The Value of Energy Analysis, from Design Day One

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THE WEIDT GROUP®

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Course #170808

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Course Description

This interactive course will provide attendees with a charrette experience for evaluating and driving building energy performance —to analyze results in real time, as early as pre-design. During this session, participants act as design team members from all disciplines, working with real building characteristics and an actual building design. Using an analysis approach that assists with a cost benefit discussion, the participants will assemble "bundles" of selected energy efficiency measures to play out what-if scenarios, discussing the merits and challenges of each "bundle.“ This session, with live tools and facilitation, will demonstrate an effective method for guiding energy decision-making during early design, towards achieving higher efficiency goals and increasingly stringent energy codes.

Learning Objectives

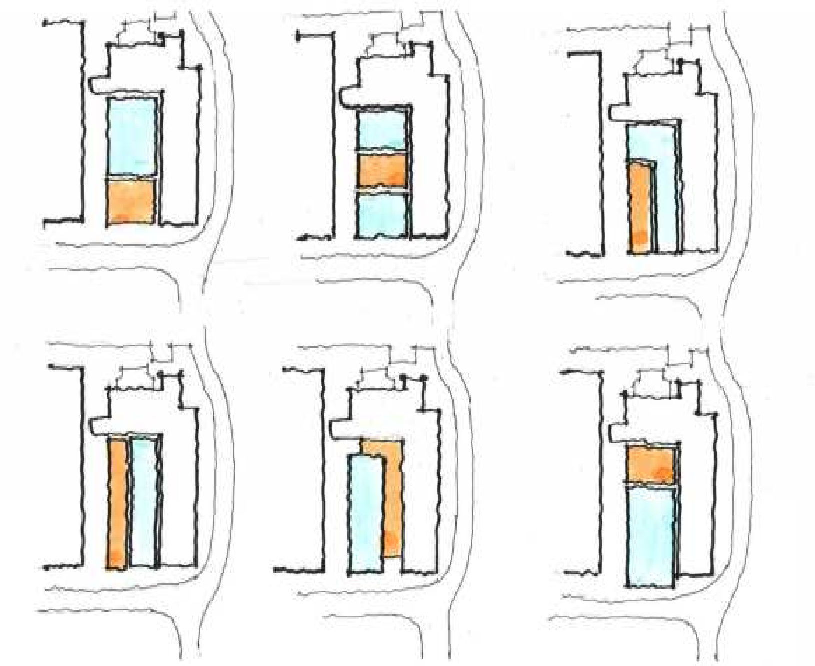
At the end of the this course, participants will be able to:

1. Recognize the value early energy analysis provides to the design process and client decision-making
2. Identify a range of energy-efficiency options and their impacts on energy outcomes during various stages of design
3. Interpret building performance and financial information provided by energy analysis results
4. Understand how decisions made very early in pre-design can increase energy savings opportunities

The Challenges

The Challenges

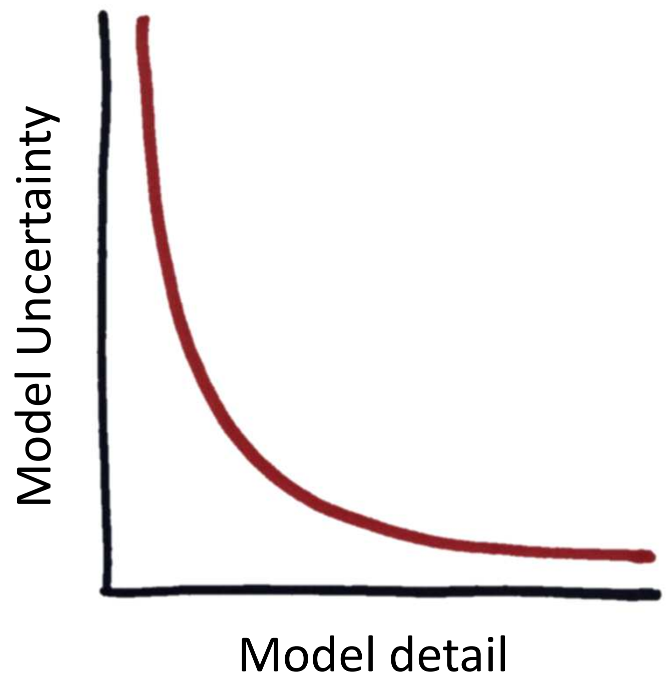
- Modeling needs to inform the design, not just score the design
- Shorter design schedules
- More stringent energy codes
- Pressure to optimize smaller buildings
- Need for more integrated design to reach energy goals



The Goal

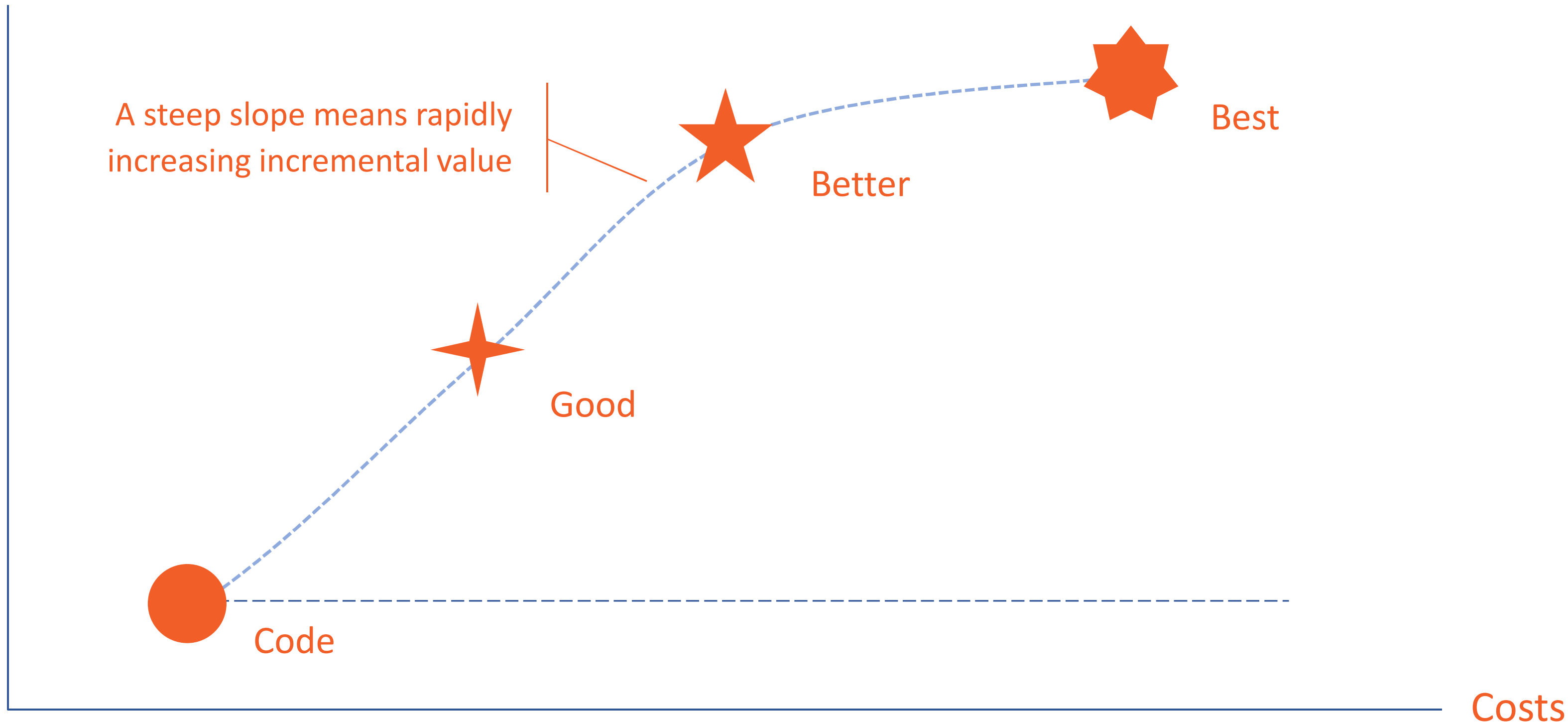
Actionable Energy Modeling

- Provide energy results with enough detail and certainty to make decisions with as few inputs as practicable
- Refine the modeling as more information is available



Optimization

Spending the Right Amount in Each Category of Savings



Integrated Design and Typical Savings

Building design fixes the load	Efficient system meet the load	Energy sources to fuel systems	People run the systems
Building shape	Envelope	Wood	Schedules
Building volume	Daylighting	Sun-active heat	Controls
Glass location	Lighting	Sun-photovoltaics	Maintenance
Glass area & type	HVAC	Wind generation	Setpoints
Insulation values	Controls	Solar electricity	Windows
Thermal mass	District heating	Gas co-gen	Equipment
Lighting concept	Domestic hot water	Micro turbines	Education
Mechanical concept		Fuel cells	Ongoing M&V
10 – 20%	**15 – 60%**		**10 – 20%**
Minimize load as first priority	Use simple, cost-effective systems	Use appropriate sources of energy	Operate the building well
		Renewable, affordable, non-polluting, local source	Functionality, efficiency, comfort

The Approach

Modeling Inputs

Setting Reasonable Assumptions

Physical Design

Typical geometry

Single system per SAT

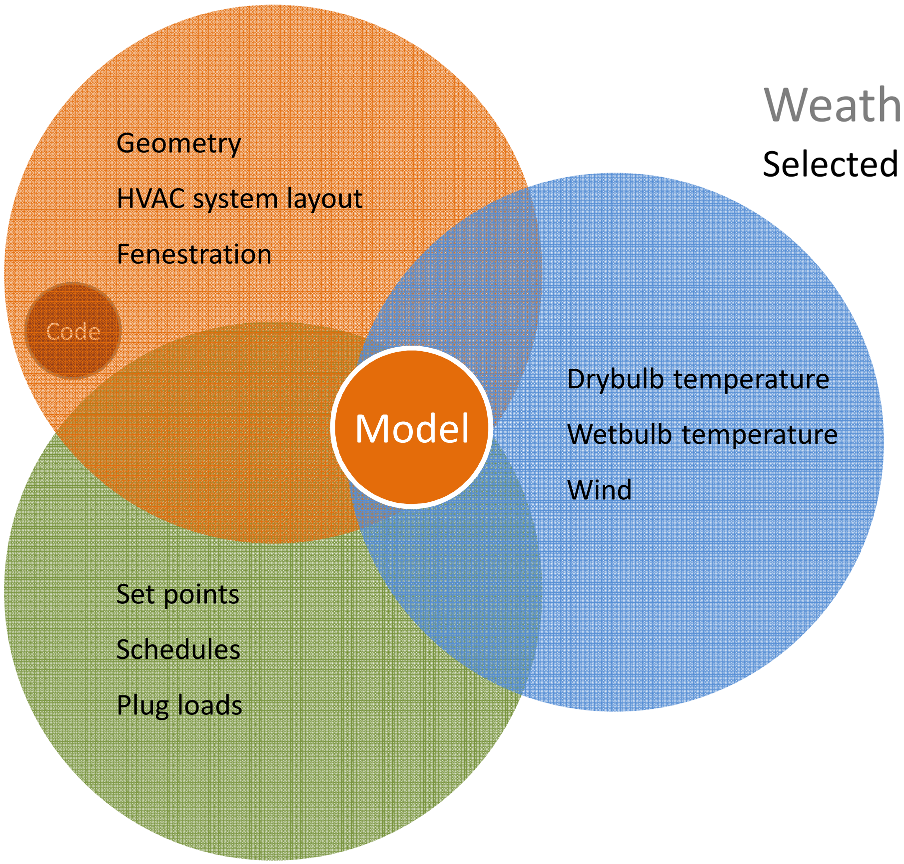
Operations

90.1 default schedules

COMNET plug loads and set points

Weather

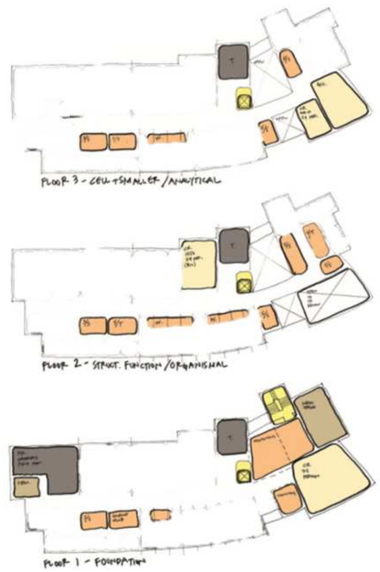
Selected by zip code



Modeling Process

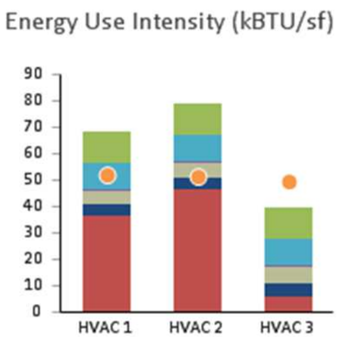
- User defines
  - Building types and subtypes (50)
  - Blocking and stacking relationships
  - HVAC systems
- Based on location
  - Energy code
  - Utility rates
  - Weather station
- Defaults that can be overridden
  - Schedules
  - Ventilation rates
  - Plug loads
  - Geometry

- Analyzing More from Less

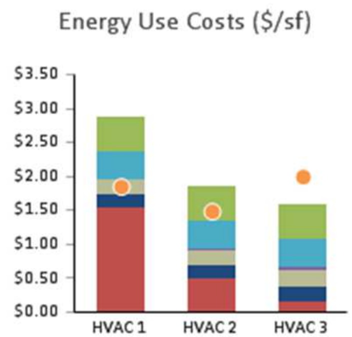


Compare up to 3 HVAC Scenarios

- Team selects 3 HVAC scenarios to compare
- Strategies can be applied to each of the scenarios
- Some systems have good “savings” because their baselines are more expensive to operate
- By selecting HVAC scenario early, engineers can focus on just one type



	HVAC 1	HVAC 2	HVAC 3
Heating	36.7	47.1	6.4
Cooling	4.5	4.4	4.9
Fans & Pumps	4.8	5.1	6.1
SWH	1.1	1.1	0.9
Lighting	9.7	9.7	9.7
Equipment	11.3	11.3	11.3
Total	68.3	78.8	39.3
Baseline	52.3	51.9	50



	HVAC 1	HVAC 2	HVAC 3
Heating	1.56	0.53	0.18
Cooling	0.19	0.19	0.21
Fans & Pumps	0.21	0.22	0.26
SWH	0.01	0.01	0.04
Lighting	0.41	0.41	0.41
Equipment	0.48	0.48	0.48
Total	2.87	1.84	1.58
Baseline	1.87	1.5	2.02

HVAC 1: VAV, DX/Furnace, electric reheat

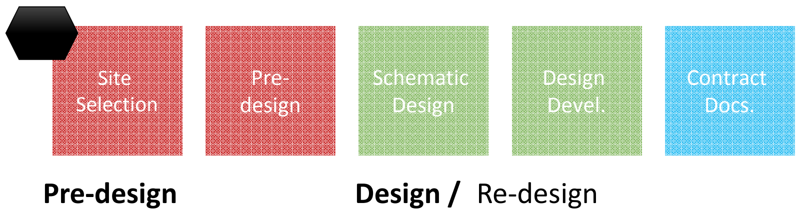
HVAC 2: VAV, Boiler, DX

HVAC 3: GSHP with DOAS

Analyzing Multiple Options

Reduce Loads

3 HVAC Options

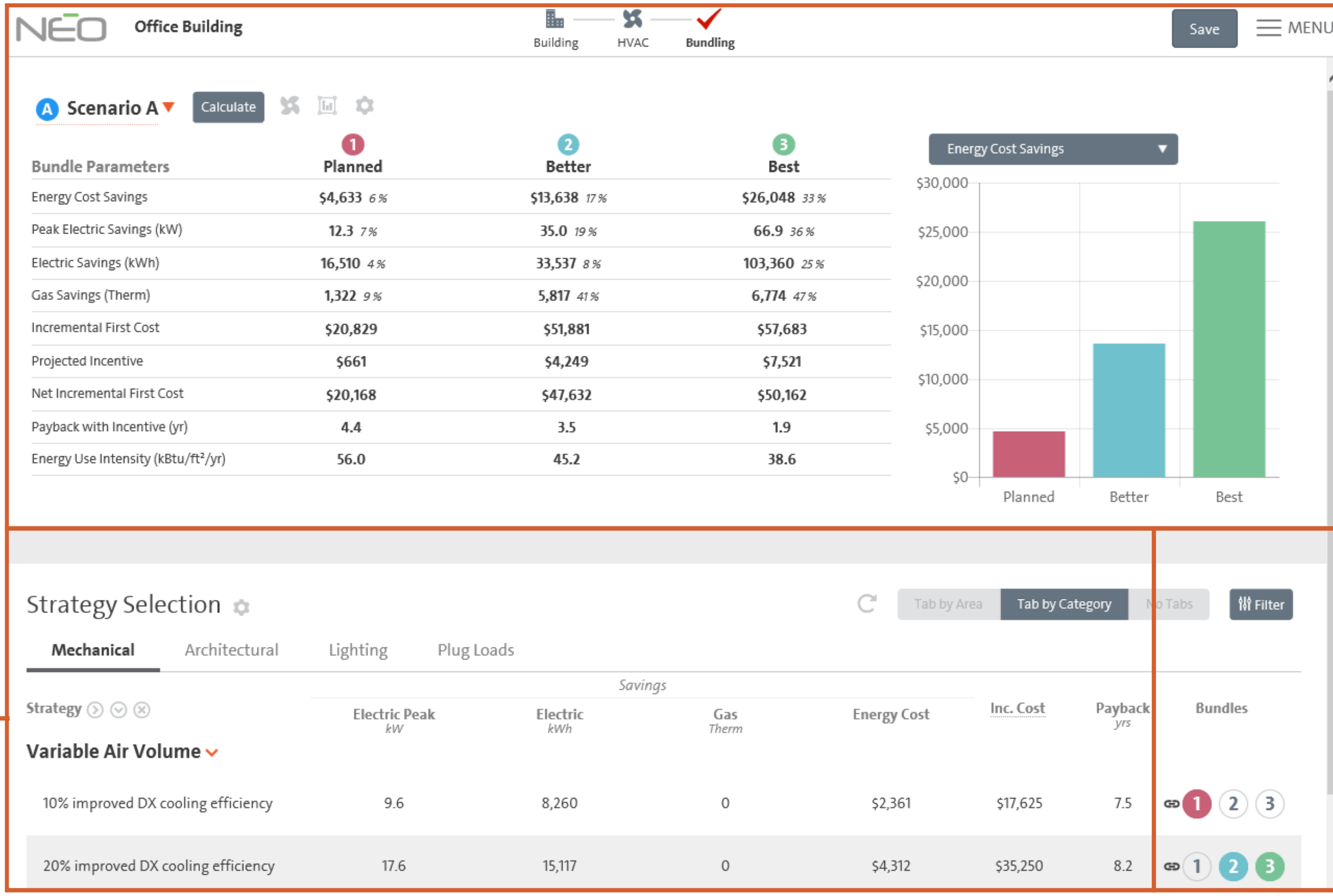


HVAC Option	Energy Use (kBtu/sf)	Total Cost of Ownership
VAV – Ground Source Heat Pumps	49	$24.1 Million
VAV – Boiler/Chiller with Data Center Heat Recovery	51	$31.6 Million
VAV – Boiler/Chiller	89	$32.0 Million

VAV – Ground Source Heat Pumps: Design team's first choice, but test wells showed not enough groundwater available on site

VAV – Boiler/Chiller with Data Center Heat Recovery: Selected for low cost of ownership and energy efficiency

Creating Custom Bundles for Each HVAC Scenario



Cumulative Bundle Results

Individual Measure Results

Bundled Measures

Making Smarter Decisions

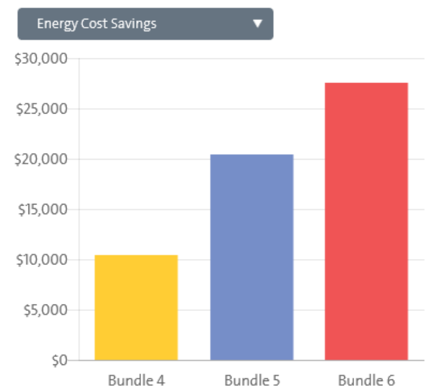
Capital costs weighed against operating costs

- Initial bundle as imagined in schematic design
    - 8% beyond baseline code
- Two other developed presented:
    - Bundle 5: 15% beyond code
    - Bundle 6: 21% beyond code

- Overall cash flow for bundles 5 and 6 were better than original design
    - Increased first cost offset by utility incentive and annual operating cost savings

Scenario B Calculate

Savings vs Baseline	Bundle 4	Bundle 5	Bundle 6
Energy Cost Savings	$10,404 8%	$20,381 15%	$27,522 21%
Peak Electric Savings (kW)	22.6 7%	76.0 23%	107.3 33%
Electric Savings (kWh)	135,346 10%	233,547 17%	309,514 22%
Gas Savings (Therm)	-2,418 -28%	-1,035 -12%	-712 -8%
Incremental First Cost	$243,596	$386,304	$557,281
Projected Incentive	$0	$16,115	$27,856
Net Incremental First Cost	$243,596	$370,189	$529,425
Payback with Incentive (yr)	23.4	18.2	19.2
Energy Use Intensity (kBtu/ft²/yr)	108.1	98.6	92.8



Net Energy Optimization Charrette

Example Project

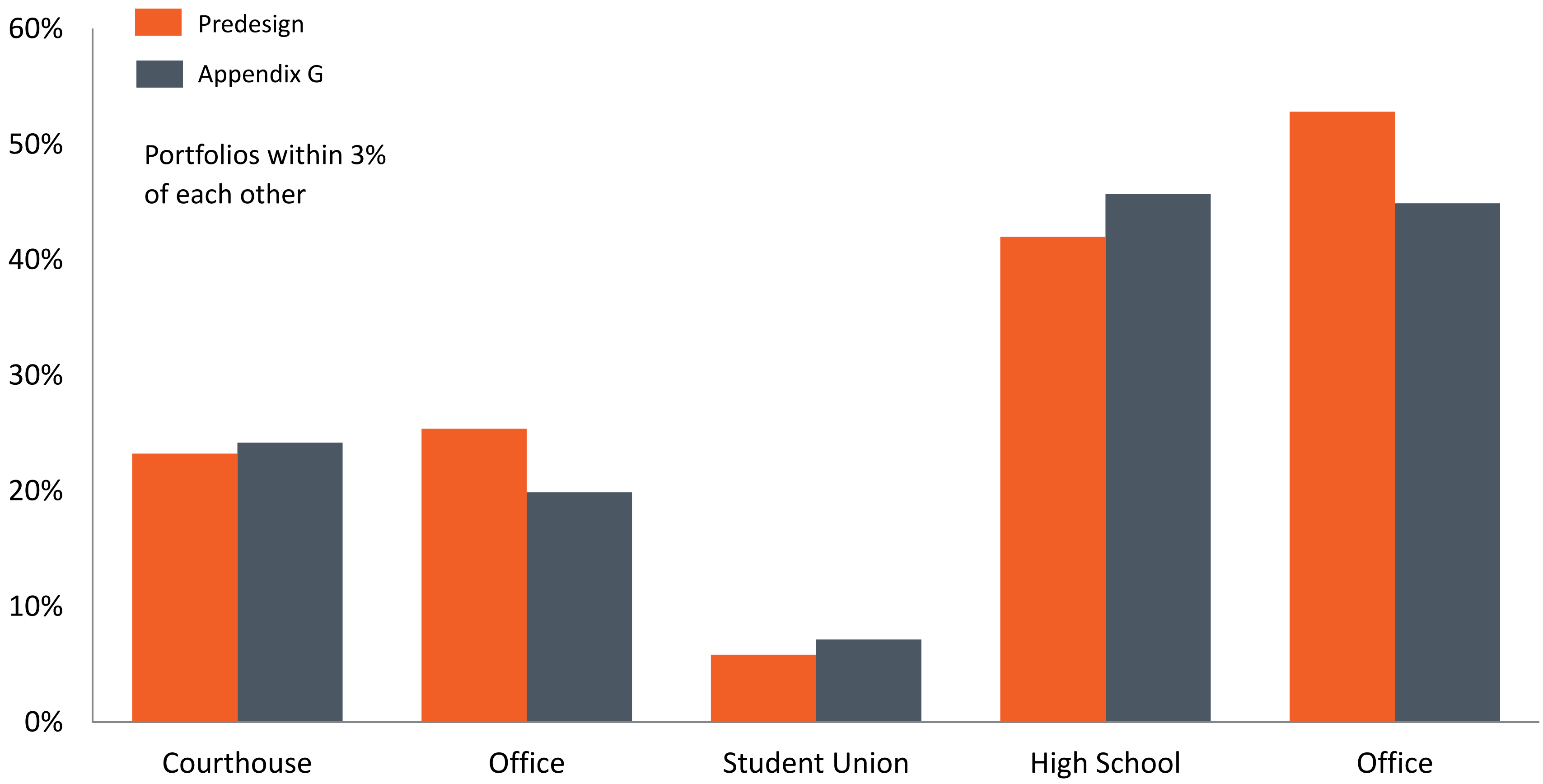
- 50,000 SF
- 2-story office building
- Saint Louis, MO
- Roles
  - Owner
  - Architect
  - Mechanical Engineer
  - Electrical Engineer

Results Comparison

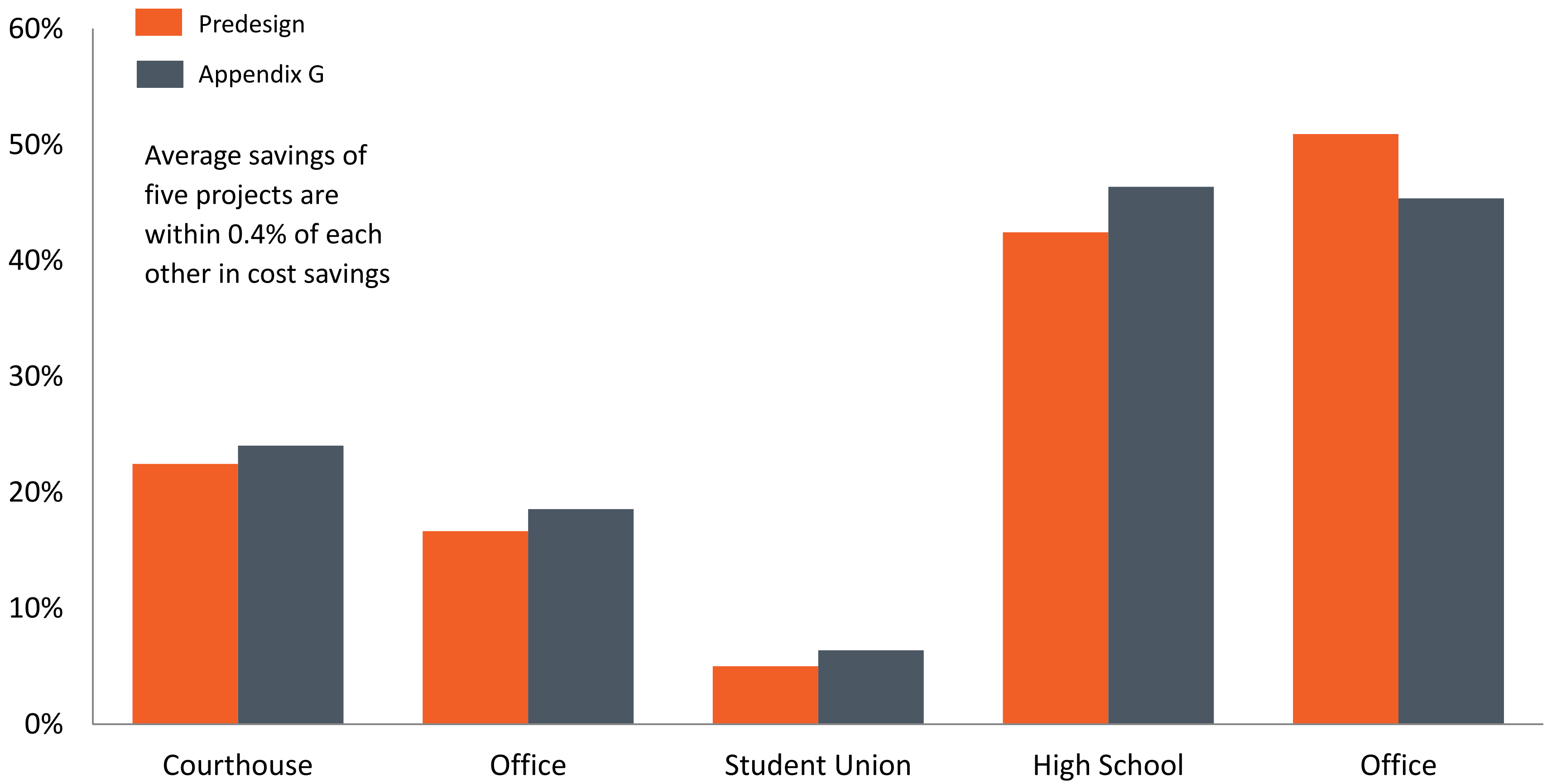
Early Modeling Comparison on 5 Projects

- 90.1 Appendix G models reviewed by 3rd party certification
- Predesign models created based on final design to test accuracy and precision of model, not variation in decisions
- Predesign models had fewer "dialed in" values
  - Limited range of strategies
  - Standard schedules and ventilation assumptions
  - Core and perimeter zoning

Energy Use Intensity Savings Comparison

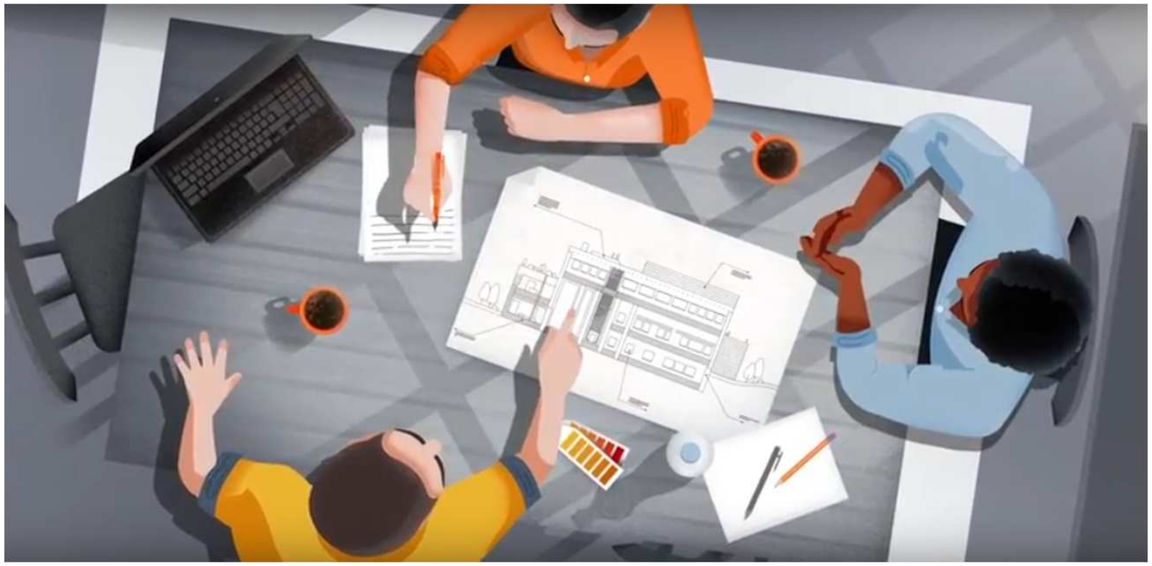


Cost Savings Comparison



Benefits

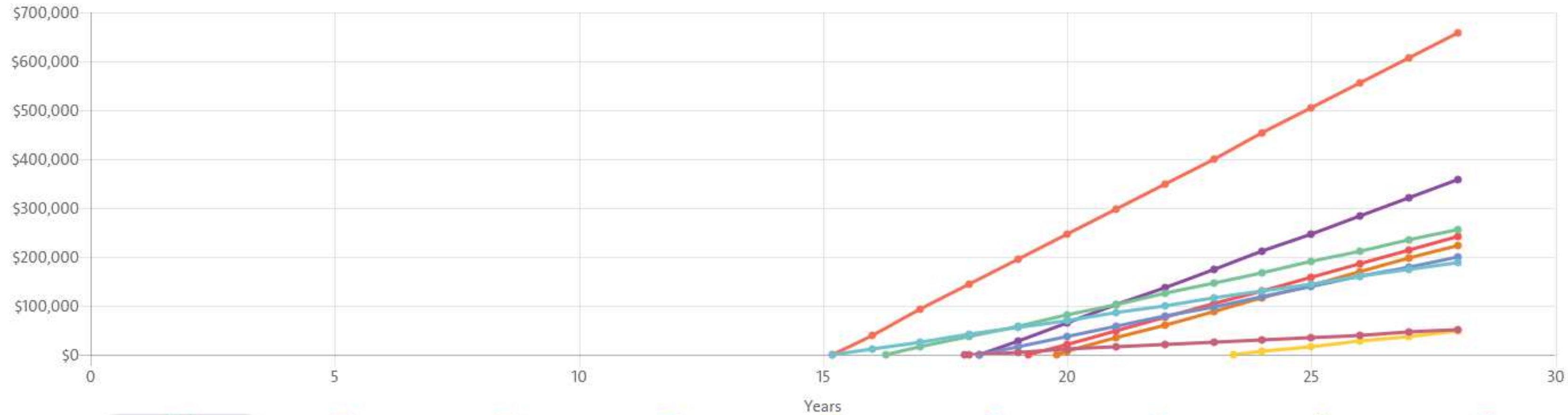
- Owners can pick the most effective strategies for their building



Benefits

- Owners can pick the most effective strategies for their building
- Design teams can settle on an energy bundle earlier
- Actual paybacks help defend those decisions against value engineering

Benefits



Savings vs Baseline	Bundle 1	Bundle 2	Bundle 3	Bundle 4	Bundle 5	Bundle 6	Bundle 7	Bundle 8	Bundle 9
Energy Cost Savings	$5,011 *4%*	$14,865 *11%*	$21,879 *16%*	$10,404 *8%*	$20,381 *15%*	$27,522 *21%*	$27,233 *19%*	$36,485 *25%*	$51,503 *36%*
Peak Electric Savings (kW)	36.2 *11%*	79.4 *24%*	106.1 *33%*	22.6 *7%*	76.0 *23%*	107.3 *33%*	96.8 *26%*	141.1 *37%*	178.8 *47%*
Electric Savings (kWh)	83,388 *6%*	180,835 *13%*	255,064 *18%*	135,346 *10%*	233,547 *17%*	309,514 *22%*	299,678 *19%*	401,484 *25%*	567,063 *36%*
Gas Savings (Therm)	-3,303 *-38%*	-1,988 *-23%*	-1,624 *-19%*	-2,418 *-28%*	-1,035 *-12%*	-712 *-8%*	71 *14%*	93 *19%*	93 *19%*
Incremental First Cost	$89,629	$226,687	$375,314	$243,596	$386,304	$557,281	$561,225	$705,893	$869,270
Projected Incentive	$0	$0	$18,620	$0	$16,115	$27,856	$23,075	$41,425	$85,699
Net Incremental First Cost	$89,629	$226,687	$356,694	$243,596	$370,189	$529,425	$538,150	$664,468	$783,571
Payback with Incentive (yr)	17.9	15.2	16.3	23.4	18.2	19.2	19.8	18.2	15.2

What We Have Learned

- Recognize the value early energy analysis provides to the design process and client decision-making
- Identify a range of energy-efficiency options and their impacts on energy outcomes during various stages of design
- Interpret building performance and financial information provided by energy analysis results
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This concludes The American Institute of Architects Continuing Education Systems Course

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Thank You

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