Energy Modeling

YONERGY

Designing Energy Efficient Buildings

By

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Who we are

Established in USA, YONERGY is a leading engineering sustainability consultancy firm. YONERGY provides comprehensive energy efficiency engineering solutions and project coordinated as a multi-disciplined approach.

18 YEARS
USA & GLOBAL EXPRIENCE

$8.3 million
Cost Savings

Over 750
BUILDING ANALYSIS

92 million
kWh Savings

1.1 million m^2
LEED DESIGN

10 MW
SOLAR ENERGY

Today You Will Learn

- ✓What is Whole-Building Energy Modeling?
- ✓Why do you need an Energy Model?
- ✓How can it help you make informed decision?
- ✓When is it required?
- ✓Case Study

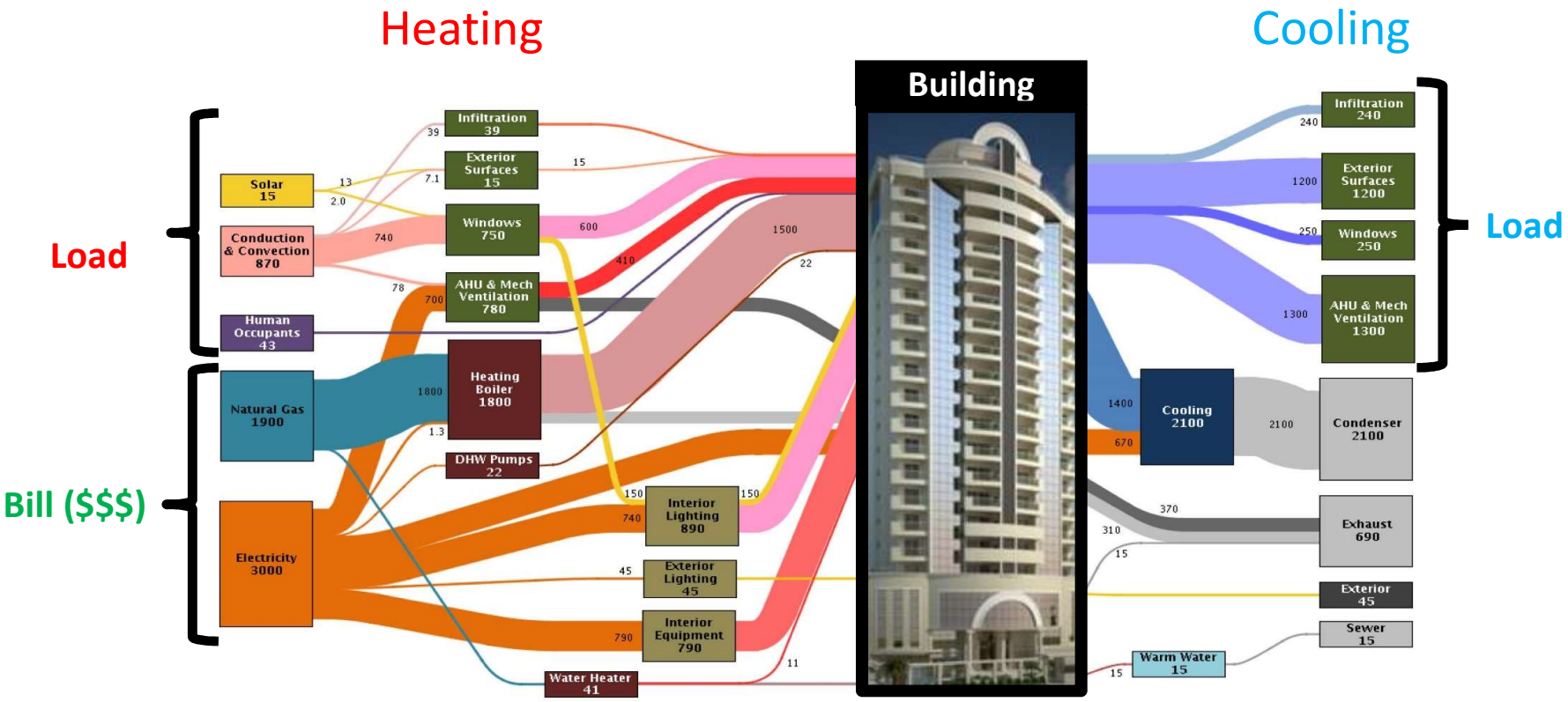
Load

Is this car overloaded?

Energy Load

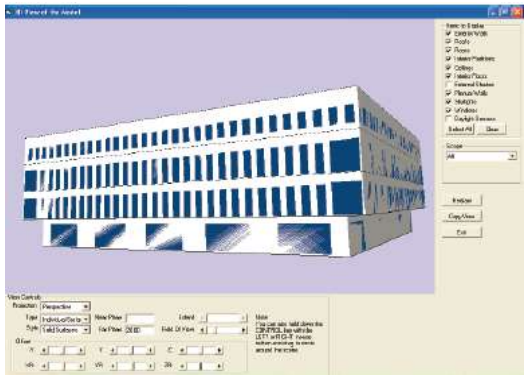
Is this building overloaded?

Energy Load


Heating
Cooling
Building
Load
Bill ($$$)
Load
Solar 15
Conduction & Convection 870
Human Occupants 43
Natural Gas 1900
Electricity 3000
Infiltration 39
Exterior Surfaces 15
Windows 750
AHU & Mech Ventilation 780
Heating Boiler 1800
DHW Pumps 22
Interior Lighting 890
Exterior Lighting 45
Interior Equipment 790
Water Heater 41
Infiltration 240
Exterior Surfaces 1200
Windows 250
AHU & Mech Ventilation 1300
Cooling 2100
Condenser 2100
Exhaust 690
Exterior 45
Sewer 15
Warm Water 15

What is an Energy Modeling?

It is usually an attempt to simulate the energy consumption of a yet-unbuilt building.



It is a tool for:

- Estimating energy use of a building
- Complying with standards to meet efficiency goals
- Optimizing economic and energy performance

It is a good predictor of the overall energy performance of a building.

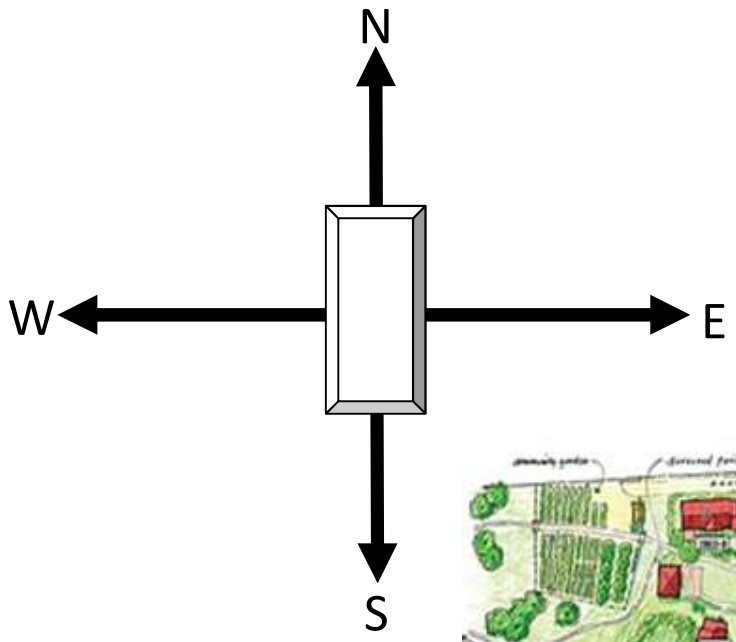
Why do you need an Energy Model?

Simply to reduce the operational cost of a building!

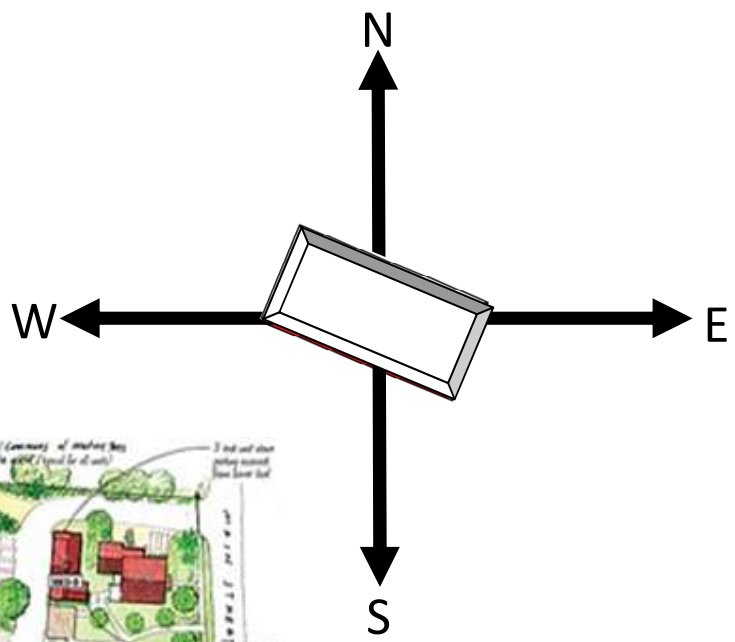
- To make informed energy decisions from the earliest phases
- Guide the design team and owner focus on energy-use reduction
- Assess and predict performance of projects
- Evaluate design alternatives throughout programming, design, construction, operation—as well as retrofit

How can it help you make informed decision?

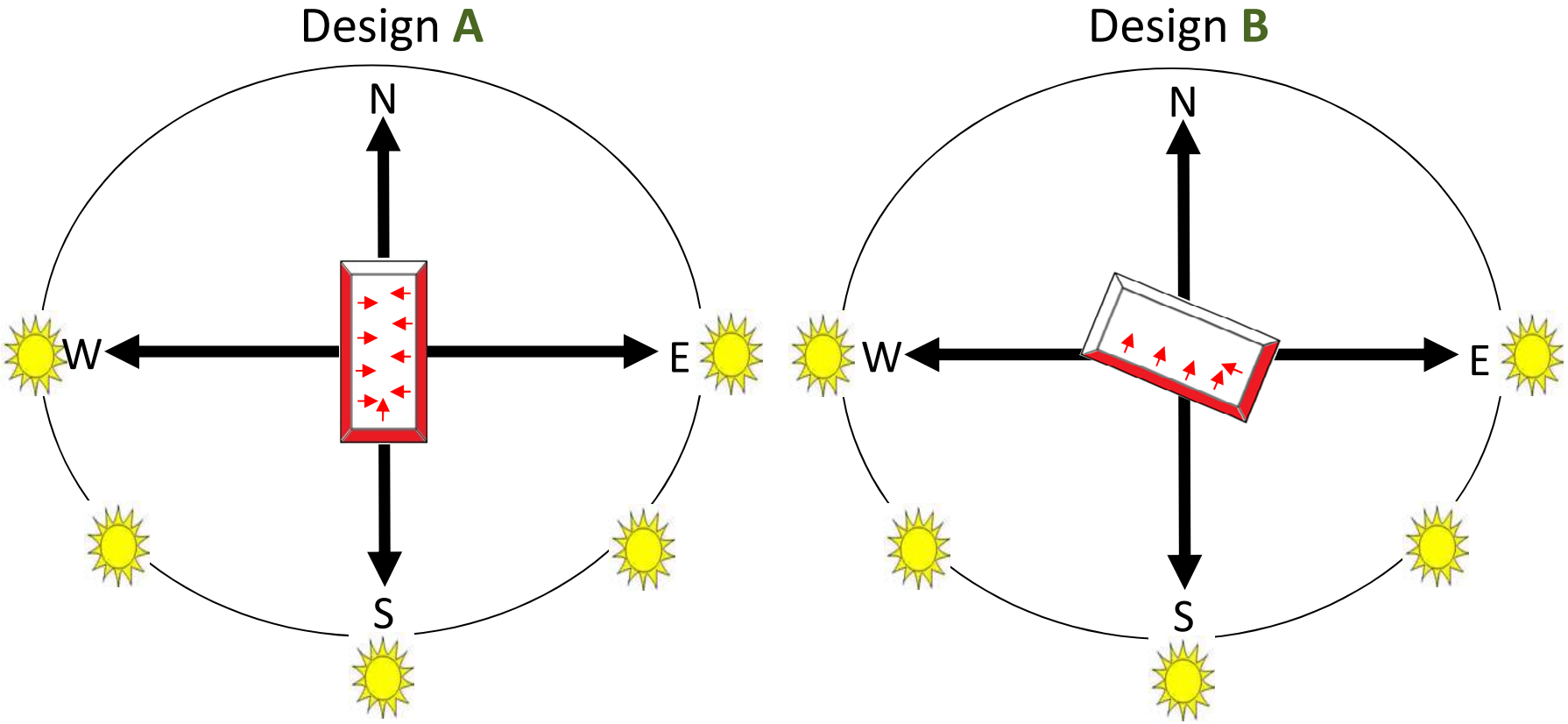
Design **A**



Design **B**

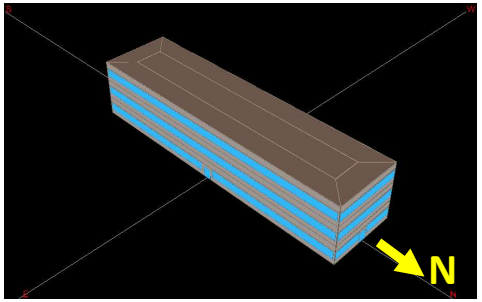


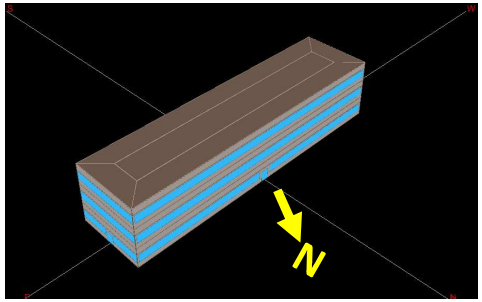
Example: making decision on building orientation



Example: making decision on building orientation

Note: 9,290 M^2 building located in hot climate.

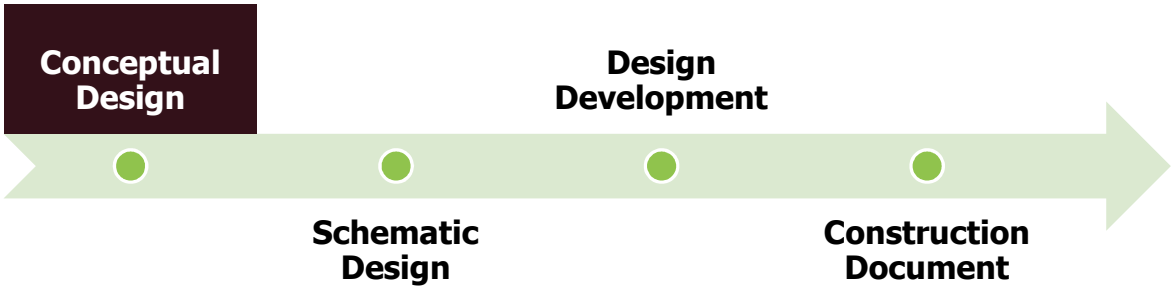




	Design A	Design B
Energy cost ($/$M^2$/year)	$26.26	$24.97
Energy cost per year	$244,000	$232,000
Life-cycle energy cost (100 years)	$24.4 million	$23.2 million
Ten (10) similar buildings	$244 million	$232 million
Life-cycle Cost Savings	-	$12 million

- As simple as building orientation can save you millions of dollars in the long run.
- Energy modeling help you avoid from constructing a wrong building

When to start Energy Modeling?

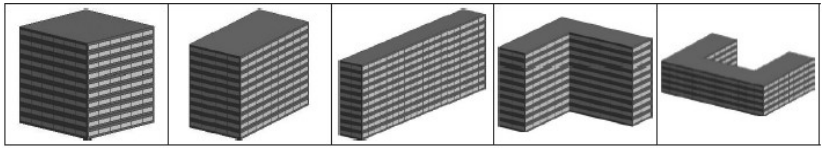


- Ideally, you should start energy modeling at the conceptual design stage. During the conceptual design of the project, energy modeling can provide you valuable input. Such as:

✓ The effects of site location

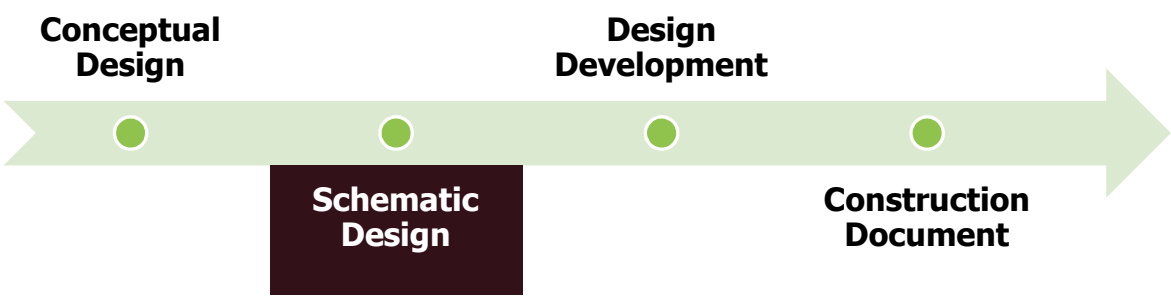
✓ Building shape

✓ Building orientation



- When just 1% of a project's up-front design costs are spent up-to 70% of its life time costs may already be committed

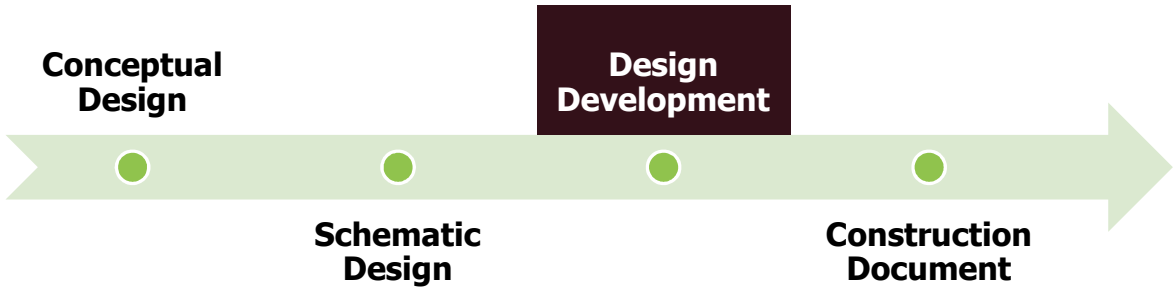
Energy Modeling is continuous process



- During schematic design, to guide those involved in the design process to optimize their focus on the most promising energy-saving strategies

- Seeing how the energy consumption of a building breaks down by fuel type, task, and building component allows the design team to focus on the major drivers of energy use

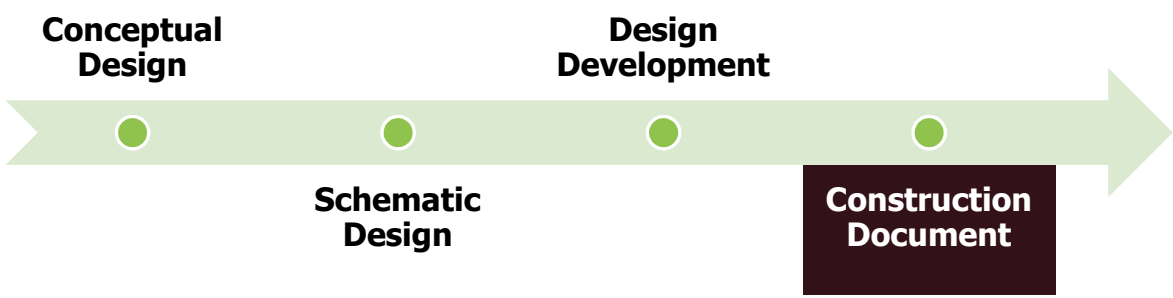
Energy Modeling is continuous process



- During design development, energy modeling permits a diagnostic testing that allows a better understanding of the energy use of each building component

- A series of simulations are done in which one component of input is set to constant. When the results are viewed, a clearer picture of how the building uses energy emerges

Energy Modeling is continuous process



- During the construction document phase, energy modeling allows comparison of the proposed design to the minimally code-complaint base-case building, to study theoretical energy use.

- Energy modeling can be used as a tool to test the building performance with regards to an established standard, and/or to compare different building systems.

Case Study

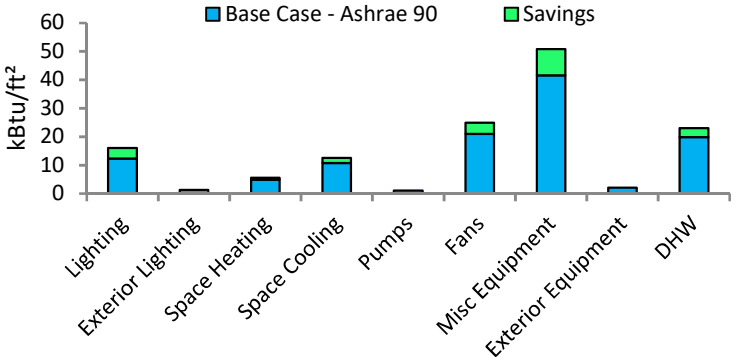
Project Summary | Low Energy Multifamily

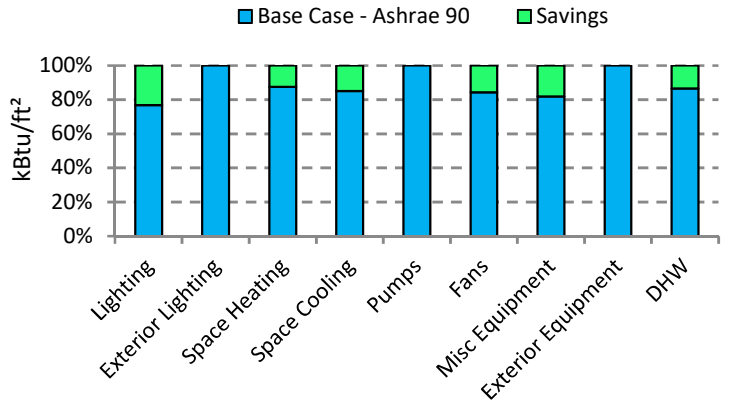
Building Type: Multi Dwelling Units
Location: California
# of Units: 400
Unit Sizes: 950 -2,300 sqft
Annual Cost Savings: $257,000

The multi dwelling building was evaluated against the Performance Rating Method of the ASHRAE/IESNA Standard 90.1-2004 Appendix G standard to determine compliance with LEED-NC v. 2.2 EAp2: Minimum Energy Performance and possible LEED points under EAc1: Optimize Energy Performance. Based on total building costs, the design building is 26.96% more efficient than the LEED baseline building.

Energy Conservation Measures (ECMs)

- **Lighting:** Energy Efficient Lighting o(Lower lighting power density (0.5 watt/ft2 instead of 0.7 watt/ft2)
- **Roof:** Wood frame with R-30 ceiling insulation instead of R-15 insulation
- **Wall:** Wood frame with R-19 wall insulation instead of steel frame with R-16.8
- **Window:** Low-E windows with U- factor = 0.35 BTU/hr-ft2-°F and solar heat gain coefficient = 0.39 instead of U-factor = 0.57 BTU/hr-ft2-°F and solar heat gain coefficient = 0.39
- **Heat Pump System:** Heat Pumps with 13.00 SEER rating instead of 9.9 SEER rating
- **Domestic Hot Water :** 95% efficient, high delta temperature boilers instead of 80% efficient standard boilers.





Components of Energy Modeling

- Weather Data
- Ground Temperatures
- Building Geometry
- Window Areas
- Constructions, wall, roof, floor
- Thermal Zoning
- Plug Loads (Electric / Gas)
- Miscellaneous Electrical Loads
- People Activity
- Lighting Type
- Infiltration
- Daylighting Configuration
- Occupancy and operation Schedules
- HVAC Systems
  - Fans
  - Boilers
  - Chillers
  - Energy Recovery
  - CAV/VAV/etc.
- Ventilation Requirements
- Exhaust Requirements
- Control Sequences
- Temperature Set Points
- DHW
- Utility Rates
- … and more

Conclusions / Recommendations

Energy modeling is useful for evaluating designs in both new and major renovation projects.

- Start early during master planning to meet set goals and team alignment
- Engaged expertise and stakeholders early & throughout
- Communicate regularly and effectively with Planners, Architects, Designers, and Developers
- Recognize design integration issues

Questions?

Thank You!

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