BUILDINGENERGY NYC

OCTOBER 15, 2015 AT TKP NEW YORK CONFERENCE CENTER

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Making Money By Saving Energy

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October 15, 2015

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

Rockefeller Center

Tuning The Rock …

A Path Towards Improved Energy Efficiency

TISHMAN SPEYER

Course Description

Provide an overview of the energy-savings investments completed at Rockefeller Center.

Discuss the approach and findings resulting from the recently completed Energy Audit and Retro-Commissioning program

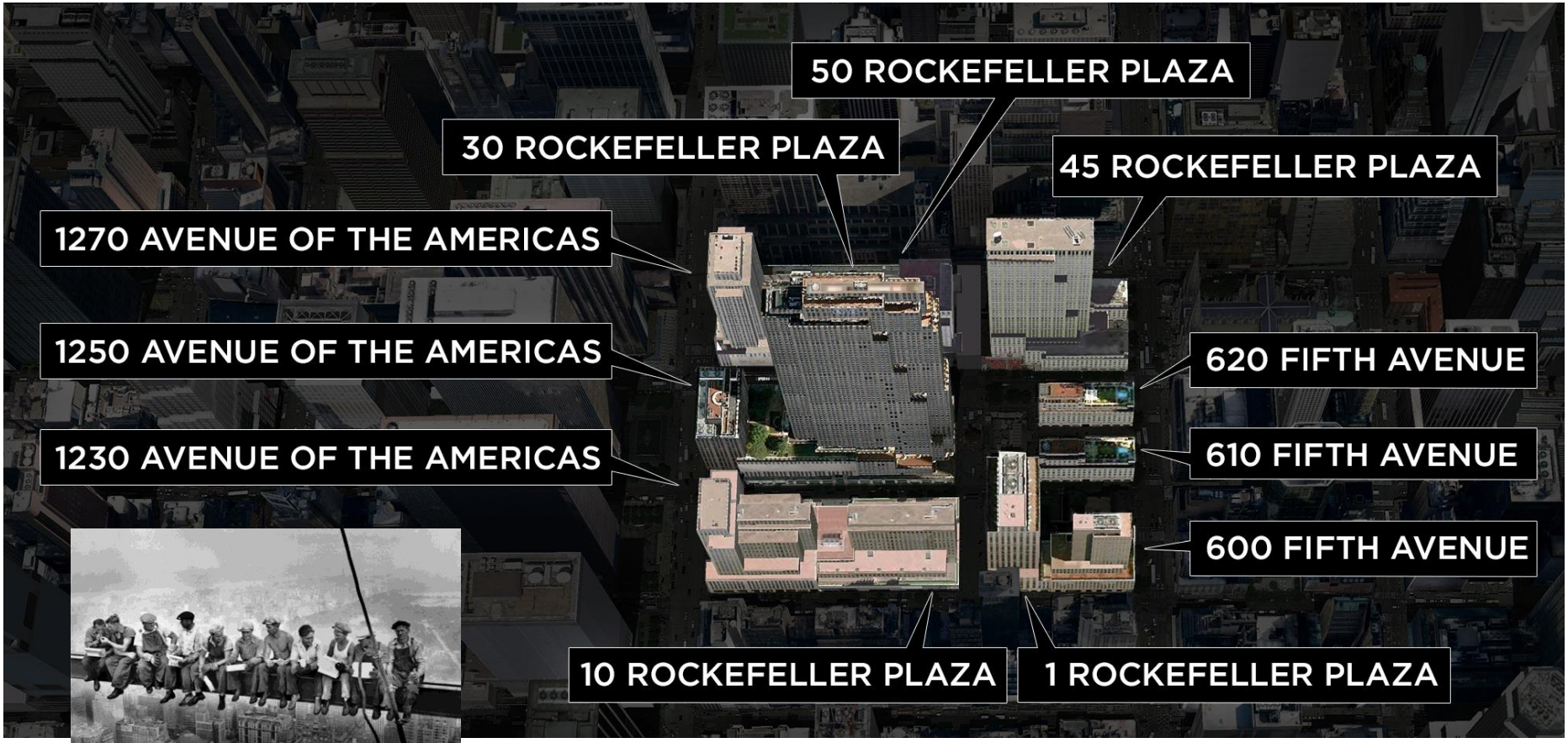
Discuss programs and initiatives moving forward.

Learning Objectives

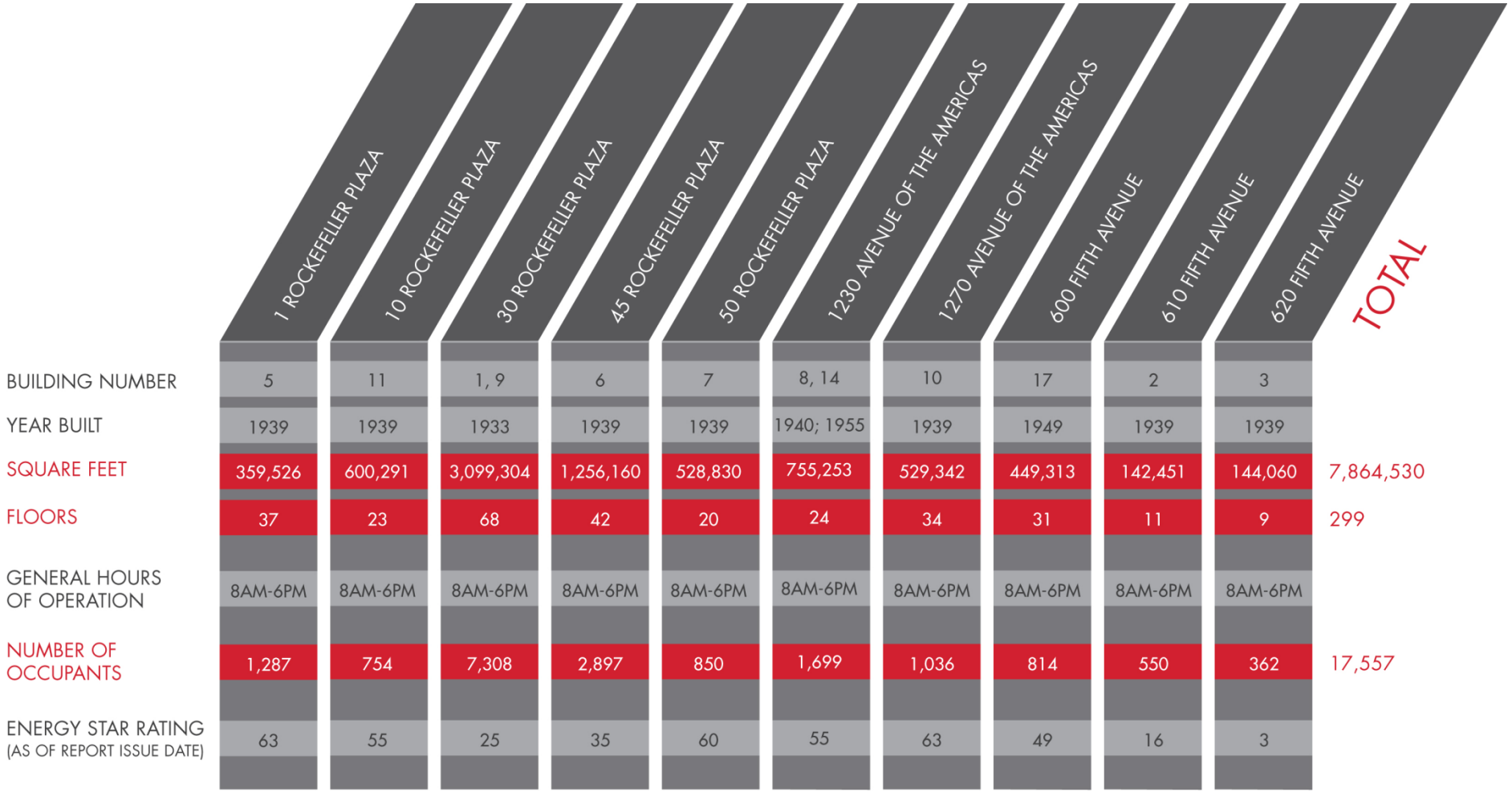
At the end of the this course, participants will be able to:

1. Consider energy conservation measures for their facilities
2. Understand requirements of Local Law 87 and how it benefits them
3. Look for No or Low Cost Energy Savings Opportunities
4. Discuss the steps for ECM implementation

Overview of Rockefeller Center



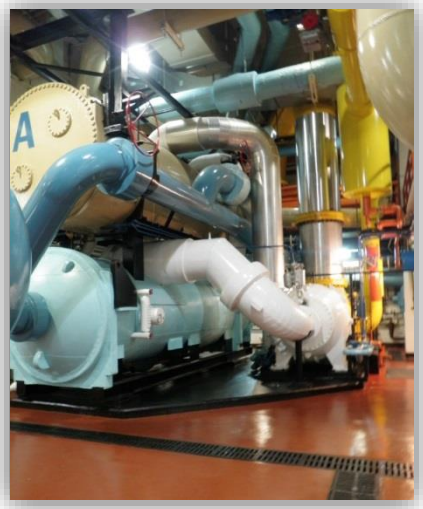
Overview of Rockefeller Center



Rock Center's Foundation

- Twenty (20) electrical accounts, including TOD for Central CHW plant.
- Ten (10) Steam accounts.
- Energy use meters and dashboard, providing daily trends, out-of-range advisories and alarms

ECMs – Central Refrigeration Plant



- Dual compressor chiller for improved off-peak efficiency
- Re-piped evaporators on two 4,000T chillers from two-pass to single-pass flow (capacity recovery at off-peak conditions)

Central Plant Refrigeration Machine Statistics		
Type	**Quantity**	**Tons**
Electric Centrifugal	3	2,500 - 4,000
Steam Turbine Centr	1	4,000
Ice Plant	1	1,300

ECMs – Central Refrigeration Plant

- Two 1,250 ton Plate Heat Exchangers - “Free Cooling” during colder weather
- VFDs on Cooling Tower fans (also for improved temperature control)
- VFDs on CHW pumps - vary based on load

Central Plant Cooling Towers	
Building	**Quantity (Cells)**
1/9	10
11	7

Energy Cost Savings Measure – Ice Storage Plant

- 41 tanks yielding 8,200 ton-hours of storage
- Ice produced at nights and “burned” during on-peak to lower our daytime peak electrical demand by approx. 1,000 kW
- TOD electric rates yield further savings

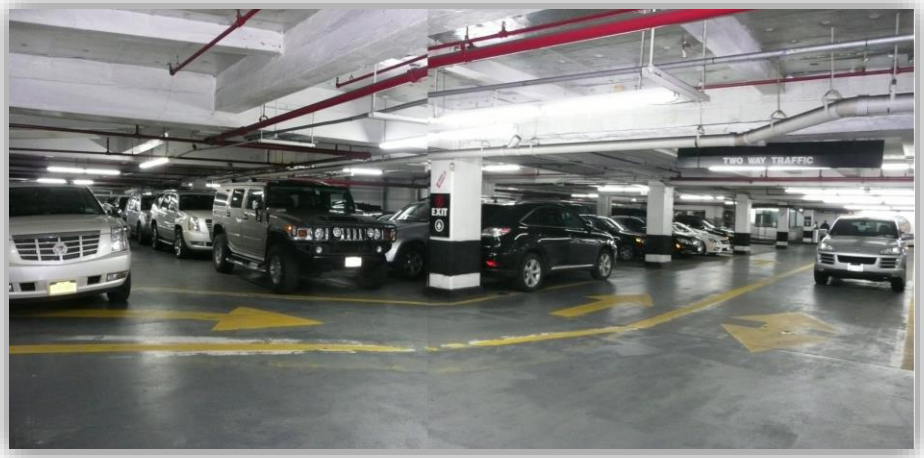
ECM – Fountain Heating

Heat contained within collected Con Ed Steam condensate used as heat source instead of steam directly

ECM – Garage HVAC

- Heat contained within collected Con Ed Steam condensate used as heat source for warming garage ventilation air

- Fan speed control based on measured CO concentration during off-peak periods



ECM - Window Replacement

- 15,550 single-pane windows from the 1930's
- Phased replacement, performed as leases roll or in close coordination with current tenants

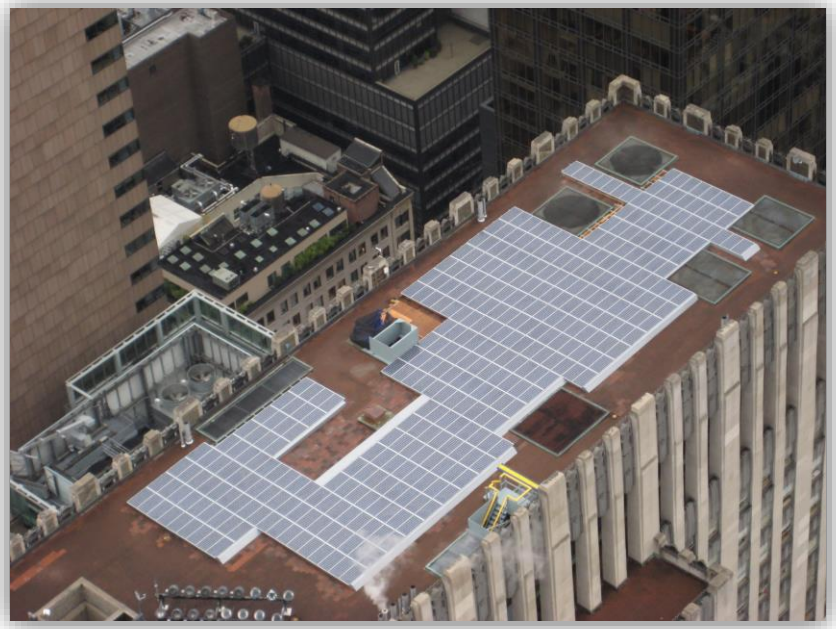
ECM - Window Replacement

- New Double-pane thermally insulated windows
- Mock-ups to determine glass type and finish to match existing appearance
- Estimated $350 annual energy savings per window

ECM – Convector Replacement

ECM – Solar Panels at 45 Rock

- 363 GE panels
- 60 kW of peak power

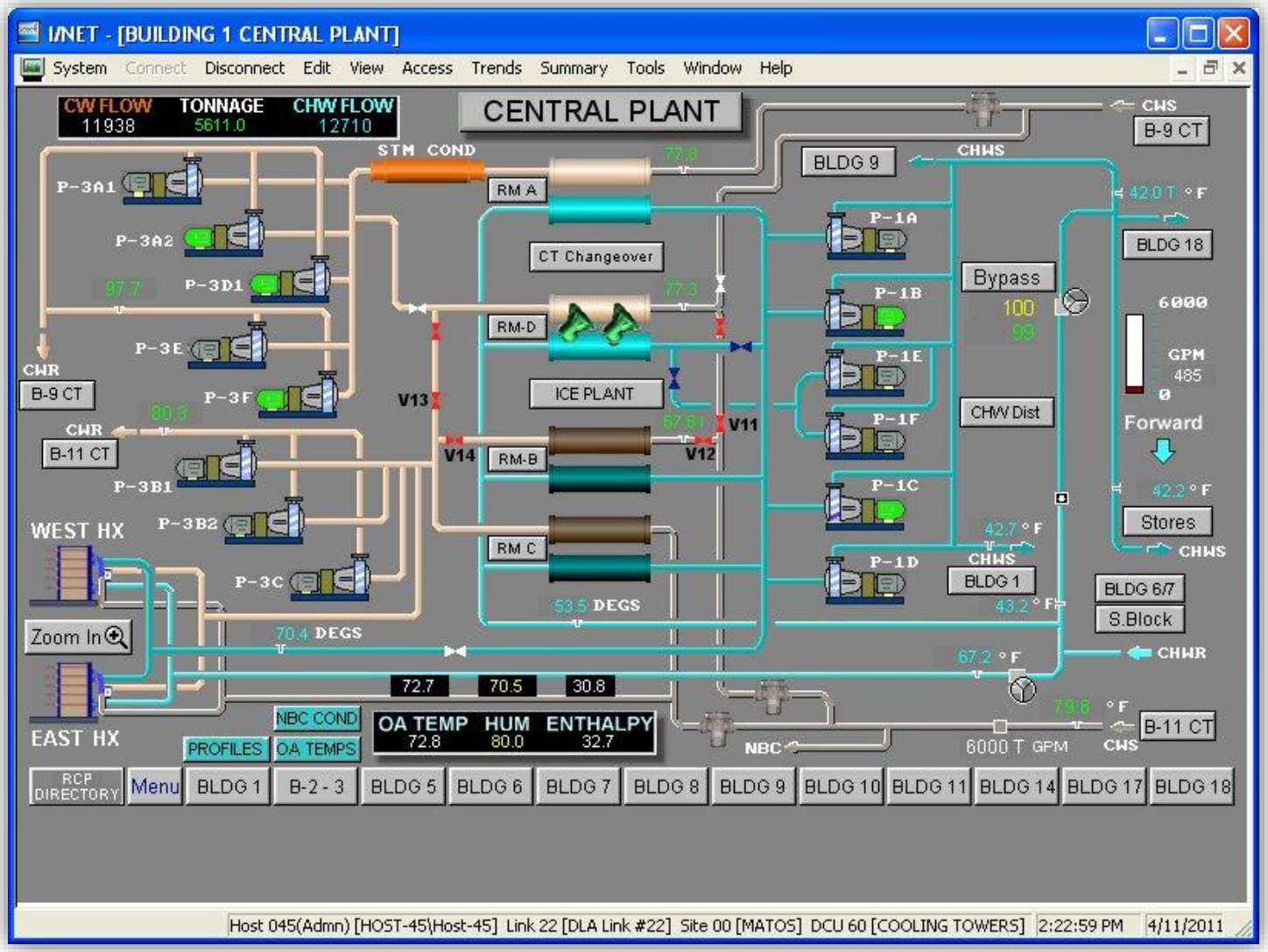


ECM – Continuous Systems Monitoring

Central Plant Control Center

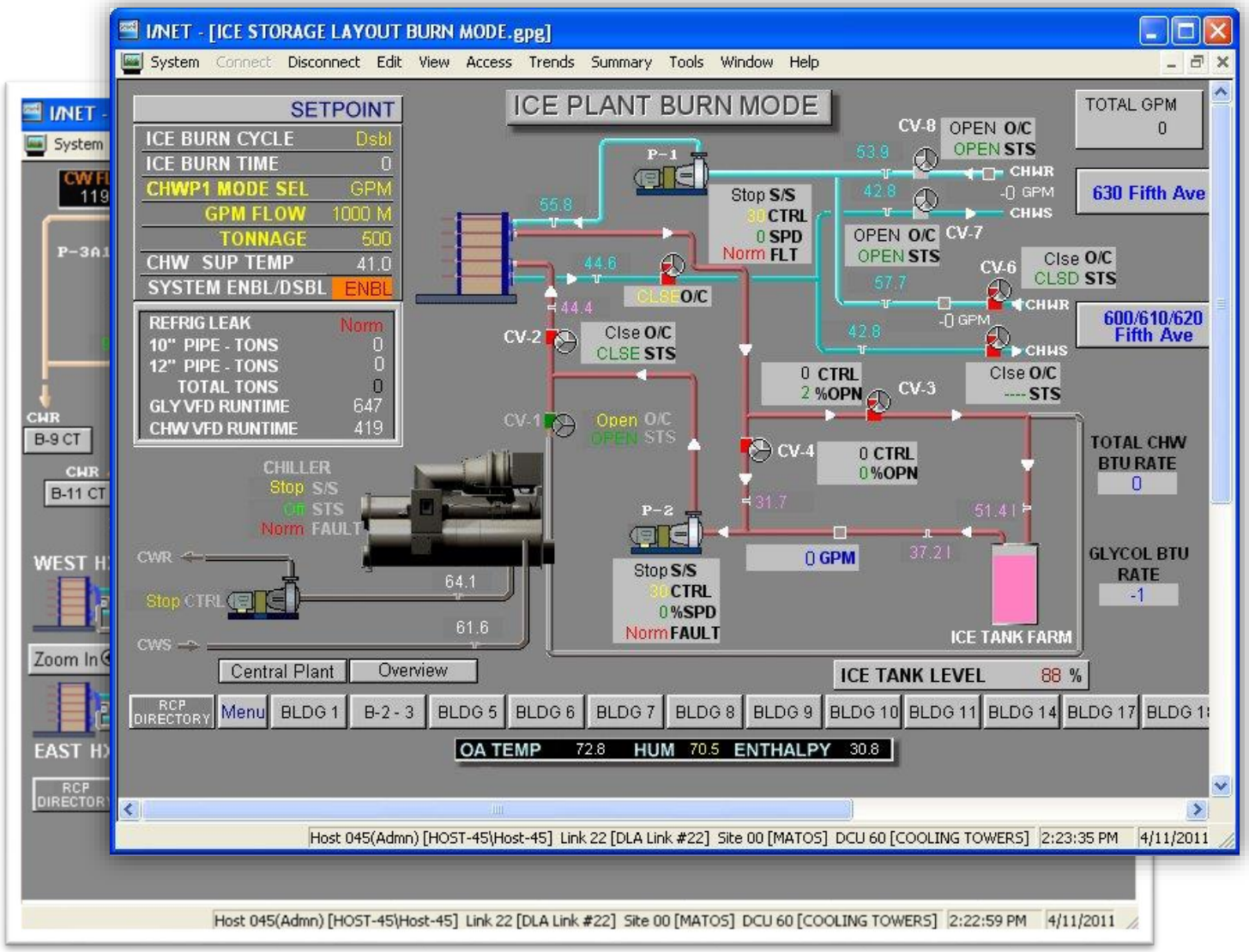
ECM – Continuous Systems Monitoring

Central Plant Overview Screen



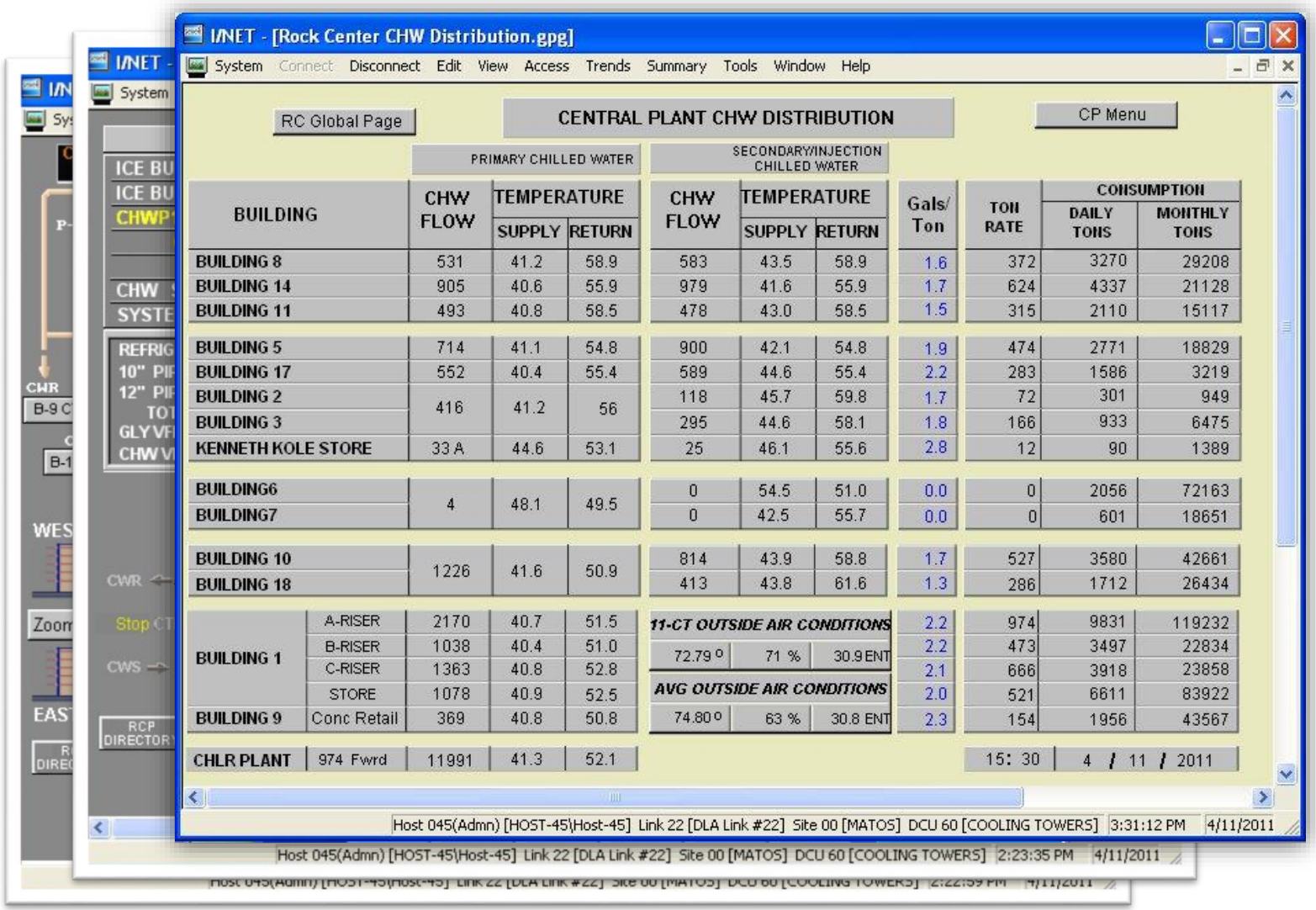
ECM – Continuous Systems Monitoring

Ice Plant Operations



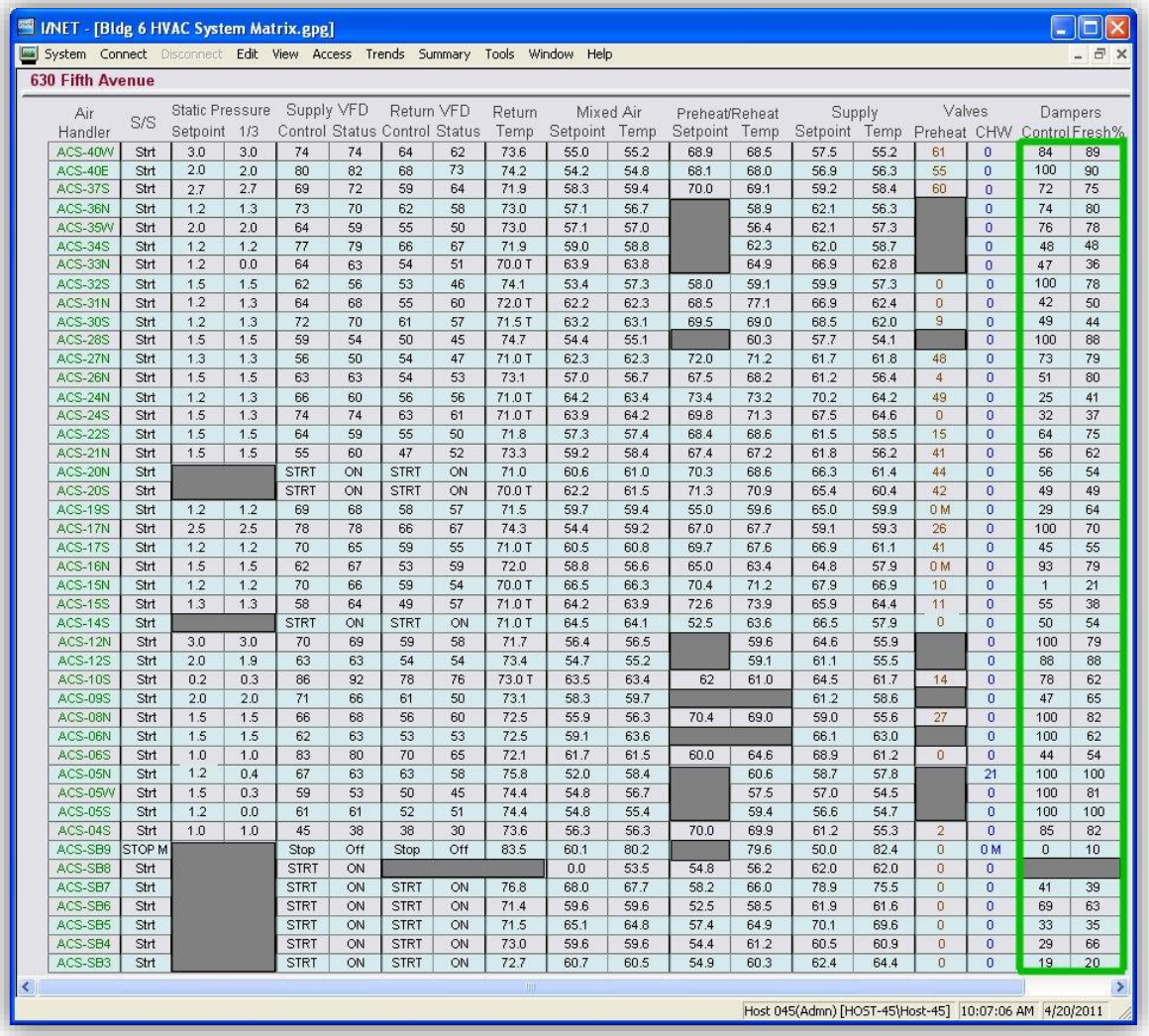
ECM – Continuous Systems Monitoring

Building by Building Temperature and CHW Usage



ECM – System Advisories

Central AHU Summary Screen

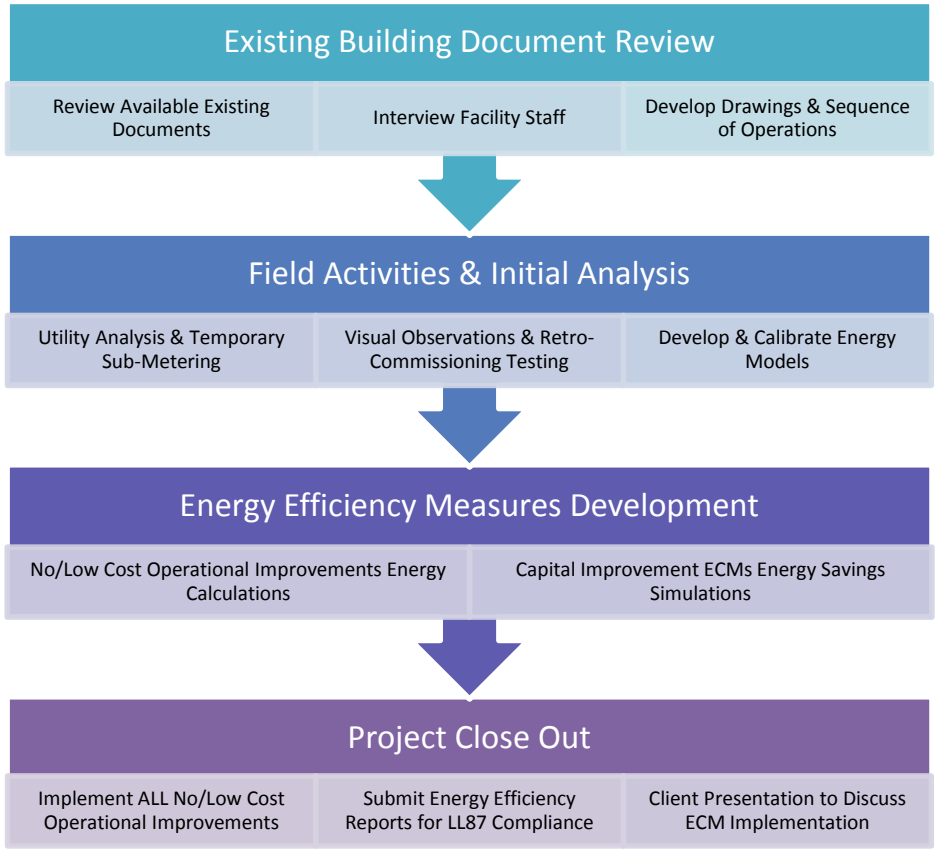


Campus-Wide Air Handling Unit Statistics

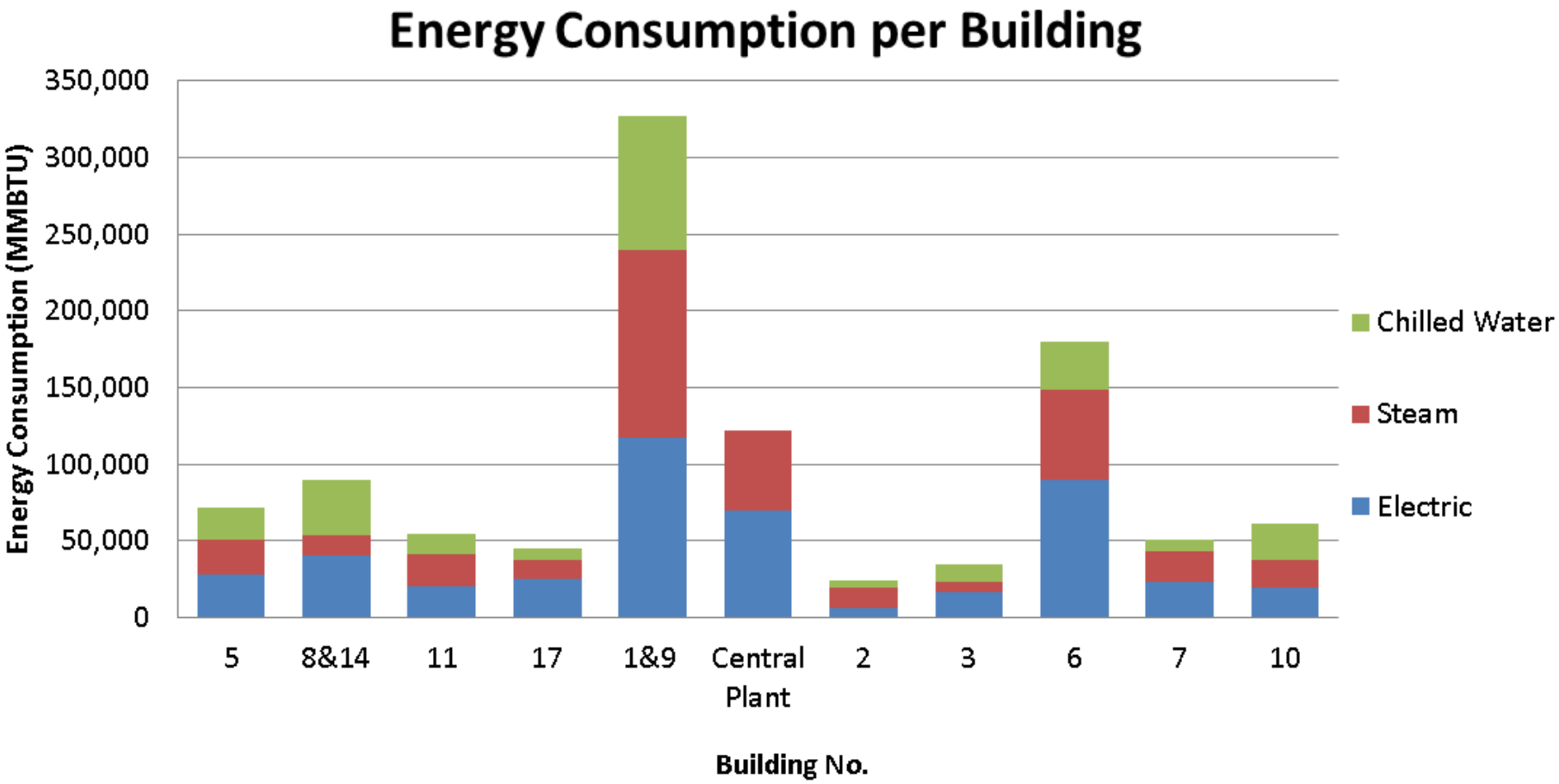
Building	Quantity	Max CFM
1/9	71	66,000
2	8	31,000
3	8	31,000
5	30	45,000
6	71	48,292
7	28	41,000
8/14	32	79,300
10	17	41,400
11	23	75,400
17	23	29,235

Early Compliance with NYC LL87

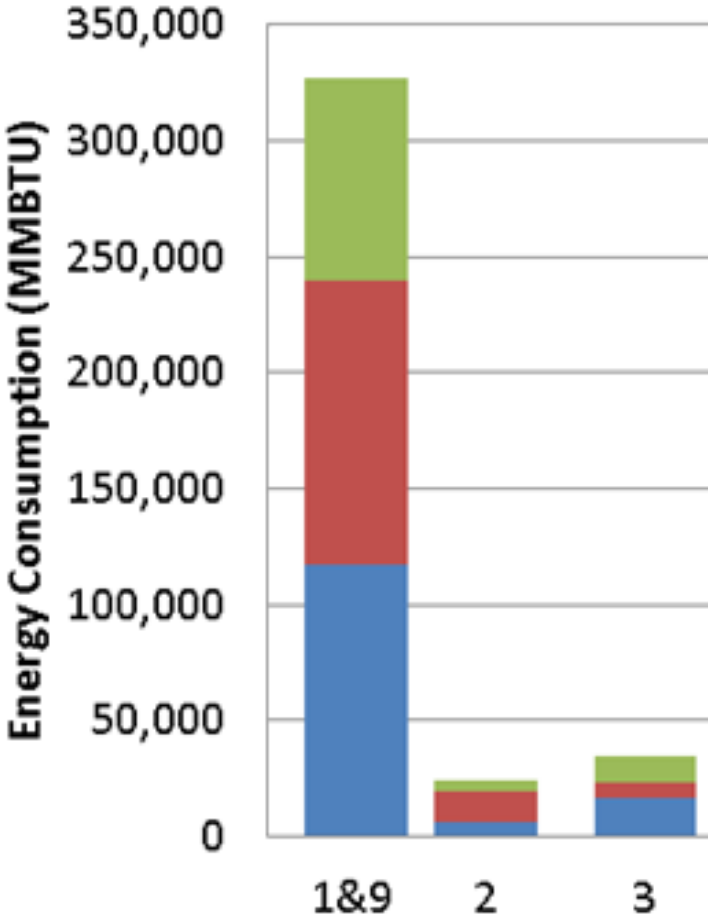
- AKF performed the following to achieve a comprehensive understanding of the buildings' system operations:
  - Document review & facility discussions
  - Utility Analysis and Temporary Metering
  - Energy Model Development & Calibration
  - Retro-Commissioning Functional Testing & TAB Measurements

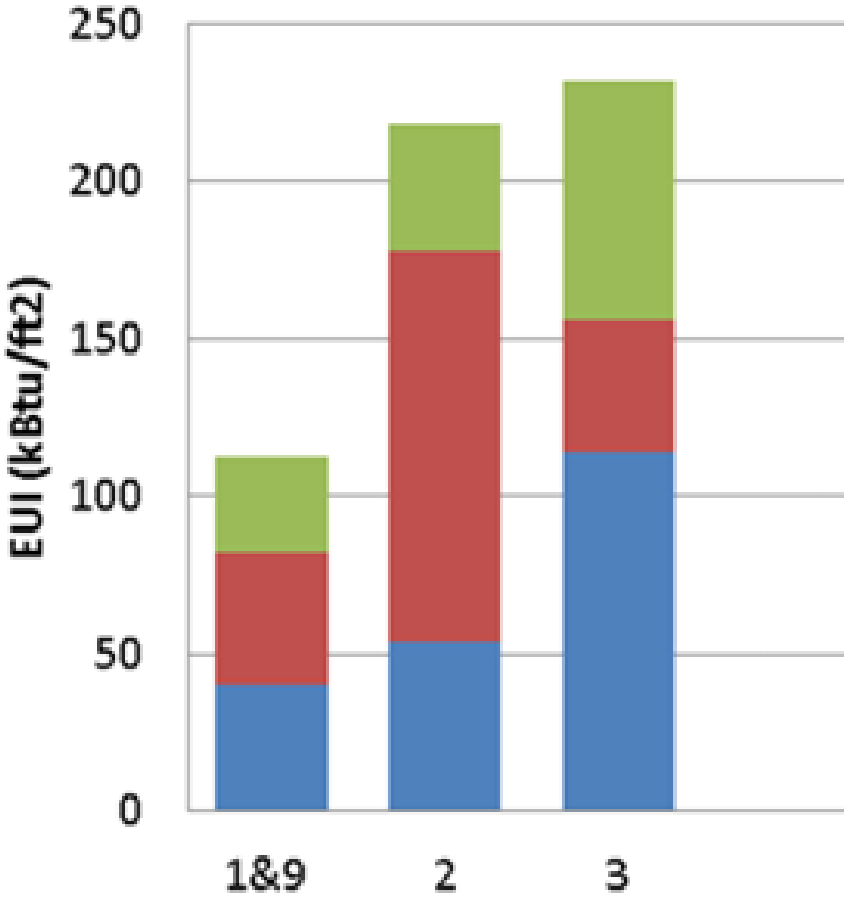


Energy Audit – Utility Analysis



Energy Consumption vs. Energy Use Intensity





Understanding the Energy Use

We identified a number of “parasitic loads” on the electrical and steam systems. The following summarizes major parasitic loads identified during the project:

Building No.	Load Type	Load Details	Annual Estimated Load
3	Electric	Serves the following miscellaneous loads at Rockefeller Center: • Fountain pumps, • Loading dock and concourse lighting, • Tenants • Loading dock Equipment	2,130,000 kWh
2	Steam	Plaza Restaurants	6,402 Mlbs
7	Electric	Serves 50 Rock Cooling Towers that provide condenser water to 50 Rock, 45 Rock and the central Ice Plant	440,000 kWh
11	Electric	Serves 10 Rock Cooling Towers that provide condenser water to the Central Plant	300,000 kWh

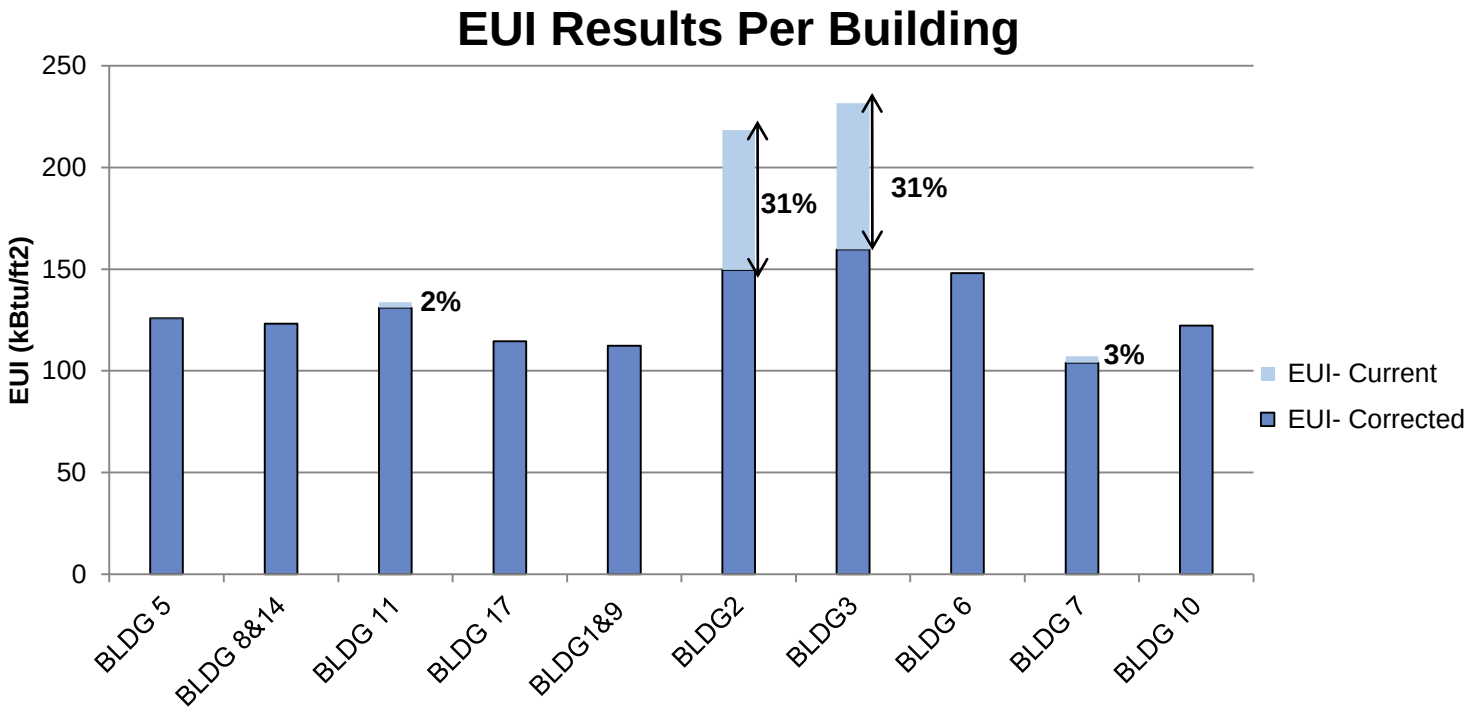
Notes:

1) Building No. 2 &3’s loads were estimated from equipment information, operational hours, and utility bill review.

2) Building No. 7&11’s loads were temporarily sub-metered to establish loads.

“Corrected” EUI Results

- Using the results from the temporary metering analysis, the following figure identifies an EUI reduction for Buildings 2, 3, 7, & 11:



Find the No or Low Cost Opportunities

- AKF performed walk-throughs with facility engineers of all mechanical equipment rooms to determine NLC improvements for the base building equipment. The following typical measures were found:

Measure No.	AHU Measure Description
NLC-01	Repair/seal air leaks at an access doors
NLC-02	**Repair/seal air leaks throughout ductwork**
NLC-03	Repair/replace ductwork insulation
NLC-04	Repair/replace thermal insulation on piping
NLC-05	Repair leaky/faulty valves and/or fittings
NLC-06	**Repair/clean damaged/dirty coils**
NLC-07	**Replace dirty filters**
NLC-08	**Repair loose fan pulleys and/or belts**
NLC-09	Repair noisy fan motors
NLC-10	Repair/replace thermal insulation on an unit casing

*Note: Measures in **blue** contributed most to energy savings.*

Retro-Commissioning Findings

- The following table represents the typical operational improvements identified during functional testing:

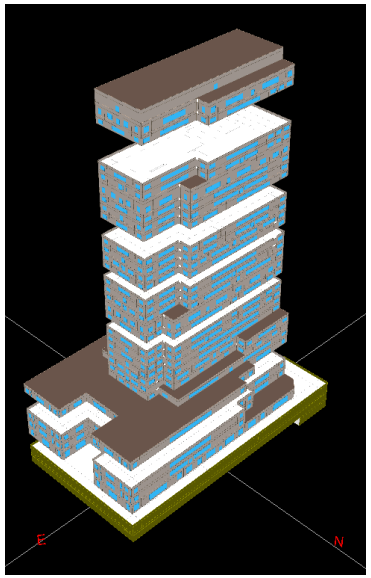
Measure No.	Description
RCx-01	Repair/replace a pump's thermal insulation on piping
RCx-02	**Repair unit damper(s) for proper normal operation (excess OA)**
RCx-03	**Repair unit damper(s) for proper economizer operation (lack of OA)**
RCx-04	Repair unit damper(s) for proper economizer operation (increased SP)
RCx-05	Repair chilled water valve leaking into coil during non-cooling hours (overcooling)
RCx-06	Repair steam valve to prevent overheating
RCx-07	Repair unit spill air damper(s) for proper economizer operation (increased RF SP)
RCx-08	**Recalibrate over-reporting sensor to prevent overheating**
RCx-09	**Recalibrate under-reporting sensor to prevent overcooling**
RCx-10	**Repair open RA damper to prevent excessive use of chilled water during economizer mode**
RCx-11	Remove blockage from the airway's path to reduce SP
RCx-12	**Re-attach SP sensor to fan to allow for variable volume control**
RCx-13	Repair an AHU's or fan's loose fan pulleys and/or belts

*Note: Measures in **blue** contributed most to energy savings.*

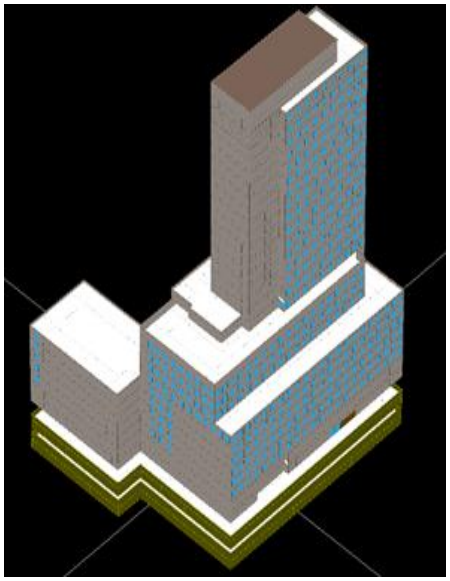
Energy Modeling – Predicting ECM Performance

- Developed (6) energy models to identify typical major end-use (lighting, plug loads, fans, pumps. etc) breakdown for Rockefeller Center buildings.

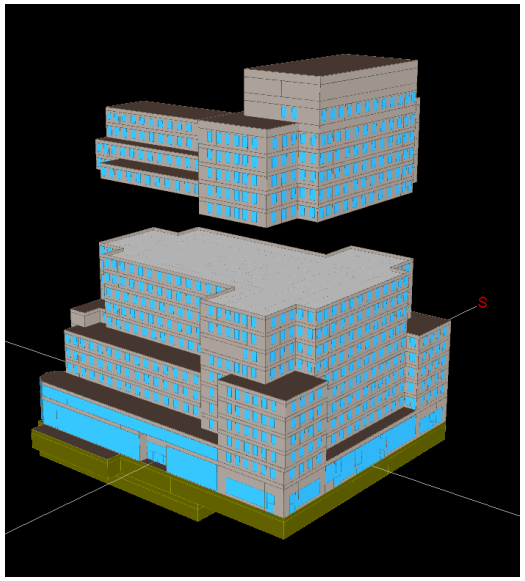
- Calibrated models to be within 5% of annual utility energy consumption and 10% for monthly utility energy consumption.



45 Rock Plaza



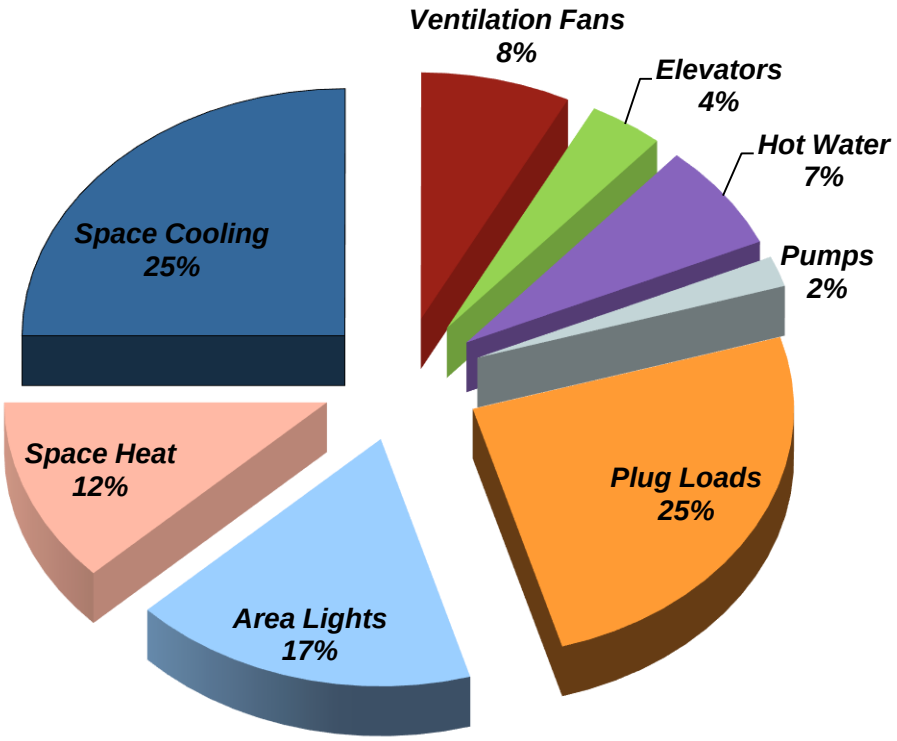
600 5th Avenue



1230 Avenue of the Americas

Modeling Results – End Use Breakdown

- The following represents a typical building's major end-use profiles for Rockefeller Center based on the modeled buildings.



Energy Efficiency Measures Development

List of Central Plant - Recommended ECMs

FIRST PRIORITY ECM RECOMMENDATIONS	
ECM Description	**Simple Payback**
Retrofit Existing 4,000 Ton Electric Chiller (RM-B) with New Complete Driveline Including Motor, Compressor, Control Panel, and VFD	~ 5
Retrofit Existing 2,500 Ton Electric Chiller (RM-D) with New Complete Driveline Including Motor, Compressor, Control Panel, and VFD	~ 3
Rebalance Central Plant Chilled Water and Condenser Water Systems	~ 1
Reset Condenser Water Temperature	~ 1
All First Priority ECMs Combined	**~ 3**

SECOND PRIORITY ECM RECOMMENDATIONS	
PLC Controller on Steam Chiller (RM-A)	~ 4
Trim CW Pump Impellers	~ 4
New 2,500 Ton Chiller	~ 4.5
All Second Priority ECMs Combined	**~ 4**

Energy Efficiency Measures Development

List of Building - Recommended ECMs

FIRST PRIORITY ECM RECOMMENDATIONS	
ECM Description	Simple
Building Chilled Water System Balancing	< 1
Install floor isolation dampers at supply air duct mains for all multifloor AHUs for 610 and 620 5th Ave.	~ 3
Exterior Lighting – Semi-Replacements	~ 1.5
All First Priority ECMs Combined	**~ 1.5**

SECOND PRIORITY ECM RECOMMENDATIONS	
Replace 30 Rock Secondary Chilled Water Heat Exchangers	~ 9
Interior Lighting - Full Replacements	~ 5.5
Recalibrate minimum OA requirements at AHUs and H&V units.	~ 4.5
All Second Priority ECMs Combined	**~ 5**

Energy Efficiency Measures Development

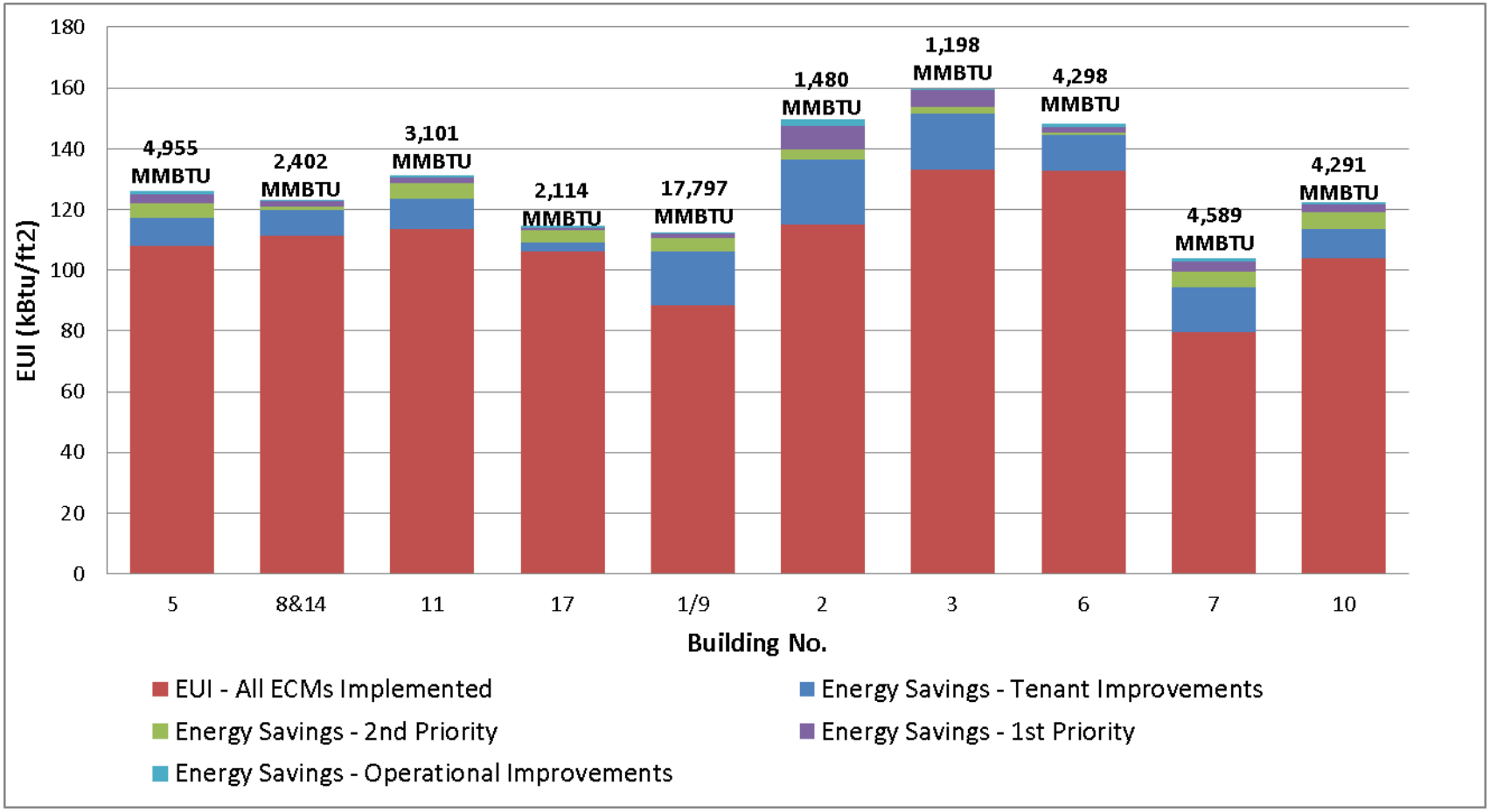
List of Tenant - Recommended ECMs

TENANT RENOVATION ECM RECOMMENDATIONS	
ECM Description	Simple Payback
Convert existing dual duct constant volume air handling systems to variable air volume systems.	~ 3.5
Retrofit existing constant volume air handling systems to variable air volume systems.	~ 15.5
Convert economizer operation from dry bulb to enthalpy-based control.	~ 7.5
Tie Perimeter Heating Controls to Space Thermostats	~ 22
Retrofit existing windows with a new standard performance window ("ClearGlass"). [Low]	~ 14.5
All Tenant Renovation ECMs Combined	**~ 19**

Energy Efficiency Measures Development

All-in Energy Reduction Findings

- The following figure presents the associated EUI reduction per building if all ECMs and operational improvements were implemented:



Moving Forward - Why Stop Here?

- Implementing Study's Findings
  - Central Plant Improvements
  - LED Exterior Façade Lights
- Investigating Additional Technologies
  - Cogeneration
  - Electric Storage
- Installing Permanent Sub-metering
  - Benchmarking
  - Regular monitoring of utility usage
  - Assess opportunities for Control Sequence Improvements
- Global Initiative – "Tishman Speyer University"
  - Training
  - Best Practices
  - Innovation Task Group

Keys to Success

- Business partners (Con Edison, NYSERDA, consultants and vendors)
- Use proven technology (reliability and competitive pricing)
- Implement systems or strategies that complement primary business focus
- Put information to use!
- Commissioning / retro-commissioning and energy audits

This concludes The American Institute of Architects
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