



# Building EQ Case Study: The New ASHRAE Global Headquarters

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## Agenda

- Overview of the New ASHRAE Global Headquarters
- Using Building EQ to Conduct a Level 1 Energy Audit
- Building EQ's Use on the New ASHRAE Global Headquarters

## Overview of the New ASHRAE Global Headquarters

- Renovation of an existing 65,000 gross sf, 2-story office building
  - Originally built in 1978 on 11 acres of land
  - Office, library/archive, server, shipping and receiving, lobby, meeting, and classroom spaces
- 125 occupants
  - Can expand to hold 140 occupants
- Construction Start: January 2020
- Occupancy: November 2020



## Owner's Project Requirements (OPR)

### Critical Requirements

- Safety, Sustainability, and Net Zero Energy (Building EQ Rating of 0)
- Exceed ASHRAE Standards 90.1-2016, 62.1-2016, 55-2017
- Meet space planning produced by the GSA Public Building Service in December 2011
- Office space exceed, by 3 to 5 NC/RNC, the acoustic requirements listed in the latest ASHRAE HVAC Applications Handbook, Chapter 48

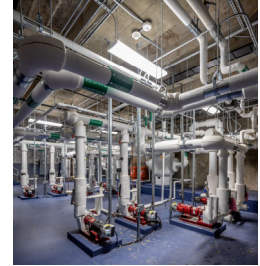
## Owner's Project Requirements (OPR)

### Highly Desirable Requirements

- Exceed ASHRAE Standard 189.1-2017
- Maximum energy consumption of 21.4 kBtu/sf-yr
  - Maximum daytime plug load less than 0.4 W/sf
- Energy use intensity (EUI) of less than 15 kBtu/sf-yr
- 30% more outside air beyond Standard 62.1 and CO2 limit of 400 ppm using demand-controlled ventilation
- Majority of occupants have a generous level of daylighting in their workspace 55% of the time

## Facility's Features

- Radiant ceiling panel system for heating and cooling
- 2 dedicated outdoor air system (DOAS) units for outdoor air ventilation with enthalpy heat recovery
- Overhead fresh air distribution system with reversible ceiling fans in open office areas and displacement distribution in the classroom
- 6 water source-heat pumps (WSHPs): 4 on basement level and 2 on upper-level atrium
- Demand Control Ventilation (DCV) for high occupancy spaces in the meeting and learning center
- Air distribution is constant volume in office areas delivered via fabric duct, reducing diffuser count and duct branches



- 2 DOAS units for building with MERV-8 pre-filter, MERV-13 filter, and UV lights
- 1 air-cooled heat pump chiller outside of facility
- 6-way valves for heating/cooling operation in exterior spaces; 2-position 2-way valves for cooling in interior zones

## Facility's Features

- Modeled Energy Use Intensity (EUI): 17 kBtu/sf-yr
- On-site electric vehicle charging stations
- Roof-top and ground mounted photovoltaic solar panels
- 18 new skylights and reconfigured window/wall ratio
- Useful daylight illuminance of greater than 300 lux at the work plane  
Window Wall Ratio (WWR) 79.9% Existing – New WWR east/west  
33.5% - north/south - 41.9%



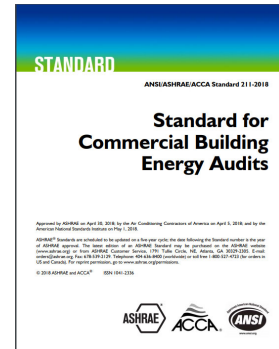
# OPR Goal Comparison





# ASHRAE Standard 211

- Normative language standard for energy audits
- Consistent approach to energy audits
- Raises and maintains the bar
- Level 1 Energy Audit is initial review that identifies possible areas for improvement (EEMs)
- Starts conversation with building owner for further investigation, action, and improvement



## ANSI/ASHRAE/ACCA Standard 211-2018 – Standard for Commercial Building Energy Audits

EEM = Energy Efficiency Measures

The basic parts of a Level 1 energy audit are:

- Energy-use Analysis – review of monthly energy bills and utility information
- Walk-thru Survey
- Identification of low-cost/no-cost energy improvement measures
- Estimated Costs and Savings
- Summary of Special Problems/Needs

The Building EQ In Operation assessment process:

- provides a consistent process for evaluating a building's energy use
- identifies actionable recommendations of EEMs that can be used to improve building energy performance
- allows a building to benchmark their building now and then re-assess after improvements have been made to verify the energy savings.

## What is Building EQ?

- Free Web-based Portal
- Benchmarks energy performance
- Calculates building EUI based on Climate Zone
- Includes Operational Carbon Metrics
- Assists with ASHRAE Level 1 Energy Audit
- Provides data to improve energy performance

CZ = Climate Zone; EUI = Energy Use Intensity – Btu/yr-ft<sup>2</sup> ; IO = In Operation; AD = As Designed

The Building EQ Portal is an online tool that includes:

- Online data entry and submission process
- Download of metered energy data from ENERGY STAR™ Portfolio Manager

Building EQ is a web based portal that compares your building's performance with similar building types.

- offers a consistent methodology,
- can also compare buildings within an owner's portfolio against each other
- can be re-evaluated over time to see if the improvements are getting the expected energy savings and performance results.
- allows owners to invest financial resources in their buildings in the ways that will provide the greatest return.

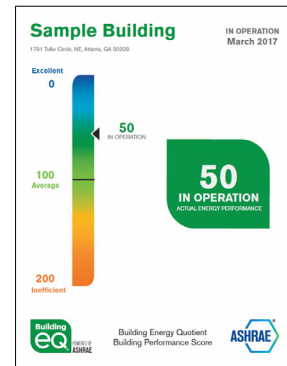
Carbon metrics are as follows (see also slide on this later in presentation):

- Total Annual GHG Emissions (lbs/yr)
- Total Annual GHG Emissions per Conditioned Space (lbs/yr/SqFt)
- Building EQ Carbon Performance Score

## Building EQ Assists with Level 1 Energy Audit

### In Operation Assessment

- Uses metered energy bills for energy usage
- Reflects how the building is designed, used, and operated
- Most common application
- Rating from 0 (zero net energy) to 200 (energy inefficient)
- Allows for tracking of improvements and comparing building to itself over time



Building EQ In Operation process compares metered energy use to a baseline median EUI using the following formula:  $(EUI_{\text{metered}}/EUI_{\text{baseline}}) \times 100$ .

- Twelve consecutive months of actual metered data is required and must be within 6 months of the assessment date.
- Metered energy data can be downloaded from ENERGY STAR Portfolio Manager so the data does not need to be reentered into the Portal.

The scale barometer shown illustrates how a building's Building Performance Score indicates a building's energy performance with a score range as follows: .

- A zero net energy building will have a score of zero (zero net energy use)
- An efficient building has a score less than 100 (low energy use / energy use approaching zero net energy use)
- An average building will fall near the median value of 100 (equals median or baseline building)
- An Inefficient building has a score greater than 100 (above average energy use / high energy use)

The baseline value of 100 also represents the median (similar to mid-point or average) energy use intensity for existing buildings of that building type.

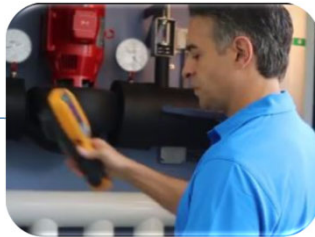
## Building EQ Complies with Standard 211

- In Operation aligned with ASHRAE Standard 211 Level 1 Audit reporting requirements
- Site visit required for both, with field data almost being the same
- Building EQ delivers a Level 1 Energy Audit Report aligned with ASHRAE Standard 211
- Customer gets understanding of how building ranks against similar buildings AND the initial evaluation on how to improve the building
- Building EQ Spreadsheet Audit Report auto populates Standard 211 spreadsheets

## Using Building EQ



How Good is My Building?



- Get energy bills
- Do a walk through
- Enter data into Portal
- Get score

Celebrate good score with ASHRAE Building EQ Label Award

Start a dialog with owner on how to improve building score

Submit project for official rating  
OR  
Use project information to start conversation

Building EQ In Operation assesses the building's energy performance.

The assessment:

- collects metered energy data
- includes a building walk-through
- supports a Level 1 Energy Audit
- identifies where and how energy is consumed,
- provides suggested EEMs (with estimated costs and payback),
- includes an IEQ screening that records measurements for thermal comfort, lighting, and ventilation for IAQ
- provides a Building EQ Performance Score

The assessor gets information that will help the building owner.

The building owner receives guidance on how to improve energy performance.

The estimated time to input the required data into the Portal is approximately 30-60 minutes depending on the size of the building and how much data is being input. This assumes that all the data is readily in hand at the time of input.

## Case Study: The New ASHRAE Global Headquarters

- What do you look for when auditing a building designed for net-zero energy consumption?
  - Recall the gaps between OPR versus operating conditions
- What is the effort to audit a building with extensive modeling and commissioning?
- How aggressive or bold should the energy conservation measures be?
  - Measures are not limited to capital improvements



# Walking Through Building EQ

Building Characteristics | Energy | EIQ Survey | Energy Efficiency Measures (EEMs) | Photos and Attachments

- Building Demographics
- Climate Information
- Building Characteristics

Gross Floor Area (GFA) <input type="text" value="64365"/>	Total Conditioned Floor Area (GFA) <input type="text" value="60731"/>
Separately Metered Excluded Area (SEEA) <input type="text" value="0"/>	Conditioned Area (Heated Only - RA) <input type="text" value="0"/>
Number of Conditioned Floors <input type="text" value="3"/>	Conditioned Area (Cooled Only - RA) <input type="text" value="3067"/>
Net Rated Floor Area (RFA) <input type="text" value="64365"/>	Floors Above Grade <input type="text" value="2"/>
Original Year of Construction <input type="text" value="1978"/>	Floors Below Grade <input type="text" value="1"/>
Hours of Operation * <input type="text" value="Average"/>	Percent Owned <input type="text" value="100"/>
Occupancy (Hrs/Wk) <input type="text" value="65"/>	Percent Leased <input type="text" value="0"/>
Occupancy (Hrs/Yr) <input type="text" value="51"/>	Historical Landmark (Y/N) <input type="text" value="No"/>
Number of Occupants <input type="text" value="125"/>	Energy Star Building Type <input type="button" value="Click Here"/>

**Brief Building Description (construction and use)**

3 story office building with open office, closed office, and conference rooms. Support spaces include lobby, lounge, copy rooms, atrium, corridor, mechanical/electrical rooms and other back of the house spaces. The building uses a DCIES with hydronic radiant ceiling panels for space conditioning and a DX heat pump with enthalpy wheel for total heat recovery. Radiant panels are served by an air-to-water heat pump system. Back of the house and atrium are conditioned by a separate

**Description of Onsite Renewable Energy Systems (construction and use)**

Solar photovoltaic panels on unused parking space and on roof

**Description of Major Renovations**

Year(s) Completed

# Walking Through Building EQ

[Building Characteristics](#) | 
 [Energy](#) | 
 [EQ Survey](#) | 
 [Energy Efficiency Measures \(EEMs\)](#) | 
 [Photos and Attachments](#)

Total Building Energy Use and Building EQ Energy Performance Score

Operational Greenhouse Gas Emissions

Utility Information

Electricity

Import PM Excel

Validation Warnings -

- Electrical load factor is out of range

### ELECTRICITY METERED DATA

Use 12 consecutive months of billing data starting at least 6 months after the building is fully occupied

Start Date	End Date	Days	kWh	US Dollar (\$)	Energy Use/Day	
2021-10-28	2021-11-30	34	10880	1993.54	320.0	X
2021-11-30	2021-12-30	30	18240	3060.48	608.0	X
2021-12-30	2022-01-31	32	18880	3241.81	590.0	X
2022-01-31	2022-03-01	29	5940	1580.37	204.8	X
2022-03-01	2022-03-31	30	2560	1476.72	85.3	X
2022-03-31	2022-04-29	29	-320	1389.18	-11.0	X
2022-04-29	2022-05-01	33	-6240	1226.46	-189.1	X
2022-05-01	2022-05-30	29	5280	1564.25	182.1	X
2022-05-30	2022-06-01	32	12000	2219.79	375.0	X



# Walking Through Building EQ

- Building Characteristics | Energy | IEQ Survey | Energy Efficiency Measures (EEMs) | Photos and Attachments
- Review of IEQ and Thermal Comfort Conditions ✓
- Space by Space Measurements ⓘ
- Lighting Quality ✗
- Review of Ventilation for IAQ ⓘ
- Survey of Air Distribution Systems ✓

**Describe HVAC system types :**

- Radiant ceiling panel system for heating and cooling  
 - 2 Dedicated outdoor air system (DOAS) for outdoor air ventilation with enthalpy heat recovery  
 - Overhead fresh air distribution system with reversible ceiling fans in open office areas and displacement distribution in the classroom  
 - 6 water source heat pumps (WSHPs) 4 on basement level and 2 on upper level atrium  
 - Demand Control Ventilation (DCV) for high occupancy spaces in the meeting and learning center  
 - Air distribution is constant volume in office areas delivered via fabric duct, mixing diffuser count and duct branches

System #1 Identifier and Type			
DOAS-E			
Scheduled Operation	Occupied periods	Distribution System	Overhead duct with diffusers, radiant panels, and floor vents
Control of Outside Air	Demand-control ventilation	OA Damper Operation	BAS controlled
Condition of Mech Rm	N/A (Roof location)	Drain Pan Drainage	Functional
Coil Cleanliness	Clean	Duct Liner	None
Return Air Plenum	Ducted exhaust	MERV Filter Level	MERV 6 pre-filter, MERV-13 filter

System #1 Identifier and Type			
DOAS-W			
Scheduled Operation	Occupied periods	Distribution System	Overhead duct with diffusers, radiant panels, and floor vents
Control of Outside Air	Passive damper controlled	OA Damper Operation	Passive damper

# Walking Through Building EQ

Building Characteristics
Energy
IEQ Survey
Energy Efficiency Measures (EEMs)
Photos and Attachments

Building Envelope ✓  
Lighting/Daylighting ✓

**Lighting/Daylighting**

Lighting/Daylighting Suggestions	Cost Range		Payback	Priority	Capital	
	Lower Cost	Upper Cost				
Verify correct operation, programming, and placement of all lighting controls	0	2000	< 1 yr	1	No	X
Test function of dimmers, multi-scene controls, occupancy and vacancy sensors, time switches, photo sensors	0	0	< 1 yr	1	No	X
<a href="#">Add Row</a>						
Additional Lighting/Daylighting Suggestions	0	0	Select...	Select...	Select...	
	0	0	Select...	Select...	Select...	
	0	0	Select...	Select...	Select...	

Impacts of Changes on Occupant Comfort, IEQ and Non-Energy Impacts:

No changes or impacts are anticipated.

[Save](#)

HVAC System ✓  
Refrigeration  
Energy Generation

# Walking Through Building EQ

- Building Characteristics
- Energy
- IEQ Survey
- Energy Efficiency Measures (EEMs)
- Photos and Attachments

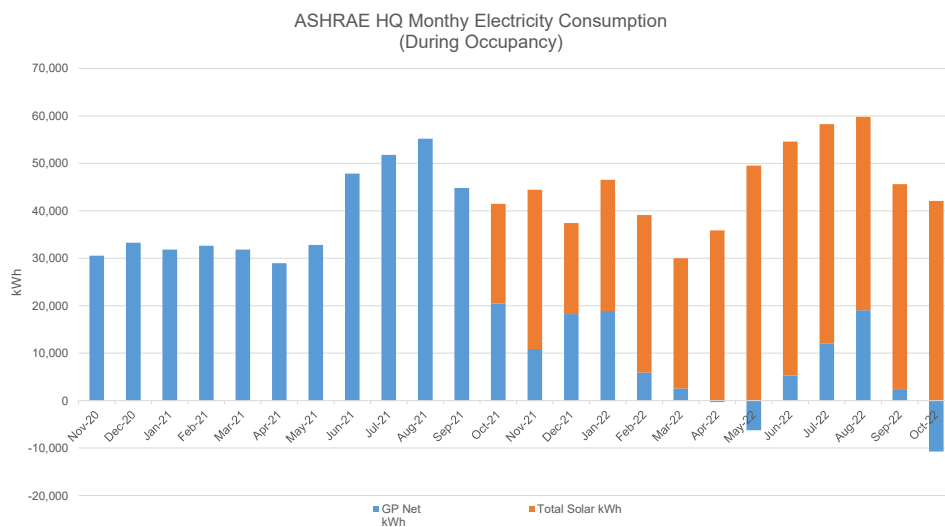
Photos ✓

Attachments ✓

Choose File No file chosen

Attachment	Description	Attachment Type	
	Commissioning and TAB Report	Commissioning Report	<input checked="" type="checkbox"/> <input type="checkbox"/>

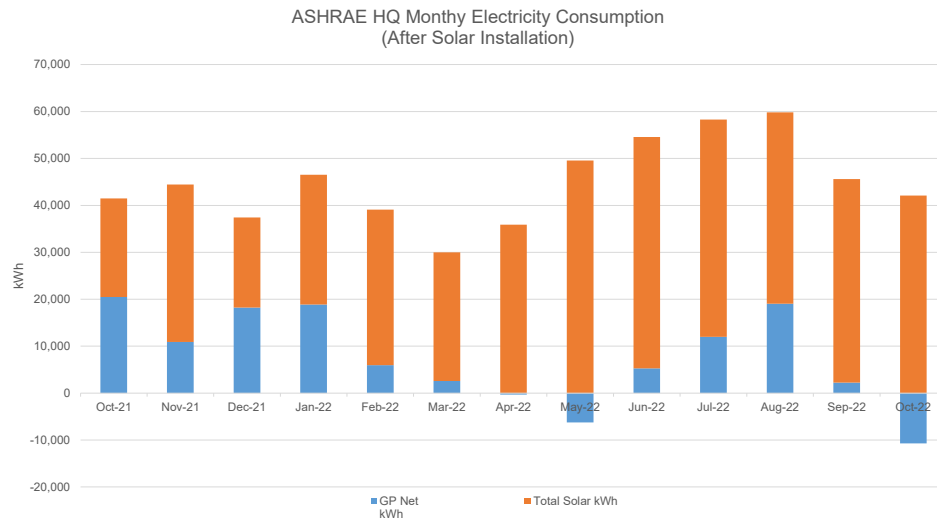
## Measuring Energy Consumption and Solar Offset



Total Since Solar PV Installation as of Oct 2022 utility bill:

- GP Net: 98,260 kWh
  - Beyond solar production
- Total Solar: 469,279 kWh
- Total Building Consumption: 567,539 kWh
- Solar Offset: 85%

## Measuring Energy Consumption and Solar Offset



Past 12-Month Total as of Oct 2022 utility bill:

- GP Net: 151,540 kWh
  - Beyond solar production
- Total Solar: 469,279 kWh
- Solar Offset: 85%
- Total Building Consumption: 526,065 kWh

## Building EQ Scores and Calculations

- Building EQ Energy Performance Score: 6
- Source EUI: 13
- Media EUI: 223
  
- Building EQ Carbon Performance Score: 6.0
- Total Annual GHG Emissions per Conditioned Space: 6.43 lbs/yr-sf

## Causes and Solutions

- Purchase more solar panels to install in unused parking areas or over used parking for shade
  - Lower solar panel performance due to weather and refining operations
- Install dedicated solar panels to feed electric vehicle charging stations
- Higher building energy consumption than modeled
  - Refine lighting, outdoor air delivery, and temperature and humidity controls
- Assess building automation system settings for non-occupancy periods
- Recommend periodic envelope inspections

## Causes and Solutions

- Recommend ongoing mechanical system maintenance
- Purchase plug load control devices and ENERGY STAR products
- Evaluate the use of analytics and fault detection to improve building systems operation, reduce energy consumption, and improve indoor environmental quality





Thank you for your time!

Questions?