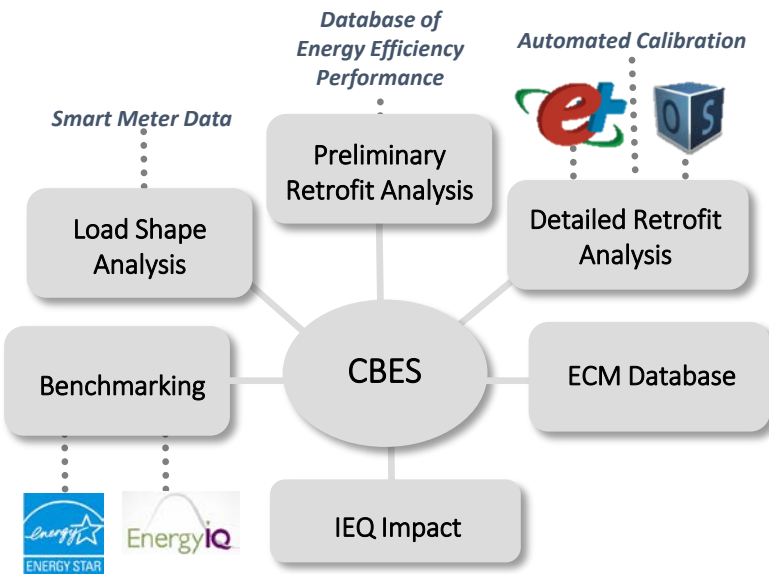


# Commercial Building Energy Saver (CBES)

Lawrence Berkeley National Laboratory



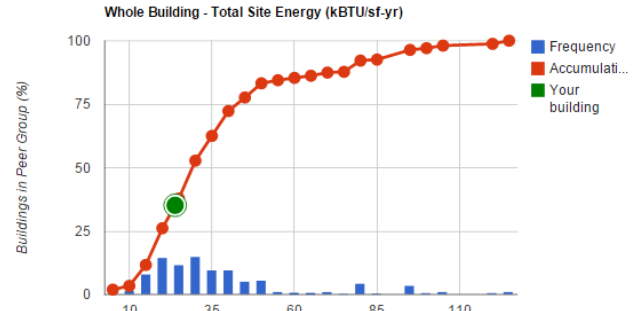
## CBES Toolkit



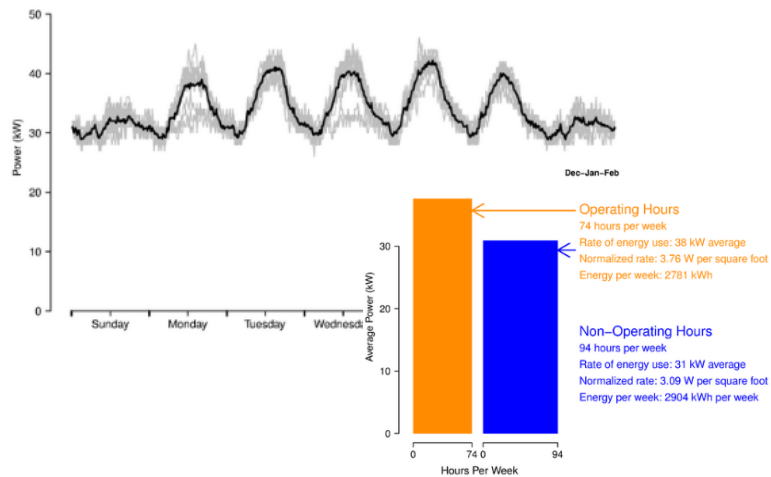
## Benchmarking Results

The **EnergyStar Score** is 97.

The **EnergyIQ** result based on California Commercial End-Use Survey (CEUS) is:



## Load Shape Analysis Results



## Overview

1. Provides three levels of retrofit analysis considering project goal, data availability, and user experience
2. Publicly available web-based application for small and medium office and retail buildings in California
3. CBES API package enabling a third party development of comprehensive retrofit apps
4. Funded by California Energy Commission PIER Program

## Main Features

1. Benchmarking using ENERGY STAR and EnergyIQ
2. Level 1: No- or Low-Cost Improvement using smart meter data and actual weather data
3. Level 2: Preliminary Retrofit Analysis powered by DEEP, a database of energy efficiency performance compiled from results of 10-million EnergyPlus simulations using NERSC clusters
4. Level 3: Detailed Retrofit Analysis providing user-configurable retrofit analysis using real-time EnergyPlus simulation
5. Considering indoor environmental quality impact during retrofits
6. 100 energy conservation measures (ECMs) including latest technologies and considering their interactions for HVAC, lighting, plug loads, service water heating, envelope, controls, and sensors calibration
7. Cost data of ECMs for economic analysis
8. Automated model calibration ensuring more reliable retrofit analysis results

## Retrofit Analysis Results

Annual economic analysis

| Measure ID(s) | Energy Cost Savings (\$) | Energy Savings (kWh) | Electricity Cost Savings (\$) | Electricity Savings (kWh) | Natural Gas Cost Savings (\$) | Natural Gas Savings (therm) | Investment Cost (\$) | Payback (Year) |
|---------------|--------------------------|----------------------|-------------------------------|---------------------------|-------------------------------|-----------------------------|----------------------|----------------|
| 1             | ECM 12:1                 | 13,662               | 88,901                        | 13,192                    | 95,248                        | -214                        | 8,564                | 0.6            |
| 2             | ECM 1:15                 | 13,472               | 87,430                        | 12,899                    | 93,132                        | -193                        | 14,320               | 1.1            |
| 3             | ECM 1                    | 11,443               | 74,429                        | 10,959                    | 79,128                        | -159                        | 6,320                | 0.6            |
| 4             | ECM 12:15                | 5,788                | 39,852                        | 5,642                     | 40,736                        | -30                         | 10,783               | 1.9            |
| 5             | ECM 36                   | 4,833                | 36,818                        | 4,432                     | 32,002                        | 163                         | 1,994                | 0.4            |
| 6             | ECM 12                   | 4,062                | 28,519                        | 4,023                     | 29,048                        | -18                         | 2,896                | 0.7            |
| 7             | ECM 31                   | 3,719                | 22,797                        | 3,618                     | 26,126                        | -112                        | 654                  | 0.2            |
| 8             | ECM 33                   | 2,195                | 11,990                        | 2,189                     | 15,804                        | -129                        | 0                    | NA             |
| 9             | ECM 14                   | 1,847                | 10,052                        | 1,851                     | 13,367                        | -112                        | 5,000                | 2.7            |
| 10            | ECM 30                   | 942                  | 9,027                         | 847                       | 6,114                         | 98                          | 0                    | NA             |

Description of measures

| Measure ID | Category                       | Name   | Cost Unit         | Total cost per Unit |
|------------|--------------------------------|--|-------------------|---------------------|
| ECM 1      | Lighting                       | Replace existing lighting with T8 upgrade                  | \$/sf             | 0.63                |
| ECM 12     | HVAC - Economizer              | Add Economizer   | \$/ton            | 387                 |
| ECM 14     | Plug Loads                     | Plug Load Efficiency Upgrade (25% efficient from Baseline) | \$/sf             | 0.5                 |
| ECM 15     | Plug Loads                     | Use Plug Load Controller (30% efficient from Baseline)     | \$/sf             | 0.8                 |
| ECM 30     | HVAC - Operation & Maintenance | Add Programmable Thermostat                                | \$/zone           | 1220                |
| ECM 31     | Lighting - Controls            | Install daylighting sensors for interior lighting control  | \$/sf_daylighting | 0.81                |
| ECM 33     | HVAC - Ventilation             | Replace Air Filter   | \$/cfm            | 0.07                |
| ECM 36     | HVAC - Ventilation             | Add Ceiling Fan  | \$/sf             | 0.2                 |

CBES web site: [cbes.lbl.gov](http://cbes.lbl.gov)

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