Energy Savings Report

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Introduction to M&V Approach

Measurement & Verification (M&V) is the process of quantifying the energy and cost savings resulting from improvements in energy-consuming systems. The effort required and rigor achieved should be commensurate with the project capital investment and savings risk. Energy and cost reductions are compared to a historical baseline, which may be adjusted to reflect changing operating conditions or utility rates. "Actual" energy savings (including water savings and related Operation & Maintenance savings) cannot be measured because they represent the absence of energy or water use and related expenditures post implementation of a performance-based contract.

Instead, savings are determined by comparing resource use before and after the installation of energy conservation measures (ECMs) and making appropriate adjustments for changes in conditions. The "before" case is called the baseline. The "after" case is referred to as the postinstallation or performance period. Proper determination of savings includes adjusting for changes that affect energy use but that are unrelated to equipment performance. Such adjustments may account for changes in weather, occupancy, or other factors between the baseline and performance periods. Equation shows the general equation used to calculate savings

Standard M&V Procedures : IPMVP

In the early days of the energy services industry, comparison of baseline and post-installation utility bills was the most common method of M&V. While this method proved adequate in the short term, it often led to difficulties in buildings and multi-building facilities with varying patterns of energy use.

- Measuring and verifying savings from performance-based contracts requires special planning and engineering activities. Although M&V is an evolving science, industry best practices have been developed. These practices are documented in several guidelines, including the International Performance Measurement and Verification Protocol (I.P.M.V.P.),

- The I.P.M.V.P. is a guidance document that provides a conceptual framework for measuring, computing, and reporting savings achieved by energy efficiency projects in commercial and industrial facilities. It defines key terms and outlines issues that must be considered in developing an M&V plan.

Support for M&V

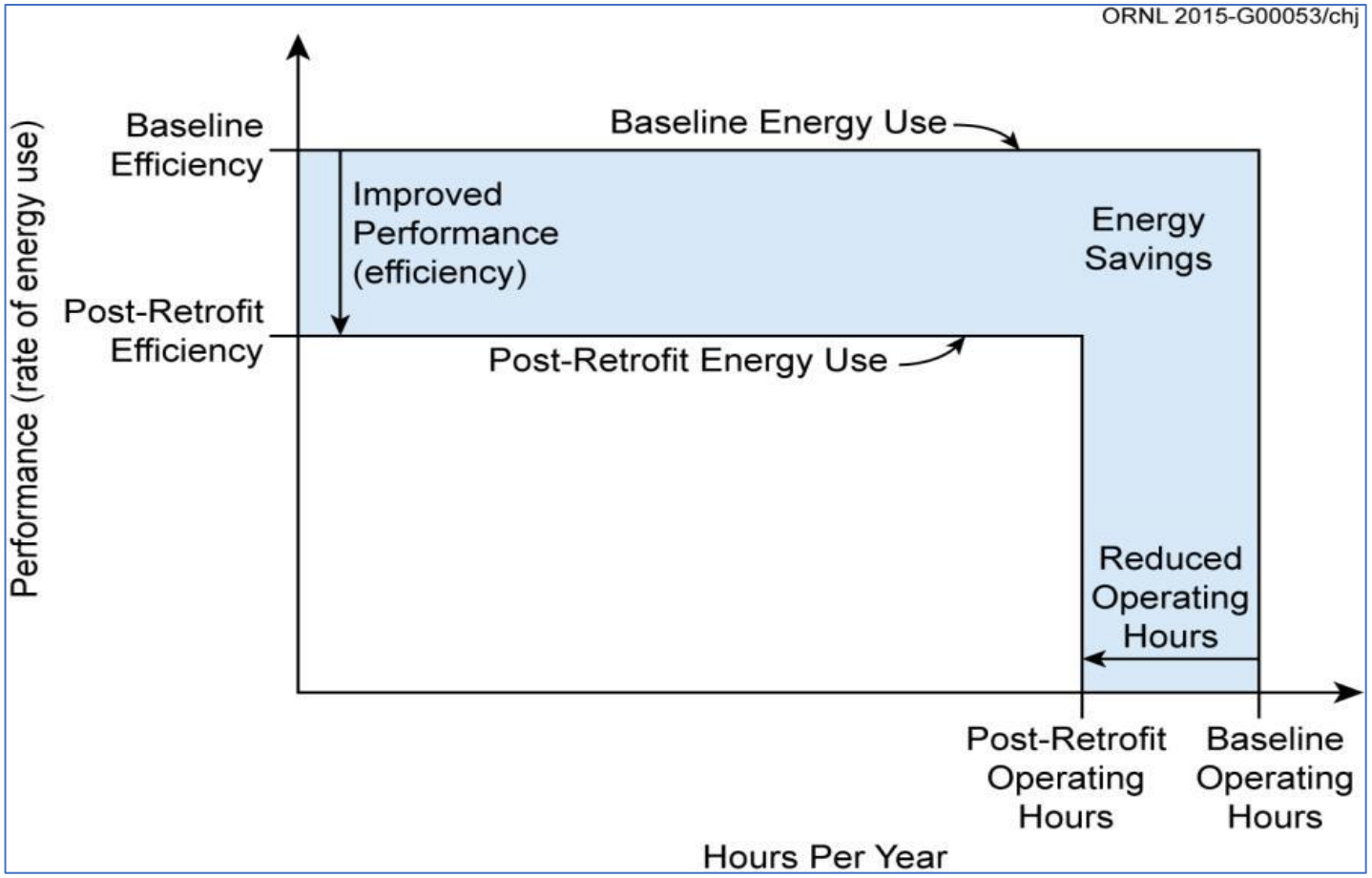
The EMS/PMS product package of Mirodata Simulations / Heta Datain is committed to providing insightful reports in internationally acclaimed standards. These reports are the keystone of efficient energy management.

One such report is the Measurement and Verification report, which is accepted throughout the UAE by a myriad of agencies.

Our system supports M&V reports and all calculations are verifiable and easily understandable. The following points can be noted:

- Historical data of the client is sourced, enabling baseline year calculations
- Our system logs data every two minutes, thereby allowing for performance year calculations
- All feeders data is accounted for in the reports
- Reports specialized towards different sectors are fully customisable
- Expert data analysts working offshore provide dedicated backend support, ensuring that the results and recommendations of all reports are clearly communiucated to the client team.

M&V Savings



Source: U.S. Department of Energy, FEMP

To Implement the M & V process, these steps are employed:

1. Collect data from Pre-installation electricity bills
2. Collect data from the Energy/Productivity management system installed at site.
3. Define & Develop baseline model
4. Specify regression model
5. Calibration of regression model using statistical indices
6. Selection of best case for Saving calculation & adjustments
7. Adjustment of baseline using routine adjustments (Variances in outdoor temperatures (C.D.D.), Changes in Occupancy) and Non routine stipulated adjustments.
8. Savings Calculations
9. Report results

Major differences between Gross Savings and Net Savings are related to the variations in outdoor temperature, occupancy, and Non Routine Adjustments

- **Adjusted baseline consumption** – Baseline consumption adjusted to include variation due to CDD, patient adjustments and operating temperatures . The baseline is adjusted using the routine adjustments.

- **Routine Adjustments** – The adjustments which are made regularly for savings calculation, in this case the following factors are considered:
  - Variances in outdoor temperatures.
  - Adjustments for changes occupancy.

- **Non Routine Adjustments** – The adjustments which are made for deviated operation of equipment, the following factor is considered:
  - Adjustments arising from stipulated operating indoor temperatures.

Routine Adjustments for Variances in Outdoor Temperatures

Adjustments for variations in outdoor Temperatures, measured in Cooling Degree Days (CDD)

- CDD data information source: www.degreedays.net
- The variations in temperatures are factored into the baseline using a regression model which defines the sensitivity of energy consumption in relation to this variable.
- Adjusted baseline consumption (kWh) = A0 +A1 CDDs, whereby A0 = intercept and A1 = slope
- The CDD in the baseline and the reporting period have been calculated monthly.
- For example – CDD for Jan 2018 has been calculated by adding daily CDD from 1st Jan to 31st Jan – 2018, while CDD for Jan 2019 has been calculated by adding daily CDD from 1st Jan to 31st Jan – 2019.

Routine Adjustments due to Occupancy

The main purpose and activities of any hospital are related to and revolve around the patients. Hence, all energy consumption is directly controlled by the number of patients and their healthcare needs. Differences in the number of patients account for change in cooling loads. An increase in the patients during the performance year 2018/19 would cause a proportional increase in the energy consumption, and vice-versa. The increase in energy must be adjusted for in accordance with the internationally accepted standards IPMVP.

These adjustments are made in kWh per patient basis, based on the measurement year and applied to the performance year. The calculations and results of patient adjustments are tabulated as shown.

Non Routine Adjustment

Stipulated Savings: Reflect saving values that are stipulated based on the engineering calculations using typical equipment characteristics and operating schedules developed for particular applications, without on-site testing or metering. This approach is designed for use with some lighting efficiency and controls projects, cooling equipment projects, and window film applications. (Source: Bureau of Energy Efficiency, Ministry of Power, Government of India)

Deemed (stipulated) savings are used to define savings values for projects with well-known and documented savings values in defined applications.

•Deemed values and deemed calculation approaches are often documented in a "Technical Reference Manual" –the Northwest's "RTF" is an example as is California's "DEER" (Source : U.S. Department of Energy)

According to the Hospital Regulations documents, a temperature of 22 degrees Celsius adheres to most areas in the hospital like O.T. , I.C.U. , Isolation room, Emergency/Casualty, Delivery Suite, Inpatient care, Outpatients Consultation & Examination, Clinical Laboratories, Diagnostic Imaging and Pharmacy.

As per the regression analysis of the performance data for 2017-2018 with respect to CDD, it is found that the base temperature of 20 degrees Celsius was maintained for the assessment year. This temperature meets some regulations, but it is also uneconomical. As it is inefficient to maintain a lower temperature than required, losses due to inflated energy bills are very significant.

It is therefore insisted/stipulated that a temperature of 22 degrees Celsius is perfectly suited for most of the hospital needs, and savings would arise from it. These savings are referred to in the International Performance Measurement and Verification Protocol as deemed savings. These form a major part of the energy savings in any organisation.

The relevant guidelines of the Hospital Regulations documents must be consulted to realise that a temperature of 22 degrees Celsius does indeed fit the bill.

NON ROUTINE STIPULATED ADJUSTMENT CALCULATION METHOD

The method employed for calculating Stipulated Savings is that which is commonly used throughout the energy industry.

- Improvement in energy savings is diretly related to percentage change in operating temperatures.
- For example, increase of some percentage in operating temperature would correspond to similar percentage of savings in the energy consumption.
- These savings are very relevant in the current scenario of energy optimization.

Net Savings 2018-19: AED 1023217 (26.62%)

Gross Savings Summary	
2017/18 Baseline Consumption (kWh)	7688240
2017/18 Baseline Bill (AED)	3844120
2018/19 Consumption (kWh)	7804210
2018/19 Bill (AED)	3902105
Gross Energy Savings (kWh)	-115969
Gross Cost Savings (AED)	-57984
Gross Savings (%)	**(1.51)**
Net Savings Summary	
Adjustments due to outdoor temperature 17-18 (kWh)	596
Adjustments due to outdoor temperature 18-19 (kWh)	1423
Adjustments due to occupancy (kWh)	347053
2017/18 Adjusted baseline (kWh)	7687644
2017/18 Adjusted baseline (AED)	3843822
Non Routine Adjustments (kWh)	1814525
2018/19 Final Adjusted (kWh)	5641208
2018/19 Final Adjusted (AED)	2820604
Net Energy Savings Calculated (kWh)	2046435
Net Cost Savings Calculated (AED)	1023217
Net Savings Calculated (%)	**26.62**

* Cost of energy : 0.5 AED/kWh,

Energy Savings Summary

Main Observations

- The billing period of 2017/18 comprises from 1st April 2017 to 31st March 2018. The system was put on savings mode from 1st April 2018 to 31st March 2019.

- It is observed that the facility is keeping the indoor/room set temperature low at around 20 degrees Celsius. Ideally it should be in the range of 22 to 24 degrees Celsius. It is recommended that the respective room's set temperatures should be kept in that range.

- All chiller fluctuations remedies have been communicated to the client team time to time.

- Savings arising from ambient weather, changing number of patients and stipulated chiller temperatures are significant.

- Net savings of around **26.62%** is calculated to have been achieved by the M&V approach.

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