Baseline Period Measurement and Verification Plan

EPC-17-008

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Prepared for

WALMART, 1275 N AZUSA AVE, COVINA, CA 91722

Prepared by

Center for Sustainable Energy

Center for Sustainable Energy®

Del Real, J. (2018), Baseline Measurement and Verification Plan, Center for Sustainable Energy.

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I. Facility and Project Overview

This plan is part of the Measurement and Verification (M&V) activities related to an Electric Program Investment Charge (EPIC) project to demonstrate emerging energy efficient technologies and strategies to reduce gross electric energy consumption by at least 20% at big box retail/grocery stores. The goal of this baseline M&V will be to define the baseline energy and water performance of the site including which building and system components will be monitored, the monitoring interval and period, the equipment necessary to obtain the required data, and other details related to equipment installation planning (if necessary). This plan will heavily leverage the information found in the Site Characterization Report. The specific site is a Walmart Supercenter located in Covina, CA, within Southern California Edison's (SCE) service territory. Walmart Supercenters offer a one-stop shopping experience by combining a grocery store with fresh produce, bakery, deli and dairy products with electronics, apparel, toys and home furnishings. Most Supercenters are open 24 hours, and may also include specialty shops such as banks, hair and nail salons, restaurants, or vision centers.

Table 1: Summary of Facility Characteristics

Building Characteristics	
Building Age/Year Constructed	20+ years old
Building Footprint	134,733 sqft
Electric End-Uses	Lighting Ventilation Air Conditioning Compressors (Air) Refrigeration Other
Type of End-Use Equipment	Package Gas Heat Roof Top Units (RTU) Low and Mid-Temp Refrigeration Compressors Condenser Fan Racks T8 Linear Fluorescents Exhaust Fans
Energy Consumption Prior to Baseline Period	3,458,799 kWh
Energy Intensity Prior to Baseline Period	87.9 kBtu/sqft (electric only)

II. Energy Efficiency Measures

The following section presents the energy efficiency and conservation measures currently proposed to be implemented as part of this project. At this time savings estimates have not been established, but will be as part of the baseline period analysis.

Table 2: Measure Identification and Descriptions

	Measure (End-Use Area)	Description
1	Bosch DC High-Bay Lights (Interior Lighting)	This technology uses a DC driver to power each LED luminaire. If installed as part of a DC microgrid, this arrangement allows for a more efficient use of on-site renewable energy (RE), as traditional DC/AC losses can be avoided. However, due to efficiency gains over AC LED drivers, Bosch's system delivers improved efficiency even when no RE system is present.
2	Integrated Comfort DualCool (HVAC)	Using a combination of direct-evaporative cooling to treat RTU condenser inlet air, and IDEC to treat incoming outdoor air (OA), Integrated Comfort's DualCool system is able to reduce RTU compressor electricity use by approximately 20%.
3	Software Motor Corporation High Rotor Pole Switched Reluctance Motors (HVAC, Refrigeration)	SMC's HRPSRM technology uses a patented design to achieve up to 91% peak motor efficiency, and similarly high levels of performance over a wide range of operating speeds.
4	SmartGreen OptiNergy (Lighting, HVAC, Refrigeration, Water)	The OptiNergy platform by SmartGreen provides whole-building optimization, AFDD, and DR capabilities across all building end-uses.
5	Water Management System (Water)	Provide continuous commissioning and process optimization to reduced domestic water consumption and assess and optimize the amount of water used and ensure reliable operation of the evaporative cooling components.
6	Retrofit constant-speed RTU supply fans with variable speed (HVAC)	Retrofit constant-speed RTU supply fans with SMC's variable speed HRPSR motors, and upgrading the unit's sensor package and controller.

III. IPMVP Option and Measurement Boundary

The project team will be utilizing International Performance Measurement and Verification Protocol (IPMVP) to verify the baseline energy usage and, eventually, the savings of the intended measures identified. The following measurement options were chosen because of the planned measures to be implemented and to appropriately meet the requirements of the grant.

Option C: Whole Facility

The project plans to install an energy management and control system which should be able to collect data on an end-use basis during the reporting period. However, during the baseline period this data may not be available. The goals of the project is to demonstrate a 20% reduction in whole facility electricity consumption from the combination of measures. Therefore, the whole facility option was most appropriate. Meters provided by the utility currently monitor the bi-directional energy flow of the

building and the solar PV inverters are recording gross generation output, which allows for the computation of energy use of the whole facility. The whole facility electricity use will be weather normalized using data collected from the building controls system at the facility and national weather data sources from the nearest station if necessary.

Option D: Calibrated Simulation

This option will utilize the Department of Energy's most recent version of OpenStudio energy modeling platform as the software for the simulation. This model will be built off existing equipment and operating conditions collected from a site visit and detailed in the Site Characterization Report. The facility also has a building control system, which will be running trends on several data points associated with the HVAC, refrigeration and lighting end-use equipment. These points will also inform the energy model to more accurately simulate actual operations. Using whole facility electricity data from the baseline period, the model will be calibrated according to industry standards such as ASHRAE's Guideline 14. Ideally this option will determine the savings contributions from individual measures and determine any potential interactive effects to energy reductions.

IV. Baseline Information

The goals of the project are focused on electricity reductions and identifying any potential water impacts, so no energy efficiency measures which would directly reduce natural gas savings were identified. Therefore, data regarding natural gas consumption has been omitted from this plan.

Baseline Period and Utility Use

The baseline data collection period will be from April 1, 2018 through April 30, 2019. Data may exist previous to these dates and may be used to confirm any relationships which affect utility consumption over the baseline period. The following tables will contain the baseline gross electricity and water consumption after the collection period. Since this site has a solar photovoltaic (PV) system, net consumption from SCE, net electricity exported to SCE and PV generation will be used to determine the gross consumption of the site. This methodology is identified in a subsequent section.

Table 3: Facility Baseline Gross Electricity Usage

Billing Period or Month	Consumption (kWh)	Maximum Demand (kW)
January		
February		
March		
April		
May		
June		
July		
August		

September		
October		
November		
December		

Table 4: Facility Baseline Gross Water Usage

Billing Period or Month	Consumption (kGal)
January	
February	
March	
April	
May	
June	
July	
August	
September	
October	
November	
December	

Influencing Variables

Over the same baseline period, data on those variables which would affect electricity consumption will also be collected. This data will be collected through the facilities building controls system. Trends have been set up to record and archive interval data for various points associated with the lighting, HVAC and refrigeration equipment. **At a minimum, outside dry bulb air temperature and relative humidity will be used to determine the periodic adjustment of the baseline whole-facility electricity consumption during the reporting period.** That is, electricity consumption will be weather normalized.

Operating Conditions and Static Factors

Detailed operational information is found in the Site Characterization report, "Description of Existing Building Systems" section. In general, the store is open seven days per week from 6am to 12am. Stocking takes place during the closed hours, so lighting and mechanical equipment essentially run continuously 24 hours. Static factors include equipment and operating modes that will be considered fixed during the baseline and reporting periods. Thus, no adjustment calculation is anticipated in the M&V plan for these factors. However, if a change occurs in the data and parameters, the baseline must be adjusted (permanently or temporarily). The list below identifies a series of static factors which will be monitored for this project.

Table 5: List of Static Factors

Static Factor	Data Source
Building or area utilization	Floor drawings
Building occupancy rate/Visitor Count	Client records
Building floor area	Floor drawings
Count and capacity of mechanical equipment (HVAC and refrigeration)	Collected during site walk-through, equipment inventories, mechanical and electrical drawings
Building standards or legislation governing ambient conditions	Client's conditions or specification documents
Building utilization schedule	Published hours of operation
Hours of operation of HVAC systems	Client records, building controls system trend data
Lighting hours of operations	Client records, building controls system trend data
Outdoor air supply rate	Mechanical drawings, building controls system trend data
Temperature setpoints	Visual inspection, Client Records, building controls system trend data
Equipment Issues (e.g. failures, repairs, etc.)	Client records
Number of Employee Shifts/Schedules	Client records

V. Reporting Period

The demonstration project will be evaluating and quantifying the post-installation performance of the identified measures from early 2019 into late 2020, but must have all results finalized and reported by the end of September 2020. The reporting period starts on the date of substantial completion of implemented measures. Therefore**, the intended reporting period will be from October 1, 2019 to September 30, 2020**. Should this timeline be compressed, the Post-Installation M&V plan will reflect any necessary explanations on how the shortened reporting period will be normalized to the baseline period, so energy consumption and demand are compared evenly and reliably.

VI. Basis for Adjustments

The following section presents the generic methods for potential baseline adjustments to allow for valid comparisons and savings calculations of energy consumption and demand during the reporting period. A more detailed outline of adjustments should be provided in the Post-Installation M&V Plan. In the avoided energy use equation, the calculation of "baseline energy" and "routine adjustments" will be performed simultaneously through the baseline mathematical model. The same applies to the avoided demand calculation.

Table 6: Generic Adjustment Methodology

Retained Option	Equation
Avoided energy use (or energy savings)	Baseline energy (±) Routine adjustments to reporting period conditions (±) Non-routine adjustments to reporting period conditions (-) Reporting period energy
Avoided demand	Baseline demand (±) Routine adjustments to reporting period conditions (±) Non-routine adjustments to reporting period conditions (-) Reporting period demand

Routine Adjustments

For each energy source, mathematical models allow baseline adjustments according to relevant independent variables. This section will present appropriate mathematical models for electricity and natural gas after the data collection period.

Non-Routine Adjustments

Baseline adjustment in case of equipment addition/removal/shutdown or change in operation

In the event that the facility adds/removes/shuts down equipment or changes its operations, data will be collected from drawings and specifications, equipment specifications, manufacturer and contractor information and/or short-term measurement campaigns. The procedure will be based on the impact of such changes on static factors. The new devices' operating hours may be estimated, at the client's convenience, based on the type of use. Adjustments will be defined either as temporary (applicable to a portion of the reporting period) or permanent (remains in effect for the rest of the reporting period).

VII. Calculation Methodology and Analysis Procedure

This section will be completed after baseline data has been collected, and be documented in the Post-Installation M&V Plan.

VIII. Energy Prices

Cost savings are determined by applying the appropriate price schedule in the following generic equation:

Cost savings = Cb – Cr

Where,

Cb = Cost of baseline energy plus any routine or non-routine adjustments;

Cr = Cost of reporting period energy plus any routine or non-routine adjustments.

Cost savings should be determined by applying the same price schedule when computing both Cb and Cr. Electricity consumption costs used for savings calculation (baseline or reporting period) are based on utility billing information during the reporting period. In case of a significant energy rate increase, no ceiling price has been established.

IX. Meter Information

Whole Facility metering will be done through the SCE electric utility meter. Details and specifications will be forthcoming and documented in the Post-Installation M&V Plan.

X. Monitoring Responsibilities

The following identifies the assigned parties responsible for the collection, analyzing, archiving, and/or reporting of data during the baseline period.

Table 7: Data Monitoring and Collection Responsibilities

Organization	Representative	Data Type	Data Description	Frequency
CSE	Chris Vogel	Energy Data	Electricity demand and consumption	Monthly
CSE	Chris Vogel	Independent Variables	Interval Outside air temperature and/or humidity	Monthly
CSE	Chris Vogel	Independent Variables	Interval building controls data points	Monthly
CSE	Chris Vogel	Independent Variables	Heating/Cooling degree-days, data collected from National Climatic Data Center	Monthly
Wal Mart	Yogesh Mardikar	Static Factors	Changes to occupancy schedules or number of shifts	Within 5 days of change
Wal Mart	Yogesh Mardikar	Static Factors	Equipment addition/removal/shutdown in the building	Within 5 days of change
Wal Mart	Yogesh Mardikar	Static Factors	Changes to building footprint	Within 5 days of change

XI. Expected Accuracy

A minimum acceptable level of accuracy has not been determined for this project yet. Expected accuracy will be determined in the Post-Installation M&V Plan, and include expected accuracy associated with any measurements, data capture, sampling, and data analysis.

XII. Budget and Reporting

From the grant project tasks, M&V activities are in Task 2: Site Characterization and Task 5: Assessment and Characterization. The approximate budget related to the M&V data collection and reporting is about $50,000. M&V reports will be produced quarterly and be in a format which is guided by the IPMVP.

XIII. Quality Assurance

To ensure integrity of data collected during the baseline period, a CSE representative will review and format all data files monthly prior to storing them in a database or file-share folder accessible by the team. The representative will be looking for data omissions, and align all data to the same timestamped interval. Where errors or gaps in data exist, the representative will determine the cause of such issues and the actions taken to account for this in a final data file. Where necessary, the impact to the baseline analysis from data issues will also be documented.

XIV. Appendices

Existing Equipment Inventories

These inventories are detailed in the Site Characterization Report.

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9325 Sky Park Court, Suite 100 - San Diego, CA 92123 - 858.244.1177 - www.energycenter.org

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