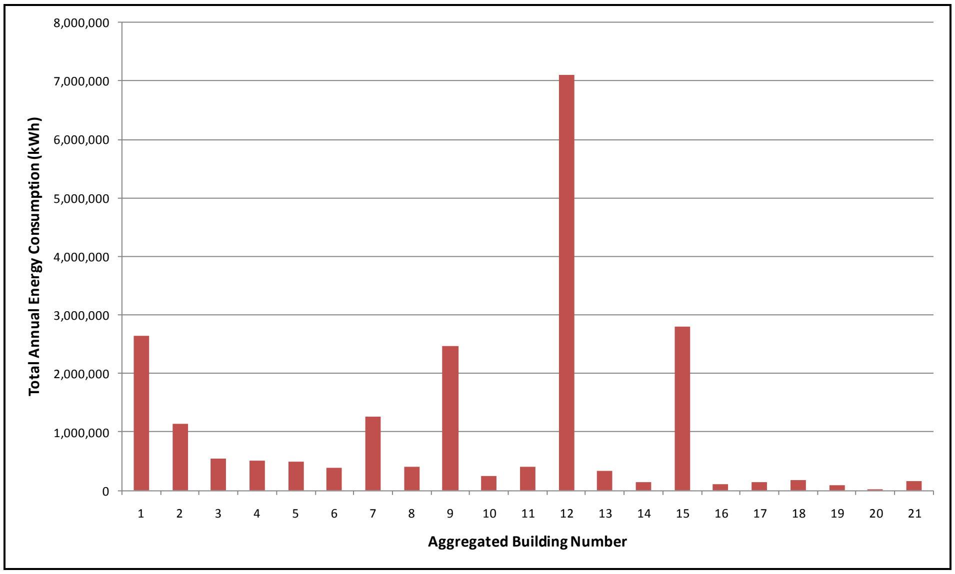


Figure 4.1 Baseline Total Annual Electric Consumption (kWh) for Camp Smith by Aggregated Building Number

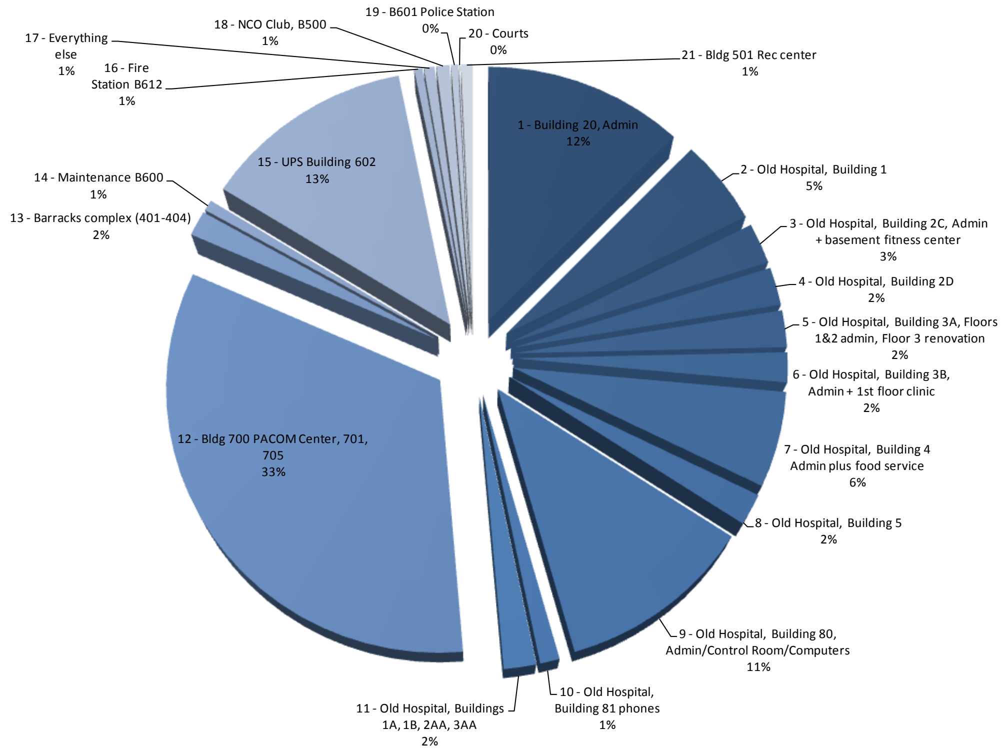


Figure 4.2 Baseline Total Annual Electric Consumption for Camp Smith by Aggregated Building Number as a Percent of Total Installation Demand

4.3 EE Modeling Input Considerations

In this subsection we review essential energy efficiency modeling input considerations that are necessary for our joint optimization approach. These considerations include a summary of the EE decision variables in the optimization model, the energy demand for the different aggregate buildings, the corresponding energy savings in these demands as a function of the different EE measures that might be employed on each building, and finally energy efficiency cost inputs for these different EE measures.

EE Decision Variables

Table 4.4 provides an overview of the EE decision variables considered for Camp Smith. The decisions are which combination, if any, of EE measures should be installed on each building. We note the numbering scheme shown is a residual of the original set of all 31 possible different combinations. In this case, the remaining numbers are those options considered viable for Camp Smith. Most notably, we removed consideration of heating system upgrades. The coding scheme used in the top row of Table 4.4 is shorthand notation for each of the candidate EE opportunities: Water Heating (W), Lighting (L), Envelope (E), Heating (H), and Cooling (C). Combinations of these opportunities are designated by multiple letters—for example "WL" indicates that a combination of water heating *and* lighting energy efficiency measures is under consideration. EE combination number 1 is reserved for the representation of the baseline demand. Finally, the "Select One" column indicates a constraint for each building which requires the selection of a one (1) or a zero (0) since the EE combination that can be selected is a binary decision variable. These binary decision variables are color coded by the green font cells. Additional details on the EE selection options are provided later in this section.

Table 4.4 Energy Efficiency Decision Variables for Camp Smith

		EE Selections															
		2	3	4	6	7	8	10	11	13	15	17	19	21	24	28	
Building Name	#	W	L	E	C	WL	WE	WC	LE	LC	EC	WLE	WLC	WEC	LEC	WLEC	Select One
Building 20, Admin	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Old Hospital, Buildin	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Old Hospital, Buildin	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Old Hospital, Buildin	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Old Hospital, Buildin	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Old Hospital, Buildin	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Old Hospital, Buildin	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Old Hospital, Buildin	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Old Hospital, Buildin	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Old Hospital, Buildin	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Old Hospital, Buildin	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Bldg 700 PACOM Cen	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
barracks complex (4	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Maintenance B600	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
UPS Building 602	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Fire Station B612	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Everything else	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
NCO Club, B500	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
B601 Police Station	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Courts	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Bldg 501 Rec center	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0

The purpose of the binary decision variables indicated in Table 4.4 is to drive a reduction in the energy demand for each building from its baseline demand. Figure 4.3 provides a graphical summary of this baseline annual demand for an example building (Aggregated Building 1) at Camp Smith. For example, if EE combination 11 (i.e., LE—lighting and envelope) is selected for Aggregated Building 4, the baseline energy demand is reduced by 11.61%. Extending this example, for Aggregated Building 4 at hour 10, the baseline demand is 86.7 kWh and LE reduces this demand by 10.1 kWh. Note: Appendix B summarizes the assumed percent reduction in baseline demand for each EE combination for each building.

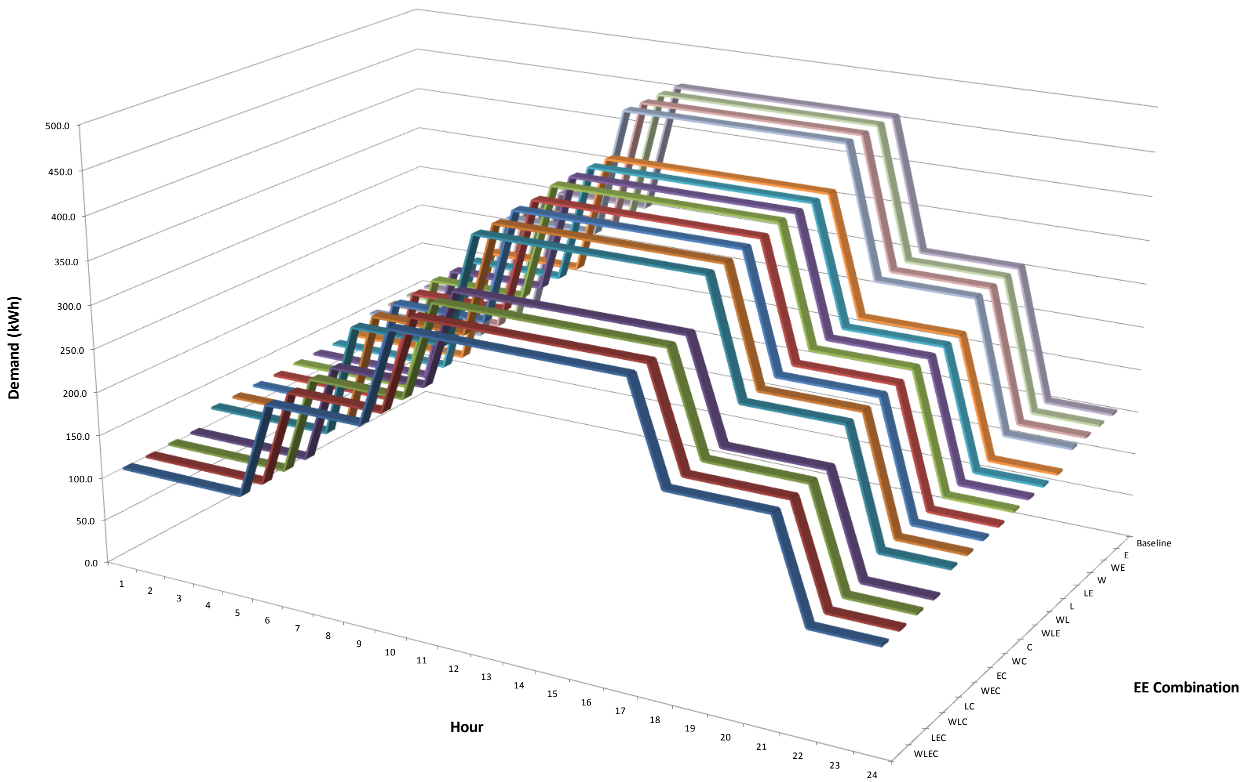


Figure 4.3 Hourly Baseline Demand and Reduced Energy Demand for Each EE Combination (Aggregated Building 1)

Energy Demand

Energy demand is measured as kilowatt hours (kWh) within the model, and is required for each aggregated building. While annual demand values are available (kWh/yr), the higher resolution requirement of daily and hourly energy demand is not. In order to accommodate the model, hourly energy demand is calculated from an average derived from the annual energy values for a building. The original values used are taken from FEDS and were shown earlier in Table 4.2 and summarized graphically in Figures 4.1 and 4.2. These numbers are a representation of the energy demand for a typical year for each building.

Ideally, in order to get the most accurate solution possible, hourly demand values would be a available for each building, but since those are currently not available, the hourly values must be derived from the annual numbers. To translate annual energy demand into hourly values, an hourly average is calculated for each building by simply taking the entire annual demand and dividing by 8,760 hours in a year. Understanding that a flat hourly average does not accurately represent a normal energy use patterns for most facilities, an energy demand profile concept is introduced to reallocate energy on an hourly basis throughout the day. Figure 4.4 below illustrates the energy demand profile used within the model. At any given hour in a day, the average hourly demand is multiplied by the corresponding percentage, yielding a time varied energy demand. This profile is applied to all buildings universally, but can potentially be applied to buildings individually if demand patterns are determined to vary significantly. The key feature of this approach is to more accurately represent and model real energy use and variations throughout the day vice a single constant number.

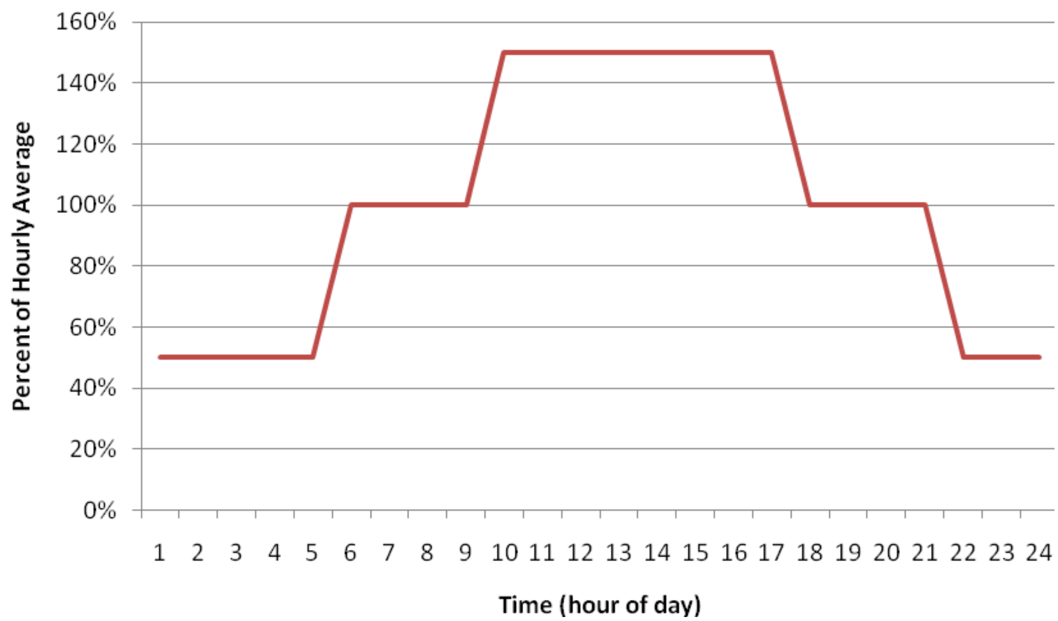


Figure 4.4 Energy Demand Profile

As an example, Table 4.5 below illustrates how annual demand is used to create an hourly energy demand for Building 20, Admin. For instance, at hour 1, the average hourly demand of 301.4 kWh/hr is multiplied by 50%, yielding a modified hourly energy demand of 150.7 kWh/hr.

Table 4.5 Example Calculation for Hourly Energy Demand (Building 20)

Building 20, Admin	Total Annual Demand (kWh/yr)	Average Hourly Demand (kWh/hr)
	2,640,426	301.4
Hour	**Percent of Average Applied**	**Hourly Energy Demand (kWh/hr)**
1	50%	150.7
2	50%	150.7
3	50%	150.7
4	50%	150.7
5	50%	150.7
6	100%	301.4
7	100%	301.4
8	100%	301.4
9	100%	301.4
10	150%	452.1
11	150%	452.1
12	150%	452.1
13	150%	452.1
14	150%	452.1
15	150%	452.1
16	150%	452.1
17	150%	452.1
18	100%	301.4
19	100%	301.4
20	100%	301.4
21	100%	301.4
22	50%	150.7
23	50%	150.7
24	50%	150.7

Appendix C contains individual tables for each building listing the baseline energy demand (the column labeled baseline) and corresponding potential reductions in this demand for each EE combination considered for each hour that will be addressed later.

As a subset of the total energy demand for each building, the model also incorporates water heating energy demand for each building. The purpose for capturing these values separately is to enable the model to make solar water heating recommendations in the solution, but not allow the solution to exceed building specific water heating demand levels. Annual water heating demand values are collected for each building, converted into kWh, and decreased by a factor of 64% in order to reduce demand to a level that can reasonably be met by solar water heating elections. FEDS supplied the annual values used for the Camp Smith demonstration. Average hourly water heating demand values are then calculated from the reduced annual water heating demand numbers and are summarized in Table 4.6 below.

Table 4.6 Annual Water Heating Energy Demand

#	Bldg Name	FEDS TMY (kWh/yr)	Apply 64% Factor
1	Building 20, Admin	7,034	4,502
2	Old Hospital, Building 1	6,741	4,314
3	Old Hospital, Building 2C, Admin + basement fitness center	9,086	5,815
4	Old Hospital, Building 2D	4,397	2,814
5	Old Hospital, Building 3A, Floors 1&2 admin, Floor 3 renovation	3,517	2,251
6	Old Hospital, Building 3B, Admin + 1st floor clinic	14,362	9,192
7	Old Hospital, Building 4 Admin plus food service	22,862	14,632
8	Old Hospital, Building 5	17,586	11,255
9	Old Hospital, Building 80, Admin/Control Room/Computers	8,793	5,628
10	Old Hospital, Building 81 phones	879	563
11	Old Hospital, Buildings 1A, 1B, 2AA, 3AA	3,810	2,439
12	Bldg 700 PACOM Center, 701, 705	260,273	166,575
13	barracks complex (401-404)	238,583	152,693
14	Maintenance B600	2,638	1,688
15	UPS Building 602	-	-
16	Fire Station B612	1,466	938
17	Everything else	-	-
18	NCO Club, B500	41,034	26,262
19	B601 Police Station	-	-
20	Courts	-	-
21	Bldg 501 Rec center	3,810	2,439

Similar to the calculations used to derive total hourly energy demand, the water heating demand calculations employ a demand profile specific to water heating, see Figure 4.5.

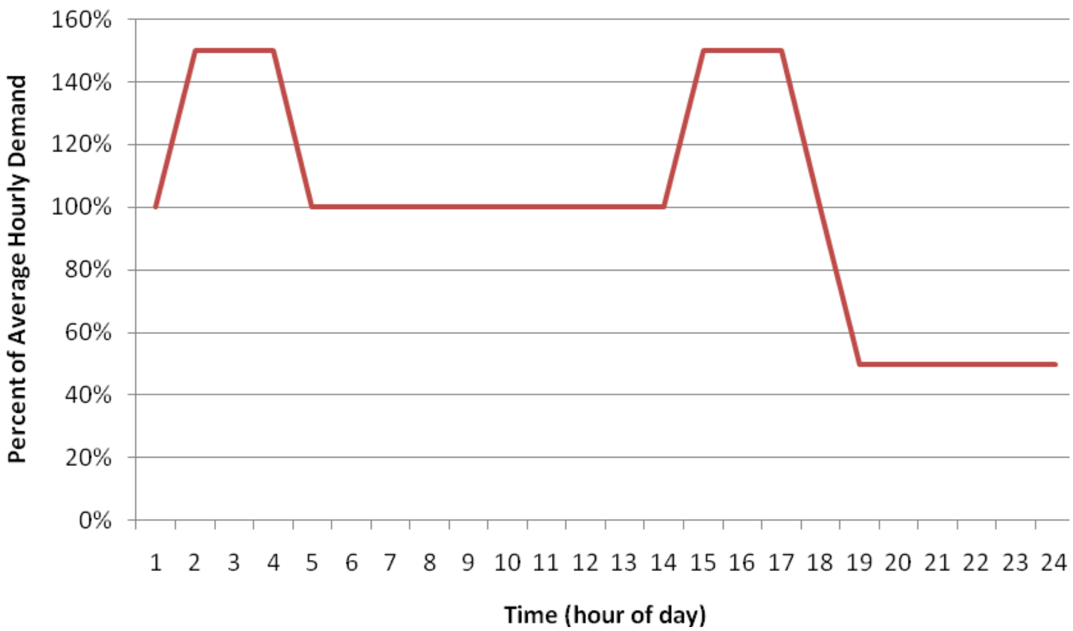


Figure 4.5 Water Heating Energy Demand Profile

As an example, Table 4.7 below illustrates how annual demand is used to create an hourly water heating energy demand for Building 20, Admin. For hour 2, the average hourly demand of 0.51 kWh/hr is multiplied by 150%, yielding a modified hourly energy demand of 0.77 kWh/hr. Appendix D shows the hourly water heating energy demand for each building in the Camp Smith demonstration.

Table 4.7 Example Calculations for Water Heating Hourly Demand (Building 20)

Building 20, Admin	Total Annual Water Heating Demand (kWh/yr)	Average Hourly Water Heating Demand (kWh/hr)
	4,502	0.51
Hour	**Percent of Average Applied**	**Hourly Energy Demand (kWh/hr)**
1	100%	0.51
2	150%	0.77
3	150%	0.77
4	150%	0.77
5	100%	0.51
6	100%	0.51
7	100%	0.51
8	100%	0.51
9	100%	0.51
10	100%	0.51
11	100%	0.51
12	100%	0.51
13	100%	0.51
14	100%	0.51
15	150%	0.77
16	150%	0.77
17	150%	0.77
18	100%	0.51
19	50%	0.26
20	50%	0.26
21	50%	0.26
22	50%	0.26
23	50%	0.26
24	50%	0.26

EE Energy Savings

Energy savings occur in the model as a result of electively choosing energy efficiency combinations for each building, thereby reducing the baseline energy demand. Energy efficiency measures are reported as providing energy savings by the recommendations from FEDS, and the results are given in MM BTU's for each EE measure. In an effort to simplify the large number of potential EE combinations, similar types of EE measures are grouped and energy savings are reported at this aggregate level. While any number of EE combinations could be considered, the initial model design includes 5 base categories for aggregation: Water Heating (W), Lighting (L), Envelope (E), Heating (H), and Cooling (C). Table 4.8 presents the output from FEDS with savings reported for each of the 5 groups for each of the 21 buildings. A blank indicates a reported zero energy savings for that building and EE measure.

Table 4.8 EE Building Energy Savings (MM BTUs)

Building List	Water	Lighting	Envel-ope	Heating	Cooling
Building 20, Admin	22	956			1110
Old Hospital, Building 1	10	243	52		
Old Hospital, Building 2C, Admin + basement fitness center	23	269			
Old Hospital, Building 2D	6	199			
Old Hospital, Building 3A, Floors 1&2 admin, Floor 3 renov.	5	182			126
Old Hospital, Building 3B, Admin + 1st floor clinic	39	177			20
Old Hospital, Building 4 Admin plus food service	60	205	255		106
Old Hospital, Building 5	56	99			135
Old Hospital, Building 80, Admin/Control Room/Computers	28	169			741
Old Hospital, Building 81 phones	1	31	4		24
Old Hospital, Buildings 1A, 1B, 2AA, 3AA	5	154			
Bldg 700 PACOM Center, 701, 705	62	2938	76		
barracks complex (401-404)	718	5			
Maintenance B600		48			
UPS Building 602		0			
Fire Station B612	0	1			
Everything else		3	75		
NCO Club, B500	9	26			114
B601 Police Station		0			
Courts					
Bldg 501 Rec center	11	8	20		

To account for potential interactions between EE measures (e.g., Lighting and Heating), all unique combinations of those 5 basic EE categories are also included as EE combinations. In total, there are 31 total possible energy efficiency combinations for each building plus an additional option to do nothing. Table 4.9 provides a list of these 31 EE combinations.

Table 4.9 Potential Energy Efficiency Combinations

Energy Efficiency Combination Detail	EE Combination Code
Water Heating	W
Lighting	L
Envelope	E
Heating	H
Cooling	C
Water Heating, Lighting	WL
Water Heating, Envelope	WE
Water Heating, Heating	WH
Water Heating, Cooling	WC
Lighting, Envelope	LE
Lighting, Heating	LH
Lighting, Cooling	LC
Envelope, Heating	EH
Envelope, Cooling	EC
Heating, Cooling	HC
Water Heating, Lighting, Envelope	WLE
Water Heating, Lighting, Heating	WLH
Water Heating, Lighting, Cooling	WLC
Water Heating, Envelope, Heating	WEH
Water Heating, Envelope, Cooling	WEC
Water Heating, Heating, Cooling	WHC
Lighting, Envelope, Heating	LEH
Lighting, Envelope, Cooling	LEC
Lighting, Heating, Cooling	LHC
Envelope, Heating, Cooling	EHC
Water Heating, Lighting, Envelope, Heating	WLEH
Water Heating, Lighting, Envelope, Cooling	WLEC
Water Heating, Lighting, Heating, Cooling	WLHC
Water Heating, Envelope, Heating, Cooling	WEHC
Lighting, Envelope, Heating, Cooling	LEHC
Water Heating, Lighting, Envelope, Heating, Cooling	WLEHC

While energy savings for some EE combinations are simply a summation of the individual EE measure's energy savings, some EE combinations are assumed to have an interaction, where the sums are inflated or reduced by a prescribed factor. Appendix E provides a table that lists the factors used for EE combinations, and the resulting EE energy savings. An energy savings percentage is calculated for each EE combination for each building, providing the mechanism within the model that decrements energy demand for a given EE combination selection. As mentioned earlier, Appendix C provides the hourly breakdown of energy savings for each building for each of the considered EE combinations. Note: This table includes all EE combinations, but no heating aspects were considered for the Camp Smith demonstration case. Accordingly, a reduced set of EE combination selections was developed for the joint optimization model demonstration for Camp Smith. This reduced set corresponds to the EE decision variables that were provided earlier in Table 4.4. In short, there are a total of 15 potential EE options plus the option to do nothing.

Energy Efficiency Cost Inputs

The final remaining piece to account for with regards to the EE combinations and energy savings is the costing of each EE combination. From FEDS, there is a cost associated with each EE measure recommended. Grouping the costs for the same 5 base categories as the energy savings and simply summing these costs for each measure within the EE combinations results in a cost per EE combination table, which can be found in Appendix F.

4.4 RE Modeling Input Considerations

In this subsection we review essential renewable energy modeling input considerations that are necessary for our joint optimization approach. These considerations include a summary of the RE decision variables considered for Camp Smith, availability by each RE energy source, RE capacity constraints, and RE cost input considerations.

RE Decision Variables

As discussed in Section 3, there are many potential RE energy sources that might be employed at an installation. However, as we build toward our demonstration of the joint optimization approach for Camp Smith, we will focus on three basic types of RE opportunities as tempered by the more detailed RE focused results produced by REO. The REO measures are photovoltaics (PV), wind energy, and solar water heating. The RE measures then are incorporated as a set of RE decision variables with the decisions being 1) how large of a central wind plant to build?; 2) how large of a central PV plant to build?; 3) how much individual solar water heating to install on each building?; and 4) how much individual PV to install on each building? In contrast to the EE decision variables that were binary, these decision variables are continuous in nature. Table 4.10 provides the specific setup for these RE decision variables as considered for Camp Smith (the green font cells). As a point of reference for model calibration we included the REO recommendations on PV in this Table.

Table 4.10 Renewable Energy Decision Variables for Camp Smith (kWh)

		RE Selections		
Installation Power		Wind Plant	PV Plant	REO Recommendation
		0.00	0.00	3187
Building Name	#	Solar WH	PV Indiv.	REO Recommendation
Building 20, Admin	1	0.0	0.0	7.7
Old Hospital, Building	2	0.0	0.0	16.1
Old Hospital, Building	3	0.0	0.0	-
Old Hospital, Building	4	0.0	0.0	-
Old Hospital, Building	5	0.0	0.0	5.2
Old Hospital, Building	6	0.0	0.0	5.2
Old Hospital, Building	7	0.0	0.0	15.5
Old Hospital, Building	8	0.0	0.0	16.5
Old Hospital, Building	9	0.0	0.0	-
Old Hospital, Building	10	0.0	0.0	-
Old Hospital, Buildings	11	0.0	0.0	-
Bldg 700 PACOM Cente	12	0.0	0.0	-
barracks complex (401	13	0.0	0.0	17.6
Maintenance B600	14	0.0	0.0	11.4
UPS Building 602	15	0.0	0.0	-
Fire Station B612	16	0.0	0.0	-
Everything else	17	0.0	0.0	-
NCO Club, B500	18	0.0	0.0	5.2
B601 Police Station	19	0.0	0.0	-
Courts	20	0.0	0.0	-
Bldg 501 Rec center	21	0.0	0.0	-

RE Availability

For each of the renewable energy source considered, availability by each hour is an input that can limit the percent of total power capacity available at any given hour from its maximum value. A prime example of this is solar power, where available sunlight drives energy production throughout the day. Specifically, the model requires a percentage for each RE source for each hour modeled, even if the availability is considered to be 100% for all hours. Table 4.11 provides the assumed power capacity percentage available at each hour for the 3 general categories of renewable energy considered.

Table 4.11 Renewable Energy Availability

Hour	Solar Water Heating	Wind	Photovoltaic
1	0.0%	100%	0.0%
2	0.0%	100%	0.0%
3	0.0%	100%	0.0%
4	0.0%	100%	0.0%
5	0.0%	100%	0.0%
6	0.0%	100%	0.0%
7	0.0%	100%	0.0%
8	12.6%	100%	12.6%
9	40.9%	100%	40.9%
10	67.2%	100%	67.2%
11	82.7%	100%	82.7%
12	94.8%	100%	94.8%
13	100.0%	100%	100.0%
14	94.4%	100%	94.4%
15	85.9%	100%	85.9%
16	66.6%	100%	66.6%
17	41.6%	100%	41.6%
18	14.1%	100%	14.1%
19	0.1%	100%	0.1%
20	0.0%	100%	0.0%
21	0.0%	100%	0.0%
22	0.0%	100%	0.0%
23	0.0%	100%	0.0%
24	0.0%	100%	0.0%

For the original version of the model wind is assumed to be available at any given hour, where efficiency and power capacity are derived in other sections. In particular the 100% capacity is based on an assumption that the average wind velocity throughout the year at Camp Smith is already captured in an efficiency measure that will be discussed below. Solar water heating and photovoltaics (both by plant and individual buildings) sources use output from PVWatts to calculate approximate availability for a single day cycle. A fixed tilt PV system in Honolulu was assumed. Taking a full year of hourly energy production limits, and averaging the percentages of the maximum energy produced for each of those hours produced the average percentage of maximum power available for each hour of the day as depicted in Figure 4.6.

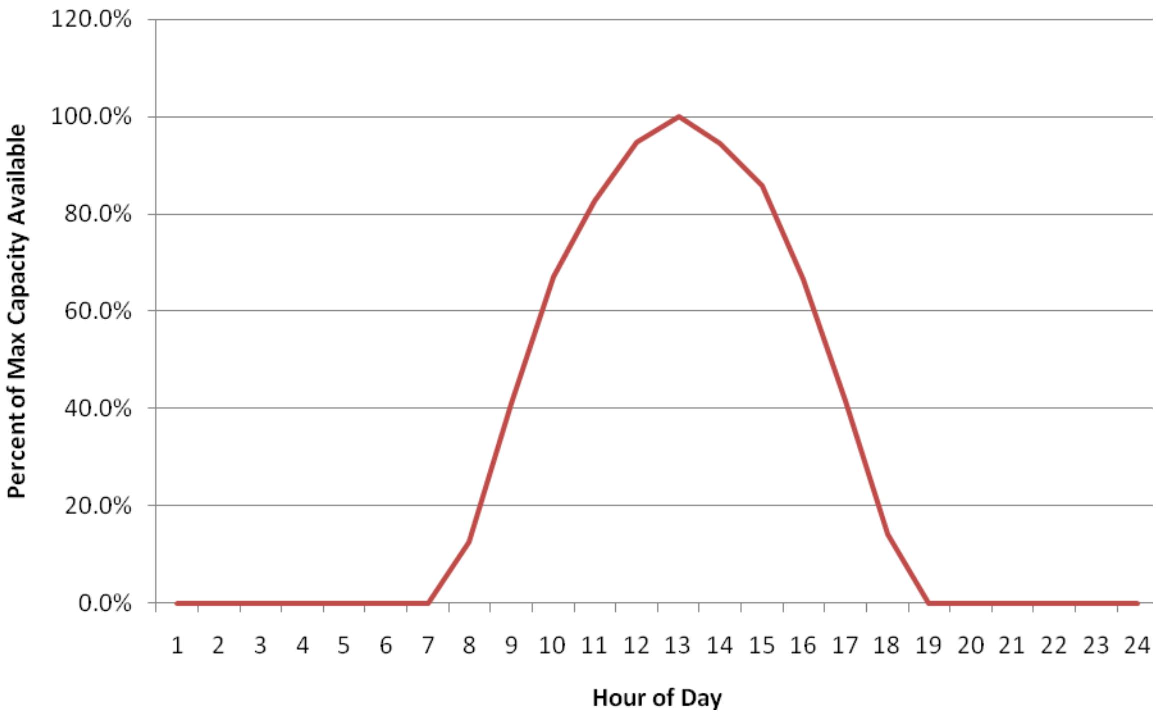


Figure 4.6 Solar PV Availability by Hour

Capacity Constraints

Each renewable energy source requires consideration of physical space requirements, environmental impacts, and other sit-specific limitations that must be considered. Any, or all, of these factors can lead to the development of model constraints that appropriately limit the maximum power capacity feasible by RE type for an installation. The current model setup allows the user to prescribe a kilowatt power capacity constraint for each type of renewable energy source, allowing flexibility to limit power capacity based on local, installation-specific considerations.

The one renewable energy source considered in the Camp Smith demonstration that does not allow a constraint input by the user is the solar hot water heating option. Rather, solar water heating is subject to the limitations of the water heating energy demand for each building, by hour. The model is constrained so that the solar water heating energy produced cannot exceed the hourly energy demand for water heating.

If additional renewable energy sources are going to be considered, meaningful capacity constraints would need to be developed for each. It is also possible to separate out a single type of renewable energy source into multiple renewable energy options and thereby enforce mutually exclusive options that may be necessary.

Currently, the capacity limits discussed are implemented in the joint optimization model via input parameters.

Renewable Energy Cost Inputs

For renewable energy technologies, there are two major cost components – acquisition costs (also referred to as installed costs (IC)) and operating and maintenance (O&M) costs. For each RE technology considered, Walker provides functions for these components (Walker 2010). In our demonstration of the joint modeling methodology, we consider three different technologies—photovoltaics (PV) installed as single platforms on individual buildings and/or installed as a plant on the installation; wind energy installed as a plant on the installation, and solar water heating (SWH) installed on individual buildings.

PV Energy Costs. As shown in Figure 4.7, Walker provides a cost function for PV energy in terms of $ per Watt based on the installed PV size in kW. To use this function, one first needs to determine the desired load to be delivered by the PV system, $x_{\text{delivered}}$. This number then must be divided by the PV efficiency (η_{PV}) in order to size the system sufficiently to deliver the desired PV load. As reported by Walker, this efficiency for PV systems is 0.77. Call the resulting desired PV capacity x, so that $x = x_{\text{delivered}} / \eta_{PV}$. Lastly, to be consistent with REO results as reported by Walker for Camp Smith, we must account for installation cost escalation factors for Hawaii. For PV systems, this factor is approximately 19%. Therefore, our installed PV cost function becomes

$$\text{Installed PV Cost (\$)} = 1.19x\left[7.0386\left(\frac{x}{1{,}000}\right)^{-0.024}\right] \quad (4.1)$$

again, where x is the desired PV capacity after accounting for efficiency and it is measured in Watts. This function is applicable to individual building PV installations or a PV plant.

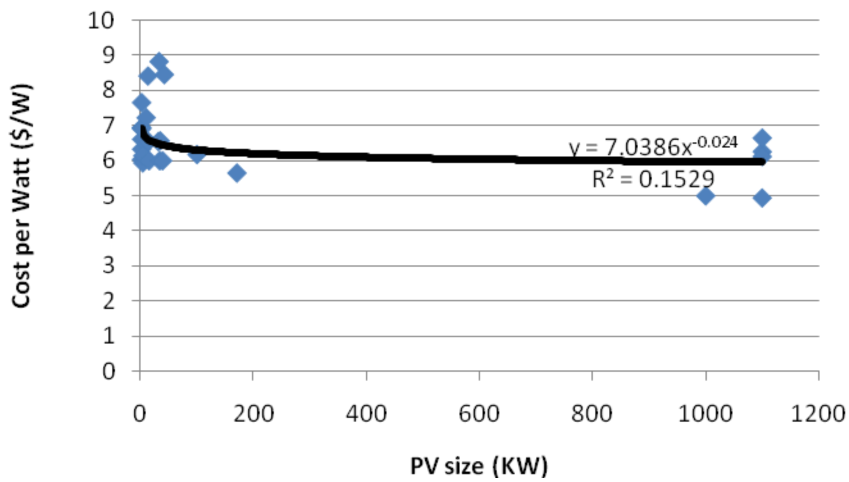


Figure 4.7 Basic Installed PV Cost Function used by REO (Walker 2010)

To compute O&M costs for PV systems, Walker provides the following:

$$\text{Annual PV O\&M (\$/year)} = 0.006(x/1{,}000) \tag{4.2}$$

where (again) x is the desired PV capacity after accounting for efficiency and it is measured in Watts. Thus, by multiplying the desired life cycle duration by the annual O&M costs for PV and adding this to the PV installed costs, one can obtain the full life cycle cost of a PV system.

Wind Plant Energy Costs. As shown in Figure 4.8, Walker provides a cost function for wind energy in terms of $ per kilowatt based on the installed wind plant size in kW. To use this function then, one first needs to determine the desired load to be delivered by the wind plant, $x_{delivered}$. This number must be divided by the wind efficiency (η_{Wind}) in order to size the system sufficiently to deliver the desired PV load. As reported by Walker, the efficiency for wind energy system turbines is 0.28. However, when also accounting for the overall average wind availability throughout the year at Camp Smith, this number is further reduced to 0.0747, based on results reported by Walker. The desired wind capacity x, then becomes $x = x_{delivered} / \eta_{Wind}$. Lastly, to be consistent with REO results as reported by Walker for Camp Smith, we must account for wind energy installation cost escalation factors for Hawaii. For wind systems, this factor is approximately 22.7%. Therefore, our installed wind energy cost function becomes

$$\text{Installed Wind Energy Cost (\$)} = 1.227x\,[10{,}605x^{-0.218}] \tag{4.3}$$

where, in this case, x is the desired wind energy plant capacity after accounting for efficiency and it is measured in kilowatts.

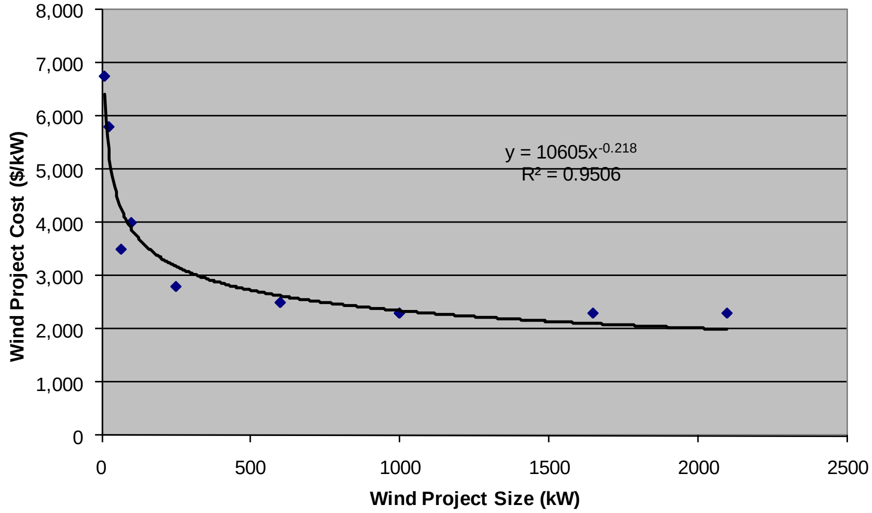


Figure 4.8 Basic Installed Wind Energy Cost Function used by REO (Walker 2010)

To compute O&M costs for wind energy systems, Walker provides the following after rearranging terms:

$$\text{Annual Wind Energy O\&M (\$/year)} = 7.9x \qquad (4.4)$$

where once more *x* is the desired wind energy plant capacity after accounting for efficiency and it is measured in kilowatts. Thus, by multiplying the desired life cycle duration by the annual O&M costs for wind energy and adding this to the wind energy installed costs, one can obtain the full life cycle cost of a wind energy plant.

Solar Water Heating Energy Costs. As shown in Figure 4.9, Walker provides a cost function for solar water heating (SWH) energy in terms of $ per square foot based on the installed SWH size in square feet. To use this function then, one first needs to determine the desired hot water energy load to be delivered by the SWH resource and convert this need to square feet. This number then must be divided by the SWH efficiency (η_{SWH}) in order to size the system sufficiently to deliver the desired hot water load. Based on our analysis of the REO reported results for Camp Smith, we determined an overall SWH efficiency of 0.429. Furthermore, via additional analysis and appropriate conversions (i.e., square feet to kWh) of the REO reported results for Camp Smith, we determined the following form for installed SHW energy costs (using the earlier cost escalation factor of ~19%)

$$\text{Installed SWH Energy Cost (\$)} = 1.19x\left[253.88\left(\frac{x}{81}\right)^{-0.116}\right] \qquad (4.5)$$

where in this case *x* is the desired SWH capacity after accounting for efficiency and it is measured in kilowatts.

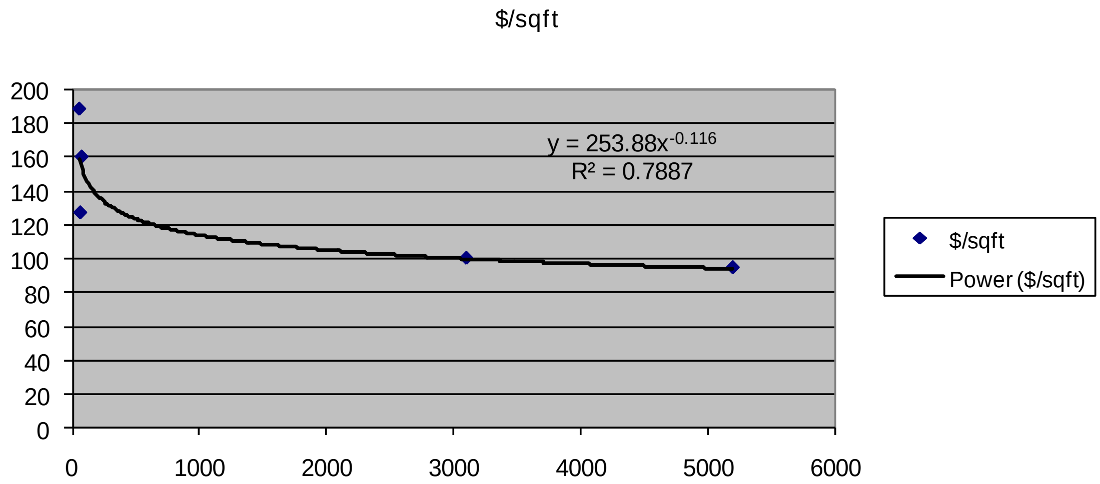


Figure 4.9 Basic Installed Solar Water Heating Energy Cost Function used by REO (Walker 2010)

To compute O&M costs for SWH energy systems, we determined the following based on results provided by Walker:

$$\text{Annual SWH O\&M (\$/year)} = 0.005(\text{SWH Installed Cost}) \qquad (4.6)$$

Thus, by multiplying the desired life cycle duration by the annual O&M costs for SWH energy and adding this to the SWH energy installed costs, one can obtain the full life cycle cost of a SWH system.

Table 4.12 summarizes all of these acquisition cost functions, O&M cost functions, and efficiencies assumed in the joint optimization model pertinent to Camp Smith.

Table 4.12 Summary of Renewable Energy Technologies Acquisition and O&M Cost Functions used by Joint Optimization Approach

RE Technology	Installed Cost Function ($)	O&M Cost Function ($/year)	Overall Efficiency Modeled*
Photovoltaics (W)	$1.19x\ [7.0386\left(\frac{x}{1{,}000}\right)^{-0.024}]$	$0.006(x/1{,}000)$	0.77
Wind Energy (kW)	$1.227x\ [10{,}605x^{-0.218}]$	$7.9x$	0.0747
Solar Water Heating (kW)	$1.19x[253.88(\frac{x}{81})^{-0.116}]$	0.005(SWH IC)	0.429

* - As previously noted, photovoltaic and SWH systems delivered energy will be reduced further throughout the day based on solar availability. This aspect is directly accounted for in our modeling via use of the PVWatts Solar Calculator. In the case of wind energy, there is no further reduction in energy delivered as the overall efficiency number provided here has assumed an average wind speed (i.e., availability) throughout the year.

4.5 Input Parameters

Finally, several input parameters are important to the full joint optimization approach and these have been accommodated in the model. In particular, input parameters that can be specified by the user fall into two categories:

Input Parameters Controlled by the User

Key input parameters that can be controlled by the user are 1) the life cycle duration considered, in years; 2) the RE goal (%) which is the overall minimum amount of RE being used to satisfy the overall net energy demand after EE measures are incorporated; 3) the PV plant maximum capacity in terms of kilowatts; 4) the wind energy plant maximum capacity in terms of kilowatts; and 5) the maximum individual building PV capacity in terms of kilowatts.

Additional Parameters to Guide Solution

Because the optimization model developed is a non-linear, it is possible to encounter local optimal solutions where the model cannot improve upon the incumbent (e.g., starting input on decision variables). To ensure that the model achieves a feasible optimal solution (and not simply a local optimal), the following additional input parameters must be specified: 1) the starting PV plant size and 2) the starting wind energy plant size.

Section 5 will make use of all of the input modeling considerations discussed in this section as specifically focused on Camp Smith. A demonstration of results for various input parameters will also be presented.

Section 5: Demonstration of Modeling Approaches on Camp Smith

In this section we demonstrate the various modeling approaches for joint energy efficiency and renewable energy by application of the approaches to the United States Pacific Command's Headquarters installation, Camp H.M. Smith, Hawaii. Throughout this section we make use of the results of the energy efficiency analysis completed by PNNL using FEDS (Chvala 2010a) and the results of the renewable energy optimization analysis completed by NREL using REO (Walker 2010).

5.1 Conventional Modeling Results

An energy assessment conducted at Camp Smith in January, 2010 by PNNL resulted in a complete energy audit report that provided recommendations for making EE retrofits within numerous buildings. Using two different financing structures (appropriated funds and alternative financing), and a baseline energy consumption estimate of 96,710 MBtu/year, it was estimated that by implementing the recommended retrofits, Camp Smith could realistically expect to reduce energy consumption by between 7,300 MMBtu/year and 9,900 MMBtu/year and expenditures by $426k to $551k[6] per year. The assessment provided a listing of 117 (91 if using alternative financing sources) energy- and cost-reducing projects that could be implemented. The retrofit opportunities are accompanied by net present value, installed cost, first year savings, simple payback, and savings-to-investment ratios (Chvala 2010a).

Camp Smith was also evaluated (under the ARRA FEMP Technical Assistance effort) from a RE opportunity perspective. The NREL report concluded that a mix of "wind, photovoltaics (PV), solar hot water, and daylighting technologies " (Walker 2010) would result in a 40-year life cycle cost savings of approximately $45 million. The initial cost to implement these RE recommendations was estimated at $28.3 million. The analysis was based on an estimated energy consumption of 77,225 MBtu/year. The specific NREL recommendations include the following: 1) installation of a 2.4 MW wind turbine, 2) installation of a 3.1 MW PV farm and 0.1 MW of roof-mounted PV systems, 3) daylighting for 5 warehouse/industrial buildings, and 4) solar hot water heating for the old hospital building, the barracks complex and the NCO club. Table 5.1 summarizes the results of the EE and RE assessments that were independently conducted for Camp Smith.

[6] The difference is driven by the funds/financing source. Annual savings of 9,900 MMBtu/yr and $551k are estimated if appropriated funds are used, and 7,300 MMBTU/yr and $426k if alternative financing is secured.

Table 5.1 Summary of Conventional Modeling Results

Installa-tion	Modeling software	Annual energy usage estimate (MBtu/yr)	Annual energy reduction estimate (MBtu/yr)	Estimate of annual energy moved off the grid (MBtu/yr)	Estimated installed cost of recommendations ($M)	Estimated annual savings ($M)
Camp Smith	FEDS (PNNL)	96,710	7,300 or 9,900	-	1.4 or 2.7	0.43 or 0.55
	REO (NREL)	77,225	-	23,726	28.3	1.1

Note: Where two numbers are reported, the first is Alternative funding, the second is Appropriated

5.2 FEDS then REO Results

When the RE assessment is made using a reduced energy demand profile (i.e. reduced by the assumed implementation of EE retrofits, as recommended by FEDS EE assessment), the recommendations, for Camp Smith, were different. Rather than a 4-technology mix of renewables[7] NREL recommended a 3-technology mix: wind, PV, and daylighting—solar hot water was not part of the recommended mix. This result was expected however, because one of the FEDS (EE) recommendations was to replace the propane-driven water heaters with energy efficient heat pumps. Table 5.2 summarizes these results.

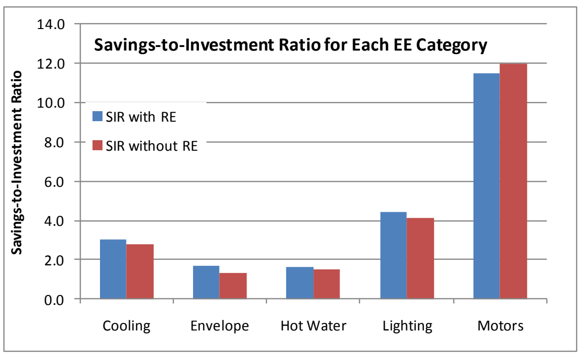
Table 5.2 Summary Comparing Modeling to FEDS then REO modeling

Conventional Independent Recommendations	FEDS then REO Recommendations
2.4 MW turbine	2.4 MW turbine
3.1 MW PV farm and 0.1 MW roof mounted PV	3.1 MW PV farm & 0.1 MW roof mounted PV
Daylighting for 5 warehouses	Daylighting for 5 warehouses
Solar hot water heating	No solar hot water heating

[7] As discussed above: 1) installation of a 2.4 MW wind turbine, 2) installation of a 3.1 MW PV farm and 0.1 MW of roof-mounted PV systems, 3) daylighting for 5 warehouse/industrial buildings, and 4) solar hot water heating for the old hospital building, the barracks complex and the NCO club.

5.3 REO then FEDS Results

Two REO then FEDS scenarios were evaluated. The first assumed that a 2.4 MW wind turbine and a 3.2 MW PV farm had been installed at Camp Smith. Here, some of the previously recommended EE retrofits fell into a "borderline" category. That is, some of the EE retrofits originally recommended by the FEDS analysis would not yield the same payback rapidity. The change however, was not great enough to disqualify specific EE retrofits—the original recommendations (i.e., without the addition of RE technologies) would remain the same. Figure 5.1 shows the Savings-to-Investment Ratio and the Simple Payback results for the conventional EE categories (cooling, envelope, hot water, lighting, and motors) under this scenario.



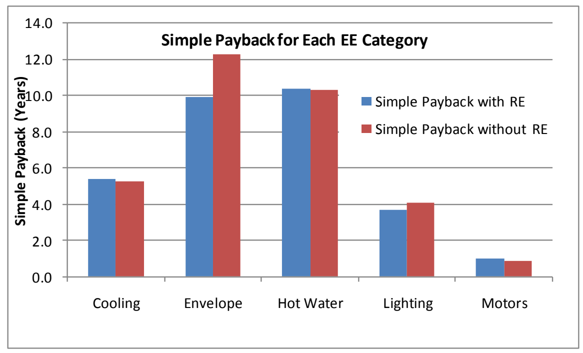


Figure 5.1 Comparison of Savings-to-Investment Ratios and Simple Payback

The second scenario examined assumed that 3 solar hot water projects were installed at Camp Smith. As with the previous scenario, the results were fairly insignificant. For building 5, the installation of a 324 ft^2 solar hot water system (recommended by NREL), which was assumed to yield approximately 90 MBtu/year would only marginally change the recommended EE retrofits: a smaller heat pump water heater would be recommended. Savings from this smaller heat pump were estimated at $2,840 (installation cost) and $363 annual operating cost. The cost of the solar hot water system was estimated at $50,151. For the barracks complex, a 1,875 ft^2 solar collector array (recommended by NREL) was assumed to be added to the building. The system was estimated to yield 517 MBtu/year of thermal energy and satisfy 63% of the building's hot water load. The system was estimated to cost $235,847. Under these assumptions, the EE retrofits were marginally changed. Instead of a heat pump hot water heater system that costs $254,728, FEDS analysis recommended a smaller unit that costs $89,162. Finally, for the NCO Club, the addition of a 363 ft^2 solar collector, which was assumed to yield approximately 90 MBtu/year of thermal energy and satisfy about 64% of the hot water load, did not change the original FEDS-generated recommendations. The reason for this is that the original FEDS runs did not recommend a hot water heater replacement and therefore, the addition of the solar system did not force any EE retrofit changes.

5.4 Joint Optimization Results

In this subsection we now demonstrate the joint EE and RE optimization modeling methodology described in Section 3 and using the input modeling considerations geared specifically at Camp Smith described in Section 4. In particular, we demonstrate the approach via a mathematical programming

(MP) implementation setup in Microsoft Excel and solved via the Excel add-in package Frontline Systems Risk Solver Platform.[8] We refer to the Excel based MP model as the Joint Energy Efficiency and Renewable Energy Optimizer (JERO).

Camp Smith Sample Run

Here we present an initial sample run for Camp Smith using the JERO model. We note that this sample run and results should not be considered as definitive recommendations for Camp Smith as this is not the intent of the model at this point. Rather, it is a demonstration of the joint optimization mathematical programming approach. However, we believe general insights and considerations from the sample run and also additional runs that will be presented and discussed are pertinent, from a theoretical standpoint.

In our initial sample run of JERO we start with the following basic input parameter settings:

- RE Goal: 30%
- Life cycle duration: 40 years
- Max wind plant capacity: 3,000 kW
- Max PV plant capacity: 3,000 kW
- Individual building PV capacity: 20 kW
- Starting solution for wind plant size: 1,000 kW
- Starting solution for PV plant size: 1,000 kW

With these parameters and invoking the Run Model button on JERO control tab, the optimization model runs to completion in approximately 1 minute. Figure 5.2 and Figure 5.3 show screenshots that capture portions of the Risk Solver Platform interface and solution status that is invoked by running JERO. Figure 5.4 shows a screen shot from the JERO model itself with the above input parameter settings after the model has run to completion. All energy units provided are in kW. In this figure we see the optimal recommendations for Camp Smith that will minimize total life cycle costs over the input duration life cycle while satisfying all specified constraints. In summary, this optimal solution provides the following key results:

- Reduction in overall annual energy consumption: 5,516 kWh (~10%)
- Life cycle savings: $41.41M
- RE energy achieved: 45.2%

[8] http://www.solver.com/platform/risk-solver-platform.htm

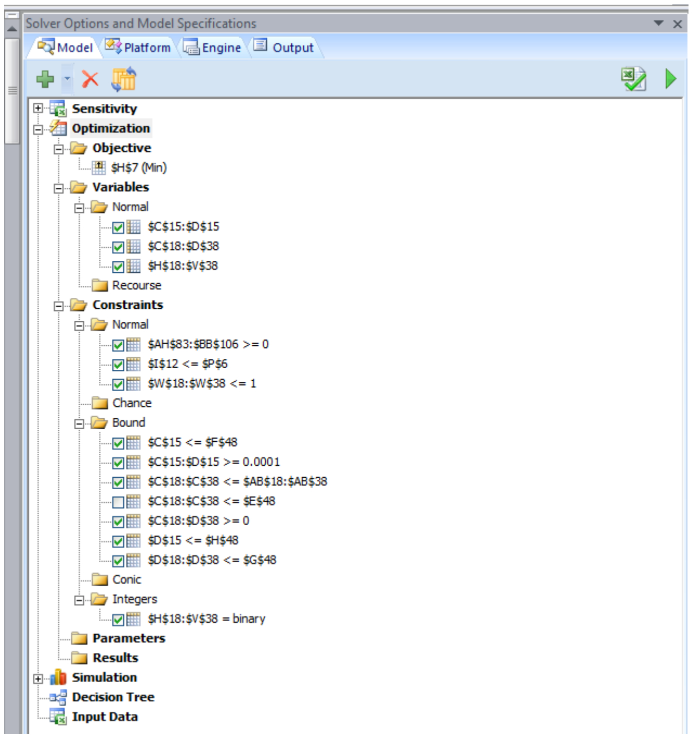


Figure 5.2 Risk Solver Platform Interface for JERO

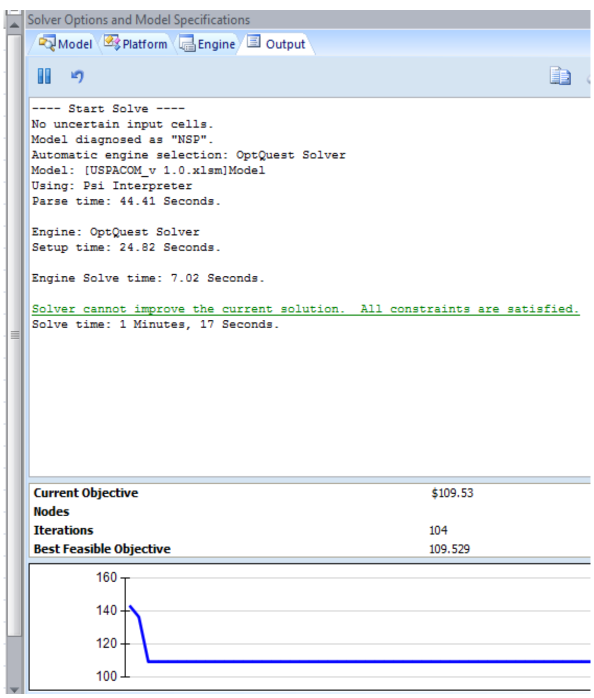


Figure 5.3 Risk Solver Platform Solution Status

This solution is comprised of recommendations for both EE and RE decisions. For EE, Figure 5.1 indicates a specific (yet varying) option for each individual building at Camp Smith. These options are indicated by the appropriate coding indicated under the Energy Efficiency column. In total, these EE measures would save Camp Smith the 5,516 kWh per year as provided above in the summary of key results.

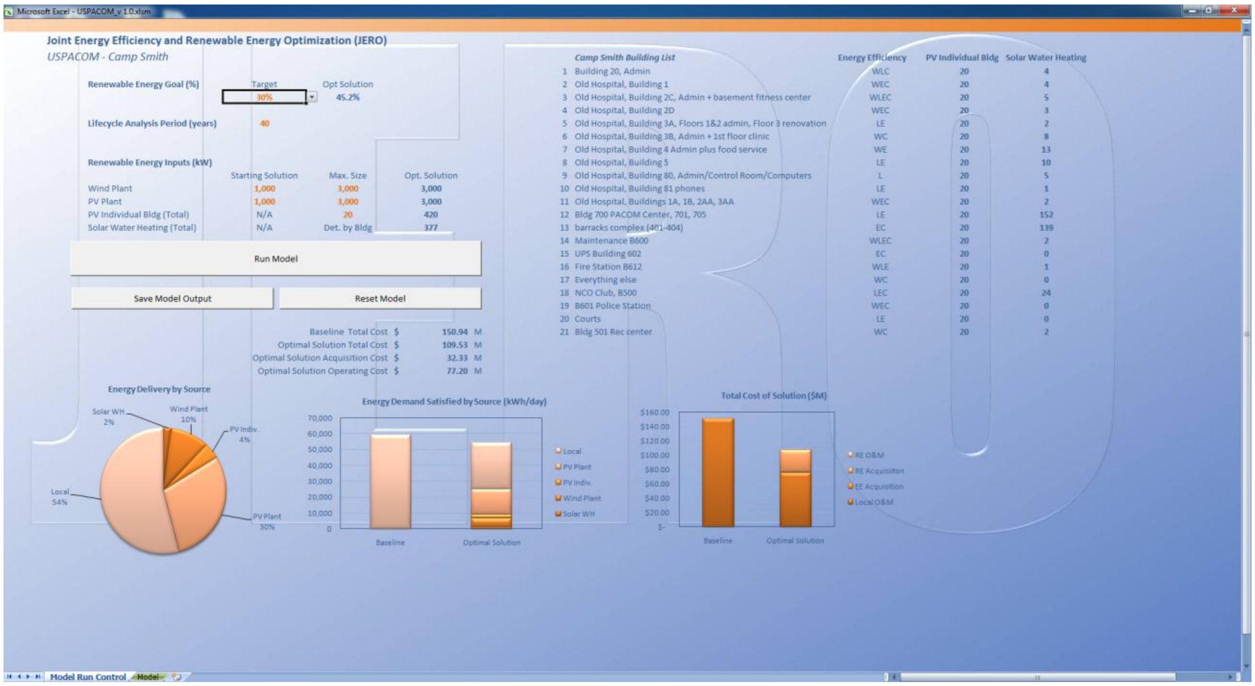


Figure 5.4 JERO Sample Run for Camp Smith

The important aspect of this result is that this set of recommendations for EE measures was selected simultaneously and as interactions/trade-offs with RE measures were being analyzed by the JERO model. We believe this is a first of this kind of joint EE/RE optimization to be accomplished in an automated fashion.

In regard to RE measures, JERO indicates specific recommendations for PV and solar water heating for each individual building as provided under the PV Individual Building and Solar Water Heating columns. We note for PV on individual buildings, a 20 kW systems was recommended for each building as this was in input capacity constraint. This implies larger systems might be yield a lower life cycle cost, but this constraint is intended to limit PV on individual buildings to account for size limitations associated with space on roofs, exterior, or other constraints on PV systems that could be mounted on individual buildings. We note that more specific individual constraints for each building could also be imposed and included in JERO vice the common 20 kW constraint that was input in this sample run.
For PV at a plant level, JERO indicates a plant size of 3,000 kW. Likewise, for wind energy, JERO indicates a plant size of 3,000 kW. As with PV on individual buildings, both of these recommendations have hit the upper capacity constraints input for Camp Smith. This is an important aspect of the model in

that more economic solutions for PV and wind plants might exist, but in reality could not be housed at Camp Smith due to geographical and space limitations of the installation. Hence, these are important constraints to include in the model and more specific analysis should be accomplished to accurately gauge the true upper limits for these systems. Such a limit might be expressed via conversion of energy to area and then this constraint could simultaneously trade-off the available space between PV and wind vice independent input constraints on these. In general, wind plants take more space per megawatt delivered than PV plants so even though they may ultimately provide a lower net cost per kWh, when land space is a constraint, they may be less attractive than PV. As a point of reference, NREL provides the following rough estimate for land space requirements in regard to PV and wind plants: PV requires approximately 7 acres of land per MW and wind energy requires between 12 to 60 acres of land per MW depending on the configuration (e.g., rows) of the wind turbines.

The combined effect of the individual PV systems for buildings, PV plant, wind plant, and solar water heating recommendations from JERO provide an estimated 45.2% of the installations energy demand after this demand is reduced by the EE measures discussed earlier. Additional figures automatically output from JERO as shown in Figure 5.5, 5.6, and 5.7 are provided below in more detailed views.

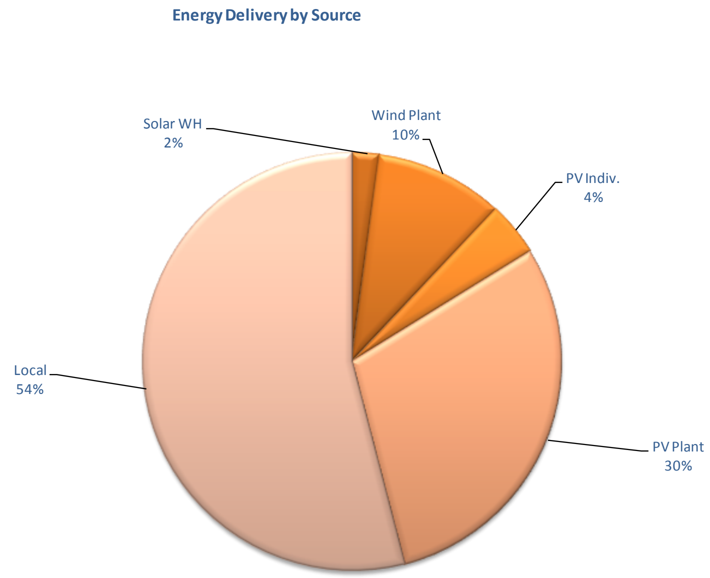


Figure 5.5 Camp Smith Sample Run – Optimized Energy Delivery by Source

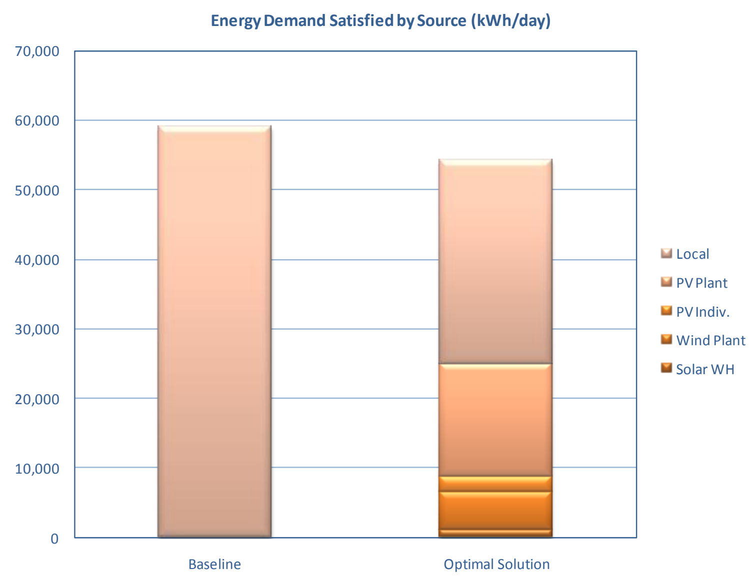


Figure 5.6 Camp Smith Sample Run – Baseline vs. Optimized Energy Delivery by Source

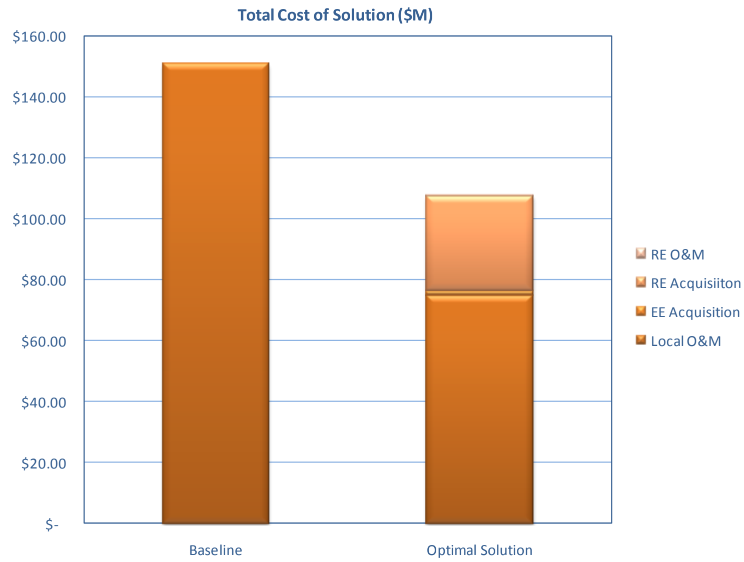


Figure 5.7 Camp Smith Sample Run – Optimized LCC vs. Baseline

5.5 Example of Joint Modeling Capabilities/Insights

In order to gain additional insights from JERO and to further demonstrate its capabilities we next established a set of varying input parameter to the model using a Design of Experiments (DOE) approach. In particular, we varied input parameters to JERO using two levels – low and high. These levels were as follows:

- RE goal (20 and 40 percent)
- Life cycle duration (20 and 40 years)
- Wind plant capacity (2,000 and 4,000 kW)
- Fixed PV plant capacity at 3,000 kW

Running all permutations of this setup requires a total of 8 (i.e., 2^3) different optimizations. A summary of the inputs and optimal output results are presented below in Table 5.1 For each run, we captured three key output metrics: RE achieved (%), life cycle cost (LCC) savings ($M), and annualized LCC savings ($M), which is an important metric as it accounts for different life cycle durations. From these results, we also plotted the RE achieved metric and the annualized LCC savings metric versus the low and high input parameter settings. These results are shown in Figures 5.8 and 5.9 and summarized in Table 5.3, below. In particular, for each input parameter, the low or high value is kept constant while the other parameters are allowed to vary across all of their low and high settings. The results provide a simple way to interpret the significance of individual parameters. For instance, the slope of the lines indicate the importance of moving from a low setting to a high setting of an individual parameter, the steeper the slope, the more significant the parameter. A positive slope indicates increasing the parameter, will increase either the RE achieved or the annualized LCC savings metric. Conversely, a negative slope indicates increasing the parameter, will decrease either the RE achieved or the annualized LCC savings.

Table 5.3 Example Joint Modeling Capabilities – Summary

Example	Input RE Goal (%)	Input Life Cycle Duration (years)	Input Wind Plant Capacity (kW)	RE Achieved (%)	LCC Savings Achieved ($M)	Annualized LCC Savings Achieved ($M)
1	20	20	2,000	29.2%	7.42	0.37
2	40	20	2,000	40.3%	4.92	0.25
3	20	40	2,000	41.9%	39.09	0.98
4	40	40	2,000	41.9%	35.09	0.88
5	20	20	4,000	44.2%	7.42	0.37
6	40	20	4,000	40.3%	5.38	0.27
7	20	40	4,000	48.5%	43.84	1.10
8	40	40	4,000	48.5%	43.84	1.10

From these plots, one can see that life cycle duration and wind plant capacity have the most significant effect on RE achieved. The input RE goal has only a minor effect. This is because the optimization is already striving to achieve as much RE as possible and the goal will naturally be met by maximizing the amount of RE that can be installed. In terms of annualized LCC savings, the life cycle duration has the most significant effect. In this case, the longer the life cycle, the more time an RE system can amortize its associated acquisition costs, and thus reduce the life cycle costs of the system. To a lesser extent, wind plant capacity also helps to reduce LCC, this makes sense from the cost curves shown in Section 4. Finally, the RE goal has a slightly decreasing effect on LCC savings, but we believe this is because the effect of the shorter life cycle duration at a high RE goal is averaged into this result. In other words, a short life cycle duration coupled with a high RE goal is not cost effective. Some additional general insights and findings for Camp Smith and the joint optimization methodology will be presented in Section 6 – Conclusions.

Finally, Appendix G contains a screen shot of each of the optimal run outputs from JERO for the DOE setup presented here.

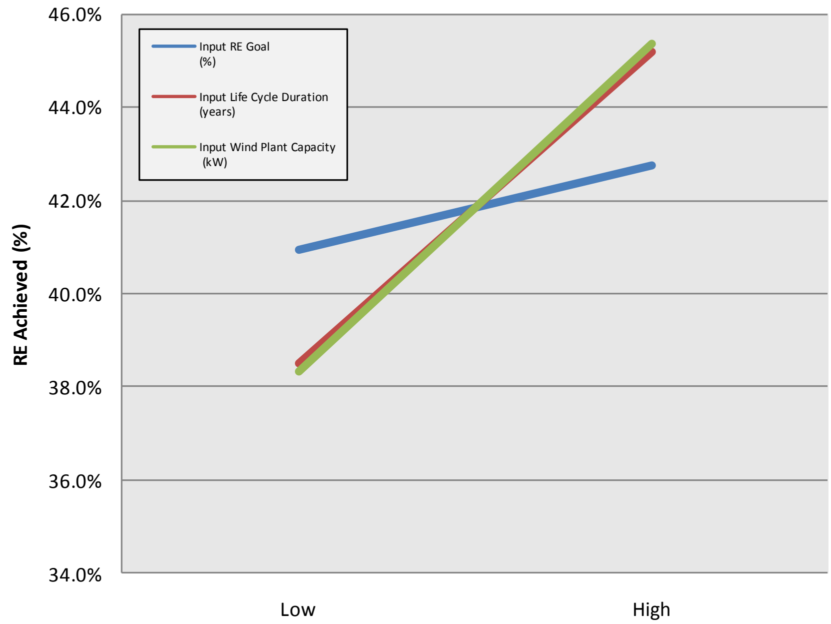


Figure 5.8 RE Achieved vs. Low and High Settings of Input Parameters

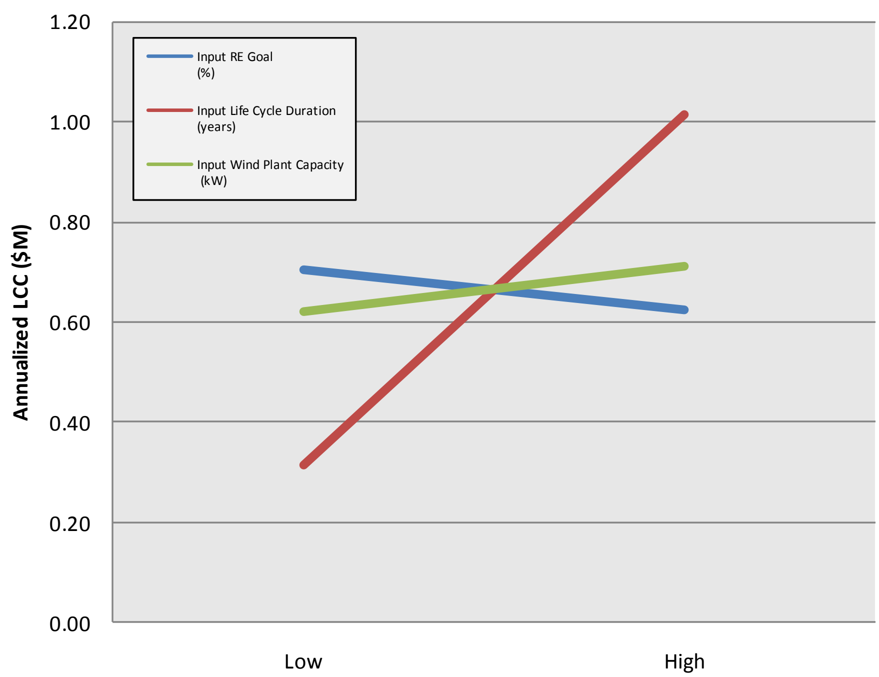


Figure 5.9 Annualized Life Cycle Cost vs. Low and High Settings of Input Parameters

Section 6: Conclusions

In this section we present conclusions from this research effort. Conclusions are presented in two major categories – general conclusions and basic conclusions from JERO that are pertinent to Camp Smith. We then also discuss some limitations and challenges identified during this effort.

6.1 General Conclusions

As previously presented, qualitative approaches to jointly consider EE and RE opportunities are utilized and discussed in the literature. However, EE and RE opportunities are not simultaneously optimized, especially via traditional Operations Research methods such as mathematical programming. Based on the results from the devised optimization methodology as demonstrated via the JERO model, we conclude that this mathematical programming approach can be used to jointly optimize EE and RE opportunities. We believe this methodology and corresponding demonstration represent a first effort of this type.

As seen in Section 4, there are several important input considerations that can dramatically drive corresponding output recommendations from a joint optimization model such as JERO. These input considerations include the life cycle duration; specified goals for RE; EE acquisition costs; and RE acquisition and O&M costs; EE opportunities by building; RE opportunities by building, as well as opportunities at the installation level (i.e., central plant); and finally PV and wind capacity considerations.

We believe that the simultaneous optimization of EE and RE opportunities has several important advantages. These include presenting the decision maker with an integrated, single set of recommendations vice independent recommendations for EE and RE that then may require further filtering and additional analysis to merge the recommendations for final action. Simultaneous optimization also affords the opportunity to account for reduced energy demand brought about by EE measures so that the benefits of RE opportunities can be appropriately weighed. This can be done via the FEDS then REO approach presented, but that method does not search for the underlying interactions and inherent trade-offs between simultaneous consideration of EE and RE measures. Therefore, this approach will most likely provide less than optimal solutions. Finally, given restricted acquisition budget mandates that should be considered (vice unrestricted acquisition budgets that are assumed available all at time zero in typical analyses), the best trade-offs between EE and RE can be determined.

With the successful demonstration of a methodology for joint EE and RE optimization, there are still several remaining challenges and limitations. These will be covered in more detail at the end of this section.

6.2 Basic Conclusions from JERO for Camp Smith

Because we used previously accomplished FEDS and REO assessments to demonstrate our optimization framework, we are able to offer some initial conclusions from JERO regarding Camp Smith. The demonstration indicates that both EE and RE systems can reduce overall life cycle costs for Camp Smith in terms of energy use and supply costs to satisfy energy demand. At the same time, these measures can satisfy mandates for RE in terms of overall use on the installation. Given the assumptions and parameters outlined in this report, a basic RE goal of 30% can be satisfied while at the same time reducing overall life cycle costs for energy at Camp Smith. In addition to EE measures, RE measures include photovoltaic systems (both installed on individual buildings and a PV plant), a wind energy plant, and solar hot water heating. The overall plant sizes for PV and wind need further exploration to determine actual capacity limitations based on available land space/siting requirements at Camp Smith. The potential to include a land availability constraint in our modeling approach is feasible. This constraint could then be used to drive the best PV and wind energy option for the installation and allow trade-offs to be explored between the two.

Our demonstration also indicated that the life cycle duration considered in an optimization analysis has the biggest influence on optimal decision recommendations. As the life cycle duration increases, RE becomes increasingly beneficial. This is because the amortized cost per kilowatt of energy provided will continue to decrease for any plant size capacity. The most significant reason for this seems to be that replacement costs are not considered during the life cycle. Figure 6.1 displays a graph of the amortized acquisition and O&M costs in terms of the net $/kWh for different life cycle durations considered for the two REO recommended photovoltaics and wind plants for Camp Smith. The baseline local utility cost (~ $0.175/kWh) is also shown. Based on this plot, the necessary life cycles for these systems to pay for themselves are approximately 23 and 27 years respectively.

This chart points out the significant influence of the assumed life cycle duration on optimal energy decisions. The same result was seen in the design of experiments results shown in the previous section. For life cycle durations of approximately 20 years, PV and wind plants of the recommended sizes would not pay for themselves. Thus the need to meet RE goals would then become a binding constraint and central plant would still likely be required to meet the RE goals. With a life cycle duration of approximately 40 years (the assumed life cycle in REO results), maximum size PV and wind plants would be desired as a means to achieve the lowest net energy cost for the installation. Given this, RE goals will naturally be met by virtue of lower delivered energy costs given long enough life cycle. It is noted that FEDS results assume a 25 year life cycle and REO assumes a 40 year life cycle per RE modeling policies and regulations. In either case, we believe that there is an important need to account for RE system replacement costs during the modeled life cycle. This consideration can provide a more realistic analysis for RE energy costs and payback potential.

In our results, we have also shown that plant capacities have a significant influence on optimal decisions. Specifically, with long life cycle durations, larger capacities are preferred. Again, this relates to the potential to provide lower net energy costs per kilowatt given a long enough life cycle to overcome the higher acquisitions costs of larger plant sizes.

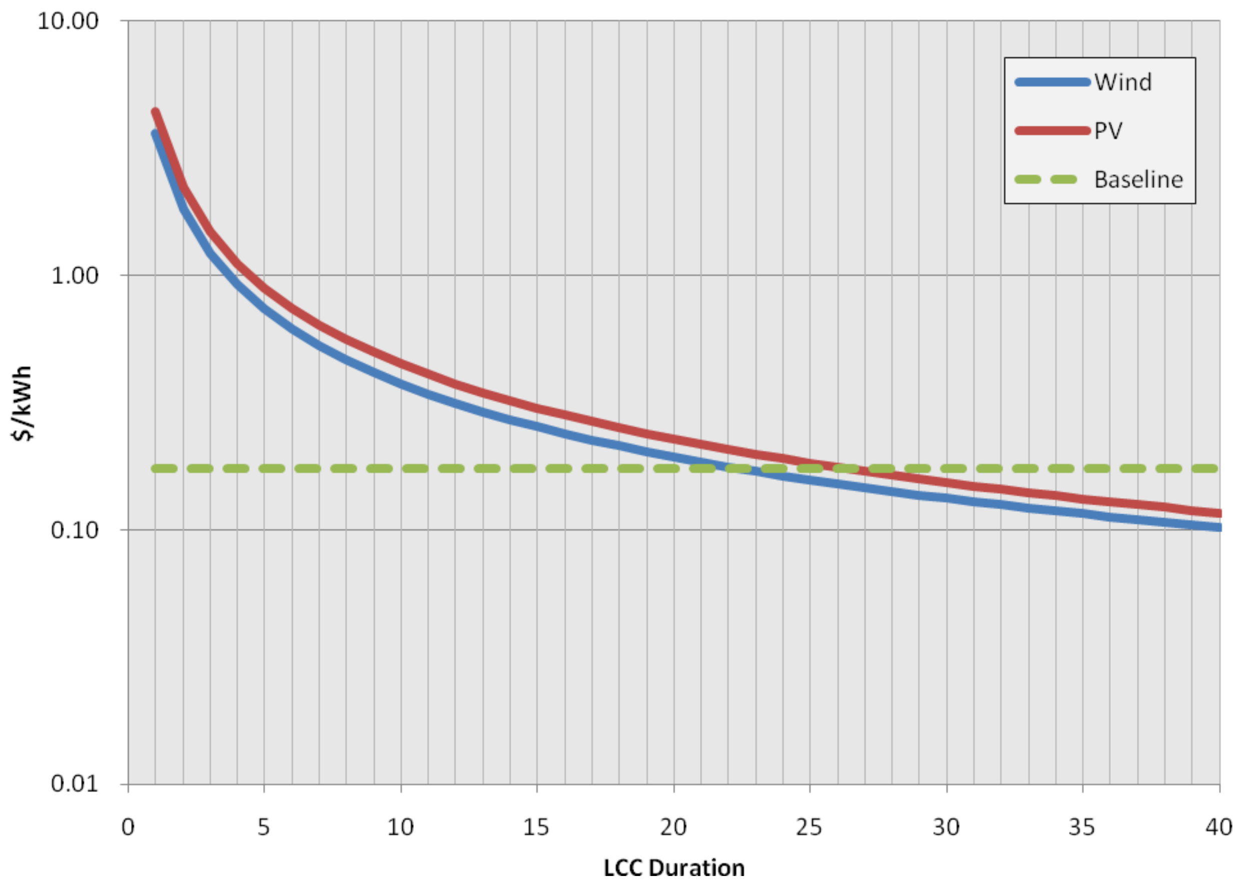


Figure 6.1 Amortized Acquisition and O&M Costs in $/kWh vs. LCC Durations Considered for REO Recommended Wind and PV Plants

6.3 Challenges

The biggest challenge in jointly modeling EE and RE opportunities is acquiring a consistent set of data to drive both sides of the optimization. As seen in Section 4, a large effort was needed to distill important data elements and characteristics of EE and RE measures from the independently completed FEDS and REO assessments from Camp Smith. These data were then manipulated further to be put in a form that is compatible with the JERO model. For a larger installation like Hickam Air Force Base, this challenge is even more significant.

Additional challenges relate to model integration and common elements for analysis such as the need for coordination on life cycle durations used in the analyses (e.g., 25 years versus 40 years); higher fidelity information in regard to facility use throughout day and year; specific benefits in EE throughout the day and year; and specific availability levels of RE resources throughout day and year. We note for example that our model as demonstrated assumed each day of the year looks like every other day. This is not a bad assumption for a tropical location like Camp Smith which is near the equator, but for other locations like installations in Alaska, this assumption is clearly not appropriate. In this regard, we believe the goal to develop an 8,760 (i.e., each hour of a year with 365 days) model is still necessary for a more accurate optimization. Moreover, the basic mathematical programming formulation can easily accommodate this potential. However, the ability and time necessary to solve a higher fidelity model like this would need to be investigated.

The potential to also model annual changes and state-of-the-art breakthroughs in EE and RE costs/capabilities should also be included as well as the ability to forecast and model emerging cost and pricing trends for energy. Such considerations would allow a more accurate representation of reality in modeling results and recommendations.

6.4 Limitations

Finally, we note some limitations of the JERO model and our joint EE and RE optimization methodology. First, JERO represents a prototype capability and as documented here is the first demonstration of its use for a single installation. JERO is currently an Excel based tool and setup requires Frontline Systems Risk Solver Platform with the OptQuest Solver add-in software to successfully run and execute.

As demonstrated, JERO has not included variability in any of the model parameters except for assumed changes in static input parameters in the design of experiments example. However, as setup, such variability could be modeled (e.g., pricing variability for local utility costs over time vice single, static costs). This potential is seen in the Frontline Systems interface shown in Figure 5.1 under the checkbox heading "Simulation" which allows the user to specify stochastic modeling elements for uncertain variables, uncertain functions, and parameters.

Other limitations for the current prototype version of JERO include a high degree of aggregation for EE opportunities. Higher fidelity EE modeling requires additional progress and interactions with FEDS developers. Additional RE opportunities beyond PV, wind, and solar water heating are not yet included in the JERO model. We do believe these are fairly straightforward additions to the model that can be incorporated as desired.

Section 7: Recommendations for Future Research

In this section we present recommendations for future research to further develop and extend the joint EE and RE optimization methodology. There are two basic sets of recommendations. The first set of future research recommendations are JERO focused and the second set is focused on a merger of EE and RE modeling constructs.

7.1 Exercise and Expand JERO Capabilities

The first set of recommendations for future research related to joint EE and RE optimization modeling focus on continued exercising of JERO and expanding its capabilities in the following areas:

1) Additional Installations. Apply and test JERO on additional installations such as Hickam Air Force Base. Since both FEDS and REO results have recently been completed for this installation, this is a logical next step.

2) Variability. Incorporate variability/stochastic elements in parameters (e.g., variability in local utility rates). As mentioned in the previous section, this can be accomplished using inherent capabilities of the current JERO setup in Excel with the Frontline Systems Risk Solver Platform.

3) EE Goals. Just as RE goals were included in JERO, goals for EE and/or a percent reduction in overall installation energy consumption through EE measures can be investigated.

4) Carbon Goals. Goals on carbon reduction can also be included in JERO through appropriate analytic functions to translate energy reductions via EE measures and energy demand provided by RE measures.

5) Budget Constraints. Budget limitations can be included in JERO as implemented as constraints on acquisition and/or O&M costs. Moreover, annual budget constraints on these two cost categories can be imposed.

6) Time Phased Goals. JERO can be modified to include a mechanism to analyze time-phased renewable energy goals (e.g., 25% by 2020, 30% by 2030, and so forth as mandates may indicate). The same applies for any EE goals that might be considered.

7) Replacement Costs. Replacement costs of RE technologies can (and should) be included in RE cost functions to provide a more realistic costing element of the optimization analysis.

8) 8,760 Model. The continued development/refinement of an 8,760 model and migration

of JERO to a more powerful optimization engine (e.g., GAMS and a non-linear solver programming package) should be investigated.

7.2 Exploration of Merging EE and RE Modeling

The second set of recommendations for future research focus on the potential to merge EE and RE modeling constructs. Specific areas for research in this regard include the following:

1) Common Life Cycle. Common life cycle durations for both the EE analysis (e.g., FEDS) and the RE analysis (e.g., REO). The current independent analyses were based on 25 year and 40 year life cycles respectively.

2) Common Time Intervals. Common time intervals (e.g., hourly or daily time increments for energy use, utility costs, etc.) for the modeling elements should be investigated.

3) Comprehensive Model Integration. Finally, and the most ambitious future research area is a full integration of EE and RE components into a single software code to minimize manual manipulation of data for JERO setup as was necessary for Camp Smith.

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Appendix A. Summary of Results Briefing to USPACOM

On 16 Sep 2010 a briefing on the joint optimization work reported in this report was presented to representatives from USPACOM. The briefing outlined the work completed under this joint EE/RE project and followed the general structure and headings of this report. In this appendix, we summarize the key discussion items from this briefing.

Theoretical Technique Demonstration

Our briefing, and the results presented are for demonstration purposes only. The emphasis of our work was to demonstrate an optimization framework, not provide installation recommendations. USPACOM representatives want to ensure that our results are not misinterpreted. We agreed.

PV Plant and Wind Energy Plant Capacities

One of the key discussion items was the capability of Camp Smith to handle the recommended sizes of the PV (i.e., 3100 kW) and wind energy (i.e., 2400 kW) plants recommended from the REO results (NREL-generated) for Camp Smith. As this was one of the input parameters in the JERO model, different outcomes and optimal decisions based on varying capacities were examined and presented. USPACOM asked if a formal analysis was completed on size limitations at Camp Smith. In follow-up discussion with NREL, they provided approximate land space requirements of 7 acres per MW of PV plant and between 12 to 60 acres per MW of wind plant (actual acreage depends on geographic turbine layout – i.e., inline or disbursed).

Time Phased RE Goals

USPACOM inquired about the possibility of considering time-phase renewable energy goals. Our optimization model did not consider the time-phased nature of the RE goals. All agreed that this is a potential focus area for future efforts. This is a fairly straightforward addition to JERO, but it implies that there are known acquisition budget constraints. The model would have to be reconfigured with more restrictive trade-offs to reflect the nature of the time-phased goals. Without these constraints, the model would force RE technology to the front of an acquisition timeline. Additionally, a more complex consideration that captures the conventional acquisition cost reductions over time could be incorporated. This consideration would offer a more robust solution trade space (e.g., the acquisition cost of a PV plant of a certain size might be lower in the future as PV becomes more common, technology breakthroughs are made, etc.). The challenging aspect of a time phased approach is an increase in model complexity (i.e., number of decision variables and constraints that must be considered) and solution run time.

USPACOM Enterprise Energy Assessment

USPACOM expressed interest in conducting an enterprise-wide (i.e., across all USPACOM installations) optimization assessment. Such an assessment would assist USPACOM in making Command-wide, vice installation-wide, decisions about energy efficiency retrofits and renewable energy technology insertions. All agreed that this effort could potentially be the focus of future research.

Alternative Financing

The potential to consider alternative financing (e.g., investment by external/commercial enterprises that would pay acquisition costs of EE and RE systems and in turn receive a return on their investment via energy savings at the installation) options in the optimization technique was discussed as a desire by USPACOM. Such considerations could be accommodated in JERO via factors to reduce and/or eliminate acquisition costs. The potential to link to a more sophisticated financial model (e.g., FATE2-P) could be considered. This is another area that offers potential follow-on research opportunities.

Experimental Design Approach

As presented in our briefing, an experimental design approach with different input parameter settings on life cycle duration, RE goal (%), and upper limit on wind capacity was conducted with JERO. USPACOM was very interested in this type of analysis and demonstration and would like to use these results to showcase and example how design of experiments (DOE) methodology was being used by USPACOM.

Data Centers

A brief discussion about the possibility of including data centers surfaced during the presentation. Data centers are unique in that they typically consume larger-than-normal quantities of energy primarily because of their specialized heating and cooling requirements. The consensus was that it would be possible to include these specialized energy consumers in our optimization analysis—acquiring the detailed input data would be the most difficult part. Also, special modeling considerations might have to be in place to accommodate these high energy use consumers. This is another area that offers potential follow-on research opportunities.

Publish JERO Methodology in Professional Journal

All agreed that the work, because of its first-of-a-kind nature should be published in a professional journal. We plan to submit an article to the Institute for Operations Research and the Management Sciences (INFORMS) Journal *Interfaces*.

Appendix B. Baseline Percent Energy Demand Reduction by EE Combination

This appendix provides the percent energy demand reduction from the baseline corresponding to different potential EE combinations for the buildings analyzed on Camp Smith.

Bldg Name	W	L	E	H	C	WL	WE	WH	WC	LE	LH	LC	EH	EC	HC	WLE
Building 20, Admin	0.24%	10.55%	0.00%	0.00%	12.24%	10.79%	0.24%	0.24%	12.49%	10.55%	10.55%	25.07%	0.00%	13.47%	12.24%	10.79%
Old Hospital, Building 1	0.25%	6.17%	1.32%	0.00%	0.00%	6.42%	1.57%	0.25%	0.25%	7.49%	6.17%	6.78%	1.32%	1.45%	0.00%	7.74%
Old Hospital, Building 2C, Admin + basement fitness center	1.24%	14.44%	0.00%	0.00%	0.00%	15.68%	1.24%	1.24%	1.24%	14.44%	14.44%	15.89%	0.00%	0.00%	0.00%	15.68%
Old Hospital, Building 2D	0.35%	11.52%	0.00%	0.00%	0.00%	11.86%	0.35%	0.35%	0.35%	11.52%	11.52%	12.67%	0.00%	0.00%	0.00%	11.86%
Old Hospital, Building 3A, Floors 1&2 admin, Floor 3 renovation	0.30%	10.86%	0.00%	0.00%	7.52%	11.16%	0.30%	0.30%	7.82%	10.86%	10.86%	20.21%	0.00%	8.27%	7.52%	11.16%
Old Hospital, Building 3B, Admin + 1st floor clinic	2.87%	13.03%	0.00%	0.00%	1.47%	15.90%	2.87%	2.87%	4.34%	13.03%	13.03%	15.95%	0.00%	1.62%	1.47%	15.90%
Old Hospital, Building 4 Admin plus food service	1.55%	5.28%	6.57%	0.00%	2.73%	6.83%	8.12%	1.55%	4.28%	11.86%	5.28%	8.82%	6.57%	10.24%	2.73%	13.40%
Old Hospital, Building 5	3.92%	6.93%	0.00%	0.00%	9.45%	10.85%	3.92%	3.92%	13.38%	6.93%	6.93%	18.03%	0.00%	10.40%	9.45%	10.85%
Old Hospital, Building 80, Admin/Control Room/Computers	0.33%	2.00%	0.00%	0.00%	8.78%	2.33%	0.33%	0.33%	9.11%	2.00%	2.00%	11.86%	0.00%	9.65%	8.78%	2.33%
Old Hospital, Building 81 phones	0.12%	3.71%	0.48%	0.00%	2.87%	3.83%	0.60%	0.12%	2.99%	4.19%	3.71%	7.24%	0.48%	3.69%	2.87%	4.31%
Old Hospital, Buildings 1A, 1B, 2AA, 3AA	0.36%	11.09%	0.00%	0.00%	0.00%	11.45%	0.36%	0.36%	0.36%	11.09%	11.09%	12.20%	0.00%	0.00%	0.00%	11.45%
Bldg 700 PACOM Center, 701, 705	0.26%	12.29%	0.32%	0.00%	0.00%	12.55%	0.58%	0.26%	0.26%	12.61%	12.29%	13.52%	0.32%	0.35%	0.00%	12.87%
barracks complex (401-404)	61.64%	0.43%	0.00%	0.00%	0.00%	62.07%	61.64%	61.64%	61.64%	0.43%	0.43%	0.47%	0.00%	0.00%	0.00%	62.07%
Maintenance B600	0.00%	9.62%	0.00%	0.00%	0.00%	9.62%	0.00%	0.00%	0.00%	9.62%	9.62%	10.59%	0.00%	0.00%	0.00%	9.62%
UPS Building 602	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Fire Station B612	0.00%	0.26%	0.00%	0.00%	0.00%	0.26%	0.00%	0.00%	0.00%	0.26%	0.26%	0.29%	0.00%	0.00%	0.00%	0.26%
Everything else	0.00%	0.61%	15.33%	0.00%	0.00%	0.61%	15.33%	0.00%	0.00%	15.95%	0.61%	0.67%	15.33%	16.87%	0.00%	15.95%
NCO Club, B500	1.51%	4.36%	0.00%	0.00%	19.10%	5.86%	1.51%	1.51%	20.61%	4.36%	4.36%	25.80%	0.00%	21.01%	19.10%	5.86%
B601 Police Station	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Courts	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Bldg 501 Rec center	2.08%	1.52%	3.79%	0.00%	0.00%	3.60%	5.88%	2.08%	2.08%	5.31%	1.52%	1.67%	3.79%	4.17%	0.00%	7.39%

Bldg Name	WLH	WLC	WEH	WEC	WHC	LEH	LEC	LHC	EHC	WLEH	WLEC	WLHC	WEHC	LEHC	WLEHC
Building 20, Admin	10.79%	25.34%	0.24%	13.74%	12.49%	10.55%	26.21%	25.07%	13.47%	10.79%	26.49%	25.34%	13.74%	26.21%	26.49%
Old Hospital, Building 1	6.42%	7.06%	1.57%	1.73%	0.25%	7.49%	8.61%	6.78%	1.45%	7.74%	8.90%	7.06%	1.73%	8.61%	8.90%
Old Hospital, Building 2C, Admin + basement fitness center	15.68%	17.25%	1.24%	1.36%	1.24%	14.44%	16.61%	15.89%	0.00%	15.68%	18.03%	17.25%	1.36%	16.61%	18.03%
Old Hospital, Building 2D	11.86%	13.05%	0.35%	0.38%	0.35%	11.52%	13.24%	12.67%	0.00%	11.86%	13.64%	13.05%	0.38%	13.24%	13.64%
Old Hospital, Building 3A, Floors 1&2 admin, Floor 3 renovation	11.16%	20.54%	0.30%	8.60%	7.82%	10.86%	21.13%	20.21%	8.27%	11.16%	21.47%	20.54%	8.60%	21.13%	21.47%
Old Hospital, Building 3B, Admin + 1st floor clinic	15.90%	19.11%	2.87%	4.78%	4.34%	13.03%	16.67%	15.95%	1.62%	15.90%	19.97%	19.11%	4.78%	16.67%	19.97%
Old Hospital, Building 4 Admin plus food service	6.83%	10.52%	8.12%	11.94%	4.28%	11.86%	16.78%	8.82%	10.24%	13.40%	18.56%	10.52%	11.94%	16.78%	18.56%
Old Hospital, Building 5	10.85%	22.34%	3.92%	14.71%	13.38%	6.93%	18.84%	18.03%	10.40%	10.85%	23.35%	22.34%	14.71%	18.84%	23.35%
Old Hospital, Building 80, Admin/Control Room/Computers	2.33%	12.22%	0.33%	10.02%	9.11%	2.00%	12.39%	11.86%	9.65%	2.33%	12.78%	12.22%	10.02%	12.39%	12.78%
Old Hospital, Building 81 phones	3.83%	7.37%	0.60%	3.82%	2.99%	4.19%	8.12%	7.24%	3.69%	4.31%	8.26%	7.37%	3.82%	8.12%	8.26%
Old Hospital, Buildings 1A, 1B, 2AA, 3AA	11.45%	12.60%	0.36%	0.40%	0.36%	11.09%	12.76%	12.20%	0.00%	11.45%	13.17%	12.60%	0.40%	12.76%	13.17%
Bldg 700 PACOM Center, 701, 705	12.55%	13.81%	0.58%	0.64%	0.26%	12.61%	14.50%	13.52%	0.35%	12.87%	14.80%	13.81%	0.64%	14.50%	14.80%
barracks complex (401-404)	62.07%	68.28%	61.64%	67.81%	61.64%	0.43%	0.49%	0.47%	0.00%	62.07%	71.38%	68.28%	67.81%	0.49%	71.38%
Maintenance B600	9.62%	10.59%	0.00%	0.00%	0.00%	9.62%	11.07%	10.59%	0.00%	9.62%	11.07%	10.59%	0.00%	11.07%	11.07%
UPS Building 602	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Fire Station B612	0.26%	0.29%	0.00%	0.00%	0.00%	0.26%	0.30%	0.29%	0.00%	0.26%	0.30%	0.29%	0.00%	0.30%	0.30%
Everything else	0.61%	0.67%	15.33%	16.87%	0.00%	15.95%	18.34%	0.67%	16.87%	15.95%	18.34%	0.67%	16.87%	18.34%	18.34%
NCO Club, B500	5.86%	27.46%	1.51%	22.67%	20.61%	4.36%	26.98%	25.80%	21.01%	5.86%	28.71%	27.46%	22.67%	26.98%	28.71%
B601 Police Station	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Courts	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Bldg 501 Rec center	3.60%	3.96%	5.88%	6.46%	2.08%	5.31%	6.10%	1.67%	4.17%	7.39%	8.50%	3.96%	6.46%	6.10%	8.50%

Appendix C. Hourly Baseline Energy Demand and Energy Efficiency Combination Energy Savings

This appendix provides the baseline energy demand by hour and the associated energy savings for each EE combination considered for the buildings analyzed on Camp Smith. All units are kWh.

1	Building 20, Admin			
Annual	Demand (kWh	per day	per hour	100 watt bulb equivelant
1	2,640,426	7234.0	301.42	3014

i	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
t	Baseline	W	L	E	H	C	WL	WE	WH	WC	LE	LH	LC	EH	EC	HC	WLE	WLH	WLC	WEH	WEC	WHC	LEH	LEC	LHC	EHC	WLEH	WLEC	WLHC	WEHC	LEHC	WLEHC
1	150.7	0.4	15.9	0.0	0.0	18.5	16.3	0.4	0.4	18.8	15.9	15.9	37.8	0.0	20.3	18.5	16.3	16.3	38.2	0.4	20.7	18.8	15.9	39.5	37.8	20.3	16.3	39.9	38.2	20.7	39.5	39.9
2	150.7	0.4	15.9	0.0	0.0	18.5	16.3	0.4	0.4	18.8	15.9	15.9	37.8	0.0	20.3	18.5	16.3	16.3	38.2	0.4	20.7	18.8	15.9	39.5	37.8	20.3	16.3	39.9	38.2	20.7	39.5	39.9
3	150.7	0.4	15.9	0.0	0.0	18.5	16.3	0.4	0.4	18.8	15.9	15.9	37.8	0.0	20.3	18.5	16.3	16.3	38.2	0.4	20.7	18.8	15.9	39.5	37.8	20.3	16.3	39.9	38.2	20.7	39.5	39.9
4	150.7	0.4	15.9	0.0	0.0	18.5	16.3	0.4	0.4	18.8	15.9	15.9	37.8	0.0	20.3	18.5	16.3	16.3	38.2	0.4	20.7	18.8	15.9	39.5	37.8	20.3	16.3	39.9	38.2	20.7	39.5	39.9
5	150.7	0.4	15.9	0.0	0.0	18.5	16.3	0.4	0.4	18.8	15.9	15.9	37.8	0.0	20.3	18.5	16.3	16.3	38.2	0.4	20.7	18.8	15.9	39.5	37.8	20.3	16.3	39.9	38.2	20.7	39.5	39.9
6	301.4	0.7	31.8	0.0	0.0	36.9	32.5	0.7	0.7	37.6	31.8	31.8	75.6	0.0	40.6	36.9	32.5	32.5	76.4	0.7	41.4	37.6	31.8	79.0	75.6	40.6	32.5	79.8	76.4	41.4	79.0	79.8
7	301.4	0.7	31.8	0.0	0.0	36.9	32.5	0.7	0.7	37.6	31.8	31.8	75.6	0.0	40.6	36.9	32.5	32.5	76.4	0.7	41.4	37.6	31.8	79.0	75.6	40.6	32.5	79.8	76.4	41.4	79.0	79.8
8	301.4	0.7	31.8	0.0	0.0	36.9	32.5	0.7	0.7	37.6	31.8	31.8	75.6	0.0	40.6	36.9	32.5	32.5	76.4	0.7	41.4	37.6	31.8	79.0	75.6	40.6	32.5	79.8	76.4	41.4	79.0	79.8
9	301.4	0.7	31.8	0.0	0.0	36.9	32.5	0.7	0.7	37.6	31.8	31.8	75.6	0.0	40.6	36.9	32.5	32.5	76.4	0.7	41.4	37.6	31.8	79.0	75.6	40.6	32.5	79.8	76.4	41.4	79.0	79.8
10	452.1	1.1	47.7	0.0	0.0	55.4	48.8	1.1	1.1	56.5	47.7	47.7	113.3	0.0	60.9	55.4	48.8	48.8	114.6	1.1	62.1	56.5	47.7	118.5	113.3	60.9	48.8	119.8	114.6	62.1	118.5	119.8
11	452.1	1.1	47.7	0.0	0.0	55.4	48.8	1.1	1.1	56.5	47.7	47.7	113.3	0.0	60.9	55.4	48.8	48.8	114.6	1.1	62.1	56.5	47.7	118.5	113.3	60.9	48.8	119.8	114.6	62.1	118.5	119.8
12	452.1	1.1	47.7	0.0	0.0	55.4	48.8	1.1	1.1	56.5	47.7	47.7	113.3	0.0	60.9	55.4	48.8	48.8	114.6	1.1	62.1	56.5	47.7	118.5	113.3	60.9	48.8	119.8	114.6	62.1	118.5	119.8
13	452.1	1.1	47.7	0.0	0.0	55.4	48.8	1.1	1.1	56.5	47.7	47.7	113.3	0.0	60.9	55.4	48.8	48.8	114.6	1.1	62.1	56.5	47.7	118.5	113.3	60.9	48.8	119.8	114.6	62.1	118.5	119.8
14	452.1	1.1	47.7	0.0	0.0	55.4	48.8	1.1	1.1	56.5	47.7	47.7	113.3	0.0	60.9	55.4	48.8	48.8	114.6	1.1	62.1	56.5	47.7	118.5	113.3	60.9	48.8	119.8	114.6	62.1	118.5	119.8
15	452.1	1.1	47.7	0.0	0.0	55.4	48.8	1.1	1.1	56.5	47.7	47.7	113.3	0.0	60.9	55.4	48.8	48.8	114.6	1.1	62.1	56.5	47.7	118.5	113.3	60.9	48.8	119.8	114.6	62.1	118.5	119.8
16	452.1	1.1	47.7	0.0	0.0	55.4	48.8	1.1	1.1	56.5	47.7	47.7	113.3	0.0	60.9	55.4	48.8	48.8	114.6	1.1	62.1	56.5	47.7	118.5	113.3	60.9	48.8	119.8	114.6	62.1	118.5	119.8
17	452.1	1.1	47.7	0.0	0.0	55.4	48.8	1.1	1.1	56.5	47.7	47.7	113.3	0.0	60.9	55.4	48.8	48.8	114.6	1.1	62.1	56.5	47.7	118.5	113.3	60.9	48.8	119.8	114.6	62.1	118.5	119.8
18	301.4	0.7	31.8	0.0	0.0	36.9	32.5	0.7	0.7	37.6	31.8	31.8	75.6	0.0	40.6	36.9	32.5	32.5	76.4	0.7	41.4	37.6	31.8	79.0	75.6	40.6	32.5	79.8	76.4	41.4	79.0	79.8
19	301.4	0.7	31.8	0.0	0.0	36.9	32.5	0.7	0.7	37.6	31.8	31.8	75.6	0.0	40.6	36.9	32.5	32.5	76.4	0.7	41.4	37.6	31.8	79.0	75.6	40.6	32.5	79.8	76.4	41.4	79.0	79.8
20	301.4	0.7	31.8	0.0	0.0	36.9	32.5	0.7	0.7	37.6	31.8	31.8	75.6	0.0	40.6	36.9	32.5	32.5	76.4	0.7	41.4	37.6	31.8	79.0	75.6	40.6	32.5	79.8	76.4	41.4	79.0	79.8
21	301.4	0.7	31.8	0.0	0.0	36.9	32.5	0.7	0.7	37.6	31.8	31.8	75.6	0.0	40.6	36.9	32.5	32.5	76.4	0.7	41.4	37.6	31.8	79.0	75.6	40.6	32.5	79.8	76.4	41.4	79.0	79.8
22	150.7	0.4	15.9	0.0	0.0	18.5	16.3	0.4	0.4	18.8	15.9	15.9	37.8	0.0	20.3	18.5	16.3	16.3	38.2	0.4	20.7	18.8	15.9	39.5	37.8	20.3	16.3	39.9	38.2	20.7	39.5	39.9
23	150.7	0.4	15.9	0.0	0.0	18.5	16.3	0.4	0.4	18.8	15.9	15.9	37.8	0.0	20.3	18.5	16.3	16.3	38.2	0.4	20.7	18.8	15.9	39.5	37.8	20.3	16.3	39.9	38.2	20.7	39.5	39.9
24	150.7	0.4	15.9	0.0	0.0	18.5	16.3	0.4	0.4	18.8	15.9	15.9	37.8	0.0	20.3	18.5	16.3	16.3	38.2	0.4	20.7	18.8	15.9	39.5	37.8	20.3	16.3	39.9	38.2	20.7	39.5	39.9

2	Old Hospital, Building 1			
	Demand (kWh	per day	per hour	100 watt bulb equivelant
2	1,139,598	3122.2	130.09	1301

i	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
t	Baseline	W	N	E	M	C	WL	WE	WH	WC	LE	LH	LC	EH	EC	HC	WLE	WLH	WLC	WEH	WEC	WHC	LEH	LEC	LHC	EHC	WLEH	WLEC	WLHC	WEHC	LEHC	WLEHC
1	65.0	0.2	4.0	0.9	0.0	0.0	4.2	1.0	0.2	0.2	4.9	4.0	4.4	0.9	0.9	0.0	5.0	4.2	4.6	1.0	1.1	0.2	4.9	5.6	4.4	0.9	5.0	5.8	4.6	1.1	5.6	5.8
2	65.0	0.2	4.0	0.9	0.0	0.0	4.2	1.0	0.2	0.2	4.9	4.0	4.4	0.9	0.9	0.0	5.0	4.2	4.6	1.0	1.1	0.2	4.9	5.6	4.4	0.9	5.0	5.8	4.6	1.1	5.6	5.8
3	65.0	0.2	4.0	0.9	0.0	0.0	4.2	1.0	0.2	0.2	4.9	4.0	4.4	0.9	0.9	0.0	5.0	4.2	4.6	1.0	1.1	0.2	4.9	5.6	4.4	0.9	5.0	5.8	4.6	1.1	5.6	5.8
4	65.0	0.2	4.0	0.9	0.0	0.0	4.2	1.0	0.2	0.2	4.9	4.0	4.4	0.9	0.9	0.0	5.0	4.2	4.6	1.0	1.1	0.2	4.9	5.6	4.4	0.9	5.0	5.8	4.6	1.1	5.6	5.8
5	65.0	0.2	4.0	0.9	0.0	0.0	4.2	1.0	0.2	0.2	4.9	4.0	4.4	0.9	0.9	0.0	5.0	4.2	4.6	1.0	1.1	0.2	4.9	5.6	4.4	0.9	5.0	5.8	4.6	1.1	5.6	5.8
6	130.1	0.3	8.0	1.7	0.0	0.0	8.4	2.0	0.3	0.3	9.7	8.0	8.8	1.7	1.9	0.0	10.1	8.4	9.2	2.0	2.3	0.3	9.7	11.2	8.8	1.9	10.1	11.6	9.2	2.3	11.2	11.6
7	130.1	0.3	8.0	1.7	0.0	0.0	8.4	2.0	0.3	0.3	9.7	8.0	8.8	1.7	1.9	0.0	10.1	8.4	9.2	2.0	2.3	0.3	9.7	11.2	8.8	1.9	10.1	11.6	9.2	2.3	11.2	11.6
8	130.1	0.3	8.0	1.7	0.0	0.0	8.4	2.0	0.3	0.3	9.7	8.0	8.8	1.7	1.9	0.0	10.1	8.4	9.2	2.0	2.3	0.3	9.7	11.2	8.8	1.9	10.1	11.6	9.2	2.3	11.2	11.6
9	130.1	0.3	8.0	1.7	0.0	0.0	8.4	2.0	0.3	0.3	9.7	8.0	8.8	1.7	1.9	0.0	10.1	8.4	9.2	2.0	2.3	0.3	9.7	11.2	8.8	1.9	10.1	11.6	9.2	2.3	11.2	11.6
10	195.1	0.5	12.0	2.6	0.0	0.0	12.5	3.1	0.5	0.5	14.6	12.0	13.2	2.6	2.8	0.0	15.1	12.5	13.8	3.1	3.4	0.5	14.6	16.8	13.2	2.8	15.1	17.4	13.8	3.4	16.8	17.4
11	195.1	0.5	12.0	2.6	0.0	0.0	12.5	3.1	0.5	0.5	14.6	12.0	13.2	2.6	2.8	0.0	15.1	12.5	13.8	3.1	3.4	0.5	14.6	16.8	13.2	2.8	15.1	17.4	13.8	3.4	16.8	17.4
12	195.1	0.5	12.0	2.6	0.0	0.0	12.5	3.1	0.5	0.5	14.6	12.0	13.2	2.6	2.8	0.0	15.1	12.5	13.8	3.1	3.4	0.5	14.6	16.8	13.2	2.8	15.1	17.4	13.8	3.4	16.8	17.4
13	195.1	0.5	12.0	2.6	0.0	0.0	12.5	3.1	0.5	0.5	14.6	12.0	13.2	2.6	2.8	0.0	15.1	12.5	13.8	3.1	3.4	0.5	14.6	16.8	13.2	2.8	15.1	17.4	13.8	3.4	16.8	17.4
14	195.1	0.5	12.0	2.6	0.0	0.0	12.5	3.1	0.5	0.5	14.6	12.0	13.2	2.6	2.8	0.0	15.1	12.5	13.8	3.1	3.4	0.5	14.6	16.8	13.2	2.8	15.1	17.4	13.8	3.4	16.8	17.4
15	195.1	0.5	12.0	2.6	0.0	0.0	12.5	3.1	0.5	0.5	14.6	12.0	13.2	2.6	2.8	0.0	15.1	12.5	13.8	3.1	3.4	0.5	14.6	16.8	13.2	2.8	15.1	17.4	13.8	3.4	16.8	17.4
16	195.1	0.5	12.0	2.6	0.0	0.0	12.5	3.1	0.5	0.5	14.6	12.0	13.2	2.6	2.8	0.0	15.1	12.5	13.8	3.1	3.4	0.5	14.6	16.8	13.2	2.8	15.1	17.4	13.8	3.4	16.8	17.4
17	195.1	0.5	12.0	2.6	0.0	0.0	12.5	3.1	0.5	0.5	14.6	12.0	13.2	2.6	2.8	0.0	15.1	12.5	13.8	3.1	3.4	0.5	14.6	16.8	13.2	2.8	15.1	17.4	13.8	3.4	16.8	17.4
18	130.1	0.3	8.0	1.7	0.0	0.0	8.4	2.0	0.3	0.3	9.7	8.0	8.8	1.7	1.9	0.0	10.1	8.4	9.2	2.0	2.3	0.3	9.7	11.2	8.8	1.9	10.1	11.6	9.2	2.3	11.2	11.6
19	130.1	0.3	8.0	1.7	0.0	0.0	8.4	2.0	0.3	0.3	9.7	8.0	8.8	1.7	1.9	0.0	10.1	8.4	9.2	2.0	2.3	0.3	9.7	11.2	8.8	1.9	10.1	11.6	9.2	2.3	11.2	11.6
20	130.1	0.3	8.0	1.7	0.0	0.0	8.4	2.0	0.3	0.3	9.7	8.0	8.8	1.7	1.9	0.0	10.1	8.4	9.2	2.0	2.3	0.3	9.7	11.2	8.8	1.9	10.1	11.6	9.2	2.3	11.2	11.6
21	130.1	0.3	8.0	1.7	0.0	0.0	8.4	2.0	0.3	0.3	9.7	8.0	8.8	1.7	1.9	0.0	10.1	8.4	9.2	2.0	2.3	0.3	9.7	11.2	8.8	1.9	10.1	11.6	9.2	2.3	11.2	11.6
22	65.0	0.2	4.0	0.9	0.0	0.0	4.2	1.0	0.2	0.2	4.9	4.0	4.4	0.9	0.9	0.0	5.0	4.2	4.6	1.0	1.1	0.2	4.9	5.6	4.4	0.9	5.0	5.8	4.6	1.1	5.6	5.8
23	65.0	0.2	4.0	0.9	0.0	0.0	4.2	1.0	0.2	0.2	4.9	4.0	4.4	0.9	0.9	0.0	5.0	4.2	4.6	1.0	1.1	0.2	4.9	5.6	4.4	0.9	5.0	5.8	4.6	1.1	5.6	5.8
24	65.0	0.2	4.0	0.9	0.0	0.0	4.2	1.0	0.2	0.2	4.9	4.0	4.4	0.9	0.9	0.0	5.0	4.2	4.6	1.0	1.1	0.2	4.9	5.6	4.4	0.9	5.0	5.8	4.6	1.1	5.6	5.8

3	Old Hospital, Building 2C, Admin + basement fitness center			
	Demand (kWh	per day	per hour	100 watt bulb equivelant
3	541,644	1484.0	61.83	618

i	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
t	Baseline	W	VH	E	L	C	WL	WE	WH	WC	LE	LH	LC	EH	EC	HC	WLE	WLH	WLC	WEH	WEC	WHC	LEH	LEC	LHC	EHC	WLEH	WLEC	WLHC	WEHC	LEHC	WLEHC
1	30.9	0.4	4.5	0.0	0.0	0.0	4.8	0.4	0.4	0.4	4.5	4.5	4.9	0.0	0.0	0.0	4.8	4.8	5.3	0.4	0.4	0.4	4.5	5.1	4.9	0.0	4.8	5.6	5.3	0.4	5.1	5.6
2	30.9	0.4	4.5	0.0	0.0	0.0	4.8	0.4	0.4	0.4	4.5	4.5	4.9	0.0	0.0	0.0	4.8	4.8	5.3	0.4	0.4	0.4	4.5	5.1	4.9	0.0	4.8	5.6	5.3	0.4	5.1	5.6
3	30.9	0.4	4.5	0.0	0.0	0.0	4.8	0.4	0.4	0.4	4.5	4.5	4.9	0.0	0.0	0.0	4.8	4.8	5.3	0.4	0.4	0.4	4.5	5.1	4.9	0.0	4.8	5.6	5.3	0.4	5.1	5.6
4	30.9	0.4	4.5	0.0	0.0	0.0	4.8	0.4	0.4	0.4	4.5	4.5	4.9	0.0	0.0	0.0	4.8	4.8	5.3	0.4	0.4	0.4	4.5	5.1	4.9	0.0	4.8	5.6	5.3	0.4	5.1	5.6
5	30.9	0.4	4.5	0.0	0.0	0.0	4.8	0.4	0.4	0.4	4.5	4.5	4.9	0.0	0.0	0.0	4.8	4.8	5.3	0.4	0.4	0.4	4.5	5.1	4.9	0.0	4.8	5.6	5.3	0.4	5.1	5.6
6	61.8	0.8	8.9	0.0	0.0	0.0	9.7	0.8	0.8	0.8	8.9	8.9	9.8	0.0	0.0	0.0	9.7	9.7	10.7	0.8	0.8	0.8	8.9	10.3	9.8	0.0	9.7	11.1	10.7	0.8	10.3	11.1
7	61.8	0.8	8.9	0.0	0.0	0.0	9.7	0.8	0.8	0.8	8.9	8.9	9.8	0.0	0.0	0.0	9.7	9.7	10.7	0.8	0.8	0.8	8.9	10.3	9.8	0.0	9.7	11.1	10.7	0.8	10.3	11.1
8	61.8	0.8	8.9	0.0	0.0	0.0	9.7	0.8	0.8	0.8	8.9	8.9	9.8	0.0	0.0	0.0	9.7	9.7	10.7	0.8	0.8	0.8	8.9	10.3	9.8	0.0	9.7	11.1	10.7	0.8	10.3	11.1
9	61.8	0.8	8.9	0.0	0.0	0.0	9.7	0.8	0.8	0.8	8.9	8.9	9.8	0.0	0.0	0.0	9.7	9.7	10.7	0.8	0.8	0.8	8.9	10.3	9.8	0.0	9.7	11.1	10.7	0.8	10.3	11.1
10	92.7	1.1	13.4	0.0	0.0	0.0	14.5	1.1	1.1	1.1	13.4	13.4	14.7	0.0	0.0	0.0	14.5	14.5	16.0	1.1	1.3	1.1	13.4	15.4	14.7	0.0	14.5	16.7	16.0	1.3	15.4	16.7
11	92.7	1.1	13.4	0.0	0.0	0.0	14.5	1.1	1.1	1.1	13.4	13.4	14.7	0.0	0.0	0.0	14.5	14.5	16.0	1.1	1.3	1.1	13.4	15.4	14.7	0.0	14.5	16.7	16.0	1.3	15.4	16.7
12	92.7	1.1	13.4	0.0	0.0	0.0	14.5	1.1	1.1	1.1	13.4	13.4	14.7	0.0	0.0	0.0	14.5	14.5	16.0	1.1	1.3	1.1	13.4	15.4	14.7	0.0	14.5	16.7	16.0	1.3	15.4	16.7
13	92.7	1.1	13.4	0.0	0.0	0.0	14.5	1.1	1.1	1.1	13.4	13.4	14.7	0.0	0.0	0.0	14.5	14.5	16.0	1.1	1.3	1.1	13.4	15.4	14.7	0.0	14.5	16.7	16.0	1.3	15.4	16.7
14	92.7	1.1	13.4	0.0	0.0	0.0	14.5	1.1	1.1	1.1	13.4	13.4	14.7	0.0	0.0	0.0	14.5	14.5	16.0	1.1	1.3	1.1	13.4	15.4	14.7	0.0	14.5	16.7	16.0	1.3	15.4	16.7
15	92.7	1.1	13.4	0.0	0.0	0.0	14.5	1.1	1.1	1.1	13.4	13.4	14.7	0.0	0.0	0.0	14.5	14.5	16.0	1.1	1.3	1.1	13.4	15.4	14.7	0.0	14.5	16.7	16.0	1.3	15.4	16.7
16	92.7	1.1	13.4	0.0	0.0	0.0	14.5	1.1	1.1	1.1	13.4	13.4	14.7	0.0	0.0	0.0	14.5	14.5	16.0	1.1	1.3	1.1	13.4	15.4	14.7	0.0	14.5	16.7	16.0	1.3	15.4	16.7
17	92.7	1.1	13.4	0.0	0.0	0.0	14.5	1.1	1.1	1.1	13.4	13.4	14.7	0.0	0.0	0.0	14.5	14.5	16.0	1.1	1.3	1.1	13.4	15.4	14.7	0.0	14.5	16.7	16.0	1.3	15.4	16.7
18	61.8	0.8	8.9	0.0	0.0	0.0	9.7	0.8	0.8	0.8	8.9	8.9	9.8	0.0	0.0	0.0	9.7	9.7	10.7	0.8	0.8	0.8	8.9	10.3	9.8	0.0	9.7	11.1	10.7	0.8	10.3	11.1
19	61.8	0.8	8.9	0.0	0.0	0.0	9.7	0.8	0.8	0.8	8.9	8.9	9.8	0.0	0.0	0.0	9.7	9.7	10.7	0.8	0.8	0.8	8.9	10.3	9.8	0.0	9.7	11.1	10.7	0.8	10.3	11.1
20	61.8	0.8	8.9	0.0	0.0	0.0	9.7	0.8	0.8	0.8	8.9	8.9	9.8	0.0	0.0	0.0	9.7	9.7	10.7	0.8	0.8	0.8	8.9	10.3	9.8	0.0	9.7	11.1	10.7	0.8	10.3	11.1
21	61.8	0.8	8.9	0.0	0.0	0.0	9.7	0.8	0.8	0.8	8.9	8.9	9.8	0.0	0.0	0.0	9.7	9.7	10.7	0.8	0.8	0.8	8.9	10.3	9.8	0.0	9.7	11.1	10.7	0.8	10.3	11.1
22	30.9	0.4	4.5	0.0	0.0	0.0	4.8	0.4	0.4	0.4	4.5	4.5	4.9	0.0	0.0	0.0	4.8	4.8	5.3	0.4	0.4	0.4	4.5	5.1	4.9	0.0	4.8	5.6	5.3	0.4	5.1	5.6
23	30.9	0.4	4.5	0.0	0.0	0.0	4.8	0.4	0.4	0.4	4.5	4.5	4.9	0.0	0.0	0.0	4.8	4.8	5.3	0.4	0.4	0.4	4.5	5.1	4.9	0.0	4.8	5.6	5.3	0.4	5.1	5.6
24	30.9	0.4	4.5	0.0	0.0	0.0	4.8	0.4	0.4	0.4	4.5	4.5	4.9	0.0	0.0	0.0	4.8	4.8	5.3	0.4	0.4	0.4	4.5	5.1	4.9	0.0	4.8	5.6	5.3	0.4	5.1	5.6

4	Old Hospital, Building 2D																															
	Demand (kWh	per day	per hour	100 watt bulb equivelant																												
4	502,328	1376.2	57.34	573																												
i	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
t	Baseline	W	H	E	N	C	WL	WE	WH	WC	LE	LH	LC	EH	EC	HC	WLE	WLH	WLC	WEH	WEC	WHC	LEH	LEC	LHC	EHC	WLEH	WLEC	WLHC	WEHC	LEHC	WLEHC
1	28.7	0.1	3.3	0.0	0.0	0.0	3.4	0.1	0.1	0.1	3.3	3.3	3.6	0.0	0.0	0.0	3.4	3.4	3.7	0.1	0.1	0.1	3.3	3.8	3.6	0.0	3.4	3.9	3.7	0.1	3.8	3.9
2	28.7	0.1	3.3	0.0	0.0	0.0	3.4	0.1	0.1	0.1	3.3	3.3	3.6	0.0	0.0	0.0	3.4	3.4	3.7	0.1	0.1	0.1	3.3	3.8	3.6	0.0	3.4	3.9	3.7	0.1	3.8	3.9
3	28.7	0.1	3.3	0.0	0.0	0.0	3.4	0.1	0.1	0.1	3.3	3.3	3.6	0.0	0.0	0.0	3.4	3.4	3.7	0.1	0.1	0.1	3.3	3.8	3.6	0.0	3.4	3.9	3.7	0.1	3.8	3.9
4	28.7	0.1	3.3	0.0	0.0	0.0	3.4	0.1	0.1	0.1	3.3	3.3	3.6	0.0	0.0	0.0	3.4	3.4	3.7	0.1	0.1	0.1	3.3	3.8	3.6	0.0	3.4	3.9	3.7	0.1	3.8	3.9
5	28.7	0.1	3.3	0.0	0.0	0.0	3.4	0.1	0.1	0.1	3.3	3.3	3.6	0.0	0.0	0.0	3.4	3.4	3.7	0.1	0.1	0.1	3.3	3.8	3.6	0.0	3.4	3.9	3.7	0.1	3.8	3.9
6	57.3	0.2	6.6	0.0	0.0	0.0	6.8	0.2	0.2	0.2	6.6	6.6	7.3	0.0	0.0	0.0	6.8	6.8	7.5	0.2	0.2	0.2	6.6	7.6	7.3	0.0	6.8	7.8	7.5	0.2	7.6	7.8
7	57.3	0.2	6.6	0.0	0.0	0.0	6.8	0.2	0.2	0.2	6.6	6.6	7.3	0.0	0.0	0.0	6.8	6.8	7.5	0.2	0.2	0.2	6.6	7.6	7.3	0.0	6.8	7.8	7.5	0.2	7.6	7.8
8	57.3	0.2	6.6	0.0	0.0	0.0	6.8	0.2	0.2	0.2	6.6	6.6	7.3	0.0	0.0	0.0	6.8	6.8	7.5	0.2	0.2	0.2	6.6	7.6	7.3	0.0	6.8	7.8	7.5	0.2	7.6	7.8
9	57.3	0.2	6.6	0.0	0.0	0.0	6.8	0.2	0.2	0.2	6.6	6.6	7.3	0.0	0.0	0.0	6.8	6.8	7.5	0.2	0.2	0.2	6.6	7.6	7.3	0.0	6.8	7.8	7.5	0.2	7.6	7.8
10	86.0	0.3	9.9	0.0	0.0	0.0	10.2	0.3	0.3	0.3	9.9	9.9	10.9	0.0	0.0	0.0	10.2	10.2	11.2	0.3	0.3	0.3	9.9	11.4	10.9	0.0	10.2	11.7	11.2	0.3	11.4	11.7
11	86.0	0.3	9.9	0.0	0.0	0.0	10.2	0.3	0.3	0.3	9.9	9.9	10.9	0.0	0.0	0.0	10.2	10.2	11.2	0.3	0.3	0.3	9.9	11.4	10.9	0.0	10.2	11.7	11.2	0.3	11.4	11.7
12	86.0	0.3	9.9	0.0	0.0	0.0	10.2	0.3	0.3	0.3	9.9	9.9	10.9	0.0	0.0	0.0	10.2	10.2	11.2	0.3	0.3	0.3	9.9	11.4	10.9	0.0	10.2	11.7	11.2	0.3	11.4	11.7
13	86.0	0.3	9.9	0.0	0.0	0.0	10.2	0.3	0.3	0.3	9.9	9.9	10.9	0.0	0.0	0.0	10.2	10.2	11.2	0.3	0.3	0.3	9.9	11.4	10.9	0.0	10.2	11.7	11.2	0.3	11.4	11.7
14	86.0	0.3	9.9	0.0	0.0	0.0	10.2	0.3	0.3	0.3	9.9	9.9	10.9	0.0	0.0	0.0	10.2	10.2	11.2	0.3	0.3	0.3	9.9	11.4	10.9	0.0	10.2	11.7	11.2	0.3	11.4	11.7
15	86.0	0.3	9.9	0.0	0.0	0.0	10.2	0.3	0.3	0.3	9.9	9.9	10.9	0.0	0.0	0.0	10.2	10.2	11.2	0.3	0.3	0.3	9.9	11.4	10.9	0.0	10.2	11.7	11.2	0.3	11.4	11.7
16	86.0	0.3	9.9	0.0	0.0	0.0	10.2	0.3	0.3	0.3	9.9	9.9	10.9	0.0	0.0	0.0	10.2	10.2	11.2	0.3	0.3	0.3	9.9	11.4	10.9	0.0	10.2	11.7	11.2	0.3	11.4	11.7
17	86.0	0.3	9.9	0.0	0.0	0.0	10.2	0.3	0.3	0.3	9.9	9.9	10.9	0.0	0.0	0.0	10.2	10.2	11.2	0.3	0.3	0.3	9.9	11.4	10.9	0.0	10.2	11.7	11.2	0.3	11.4	11.7
18	57.3	0.2	6.6	0.0	0.0	0.0	6.8	0.2	0.2	0.2	6.6	6.6	7.3	0.0	0.0	0.0	6.8	6.8	7.5	0.2	0.2	0.2	6.6	7.6	7.3	0.0	6.8	7.8	7.5	0.2	7.6	7.8
19	57.3	0.2	6.6	0.0	0.0	0.0	6.8	0.2	0.2	0.2	6.6	6.6	7.3	0.0	0.0	0.0	6.8	6.8	7.5	0.2	0.2	0.2	6.6	7.6	7.3	0.0	6.8	7.8	7.5	0.2	7.6	7.8
20	57.3	0.2	6.6	0.0	0.0	0.0	6.8	0.2	0.2	0.2	6.6	6.6	7.3	0.0	0.0	0.0	6.8	6.8	7.5	0.2	0.2	0.2	6.6	7.6	7.3	0.0	6.8	7.8	7.5	0.2	7.6	7.8
21	57.3	0.2	6.6	0.0	0.0	0.0	6.8	0.2	0.2	0.2	6.6	6.6	7.3	0.0	0.0	0.0	6.8	6.8	7.5	0.2	0.2	0.2	6.6	7.6	7.3	0.0	6.8	7.8	7.5	0.2	7.6	7.8
22	28.7	0.1	3.3	0.0	0.0	0.0	3.4	0.1	0.1	0.1	3.3	3.3	3.6	0.0	0.0	0.0	3.4	3.4	3.7	0.1	0.1	0.1	3.3	3.8	3.6	0.0	3.4	3.9	3.7	0.1	3.8	3.9
23	28.7	0.1	3.3	0.0	0.0	0.0	3.4	0.1	0.1	0.1	3.3	3.3	3.6	0.0	0.0	0.0	3.4	3.4	3.7	0.1	0.1	0.1	3.3	3.8	3.6	0.0	3.4	3.9	3.7	0.1	3.8	3.9
24	28.7	0.1	3.3	0.0	0.0	0.0	3.4	0.1	0.1	0.1	3.3	3.3	3.6	0.0	0.0	0.0	3.4	3.4	3.7	0.1	0.1	0.1	3.3	3.8	3.6	0.0	3.4	3.9	3.7	0.1	3.8	3.9

5	Old Hospital, Building 3A, Floors 1&2 admin, Floor 3 renovation																															
	Demand (kWh	per day	per hour	100 watt bulb equivelant																												
5	487,044	1334.4	55.60	556																												
i	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
t	Baseline	W	M	E	VH	C	WL	WE	WH	WC	LE	LH	LC	EH	EC	HC	WLE	WLH	WLC	WEH	WEC	WHC	LEH	LEC	LHC	EHC	WLEH	WLEC	WLHC	WEHC	LEHC	WLEHC
1	27.8	0.1	3.0	0.0	0.0	2.1	3.1	0.1	0.1	2.2	3.0	3.0	5.6	0.0	2.3	2.1	3.1	3.1	5.7	0.1	2.4	2.2	3.0	5.9	5.6	2.3	3.1	6.0	5.7	2.4	5.9	6.0
2	27.8	0.1	3.0	0.0	0.0	2.1	3.1	0.1	0.1	2.2	3.0	3.0	5.6	0.0	2.3	2.1	3.1	3.1	5.7	0.1	2.4	2.2	3.0	5.9	5.6	2.3	3.1	6.0	5.7	2.4	5.9	6.0
3	27.8	0.1	3.0	0.0	0.0	2.1	3.1	0.1	0.1	2.2	3.0	3.0	5.6	0.0	2.3	2.1	3.1	3.1	5.7	0.1	2.4	2.2	3.0	5.9	5.6	2.3	3.1	6.0	5.7	2.4	5.9	6.0
4	27.8	0.1	3.0	0.0	0.0	2.1	3.1	0.1	0.1	2.2	3.0	3.0	5.6	0.0	2.3	2.1	3.1	3.1	5.7	0.1	2.4	2.2	3.0	5.9	5.6	2.3	3.1	6.0	5.7	2.4	5.9	6.0
5	27.8	0.1	3.0	0.0	0.0	2.1	3.1	0.1	0.1	2.2	3.0	3.0	5.6	0.0	2.3	2.1	3.1	3.1	5.7	0.1	2.4	2.2	3.0	5.9	5.6	2.3	3.1	6.0	5.7	2.4	5.9	6.0
6	55.6	0.2	6.0	0.0	0.0	4.2	6.2	0.2	0.2	4.3	6.0	6.0	11.2	0.0	4.6	4.2	6.2	6.2	11.4	0.2	4.8	4.3	6.0	11.7	11.2	4.6	6.2	11.9	11.4	4.8	11.7	11.9
7	55.6	0.2	6.0	0.0	0.0	4.2	6.2	0.2	0.2	4.3	6.0	6.0	11.2	0.0	4.6	4.2	6.2	6.2	11.4	0.2	4.8	4.3	6.0	11.7	11.2	4.6	6.2	11.9	11.4	4.8	11.7	11.9
8	55.6	0.2	6.0	0.0	0.0	4.2	6.2	0.2	0.2	4.3	6.0	6.0	11.2	0.0	4.6	4.2	6.2	6.2	11.4	0.2	4.8	4.3	6.0	11.7	11.2	4.6	6.2	11.9	11.4	4.8	11.7	11.9
9	55.6	0.2	6.0	0.0	0.0	4.2	6.2	0.2	0.2	4.3	6.0	6.0	11.2	0.0	4.6	4.2	6.2	6.2	11.4	0.2	4.8	4.3	6.0	11.7	11.2	4.6	6.2	11.9	11.4	4.8	11.7	11.9
10	83.4	0.2	9.1	0.0	0.0	6.3	9.3	0.2	0.2	6.5	9.1	9.1	16.9	0.0	6.9	6.3	9.3	9.3	17.1	0.2	7.2	6.5	9.1	17.6	16.9	6.9	9.3	17.9	17.1	7.2	17.6	17.9
11	83.4	0.2	9.1	0.0	0.0	6.3	9.3	0.2	0.2	6.5	9.1	9.1	16.9	0.0	6.9	6.3	9.3	9.3	17.1	0.2	7.2	6.5	9.1	17.6	16.9	6.9	9.3	17.9	17.1	7.2	17.6	17.9
12	83.4	0.2	9.1	0.0	0.0	6.3	9.3	0.2	0.2	6.5	9.1	9.1	16.9	0.0	6.9	6.3	9.3	9.3	17.1	0.2	7.2	6.5	9.1	17.6	16.9	6.9	9.3	17.9	17.1	7.2	17.6	17.9
13	83.4	0.2	9.1	0.0	0.0	6.3	9.3	0.2	0.2	6.5	9.1	9.1	16.9	0.0	6.9	6.3	9.3	9.3	17.1	0.2	7.2	6.5	9.1	17.6	16.9	6.9	9.3	17.9	17.1	7.2	17.6	17.9
14	83.4	0.2	9.1	0.0	0.0	6.3	9.3	0.2	0.2	6.5	9.1	9.1	16.9	0.0	6.9	6.3	9.3	9.3	17.1	0.2	7.2	6.5	9.1	17.6	16.9	6.9	9.3	17.9	17.1	7.2	17.6	17.9
15	83.4	0.2	9.1	0.0	0.0	6.3	9.3	0.2	0.2	6.5	9.1	9.1	16.9	0.0	6.9	6.3	9.3	9.3	17.1	0.2	7.2	6.5	9.1	17.6	16.9	6.9	9.3	17.9	17.1	7.2	17.6	17.9
16	83.4	0.2	9.1	0.0	0.0	6.3	9.3	0.2	0.2	6.5	9.1	9.1	16.9	0.0	6.9	6.3	9.3	9.3	17.1	0.2	7.2	6.5	9.1	17.6	16.9	6.9	9.3	17.9	17.1	7.2	17.6	17.9
17	83.4	0.2	9.1	0.0	0.0	6.3	9.3	0.2	0.2	6.5	9.1	9.1	16.9	0.0	6.9	6.3	9.3	9.3	17.1	0.2	7.2	6.5	9.1	17.6	16.9	6.9	9.3	17.9	17.1	7.2	17.6	17.9
18	55.6	0.2	6.0	0.0	0.0	4.2	6.2	0.2	0.2	4.3	6.0	6.0	11.2	0.0	4.6	4.2	6.2	6.2	11.4	0.2	4.8	4.3	6.0	11.7	11.2	4.6	6.2	11.9	11.4	4.8	11.7	11.9
19	55.6	0.2	6.0	0.0	0.0	4.2	6.2	0.2	0.2	4.3	6.0	6.0	11.2	0.0	4.6	4.2	6.2	6.2	11.4	0.2	4.8	4.3	6.0	11.7	11.2	4.6	6.2	11.9	11.4	4.8	11.7	11.9
20	55.6	0.2	6.0	0.0	0.0	4.2	6.2	0.2	0.2	4.3	6.0	6.0	11.2	0.0	4.6	4.2	6.2	6.2	11.4	0.2	4.8	4.3	6.0	11.7	11.2	4.6	6.2	11.9	11.4	4.8	11.7	11.9
21	55.6	0.2	6.0	0.0	0.0	4.2	6.2	0.2	0.2	4.3	6.0	6.0	11.2	0.0	4.6	4.2	6.2	6.2	11.4	0.2	4.8	4.3	6.0	11.7	11.2	4.6	6.2	11.9	11.4	4.8	11.7	11.9
22	27.8	0.1	3.0	0.0	0.0	2.1	3.1	0.1	0.1	2.2	3.0	3.0	5.6	0.0	2.3	2.1	3.1	3.1	5.7	0.1	2.4	2.2	3.0	5.9	5.6	2.3	3.1	6.0	5.7	2.4	5.9	6.0
23	27.8	0.1	3.0	0.0	0.0	2.1	3.1	0.1	0.1	2.2	3.0	3.0	5.6	0.0	2.3	2.1	3.1	3.1	5.7	0.1	2.4	2.2	3.0	5.9	5.6	2.3	3.1	6.0	5.7	2.4	5.9	6.0
24	27.8	0.1	3.0	0.0	0.0	2.1	3.1	0.1	0.1	2.2	3.0	3.0	5.6	0.0	2.3	2.1	3.1	3.1	5.7	0.1	2.4	2.2	3.0	5.9	5.6	2.3	3.1	6.0	5.7	2.4	5.9	6.0

6	Old Hospital, Building 3B, Admin + 1st floor clinic																															
	Demand (kWh	per day	per hour	100 watt bulb equivelant																												
6	394,600	1081.1	45.05	450																												
i	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
t	Baseline	W	L	E	H	C	WL	WE	WH	WC	LE	LH	LC	EH	EC	HC	WLE	WLH	WLC	WEH	WEC	WHC	LEH	LEC	LHC	EHC	WLEH	WLEC	WLHC	WEHC	LEHC	WLEHC
1	22.5	0.6	2.9	0.0	0.0	0.3	3.6	0.6	0.6	1.0	2.9	2.9	3.6	0.0	0.4	0.3	3.6	3.6	4.3	0.6	1.1	1.0	2.9	3.8	3.6	0.4	3.6	4.5	4.3	1.1	3.8	4.5
2	22.5	0.6	2.9	0.0	0.0	0.3	3.6	0.6	0.6	1.0	2.9	2.9	3.6	0.0	0.4	0.3	3.6	3.6	4.3	0.6	1.1	1.0	2.9	3.8	3.6	0.4	3.6	4.5	4.3	1.1	3.8	4.5
3	22.5	0.6	2.9	0.0	0.0	0.3	3.6	0.6	0.6	1.0	2.9	2.9	3.6	0.0	0.4	0.3	3.6	3.6	4.3	0.6	1.1	1.0	2.9	3.8	3.6	0.4	3.6	4.5	4.3	1.1	3.8	4.5
4	22.5	0.6	2.9	0.0	0.0	0.3	3.6	0.6	0.6	1.0	2.9	2.9	3.6	0.0	0.4	0.3	3.6	3.6	4.3	0.6	1.1	1.0	2.9	3.8	3.6	0.4	3.6	4.5	4.3	1.1	3.8	4.5
5	22.5	0.6	2.9	0.0	0.0	0.3	3.6	0.6	0.6	1.0	2.9	2.9	3.6	0.0	0.4	0.3	3.6	3.6	4.3	0.6	1.1	1.0	2.9	3.8	3.6	0.4	3.6	4.5	4.3	1.1	3.8	4.5
6	45.0	1.3	5.9	0.0	0.0	0.7	7.2	1.3	1.3	2.0	5.9	5.9	7.2	0.0	0.7	0.7	7.2	7.2	8.6	1.3	2.2	2.0	5.9	7.5	7.2	0.7	7.2	9.0	8.6	2.2	7.5	9.0
7	45.0	1.3	5.9	0.0	0.0	0.7	7.2	1.3	1.3	2.0	5.9	5.9	7.2	0.0	0.7	0.7	7.2	7.2	8.6	1.3	2.2	2.0	5.9	7.5	7.2	0.7	7.2	9.0	8.6	2.2	7.5	9.0
8	45.0	1.3	5.9	0.0	0.0	0.7	7.2	1.3	1.3	2.0	5.9	5.9	7.2	0.0	0.7	0.7	7.2	7.2	8.6	1.3	2.2	2.0	5.9	7.5	7.2	0.7	7.2	9.0	8.6	2.2	7.5	9.0
9	45.0	1.3	5.9	0.0	0.0	0.7	7.2	1.3	1.3	2.0	5.9	5.9	7.2	0.0	0.7	0.7	7.2	7.2	8.6	1.3	2.2	2.0	5.9	7.5	7.2	0.7	7.2	9.0	8.6	2.2	7.5	9.0
10	67.6	1.9	8.8	0.0	0.0	1.0	10.7	1.9	1.9	2.9	8.8	8.8	10.8	0.0	1.1	1.0	10.7	10.7	12.9	1.9	3.2	2.9	8.8	11.3	10.8	1.1	10.7	13.5	12.9	3.2	11.3	13.5
11	67.6	1.9	8.8	0.0	0.0	1.0	10.7	1.9	1.9	2.9	8.8	8.8	10.8	0.0	1.1	1.0	10.7	10.7	12.9	1.9	3.2	2.9	8.8	11.3	10.8	1.1	10.7	13.5	12.9	3.2	11.3	13.5
12	67.6	1.9	8.8	0.0	0.0	1.0	10.7	1.9	1.9	2.9	8.8	8.8	10.8	0.0	1.1	1.0	10.7	10.7	12.9	1.9	3.2	2.9	8.8	11.3	10.8	1.1	10.7	13.5	12.9	3.2	11.3	13.5
13	67.6	1.9	8.8	0.0	0.0	1.0	10.7	1.9	1.9	2.9	8.8	8.8	10.8	0.0	1.1	1.0	10.7	10.7	12.9	1.9	3.2	2.9	8.8	11.3	10.8	1.1	10.7	13.5	12.9	3.2	11.3	13.5
14	67.6	1.9	8.8	0.0	0.0	1.0	10.7	1.9	1.9	2.9	8.8	8.8	10.8	0.0	1.1	1.0	10.7	10.7	12.9	1.9	3.2	2.9	8.8	11.3	10.8	1.1	10.7	13.5	12.9	3.2	11.3	13.5
15	67.6	1.9	8.8	0.0	0.0	1.0	10.7	1.9	1.9	2.9	8.8	8.8	10.8	0.0	1.1	1.0	10.7	10.7	12.9	1.9	3.2	2.9	8.8	11.3	10.8	1.1	10.7	13.5	12.9	3.2	11.3	13.5
16	67.6	1.9	8.8	0.0	0.0	1.0	10.7	1.9	1.9	2.9	8.8	8.8	10.8	0.0	1.1	1.0	10.7	10.7	12.9	1.9	3.2	2.9	8.8	11.3	10.8	1.1	10.7	13.5	12.9	3.2	11.3	13.5
17	67.6	1.9	8.8	0.0	0.0	1.0	10.7	1.9	1.9	2.9	8.8	8.8	10.8	0.0	1.1	1.0	10.7	10.7	12.9	1.9	3.2	2.9	8.8	11.3	10.8	1.1	10.7	13.5	12.9	3.2	11.3	13.5
18	45.0	1.3	5.9	0.0	0.0	0.7	7.2	1.3	1.3	2.0	5.9	5.9	7.2	0.0	0.7	0.7	7.2	7.2	8.6	1.3	2.2	2.0	5.9	7.5	7.2	0.7	7.2	9.0	8.6	2.2	7.5	9.0
19	45.0	1.3	5.9	0.0	0.0	0.7	7.2	1.3	1.3	2.0	5.9	5.9	7.2	0.0	0.7	0.7	7.2	7.2	8.6	1.3	2.2	2.0	5.9	7.5	7.2	0.7	7.2	9.0	8.6	2.2	7.5	9.0
20	45.0	1.3	5.9	0.0	0.0	0.7	7.2	1.3	1.3	2.0	5.9	5.9	7.2	0.0	0.7	0.7	7.2	7.2	8.6	1.3	2.2	2.0	5.9	7.5	7.2	0.7	7.2	9.0	8.6	2.2	7.5	9.0
21	45.0	1.3	5.9	0.0	0.0	0.7	7.2	1.3	1.3	2.0	5.9	5.9	7.2	0.0	0.7	0.7	7.2	7.2	8.6	1.3	2.2	2.0	5.9	7.5	7.2	0.7	7.2	9.0	8.6	2.2	7.5	9.0
22	22.5	0.6	2.9	0.0	0.0	0.3	3.6	0.6	0.6	1.0	2.9	2.9	3.6	0.0	0.4	0.3	3.6	3.6	4.3	0.6	1.1	1.0	2.9	3.8	3.6	0.4	3.6	4.5	4.3	1.1	3.8	4.5
23	22.5	0.6	2.9	0.0	0.0	0.3	3.6	0.6	0.6	1.0	2.9	2.9	3.6	0.0	0.4	0.3	3.6	3.6	4.3	0.6	1.1	1.0	2.9	3.8	3.6	0.4	3.6	4.5	4.3	1.1	3.8	4.5
24	22.5	0.6	2.9	0.0	0.0	0.3	3.6	0.6	0.6	1.0	2.9	2.9	3.6	0.0	0.4	0.3	3.6	3.6	4.3	0.6	1.1	1.0	2.9	3.8	3.6	0.4	3.6	4.5	4.3	1.1	3.8	4.5

7	Old Hospital, Building 4 Admin plus food service																															
	Demand (kWh	per day	per hour	100 watt bulb equivelant																												
7	1,256,773	3443.2	143.47	1435																												
i	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
t	Baseline	W	N	E	M	C	WL	WE	WH	WC	LE	LH	LC	EH	EC	HC	WLE	WLH	WLC	WEH	WEC	WHC	LEH	LEC	LHC	EHC	WLEH	WLEC	WLHC	WEHC	LEHC	WLEHC
1	71.7	1.1	3.8	4.7	0.0	2.0	4.9	5.8	1.1	3.1	8.5	3.8	6.3	4.7	7.3	2.0	9.6	4.9	7.5	5.8	8.6	3.1	8.5	12.0	6.3	7.3	9.6	13.3	7.5	8.6	12.0	13.3
2	71.7	1.1	3.8	4.7	0.0	2.0	4.9	5.8	1.1	3.1	8.5	3.8	6.3	4.7	7.3	2.0	9.6	4.9	7.5	5.8	8.6	3.1	8.5	12.0	6.3	7.3	9.6	13.3	7.5	8.6	12.0	13.3
3	71.7	1.1	3.8	4.7	0.0	2.0	4.9	5.8	1.1	3.1	8.5	3.8	6.3	4.7	7.3	2.0	9.6	4.9	7.5	5.8	8.6	3.1	8.5	12.0	6.3	7.3	9.6	13.3	7.5	8.6	12.0	13.3
4	71.7	1.1	3.8	4.7	0.0	2.0	4.9	5.8	1.1	3.1	8.5	3.8	6.3	4.7	7.3	2.0	9.6	4.9	7.5	5.8	8.6	3.1	8.5	12.0	6.3	7.3	9.6	13.3	7.5	8.6	12.0	13.3
5	71.7	1.1	3.8	4.7	0.0	2.0	4.9	5.8	1.1	3.1	8.5	3.8	6.3	4.7	7.3	2.0	9.6	4.9	7.5	5.8	8.6	3.1	8.5	12.0	6.3	7.3	9.6	13.3	7.5	8.6	12.0	13.3
6	143.5	2.2	7.6	9.4	0.0	3.9	9.8	11.6	2.2	6.1	17.0	7.6	12.7	9.4	14.7	3.9	19.2	9.8	15.1	11.6	17.1	6.1	17.0	24.1	12.7	14.7	19.2	26.6	15.1	17.1	24.1	26.6
7	143.5	2.2	7.6	9.4	0.0	3.9	9.8	11.6	2.2	6.1	17.0	7.6	12.7	9.4	14.7	3.9	19.2	9.8	15.1	11.6	17.1	6.1	17.0	24.1	12.7	14.7	19.2	26.6	15.1	17.1	24.1	26.6
8	143.5	2.2	7.6	9.4	0.0	3.9	9.8	11.6	2.2	6.1	17.0	7.6	12.7	9.4	14.7	3.9	19.2	9.8	15.1	11.6	17.1	6.1	17.0	24.1	12.7	14.7	19.2	26.6	15.1	17.1	24.1	26.6
9	143.5	2.2	7.6	9.4	0.0	3.9	9.8	11.6	2.2	6.1	17.0	7.6	12.7	9.4	14.7	3.9	19.2	9.8	15.1	11.6	17.1	6.1	17.0	24.1	12.7	14.7	19.2	26.6	15.1	17.1	24.1	26.6
10	215.2	3.3	11.4	14.1	0.0	5.9	14.7	17.5	3.3	9.2	25.5	11.4	19.0	14.1	22.0	5.9	28.8	14.7	22.6	17.5	25.7	9.2	25.5	36.1	19.0	22.0	28.8	39.9	22.6	25.7	36.1	39.9
11	215.2	3.3	11.4	14.1	0.0	5.9	14.7	17.5	3.3	9.2	25.5	11.4	19.0	14.1	22.0	5.9	28.8	14.7	22.6	17.5	25.7	9.2	25.5	36.1	19.0	22.0	28.8	39.9	22.6	25.7	36.1	39.9
12	215.2	3.3	11.4	14.1	0.0	5.9	14.7	17.5	3.3	9.2	25.5	11.4	19.0	14.1	22.0	5.9	28.8	14.7	22.6	17.5	25.7	9.2	25.5	36.1	19.0	22.0	28.8	39.9	22.6	25.7	36.1	39.9
13	215.2	3.3	11.4	14.1	0.0	5.9	14.7	17.5	3.3	9.2	25.5	11.4	19.0	14.1	22.0	5.9	28.8	14.7	22.6	17.5	25.7	9.2	25.5	36.1	19.0	22.0	28.8	39.9	22.6	25.7	36.1	39.9
14	215.2	3.3	11.4	14.1	0.0	5.9	14.7	17.5	3.3	9.2	25.5	11.4	19.0	14.1	22.0	5.9	28.8	14.7	22.6	17.5	25.7	9.2	25.5	36.1	19.0	22.0	28.8	39.9	22.6	25.7	36.1	39.9
15	215.2	3.3	11.4	14.1	0.0	5.9	14.7	17.5	3.3	9.2	25.5	11.4	19.0	14.1	22.0	5.9	28.8	14.7	22.6	17.5	25.7	9.2	25.5	36.1	19.0	22.0	28.8	39.9	22.6	25.7	36.1	39.9
16	215.2	3.3	11.4	14.1	0.0	5.9	14.7	17.5	3.3	9.2	25.5	11.4	19.0	14.1	22.0	5.9	28.8	14.7	22.6	17.5	25.7	9.2	25.5	36.1	19.0	22.0	28.8	39.9	22.6	25.7	36.1	39.9
17	215.2	3.3	11.4	14.1	0.0	5.9	14.7	17.5	3.3	9.2	25.5	11.4	19.0	14.1	22.0	5.9	28.8	14.7	22.6	17.5	25.7	9.2	25.5	36.1	19.0	22.0	28.8	39.9	22.6	25.7	36.1	39.9
18	143.5	2.2	7.6	9.4	0.0	3.9	9.8	11.6	2.2	6.1	17.0	7.6	12.7	9.4	14.7	3.9	19.2	9.8	15.1	11.6	17.1	6.1	17.0	24.1	12.7	14.7	19.2	26.6	15.1	17.1	24.1	26.6
19	143.5	2.2	7.6	9.4	0.0	3.9	9.8	11.6	2.2	6.1	17.0	7.6	12.7	9.4	14.7	3.9	19.2	9.8	15.1	11.6	17.1	6.1	17.0	24.1	12.7	14.7	19.2	26.6	15.1	17.1	24.1	26.6
20	143.5	2.2	7.6	9.4	0.0	3.9	9.8	11.6	2.2	6.1	17.0	7.6	12.7	9.4	14.7	3.9	19.2	9.8	15.1	11.6	17.1	6.1	17.0	24.1	12.7	14.7	19.2	26.6	15.1	17.1	24.1	26.6
21	143.5	2.2	7.6	9.4	0.0	3.9	9.8	11.6	2.2	6.1	17.0	7.6	12.7	9.4	14.7	3.9	19.2	9.8	15.1	11.6	17.1	6.1	17.0	24.1	12.7	14.7	19.2	26.6	15.1	17.1	24.1	26.6
22	71.7	1.1	3.8	4.7	0.0	2.0	4.9	5.8	1.1	3.1	8.5	3.8	6.3	4.7	7.3	2.0	9.6	4.9	7.5	5.8	8.6	3.1	8.5	12.0	6.3	7.3	9.6	13.3	7.5	8.6	12.0	13.3
23	71.7	1.1	3.8	4.7	0.0	2.0	4.9	5.8	1.1	3.1	8.5	3.8	6.3	4.7	7.3	2.0	9.6	4.9	7.5	5.8	8.6	3.1	8.5	12.0	6.3	7.3	9.6	13.3	7.5	8.6	12.0	13.3
24	71.7	1.1	3.8	4.7	0.0	2.0	4.9	5.8	1.1	3.1	8.5	3.8	6.3	4.7	7.3	2.0	9.6	4.9	7.5	5.8	8.6	3.1	8.5	12.0	6.3	7.3	9.6	13.3	7.5	8.6	12.0	13.3

8	Old Hospital, Building 5																															
	Demand (kWh)	per day	per hour	100 watt bulb equivelant																												
8	413,130	1131.9	47.16	472																												
i	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
t	Baseline	W	VH	E	L	C	WL	WE	WH	WC	LE	LH	LC	EH	EC	HC	WLE	WLH	WLC	WEH	WEC	WHC	LEH	LEC	LHC	EHC	WLEH	WLEC	WLHC	WEHC	LEHC	WLEHC
1	23.6	0.9	1.6	0.0	0.0	2.2	2.6	0.9	0.9	3.2	1.6	1.6	4.3	0.0	2.5	2.2	2.6	2.6	5.3	0.9	3.5	3.2	1.6	4.4	4.3	2.5	2.6	5.5	5.3	3.5	4.4	5.5
2	23.6	0.9	1.6	0.0	0.0	2.2	2.6	0.9	0.9	3.2	1.6	1.6	4.3	0.0	2.5	2.2	2.6	2.6	5.3	0.9	3.5	3.2	1.6	4.4	4.3	2.5	2.6	5.5	5.3	3.5	4.4	5.5
3	23.6	0.9	1.6	0.0	0.0	2.2	2.6	0.9	0.9	3.2	1.6	1.6	4.3	0.0	2.5	2.2	2.6	2.6	5.3	0.9	3.5	3.2	1.6	4.4	4.3	2.5	2.6	5.5	5.3	3.5	4.4	5.5
4	23.6	0.9	1.6	0.0	0.0	2.2	2.6	0.9	0.9	3.2	1.6	1.6	4.3	0.0	2.5	2.2	2.6	2.6	5.3	0.9	3.5	3.2	1.6	4.4	4.3	2.5	2.6	5.5	5.3	3.5	4.4	5.5
5	23.6	0.9	1.6	0.0	0.0	2.2	2.6	0.9	0.9	3.2	1.6	1.6	4.3	0.0	2.5	2.2	2.6	2.6	5.3	0.9	3.5	3.2	1.6	4.4	4.3	2.5	2.6	5.5	5.3	3.5	4.4	5.5
6	47.2	1.8	3.3	0.0	0.0	4.5	5.1	1.8	1.8	6.3	3.3	3.3	8.5	0.0	4.9	4.5	5.1	5.1	10.5	1.8	6.9	6.3	3.3	8.9	8.5	4.9	5.1	11.0	10.5	6.9	8.9	11.0
7	47.2	1.8	3.3	0.0	0.0	4.5	5.1	1.8	1.8	6.3	3.3	3.3	8.5	0.0	4.9	4.5	5.1	5.1	10.5	1.8	6.9	6.3	3.3	8.9	8.5	4.9	5.1	11.0	10.5	6.9	8.9	11.0
8	47.2	1.8	3.3	0.0	0.0	4.5	5.1	1.8	1.8	6.3	3.3	3.3	8.5	0.0	4.9	4.5	5.1	5.1	10.5	1.8	6.9	6.3	3.3	8.9	8.5	4.9	5.1	11.0	10.5	6.9	8.9	11.0
9	47.2	1.8	3.3	0.0	0.0	4.5	5.1	1.8	1.8	6.3	3.3	3.3	8.5	0.0	4.9	4.5	5.1	5.1	10.5	1.8	6.9	6.3	3.3	8.9	8.5	4.9	5.1	11.0	10.5	6.9	8.9	11.0
10	70.7	2.8	4.9	0.0	0.0	6.7	7.7	2.8	2.8	9.5	4.9	4.9	12.8	0.0	7.4	6.7	7.7	7.7	15.8	2.8	10.4	9.5	4.9	13.3	12.8	7.4	7.7	16.5	15.8	10.4	13.3	16.5
11	70.7	2.8	4.9	0.0	0.0	6.7	7.7	2.8	2.8	9.5	4.9	4.9	12.8	0.0	7.4	6.7	7.7	7.7	15.8	2.8	10.4	9.5	4.9	13.3	12.8	7.4	7.7	16.5	15.8	10.4	13.3	16.5
12	70.7	2.8	4.9	0.0	0.0	6.7	7.7	2.8	2.8	9.5	4.9	4.9	12.8	0.0	7.4	6.7	7.7	7.7	15.8	2.8	10.4	9.5	4.9	13.3	12.8	7.4	7.7	16.5	15.8	10.4	13.3	16.5
13	70.7	2.8	4.9	0.0	0.0	6.7	7.7	2.8	2.8	9.5	4.9	4.9	12.8	0.0	7.4	6.7	7.7	7.7	15.8	2.8	10.4	9.5	4.9	13.3	12.8	7.4	7.7	16.5	15.8	10.4	13.3	16.5
14	70.7	2.8	4.9	0.0	0.0	6.7	7.7	2.8	2.8	9.5	4.9	4.9	12.8	0.0	7.4	6.7	7.7	7.7	15.8	2.8	10.4	9.5	4.9	13.3	12.8	7.4	7.7	16.5	15.8	10.4	13.3	16.5
15	70.7	2.8	4.9	0.0	0.0	6.7	7.7	2.8	2.8	9.5	4.9	4.9	12.8	0.0	7.4	6.7	7.7	7.7	15.8	2.8	10.4	9.5	4.9	13.3	12.8	7.4	7.7	16.5	15.8	10.4	13.3	16.5
16	70.7	2.8	4.9	0.0	0.0	6.7	7.7	2.8	2.8	9.5	4.9	4.9	12.8	0.0	7.4	6.7	7.7	7.7	15.8	2.8	10.4	9.5	4.9	13.3	12.8	7.4	7.7	16.5	15.8	10.4	13.3	16.5
17	70.7	2.8	4.9	0.0	0.0	6.7	7.7	2.8	2.8	9.5	4.9	4.9	12.8	0.0	7.4	6.7	7.7	7.7	15.8	2.8	10.4	9.5	4.9	13.3	12.8	7.4	7.7	16.5	15.8	10.4	13.3	16.5
18	47.2	1.8	3.3	0.0	0.0	4.5	5.1	1.8	1.8	6.3	3.3	3.3	8.5	0.0	4.9	4.5	5.1	5.1	10.5	1.8	6.9	6.3	3.3	8.9	8.5	4.9	5.1	11.0	10.5	6.9	8.9	11.0
19	47.2	1.8	3.3	0.0	0.0	4.5	5.1	1.8	1.8	6.3	3.3	3.3	8.5	0.0	4.9	4.5	5.1	5.1	10.5	1.8	6.9	6.3	3.3	8.9	8.5	4.9	5.1	11.0	10.5	6.9	8.9	11.0
20	47.2	1.8	3.3	0.0	0.0	4.5	5.1	1.8	1.8	6.3	3.3	3.3	8.5	0.0	4.9	4.5	5.1	5.1	10.5	1.8	6.9	6.3	3.3	8.9	8.5	4.9	5.1	11.0	10.5	6.9	8.9	11.0
21	47.2	1.8	3.3	0.0	0.0	4.5	5.1	1.8	1.8	6.3	3.3	3.3	8.5	0.0	4.9	4.5	5.1	5.1	10.5	1.8	6.9	6.3	3.3	8.9	8.5	4.9	5.1	11.0	10.5	6.9	8.9	11.0
22	23.6	0.9	1.6	0.0	0.0	2.2	2.6	0.9	0.9	3.2	1.6	1.6	4.3	0.0	2.5	2.2	2.6	2.6	5.3	0.9	3.5	3.2	1.6	4.4	4.3	2.5	2.6	5.5	5.3	3.5	4.4	5.5
23	23.6	0.9	1.6	0.0	0.0	2.2	2.6	0.9	0.9	3.2	1.6	1.6	4.3	0.0	2.5	2.2	2.6	2.6	5.3	0.9	3.5	3.2	1.6	4.4	4.3	2.5	2.6	5.5	5.3	3.5	4.4	5.5
24	23.6	0.9	1.6	0.0	0.0	2.2	2.6	0.9	0.9	3.2	1.6	1.6	4.3	0.0	2.5	2.2	2.6	2.6	5.3	0.9	3.5	3.2	1.6	4.4	4.3	2.5	2.6	5.5	5.3	3.5	4.4	5.5

9	Old Hospital, Building 80, Admin/Control Room/Computers																															
	Demand (kWh)	per day	per hour	100 watt bulb equivelant																												
9	2,468,113	6762.0	281.75	2817																												
i	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
t	Baseline	W	H	E	N	C	WL	WE	WH	WC	LE	LH	LC	EH	EC	HC	WLE	WLH	WLC	WEH	WEC	WHC	LEH	LEC	LHC	EHC	WLEH	WLEC	WLHC	WEHC	LEHC	WLEHC
1	140.9	0.5	2.8	0.0	0.0	12.4	3.3	0.5	0.5	12.8	2.8	2.8	16.7	0.0	13.6	12.4	3.3	3.3	17.2	0.5	14.1	12.8	2.8	17.5	16.7	13.6	3.3	18.0	17.2	14.1	17.5	18.0
2	140.9	0.5	2.8	0.0	0.0	12.4	3.3	0.5	0.5	12.8	2.8	2.8	16.7	0.0	13.6	12.4	3.3	3.3	17.2	0.5	14.1	12.8	2.8	17.5	16.7	13.6	3.3	18.0	17.2	14.1	17.5	18.0
3	140.9	0.5	2.8	0.0	0.0	12.4	3.3	0.5	0.5	12.8	2.8	2.8	16.7	0.0	13.6	12.4	3.3	3.3	17.2	0.5	14.1	12.8	2.8	17.5	16.7	13.6	3.3	18.0	17.2	14.1	17.5	18.0
4	140.9	0.5	2.8	0.0	0.0	12.4	3.3	0.5	0.5	12.8	2.8	2.8	16.7	0.0	13.6	12.4	3.3	3.3	17.2	0.5	14.1	12.8	2.8	17.5	16.7	13.6	3.3	18.0	17.2	14.1	17.5	18.0
5	140.9	0.5	2.8	0.0	0.0	12.4	3.3	0.5	0.5	12.8	2.8	2.8	16.7	0.0	13.6	12.4	3.3	3.3	17.2	0.5	14.1	12.8	2.8	17.5	16.7	13.6	3.3	18.0	17.2	14.1	17.5	18.0
6	281.7	0.9	5.6	0.0	0.0	24.7	6.6	0.9	0.9	25.7	5.6	5.6	33.4	0.0	27.2	24.7	6.6	6.6	34.4	0.9	28.2	25.7	5.6	34.9	33.4	27.2	6.6	36.0	34.4	28.2	34.9	36.0
7	281.7	0.9	5.6	0.0	0.0	24.7	6.6	0.9	0.9	25.7	5.6	5.6	33.4	0.0	27.2	24.7	6.6	6.6	34.4	0.9	28.2	25.7	5.6	34.9	33.4	27.2	6.6	36.0	34.4	28.2	34.9	36.0
8	281.7	0.9	5.6	0.0	0.0	24.7	6.6	0.9	0.9	25.7	5.6	5.6	33.4	0.0	27.2	24.7	6.6	6.6	34.4	0.9	28.2	25.7	5.6	34.9	33.4	27.2	6.6	36.0	34.4	28.2	34.9	36.0
9	281.7	0.9	5.6	0.0	0.0	24.7	6.6	0.9	0.9	25.7	5.6	5.6	33.4	0.0	27.2	24.7	6.6	6.6	34.4	0.9	28.2	25.7	5.6	34.9	33.4	27.2	6.6	36.0	34.4	28.2	34.9	36.0
10	422.6	1.4	8.5	0.0	0.0	37.1	9.9	1.4	1.4	38.5	8.5	8.5	50.1	0.0	40.8	37.1	9.9	9.9	51.6	1.4	42.3	38.5	8.5	52.4	50.1	40.8	9.9	54.0	51.6	42.3	52.4	54.0
11	422.6	1.4	8.5	0.0	0.0	37.1	9.9	1.4	1.4	38.5	8.5	8.5	50.1	0.0	40.8	37.1	9.9	9.9	51.6	1.4	42.3	38.5	8.5	52.4	50.1	40.8	9.9	54.0	51.6	42.3	52.4	54.0
12	422.6	1.4	8.5	0.0	0.0	37.1	9.9	1.4	1.4	38.5	8.5	8.5	50.1	0.0	40.8	37.1	9.9	9.9	51.6	1.4	42.3	38.5	8.5	52.4	50.1	40.8	9.9	54.0	51.6	42.3	52.4	54.0
13	422.6	1.4	8.5	0.0	0.0	37.1	9.9	1.4	1.4	38.5	8.5	8.5	50.1	0.0	40.8	37.1	9.9	9.9	51.6	1.4	42.3	38.5	8.5	52.4	50.1	40.8	9.9	54.0	51.6	42.3	52.4	54.0
14	422.6	1.4	8.5	0.0	0.0	37.1	9.9	1.4	1.4	38.5	8.5	8.5	50.1	0.0	40.8	37.1	9.9	9.9	51.6	1.4	42.3	38.5	8.5	52.4	50.1	40.8	9.9	54.0	51.6	42.3	52.4	54.0
15	422.6	1.4	8.5	0.0	0.0	37.1	9.9	1.4	1.4	38.5	8.5	8.5	50.1	0.0	40.8	37.1	9.9	9.9	51.6	1.4	42.3	38.5	8.5	52.4	50.1	40.8	9.9	54.0	51.6	42.3	52.4	54.0
16	422.6	1.4	8.5	0.0	0.0	37.1	9.9	1.4	1.4	38.5	8.5	8.5	50.1	0.0	40.8	37.1	9.9	9.9	51.6	1.4	42.3	38.5	8.5	52.4	50.1	40.8	9.9	54.0	51.6	42.3	52.4	54.0
17	422.6	1.4	8.5	0.0	0.0	37.1	9.9	1.4	1.4	38.5	8.5	8.5	50.1	0.0	40.8	37.1	9.9	9.9	51.6	1.4	42.3	38.5	8.5	52.4	50.1	40.8	9.9	54.0	51.6	42.3	52.4	54.0
18	281.7	0.9	5.6	0.0	0.0	24.7	6.6	0.9	0.9	25.7	5.6	5.6	33.4	0.0	27.2	24.7	6.6	6.6	34.4	0.9	28.2	25.7	5.6	34.9	33.4	27.2	6.6	36.0	34.4	28.2	34.9	36.0
19	281.7	0.9	5.6	0.0	0.0	24.7	6.6	0.9	0.9	25.7	5.6	5.6	33.4	0.0	27.2	24.7	6.6	6.6	34.4	0.9	28.2	25.7	5.6	34.9	33.4	27.2	6.6	36.0	34.4	28.2	34.9	36.0
20	281.7	0.9	5.6	0.0	0.0	24.7	6.6	0.9	0.9	25.7	5.6	5.6	33.4	0.0	27.2	24.7	6.6	6.6	34.4	0.9	28.2	25.7	5.6	34.9	33.4	27.2	6.6	36.0	34.4	28.2	34.9	36.0
21	281.7	0.9	5.6	0.0	0.0	24.7	6.6	0.9	0.9	25.7	5.6	5.6	33.4	0.0	27.2	24.7	6.6	6.6	34.4	0.9	28.2	25.7	5.6	34.9	33.4	27.2	6.6	36.0	34.4	28.2	34.9	36.0
22	140.9	0.5	2.8	0.0	0.0	12.4	3.3	0.5	0.5	12.8	2.8	2.8	16.7	0.0	13.6	12.4	3.3	3.3	17.2	0.5	14.1	12.8	2.8	17.5	16.7	13.6	3.3	18.0	17.2	14.1	17.5	18.0
23	140.9	0.5	2.8	0.0	0.0	12.4	3.3	0.5	0.5	12.8	2.8	2.8	16.7	0.0	13.6	12.4	3.3	3.3	17.2	0.5	14.1	12.8	2.8	17.5	16.7	13.6	3.3	18.0	17.2	14.1	17.5	18.0
24	140.9	0.5	2.8	0.0	0.0	12.4	3.3	0.5	0.5	12.8	2.8	2.8	16.7	0.0	13.6	12.4	3.3	3.3	17.2	0.5	14.1	12.8	2.8	17.5	16.7	13.6	3.3	18.0	17.2	14.1	17.5	18.0

10	Old Hospital, Building 81 phones																															
	Demand (kWh)	per day	per hour	100 watt bulb equivelant																												
10	243,779	667.9	27.83	278																												
i	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
t	Baseline	W	M	E	VH	C	WL	WE	WH	WC	LE	LH	LC	EH	EC	HC	WLE	WLH	WLC	WEH	WEC	WHC	LEH	LEC	LHC	EHC	WLEH	WLEC	WLHC	WEHC	LEHC	WLEHC
1	13.9	0.0	0.5	0.1	0.0	0.4	0.5	0.1	0.0	0.4	0.6	0.5	1.0	0.1	0.5	0.4	0.6	0.5	1.0	0.1	0.5	0.4	0.6	1.1	1.0	0.5	0.6	1.1	1.0	0.5	1.1	1.1
2	13.9	0.0	0.5	0.1	0.0	0.4	0.5	0.1	0.0	0.4	0.6	0.5	1.0	0.1	0.5	0.4	0.6	0.5	1.0	0.1	0.5	0.4	0.6	1.1	1.0	0.5	0.6	1.1	1.0	0.5	1.1	1.1
3	13.9	0.0	0.5	0.1	0.0	0.4	0.5	0.1	0.0	0.4	0.6	0.5	1.0	0.1	0.5	0.4	0.6	0.5	1.0	0.1	0.5	0.4	0.6	1.1	1.0	0.5	0.6	1.1	1.0	0.5	1.1	1.1
4	13.9	0.0	0.5	0.1	0.0	0.4	0.5	0.1	0.0	0.4	0.6	0.5	1.0	0.1	0.5	0.4	0.6	0.5	1.0	0.1	0.5	0.4	0.6	1.1	1.0	0.5	0.6	1.1	1.0	0.5	1.1	1.1
5	13.9	0.0	0.5	0.1	0.0	0.4	0.5	0.1	0.0	0.4	0.6	0.5	1.0	0.1	0.5	0.4	0.6	0.5	1.0	0.1	0.5	0.4	0.6	1.1	1.0	0.5	0.6	1.1	1.0	0.5	1.1	1.1
6	27.8	0.0	1.0	0.1	0.0	0.8	1.1	0.2	0.0	0.8	1.2	1.0	2.0	0.1	1.0	0.8	1.2	1.1	2.1	0.2	1.1	0.8	1.2	2.3	2.0	1.0	1.2	2.3	2.1	1.1	2.3	2.3
7	27.8	0.0	1.0	0.1	0.0	0.8	1.1	0.2	0.0	0.8	1.2	1.0	2.0	0.1	1.0	0.8	1.2	1.1	2.1	0.2	1.1	0.8	1.2	2.3	2.0	1.0	1.2	2.3	2.1	1.1	2.3	2.3
8	27.8	0.0	1.0	0.1	0.0	0.8	1.1	0.2	0.0	0.8	1.2	1.0	2.0	0.1	1.0	0.8	1.2	1.1	2.1	0.2	1.1	0.8	1.2	2.3	2.0	1.0	1.2	2.3	2.1	1.1	2.3	2.3
9	27.8	0.0	1.0	0.1	0.0	0.8	1.1	0.2	0.0	0.8	1.2	1.0	2.0	0.1	1.0	0.8	1.2	1.1	2.1	0.2	1.1	0.8	1.2	2.3	2.0	1.0	1.2	2.3	2.1	1.1	2.3	2.3
10	41.7	0.0	1.5	0.2	0.0	1.2	1.6	0.2	0.0	1.2	1.7	1.5	3.0	0.2	1.5	1.2	1.8	1.6	3.1	0.2	1.6	1.2	1.7	3.4	3.0	1.5	1.8	3.4	3.1	1.6	3.4	3.4
11	41.7	0.0	1.5	0.2	0.0	1.2	1.6	0.2	0.0	1.2	1.7	1.5	3.0	0.2	1.5	1.2	1.8	1.6	3.1	0.2	1.6	1.2	1.7	3.4	3.0	1.5	1.8	3.4	3.1	1.6	3.4	3.4
12	41.7	0.0	1.5	0.2	0.0	1.2	1.6	0.2	0.0	1.2	1.7	1.5	3.0	0.2	1.5	1.2	1.8	1.6	3.1	0.2	1.6	1.2	1.7	3.4	3.0	1.5	1.8	3.4	3.1	1.6	3.4	3.4
13	41.7	0.0	1.5	0.2	0.0	1.2	1.6	0.2	0.0	1.2	1.7	1.5	3.0	0.2	1.5	1.2	1.8	1.6	3.1	0.2	1.6	1.2	1.7	3.4	3.0	1.5	1.8	3.4	3.1	1.6	3.4	3.4
14	41.7	0.0	1.5	0.2	0.0	1.2	1.6	0.2	0.0	1.2	1.7	1.5	3.0	0.2	1.5	1.2	1.8	1.6	3.1	0.2	1.6	1.2	1.7	3.4	3.0	1.5	1.8	3.4	3.1	1.6	3.4	3.4
15	41.7	0.0	1.5	0.2	0.0	1.2	1.6	0.2	0.0	1.2	1.7	1.5	3.0	0.2	1.5	1.2	1.8	1.6	3.1	0.2	1.6	1.2	1.7	3.4	3.0	1.5	1.8	3.4	3.1	1.6	3.4	3.4
16	41.7	0.0	1.5	0.2	0.0	1.2	1.6	0.2	0.0	1.2	1.7	1.5	3.0	0.2	1.5	1.2	1.8	1.6	3.1	0.2	1.6	1.2	1.7	3.4	3.0	1.5	1.8	3.4	3.1	1.6	3.4	3.4
17	41.7	0.0	1.5	0.2	0.0	1.2	1.6	0.2	0.0	1.2	1.7	1.5	3.0	0.2	1.5	1.2	1.8	1.6	3.1	0.2	1.6	1.2	1.7	3.4	3.0	1.5	1.8	3.4	3.1	1.6	3.4	3.4
18	27.8	0.0	1.0	0.1	0.0	0.8	1.1	0.2	0.0	0.8	1.2	1.0	2.0	0.1	1.0	0.8	1.2	1.1	2.1	0.2	1.1	0.8	1.2	2.3	2.0	1.0	1.2	2.3	2.1	1.1	2.3	2.3
19	27.8	0.0	1.0	0.1	0.0	0.8	1.1	0.2	0.0	0.8	1.2	1.0	2.0	0.1	1.0	0.8	1.2	1.1	2.1	0.2	1.1	0.8	1.2	2.3	2.0	1.0	1.2	2.3	2.1	1.1	2.3	2.3
20	27.8	0.0	1.0	0.1	0.0	0.8	1.1	0.2	0.0	0.8	1.2	1.0	2.0	0.1	1.0	0.8	1.2	1.1	2.1	0.2	1.1	0.8	1.2	2.3	2.0	1.0	1.2	2.3	2.1	1.1	2.3	2.3
21	27.8	0.0	1.0	0.1	0.0	0.8	1.1	0.2	0.0	0.8	1.2	1.0	2.0	0.1	1.0	0.8	1.2	1.1	2.1	0.2	1.1	0.8	1.2	2.3	2.0	1.0	1.2	2.3	2.1	1.1	2.3	2.3
22	13.9	0.0	0.5	0.1	0.0	0.4	0.5	0.1	0.0	0.4	0.6	0.5	1.0	0.1	0.5	0.4	0.6	0.5	1.0	0.1	0.5	0.4	0.6	1.1	1.0	0.5	0.6	1.1	1.0	0.5	1.1	1.1
23	13.9	0.0	0.5	0.1	0.0	0.4	0.5	0.1	0.0	0.4	0.6	0.5	1.0	0.1	0.5	0.4	0.6	0.5	1.0	0.1	0.5	0.4	0.6	1.1	1.0	0.5	0.6	1.1	1.0	0.5	1.1	1.1
24	13.9	0.0	0.5	0.1	0.0	0.4	0.5	0.1	0.0	0.4	0.6	0.5	1.0	0.1	0.5	0.4	0.6	0.5	1.0	0.1	0.5	0.4	0.6	1.1	1.0	0.5	0.6	1.1	1.0	0.5	1.1	1.1

11	Old Hospital, Buildings 1A, 1B, 2AA, 3AA																															
	Demand (kWh	per day	per hour	100 watt bulb equivelant																												
11	401,402	1099.7	45.82	458																												
i	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
t	Baseline	W	L	E	H	C	WL	WE	WH	WC	LE	LH	LC	EH	EC	HC	WLE	WLH	WLC	WEH	WEC	WHC	LEH	LEC	LHC	EHC	WLEH	WLEC	WLHC	WEHC	LEHC	WLEHC
1	22.9	0.1	2.5	0.0	0.0	0.0	2.6	0.1	0.1	0.1	2.5	2.5	2.8	0.0	0.0	0.0	2.6	2.6	2.9	0.1	0.1	0.1	2.5	2.9	2.8	0.0	2.6	3.0	2.9	0.1	2.9	3.0
2	22.9	0.1	2.5	0.0	0.0	0.0	2.6	0.1	0.1	0.1	2.5	2.5	2.8	0.0	0.0	0.0	2.6	2.6	2.9	0.1	0.1	0.1	2.5	2.9	2.8	0.0	2.6	3.0	2.9	0.1	2.9	3.0
3	22.9	0.1	2.5	0.0	0.0	0.0	2.6	0.1	0.1	0.1	2.5	2.5	2.8	0.0	0.0	0.0	2.6	2.6	2.9	0.1	0.1	0.1	2.5	2.9	2.8	0.0	2.6	3.0	2.9	0.1	2.9	3.0
4	22.9	0.1	2.5	0.0	0.0	0.0	2.6	0.1	0.1	0.1	2.5	2.5	2.8	0.0	0.0	0.0	2.6	2.6	2.9	0.1	0.1	0.1	2.5	2.9	2.8	0.0	2.6	3.0	2.9	0.1	2.9	3.0
5	22.9	0.1	2.5	0.0	0.0	0.0	2.6	0.1	0.1	0.1	2.5	2.5	2.8	0.0	0.0	0.0	2.6	2.6	2.9	0.1	0.1	0.1	2.5	2.9	2.8	0.0	2.6	3.0	2.9	0.1	2.9	3.0
6	45.8	0.2	5.1	0.0	0.0	0.0	5.2	0.2	0.2	0.2	5.1	5.1	5.6	0.0	0.0	0.0	5.2	5.2	5.8	0.2	0.2	0.2	5.1	5.8	5.6	0.0	5.2	6.0	5.8	0.2	5.8	6.0
7	45.8	0.2	5.1	0.0	0.0	0.0	5.2	0.2	0.2	0.2	5.1	5.1	5.6	0.0	0.0	0.0	5.2	5.2	5.8	0.2	0.2	0.2	5.1	5.8	5.6	0.0	5.2	6.0	5.8	0.2	5.8	6.0
8	45.8	0.2	5.1	0.0	0.0	0.0	5.2	0.2	0.2	0.2	5.1	5.1	5.6	0.0	0.0	0.0	5.2	5.2	5.8	0.2	0.2	0.2	5.1	5.8	5.6	0.0	5.2	6.0	5.8	0.2	5.8	6.0
9	45.8	0.2	5.1	0.0	0.0	0.0	5.2	0.2	0.2	0.2	5.1	5.1	5.6	0.0	0.0	0.0	5.2	5.2	5.8	0.2	0.2	0.2	5.1	5.8	5.6	0.0	5.2	6.0	5.8	0.2	5.8	6.0
10	68.7	0.2	7.6	0.0	0.0	0.0	7.9	0.2	0.2	0.2	7.6	7.6	8.4	0.0	0.0	0.0	7.9	7.9	8.7	0.2	0.3	0.2	7.6	8.8	8.4	0.0	7.9	9.1	8.7	0.3	8.8	9.1
11	68.7	0.2	7.6	0.0	0.0	0.0	7.9	0.2	0.2	0.2	7.6	7.6	8.4	0.0	0.0	0.0	7.9	7.9	8.7	0.2	0.3	0.2	7.6	8.8	8.4	0.0	7.9	9.1	8.7	0.3	8.8	9.1
12	68.7	0.2	7.6	0.0	0.0	0.0	7.9	0.2	0.2	0.2	7.6	7.6	8.4	0.0	0.0	0.0	7.9	7.9	8.7	0.2	0.3	0.2	7.6	8.8	8.4	0.0	7.9	9.1	8.7	0.3	8.8	9.1
13	68.7	0.2	7.6	0.0	0.0	0.0	7.9	0.2	0.2	0.2	7.6	7.6	8.4	0.0	0.0	0.0	7.9	7.9	8.7	0.2	0.3	0.2	7.6	8.8	8.4	0.0	7.9	9.1	8.7	0.3	8.8	9.1
14	68.7	0.2	7.6	0.0	0.0	0.0	7.9	0.2	0.2	0.2	7.6	7.6	8.4	0.0	0.0	0.0	7.9	7.9	8.7	0.2	0.3	0.2	7.6	8.8	8.4	0.0	7.9	9.1	8.7	0.3	8.8	9.1
15	68.7	0.2	7.6	0.0	0.0	0.0	7.9	0.2	0.2	0.2	7.6	7.6	8.4	0.0	0.0	0.0	7.9	7.9	8.7	0.2	0.3	0.2	7.6	8.8	8.4	0.0	7.9	9.1	8.7	0.3	8.8	9.1
16	68.7	0.2	7.6	0.0	0.0	0.0	7.9	0.2	0.2	0.2	7.6	7.6	8.4	0.0	0.0	0.0	7.9	7.9	8.7	0.2	0.3	0.2	7.6	8.8	8.4	0.0	7.9	9.1	8.7	0.3	8.8	9.1
17	68.7	0.2	7.6	0.0	0.0	0.0	7.9	0.2	0.2	0.2	7.6	7.6	8.4	0.0	0.0	0.0	7.9	7.9	8.7	0.2	0.3	0.2	7.6	8.8	8.4	0.0	7.9	9.1	8.7	0.3	8.8	9.1
18	45.8	0.2	5.1	0.0	0.0	0.0	5.2	0.2	0.2	0.2	5.1	5.1	5.6	0.0	0.0	0.0	5.2	5.2	5.8	0.2	0.2	0.2	5.1	5.8	5.6	0.0	5.2	6.0	5.8	0.2	5.8	6.0
19	45.8	0.2	5.1	0.0	0.0	0.0	5.2	0.2	0.2	0.2	5.1	5.1	5.6	0.0	0.0	0.0	5.2	5.2	5.8	0.2	0.2	0.2	5.1	5.8	5.6	0.0	5.2	6.0	5.8	0.2	5.8	6.0
20	45.8	0.2	5.1	0.0	0.0	0.0	5.2	0.2	0.2	0.2	5.1	5.1	5.6	0.0	0.0	0.0	5.2	5.2	5.8	0.2	0.2	0.2	5.1	5.8	5.6	0.0	5.2	6.0	5.8	0.2	5.8	6.0
21	45.8	0.2	5.1	0.0	0.0	0.0	5.2	0.2	0.2	0.2	5.1	5.1	5.6	0.0	0.0	0.0	5.2	5.2	5.8	0.2	0.2	0.2	5.1	5.8	5.6	0.0	5.2	6.0	5.8	0.2	5.8	6.0
22	22.9	0.1	2.5	0.0	0.0	0.0	2.6	0.1	0.1	0.1	2.5	2.5	2.8	0.0	0.0	0.0	2.6	2.6	2.9	0.1	0.1	0.1	2.5	2.9	2.8	0.0	2.6	3.0	2.9	0.1	2.9	3.0
23	22.9	0.1	2.5	0.0	0.0	0.0	2.6	0.1	0.1	0.1	2.5	2.5	2.8	0.0	0.0	0.0	2.6	2.6	2.9	0.1	0.1	0.1	2.5	2.9	2.8	0.0	2.6	3.0	2.9	0.1	2.9	3.0
24	22.9	0.1	2.5	0.0	0.0	0.0	2.6	0.1	0.1	0.1	2.5	2.5	2.8	0.0	0.0	0.0	2.6	2.6	2.9	0.1	0.1	0.1	2.5	2.9	2.8	0.0	2.6	3.0	2.9	0.1	2.9	3.0

12	Bldg 700 PACOM Center, 701, 705			
	Demand (kWh)	per day	per hour	100 watt bulb equivelant
12	7,112,806	19487.1	811.96	8120

i	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
t	Baseline	W	N	E	M	C	WL	WE	WH	WC	LE	LH	LC	EH	EC	HC	WLE	WLH	WLC	WEH	WEC	WHC	LEH	LEC	LHC	EHC	WLEH	WLEC	WLHC	WEHC	LEHC	WLEHC
1	406.0	1.1	49.9	1.3	0.0	0.0	51.0	2.3	1.1	1.1	51.2	49.9	54.9	1.3	1.4	0.0	52.3	51.0	56.1	2.3	2.6	1.1	51.2	58.9	54.9	1.4	52.3	60.1	56.1	2.6	58.9	60.1
2	406.0	1.1	49.9	1.3	0.0	0.0	51.0	2.3	1.1	1.1	51.2	49.9	54.9	1.3	1.4	0.0	52.3	51.0	56.1	2.3	2.6	1.1	51.2	58.9	54.9	1.4	52.3	60.1	56.1	2.6	58.9	60.1
3	406.0	1.1	49.9	1.3	0.0	0.0	51.0	2.3	1.1	1.1	51.2	49.9	54.9	1.3	1.4	0.0	52.3	51.0	56.1	2.3	2.6	1.1	51.2	58.9	54.9	1.4	52.3	60.1	56.1	2.6	58.9	60.1
4	406.0	1.1	49.9	1.3	0.0	0.0	51.0	2.3	1.1	1.1	51.2	49.9	54.9	1.3	1.4	0.0	52.3	51.0	56.1	2.3	2.6	1.1	51.2	58.9	54.9	1.4	52.3	60.1	56.1	2.6	58.9	60.1
5	406.0	1.1	49.9	1.3	0.0	0.0	51.0	2.3	1.1	1.1	51.2	49.9	54.9	1.3	1.4	0.0	52.3	51.0	56.1	2.3	2.6	1.1	51.2	58.9	54.9	1.4	52.3	60.1	56.1	2.6	58.9	60.1
6	812.0	2.1	99.8	2.6	0.0	0.0	101.9	4.7	2.1	2.1	102.4	99.8	109.8	2.6	2.8	0.0	104.5	101.9	112.1	4.7	5.2	2.1	102.4	117.8	109.8	2.8	104.5	120.2	112.1	5.2	117.8	120.2
7	812.0	2.1	99.8	2.6	0.0	0.0	101.9	4.7	2.1	2.1	102.4	99.8	109.8	2.6	2.8	0.0	104.5	101.9	112.1	4.7	5.2	2.1	102.4	117.8	109.8	2.8	104.5	120.2	112.1	5.2	117.8	120.2
8	812.0	2.1	99.8	2.6	0.0	0.0	101.9	4.7	2.1	2.1	102.4	99.8	109.8	2.6	2.8	0.0	104.5	101.9	112.1	4.7	5.2	2.1	102.4	117.8	109.8	2.8	104.5	120.2	112.1	5.2	117.8	120.2
9	812.0	2.1	99.8	2.6	0.0	0.0	101.9	4.7	2.1	2.1	102.4	99.8	109.8	2.6	2.8	0.0	104.5	101.9	112.1	4.7	5.2	2.1	102.4	117.8	109.8	2.8	104.5	120.2	112.1	5.2	117.8	120.2
10	1217.9	3.2	149.7	3.9	0.0	0.0	152.9	7.0	3.2	3.2	153.6	149.7	164.7	3.9	4.3	0.0	156.8	152.9	168.2	7.0	7.7	3.2	153.6	176.7	164.7	4.3	156.8	180.3	168.2	7.7	176.7	180.3
11	1217.9	3.2	149.7	3.9	0.0	0.0	152.9	7.0	3.2	3.2	153.6	149.7	164.7	3.9	4.3	0.0	156.8	152.9	168.2	7.0	7.7	3.2	153.6	176.7	164.7	4.3	156.8	180.3	168.2	7.7	176.7	180.3
12	1217.9	3.2	149.7	3.9	0.0	0.0	152.9	7.0	3.2	3.2	153.6	149.7	164.7	3.9	4.3	0.0	156.8	152.9	168.2	7.0	7.7	3.2	153.6	176.7	164.7	4.3	156.8	180.3	168.2	7.7	176.7	180.3
13	1217.9	3.2	149.7	3.9	0.0	0.0	152.9	7.0	3.2	3.2	153.6	149.7	164.7	3.9	4.3	0.0	156.8	152.9	168.2	7.0	7.7	3.2	153.6	176.7	164.7	4.3	156.8	180.3	168.2	7.7	176.7	180.3
14	1217.9	3.2	149.7	3.9	0.0	0.0	152.9	7.0	3.2	3.2	153.6	149.7	164.7	3.9	4.3	0.0	156.8	152.9	168.2	7.0	7.7	3.2	153.6	176.7	164.7	4.3	156.8	180.3	168.2	7.7	176.7	180.3
15	1217.9	3.2	149.7	3.9	0.0	0.0	152.9	7.0	3.2	3.2	153.6	149.7	164.7	3.9	4.3	0.0	156.8	152.9	168.2	7.0	7.7	3.2	153.6	176.7	164.7	4.3	156.8	180.3	168.2	7.7	176.7	180.3
16	1217.9	3.2	149.7	3.9	0.0	0.0	152.9	7.0	3.2	3.2	153.6	149.7	164.7	3.9	4.3	0.0	156.8	152.9	168.2	7.0	7.7	3.2	153.6	176.7	164.7	4.3	156.8	180.3	168.2	7.7	176.7	180.3
17	1217.9	3.2	149.7	3.9	0.0	0.0	152.9	7.0	3.2	3.2	153.6	149.7	164.7	3.9	4.3	0.0	156.8	152.9	168.2	7.0	7.7	3.2	153.6	176.7	164.7	4.3	156.8	180.3	168.2	7.7	176.7	180.3
18	812.0	2.1	99.8	2.6	0.0	0.0	101.9	4.7	2.1	2.1	102.4	99.8	109.8	2.6	2.8	0.0	104.5	101.9	112.1	4.7	5.2	2.1	102.4	117.8	109.8	2.8	104.5	120.2	112.1	5.2	117.8	120.2
19	812.0	2.1	99.8	2.6	0.0	0.0	101.9	4.7	2.1	2.1	102.4	99.8	109.8	2.6	2.8	0.0	104.5	101.9	112.1	4.7	5.2	2.1	102.4	117.8	109.8	2.8	104.5	120.2	112.1	5.2	117.8	120.2
20	812.0	2.1	99.8	2.6	0.0	0.0	101.9	4.7	2.1	2.1	102.4	99.8	109.8	2.6	2.8	0.0	104.5	101.9	112.1	4.7	5.2	2.1	102.4	117.8	109.8	2.8	104.5	120.2	112.1	5.2	117.8	120.2
21	812.0	2.1	99.8	2.6	0.0	0.0	101.9	4.7	2.1	2.1	102.4	99.8	109.8	2.6	2.8	0.0	104.5	101.9	112.1	4.7	5.2	2.1	102.4	117.8	109.8	2.8	104.5	120.2	112.1	5.2	117.8	120.2
22	406.0	1.1	49.9	1.3	0.0	0.0	51.0	2.3	1.1	1.1	51.2	49.9	54.9	1.3	1.4	0.0	52.3	51.0	56.1	2.3	2.6	1.1	51.2	58.9	54.9	1.4	52.3	60.1	56.1	2.6	58.9	60.1
23	406.0	1.1	49.9	1.3	0.0	0.0	51.0	2.3	1.1	1.1	51.2	49.9	54.9	1.3	1.4	0.0	52.3	51.0	56.1	2.3	2.6	1.1	51.2	58.9	54.9	1.4	52.3	60.1	56.1	2.6	58.9	60.1
24	406.0	1.1	49.9	1.3	0.0	0.0	51.0	2.3	1.1	1.1	51.2	49.9	54.9	1.3	1.4	0.0	52.3	51.0	56.1	2.3	2.6	1.1	51.2	58.9	54.9	1.4	52.3	60.1	56.1	2.6	58.9	60.1

13	barracks complex (401-404)			
	Demand (kW	per day	per hour	100 watt bulb equivelant
13	332,824	911.8	37.99	380

i	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
t	Baseline	W	VH	E	L	C	WL	WE	WH	WC	LE	LH	LC	EH	EC	HC	WLE	WLH	WLC	WEH	WEC	WHC	LEH	LEC	LHC	EHC	WLEH	WLEC	WLHC	WEHC	LEHC	WLEHC
1	19.0	11.7	0.1	0.0	0.0	0.0	11.8	11.7	11.7	11.7	0.1	0.1	0.1	0.0	0.0	0.0	11.8	11.8	13.0	11.7	12.9	11.7	0.1	0.1	0.1	0.0	11.8	13.6	13.0	12.9	0.1	13.6
2	19.0	11.7	0.1	0.0	0.0	0.0	11.8	11.7	11.7	11.7	0.1	0.1	0.1	0.0	0.0	0.0	11.8	11.8	13.0	11.7	12.9	11.7	0.1	0.1	0.1	0.0	11.8	13.6	13.0	12.9	0.1	13.6
3	19.0	11.7	0.1	0.0	0.0	0.0	11.8	11.7	11.7	11.7	0.1	0.1	0.1	0.0	0.0	0.0	11.8	11.8	13.0	11.7	12.9	11.7	0.1	0.1	0.1	0.0	11.8	13.6	13.0	12.9	0.1	13.6
4	19.0	11.7	0.1	0.0	0.0	0.0	11.8	11.7	11.7	11.7	0.1	0.1	0.1	0.0	0.0	0.0	11.8	11.8	13.0	11.7	12.9	11.7	0.1	0.1	0.1	0.0	11.8	13.6	13.0	12.9	0.1	13.6
5	19.0	11.7	0.1	0.0	0.0	0.0	11.8	11.7	11.7	11.7	0.1	0.1	0.1	0.0	0.0	0.0	11.8	11.8	13.0	11.7	12.9	11.7	0.1	0.1	0.1	0.0	11.8	13.6	13.0	12.9	0.1	13.6
6	38.0	23.4	0.2	0.0	0.0	0.0	23.6	23.4	23.4	23.4	0.2	0.2	0.2	0.0	0.0	0.0	23.6	23.6	25.9	23.4	25.8	23.4	0.2	0.2	0.2	0.0	23.6	27.1	25.9	25.8	0.2	27.1
7	38.0	23.4	0.2	0.0	0.0	0.0	23.6	23.4	23.4	23.4	0.2	0.2	0.2	0.0	0.0	0.0	23.6	23.6	25.9	23.4	25.8	23.4	0.2	0.2	0.2	0.0	23.6	27.1	25.9	25.8	0.2	27.1
8	38.0	23.4	0.2	0.0	0.0	0.0	23.6	23.4	23.4	23.4	0.2	0.2	0.2	0.0	0.0	0.0	23.6	23.6	25.9	23.4	25.8	23.4	0.2	0.2	0.2	0.0	23.6	27.1	25.9	25.8	0.2	27.1
9	38.0	23.4	0.2	0.0	0.0	0.0	23.6	23.4	23.4	23.4	0.2	0.2	0.2	0.0	0.0	0.0	23.6	23.6	25.9	23.4	25.8	23.4	0.2	0.2	0.2	0.0	23.6	27.1	25.9	25.8	0.2	27.1
10	57.0	35.1	0.2	0.0	0.0	0.0	35.4	35.1	35.1	35.1	0.2	0.2	0.3	0.0	0.0	0.0	35.4	35.4	38.9	35.1	38.6	35.1	0.2	0.3	0.3	0.0	35.4	40.7	38.9	38.6	0.3	40.7
11	57.0	35.1	0.2	0.0	0.0	0.0	35.4	35.1	35.1	35.1	0.2	0.2	0.3	0.0	0.0	0.0	35.4	35.4	38.9	35.1	38.6	35.1	0.2	0.3	0.3	0.0	35.4	40.7	38.9	38.6	0.3	40.7
12	57.0	35.1	0.2	0.0	0.0	0.0	35.4	35.1	35.1	35.1	0.2	0.2	0.3	0.0	0.0	0.0	35.4	35.4	38.9	35.1	38.6	35.1	0.2	0.3	0.3	0.0	35.4	40.7	38.9	38.6	0.3	40.7
13	57.0	35.1	0.2	0.0	0.0	0.0	35.4	35.1	35.1	35.1	0.2	0.2	0.3	0.0	0.0	0.0	35.4	35.4	38.9	35.1	38.6	35.1	0.2	0.3	0.3	0.0	35.4	40.7	38.9	38.6	0.3	40.7
14	57.0	35.1	0.2	0.0	0.0	0.0	35.4	35.1	35.1	35.1	0.2	0.2	0.3	0.0	0.0	0.0	35.4	35.4	38.9	35.1	38.6	35.1	0.2	0.3	0.3	0.0	35.4	40.7	38.9	38.6	0.3	40.7
15	57.0	35.1	0.2	0.0	0.0	0.0	35.4	35.1	35.1	35.1	0.2	0.2	0.3	0.0	0.0	0.0	35.4	35.4	38.9	35.1	38.6	35.1	0.2	0.3	0.3	0.0	35.4	40.7	38.9	38.6	0.3	40.7
16	57.0	35.1	0.2	0.0	0.0	0.0	35.4	35.1	35.1	35.1	0.2	0.2	0.3	0.0	0.0	0.0	35.4	35.4	38.9	35.1	38.6	35.1	0.2	0.3	0.3	0.0	35.4	40.7	38.9	38.6	0.3	40.7
17	57.0	35.1	0.2	0.0	0.0	0.0	35.4	35.1	35.1	35.1	0.2	0.2	0.3	0.0	0.0	0.0	35.4	35.4	38.9	35.1	38.6	35.1	0.2	0.3	0.3	0.0	35.4	40.7	38.9	38.6	0.3	40.7
18	38.0	23.4	0.2	0.0	0.0	0.0	23.6	23.4	23.4	23.4	0.2	0.2	0.2	0.0	0.0	0.0	23.6	23.6	25.9	23.4	25.8	23.4	0.2	0.2	0.2	0.0	23.6	27.1	25.9	25.8	0.2	27.1
19	38.0	23.4	0.2	0.0	0.0	0.0	23.6	23.4	23.4	23.4	0.2	0.2	0.2	0.0	0.0	0.0	23.6	23.6	25.9	23.4	25.8	23.4	0.2	0.2	0.2	0.0	23.6	27.1	25.9	25.8	0.2	27.1
20	38.0	23.4	0.2	0.0	0.0	0.0	23.6	23.4	23.4	23.4	0.2	0.2	0.2	0.0	0.0	0.0	23.6	23.6	25.9	23.4	25.8	23.4	0.2	0.2	0.2	0.0	23.6	27.1	25.9	25.8	0.2	27.1
21	38.0	23.4	0.2	0.0	0.0	0.0	23.6	23.4	23.4	23.4	0.2	0.2	0.2	0.0	0.0	0.0	23.6	23.6	25.9	23.4	25.8	23.4	0.2	0.2	0.2	0.0	23.6	27.1	25.9	25.8	0.2	27.1
22	19.0	11.7	0.1	0.0	0.0	0.0	11.8	11.7	11.7	11.7	0.1	0.1	0.1	0.0	0.0	0.0	11.8	11.8	13.0	11.7	12.9	11.7	0.1	0.1	0.1	0.0	11.8	13.6	13.0	12.9	0.1	13.6
23	19.0	11.7	0.1	0.0	0.0	0.0	11.8	11.7	11.7	11.7	0.1	0.1	0.1	0.0	0.0	0.0	11.8	11.8	13.0	11.7	12.9	11.7	0.1	0.1	0.1	0.0	11.8	13.6	13.0	12.9	0.1	13.6
24	19.0	11.7	0.1	0.0	0.0	0.0	11.8	11.7	11.7	11.7	0.1	0.1	0.1	0.0	0.0	0.0	11.8	11.8	13.0	11.7	12.9	11.7	0.1	0.1	0.1	0.0	11.8	13.6	13.0	12.9	0.1	13.6

14	Maintenance B600			
	Demand (kWh	per day	per hour	100 watt bulb equivelant
14	144,713	396.5	16.52	165

i	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
t	Baseline	W	H	E	N	C	WL	WE	WH	WC	LE	LH	LC	EH	EC	HC	WLE	WLH	WLC	WEH	WEC	WHC	LEH	LEC	LHC	EHC	WLEH	WLEC	WLHC	WEHC	LEHC	WLEHC
1	8.3	0.0	0.8	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.8	0.8	0.9	0.0	0.0	0.0	0.8	0.8	0.9	0.0	0.0	0.0	0.8	0.9	0.9	0.0	0.8	0.9	0.9	0.0	0.9	0.9
2	8.3	0.0	0.8	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.8	0.8	0.9	0.0	0.0	0.0	0.8	0.8	0.9	0.0	0.0	0.0	0.8	0.9	0.9	0.0	0.8	0.9	0.9	0.0	0.9	0.9
3	8.3	0.0	0.8	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.8	0.8	0.9	0.0	0.0	0.0	0.8	0.8	0.9	0.0	0.0	0.0	0.8	0.9	0.9	0.0	0.8	0.9	0.9	0.0	0.9	0.9
4	8.3	0.0	0.8	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.8	0.8	0.9	0.0	0.0	0.0	0.8	0.8	0.9	0.0	0.0	0.0	0.8	0.9	0.9	0.0	0.8	0.9	0.9	0.0	0.9	0.9
5	8.3	0.0	0.8	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.8	0.8	0.9	0.0	0.0	0.0	0.8	0.8	0.9	0.0	0.0	0.0	0.8	0.9	0.9	0.0	0.8	0.9	0.9	0.0	0.9	0.9
6	16.5	0.0	1.6	0.0	0.0	0.0	1.6	0.0	0.0	0.0	1.6	1.6	1.7	0.0	0.0	0.0	1.6	1.6	1.7	0.0	0.0	0.0	1.6	1.8	1.7	0.0	1.6	1.8	1.7	0.0	1.8	1.8
7	16.5	0.0	1.6	0.0	0.0	0.0	1.6	0.0	0.0	0.0	1.6	1.6	1.7	0.0	0.0	0.0	1.6	1.6	1.7	0.0	0.0	0.0	1.6	1.8	1.7	0.0	1.6	1.8	1.7	0.0	1.8	1.8
8	16.5	0.0	1.6	0.0	0.0	0.0	1.6	0.0	0.0	0.0	1.6	1.6	1.7	0.0	0.0	0.0	1.6	1.6	1.7	0.0	0.0	0.0	1.6	1.8	1.7	0.0	1.6	1.8	1.7	0.0	1.8	1.8
9	16.5	0.0	1.6	0.0	0.0	0.0	1.6	0.0	0.0	0.0	1.6	1.6	1.7	0.0	0.0	0.0	1.6	1.6	1.7	0.0	0.0	0.0	1.6	1.8	1.7	0.0	1.6	1.8	1.7	0.0	1.8	1.8
10	24.8	0.0	2.4	0.0	0.0	0.0	2.4	0.0	0.0	0.0	2.4	2.4	2.6	0.0	0.0	0.0	2.4	2.4	2.6	0.0	0.0	0.0	2.4	2.7	2.6	0.0	2.4	2.7	2.6	0.0	2.7	2.7
11	24.8	0.0	2.4	0.0	0.0	0.0	2.4	0.0	0.0	0.0	2.4	2.4	2.6	0.0	0.0	0.0	2.4	2.4	2.6	0.0	0.0	0.0	2.4	2.7	2.6	0.0	2.4	2.7	2.6	0.0	2.7	2.7
12	24.8	0.0	2.4	0.0	0.0	0.0	2.4	0.0	0.0	0.0	2.4	2.4	2.6	0.0	0.0	0.0	2.4	2.4	2.6	0.0	0.0	0.0	2.4	2.7	2.6	0.0	2.4	2.7	2.6	0.0	2.7	2.7
13	24.8	0.0	2.4	0.0	0.0	0.0	2.4	0.0	0.0	0.0	2.4	2.4	2.6	0.0	0.0	0.0	2.4	2.4	2.6	0.0	0.0	0.0	2.4	2.7	2.6	0.0	2.4	2.7	2.6	0.0	2.7	2.7
14	24.8	0.0	2.4	0.0	0.0	0.0	2.4	0.0	0.0	0.0	2.4	2.4	2.6	0.0	0.0	0.0	2.4	2.4	2.6	0.0	0.0	0.0	2.4	2.7	2.6	0.0	2.4	2.7	2.6	0.0	2.7	2.7
15	24.8	0.0	2.4	0.0	0.0	0.0	2.4	0.0	0.0	0.0	2.4	2.4	2.6	0.0	0.0	0.0	2.4	2.4	2.6	0.0	0.0	0.0	2.4	2.7	2.6	0.0	2.4	2.7	2.6	0.0	2.7	2.7
16	24.8	0.0	2.4	0.0	0.0	0.0	2.4	0.0	0.0	0.0	2.4	2.4	2.6	0.0	0.0	0.0	2.4	2.4	2.6	0.0	0.0	0.0	2.4	2.7	2.6	0.0	2.4	2.7	2.6	0.0	2.7	2.7
17	24.8	0.0	2.4	0.0	0.0	0.0	2.4	0.0	0.0	0.0	2.4	2.4	2.6	0.0	0.0	0.0	2.4	2.4	2.6	0.0	0.0	0.0	2.4	2.7	2.6	0.0	2.4	2.7	2.6	0.0	2.7	2.7
18	16.5	0.0	1.6	0.0	0.0	0.0	1.6	0.0	0.0	0.0	1.6	1.6	1.7	0.0	0.0	0.0	1.6	1.6	1.7	0.0	0.0	0.0	1.6	1.8	1.7	0.0	1.6	1.8	1.7	0.0	1.8	1.8
19	16.5	0.0	1.6	0.0	0.0	0.0	1.6	0.0	0.0	0.0	1.6	1.6	1.7	0.0	0.0	0.0	1.6	1.6	1.7	0.0	0.0	0.0	1.6	1.8	1.7	0.0	1.6	1.8	1.7	0.0	1.8	1.8
20	16.5	0.0	1.6	0.0	0.0	0.0	1.6	0.0	0.0	0.0	1.6	1.6	1.7	0.0	0.0	0.0	1.6	1.6	1.7	0.0	0.0	0.0	1.6	1.8	1.7	0.0	1.6	1.8	1.7	0.0	1.8	1.8
21	16.5	0.0	1.6	0.0	0.0	0.0	1.6	0.0	0.0	0.0	1.6	1.6	1.7	0.0	0.0	0.0	1.6	1.6	1.7	0.0	0.0	0.0	1.6	1.8	1.7	0.0	1.6	1.8	1.7	0.0	1.8	1.8
22	8.3	0.0	0.8	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.8	0.8	0.9	0.0	0.0	0.0	0.8	0.8	0.9	0.0	0.0	0.0	0.8	0.9	0.9	0.0	0.8	0.9	0.9	0.0	0.9	0.9
23	8.3	0.0	0.8	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.8	0.8	0.9	0.0	0.0	0.0	0.8	0.8	0.9	0.0	0.0	0.0	0.8	0.9	0.9	0.0	0.8	0.9	0.9	0.0	0.9	0.9
24	8.3	0.0	0.8	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.8	0.8	0.9	0.0	0.0	0.0	0.8	0.8	0.9	0.0	0.0	0.0	0.8	0.9	0.9	0.0	0.8	0.9	0.9	0.0	0.9	0.9

15	UPS Building 602			
	Demand (kWI	per day	per hour	100 watt bulb equivelant
15	2,800,413	7672.4	319.68	3197

i	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
t	Baseline	W	M	E	VH	C	WL	WE	WH	WC	LE	LH	LC	EH	EC	HC	WLE	WLH	WLC	WEH	WEC	WHC	LEH	LEC	LHC	EHC	WLEH	WLEC	WLHC	WEHC	LEHC	WLEHC
1	159.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	159.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	159.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	159.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	159.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	319.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	319.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	319.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	319.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	479.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	479.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	479.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	479.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	479.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	479.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	479.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	479.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	319.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	319.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	319.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	319.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	159.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	159.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	159.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

16	Fire Station B612			
	Demand (kWh)	per day	per hour	100 watt bulb equivelant
16	109,966	301.3	12.55	126

i	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
t	Baseline	W	L	E	H	C	WL	WE	WH	WC	LE	LH	LC	EH	EC	HC	WLE	WLH	WLC	WEH	WEC	WHC	LEH	LEC	LHC	EHC	WLEH	WLEC	WLHC	WEHC	LEHC	WLEHC
1	6.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	6.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	6.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	6.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	6.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	12.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	12.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	12.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	12.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	18.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.1	0.0	0.1	0.1
11	18.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.1	0.0	0.1	0.1
12	18.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.1	0.0	0.1	0.1
13	18.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.1	0.0	0.1	0.1
14	18.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.1	0.0	0.1	0.1
15	18.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.1	0.0	0.1	0.1
16	18.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.1	0.0	0.1	0.1
17	18.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.1	0.0	0.1	0.1
18	12.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	12.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	12.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	12.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	6.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	6.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	6.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

17	Everything else			
	Demand (kV	per day	per hour	100 watt bulb equivelant
17	140,028	383.6	15.98	160

i	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
t	Baseline	W	N	E	M	C	WL	WE	WH	WC	LE	LH	LC	EH	EC	HC	WLE	WLH	WLC	WEH	WEC	WHC	LEH	LEC	LHC	EHC	WLEH	WLEC	WLHC	WEHC	LEHC	WLEHC
1	8.0	0.0	0.0	1.2	0.0	0.0	0.0	1.2	0.0	0.0	1.3	0.0	0.1	1.2	1.3	0.0	1.3	0.0	0.1	1.2	1.3	0.0	1.3	1.5	0.1	1.3	1.3	1.5	0.1	1.3	1.5	1.5
2	8.0	0.0	0.0	1.2	0.0	0.0	0.0	1.2	0.0	0.0	1.3	0.0	0.1	1.2	1.3	0.0	1.3	0.0	0.1	1.2	1.3	0.0	1.3	1.5	0.1	1.3	1.3	1.5	0.1	1.3	1.5	1.5
3	8.0	0.0	0.0	1.2	0.0	0.0	0.0	1.2	0.0	0.0	1.3	0.0	0.1	1.2	1.3	0.0	1.3	0.0	0.1	1.2	1.3	0.0	1.3	1.5	0.1	1.3	1.3	1.5	0.1	1.3	1.5	1.5
4	8.0	0.0	0.0	1.2	0.0	0.0	0.0	1.2	0.0	0.0	1.3	0.0	0.1	1.2	1.3	0.0	1.3	0.0	0.1	1.2	1.3	0.0	1.3	1.5	0.1	1.3	1.3	1.5	0.1	1.3	1.5	1.5
5	8.0	0.0	0.0	1.2	0.0	0.0	0.0	1.2	0.0	0.0	1.3	0.0	0.1	1.2	1.3	0.0	1.3	0.0	0.1	1.2	1.3	0.0	1.3	1.5	0.1	1.3	1.3	1.5	0.1	1.3	1.5	1.5
6	16.0	0.0	0.1	2.5	0.0	0.0	0.1	2.5	0.0	0.0	2.5	0.1	0.1	2.5	2.7	0.0	2.5	0.1	0.1	2.5	2.7	0.0	2.5	2.9	0.1	2.7	2.5	2.9	0.1	2.7	2.9	2.9
7	16.0	0.0	0.1	2.5	0.0	0.0	0.1	2.5	0.0	0.0	2.5	0.1	0.1	2.5	2.7	0.0	2.5	0.1	0.1	2.5	2.7	0.0	2.5	2.9	0.1	2.7	2.5	2.9	0.1	2.7	2.9	2.9
8	16.0	0.0	0.1	2.5	0.0	0.0	0.1	2.5	0.0	0.0	2.5	0.1	0.1	2.5	2.7	0.0	2.5	0.1	0.1	2.5	2.7	0.0	2.5	2.9	0.1	2.7	2.5	2.9	0.1	2.7	2.9	2.9
9	16.0	0.0	0.1	2.5	0.0	0.0	0.1	2.5	0.0	0.0	2.5	0.1	0.1	2.5	2.7	0.0	2.5	0.1	0.1	2.5	2.7	0.0	2.5	2.9	0.1	2.7	2.5	2.9	0.1	2.7	2.9	2.9
10	24.0	0.0	0.1	3.7	0.0	0.0	0.1	3.7	0.0	0.0	3.8	0.1	0.2	3.7	4.0	0.0	3.8	0.1	0.2	3.7	4.0	0.0	3.8	4.4	0.2	4.0	3.8	4.4	0.2	4.0	4.4	4.4
11	24.0	0.0	0.1	3.7	0.0	0.0	0.1	3.7	0.0	0.0	3.8	0.1	0.2	3.7	4.0	0.0	3.8	0.1	0.2	3.7	4.0	0.0	3.8	4.4	0.2	4.0	3.8	4.4	0.2	4.0	4.4	4.4
12	24.0	0.0	0.1	3.7	0.0	0.0	0.1	3.7	0.0	0.0	3.8	0.1	0.2	3.7	4.0	0.0	3.8	0.1	0.2	3.7	4.0	0.0	3.8	4.4	0.2	4.0	3.8	4.4	0.2	4.0	4.4	4.4
13	24.0	0.0	0.1	3.7	0.0	0.0	0.1	3.7	0.0	0.0	3.8	0.1	0.2	3.7	4.0	0.0	3.8	0.1	0.2	3.7	4.0	0.0	3.8	4.4	0.2	4.0	3.8	4.4	0.2	4.0	4.4	4.4
14	24.0	0.0	0.1	3.7	0.0	0.0	0.1	3.7	0.0	0.0	3.8	0.1	0.2	3.7	4.0	0.0	3.8	0.1	0.2	3.7	4.0	0.0	3.8	4.4	0.2	4.0	3.8	4.4	0.2	4.0	4.4	4.4
15	24.0	0.0	0.1	3.7	0.0	0.0	0.1	3.7	0.0	0.0	3.8	0.1	0.2	3.7	4.0	0.0	3.8	0.1	0.2	3.7	4.0	0.0	3.8	4.4	0.2	4.0	3.8	4.4	0.2	4.0	4.4	4.4
16	24.0	0.0	0.1	3.7	0.0	0.0	0.1	3.7	0.0	0.0	3.8	0.1	0.2	3.7	4.0	0.0	3.8	0.1	0.2	3.7	4.0	0.0	3.8	4.4	0.2	4.0	3.8	4.4	0.2	4.0	4.4	4.4
17	24.0	0.0	0.1	3.7	0.0	0.0	0.1	3.7	0.0	0.0	3.8	0.1	0.2	3.7	4.0	0.0	3.8	0.1	0.2	3.7	4.0	0.0	3.8	4.4	0.2	4.0	3.8	4.4	0.2	4.0	4.4	4.4
18	16.0	0.0	0.1	2.5	0.0	0.0	0.1	2.5	0.0	0.0	2.5	0.1	0.1	2.5	2.7	0.0	2.5	0.1	0.1	2.5	2.7	0.0	2.5	2.9	0.1	2.7	2.5	2.9	0.1	2.7	2.9	2.9
19	16.0	0.0	0.1	2.5	0.0	0.0	0.1	2.5	0.0	0.0	2.5	0.1	0.1	2.5	2.7	0.0	2.5	0.1	0.1	2.5	2.7	0.0	2.5	2.9	0.1	2.7	2.5	2.9	0.1	2.7	2.9	2.9
20	16.0	0.0	0.1	2.5	0.0	0.0	0.1	2.5	0.0	0.0	2.5	0.1	0.1	2.5	2.7	0.0	2.5	0.1	0.1	2.5	2.7	0.0	2.5	2.9	0.1	2.7	2.5	2.9	0.1	2.7	2.9	2.9
21	16.0	0.0	0.1	2.5	0.0	0.0	0.1	2.5	0.0	0.0	2.5	0.1	0.1	2.5	2.7	0.0	2.5	0.1	0.1	2.5	2.7	0.0	2.5	2.9	0.1	2.7	2.5	2.9	0.1	2.7	2.9	2.9
22	8.0	0.0	0.0	1.2	0.0	0.0	0.0	1.2	0.0	0.0	1.3	0.0	0.1	1.2	1.3	0.0	1.3	0.0	0.1	1.2	1.3	0.0	1.3	1.5	0.1	1.3	1.3	1.5	0.1	1.3	1.5	1.5
23	8.0	0.0	0.0	1.2	0.0	0.0	0.0	1.2	0.0	0.0	1.3	0.0	0.1	1.2	1.3	0.0	1.3	0.0	0.1	1.2	1.3	0.0	1.3	1.5	0.1	1.3	1.3	1.5	0.1	1.3	1.5	1.5
24	8.0	0.0	0.0	1.2	0.0	0.0	0.0	1.2	0.0	0.0	1.3	0.0	0.1	1.2	1.3	0.0	1.3	0.0	0.1	1.2	1.3	0.0	1.3	1.5	0.1	1.3	1.3	1.5	0.1	1.3	1.5	1.5

18	NCO Club, B500			
	Demand (kW	per day	per hour	100 watt bulb equivelant
18	172,115	471.5	19.65	196

i	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
t	Baseline	W	VH	E	L	C	WL	WE	WH	WC	LE	LH	LC	EH	EC	HC	WLE	WLH	WLC	WEH	WEC	WHC	LEH	LEC	LHC	EHC	WLEH	WLEC	WLHC	WEHC	LEHC	WLEHC
1	9.8	0.1	0.4	0.0	0.0	1.9	0.6	0.1	0.1	2.0	0.4	0.4	2.5	0.0	2.1	1.9	0.6	0.6	2.7	0.1	2.2	2.0	0.4	2.7	2.5	2.1	0.6	2.8	2.7	2.2	2.7	2.8
2	9.8	0.1	0.4	0.0	0.0	1.9	0.6	0.1	0.1	2.0	0.4	0.4	2.5	0.0	2.1	1.9	0.6	0.6	2.7	0.1	2.2	2.0	0.4	2.7	2.5	2.1	0.6	2.8	2.7	2.2	2.7	2.8
3	9.8	0.1	0.4	0.0	0.0	1.9	0.6	0.1	0.1	2.0	0.4	0.4	2.5	0.0	2.1	1.9	0.6	0.6	2.7	0.1	2.2	2.0	0.4	2.7	2.5	2.1	0.6	2.8	2.7	2.2	2.7	2.8
4	9.8	0.1	0.4	0.0	0.0	1.9	0.6	0.1	0.1	2.0	0.4	0.4	2.5	0.0	2.1	1.9	0.6	0.6	2.7	0.1	2.2	2.0	0.4	2.7	2.5	2.1	0.6	2.8	2.7	2.2	2.7	2.8
5	9.8	0.1	0.4	0.0	0.0	1.9	0.6	0.1	0.1	2.0	0.4	0.4	2.5	0.0	2.1	1.9	0.6	0.6	2.7	0.1	2.2	2.0	0.4	2.7	2.5	2.1	0.6	2.8	2.7	2.2	2.7	2.8
6	19.6	0.3	0.9	0.0	0.0	3.8	1.2	0.3	0.3	4.0	0.9	0.9	5.1	0.0	4.1	3.8	1.2	1.2	5.4	0.3	4.5	4.0	0.9	5.3	5.1	4.1	1.2	5.6	5.4	4.5	5.3	5.6
7	19.6	0.3	0.9	0.0	0.0	3.8	1.2	0.3	0.3	4.0	0.9	0.9	5.1	0.0	4.1	3.8	1.2	1.2	5.4	0.3	4.5	4.0	0.9	5.3	5.1	4.1	1.2	5.6	5.4	4.5	5.3	5.6
8	19.6	0.3	0.9	0.0	0.0	3.8	1.2	0.3	0.3	4.0	0.9	0.9	5.1	0.0	4.1	3.8	1.2	1.2	5.4	0.3	4.5	4.0	0.9	5.3	5.1	4.1	1.2	5.6	5.4	4.5	5.3	5.6
9	19.6	0.3	0.9	0.0	0.0	3.8	1.2	0.3	0.3	4.0	0.9	0.9	5.1	0.0	4.1	3.8	1.2	1.2	5.4	0.3	4.5	4.0	0.9	5.3	5.1	4.1	1.2	5.6	5.4	4.5	5.3	5.6
10	29.5	0.4	1.3	0.0	0.0	5.6	1.7	0.4	0.4	6.1	1.3	1.3	7.6	0.0	6.2	5.6	1.7	1.7	8.1	0.4	6.7	6.1	1.3	8.0	7.6	6.2	1.7	8.5	8.1	6.7	8.0	8.5
11	29.5	0.4	1.3	0.0	0.0	5.6	1.7	0.4	0.4	6.1	1.3	1.3	7.6	0.0	6.2	5.6	1.7	1.7	8.1	0.4	6.7	6.1	1.3	8.0	7.6	6.2	1.7	8.5	8.1	6.7	8.0	8.5
12	29.5	0.4	1.3	0.0	0.0	5.6	1.7	0.4	0.4	6.1	1.3	1.3	7.6	0.0	6.2	5.6	1.7	1.7	8.1	0.4	6.7	6.1	1.3	8.0	7.6	6.2	1.7	8.5	8.1	6.7	8.0	8.5
13	29.5	0.4	1.3	0.0	0.0	5.6	1.7	0.4	0.4	6.1	1.3	1.3	7.6	0.0	6.2	5.6	1.7	1.7	8.1	0.4	6.7	6.1	1.3	8.0	7.6	6.2	1.7	8.5	8.1	6.7	8.0	8.5
14	29.5	0.4	1.3	0.0	0.0	5.6	1.7	0.4	0.4	6.1	1.3	1.3	7.6	0.0	6.2	5.6	1.7	1.7	8.1	0.4	6.7	6.1	1.3	8.0	7.6	6.2	1.7	8.5	8.1	6.7	8.0	8.5
15	29.5	0.4	1.3	0.0	0.0	5.6	1.7	0.4	0.4	6.1	1.3	1.3	7.6	0.0	6.2	5.6	1.7	1.7	8.1	0.4	6.7	6.1	1.3	8.0	7.6	6.2	1.7	8.5	8.1	6.7	8.0	8.5
16	29.5	0.4	1.3	0.0	0.0	5.6	1.7	0.4	0.4	6.1	1.3	1.3	7.6	0.0	6.2	5.6	1.7	1.7	8.1	0.4	6.7	6.1	1.3	8.0	7.6	6.2	1.7	8.5	8.1	6.7	8.0	8.5
17	29.5	0.4	1.3	0.0	0.0	5.6	1.7	0.4	0.4	6.1	1.3	1.3	7.6	0.0	6.2	5.6	1.7	1.7	8.1	0.4	6.7	6.1	1.3	8.0	7.6	6.2	1.7	8.5	8.1	6.7	8.0	8.5
18	19.6	0.3	0.9	0.0	0.0	3.8	1.2	0.3	0.3	4.0	0.9	0.9	5.1	0.0	4.1	3.8	1.2	1.2	5.4	0.3	4.5	4.0	0.9	5.3	5.1	4.1	1.2	5.6	5.4	4.5	5.3	5.6
19	19.6	0.3	0.9	0.0	0.0	3.8	1.2	0.3	0.3	4.0	0.9	0.9	5.1	0.0	4.1	3.8	1.2	1.2	5.4	0.3	4.5	4.0	0.9	5.3	5.1	4.1	1.2	5.6	5.4	4.5	5.3	5.6
20	19.6	0.3	0.9	0.0	0.0	3.8	1.2	0.3	0.3	4.0	0.9	0.9	5.1	0.0	4.1	3.8	1.2	1.2	5.4	0.3	4.5	4.0	0.9	5.3	5.1	4.1	1.2	5.6	5.4	4.5	5.3	5.6
21	19.6	0.3	0.9	0.0	0.0	3.8	1.2	0.3	0.3	4.0	0.9	0.9	5.1	0.0	4.1	3.8	1.2	1.2	5.4	0.3	4.5	4.0	0.9	5.3	5.1	4.1	1.2	5.6	5.4	4.5	5.3	5.6
22	9.8	0.1	0.4	0.0	0.0	1.9	0.6	0.1	0.1	2.0	0.4	0.4	2.5	0.0	2.1	1.9	0.6	0.6	2.7	0.1	2.2	2.0	0.4	2.7	2.5	2.1	0.6	2.8	2.7	2.2	2.7	2.8
23	9.8	0.1	0.4	0.0	0.0	1.9	0.6	0.1	0.1	2.0	0.4	0.4	2.5	0.0	2.1	1.9	0.6	0.6	2.7	0.1	2.2	2.0	0.4	2.7	2.5	2.1	0.6	2.8	2.7	2.2	2.7	2.8
24	9.8	0.1	0.4	0.0	0.0	1.9	0.6	0.1	0.1	2.0	0.4	0.4	2.5	0.0	2.1	1.9	0.6	0.6	2.7	0.1	2.2	2.0	0.4	2.7	2.5	2.1	0.6	2.8	2.7	2.2	2.7	2.8

19	B601 Police Station			
	Demand (k	per day	per hour	100 watt bulb equivelant
19	91,838	251.6	10.48	105

i	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
t	Baseline	W	H	E	N	C	WL	WE	WH	WC	LE	LH	LC	EH	EC	HC	WLE	WLH	WLC	WEH	WEC	WHC	LEH	LEC	LHC	EHC	WLEH	WLEC	WLHC	WEHC	LEHC	WLEHC
1	5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	10.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	10.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	10.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	10.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	15.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	15.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	15.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	15.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	15.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	15.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	15.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	15.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	10.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	10.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	10.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	10.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

20	Courts																															
	Demand (kW	per day	per hour	100 watt bulb equivelant																												
20	16,557	45.4	1.89	19																												
i	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
t	Baseline	W	M	E	VH	C	WL	WE	WH	WC	LE	LH	LC	EH	EC	HC	WLE	WLH	WLC	WEH	WEC	WHC	LEH	LEC	LHC	EHC	WLEH	WLEC	WLHC	WEHC	LEHC	WLEHC
1	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

21	Bldg 501 Rec center																															
	Demand (kWh)	per day	per hour	100 watt bulb equivelant																												
21	153,090	419.4	17.48	175																												
i	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
t	Baseline	W	L	E	H	C	WL	WE	WH	WC	LE	LH	LC	EH	EC	HC	WLE	WLH	WLC	WEH	WEC	WHC	LEH	LEC	LHC	EHC	WLEH	WLEC	WLHC	WEHC	LEHC	WLEHC
1	8.7	0.2	0.1	0.3	0.0	0.0	0.3	0.5	0.2	0.2	0.5	0.1	0.1	0.3	0.4	0.0	0.6	0.3	0.3	0.5	0.6	0.2	0.5	0.5	0.1	0.4	0.6	0.7	0.3	0.6	0.5	0.7
2	8.7	0.2	0.1	0.3	0.0	0.0	0.3	0.5	0.2	0.2	0.5	0.1	0.1	0.3	0.4	0.0	0.6	0.3	0.3	0.5	0.6	0.2	0.5	0.5	0.1	0.4	0.6	0.7	0.3	0.6	0.5	0.7
3	8.7	0.2	0.1	0.3	0.0	0.0	0.3	0.5	0.2	0.2	0.5	0.1	0.1	0.3	0.4	0.0	0.6	0.3	0.3	0.5	0.6	0.2	0.5	0.5	0.1	0.4	0.6	0.7	0.3	0.6	0.5	0.7
4	8.7	0.2	0.1	0.3	0.0	0.0	0.3	0.5	0.2	0.2	0.5	0.1	0.1	0.3	0.4	0.0	0.6	0.3	0.3	0.5	0.6	0.2	0.5	0.5	0.1	0.4	0.6	0.7	0.3	0.6	0.5	0.7
5	8.7	0.2	0.1	0.3	0.0	0.0	0.3	0.5	0.2	0.2	0.5	0.1	0.1	0.3	0.4	0.0	0.6	0.3	0.3	0.5	0.6	0.2	0.5	0.5	0.1	0.4	0.6	0.7	0.3	0.6	0.5	0.7
6	17.5	0.4	0.3	0.7	0.0	0.0	0.6	1.0	0.4	0.4	0.9	0.3	0.3	0.7	0.7	0.0	1.3	0.6	0.7	1.0	1.1	0.4	0.9	1.1	0.3	0.7	1.3	1.5	0.7	1.1	1.1	1.5
7	17.5	0.4	0.3	0.7	0.0	0.0	0.6	1.0	0.4	0.4	0.9	0.3	0.3	0.7	0.7	0.0	1.3	0.6	0.7	1.0	1.1	0.4	0.9	1.1	0.3	0.7	1.3	1.5	0.7	1.1	1.1	1.5
8	17.5	0.4	0.3	0.7	0.0	0.0	0.6	1.0	0.4	0.4	0.9	0.3	0.3	0.7	0.7	0.0	1.3	0.6	0.7	1.0	1.1	0.4	0.9	1.1	0.3	0.7	1.3	1.5	0.7	1.1	1.1	1.5
9	17.5	0.4	0.3	0.7	0.0	0.0	0.6	1.0	0.4	0.4	0.9	0.3	0.3	0.7	0.7	0.0	1.3	0.6	0.7	1.0	1.1	0.4	0.9	1.1	0.3	0.7	1.3	1.5	0.7	1.1	1.1	1.5
10	26.2	0.5	0.4	1.0	0.0	0.0	0.9	1.5	0.5	0.5	1.4	0.4	0.4	1.0	1.1	0.0	1.9	0.9	1.0	1.5	1.7	0.5	1.4	1.6	0.4	1.1	1.9	2.2	1.0	1.7	1.6	2.2
11	26.2	0.5	0.4	1.0	0.0	0.0	0.9	1.5	0.5	0.5	1.4	0.4	0.4	1.0	1.1	0.0	1.9	0.9	1.0	1.5	1.7	0.5	1.4	1.6	0.4	1.1	1.9	2.2	1.0	1.7	1.6	2.2
12	26.2	0.5	0.4	1.0	0.0	0.0	0.9	1.5	0.5	0.5	1.4	0.4	0.4	1.0	1.1	0.0	1.9	0.9	1.0	1.5	1.7	0.5	1.4	1.6	0.4	1.1	1.9	2.2	1.0	1.7	1.6	2.2
13	26.2	0.5	0.4	1.0	0.0	0.0	0.9	1.5	0.5	0.5	1.4	0.4	0.4	1.0	1.1	0.0	1.9	0.9	1.0	1.5	1.7	0.5	1.4	1.6	0.4	1.1	1.9	2.2	1.0	1.7	1.6	2.2
14	26.2	0.5	0.4	1.0	0.0	0.0	0.9	1.5	0.5	0.5	1.4	0.4	0.4	1.0	1.1	0.0	1.9	0.9	1.0	1.5	1.7	0.5	1.4	1.6	0.4	1.1	1.9	2.2	1.0	1.7	1.6	2.2
15	26.2	0.5	0.4	1.0	0.0	0.0	0.9	1.5	0.5	0.5	1.4	0.4	0.4	1.0	1.1	0.0	1.9	0.9	1.0	1.5	1.7	0.5	1.4	1.6	0.4	1.1	1.9	2.2	1.0	1.7	1.6	2.2
16	26.2	0.5	0.4	1.0	0.0	0.0	0.9	1.5	0.5	0.5	1.4	0.4	0.4	1.0	1.1	0.0	1.9	0.9	1.0	1.5	1.7	0.5	1.4	1.6	0.4	1.1	1.9	2.2	1.0	1.7	1.6	2.2
17	26.2	0.5	0.4	1.0	0.0	0.0	0.9	1.5	0.5	0.5	1.4	0.4	0.4	1.0	1.1	0.0	1.9	0.9	1.0	1.5	1.7	0.5	1.4	1.6	0.4	1.1	1.9	2.2	1.0	1.7	1.6	2.2
18	17.5	0.4	0.3	0.7	0.0	0.0	0.6	1.0	0.4	0.4	0.9	0.3	0.3	0.7	0.7	0.0	1.3	0.6	0.7	1.0	1.1	0.4	0.9	1.1	0.3	0.7	1.3	1.5	0.7	1.1	1.1	1.5
19	17.5	0.4	0.3	0.7	0.0	0.0	0.6	1.0	0.4	0.4	0.9	0.3	0.3	0.7	0.7	0.0	1.3	0.6	0.7	1.0	1.1	0.4	0.9	1.1	0.3	0.7	1.3	1.5	0.7	1.1	1.1	1.5
20	17.5	0.4	0.3	0.7	0.0	0.0	0.6	1.0	0.4	0.4	0.9	0.3	0.3	0.7	0.7	0.0	1.3	0.6	0.7	1.0	1.1	0.4	0.9	1.1	0.3	0.7	1.3	1.5	0.7	1.1	1.1	1.5
21	17.5	0.4	0.3	0.7	0.0	0.0	0.6	1.0	0.4	0.4	0.9	0.3	0.3	0.7	0.7	0.0	1.3	0.6	0.7	1.0	1.1	0.4	0.9	1.1	0.3	0.7	1.3	1.5	0.7	1.1	1.1	1.5
22	8.7	0.2	0.1	0.3	0.0	0.0	0.3	0.5	0.2	0.2	0.5	0.1	0.1	0.3	0.4	0.0	0.6	0.3	0.3	0.5	0.6	0.2	0.5	0.5	0.1	0.4	0.6	0.7	0.3	0.6	0.5	0.7
23	8.7	0.2	0.1	0.3	0.0	0.0	0.3	0.5	0.2	0.2	0.5	0.1	0.1	0.3	0.4	0.0	0.6	0.3	0.3	0.5	0.6	0.2	0.5	0.5	0.1	0.4	0.6	0.7	0.3	0.6	0.5	0.7
24	8.7	0.2	0.1	0.3	0.0	0.0	0.3	0.5	0.2	0.2	0.5	0.1	0.1	0.3	0.4	0.0	0.6	0.3	0.3	0.5	0.6	0.2	0.5	0.5	0.1	0.4	0.6	0.7	0.3	0.6	0.5	0.7

Appendix D. Hourly Water Heating Demand

This appendix shows the hourly water heating energy demand for each building in the Camp Smith demonstration.

Hour	Building 20, Admin	Old Hospital, Building 1	Old Hospital, Building 2C, Admin + basement fitness center	Old Hospital, Building 2D	Old Hospital, Building 3A, Floors 1&2 admin, Floor 3 renovation	Old Hospital, Building 3B, Admin + 1st floor clinic	Old Hospital, Building 4 Admin plus food service	Old Hospital, Building 5	Old Hospital, Building 80, Admin/Control Room/Computers	Old Hospital, Building 81 phones	Old Hospital, Buildings 1A, 1B, 2AA, 3AA	Bldg 700 PACOM Center, 701, 705	barracks complex (401-404)	Maintenance B600	UPS Building 602	Fire Station B612	Everything else	NCO Club, B500	B601 Police Station	Courts	Bldg 501 Rec center
1	0.51	0.49	0.66	0.32	0.26	1.05	1.67	1.28	0.64	0.06	0.28	19	17.4	0.2	0	0.11	0	3	0	0	0.28
2	0.77	0.74	1	0.48	0.39	1.57	2.51	1.93	0.96	0.1	0.42	28.5	26.1	0.3	0	0.16	0	4.5	0	0	0.42
3	0.77	0.74	1	0.48	0.39	1.57	2.51	1.93	0.96	0.1	0.42	28.5	26.1	0.3	0	0.16	0	4.5	0	0	0.42
4	0.77	0.74	1	0.48	0.39	1.57	2.51	1.93	0.96	0.1	0.42	28.5	26.1	0.3	0	0.16	0	4.5	0	0	0.42
5	0.51	0.49	0.66	0.32	0.26	1.05	1.67	1.28	0.64	0.06	0.28	19	17.4	0.2	0	0.11	0	3	0	0	0.28
6	0.51	0.49	0.66	0.32	0.26	1.05	1.67	1.28	0.64	0.06	0.28	19	17.4	0.2	0	0.11	0	3	0	0	0.28
7	0.51	0.49	0.66	0.32	0.26	1.05	1.67	1.28	0.64	0.06	0.28	19	17.4	0.2	0	0.11	0	3	0	0	0.28
8	0.51	0.49	0.66	0.32	0.26	1.05	1.67	1.28	0.64	0.06	0.28	19	17.4	0.2	0	0.11	0	3	0	0	0.28
9	0.51	0.49	0.66	0.32	0.26	1.05	1.67	1.28	0.64	0.06	0.28	19	17.4	0.2	0	0.11	0	3	0	0	0.28
10	0.51	0.49	0.66	0.32	0.26	1.05	1.67	1.28	0.64	0.06	0.28	19	17.4	0.2	0	0.11	0	3	0	0	0.28
11	0.51	0.49	0.66	0.32	0.26	1.05	1.67	1.28	0.64	0.06	0.28	19	17.4	0.2	0	0.11	0	3	0	0	0.28
12	0.51	0.49	0.66	0.32	0.26	1.05	1.67	1.28	0.64	0.06	0.28	19	17.4	0.2	0	0.11	0	3	0	0	0.28
13	0.51	0.49	0.66	0.32	0.26	1.05	1.67	1.28	0.64	0.06	0.28	19	17.4	0.2	0	0.11	0	3	0	0	0.28
14	0.51	0.49	0.66	0.32	0.26	1.05	1.67	1.28	0.64	0.06	0.28	19	17.4	0.2	0	0.11	0	3	0	0	0.28
15	0.77	0.74	1	0.48	0.39	1.57	2.51	1.93	0.96	0.1	0.42	28.5	26.1	0.3	0	0.16	0	4.5	0	0	0.42
16	0.77	0.74	1	0.48	0.39	1.57	2.51	1.93	0.96	0.1	0.42	28.5	26.1	0.3	0	0.16	0	4.5	0	0	0.42
17	0.77	0.74	1	0.48	0.39	1.57	2.51	1.93	0.96	0.1	0.42	28.5	26.1	0.3	0	0.16	0	4.5	0	0	0.42
18	0.51	0.49	0.66	0.32	0.26	1.05	1.67	1.28	0.64	0.06	0.28	19	17.4	0.2	0	0.11	0	3	0	0	0.28
19	0.26	0.25	0.33	0.16	0.13	0.52	0.84	0.64	0.32	0.03	0.14	9.51	8.72	0.1	0	0.05	0	1.5	0	0	0.14
20	0.26	0.25	0.33	0.16	0.13	0.52	0.84	0.64	0.32	0.03	0.14	9.51	8.72	0.1	0	0.05	0	1.5	0	0	0.14
21	0.26	0.25	0.33	0.16	0.13	0.52	0.84	0.64	0.32	0.03	0.14	9.51	8.72	0.1	0	0.05	0	1.5	0	0	0.14
22	0.26	0.25	0.33	0.16	0.13	0.52	0.84	0.64	0.32	0.03	0.14	9.51	8.72	0.1	0	0.05	0	1.5	0	0	0.14
23	0.26	0.25	0.33	0.16	0.13	0.52	0.84	0.64	0.32	0.03	0.14	9.51	8.72	0.1	0	0.05	0	1.5	0	0	0.14
24	0.26	0.25	0.33	0.16	0.13	0.52	0.84	0.64	0.32	0.03	0.14	9.51	8.72	0.1	0	0.05	0	1.5	0	0	0.14

Appendix E. Interaction Factors for EE Combinations and Energy Savings

This appendix lists the interaction factors used for EE combinations and the resulting EE energy savings for each building. Units are in MM BTUs.

	W	L	E	H	C	WL	WE	WH	WC	LE	LH	LC	EH	EC	HC	WLE
EE Combination Interaction Factor	-	-	-	-	-	1	1	1	1	1	1	1.1	1	1.1	1	1
Building 20, Admin	22	956			1,110	978	22	22	1,132	956	956	2,273	-	1,221	1,110	978
Old Hospital, Building 1	10	243	52			253	62	10	10	295	243	267	52	57	-	305
Old Hospital, Building 2C, Admin + basement fitness center	23	269				292	23	23	23	269	269	296	-	-	-	292
Old Hospital, Building 2D	6	199				205	6	6	6	199	199	219	-	-	-	205
Old Hospital, Building 3A, Floors 1&2 admin, Floor 3 renov.	5	182			126	187	5	5	131	182	182	339	-	139	126	187
Old Hospital, Building 3B, Admin + 1st floor clinic	39	177			20	216	39	39	59	177	177	217	-	22	20	216
Old Hospital, Building 4 Admin plus food service	60	205	255		106	265	315	60	166	460	205	342	255	397	106	520
Old Hospital, Building 5	56	99			135	155	56	56	191	99	99	257	-	149	135	155
Old Hospital, Building 80, Admin/Control Room/Computers	28	169			741	197	28	28	769	169	169	1,001	-	815	741	197
Old Hospital, Building 81 phones	1	31	4		24	32	5	1	25	35	31	61	4	31	24	36
Old Hospital, Buildings 1A, 1B, 2AA, 3AA	5	154				159	5	5	5	154	154	169	-	-	-	159
Bldg 700 PACOM Center, 701, 705	62	2,938	76			3,000	138	62	62	3,014	2,938	3,232	76	84	-	3,076
barracks complex (401-404)	718	5				723	718	718	718	5	5	6	-	-	-	723
Maintenance B600		48				48	-	-	-	48	48	53	-	-	-	48
UPS Building 602		-				-	-	-	-	-	-	-	-	-	-	-
Fire Station B612	-	1				1	-	-	-	1	1	1	-	-	-	1
Everything else		3	75			3	75	-	-	78	3	3	75	83	-	78
NCO Club, B500	9	26			114	35	9	9	123	26	26	154	-	125	114	35
B601 Police Station		-				-	-	-	-	-	-	-	-	-	-	-
Courts						-	-	-	-	-	-	-	-	-	-	-
Bldg 501 Rec center	11	8	20			19	31	11	11	28	8	9	20	22	-	39

	WLH	WLC	WEH	WEC	WHC	LEH	LEC	LHC	EHC	WLEH	WLEC	WLHC	WEHC	LEHC	WLEHC
EE Combination Interaction Factor	1	1.1	1	1.1	1	1	1.15	1.1	1.1	1	1.15	1.1	1.1	1.15	1.15
Building 20, Admin	978	2,297	22	1,245	1,132	956	2,376	2,273	1,221	978	2,401	2,297	1,245	2,376	2,401
Old Hospital, Building 1	253	278	62	68	10	295	339	267	57	305	351	278	68	339	351
Old Hospital, Building 2C, Admin + basement fitness center	292	321	23	25	23	269	309	296	-	292	336	321	25	309	336
Old Hospital, Building 2D	205	226	6	7	6	199	229	219	-	205	236	226	7	229	236
Old Hospital, Building 3A, Floors 1&2 admin, Floor 3 renov.	187	344	5	144	131	182	354	339	139	187	360	344	144	354	360
Old Hospital, Building 3B, Admin + 1st floor clinic	216	260	39	65	59	177	227	217	22	216	271	260	65	227	271
Old Hospital, Building 4 Admin plus food service	265	408	315	463	166	460	651	342	397	520	720	408	463	651	720
Old Hospital, Building 5	155	319	56	210	191	99	269	257	149	155	334	319	210	269	334
Old Hospital, Building 80, Admin/Control Room/Computers	197	1,032	28	846	769	169	1,047	1,001	815	197	1,079	1,032	846	1,047	1,079
Old Hospital, Building 81 phones	32	62	5	32	25	35	68	61	31	36	69	62	32	68	69
Old Hospital, Buildings 1A, 1B, 2AA, 3AA	159	175	5	6	5	154	177	169	-	159	183	175	6	177	183
Bldg 700 PACOM Center, 701, 705	3,000	3,300	138	152	62	3,014	3,466	3,232	84	3,076	3,537	3,300	152	3,466	3,537
barracks complex (401-404)	723	795	718	790	718	5	6	6	-	723	831	795	790	6	831
Maintenance B600	48	53	-	-	-	48	55	53	-	48	55	53	-	55	55
UPS Building 602	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fire Station B612	1	1	-	-	-	1	1	1	-	1	1	1	-	1	1
Everything else	3	3	75	83	-	78	90	3	83	78	90	3	83	90	90
NCO Club, B500	35	164	9	135	123	26	161	154	125	35	171	164	135	161	171
B601 Police Station	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Courts	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bldg 501 Rec center	19	21	31	34	11	28	32	9	22	39	45	21	34	32	45

Appendix F. Acquisitions Costs for Various EE Combinations

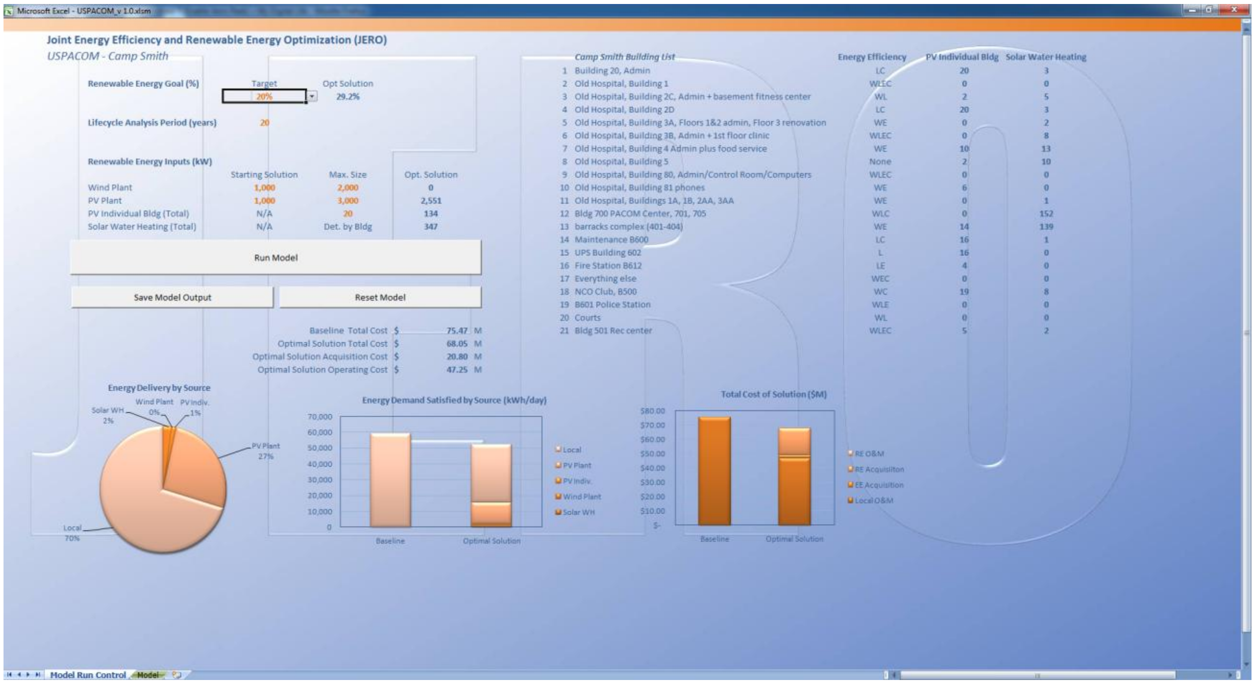
This appendix provides the acquisition costs for each potential EE combination for each building considered in the Camp Smith demonstration.

Bldg Name	W	L	E	H	C	WL	WE	WH	WC	LE	LH	LC	EH	EC	HC	WLE
Building 20, Admin	$3,984	$178,927			$172,468	$182,911	$3,984	$3,984	$176,452	$178,927	$178,927	$351,395	$ -	$172,468	$172,468	$182,911
Old Hospital, Building 1	$673	$107,216	$30,431			$107,889	$31,104	$673	$673	$137,647	$107,216	$107,216	$30,431	$30,431	$ -	$138,320
Old Hospital, Building 2C, Admin + basement fitness center	$3,834	$90,217				$94,051	$3,834	$3,834	$3,834	$90,217	$90,217	$90,217	$ -	$ -	$ -	$94,051
Old Hospital, Building 2D	$407	$52,163				$52,570	$407	$407	$407	$52,163	$52,163	$52,163	$ -	$ -	$ -	$52,570
Old Hospital, Building 3A, Floors 1&2 admin, Floor 3 renovation	$400	$74,025			$49,818	$74,425	$400	$400	$50,218	$74,025	$74,025	$123,843	$ -	$49,818	$49,818	$74,425
Old Hospital, Building 3B, Admin + 1st floor clinic	$3,708	$61,191			$19,100	$64,899	$3,708	$3,708	$22,808	$61,191	$61,191	$80,291	$ -	$19,100	$19,100	$64,899
Old Hospital, Building 4 Admin plus food service	$17,816	$87,105	$144,699		$45,734	$104,921	$162,515	$17,816	$63,550	$231,804	$87,105	$132,839	$144,699	$190,433	$45,734	$249,620
Old Hospital, Building 5	$12,909	$48,695			$51,053	$61,604	$12,909	$12,909	$63,962	$48,695	$48,695	$99,748	$ -	$51,053	$51,053	$61,604
Old Hospital, Building 80, Admin/Control Room/Computers	$12,881	$49,788			$166,817	$62,669	$12,881	$12,881	$179,698	$49,788	$49,788	$216,605	$ -	$166,817	$166,817	$62,669
Old Hospital, Building 81 phones	$126	$7,052	$2,002		$21,912	$7,178	$2,128	$126	$22,038	$9,054	$7,052	$28,964	$2,002	$23,914	$21,912	$9,180
Old Hospital, Buildings 1A, 1B, 2AA, 3AA	$562	$72,139				$72,701	$562	$562	$562	$72,139	$72,139	$72,139	$ -	$ -	$ -	$72,701
Bldg 700 PACOM Center, 701, 705	$980	$511,713	$62,344			$512,693	$63,324	$980	$980	$574,057	$511,713	$511,713	$62,344	$62,344	$ -	$575,037
barracks complex (401-404)	$254,728	$5,591				$260,319	$254,728	$254,728	$254,728	$5,591	$5,591	$5,591	$ -	$ -	$ -	$260,319
Maintenance B600		$26,167				$26,167	$ -	$ -	$ -	$26,167	$26,167	$26,167	$ -	$ -	$ -	$26,167
UPS Building 602		$621				$621	$ -	$ -	$ -	$621	$621	$621	$ -	$ -	$ -	$621
Fire Station B612	$112	$621				$733	$112	$112	$112	$621	$621	$621	$ -	$ -	$ -	$733
Everything else		$3,106	$59,364			$3,106	$59,364	$ -	$ -	$62,470	$3,106	$3,106	$59,364	$59,364	$ -	$62,470
NCO Club, B500	$123	$2,626			$46,306	$2,749	$123	$123	$46,429	$2,626	$2,626	$48,932	$ -	$46,306	$46,306	$2,749
B601 Police Station		$621				$621	$ -	$ -	$ -	$621	$621	$621	$ -	$ -	$ -	$621
Courts						$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Bldg 501 Rec center	$2,013	$2,015	$18,710			$4,028	$20,723	$2,013	$2,013	$20,725	$2,015	$2,015	$18,710	$18,710	$ -	$22,738

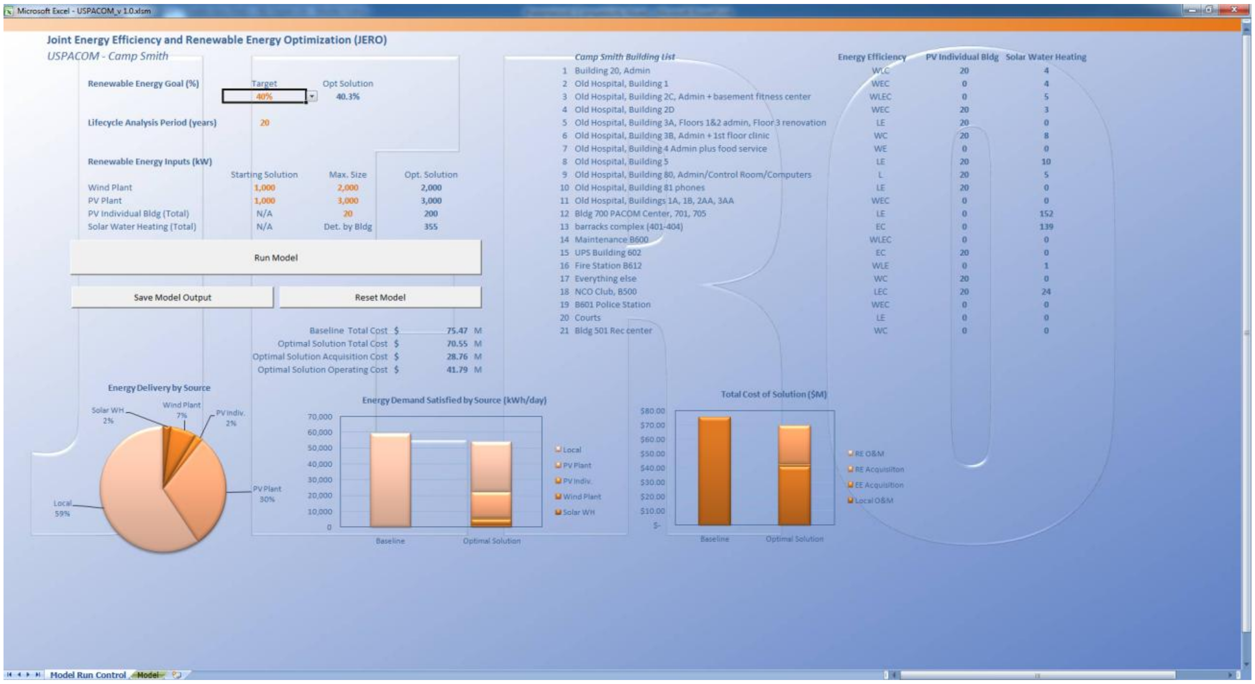
Bldg Name	WLH	WLC	WEH	WEC	WHC	LEH	LEC	LHC	EHC	WLEH	WLEC	WLHC	WEHC	LEHC	WLEHC
Building 20, Admin	$182,911	$355,379	$3,984	$176,452	$176,452	$178,927	$351,395	$351,395	$172,468	$182,911	$355,379	$355,379	$176,452	$351,395	$355,379
Old Hospital, Building 1	$107,889	$107,889	$31,104	$31,104	$673	$137,647	$137,647	$107,216	$30,431	$138,320	$138,320	$107,889	$31,104	$137,647	$138,320
Old Hospital, Building 2C, Admin + basement fitness center	$94,051	$94,051	$3,834	$3,834	$3,834	$90,217	$90,217	$90,217	$ -	$94,051	$94,051	$94,051	$3,834	$90,217	$94,051
Old Hospital, Building 2D	$52,570	$52,570	$407	$407	$407	$52,163	$52,163	$52,163	$ -	$52,570	$52,570	$52,570	$407	$52,163	$52,570
Old Hospital, Building 3A, Floors 1&2 admin, Floor 3 renovation	$74,425	$124,243	$400	$50,218	$50,218	$74,025	$123,843	$123,843	$49,818	$74,425	$124,243	$124,243	$50,218	$123,843	$124,243
Old Hospital, Building 3B, Admin + 1st floor clinic	$64,899	$83,999	$3,708	$22,808	$22,808	$61,191	$80,291	$80,291	$19,100	$64,899	$83,999	$83,999	$22,808	$80,291	$83,999
Old Hospital, Building 4 Admin plus food service	$104,921	$150,655	$162,515	$208,249	$63,550	$231,804	$277,538	$132,839	$190,433	$249,620	$295,354	$150,655	$208,249	$277,538	$295,354
Old Hospital, Building 5	$61,604	$112,657	$12,909	$63,962	$63,962	$48,695	$99,748	$99,748	$51,053	$61,604	$112,657	$112,657	$63,962	$99,748	$112,657
Old Hospital, Building 80, Admin/Control Room/Computers	$62,669	$229,486	$12,881	$179,698	$179,698	$49,788	$216,605	$216,605	$166,817	$62,669	$229,486	$229,486	$179,698	$216,605	$229,486
Old Hospital, Building 81 phones	$7,178	$29,090	$2,128	$24,040	$22,038	$9,054	$30,966	$28,964	$23,914	$9,180	$31,092	$29,090	$24,040	$30,966	$31,092
Old Hospital, Buildings 1A, 1B, 2AA, 3AA	$72,701	$72,701	$562	$562	$562	$72,139	$72,139	$72,139	$ -	$72,701	$72,701	$72,701	$562	$72,139	$72,701
Bldg 700 PACOM Center, 701, 705	$512,693	$512,693	$63,324	$63,324	$980	$574,057	$574,057	$511,713	$62,344	$575,037	$575,037	$512,693	$63,324	$574,057	$575,037
barracks complex (401-404)	$260,319	$260,319	$254,728	$254,728	$254,728	$5,591	$5,591	$5,591	$ -	$260,319	$260,319	$260,319	$254,728	$5,591	$260,319
Maintenance B600	$26,167	$26,167	$ -	$ -	$ -	$26,167	$26,167	$26,167	$ -	$26,167	$26,167	$26,167	$ -	$26,167	$26,167
UPS Building 602	$621	$621	$ -	$ -	$ -	$621	$621	$621	$ -	$621	$621	$621	$ -	$621	$621
Fire Station B612	$733	$733	$112	$112	$112	$621	$621	$621	$ -	$733	$733	$733	$112	$621	$733
Everything else	$3,106	$3,106	$59,364	$59,364	$ -	$62,470	$62,470	$3,106	$59,364	$62,470	$62,470	$3,106	$59,364	$62,470	$62,470
NCO Club, B500	$2,749	$49,055	$123	$46,429	$46,429	$2,626	$48,932	$48,932	$46,306	$2,749	$49,055	$49,055	$46,429	$48,932	$49,055
B601 Police Station	$621	$621	$ -	$ -	$ -	$621	$621	$621	$ -	$621	$621	$621	$ -	$621	$621
Courts	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Bldg 501 Rec center	$4,028	$4,028	$20,723	$20,723	$2,013	$20,725	$20,725	$2,015	$18,710	$22,738	$22,738	$4,028	$20,723	$20,725	$22,738

Appendix G. DOE Summary

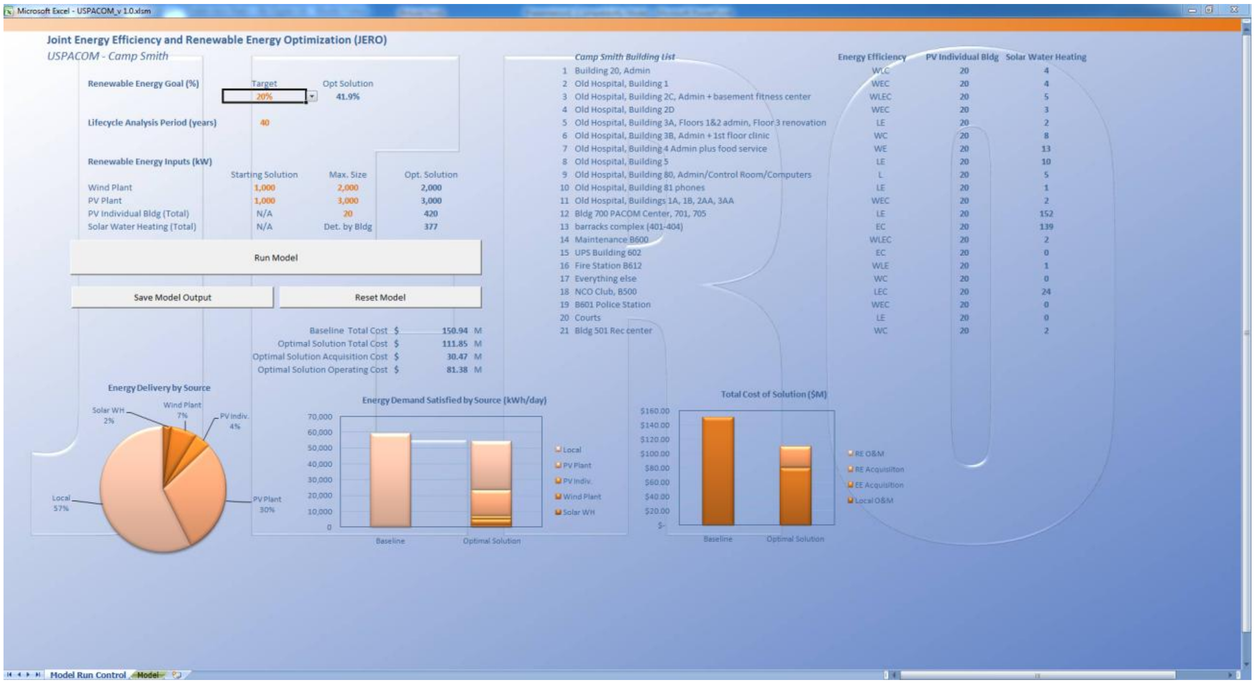
This appendix contains JERO screen shots for the DOE results provided in Section 5, Table 5.1.



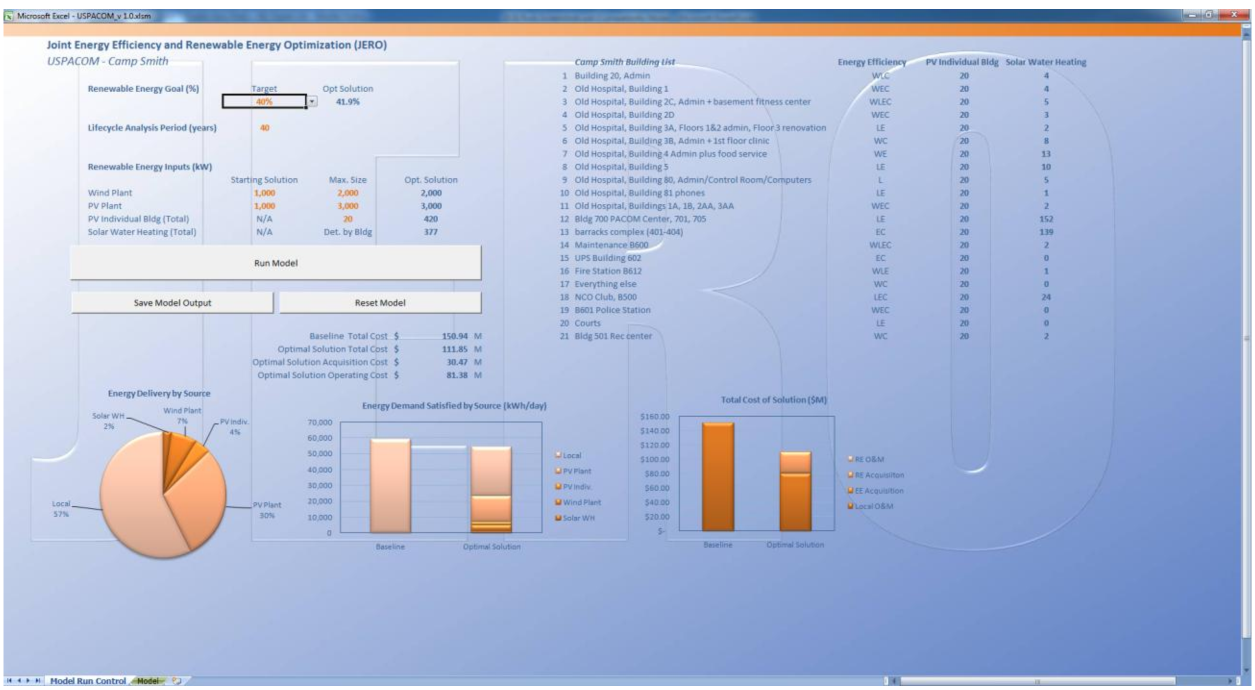
Design Point 1



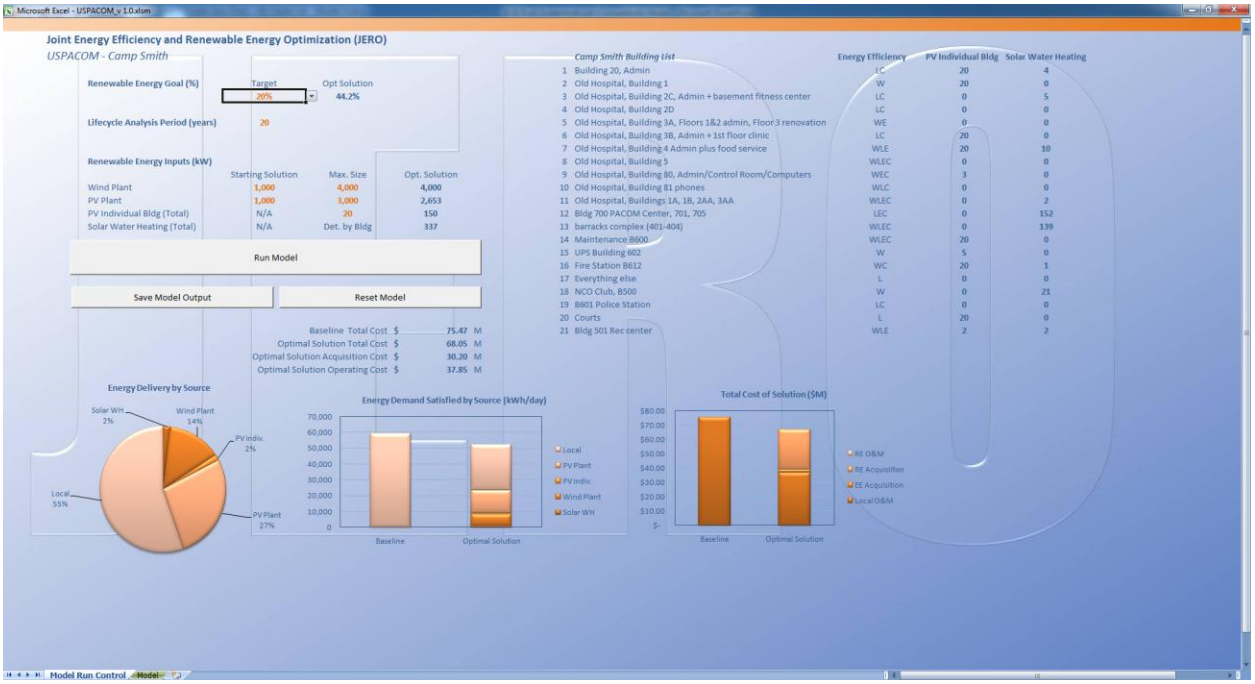
Design Point 2



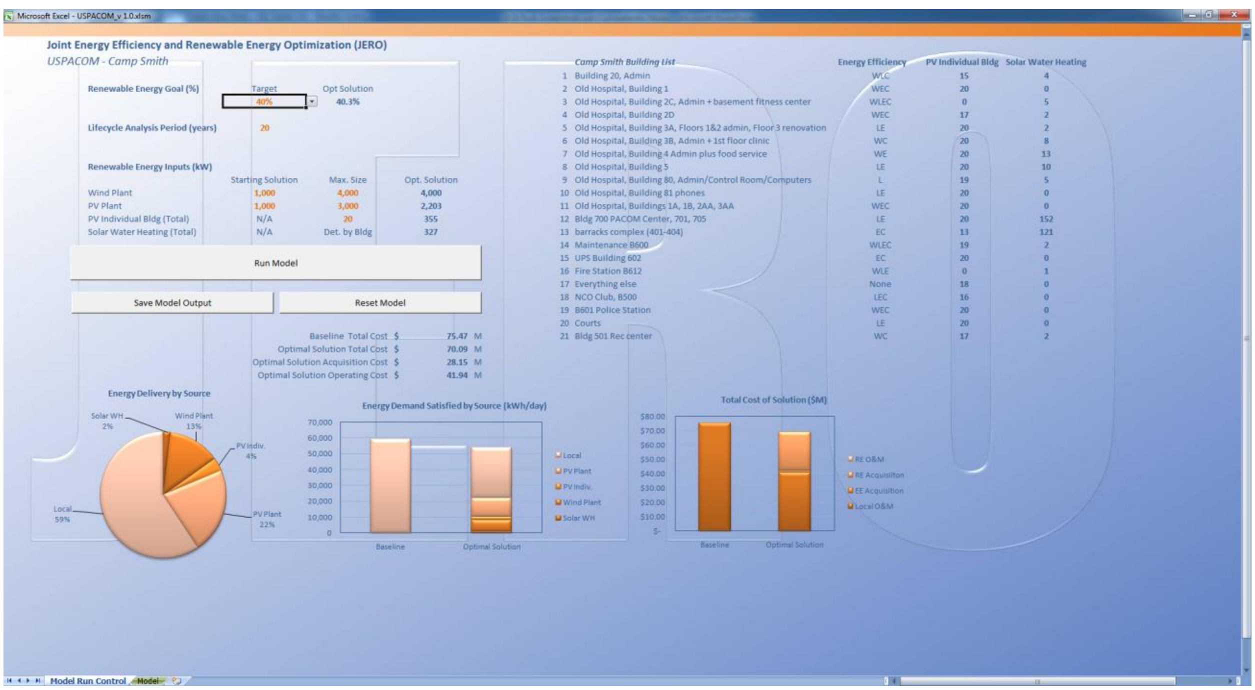
Design Point 3



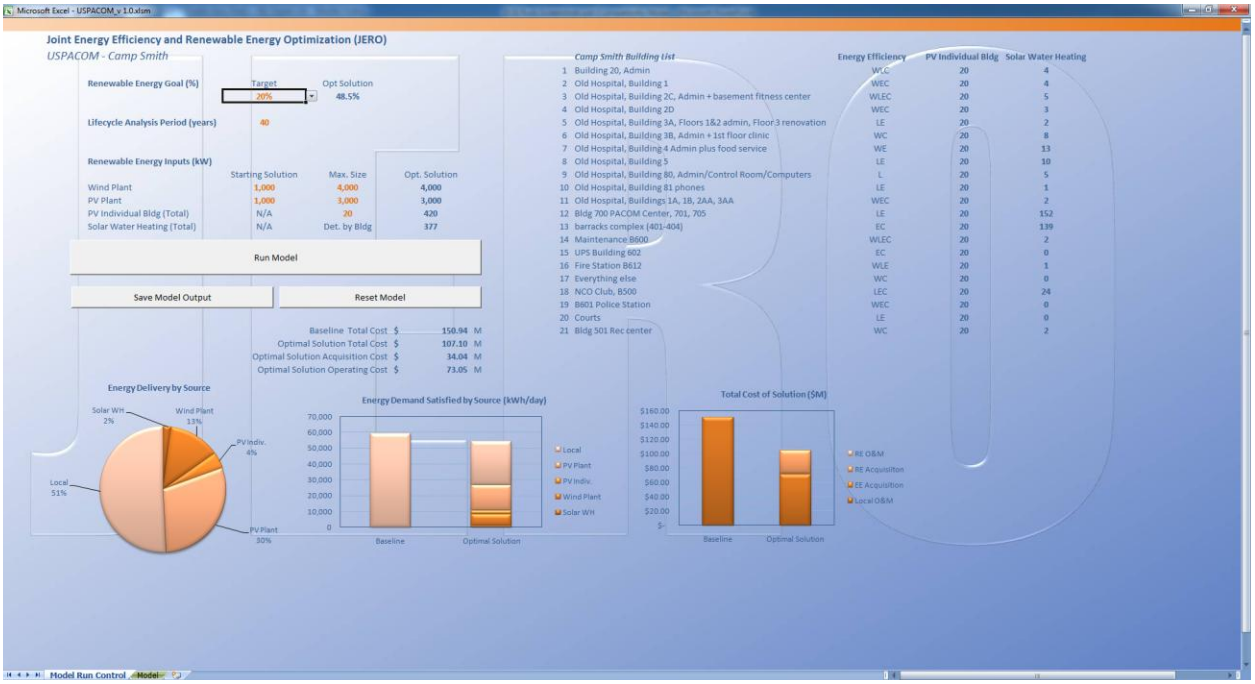
Design Point 4



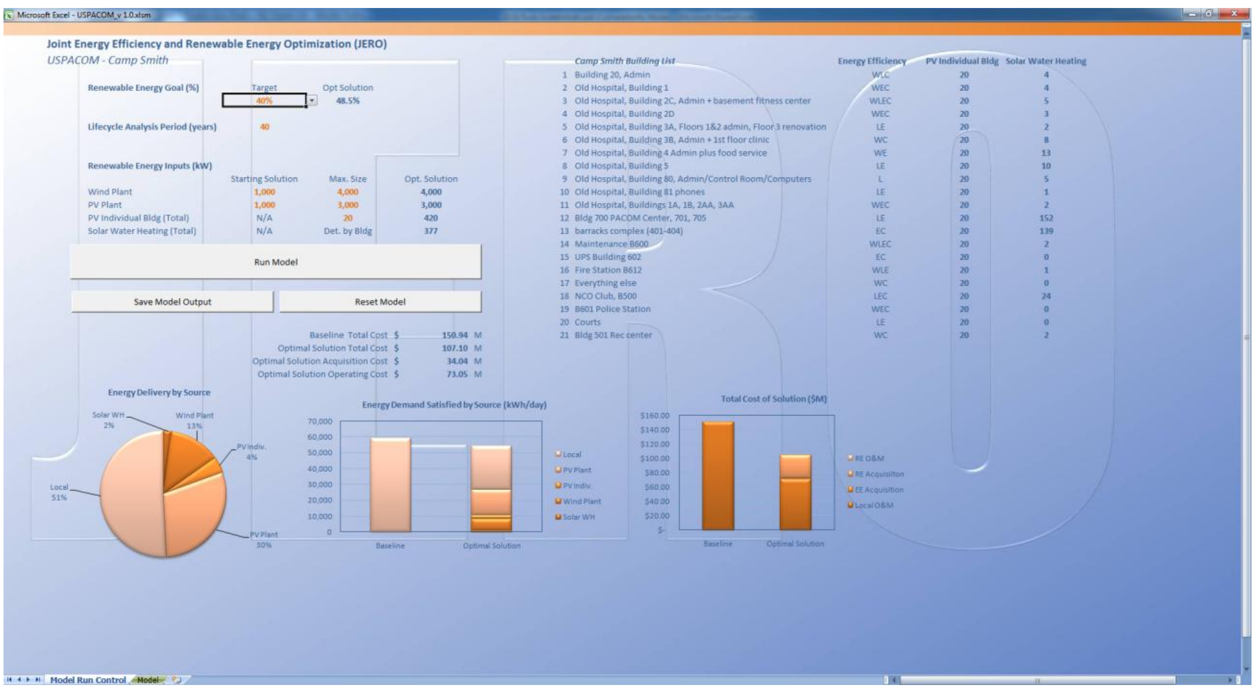
Design Point 5



Design Point 6



Design Point 7



Design Point 8

Appendix H. Energy Conversion Factors

Energy Conversions						
	British Thermal Unit	**Foot-pounds**	**Joules**	**calories**	**Kilo-calories**	**Kilowatt-hours**
1 British Thermal Unit	1	777.9	1055	252.0	0.252	2.93×10^{-4}
1 Foot-pound	0.001285	1	1.356	0.3238	3.238×10^{-4}	3.766×10^{-7}
1 joule	9.481×10^{-4}	0.7376	1	0.2388	2.388×10^{-4}	2.778×10^{-7}
1 calorie	0.003969	3.088	4.187	1	0.001	1.163×10^{-6}
1 kilocalorie	3.969	3088	4187	1000	1	0.001163
1 kilowatt hour	3413	2.655×10^{6}	3.6×10^{6}	8.598×10^{5}	859.8	1

Table adapted from "ELEMENTS OF PHYSICS 5/E. by SHORTLEY/WILLIAMS, 1971. Adapted by permission of Prentice-Hall, Inc., Upper Saddle River, N.J.

Appendix I. Summary of Renewable Energy Goals

Origin	Type	Goal/Requirement/Preference	Notes
Army Energy Campaign Plan	consumption	Reduce energy consumption 5% per year for the next 4 years	
Energy Policy Act (EPAct) of 2005		2% per year for FY 2006 through FY 2015	
Energy Policy Act (EPAct) of 2006		20% reduction by FY 2015 using FY 2003 as baseline	
Executive Order 13423 & PEPSC		energy reduction goal to 3% per year or 30% reduction by FY 2015	
Executive Order 13123 Sec. 201	emissions	Reduce GHG emissions from federal facilities 30% by 2010	
Presidential 2009 Energy Plan		Reduce our greenhouse gas emissions 80% by 2050	
Army Energy Campaign Plan	production	3% on-site renewable by 2010	Already past and HCEI more stringent
Army Energy Campaign Plan		40% on-site renewable by 2030	HCEI more stringent
Army Energy Campaign Plan		50% renewable electricity by 2030	HCEI more stringent
Energy Policy Act (EPAct) of 2005		Use 3% renewable energy by FY07	Already past
Energy Policy Act (EPAct) of 2005		Use 5% renewable energy by FY10	Already past
Energy Policy Act (EPAct) of 2005		Use 7.5% renewable energy by FY13	Presidential Goals more stringent
Energy Policy Act (EPAct) of 2005		Use 25% renewable energy by FY25	HCEI more stringent
Hawaii Clean Energy Initiative		requirement: 10% renewables by 2010	Already past
Hawaii Clean Energy Initiative		requirement: 15% renewables by 2015	
Hawaii Clean Energy Initiative		requirement: 25% renewables by 2020	
Hawaii Clean Energy Initiative		requirement: 40% renewables by 2040	
Hawaii Clean Energy Initiative		goal: 70% renewable energy by 2030	
Hawaii Clean Energy Initiative		No more than 30% of renewables may be imported bio fuels in utility-owned units through 2015	
Hawaii Clean Energy Initiative		700 MW of new renewables by 2014	
Hawaii Clean Energy Initiative		1100 MW of new renewables by 2030	
Hawaii Clean Energy Initiative		No new fossil fuel plants without retiring equal size plants	
Presidential Goals		10% renewable electricity by 2012	
Presidential Goals		25% renewable electricity by 2025	HCEI more stringent