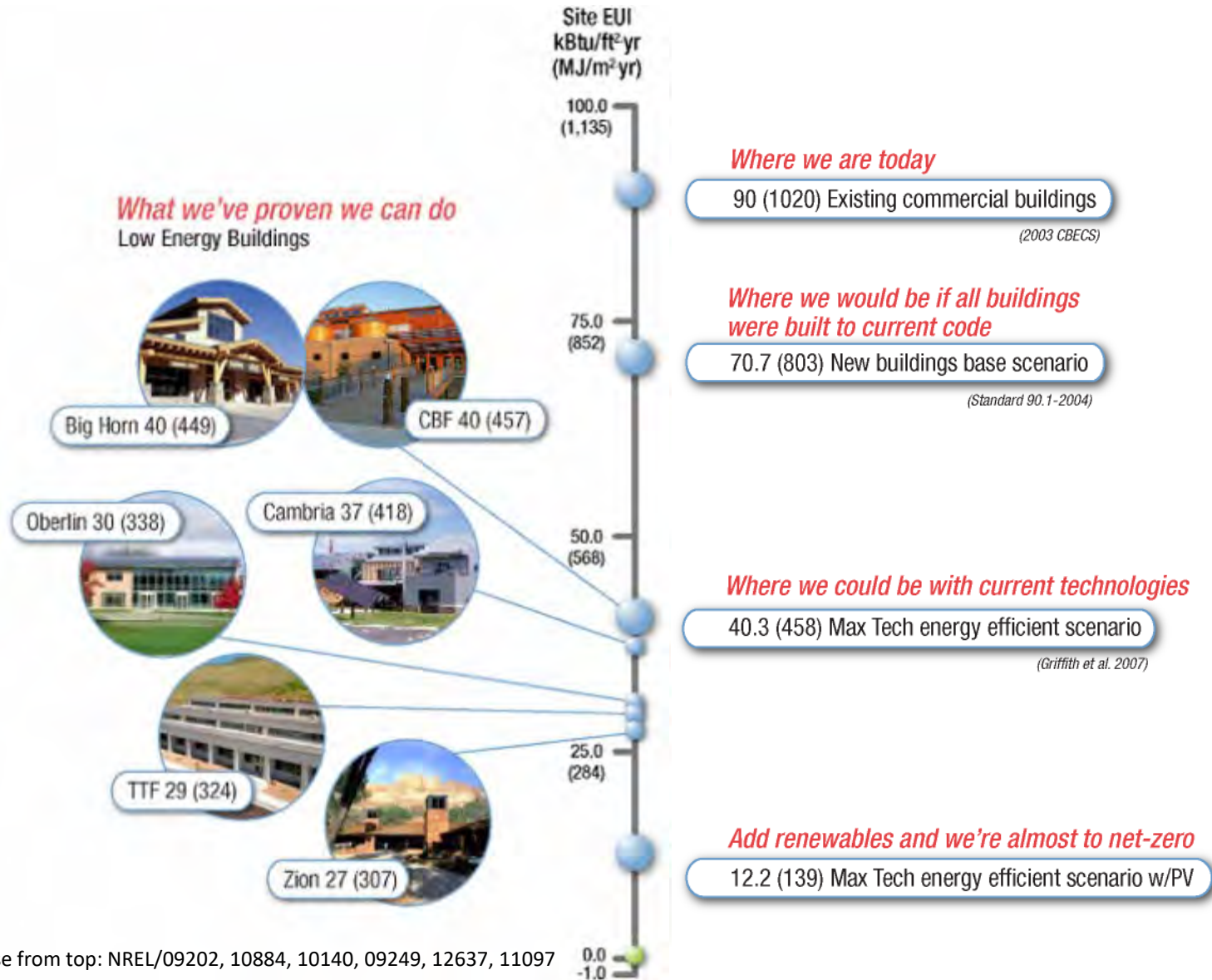


# Great potential in commercial buildings



Clockwise from top: NREL/09202, 10884, 10140, 09249, 12637, 11097

# Many Pieces

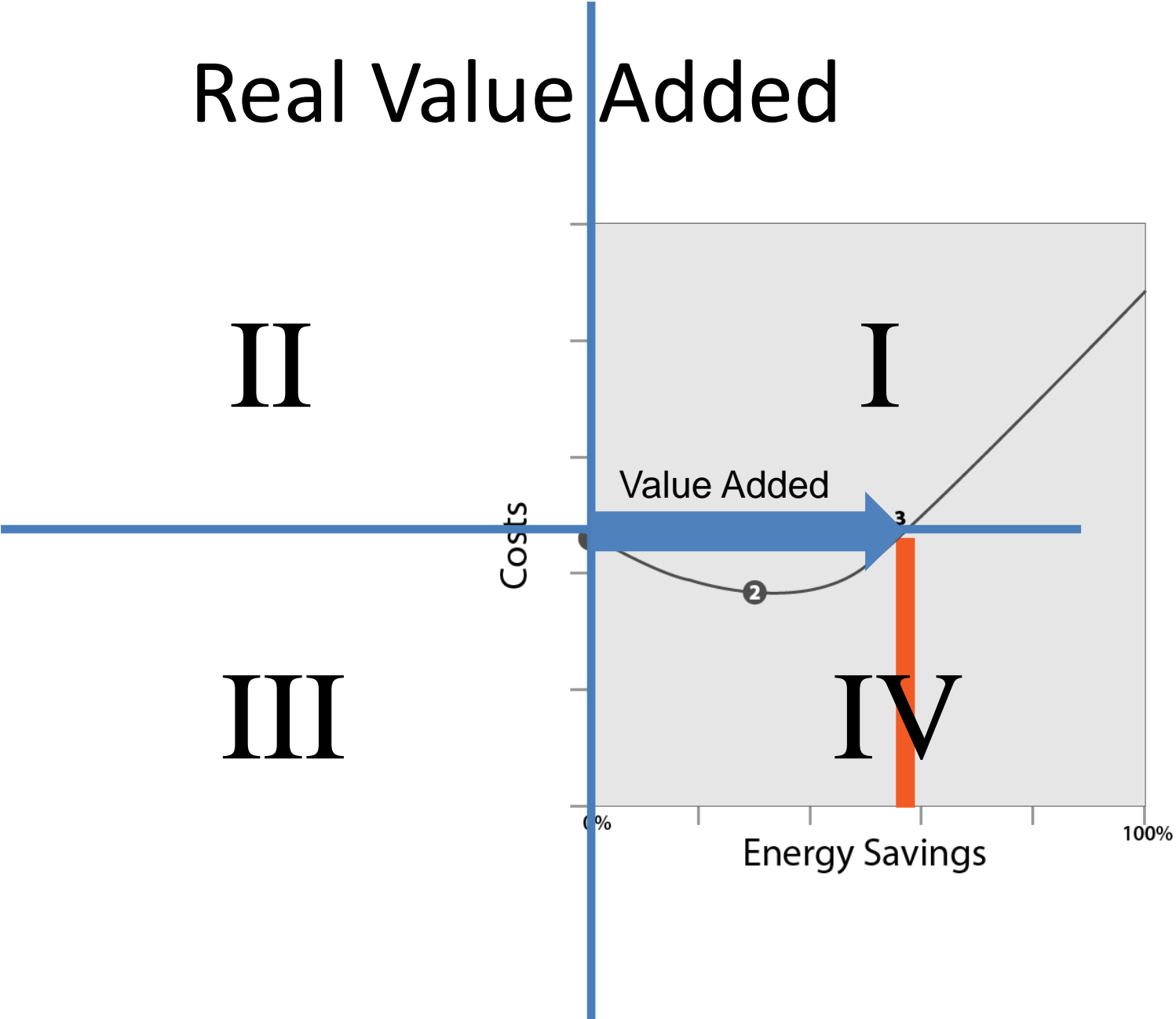
- So many ways to assemble the pieces
- Design is about making decisions – need motivation to make the right decisions
- Who are the decision makers?
- Today's decisions mortgage the energy futures of the world.





- RSF uses 50% less energy than if it were built to current commercial codes at no extra capital cost
- RSF increases space at NREL by 60% but only increases energy use by 6%

# Real Value Added



# The Process

- Owner made tough decisions up-front
  - Set budget
  - Sought maximum value for that budget
  - Prioritized goals
- Created a Performance Based RFP
  - Managed the team to the RFP and its substantiation criteria
  - Rewards
- Allowed contractor team to use creativity to maximize value--innovation
- Owner did not solve the problem (but knew the solution existed)

# Problem Definition: RFP Objectives

## MISSION CRITICAL

Attain safe work performance/Safe Design Practices

## **LEED Platinum**

Energy Star “Plus”

## HIGHLY DESIRABLE

800 staff Capacity

## **25 kBTU/ft<sup>2</sup>/year**

Architectural integrity

Honor future staff needs

Measurable ASHRAE 90.1

Support culture and amenities

Expandable building

Ergonomics

Flexible workspace

Support future technologies

Documentation to produce a “How to” manual

“PR” campaign implemented in real-time

Allow secure collaboration with outsiders

Building information modeling

Substantial Completion by 2010

## IF POSSIBLE

## **Zero energy**

**Most energy efficient building in the world**

## **LEED Platinum Plus**

## **ASHRAE 90.1 + 50%**

Visual displays of current energy efficiency

Support public tours

Achieve national and global recognition and awards

Support personnel turnover

# Problem Definition: RFP Objectives



MISSION  
CRITICAL

- Attain safe work performance/  
Safe Design Practices
- **LEED Platinum**
- ENERGY STAR “Plus”

# Problem Definition: RFP Objectives

**HIGHLY  
DESIRABLE**

- 800 staff capacity
- **25kBTU/sf/year**
- Architectural integrity
- Honor future staff needs
- Measurable ASHRAE 90.1
- Support culture and amenities
- Expandable building
- Ergonomics
- Flexible workspace
- Support future technologies
- Documentation to produce a “How to” manual
- “PR” campaign implemented in real-time
- Allow secure collaboration with outsiders
- Building information modeling
- Substantial completion by 2010



# Problem Definition: RFP Objectives

**IF  
POSSIBLE**

- **Net Zero/design approach**
- **Most energy efficient building in the world**
- **LEED Platinum Plus**
- **ASHRAE 90.1 + 50%**
- Visual displays of current energy efficiency
- Support public tours
- Achieve national and global recognition and awards
- Support personnel turnover

# Owner Role

- Spend the time to get RFP right
  - Design/build team will study to pass the test
- Set up acquisition process to “force” integrated design
  - Energy modeling guides conceptual design decisions
  - Architecture and envelope are also efficiency measures



# Owner Role

- Unwavering commitment to problem statement
  - Unleash power of design/build team of experts to meet your needs
    - true value engineering
  - Commit to your objectives and the prioritization and don't adjust



Clockwise from top:  
NREL/18784, 24690, 17823

# Guidance for Unknowns

- Benchmarked current plug loads and data center load
  - Provided peak uses and occupancy schedule by plug load type
    - Laptops, monitors, copiers, kitchen equipment, task lights, etc.
    - 65 Watts/occupant 24/7 for datacenter
  - Allowed design-build team to make recommendations on plug load reductions.



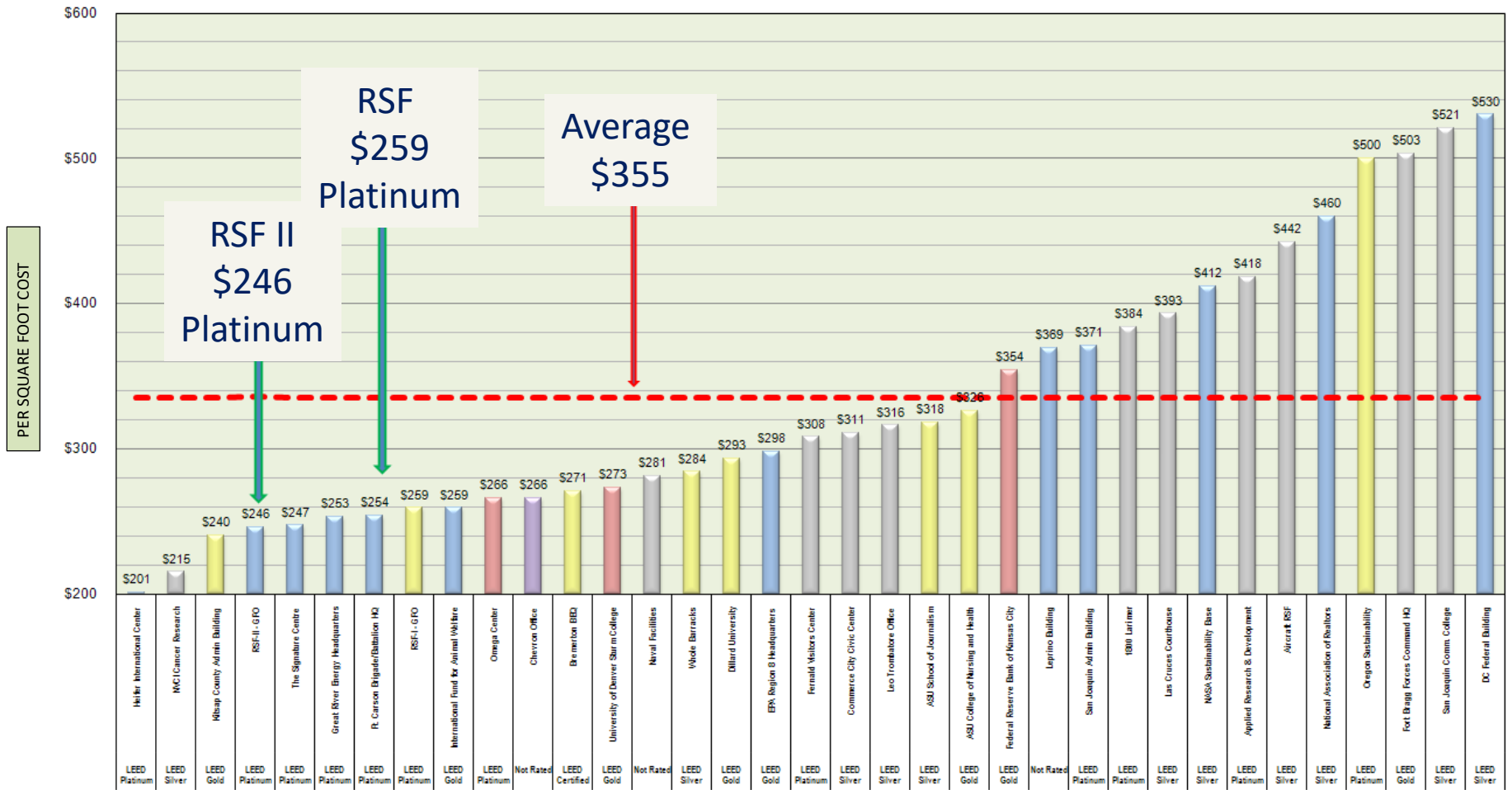
NREL/15884

# Steps...

- RFQ: Short list to 3 teams
- Pay for conceptual design (share the risk)
- Select best value for fixed price
- Incentives
- Require substantiation



# COMMERCIAL BUILDING CONSTRUCTION COST



## LEGEND:

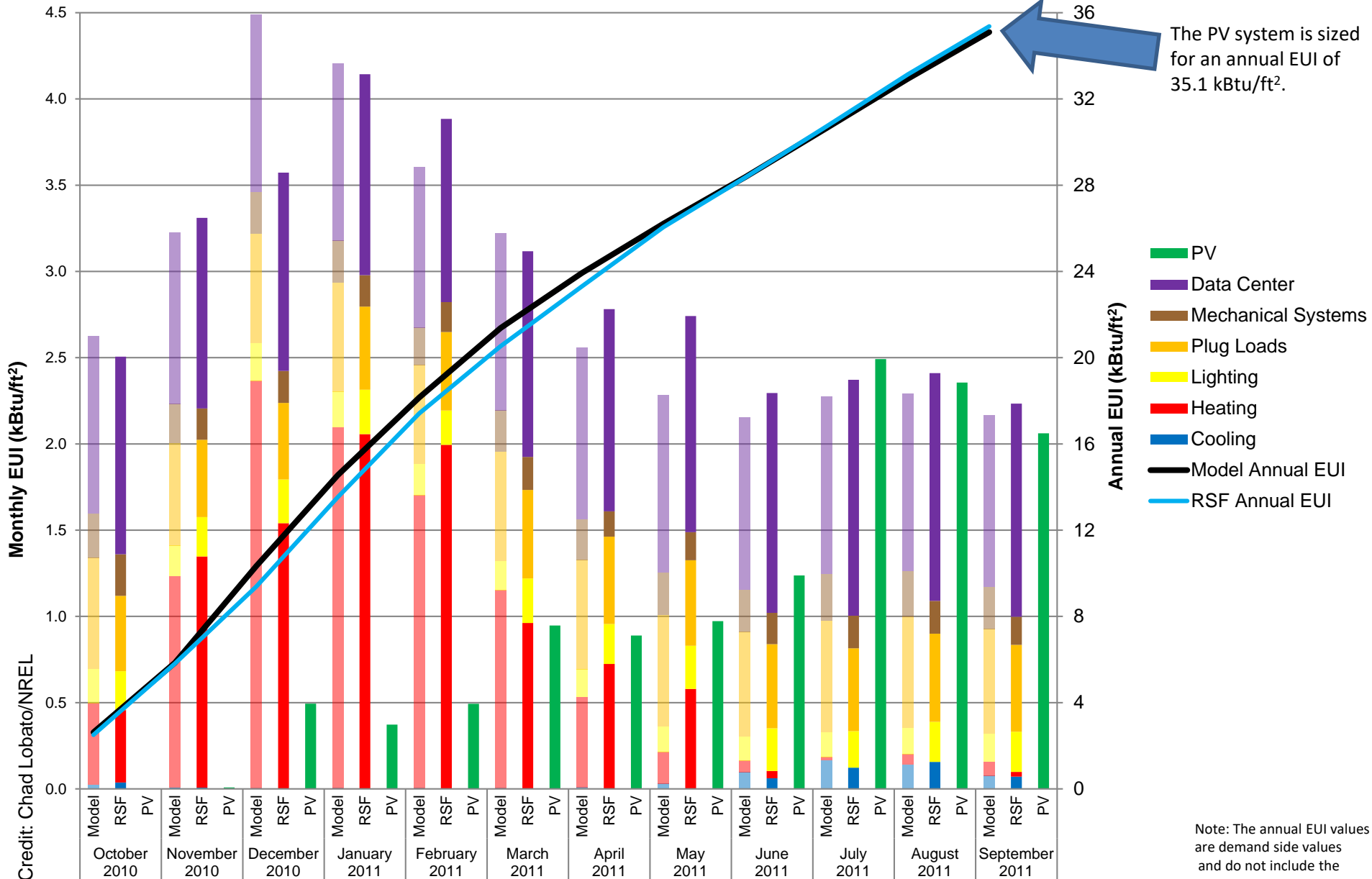


## PROJECTS AND LEED CERTIFICATION

## SOURCES:

- [www.fayobserver.com](http://www.fayobserver.com)
- [www.dbia.com](http://www.dbia.com)
- [www.nasa.gov](http://www.nasa.gov)
- [www.eomega.org](http://www.eomega.org)
- [www.oregonustainabilitycenter.org](http://www.oregonustainabilitycenter.org)
- [www.americas.rlb.com](http://www.americas.rlb.com)
- <http://greensource.construction.com>
- [www.1800larimer.com](http://www.1800larimer.com)
- [www.usgbc.org](http://www.usgbc.org)
- [www.smithgroup.com](http://www.smithgroup.com)
- [www.cronkite.asu.edu](http://www.cronkite.asu.edu)

# Measured Versus Modeled Monthly and Cumulative EUI



# Research Support Facility

- 800 people
- 220,000 ft<sup>2</sup>
- 25 kBtu/ft<sup>2</sup>
- 50% energy savings
- \$259/ft<sup>2</sup>
- LEED Platinum
- Replicable
  - process
  - technologies
  - cost
- Site, source, carbon, cost ZEB
  - Includes plugs loads and datacenter
- Design/Build Process with required energy goals



Credit: Frank Rukavina- NREL



Credit: NREL PIX

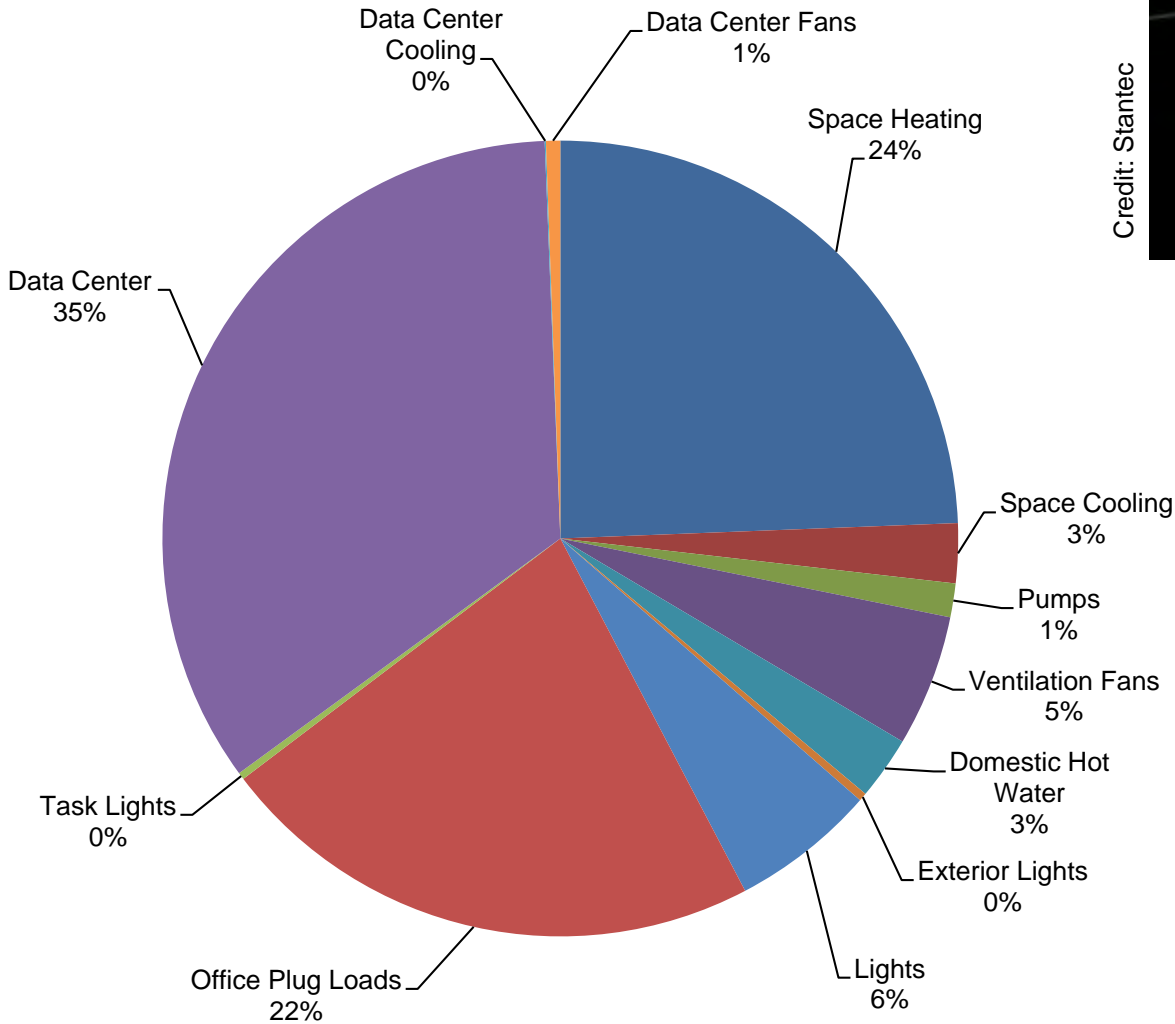


# Is this photo significant?



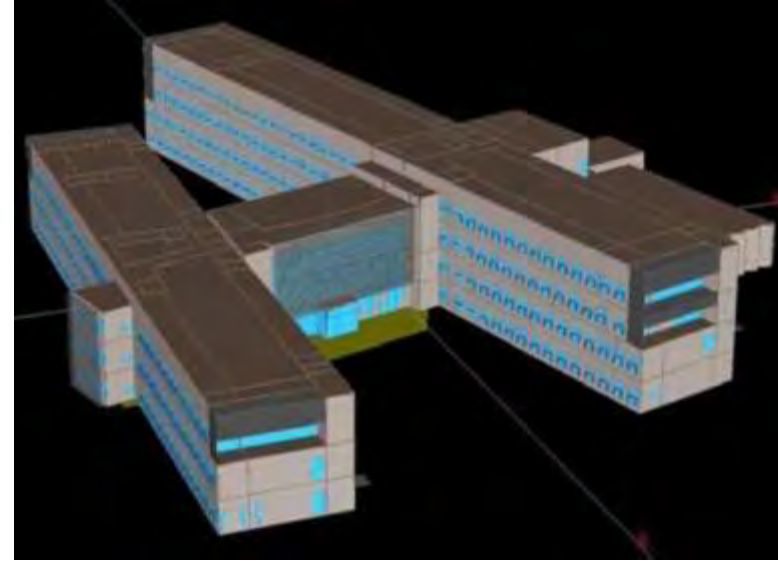
# RSF Energy Modeling

## NREL RSF Energy Use Breakdown



Credit: Chad Lobato/NREL

Credit: Stantec



End Use	kBtu/ft <sup>2</sup>
Space Heating	8.58
Space Cooling	0.85
Pumps	0.48
Ventilation Fans	1.88
Domestic Hot Water	0.90
Exterior Lights	0.12
Lights	2.07
Office Plug Loads	7.87
Task Lights	0.10
Data Center	12.11
Data Center Cooling	0.02
Data Center Fans	0.20

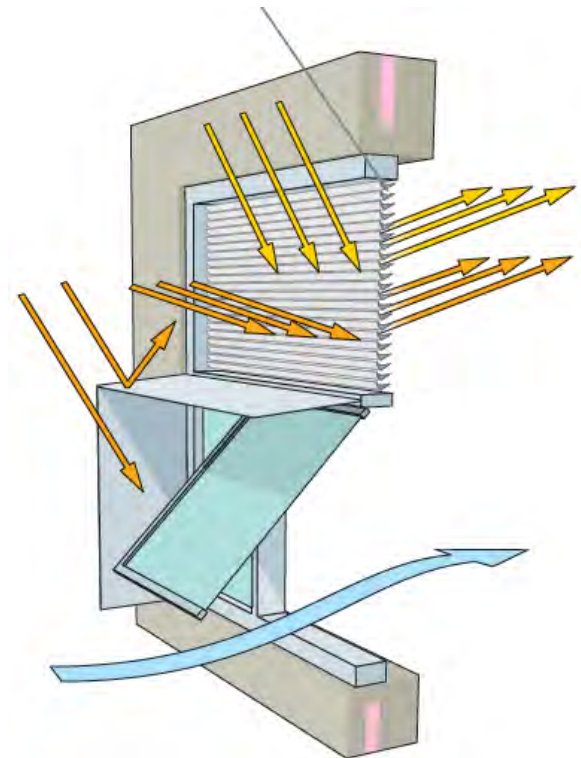
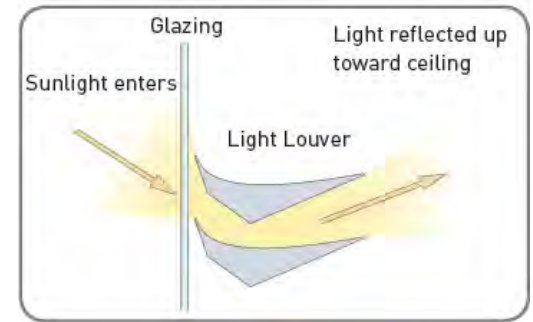
# Window Design



NREL/17900

A light redirecting device reflects sunlight to the ceiling, creating an indirect lighting effect.

Fixed sunshades limit excess light and glare.



Credit: RNL

60 Feet Wide

PV System

Natural Ventilation

Thermal Mass

Transpired Collectors

Daylighting

Thermal Bridging

Enhanced Envelope

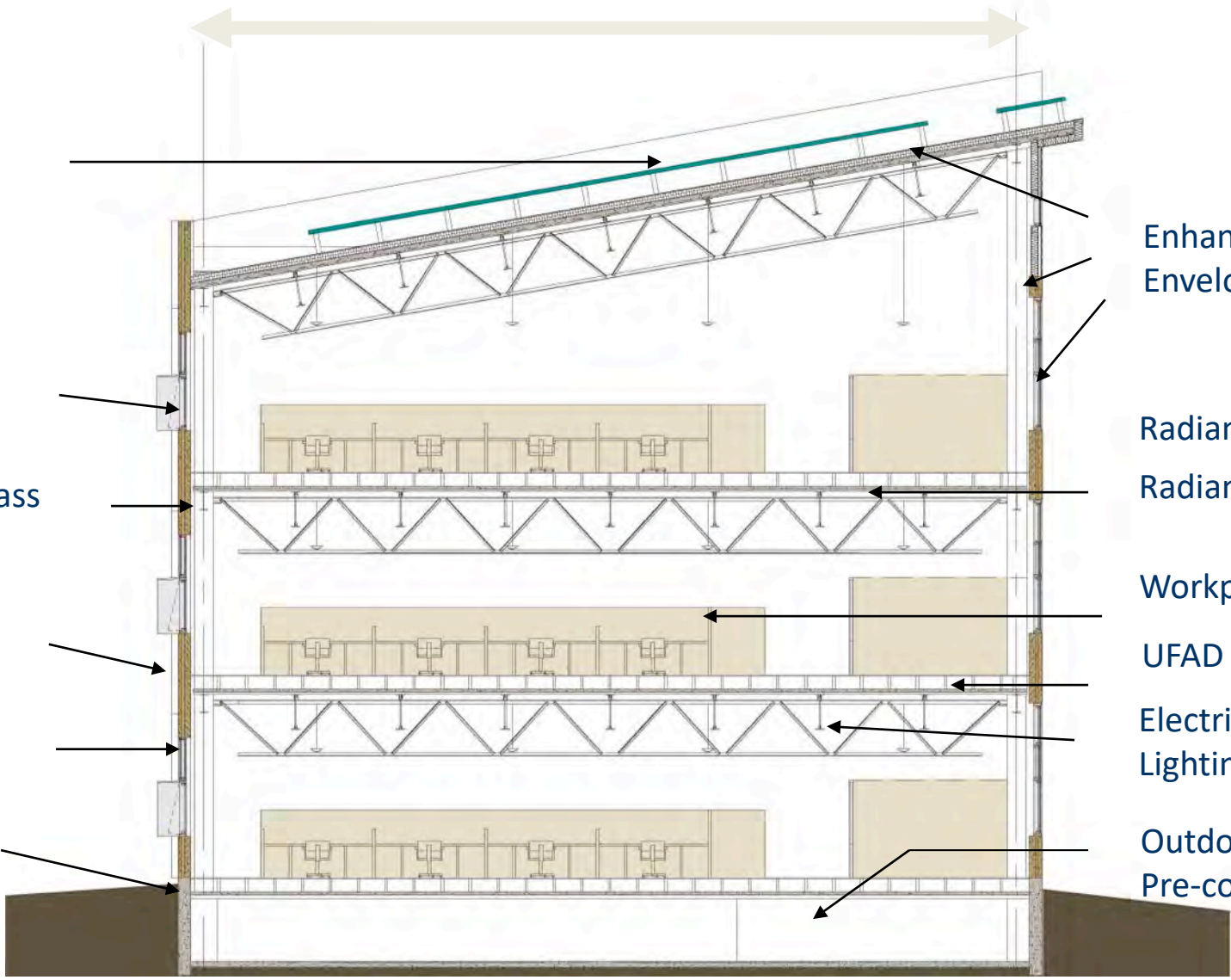
Radiant Cooling  
Radiant Heating

Workplace

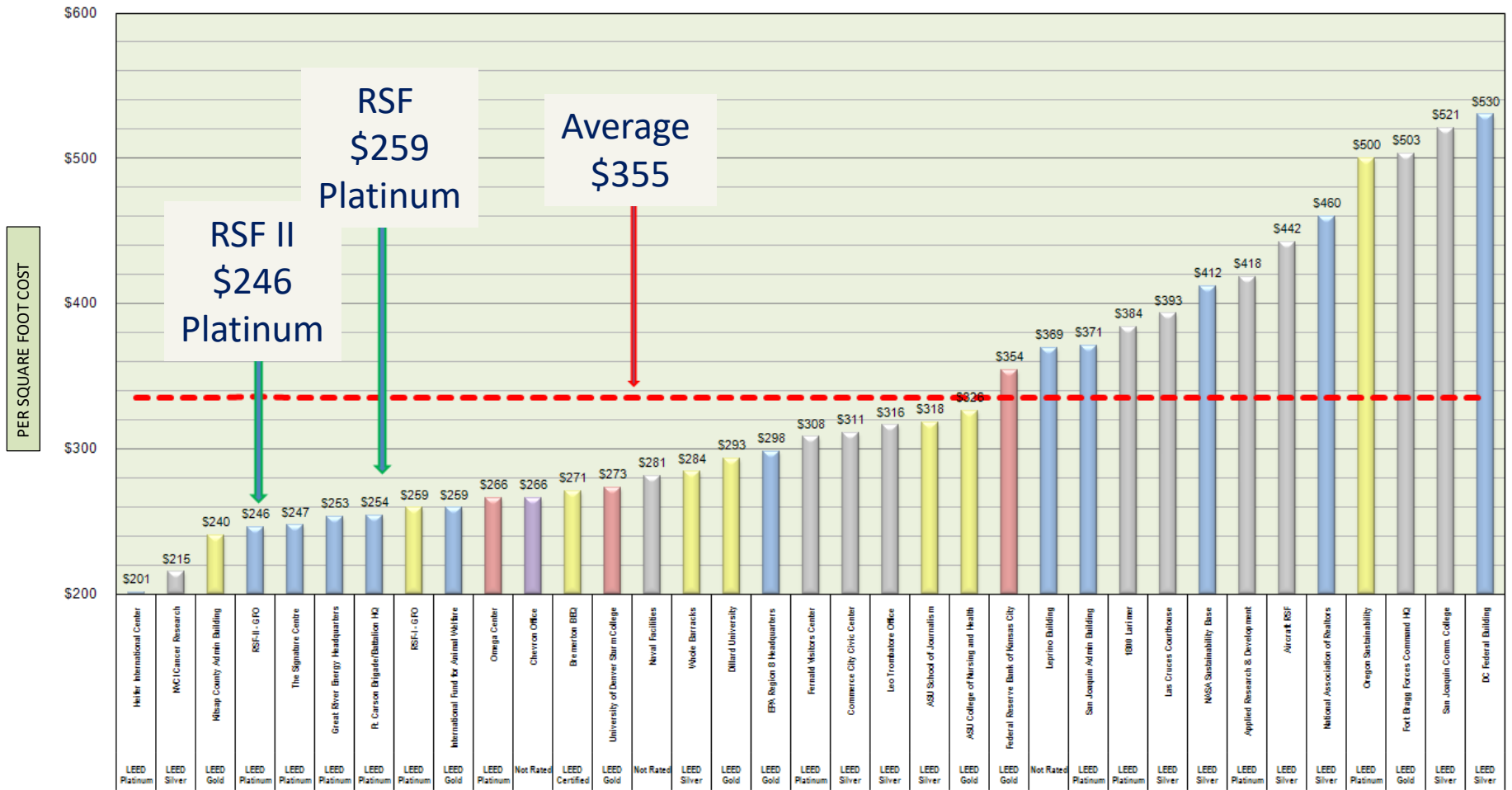
UFAD

Electrical Lighting

Outdoor Air Pre-cool



# COMMERCIAL BUILDING CONSTRUCTION COST



## LEGEND:



## PROJECTS AND LEED CERTIFICATION

## SOURCES:

- [www.favobserver.com](http://www.favobserver.com)
- [www.dbia.com](http://www.dbia.com)
- [www.nasa.gov](http://www.nasa.gov)
- [www.eomega.org](http://www.eomega.org)
- [www.oregonustainabilitycenter.org](http://www.oregonustainabilitycenter.org)
- [www.americas.rlb.com](http://www.americas.rlb.com)
- <http://greensource.construction.com>
- [www.1800larimer.com](http://www.1800larimer.com)
- [www.usgbc.org](http://www.usgbc.org)
- [www.smithgroup.com](http://www.smithgroup.com)
- [www.cronkite.asu.edu](http://www.cronkite.asu.edu)

# You Can Get Involved?

- Teaming up with Utility Incentive Programs (started with Connecticut)
- Incentive programs to support innovative process
- Owners get our expertise to help with the procurement process

BIG Architects  
Clayco/Forum

- EUI – 46
- Hybrid Geothermal w/  
Condensing Boilers and  
Campus Chilled Water
- FCU in residential units

46 kBtu/ft<sup>2</sup>/yr

Hopkins Architects  
Holabird and Root  
Gilbane

- EUI – 54
- Condensing Boilers and  
Campus Chilled Water
- FCU in residential units

54 kBtu/ft<sup>2</sup>/yr

Perkins + Will  
Pepper Construction

- EUI – 52
- Hybrid Geothermal w/  
Condensing Boilers and  
Campus Chilled Water
- Radiant panels with  
DOAS

52 kBtu/ft<sup>2</sup>/yr

Studio Gang Architects  
Mortenson Construction

- EUI – 51
- Condensing Boilers and  
Campus Chilled Water
- Radiant Slab with DOAS

51 kBtu/ft<sup>2</sup>/yr