Architecture 2030 for Labs

OHSU Knight Cancer Research Building

August 15, 2018
Presented to BESF

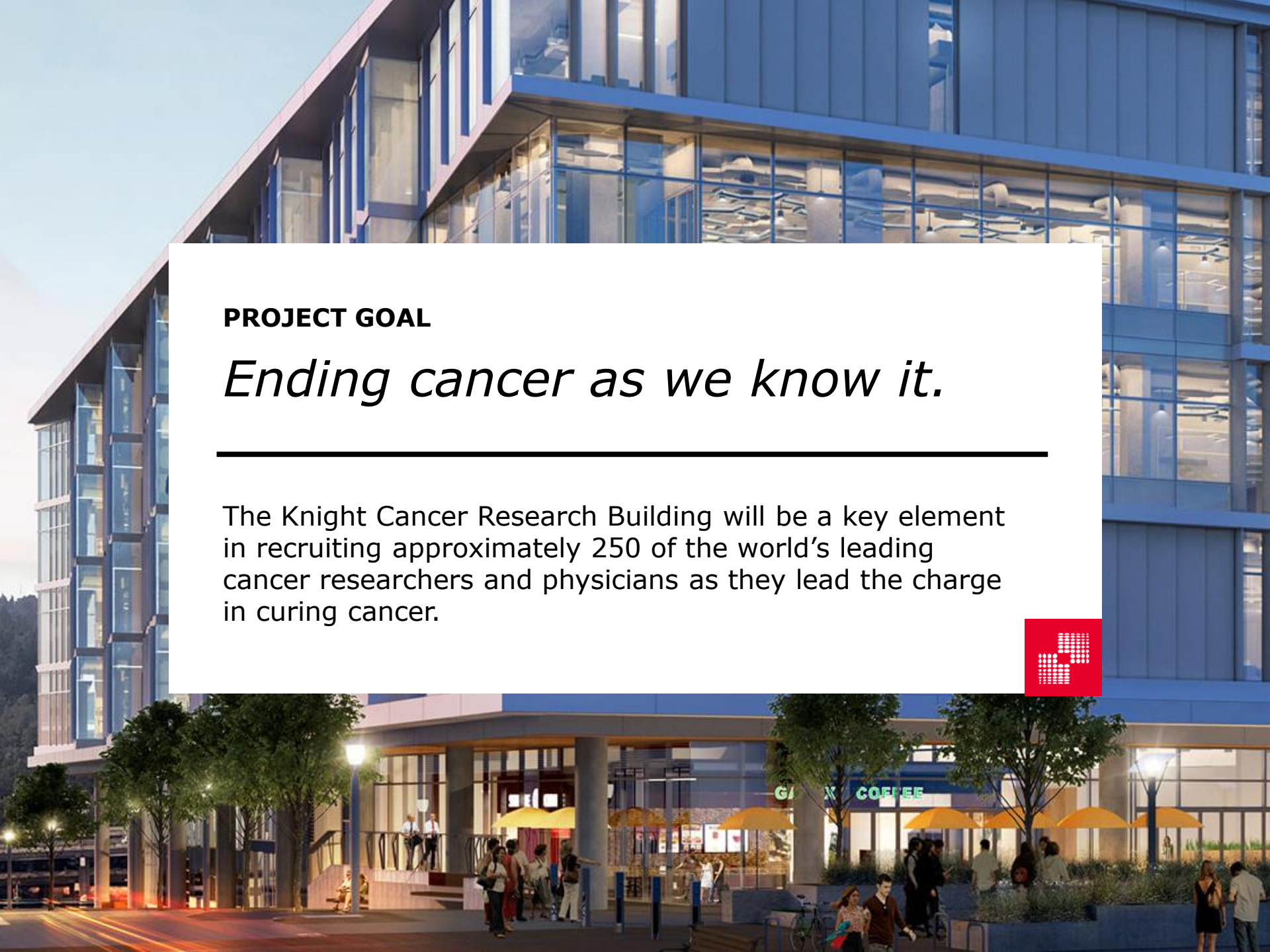
Outline

Overview

- Project Summary
- Energy Use in Labs
- Benchmarking and Energy Targets

Our Building

- Energy Trust Baseline
- Energy Conservation Measures
- Final Results



PROJECT GOAL

Ending cancer as we know it.

The Knight Cancer Research Building will be a key element in recruiting approximately 250 of the world's leading cancer researchers and physicians as they lead the charge in curing cancer.

Phil Knight pledged $500M if $500M in private donations could be raised. The institute was seeded with $1B to create the building and populate it. Construction budget for the building was $160M.

TEAM:

OHSU
SRG
PAE
McCARTHY
ANDERSEN CONSTRUCTION

PROJECT SPECS

Pursuing LEED Platinum
333,000 square feet
IPD Contract with Co-Location and Triparty agreement

Project Overview

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Rendering Courtesy of SRG

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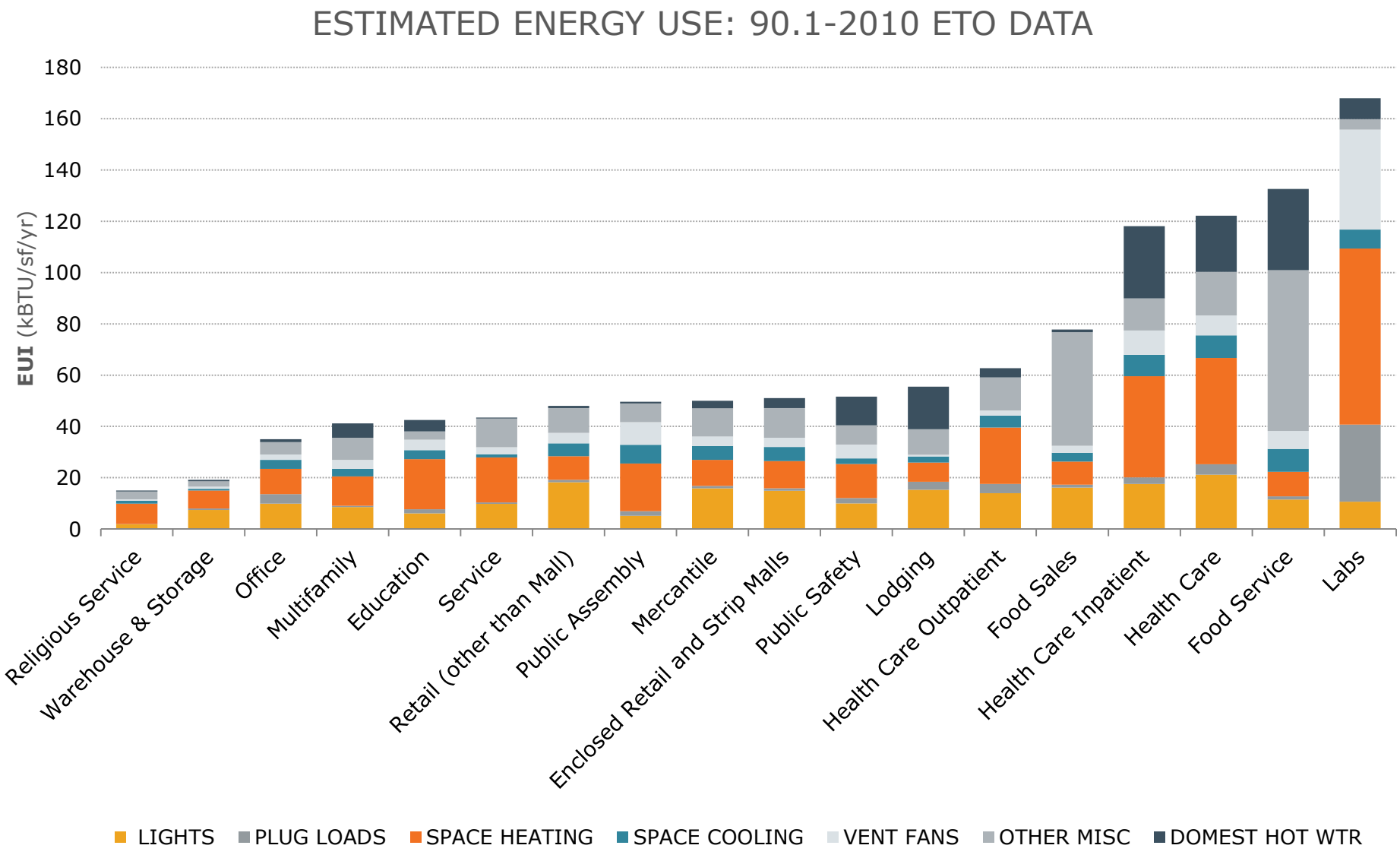
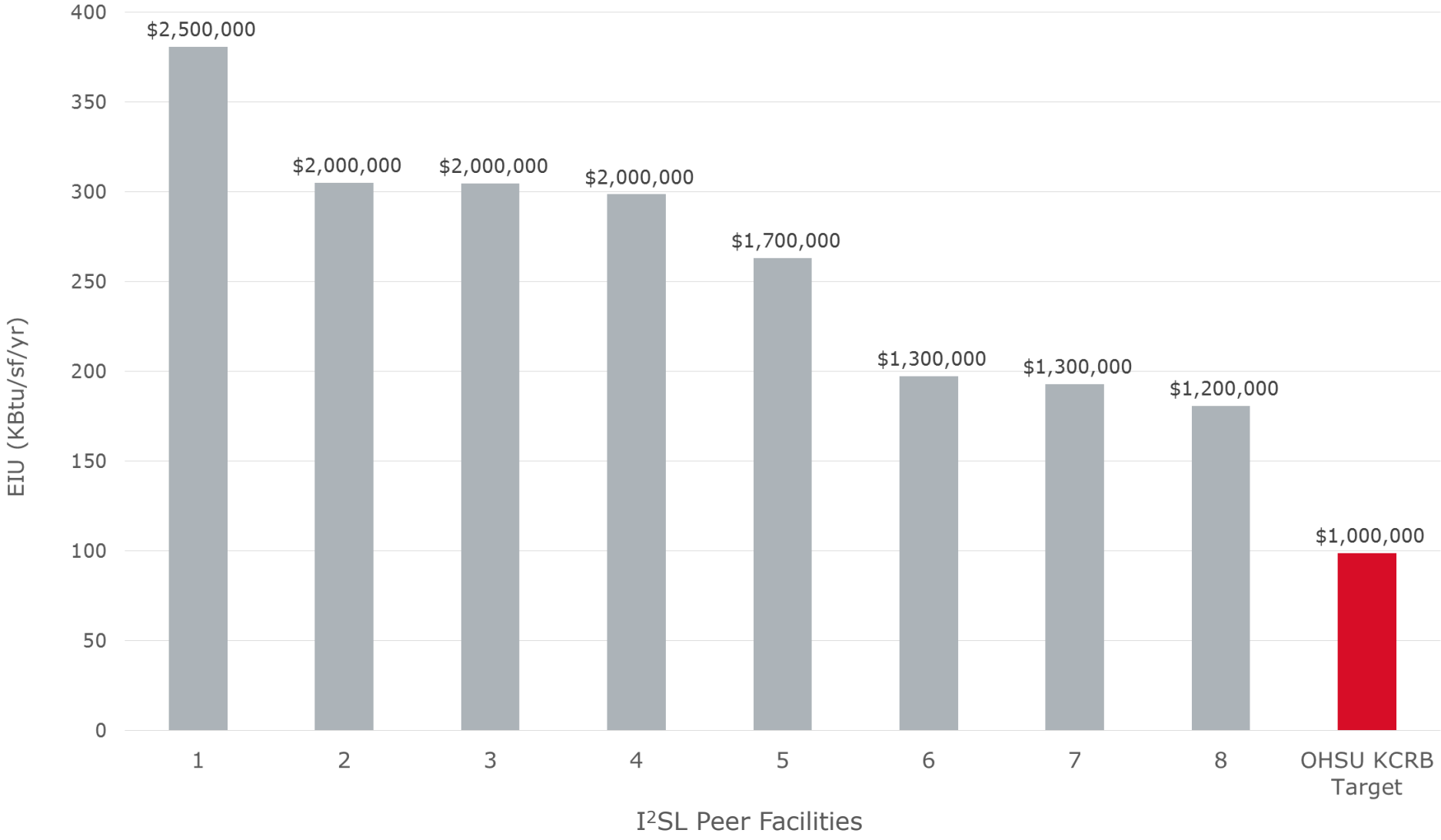
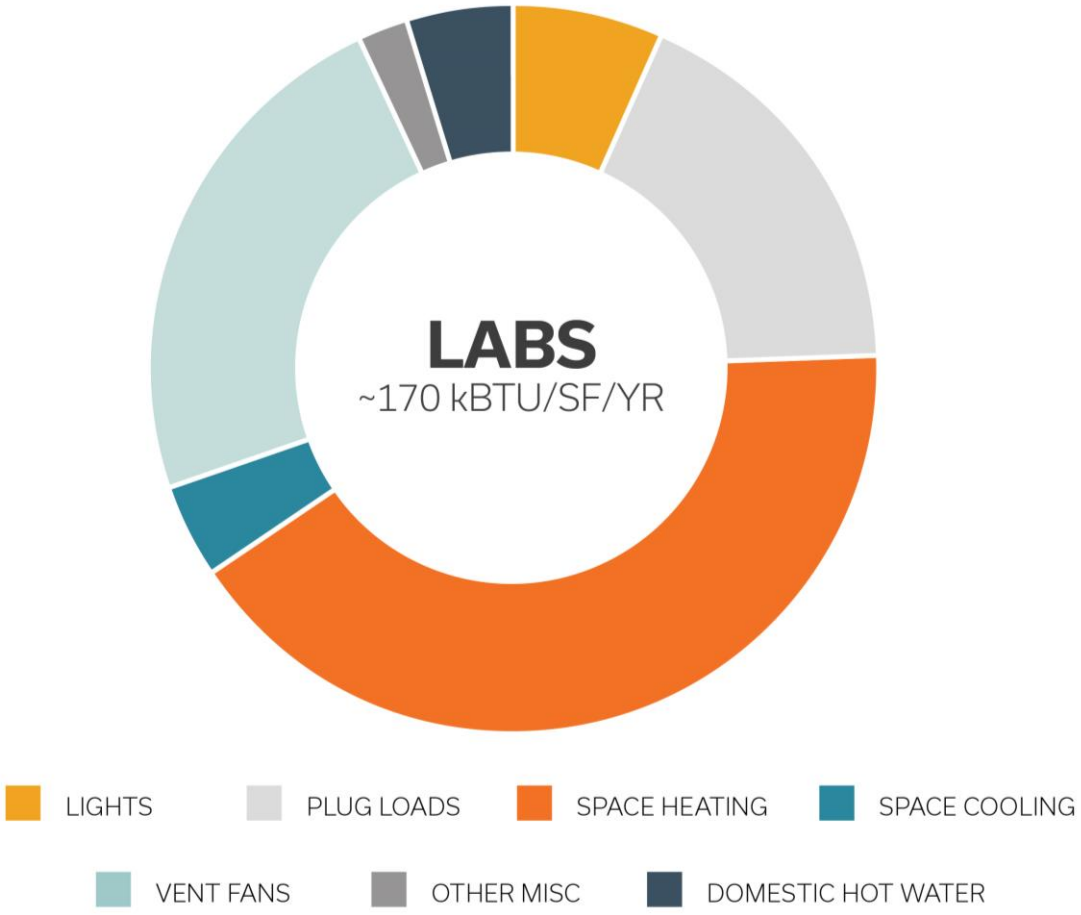
Energy Use in Lab Buildings



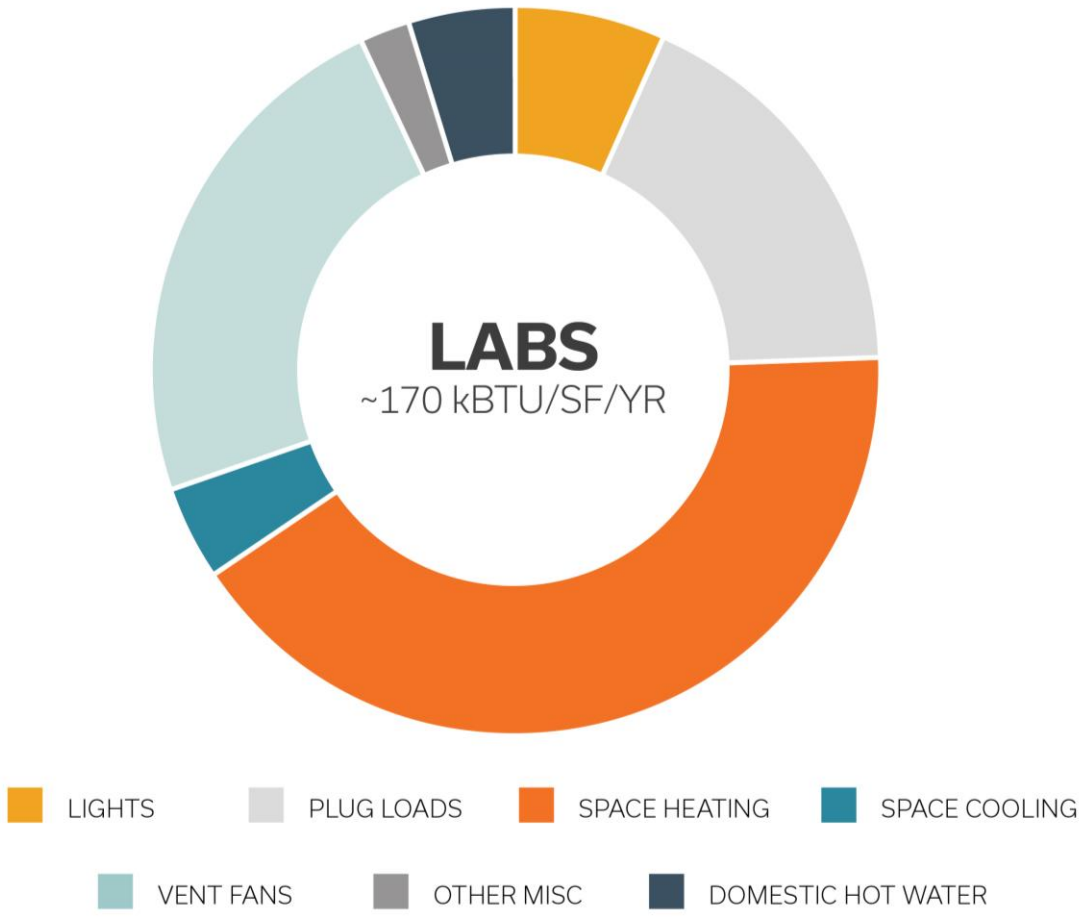
I²SL Database Peer Facilities



Energy Use in Lab Buildings - Baseline



Energy Use in Lab Buildings - Baseline



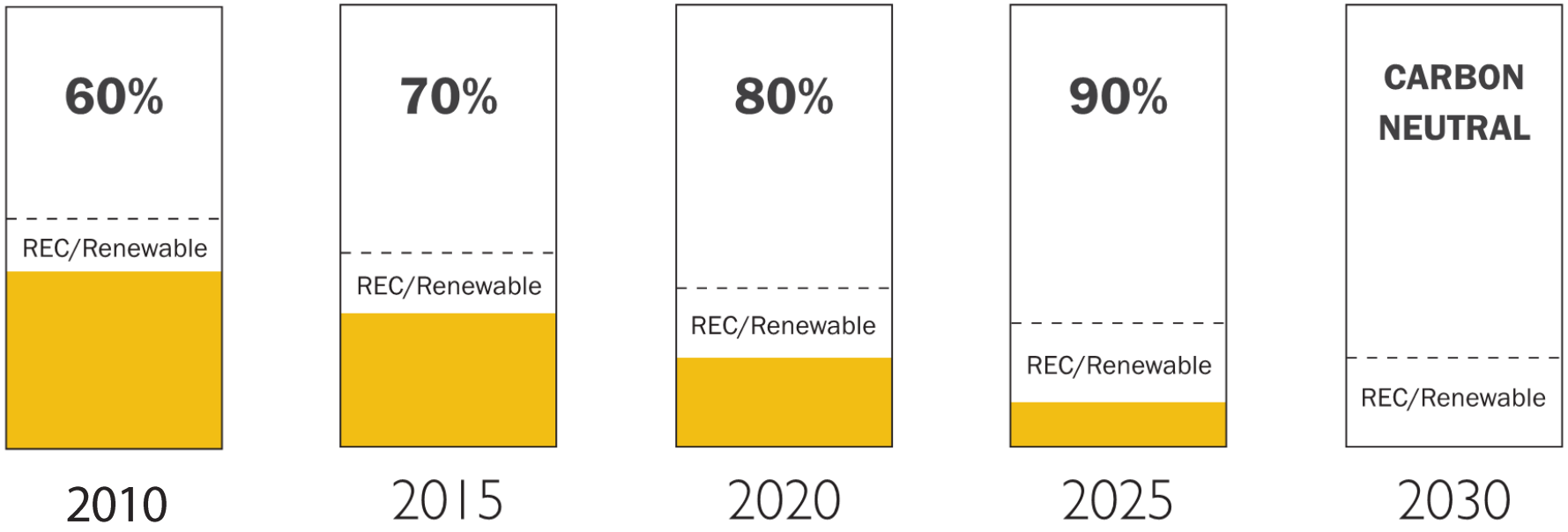
High Internal Loads
- Up to 10 W/sf
- Increases cooling energy, fan energy, heat rejection

Exhaust Rates
- 4-6 air changes per hour
- Increases fan energy, heating, cooling, and heat rejection
- Increases reheat

High Lighting Energy
- Lighting, cooling, fans

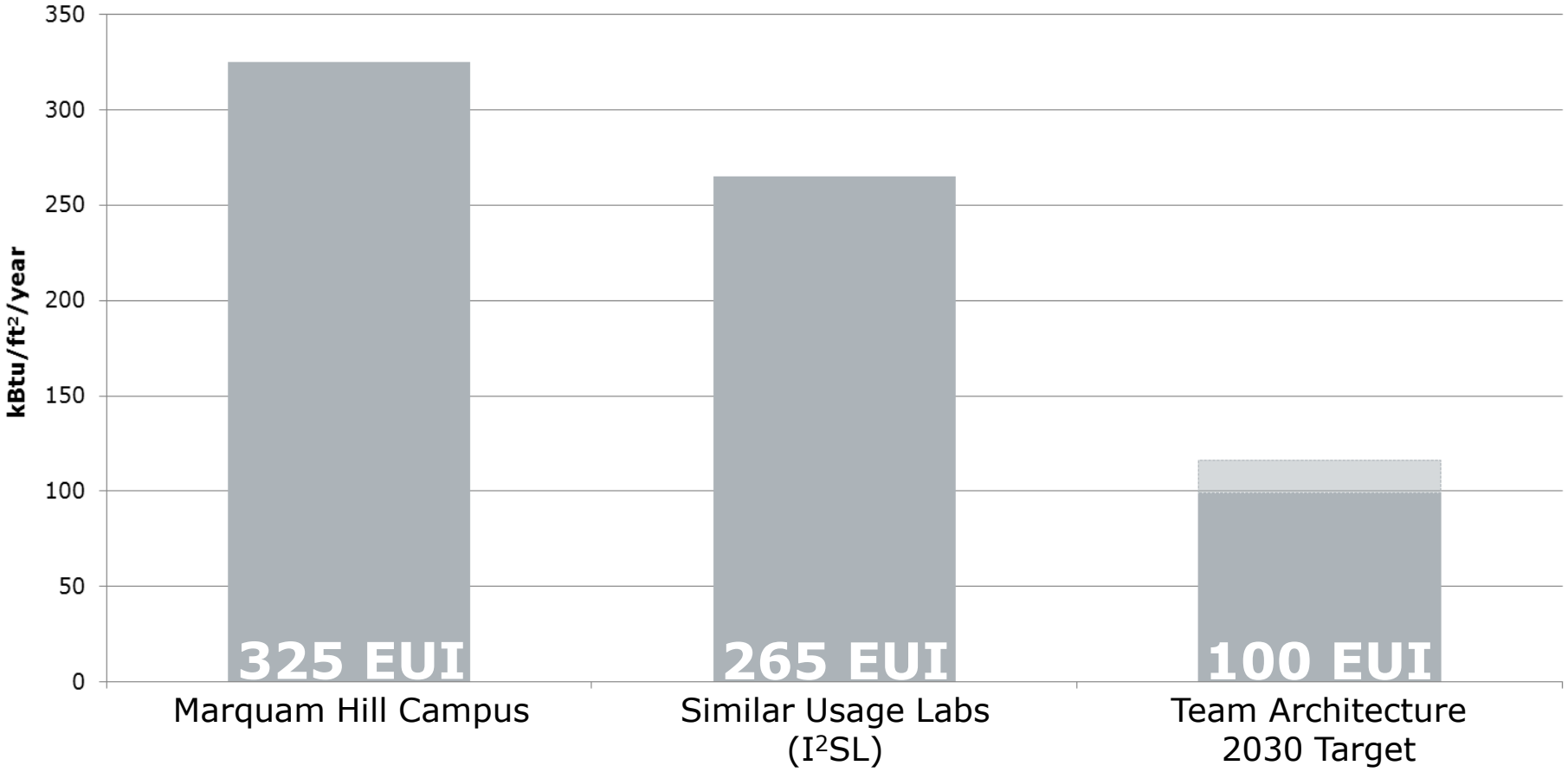
Long Operating Hours
- All of the above

Targets for Energy Savings: Architecture 2030 Challenge

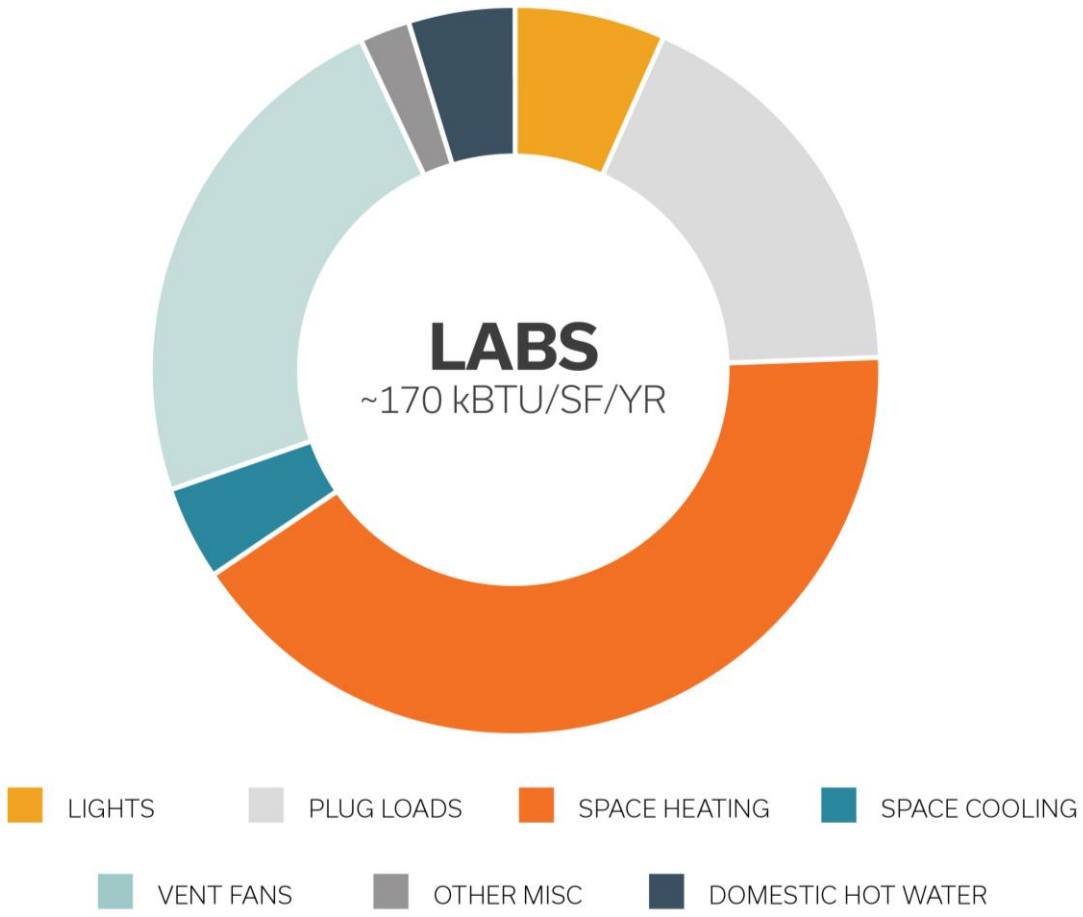


- Choose appropriate baseline
- Savings target for 2015-2019 = 70%
- Renewable energy (including purchase) can be 20% of the 70%

Benchmarking & Energy Targets



Energy Use in Lab Buildings – Energy Savings Strategies



Lower Internal Loads
- Lights & equipment

Reduce Outside Air
- Lower air change rates
- Reuse outside air
- Variable supply & exhaust
- Limit envelope loads to OA requirements

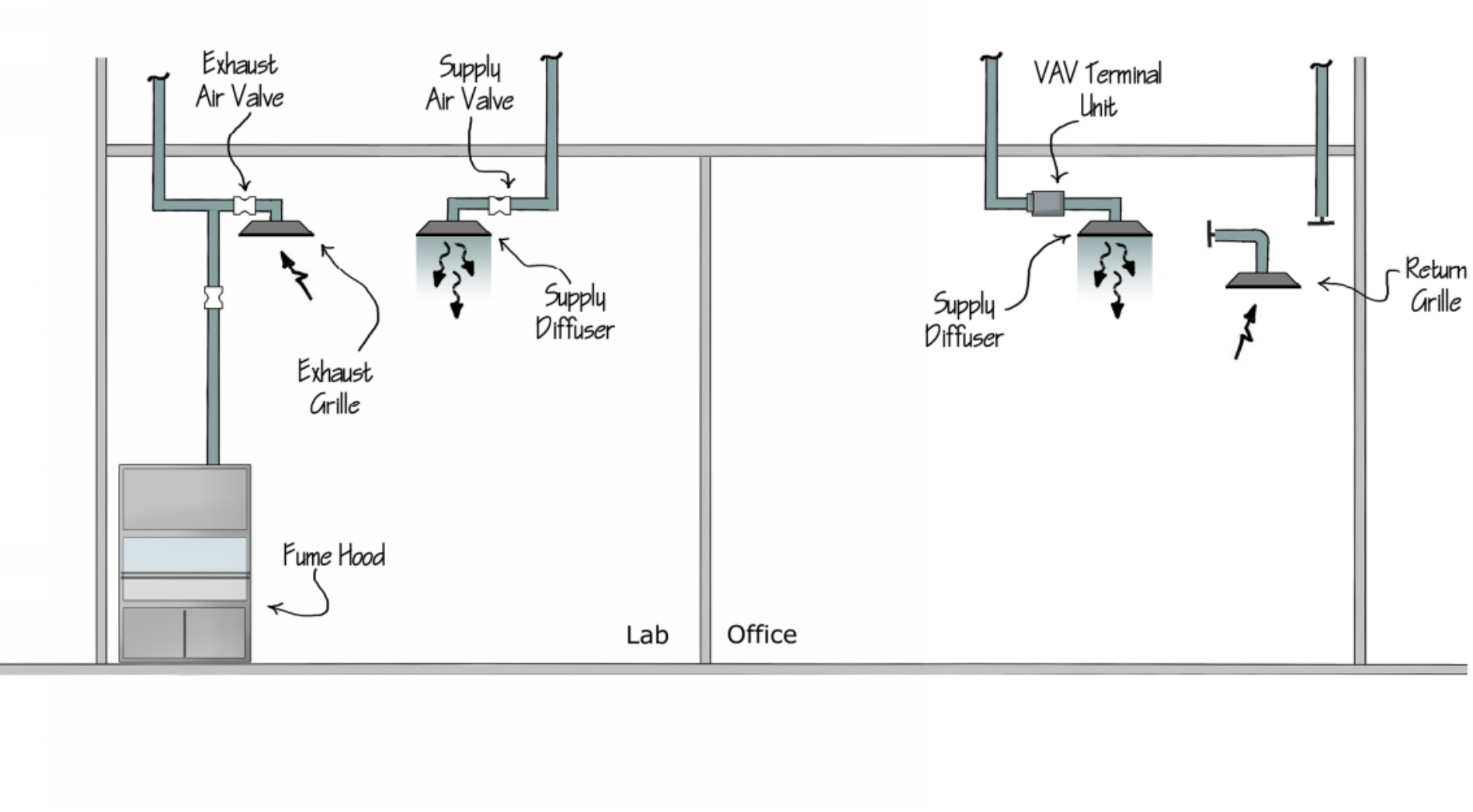
Heat Recovery
- Air-to-air
- Water-to-water

Zone Cooling to Reduce/Eliminate Reheat
- Low static air distribution
- Select efficient equipment

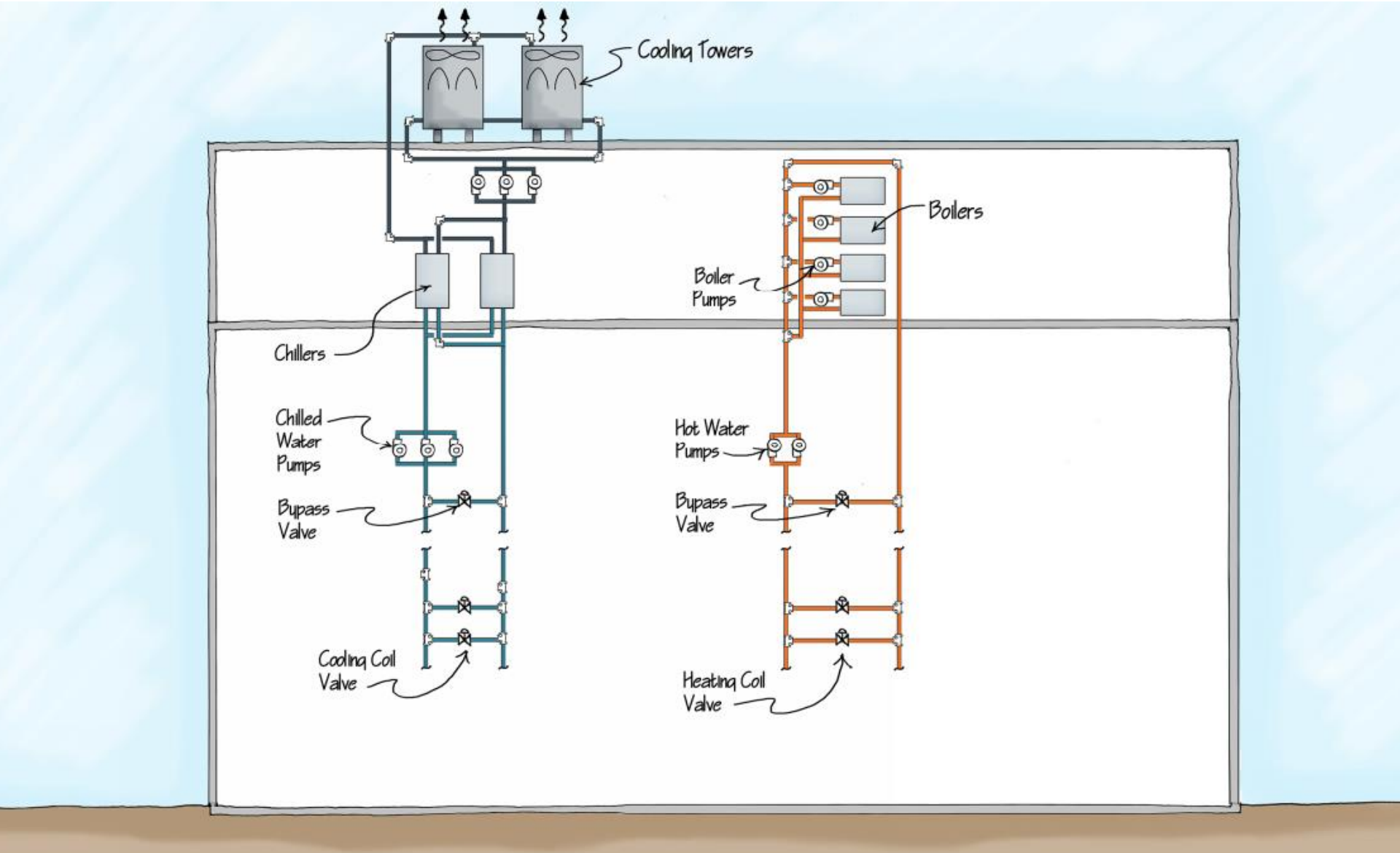
Oregon Code Baseline

- Envelope just meeting OEESC
- Code maximum lighting power densities
- VAV air handlers two per floor (one for offices, one for labs)
- Water-cooled chiller plant
- 80% efficient gas-fired boilers

Traditional VAV



Mechanical Control Plant: Traditional Chiller & Boiler Plant



Code Baseline

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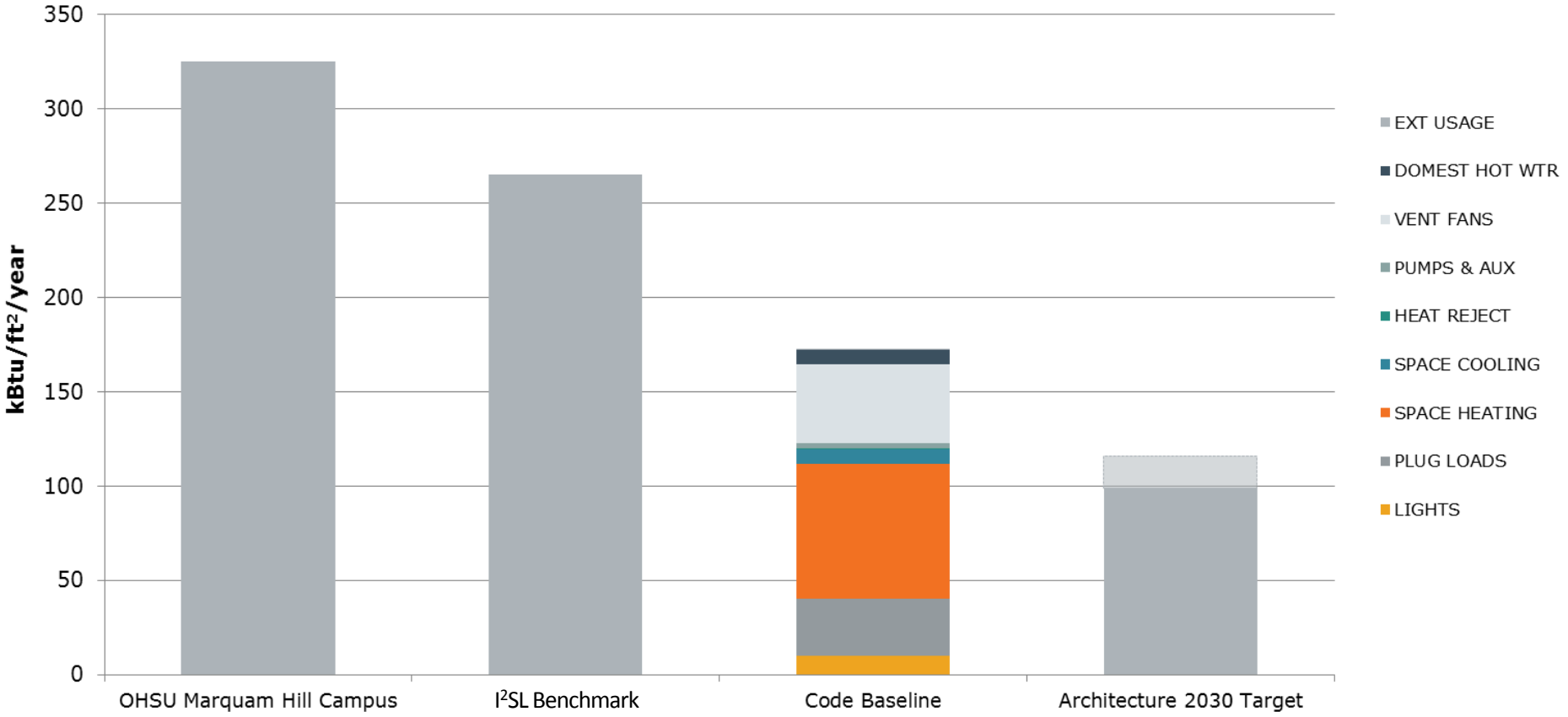
Code Baseline



Energy Conservation Measures (ECMs)

Efficient Air-side HVAC System

Efficient Central Plant

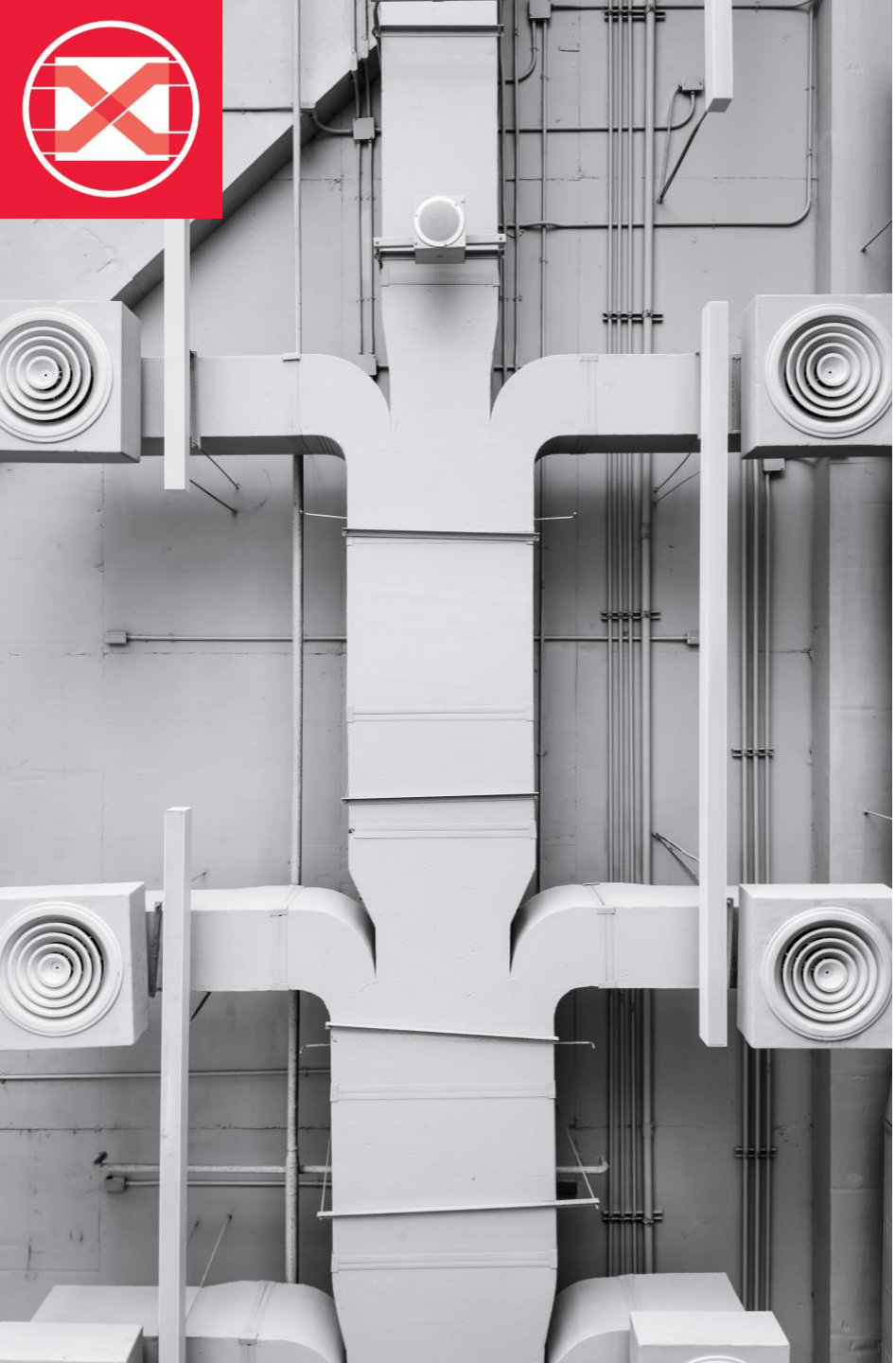
LED Lighting with Occupancy Sensors and Daylight Control

Condensing Water Heaters with Low-flow Fixtures

Wind-based Laboratory Exhaust Control Strategy

Building Envelope

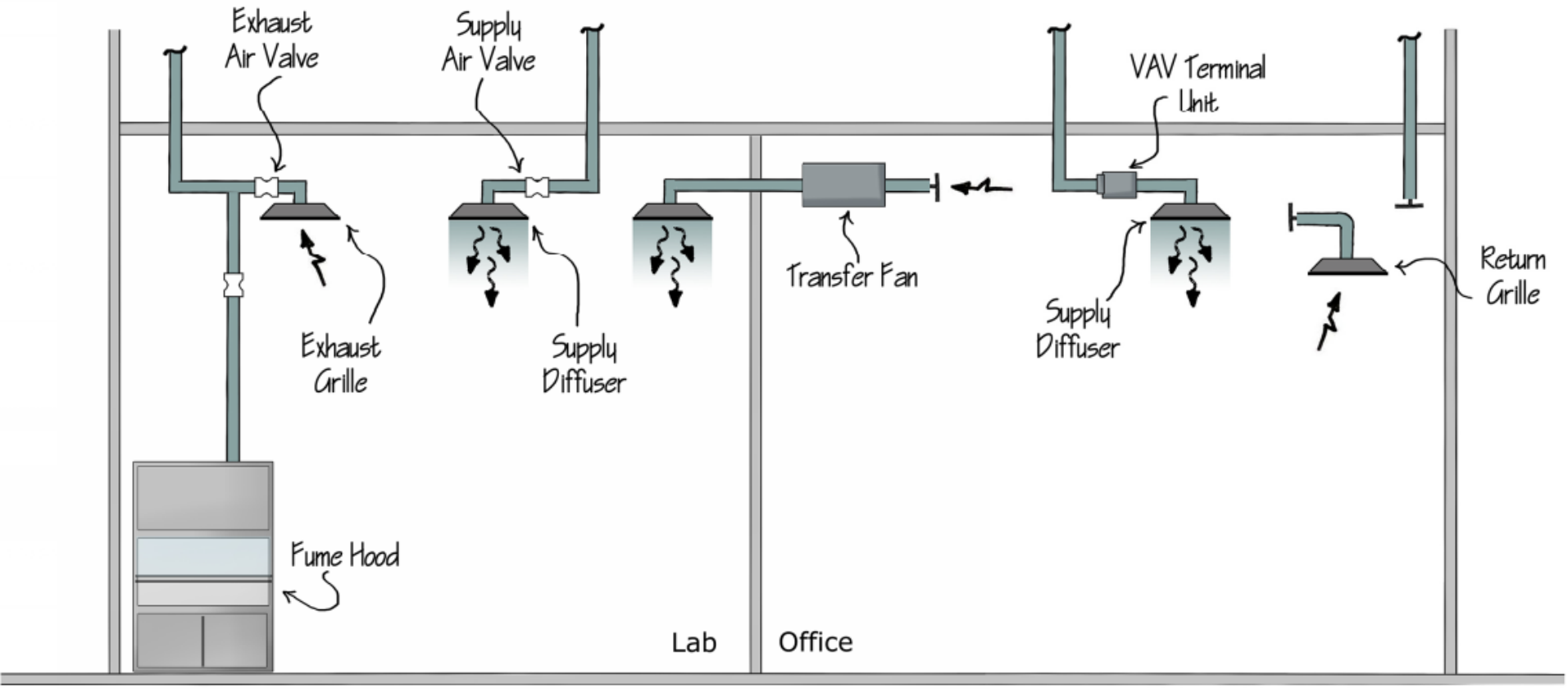
- Maximize daylighting opportunity
- Making sure systems work with loads
- Loads more driven by internal gains and ventilation than envelope



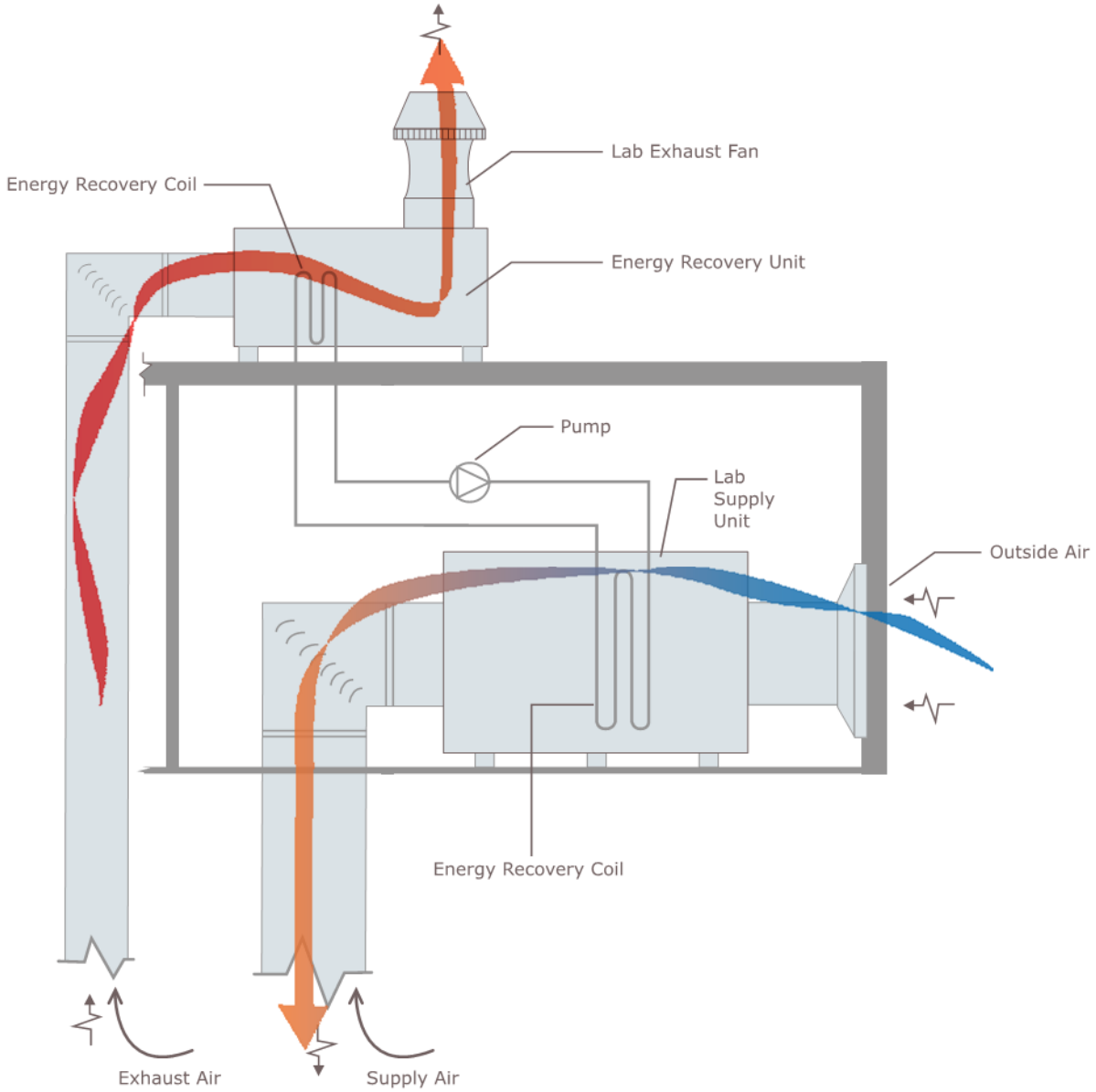
Air-side HVAC

- More effective zoning (offices, labs, support areas, auditorium)
- Heat recovery via glycol run-around loop
- Transfer fans move air from offices to labs to provide required air changes
  - Minimum flow schedules on lab zones with transfer fans account for OA requirements only
  - Other air supplied room-neutral via transfer, so space temperature impacts not a concern
  - Transfer fan energy accounted for with direct metered load
  - Zone-by-zone hourly reports examined to verify desired airflows met

Transfer Fans



Heat Recovery



Air-side Improvements

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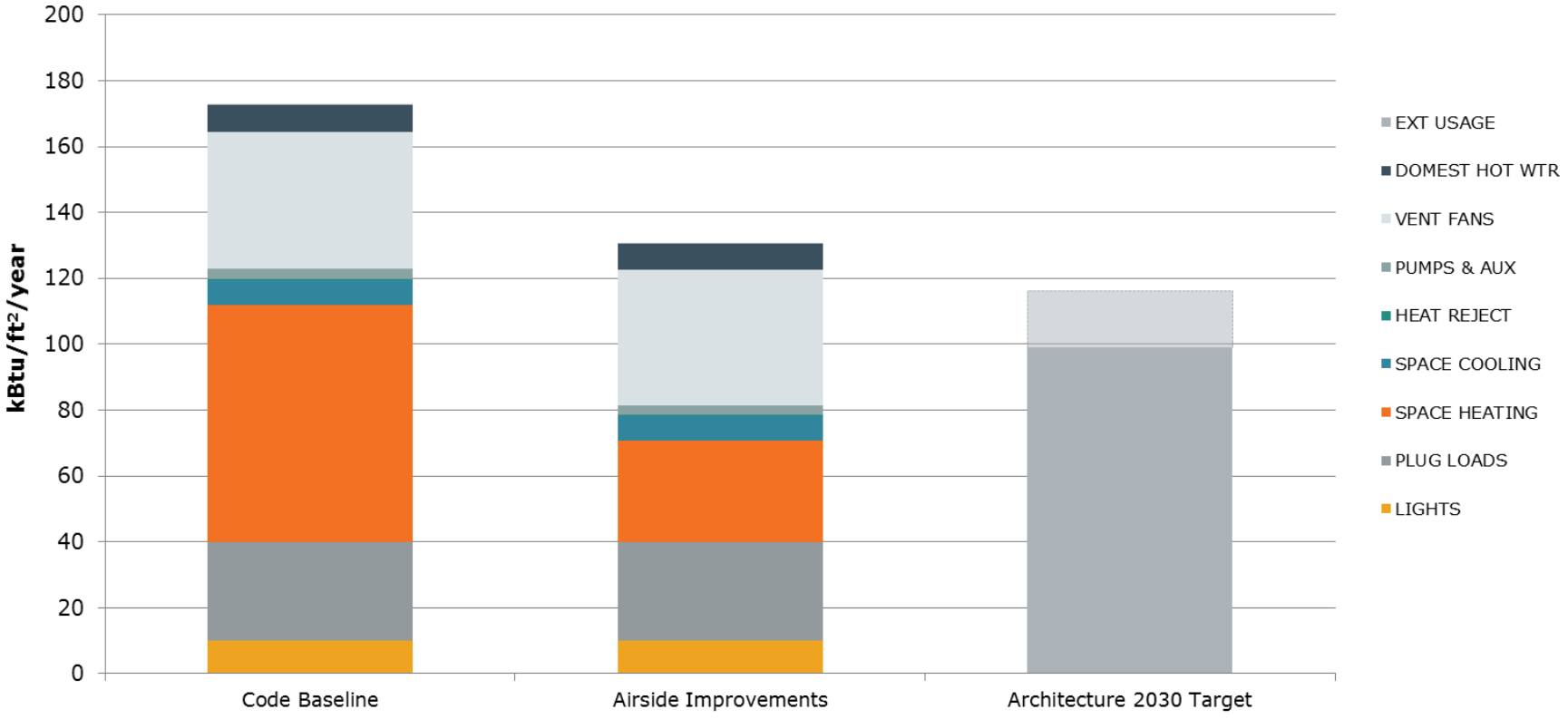
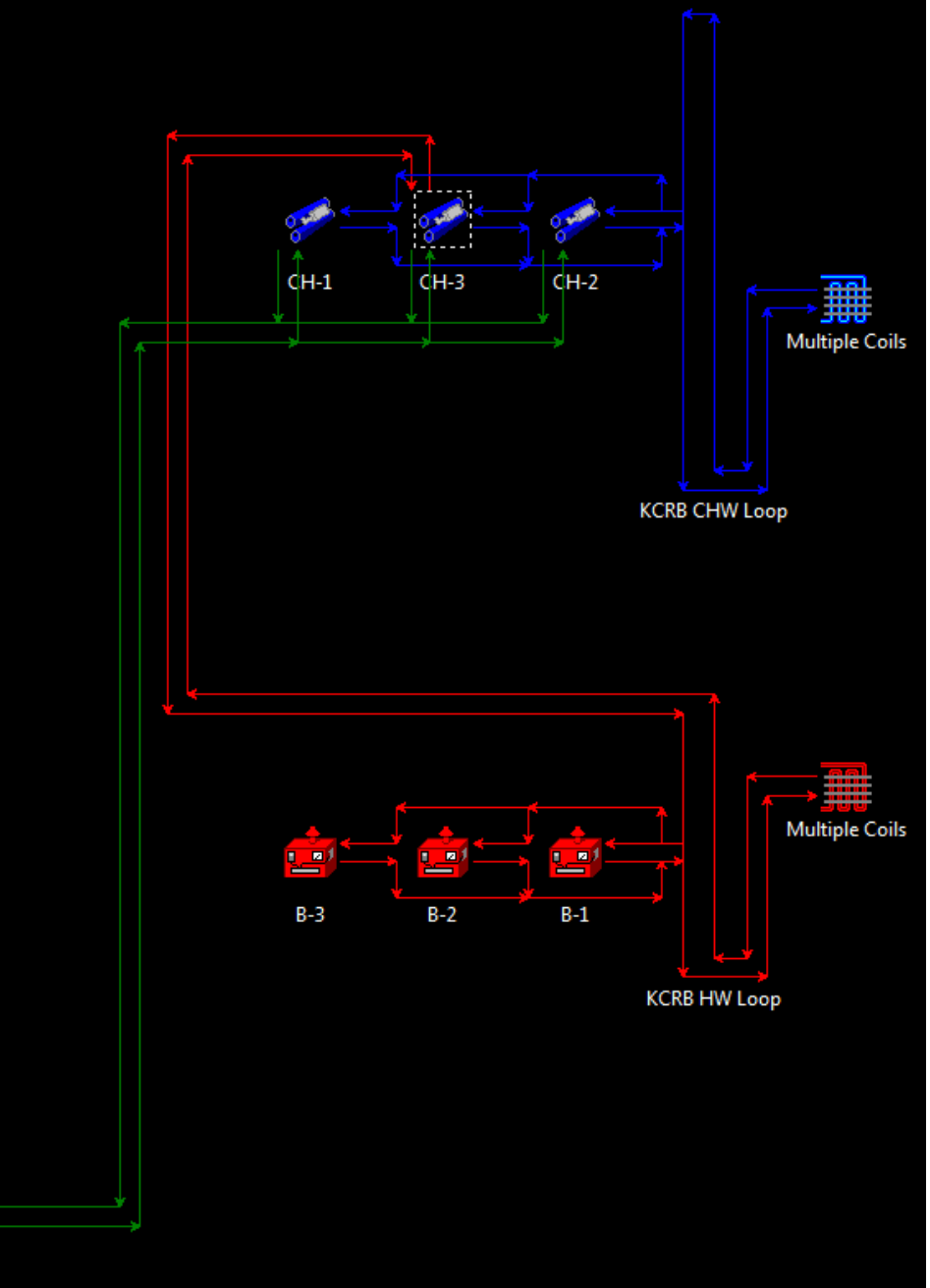
After air-side improvements

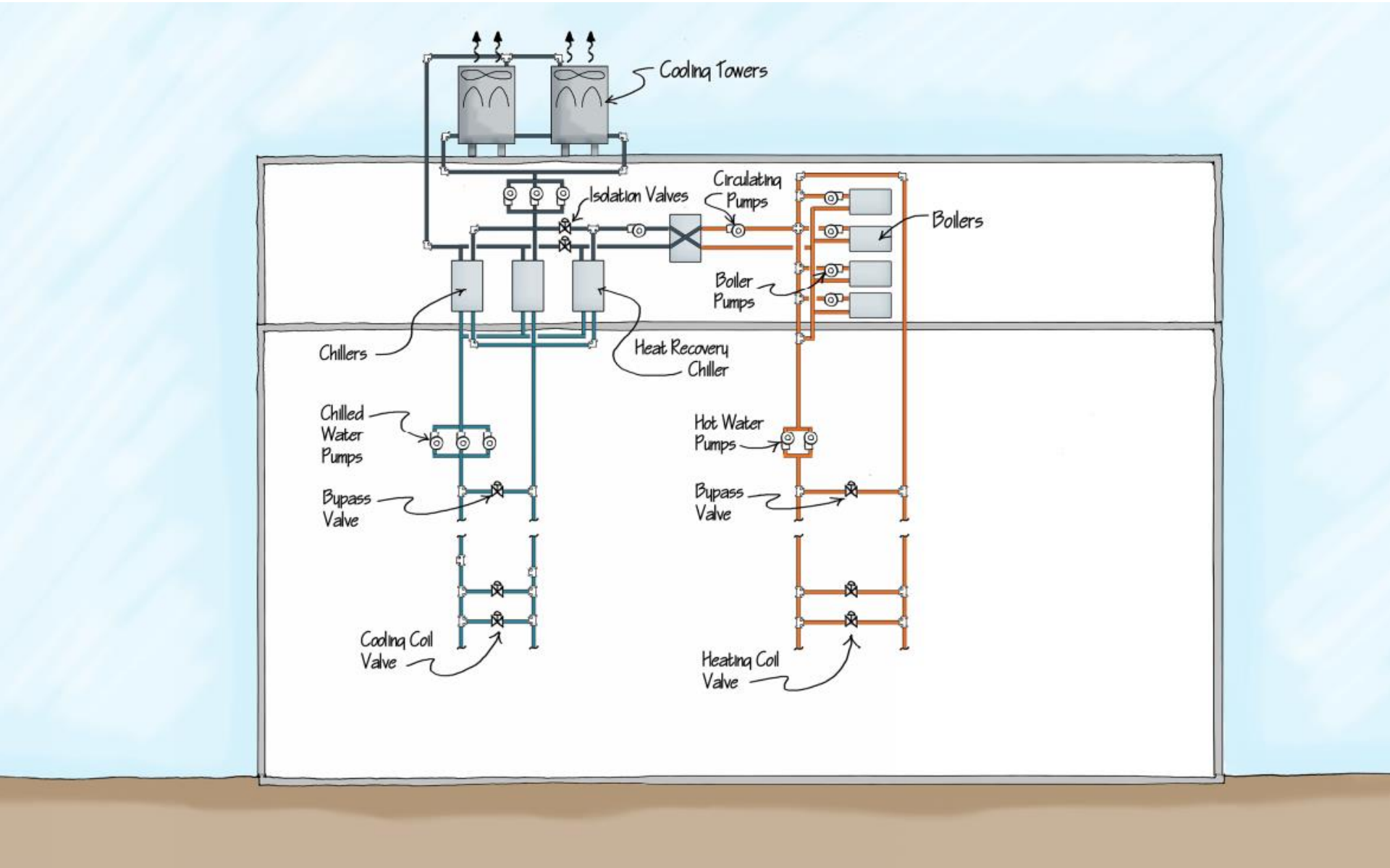




Water-side Equipment

- Heat recovery chiller as primary cooling and heating source
- Two other water-cooled chillers with cooling towers
- Condensing gas boilers for remainder of heating needs
- Free cooling capability through cooling towers when outdoor conditions allow
- Variable speed pumping everywhere

Mechanical Central Plant: Heat Recovery Chiller



Water-side Improvements

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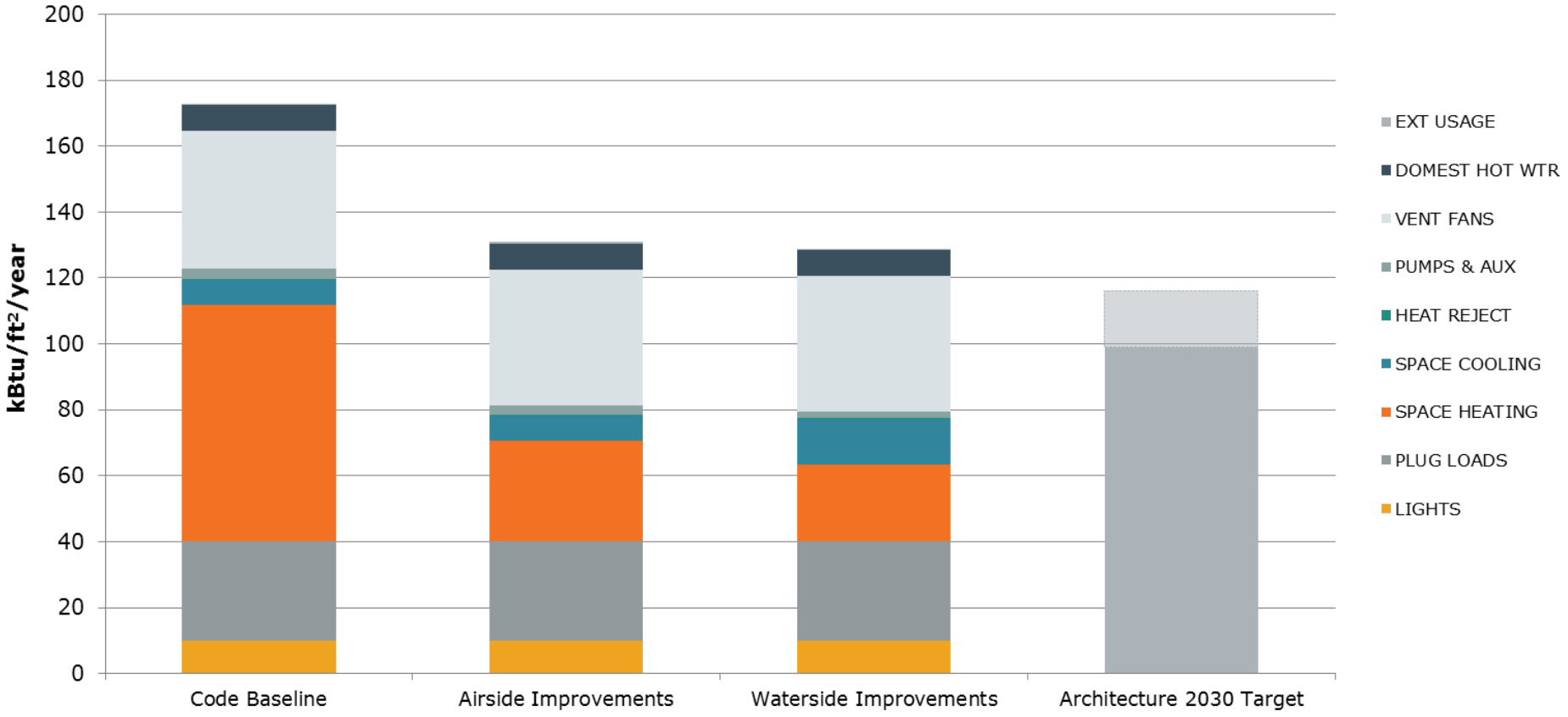
After water-side improvements



Lighting Upgrades

- All LED fixtures
- Occupancy sensors (credit taken where not code-required)
- Daylight harvesting with continuous dimming in south-facing labs and north-facing offices

Lighting Upgrades

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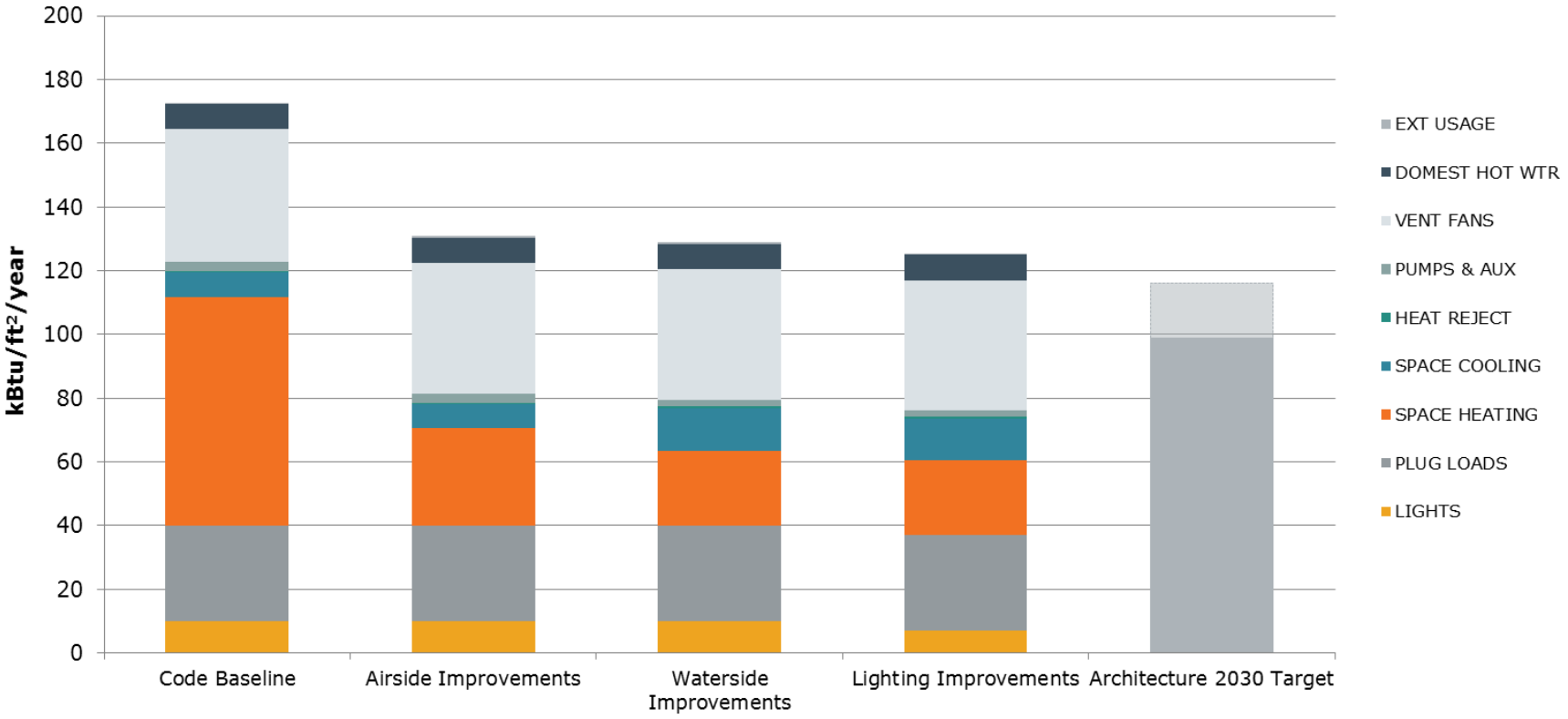
After lighting upgrades



Service Hot Water Improvements

- Condensing gas-fired heaters for both domestic (lavatory) and process (laboratory) usage
- Low-flow fixtures in lavatories

Service Hot Water

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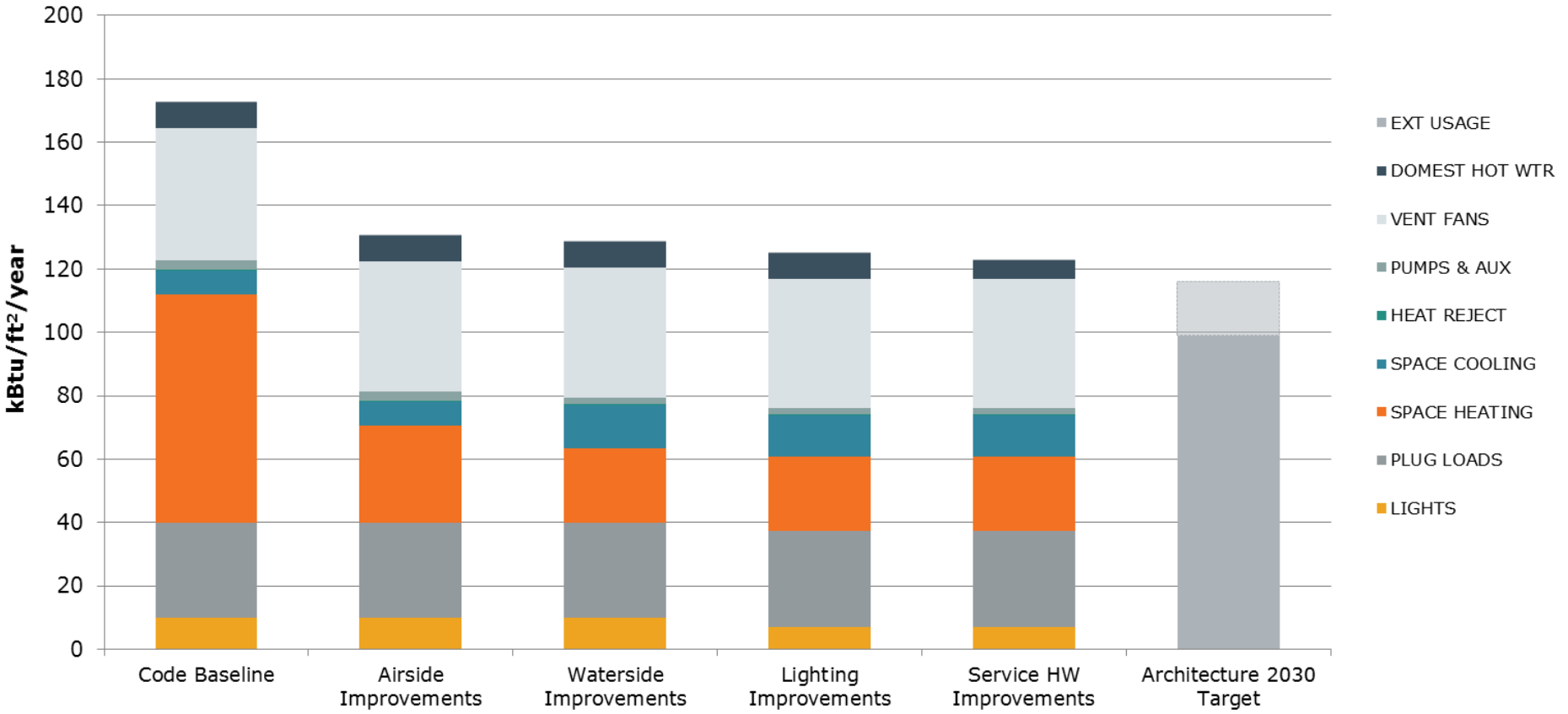
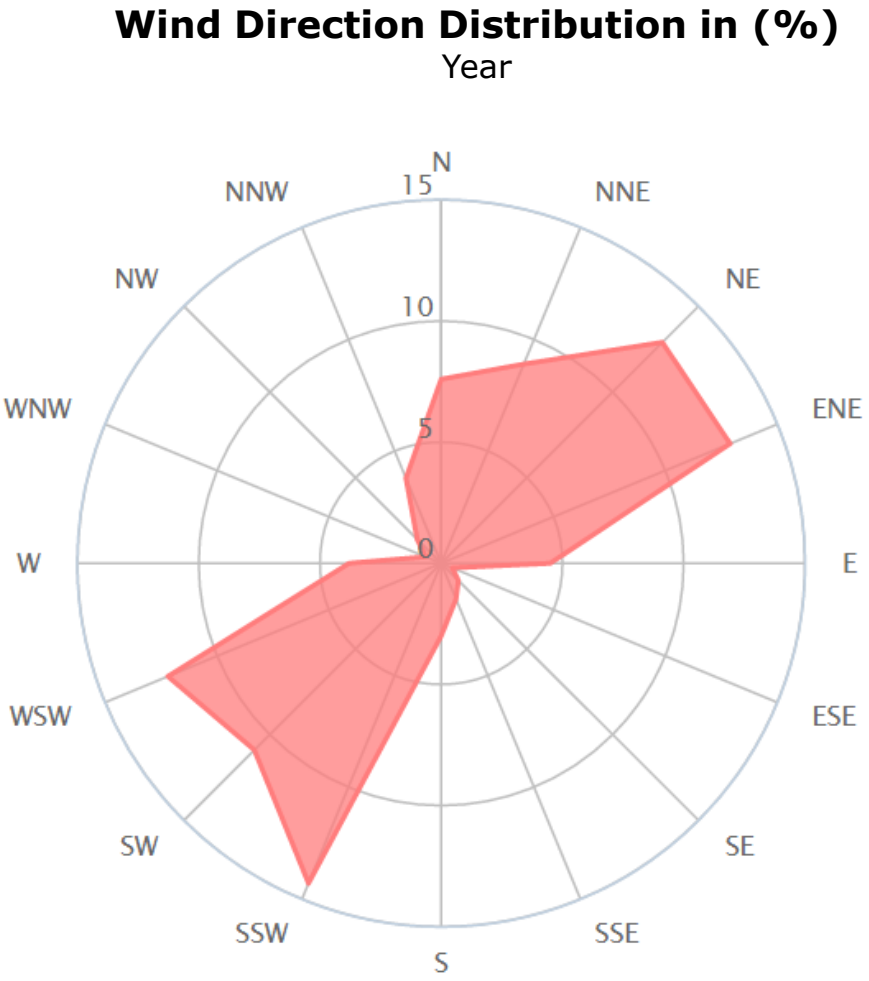
After hot water improvements



Control of Laboratory Exhaust



- Use VFDs with redundant fans to reduce fan energy
- Select number and speed of fans to meet necessary plume
- Wind study/mock-up performed to inform control sequence
- On-site weather station provides wind conditions

Control of Laboratory Exhaust

Minimum Fan Speed	
Fan System:	LEF-3,4,5,6
Design Criterion:	400
Stack Height:	30ft
Volume Flow Rate:	37,000 cfm
Exit Velocity:	2,775 fpm
Anemometer Height:	12ft above the CLSB Penthouse

Anemometer Wind Speed* (MPH)																
Wind Direction																
Min	Max	<1	1	2	3	4	5	6	8	10	12	14	16	19	22	25
350	10	48%	50%	56%	61%	66%	69%	73%	78%	84%	89%	94%	99%	100%	100%	100%
10	30	48%	50%	55%	60%	65%	69%	75%	85%	95%	100%	100%	100%	100%	100%	100%
30	50	48%	47%	52%	58%	63%	68%	74%	85%	97%	100%	100%	100%	100%	100%	100%
50	70	48%	17%	31%	43%	54%	64%	73%	90%	100%	100%	100%	100%	100%	100%	100%
70	90	48%	17%	30%	41%	52%	61%	70%	85%	98%	100%	100%	100%	100%	100%	100%
90	110	48%	23%	35%	44%	52%	58%	63%	69%	72%	73%	73%	73%	72%	71%	71%
110	130	48%	34%	53%	70%	84%	97%	100%	100%	100%	100%	100%	100%	100%	100%	100%
130	150	48%	35%	54%	71%	86%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%
150	170	48%	35%	53%	69%	83%	95%	100%	100%	100%	100%	100%	100%	100%	100%	100%
170	190	48%	46%	59%	68%	74%	77%	79%	78%	75%	71%	68%	65%	62%	59%	55%
190	210	48%	52%	61%	66%	67%	66%	64%	57%	50%	45%	42%	42%	42%	42%	39%
210	230	48%	51%	60%	65%	66%	64%	62%	54%	48%	43%	42%	42%	43%	42%	38%
230	250	48%	30%	29%	28%	25%	22%	20%	15%	13%	13%	14%	16%	17%	15%	12%
250	270	48%	11%	13%	13%	12%	12%	11%	9%	8%	8%	8%	9%	8%	8%	8%
270	290	48%	14%	13%	12%	11%	10%	10%	9%	8%	8%	9%	9%	9%	8%	8%
290	310	48%	34%	34%	33%	30%	27%	24%	18%	15%	14%	15%	17%	20%	19%	15%
310	330	48%	36%	43%	47%	50%	51%	51%	49%	46%	43%	40%	38%	37%	37%	37%
330	350	48%	48%	54%	58%	60%	61%	61%	60%	57%	55%	54%	53%	51%	50%	47%
*Local anemometer wind speed																

Laboratory Exhaust

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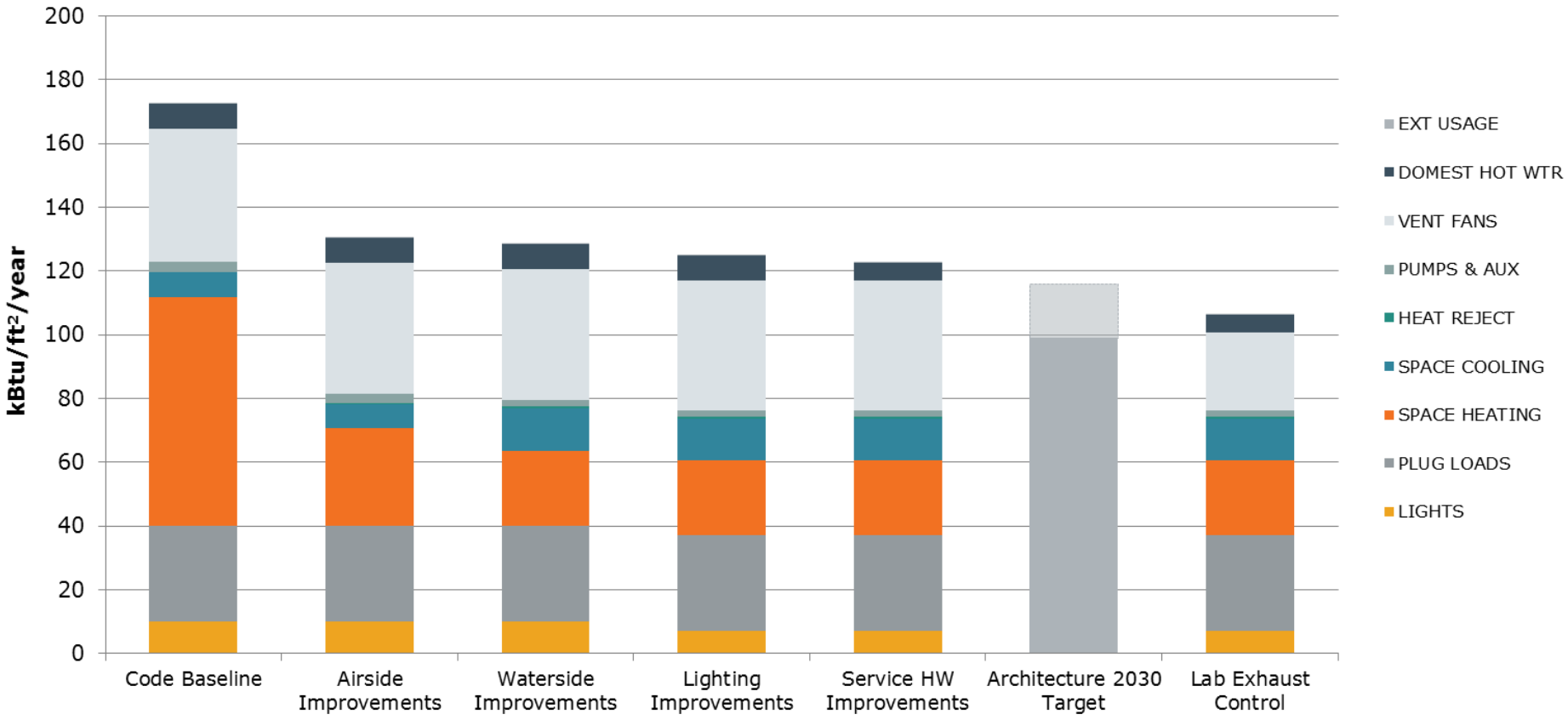
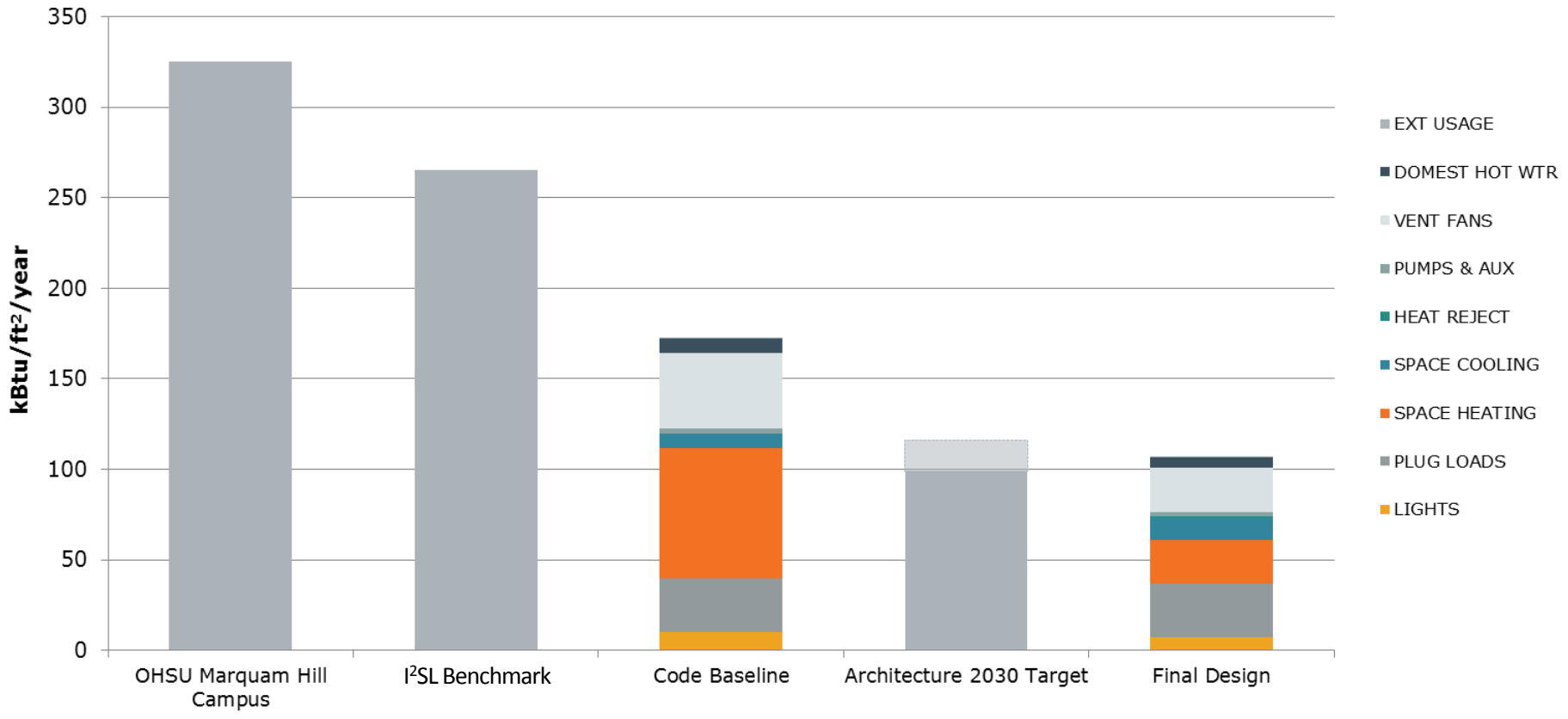
After exhaust control



Summary


350
300
250
200
150
100
50
0
kBtu/ft²/year
OHSU Marquam Hill Campus
I²SL Benchmark
Code Baseline
Architecture 2030 Target
Final Design
EXT USAGE
DOMEST HOT WTR
VENT FANS
PUMPS & AUX
HEAT REJECT
SPACE COOLING
SPACE HEATING
PLUG LOADS
LIGHTS

Creating a better environment

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