

System Modeling w/ eQUEST to Implement Energy Efficiency Projects

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Introduction

- Why Model?
 - Quantify energy savings
 - Utility Incentives
 - LEED Credits
 - Measure Interaction
 - Code compliance
 - ASHRAE Energy Cost Budget Method
 - NY State EO 111
 - ┌ Whole Building Design
 - Right-sizing
 - System optimization
 - ┌ Predict Operating Costs

Topics

- Energy Modeling
- eQUEST Energy Analysis Tool
- Case Studies

Energy Modeling – Getting Started

- Define Scope
 - Set priorities
- Gather Data
 - Architectural Plans
 - Building geometry
 - Walls/ windows
 - Mechanical Plans
 - Systems
 - Equipment schedules and spec 's
 - Electrical Plans
 - Lighting fixture layout and schedules

Energy Modeling (cont'd)

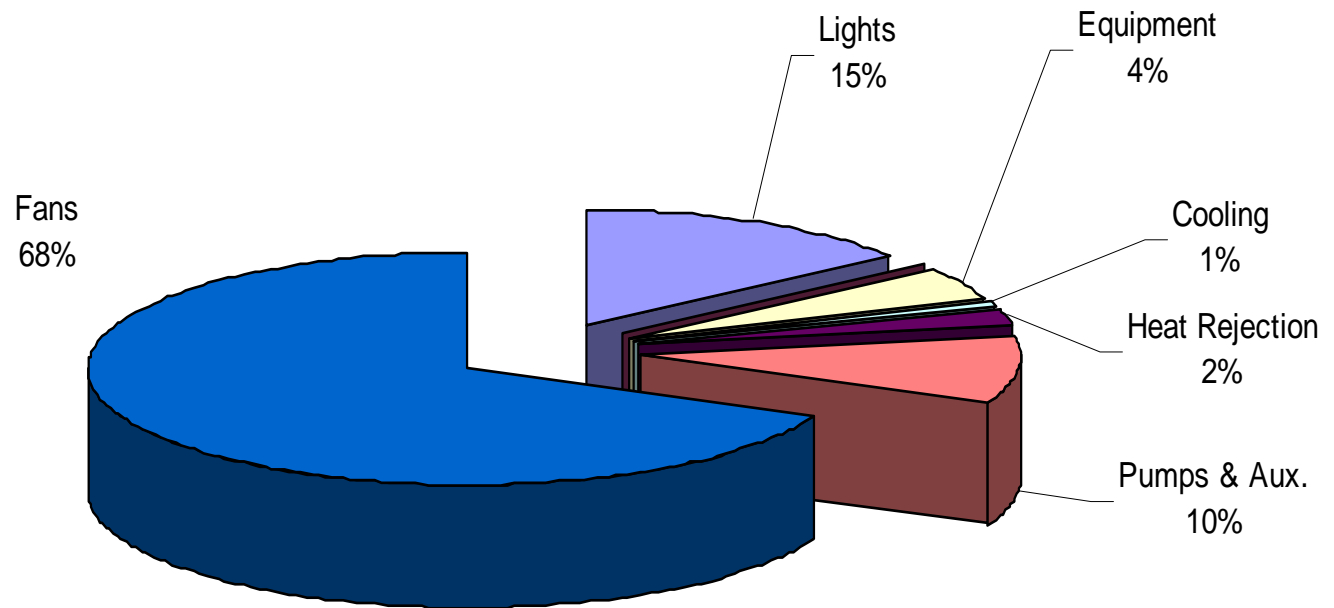
- Internal load data and schedules
 - Lights
 - Equipment
 - People
- Zoning
 - Thermal zones

Create Baseline Model

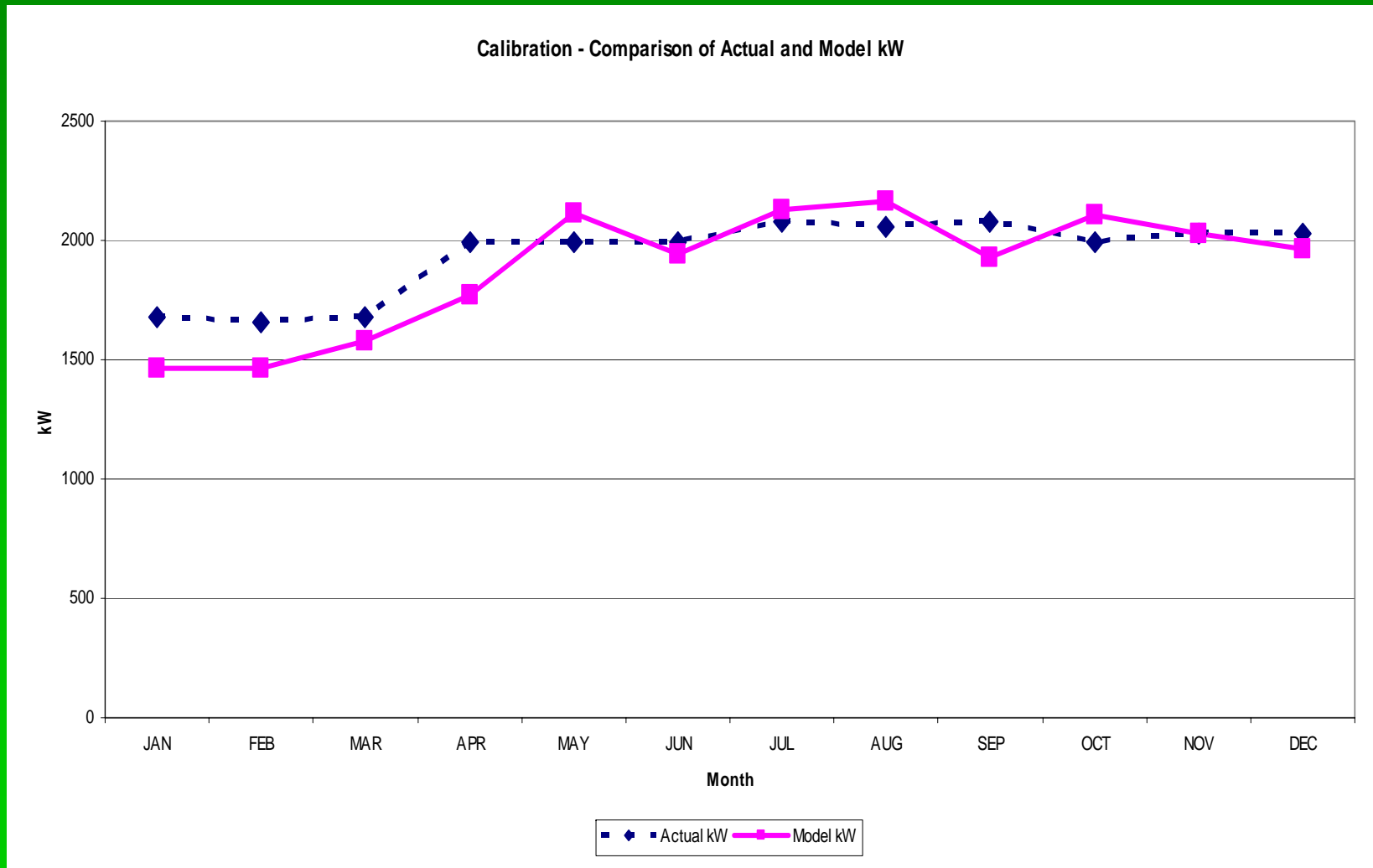
- Building shell / spaces
- Schedules
- Mechanical systems/ equipment

Review Results

Electric Energy Use Components



Calibrate Model



Model Alternatives

- Compare results

Electricity	Base	Lighting Controls	Day Lighting	High Efficiency Lighting	Demand Ventilation	PIU Motors	High Efficiency Chiller
Lights	976,004	894,667	934,845	837,211	976,004	976,004	976,004
Equipment	115,472	115,472	115,472	115,472	115,472	115,472	115,472
Cooling	62,745	61,541	62,564	60,510	60,445	62,463	40,739
Heat Rejection	0	0	0	0	0	0	705
Pumps & Aux.	103,365	103,483	103,556	103,279	103,012	103,643	113,221
Fans	757,393	756,326	757,259	756,814	757,393	711,763	757,393
Total	2,014,979	1,931,489	1,973,696	1,873,286	2,012,326	1,969,345	2,003,534
KWH tot	2,014,980	1,931,488	1,973,696	1,873,285	2,012,326	1,969,345	2,003,534
	\$222,485	\$215,497	\$216,559	\$205,589	\$221,023	\$217,513	\$218,237
Savings		83,492	41,284	141,695	2,654	45,635	11,446
		\$6,988	\$5,926	\$16,896	\$1,462	\$4,972	\$4,248
		\$0.0837	\$0.1435	\$0.1192	\$0.5509	\$0.1090	\$0.3711

eQUEST

- DOE2.2 Based w/ GUI
 - 8760 hr/yr
 - TMY2 weather data
- Includes Wizard
 - Walks you through model creation
 - Energy Efficiency Measures Wizard
 - Limited HVAC measures
- Parametric Analysis in Detail Mode
- Graphic Output

eQUEST (cont'd)

eQUEST DD Wizard: Shell Component -- Shell 1

Zone Group Definitions

Select Zone Group to View/Edit:

- EL1 Ground Floor Core
- EL1 Ground Floor Perimeter
- EL1 Top Floor Core
- EL1 Top Floor Perimeter**

	Activity Area Type	Percent (%)	Area (ft2)	Bldg Pc (%)
1	Office (Executive/Private)	100.0	6,959	70
2	Corridor	0.0	0	10
3	Lobby (Office Reception/Waiting)	0.0	0	5
4	Restrooms	0.0	0	5
5	Conference Room	0.0	0	4

Conditioned
HVAC System: HVAC Wizard 1

Create Zone Grp Delete Zone Grp Zone Group Details...

Ground Floor Top Floor

This Zone Group Other Zone Group(s) Not Assigned to Any Zone Group

Wizard Screen 14 of 25

Help Previous Screen Next Screen Return to Navigator

eQUEST (cont'd)

The screenshot displays the eQUEST software interface for 'Project 4 - eQUEST Quick Energy Simulation Tool'. The main window is titled 'Air-Side HVAC System' and shows a schematic diagram of a 'Pkgd Single Zone' system. The diagram includes components such as an Air Cooled Condenser, Evap or Desic, Pre Heat, DX Cooling Coil, Furnace, Supply Fan, Return Fan, Humid Istat., Nat Vent, System Refrig, System Baseboards, Heat Recovery, and Outside Air Economizer. The system is connected to 'Other Zones' and 'Return' air paths.

On the left side, a tree view shows the project structure, including 'Global Parameter' and multiple 'EL1 Sys1 (PSZ)' units for various zones like 'EL1 South Pe', 'EL1 East Peri', 'EL1 North Pe', 'EL1 West Peri', and 'EL1 Core Zn'.

On the right side, there are two panels:

- Zone Assignments:** A list of zones with checkboxes. The 'EL1 East Perim Zn (G.E2)' is checked. Other zones listed include 'EL1 South Perim Zn (G.S)', 'EL1 North Perim Zn (G.N)', and 'EL1 West Perim Zn (G.W)'.
- Zone Locations:** A 3D wireframe model of the building layout, with a red rectangular area highlighted on the right side.

The interface also features a menu bar (File, Edit, View, Mode, Tools, Help), a toolbar with various icons, and a status bar at the bottom indicating 'Ready'.

Built-in Controls ECM's

- Optimal Start
- Night Setback/ Set-up
- Supply Air Reset
 - Outdoor temperature
 - Scheduled
 - Zone of maximum demand
- Loop Temperature Control
 - Scheduled
 - Reset
 - Load

Built-in Controls ECM's

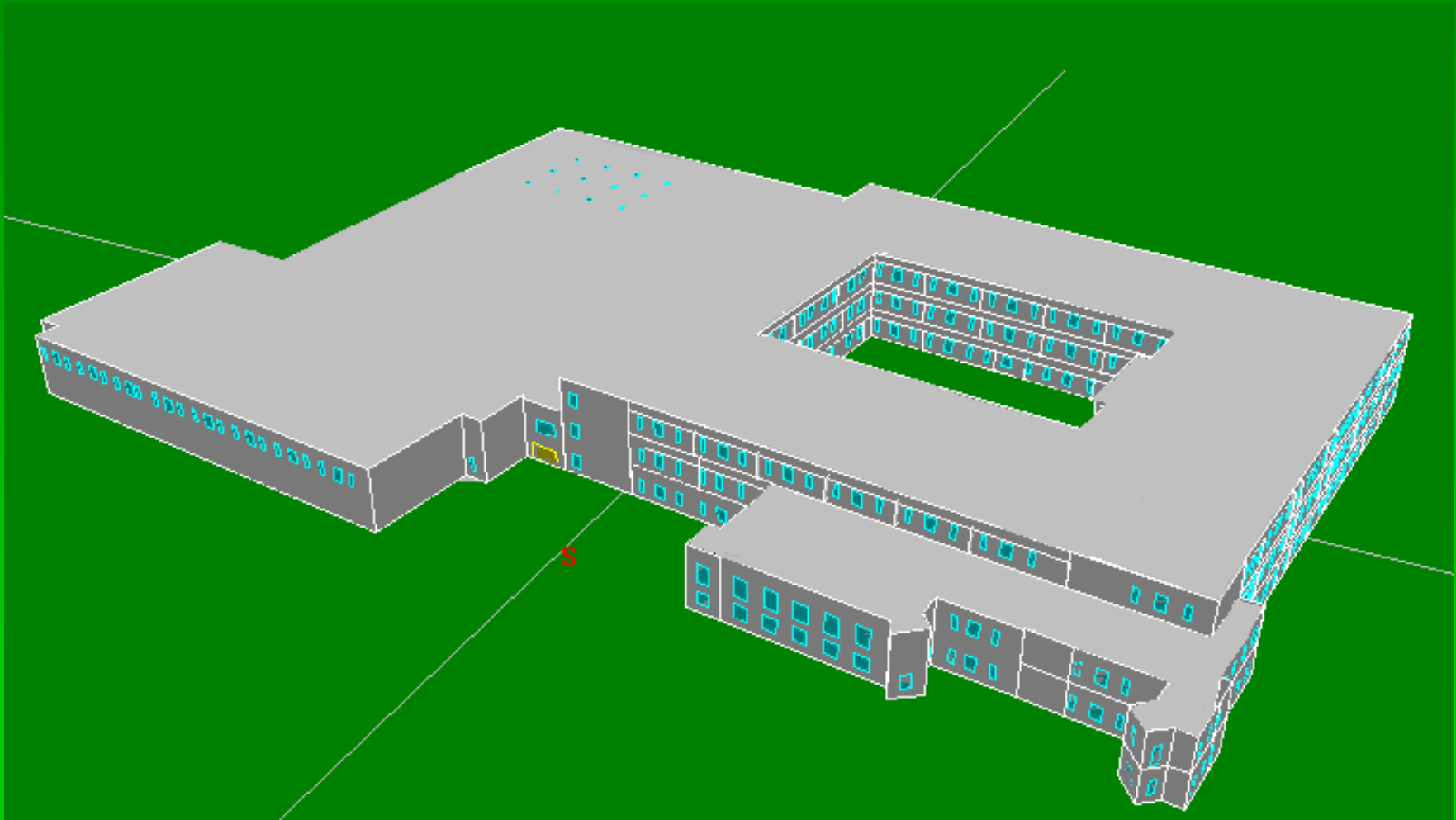
- VFD's
 - Supply/ return air
 - Chilled/ hot/ condenser water loops
- Static Pressure Reset
- Airside Economizers
 - ┆ Dry Bulb (single and dual)
 - ┆ Enthalpy (single and dual)

Other Controls ECM's

- Demand Ventilation
- VAV Fume Hood Exhaust
- Occupancy Based Controls

Whitman-Hanson High School

Whitman, Massachusetts



Whitman-Hanson High School

Whitman, Massachusetts

.234,500 SF

.Annual total energy savings = 39%.

.Total annual energy cost savings = \$ 100,160

.Estimated utility incentives = \$ 440,671

Measures analyzed include:

.High Efficiency Lighting

.Daylight Sensor Lighting Controls for Classrooms and Cafeteria

.Window Upgrade

.VAV System with Optimized Controls

.Hot and Chilled Water Pump VFDs

.Kitchen Hood Controls

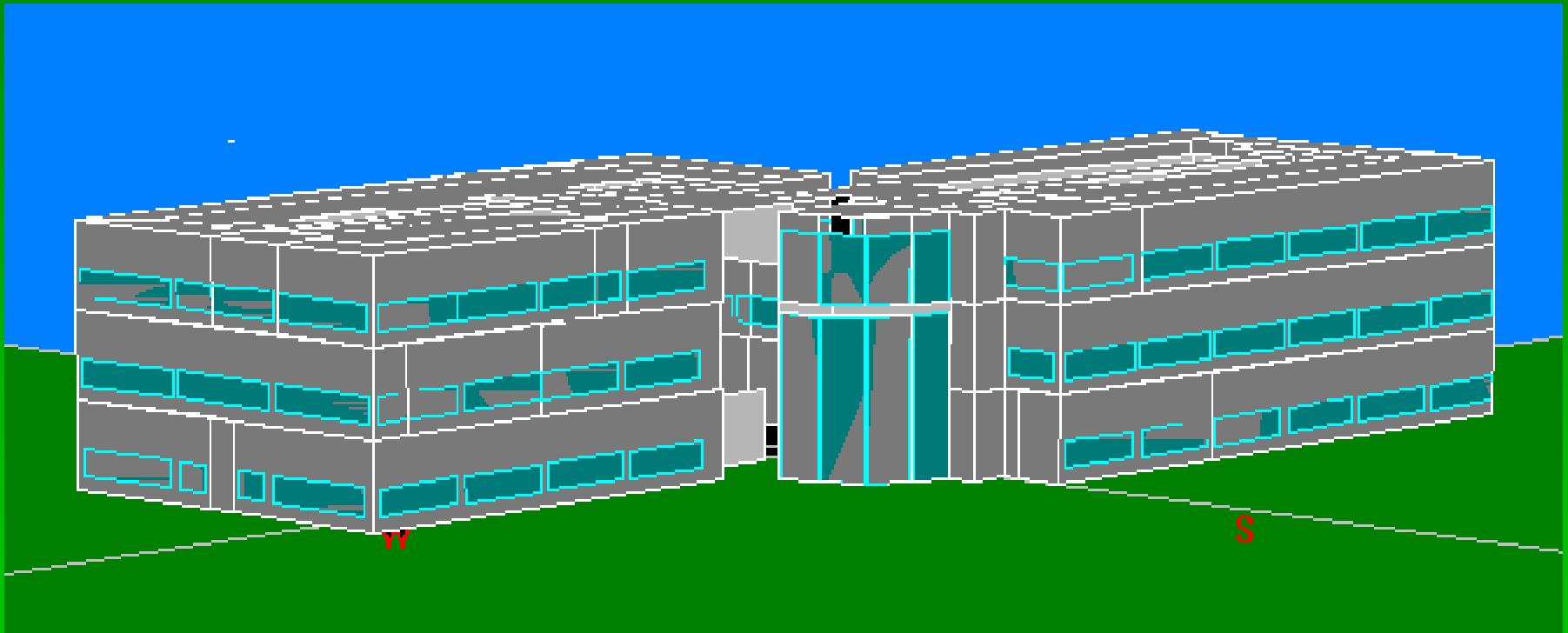
.Optimized Chiller Plant

.Demand Ventilation

.High Efficiency Boilers

.Renewables: Photovoltaic, Wind Turbine

Four BioTech *Worcester, Massachusetts*



Four BioTech

Worcester, Massachusetts

.90,000 SF

.Annual energy savings = 30.2%

.Total annual energy cost savings = \$ 170,557

.Estimated utility incentives = \$ 790,137

Measures analyzed include:

.Water Cooled Chiller

.Fume Hood Retrofit

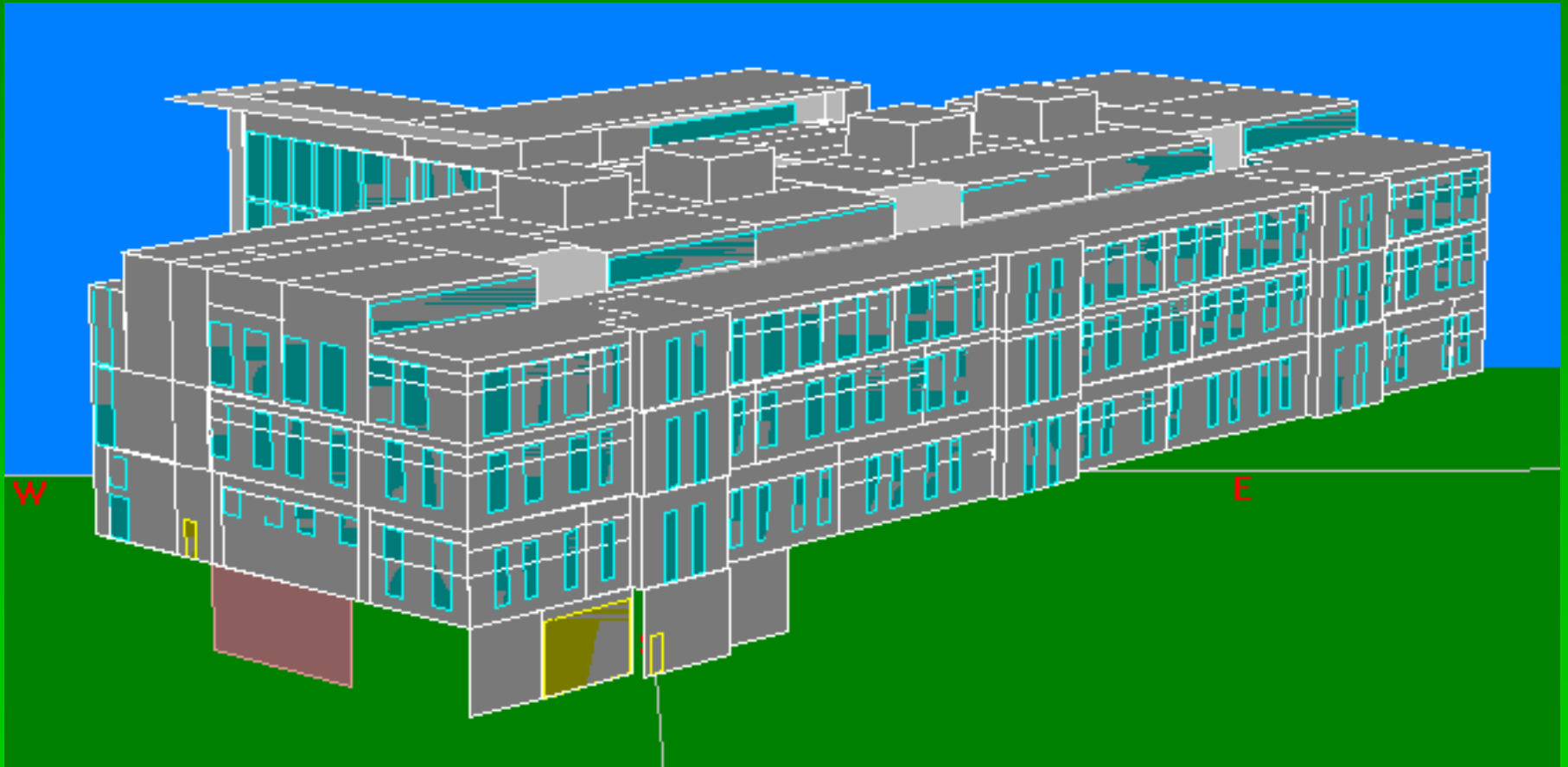
.Water Side Economizer

.Occupancy Sensor Lighting Controls

.Direct Digital Controls for VAVs

Plymouth Court House

Plymouth, Massachusetts



Plymouth Court House

Plymouth, Massachusetts

.140,000 SF

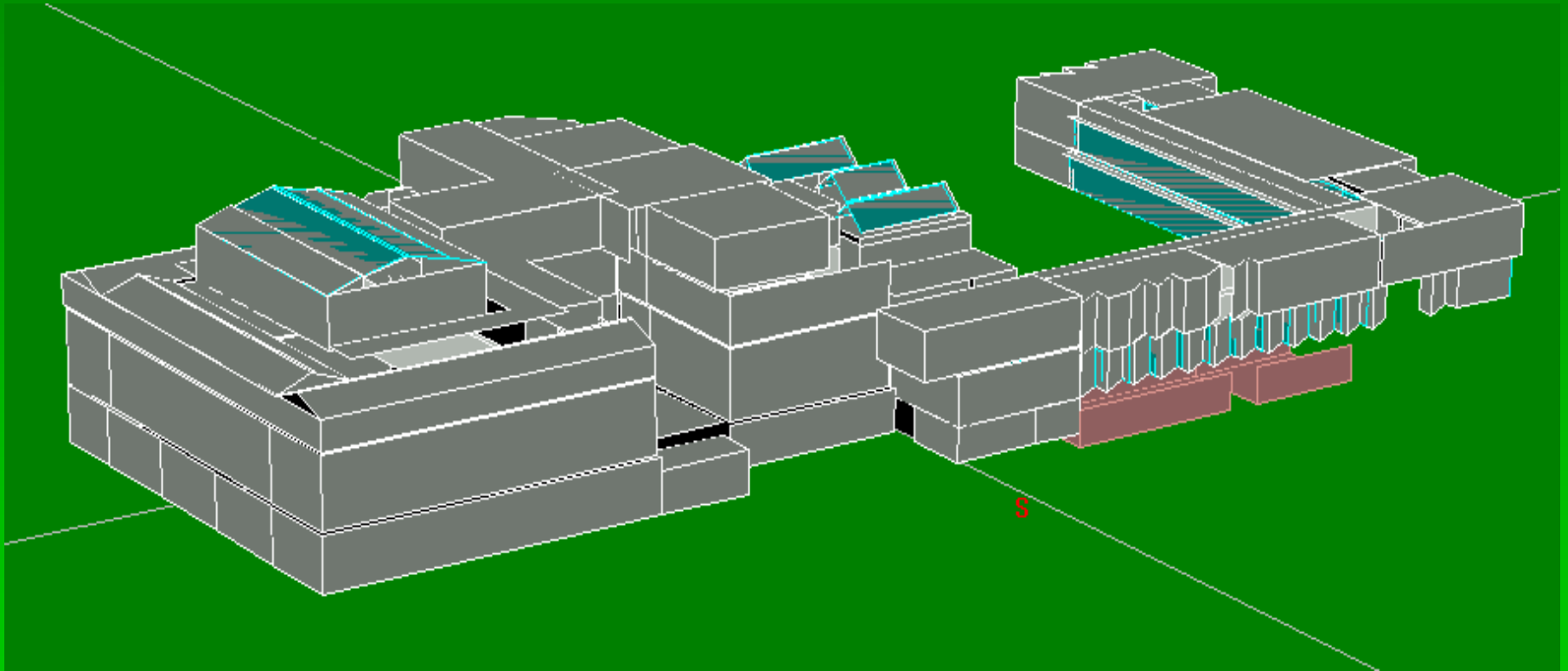
.Annual electric energy savings = 23.5%.

.Annual electric energy cost savings = \$ 42,697

Measures analyzed include:

- .Daylight Sensor Lighting Controls
- .High Efficiency Lighting
- .High Efficiency VSD Chiller
- .Premium Efficiency Motors
- .VAV System Static Pressure Reset
- .High Efficiency Condensing Boilers
- .Demand Ventilation

Worcester Art Museum *Worcester, Massachusetts*



Worcester Art Museum

Worcester, Massachusetts

.120,000 SF

.Annual electric energy savings = 25%.

.Annual electric energy cost savings = \$ 44,986

Measures analyzed include:

.Daylight Sensor Lighting Controls

.High Efficiency Lighting

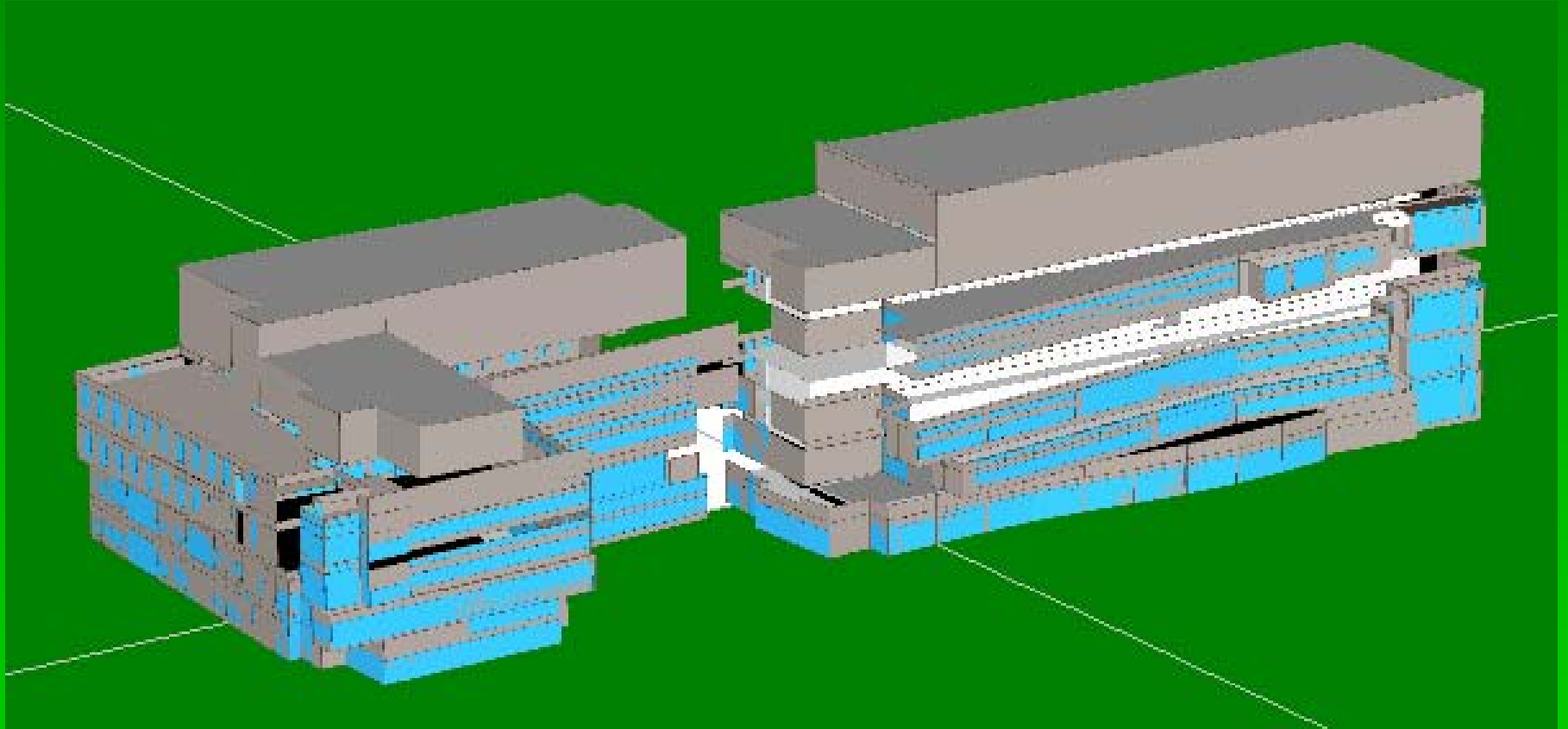
.VAV conversion

.High Efficiency Chiller

.VFDs for Hot Water, Chilled Water, and Condenser Water Pumps.

Buffalo Science Center

Buffalo, New York



Buffalo Science Center

Buffalo, New York

.525,000 SF

.Annual energy savings = 30.3%

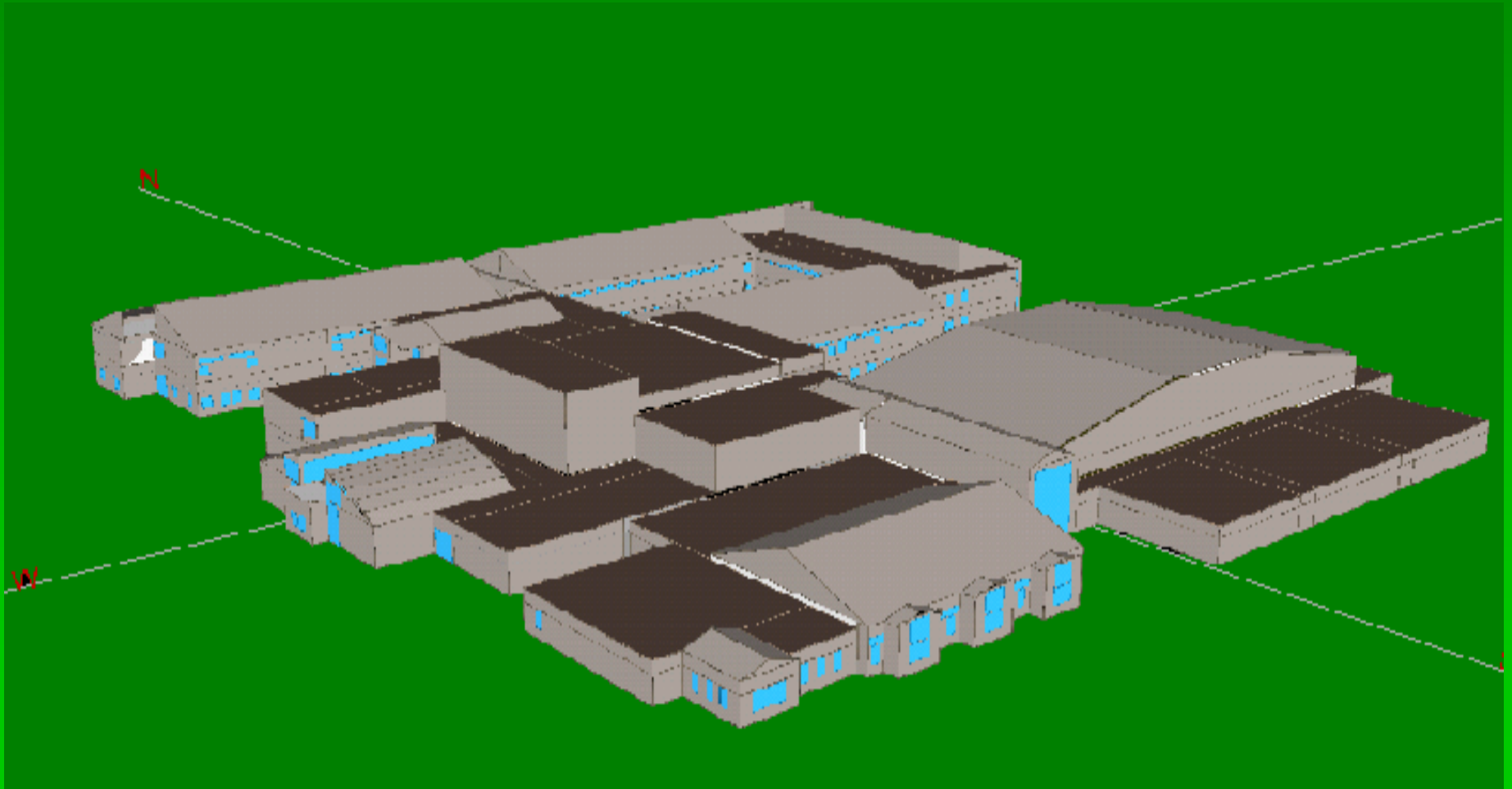
.Qualifies for 4 LEED points for Optimized Energy Performance

Measures analyzed include:

- .High Efficiency Lighting
- .Energy Recovery
- .VFD for HVAC
- .Occupancy Sensor Lighting Controls
- .Premium Efficiency Motors
- .Hot Water Pump VFD
- .Daylight Sensor Lighting Controls

Ashland High School

Ashland, Massachusetts



Ashland High School

Ashland, Massachusetts

.202,465 SF

.Annual total energy savings = 27%

.Total annual energy cost savings = \$ 76,997

.Estimated utility incentives = \$ 431,436

Measures analyzed include:

.Occupancy Sensor Lighting Controls

.Daylight Sensor Lighting Controls for Classrooms and Offices

.High Efficiency Lighting

.Demand Ventilation

.EC Motor for Fan Powered Boxes

.Water Cooled Chiller

.High Efficiency Boilers

.Energy Recovery

.Occupancy Based HVAC Controls

.Pump VFDs

.Daylight Sensor Lighting Controls for Gym, Cafeteria, Library and Corridors

Where to Get More Information

- <http://doe2.com>
- <http://gundog.lbl.gov>
- <http://www.gard.com/ml/bldg-sim.htm>



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