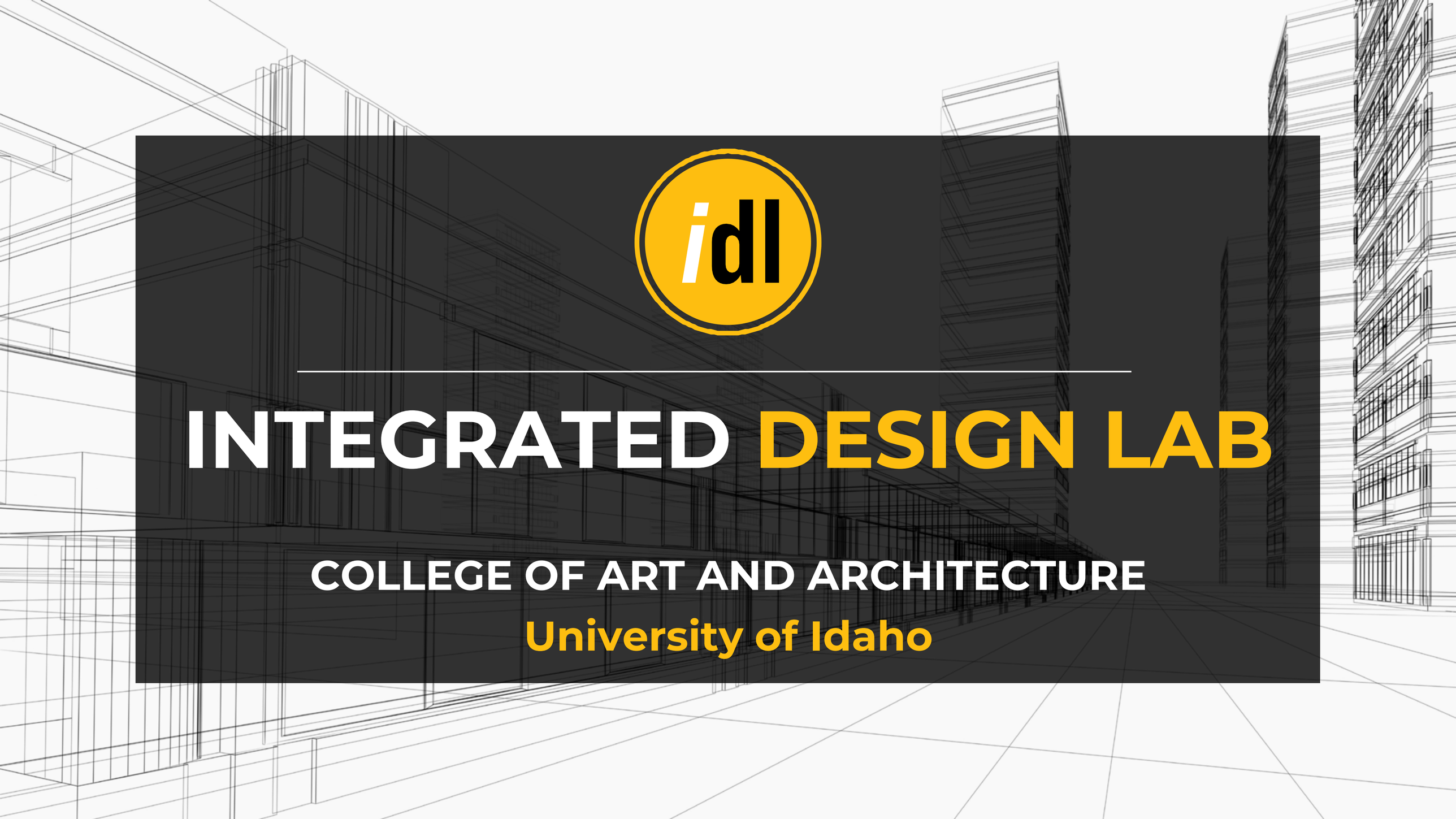

idl
INTEGRATED DESIGN LAB
COLLEGE OF ART AND ARCHITECTURE
University of Idaho

University of Idaho
College of Art and Architecture

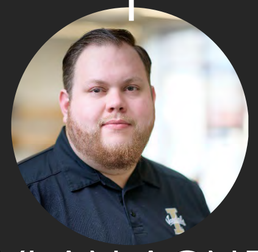
OUR TEAM MEMBERS

SHAUNA CORRY
CAA Dean

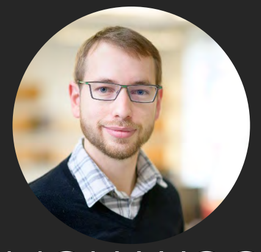
RANDY TEAL
ARCH Chair

KIM OSBORNE
ARCH Fiscal Officer

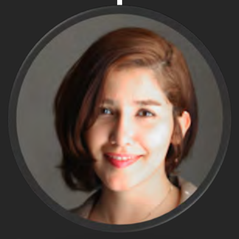
idl



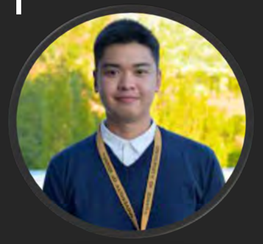
DYLAN AGNES
Research Scientist I
M. Architecture



DAMON WOODS
Director
Ph.D Mechanical Engineering



FARNAZ NAZARI
Research Scientist
M. Architecture + M.S. Computer Science



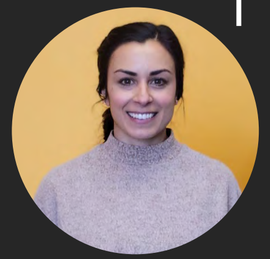
FELINO MACATUNO
Research Assistant
Mathematics

GREGORY REYES
Research Assistant
M. Architecture

NATALIE ALAYA
Research Assistant
B.S. Mech. Engineering

ISABELLE BOICOURT
Research Assistant
B.S. Civil Engineering

JOSEPH SEDILLO
Research Assistant
M. Architecture



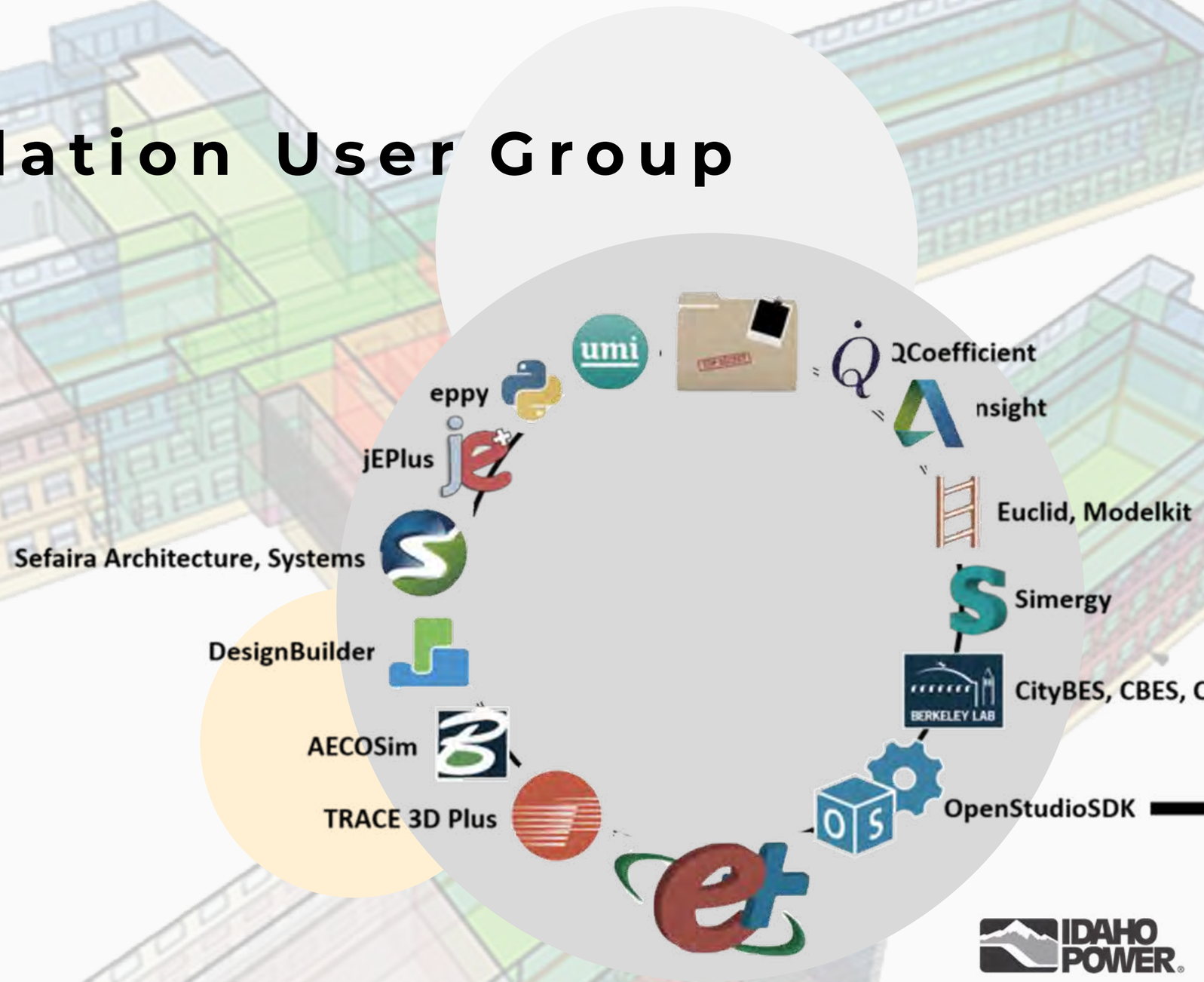
MALLORY BUSCEMI
Research Assistant
M. Architecture

Building Simulation User Group
BSUG

//

BSUG is a free lecture series that brings together architecture and engineering professional focused on building simulation.

There are six lecture given each year. Lectures are split up to be presented in the first half of the year and the end of the year. Topics include energy modeling software, integrating building performance in the design process, and workflow/methods for an integrated design process. Door prizes are given away each lecture. Prizes focus on energy efficiency or related lecture topics.



idl

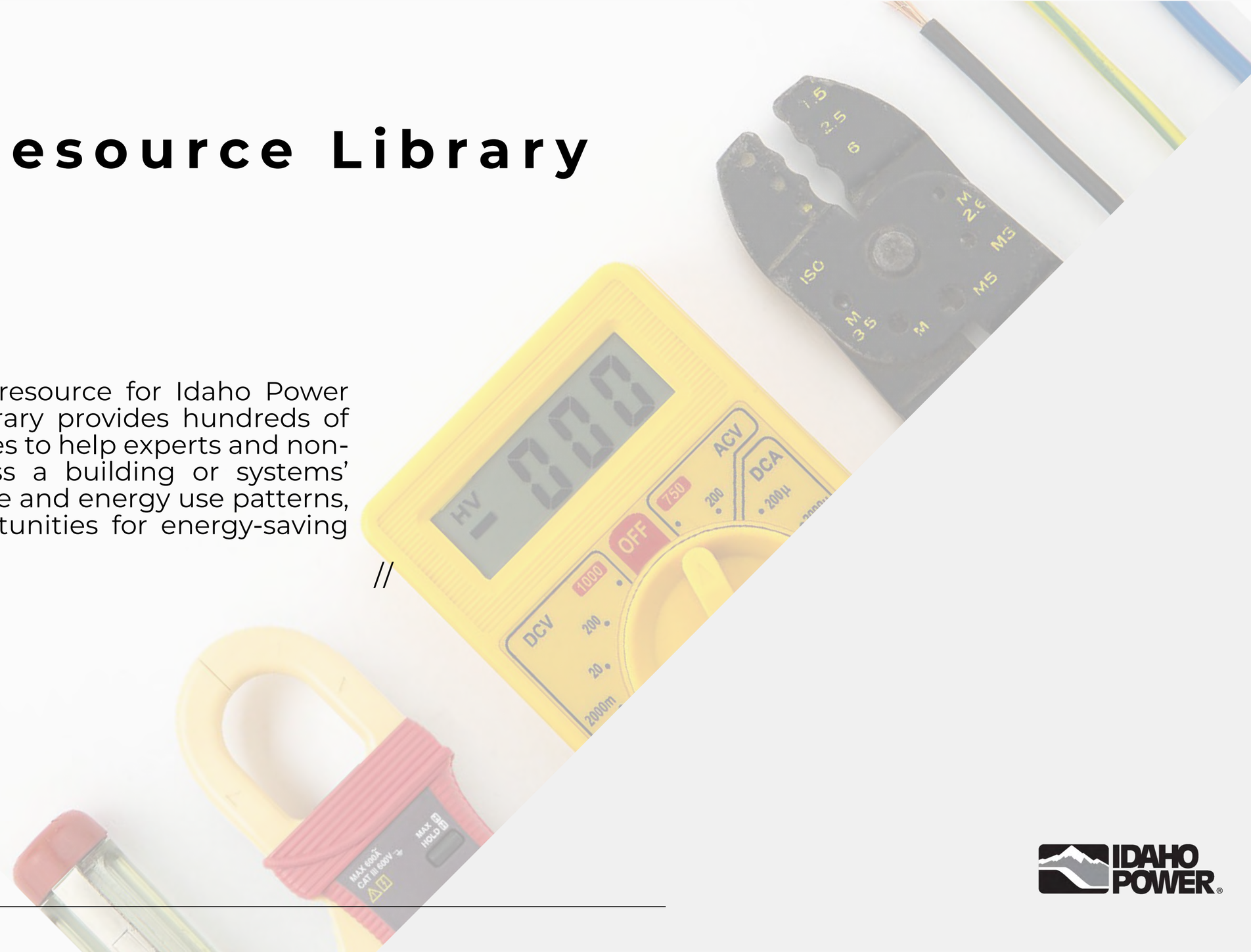
IDAHO POWER

Energy Resource Library
ERL

//

The ERL is a free resource for Idaho Power customers. The library provides hundreds of free tools and guides to help experts and non-experts alike assess a building or systems' energy performance and energy use patterns, and identify opportunities for energy-saving improvements.

//



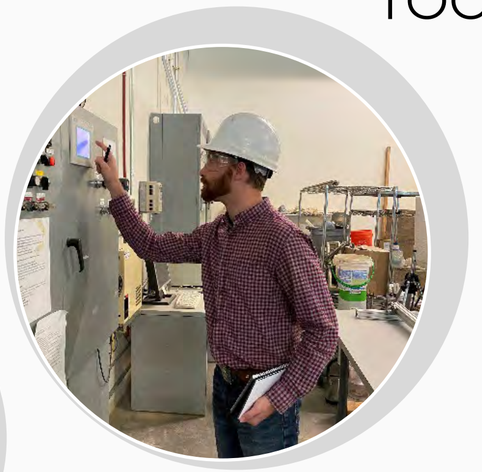
Technical Design Assistance

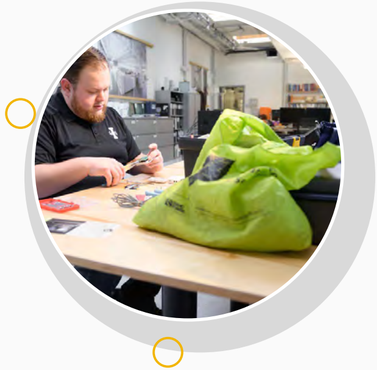
The IDL can provide varying levels of energy efficiency technical assistance and project-based training to building industry professionals and customers in Idaho Power's service area.

IDL WORKFLOW

LECTURES

TOOLS + MEASUREMENTS

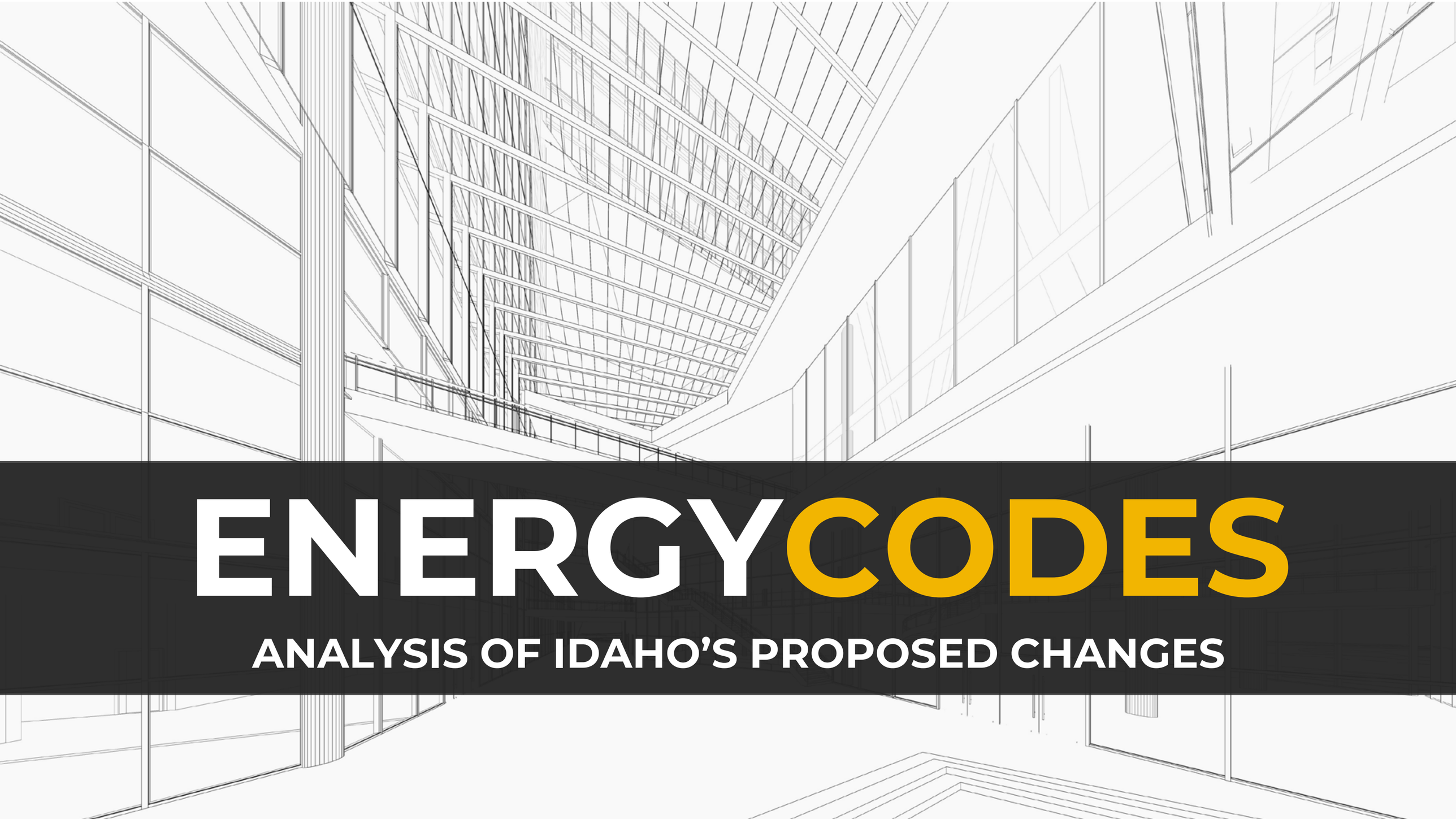




PHYSICAL

VIRTUAL

MODELING & ESTIMATES



ENERGYCODES

ANALYSIS OF IDAHO'S PROPOSED CHANGES

Zero-Based Regulation

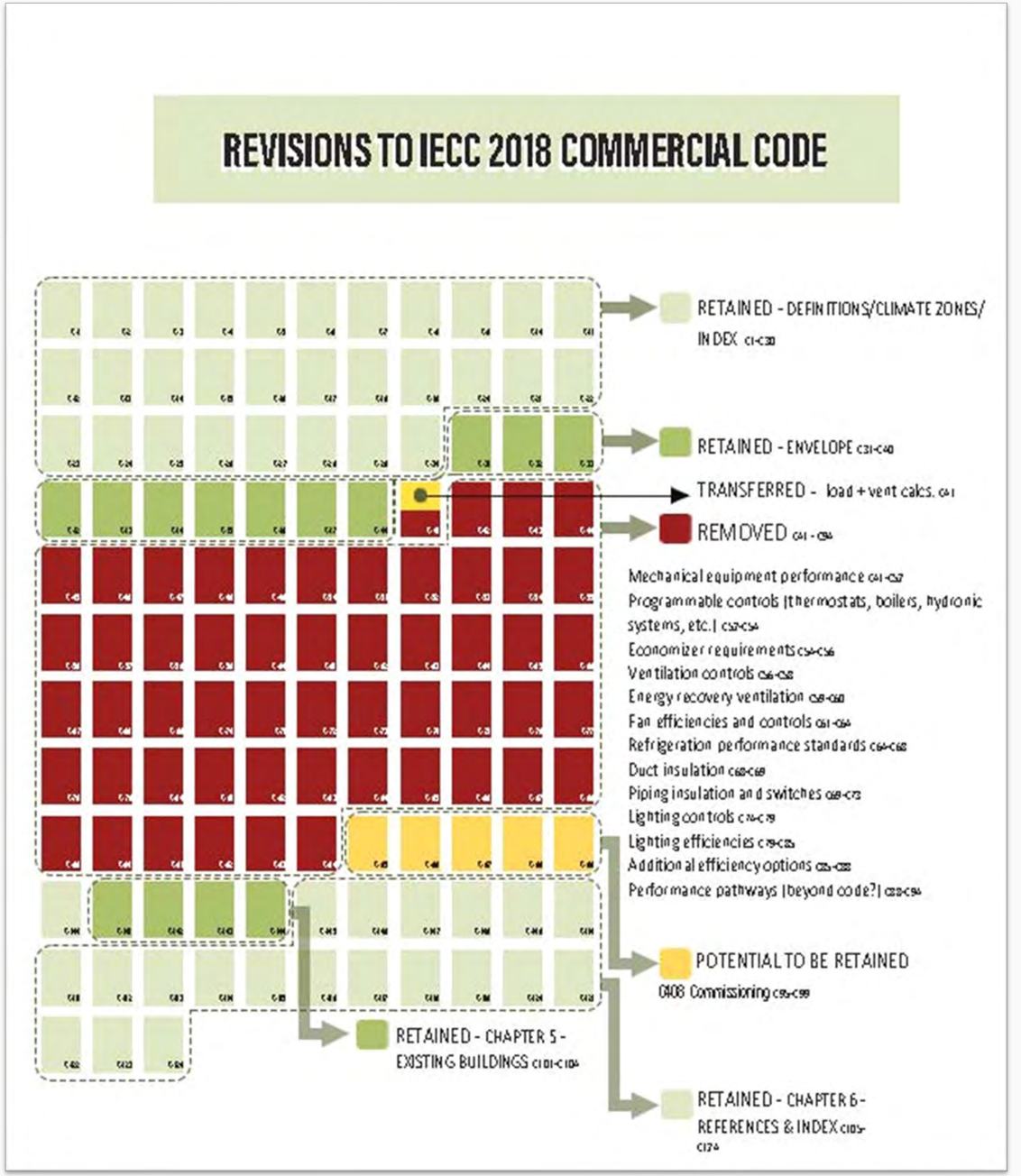
Idaho Executive Order No. 2020-01

IDAHO'S CLIMATE

- Idaho currently adheres to the 2018 IECC (with some exceptions)
- There is a stronger political will to decrease regulation than there is to combat climate change
- No city can adopt a stricter energy code than the state minimum (HB 660)

Zero-Based-Rulemaking

1. Removing all lighting requirements
2. Removing most of mechanical code
3. Removing water heating requirements
4. Removing additional efficiency options



Impact Modeling: How does this compare to other states?

- **Alaska:**

While Alaska does not have a mandatory statewide code, the state has developed Building Energy Efficiency Standards (BEES), which is based on the 2018 IECC with state-specific amendments.

- **Wyoming**

Wyoming allows different jurisdictions to have more stringent codes. Thus, the city of Cheyenne requires blower door testing and the city of Casper has adopted IECC 2021 with some local amendments.

- **North Dakota**

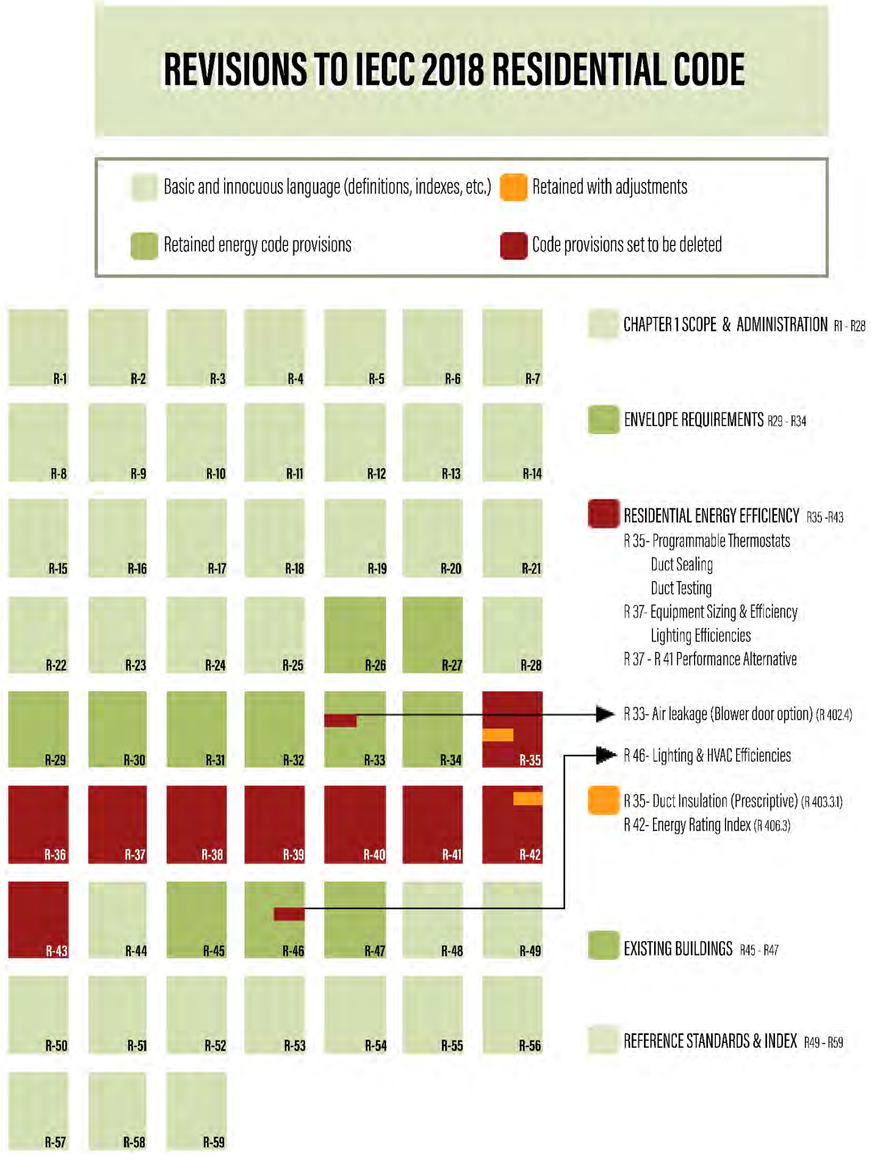
North Dakota is a home rule state. “While it has no statewide mandatory energy codes, the state recently adopted the 2018 IECC as its voluntary commercial code. Approximately 91% of the state’s population lives in a jurisdiction that has adopted the ND State Building Code which includes the 2018 IECC.”[1]

- **Utah**

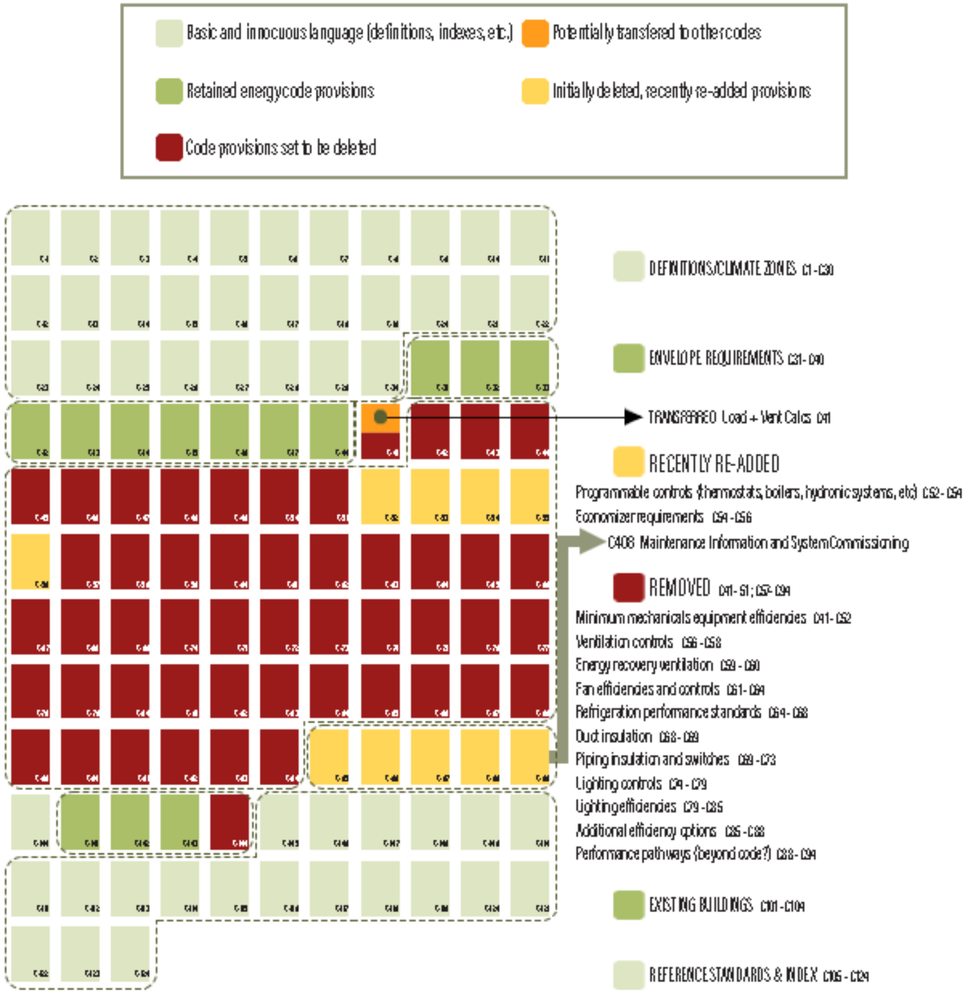
Utah passed HB 218 adopting the 2018 IECC commercial provisions in their entirety. Localities may also adopt stretch codes.[1]

1. https://database.aceee.org/state/residential-codes

REVISIONS TO IECC 2018 RESIDENTIAL CODE



REVISIONS TO IECC 2018 COMMERCIAL CODE

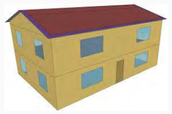


Impact Modeling: What effect will this have?

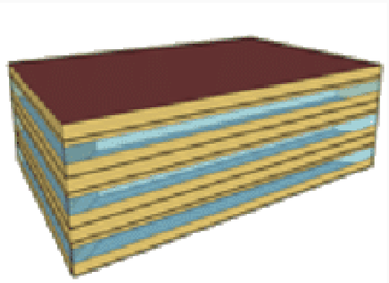
AFFORDABILITY

Last month, more than 1 in 5 Idahoans could not afford to pay an energy bill [1]

Typical Residence



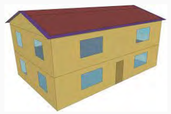
Typical Medium Office



[1] https://www.census.gov/data-tools/demo/hhp/#/?measures=ENERGYBILL&s_state=00016

RESIDENTIAL IMPACTS

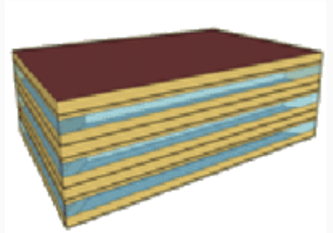
Typical Residence



- A house in Idaho's Southwest that has an Air Change per Hour (ACH) of 5 vs an ACH of 3 pays an **additional $75 per year in utilities.**
- A house with 7ACH would pay an additional $153 per year vs a house with a 3ACH tight envelope.
- The cost to do blower door and duct tightness testing is about $150 per house. Since Idaho's current amendments only require this to be done for 1 of 5 homes, this cost ends up closer to $30 per home, resulting in **a payback of 6 months or less to ensure that homes stay at an ACH of 3 vs an ACH of 5.**
- These savings may be higher for houses in climate zone 6B or with different utilities and heating (for example it is much more expensive to heat with propane or electric resistance)
- This analysis considered ONLY changes in air-tightness, keeping every other parameter the same. It did not consider the impact of duct tightness, lighting efficiencies, or mechanical equipment efficiencies all of which are also slated for removal.

COMMERCIAL IMPACTS

Typical Medium Office

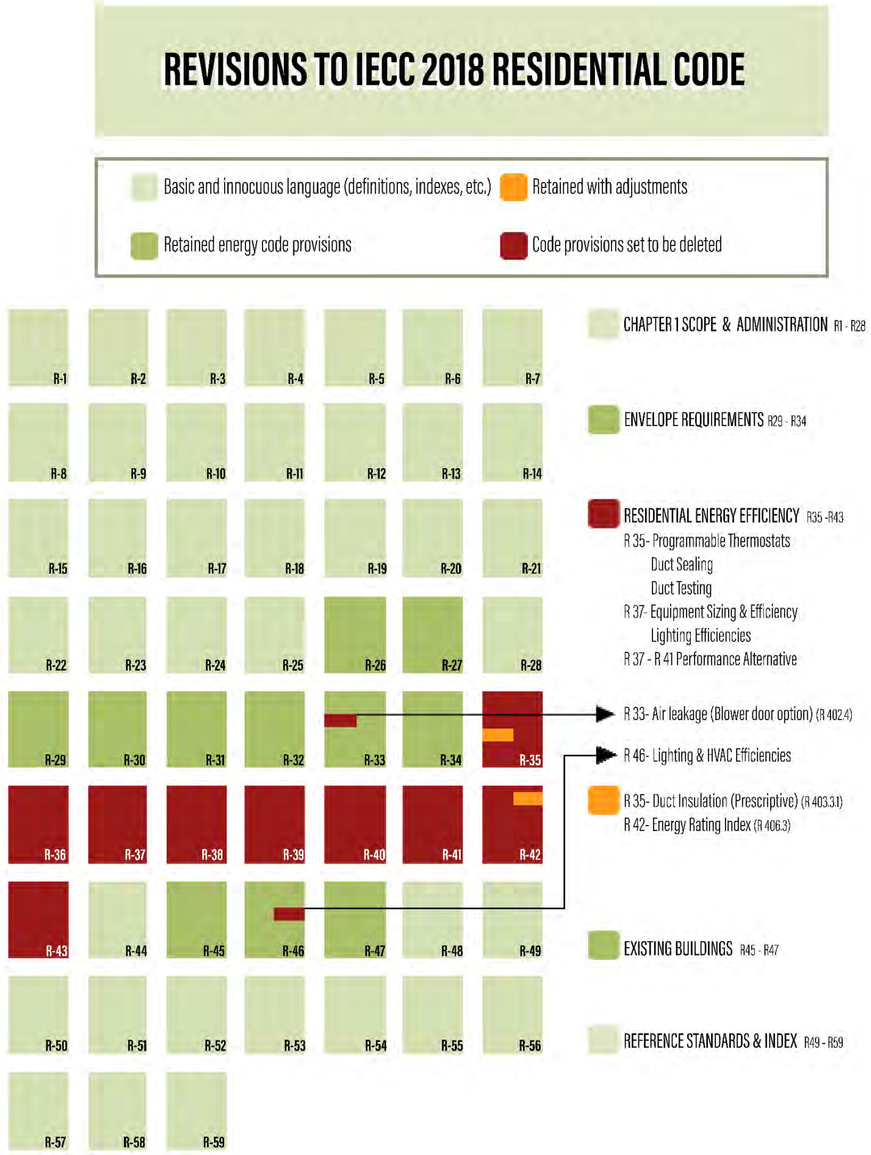


- Removing the ventilation controls, daylight controls, and assuming slightly (10%) less efficient lighting and equipment results in an additional annual cost to the building owner of **$2,285 per year in utilities**.

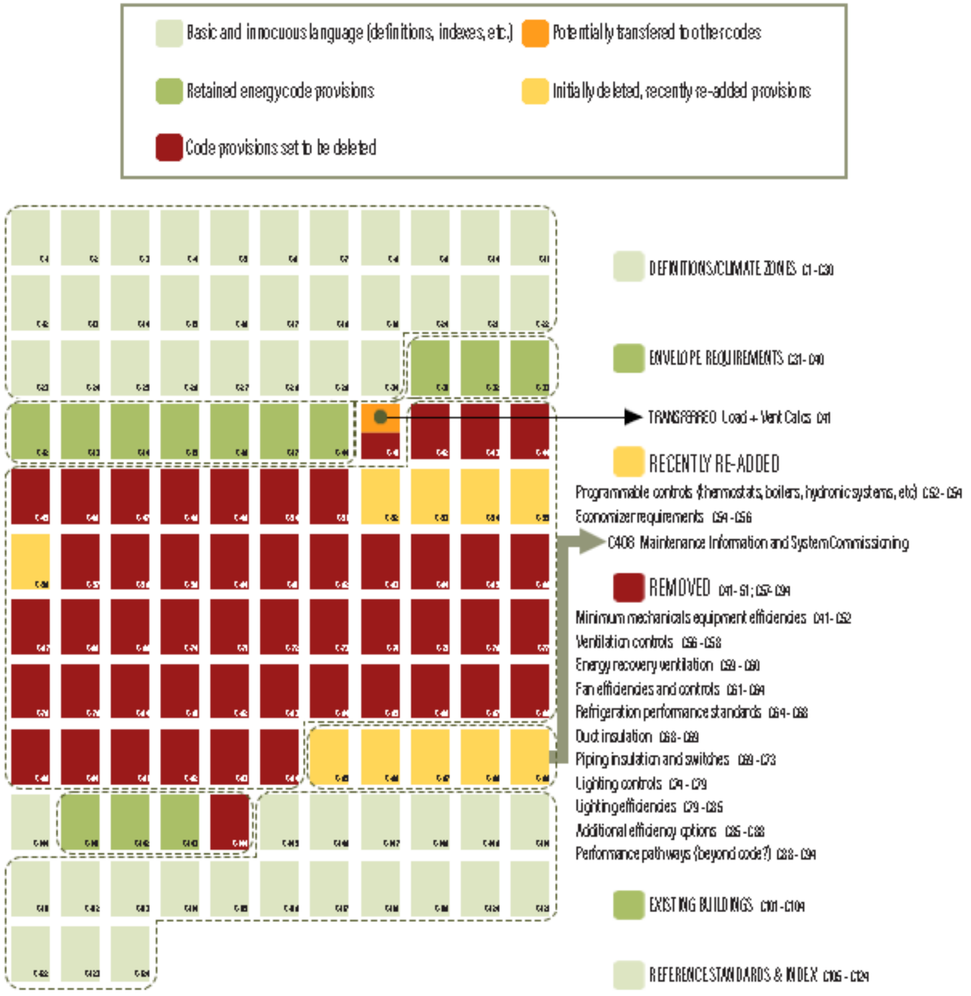
- Removing programmable controls and economizers (which until last week were also slated for removal), would have cost an additional **$2,097 per year in utilities.**

- It is difficult to know the full impact of removing all minimum fan, HVAC, water heating, and lighting efficiencies. While US manufacturers have minimum requirements, overseas equipment could be installed that could be far less efficient. A conservative estimate of 10% increased inefficiency was used for this analysis.

REVISIONS TO IECC 2018 RESIDENTIAL CODE



REVISIONS TO IECC 2018 COMMERCIAL CODE



VIRUS MITIGATION

ENERGY IMPACTS OF IAQ INTERVENTIONS

“We don’t drink contaminated water. Why do we tolerate breathing contaminated air?”

https://www.visualcapitalist.com/safe-spaces-why-indoor-air-quality-has-never-mattered-more/

Public Health Guidance:

- "Follow all current regulatory and statutory requirements and recommendations"

- **Ventilation, Filtration, Air Cleaning:**
- Maintain outdoor airflow rates for ventilation up to or beyond code.
- Merv-13 or better
- Only use air cleaners with clear evidence of effectiveness and safety
- Select control options that provide desired exposure reduction while minimizing energy penalties.

Air Distribution

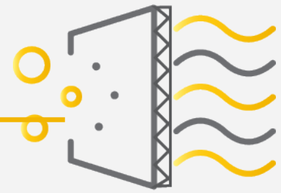
- Promotes air mixing without causing strong air currents

HVAC System Operation

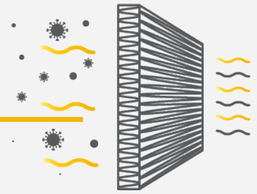
- Maintain temperature and humidity design setpoints
- Achieve three ach (air changes per hour)to flush space between occupancy periods.
- Limit re-entry of contaminated air.

ASHRAE Epidemic Task Force

MERV Filters



HEPA Filters



- Portable
- In-Duct

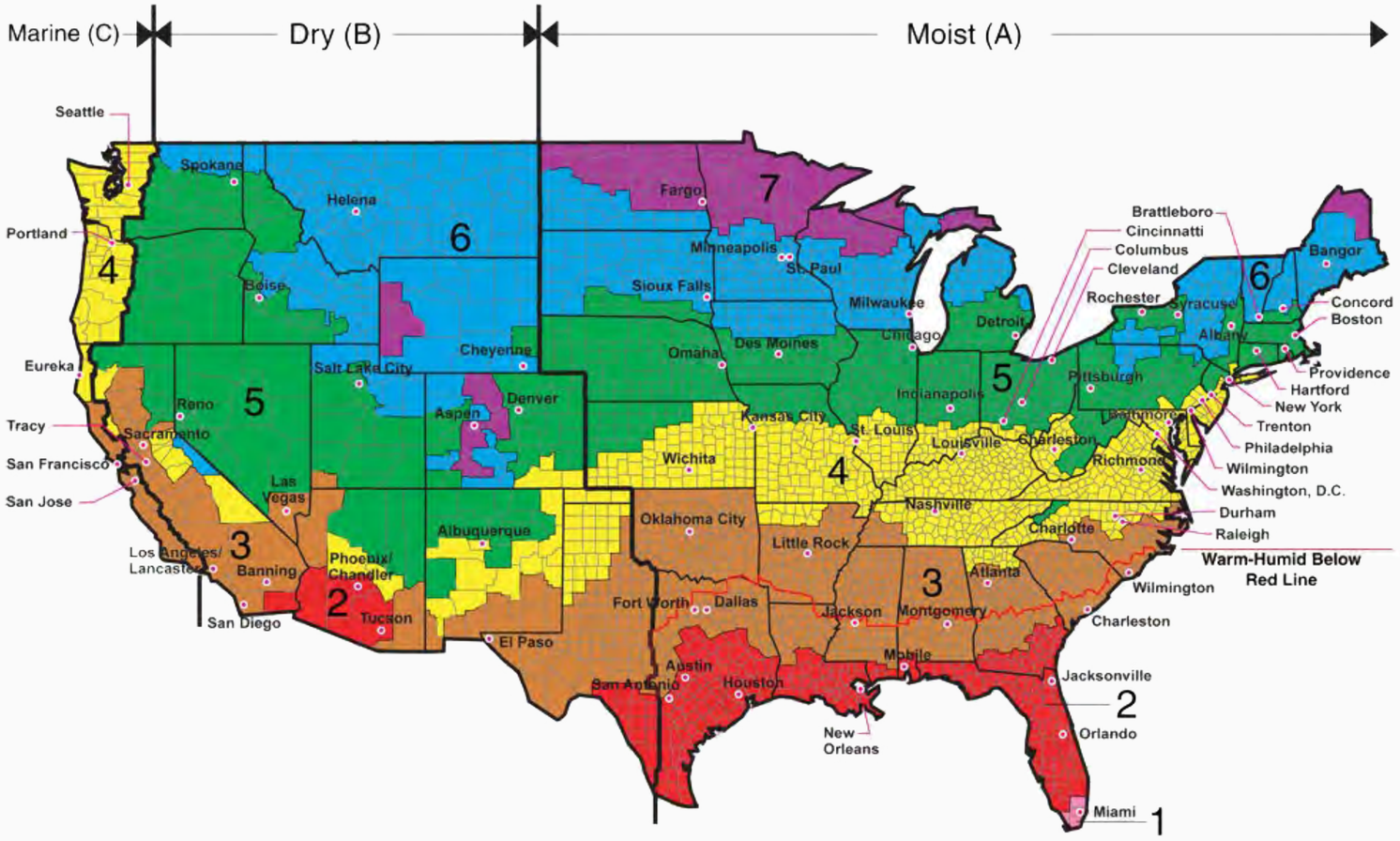
UV Light

- Upper Room
- In-Duct

Ionization

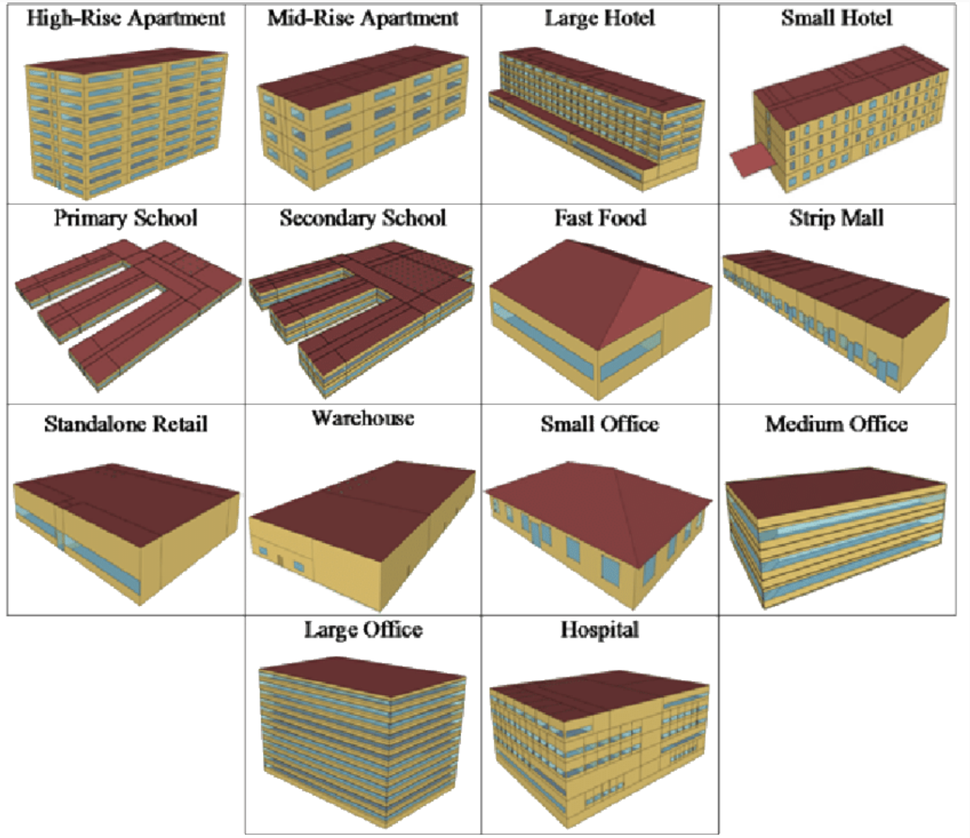
Outdoor Air

- 100% OA
- 3 ach



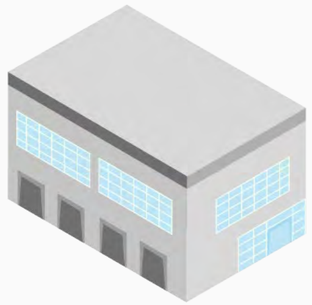
All of Alaska in Zone 7 except for the following Boroughs in Zone 8: Bethel, Dellingham, Fairbanks, N. Star, Nome North Slope, Northwest Arctic, Southeast Fairbanks, Wade Hampton, and Yukon-Koyukuk

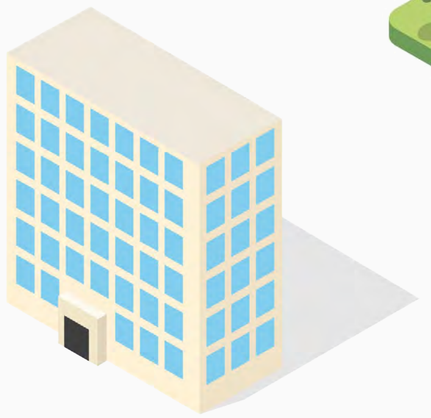
Zone 1 includes: Hawaii, Guam, Puerto Rico, and the Virgin Islands



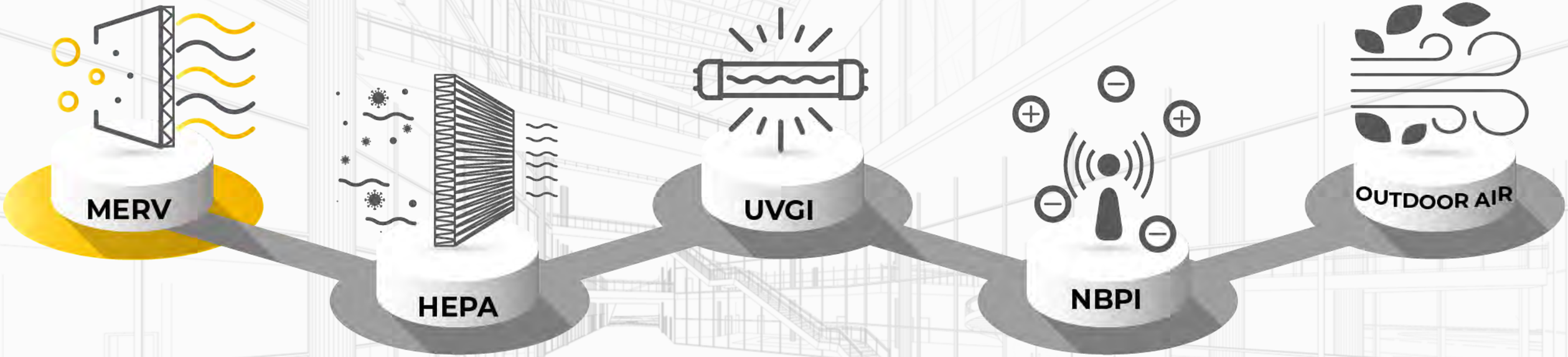
DOE COMMERCIAL BUILDING PROTOTYPES

Building Type	Square Footage	Number of Stories	Heating	Cooling	Air Distribution	Systems
Medium Office	53600	3	Furnace	PACU	MZ	3
Stand-Alone Retail	24695	1	Furnace	PACU	ZN PSZ-AC	4
Secondary School	210900	2	Boiler	Air Cooled Chiller	MZ VAV	5 CAV, 4 VAV
Hospital	241410	5	Boiler	Water Cooled Chiller	CAV + VAV	2 VAV
Large Hotel	122132	6	Boiler	Air Colled Chiller	DOAS + VAV	2
Warehouse	49495	1	Furnace	PACU	ZN HVAC	2
Full-Service Restaurant	5502	1	Furnace	PACU	ZN PSZ-AC	2
Mid-Rise Apartment	33700	4	Furnace	Split System DX (1 per apt	SAC	24



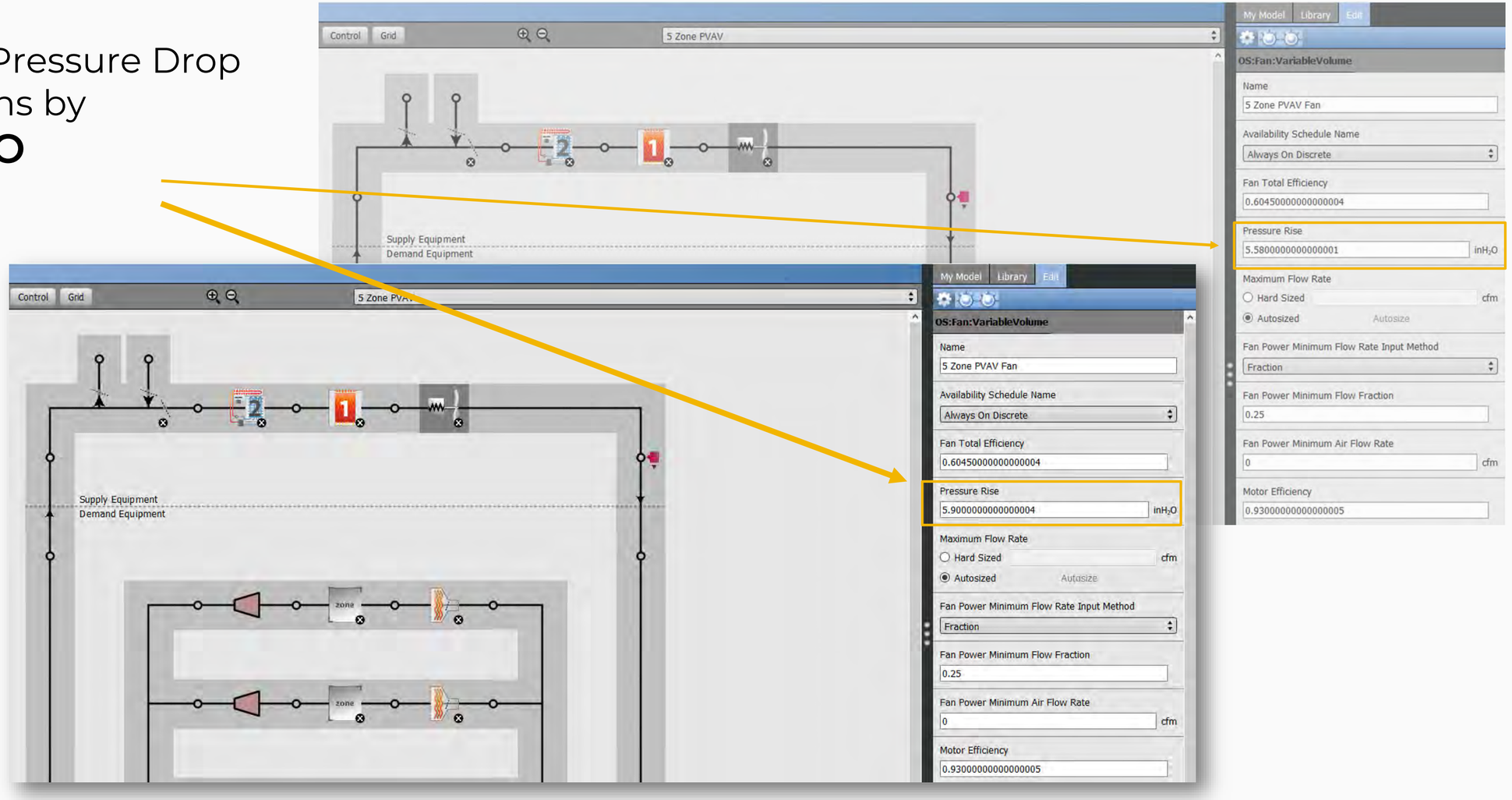


MEDIUM EFFICIENCY REPORTING VALUE

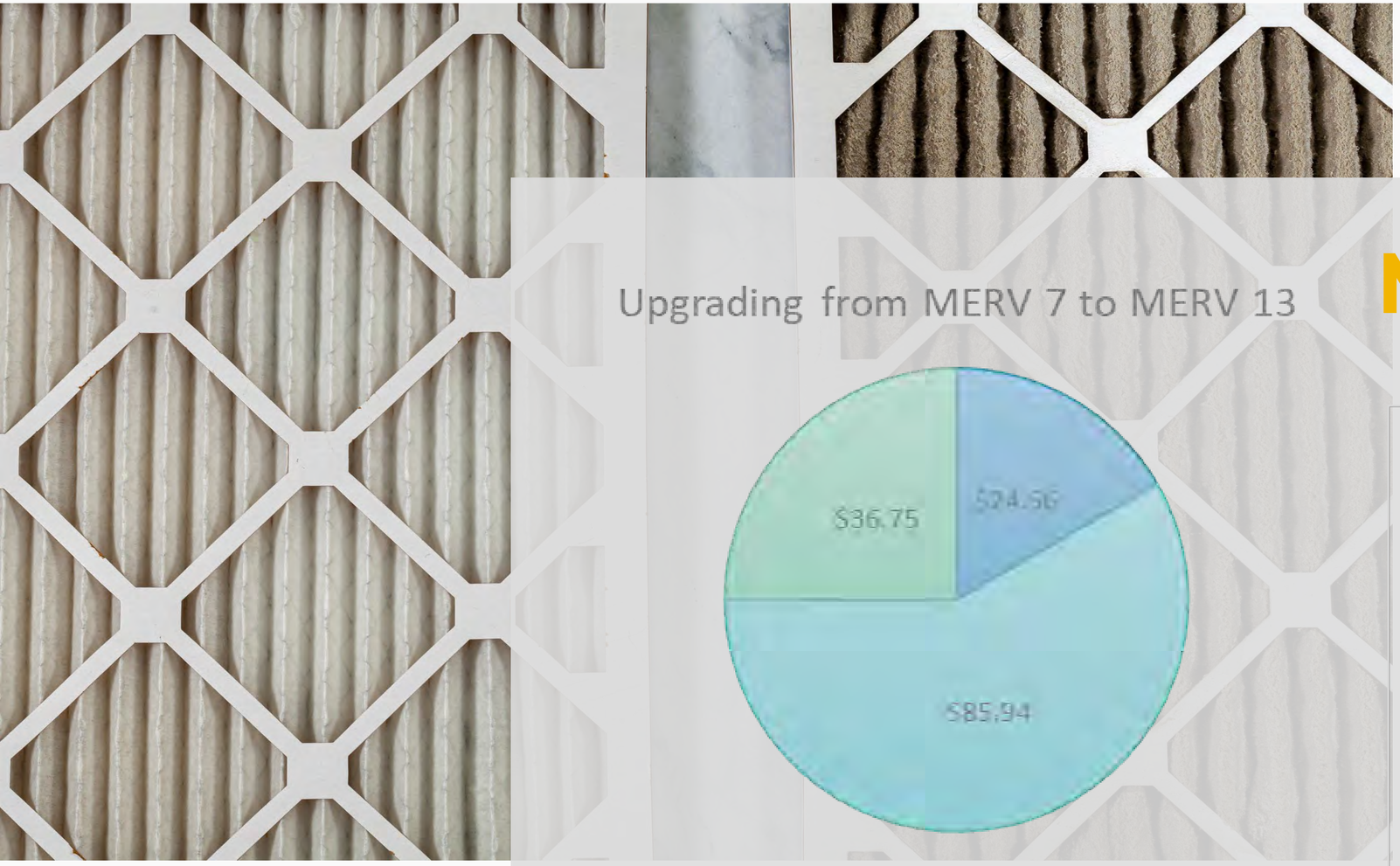


1

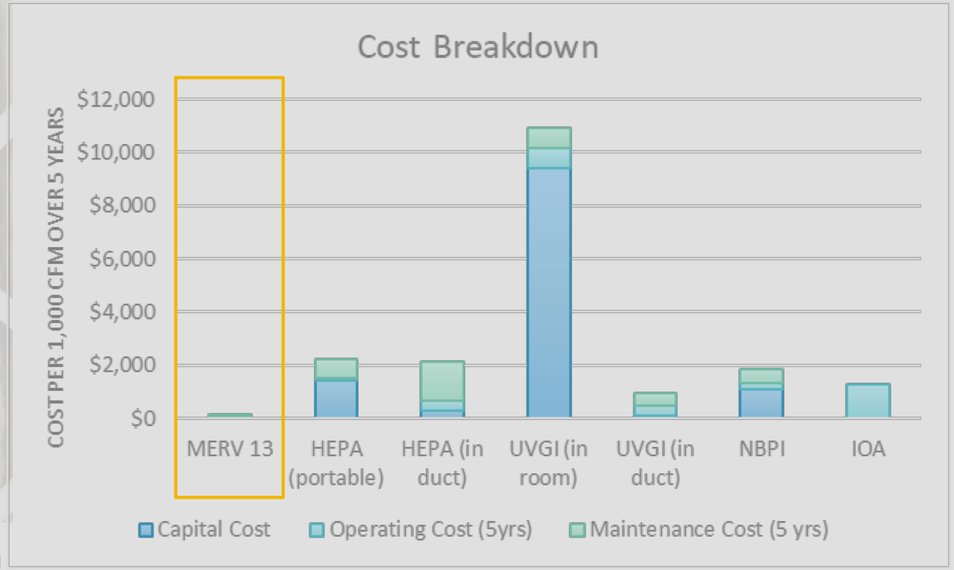
Increase Pressure Drop across Fans by **0.4 inH_2O**



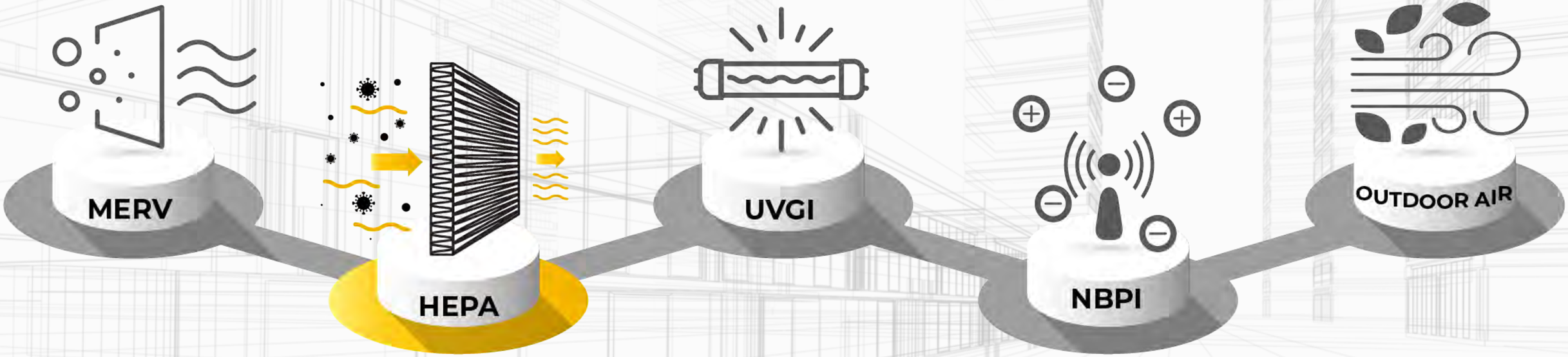
[1] MERV filter drop of 0.4" H2O: From ASHRAE Standard 90.1 Table 6.5.3.1-2 "Fan Power Limitation Pressure Drop Adjustment"

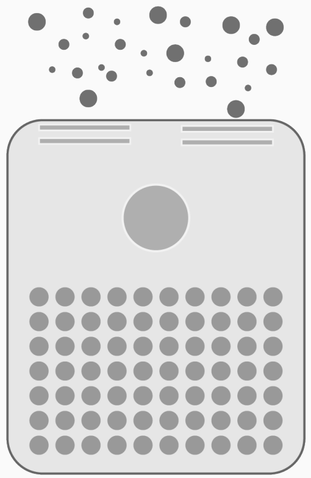


MERV FILTRATION



HIGH EFFICIENCY PARTICULATE AIR





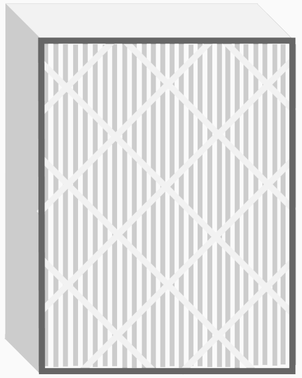
PORTABLE HEPA

PROS

- Portable, “plug and play”
- More effective at filtering sub-micron and nanoparticles
- Can be moved to optimize effectiveness

CONS

- Floor space and outlets
- Noisy at high speeds
- Additional maintenance



IN DUCT MERV

PROS

- Single-point intervention. No extra space needed
- Minimal change to maintenance requirements
- Easy to install into existing HVAC systems

CONS

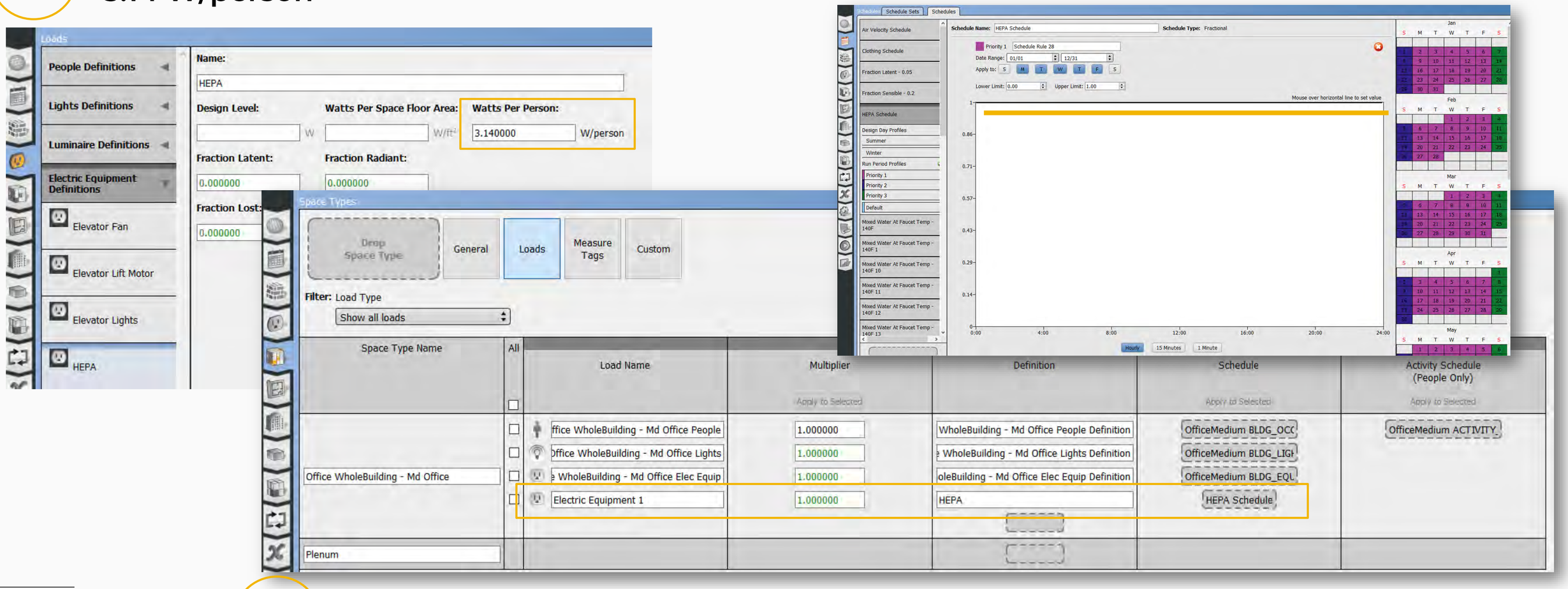
- Less effective at filtering sub-micron and nanoparticles.
- Effectiveness is limited by airflow

Portable HEPA

Model Parameters

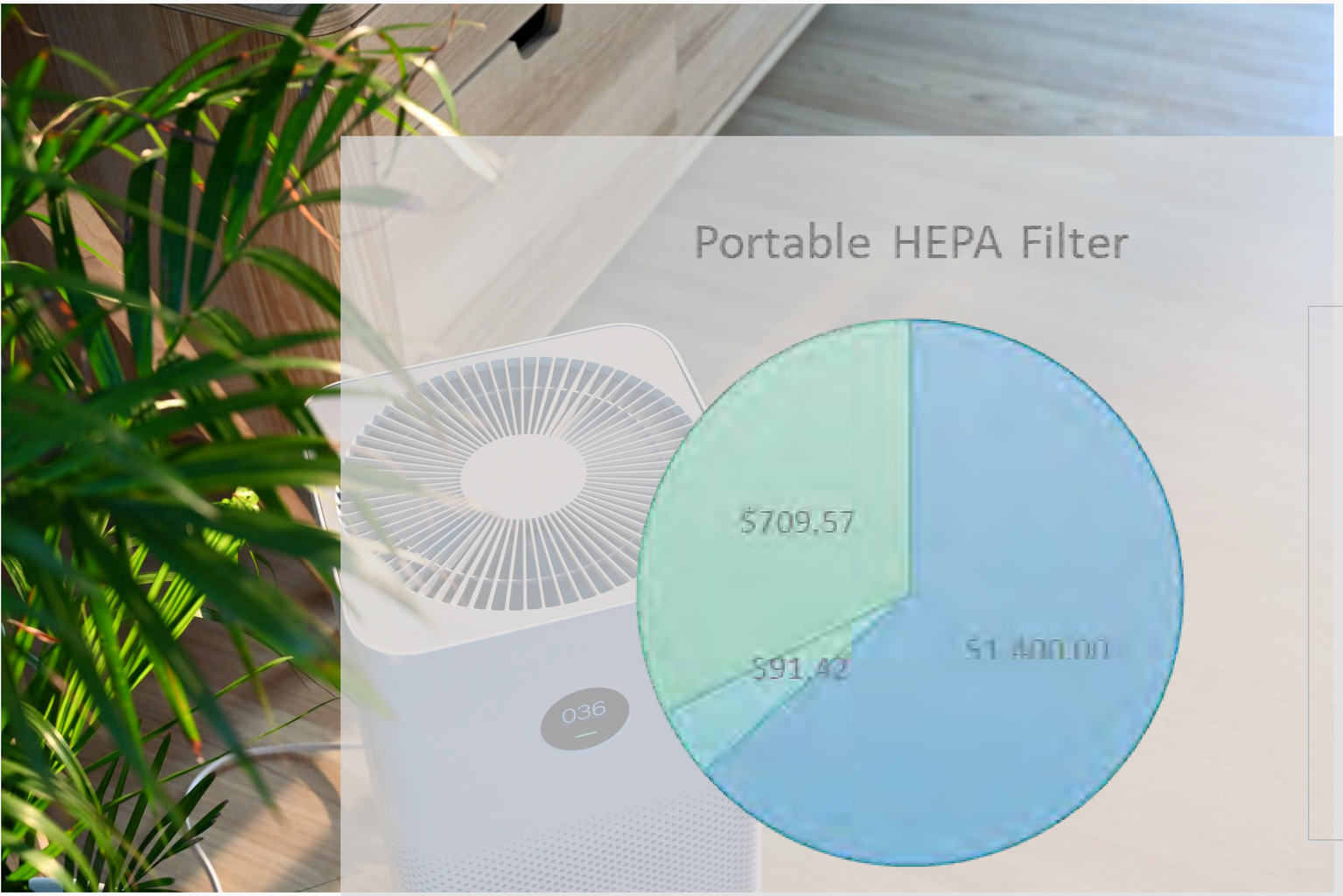
1 Plug Load:
3.14 W/person

3 Schedule: **Always on M-F**



2 Space Type: **Whole Building**

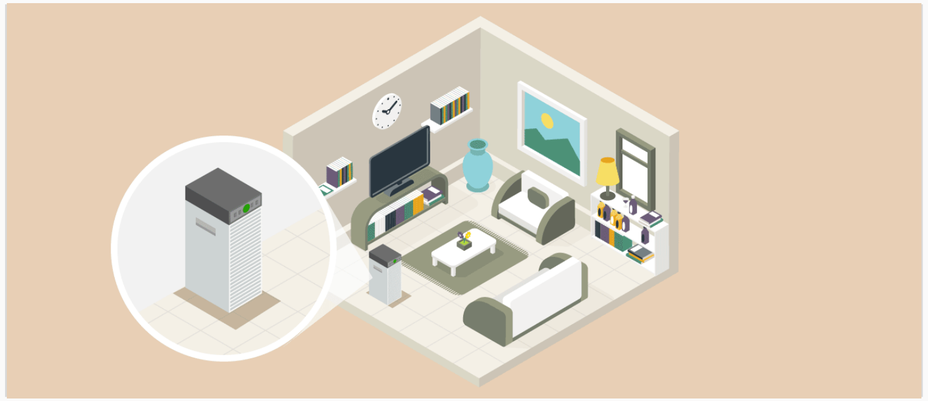
[1] Xiang, Jianbang, et al. "Energy Consumption of Using HEPA-Based Portable Air Cleaner in Residences: A Monitoring Study in Seattle, US." Energy and Buildings, vol. 236, 2021, p. 110773., https://doi.org/10.1016/j.enbuild.2021.110773.

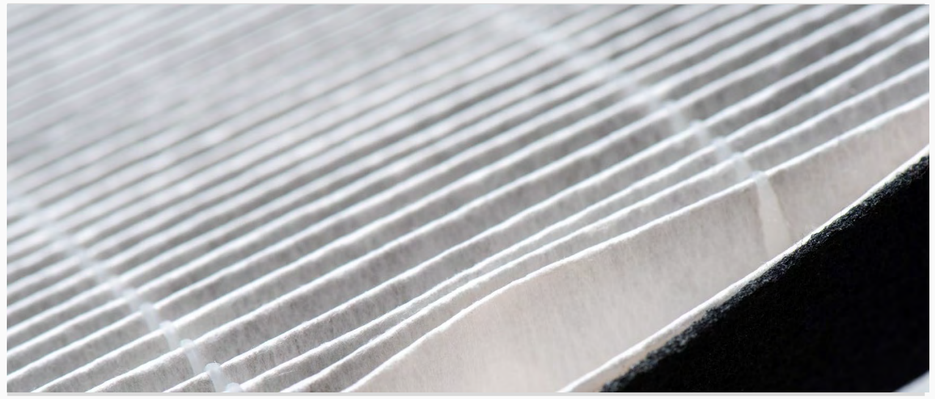


Portable HEPA

Portable HEPA

Design Guidelines





// High CADR (Clean Air Delivery Rate)

// Placement is key

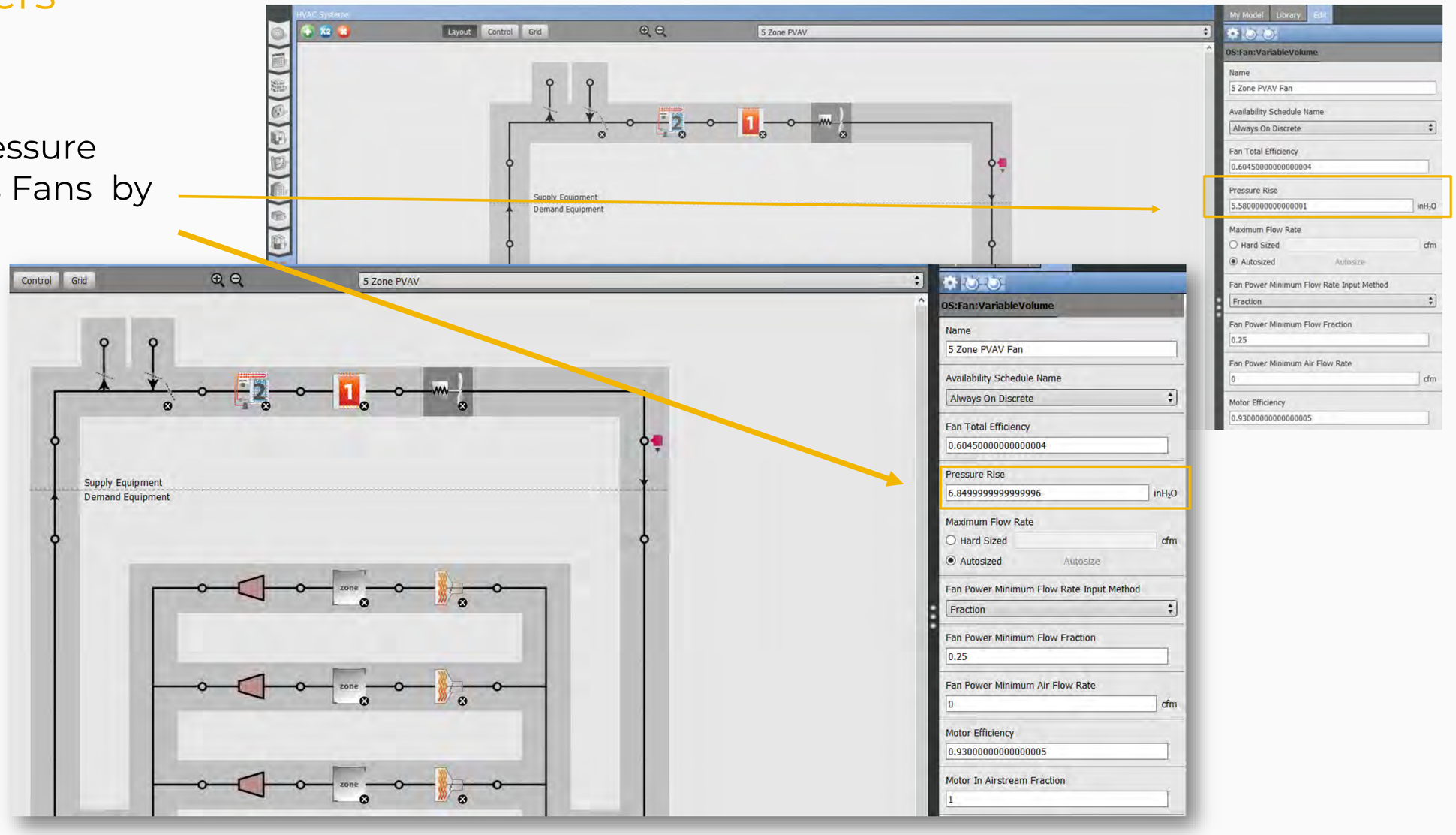
// Change Filters Regularly

In-Duct HEPA

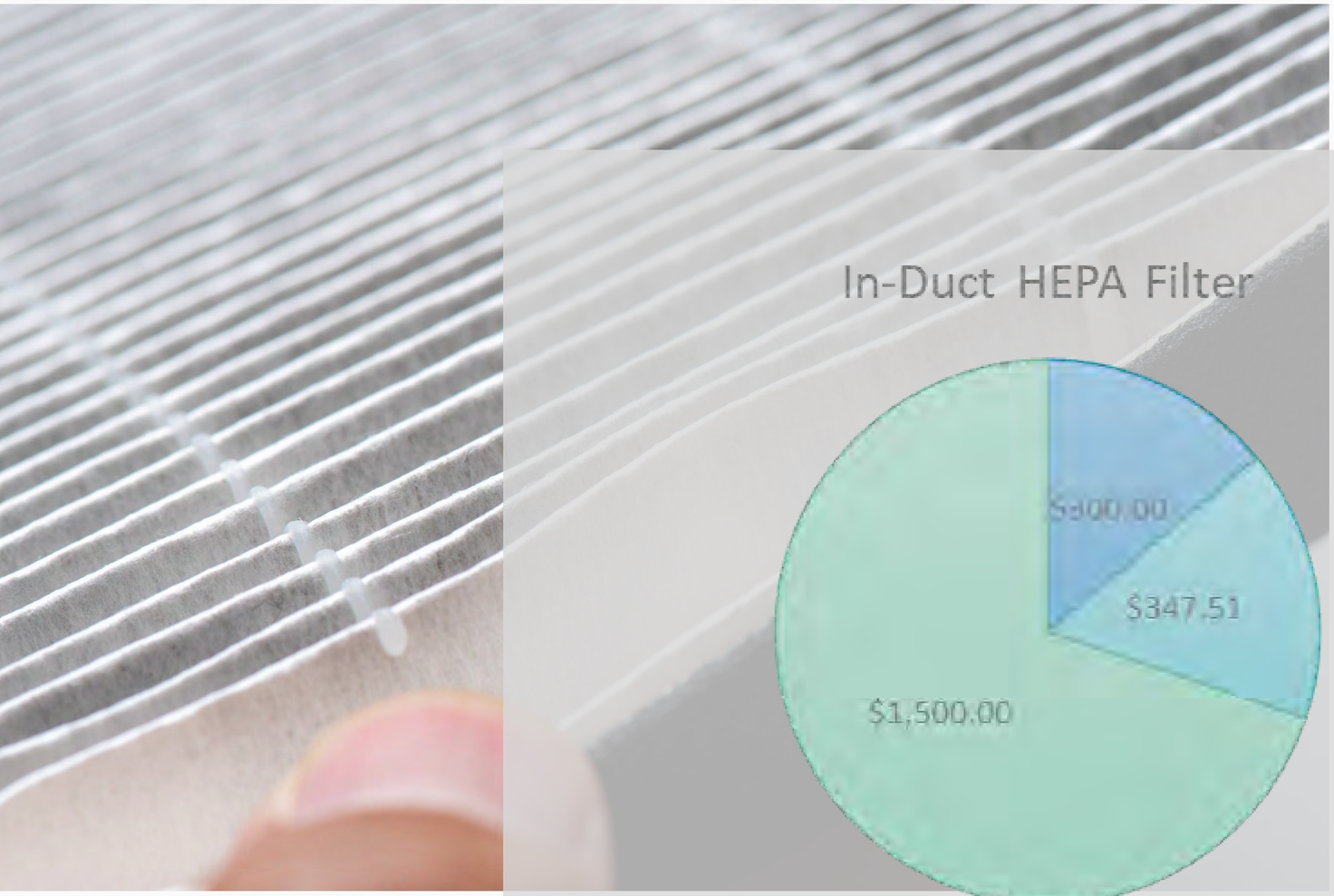
Model Parameters

1

Increase Pressure Drop Across Fans by **1.25 inH_2O**

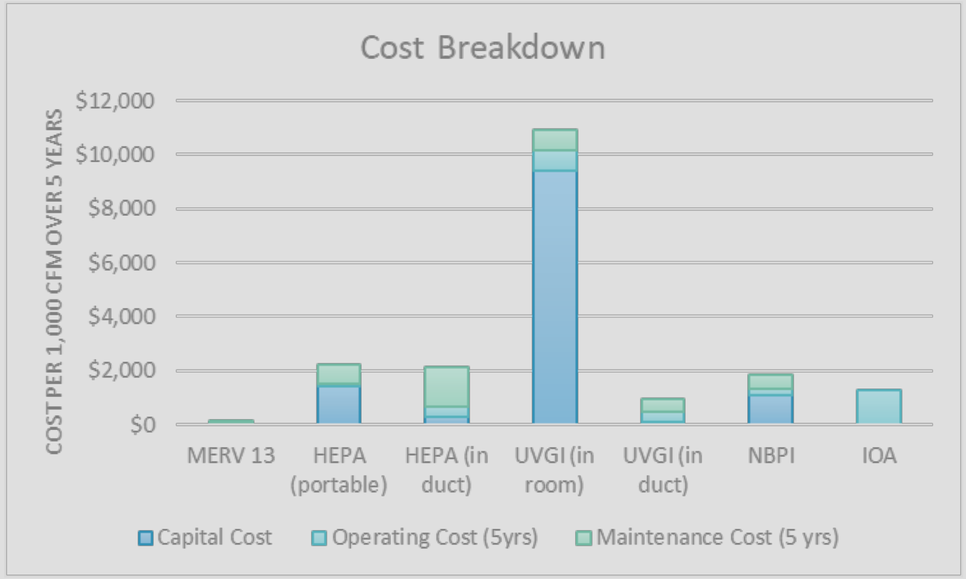


[1] Kowalski, Wladyslaw J. Immune Building Systems Technology. The McGraw-Hill Companies, Inc., 2003.

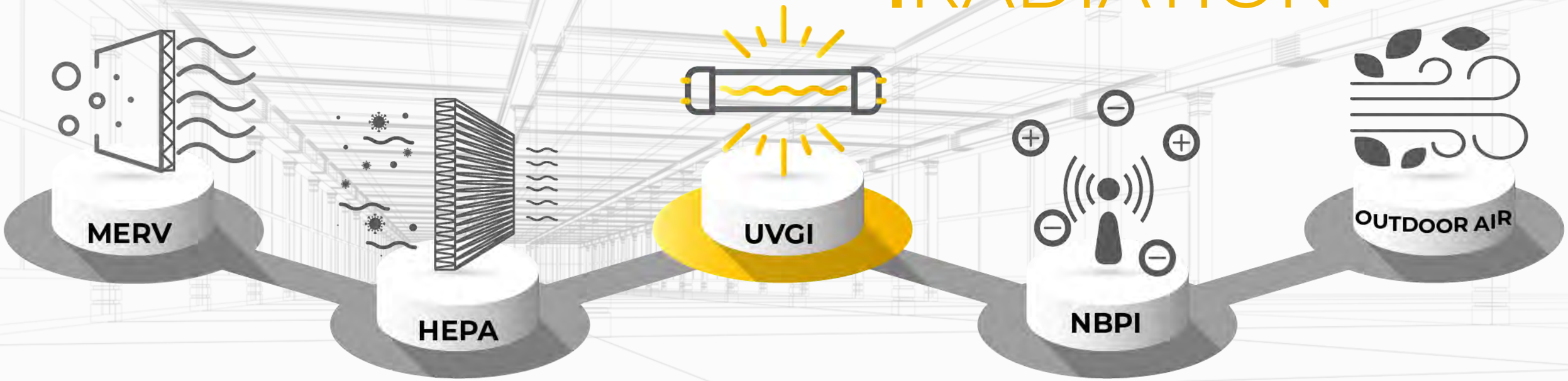


In-Duct HEPA

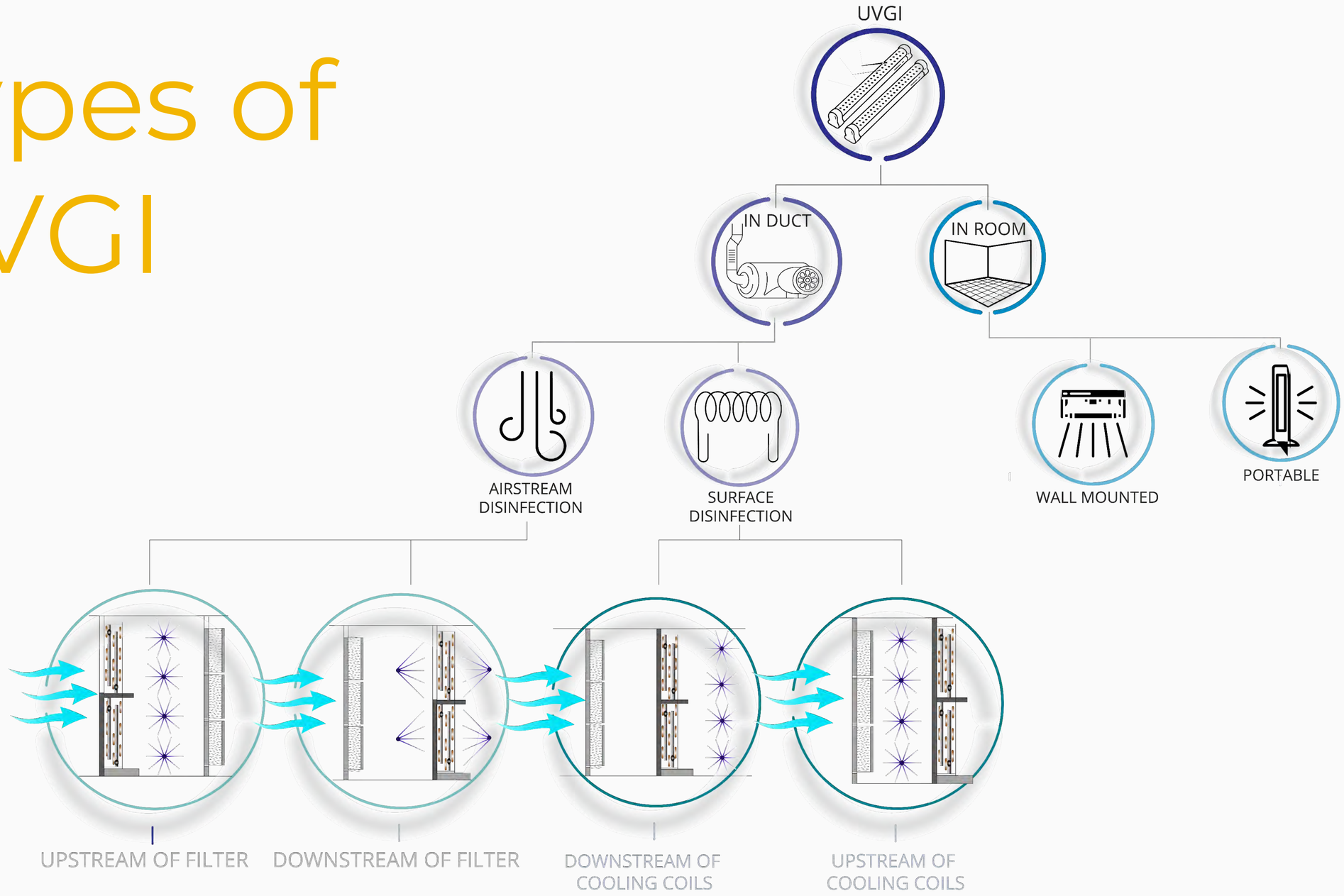
In-Duct HEPA Filter
$347.51
$1,500.00
Capital Cost
Operating Cost (5yrs)
Maintenance Cost (5 yrs)


Cost Breakdown
COST PER 1,000 CFM OVER 5 YEARS
$12,000
$10,000
$8,000
$6,000
$4,000
$2,000
$0
MERV 13
HEPA (portable)
HEPA (in duct)
UVGI (in room)
UVGI (in duct)
NBPI
IOA
Capital Cost
Operating Cost (5yrs)
Maintenance Cost (5 yrs)

ULTRA VIOLET GERMICIDAL IRADIATION



Types of UVGI

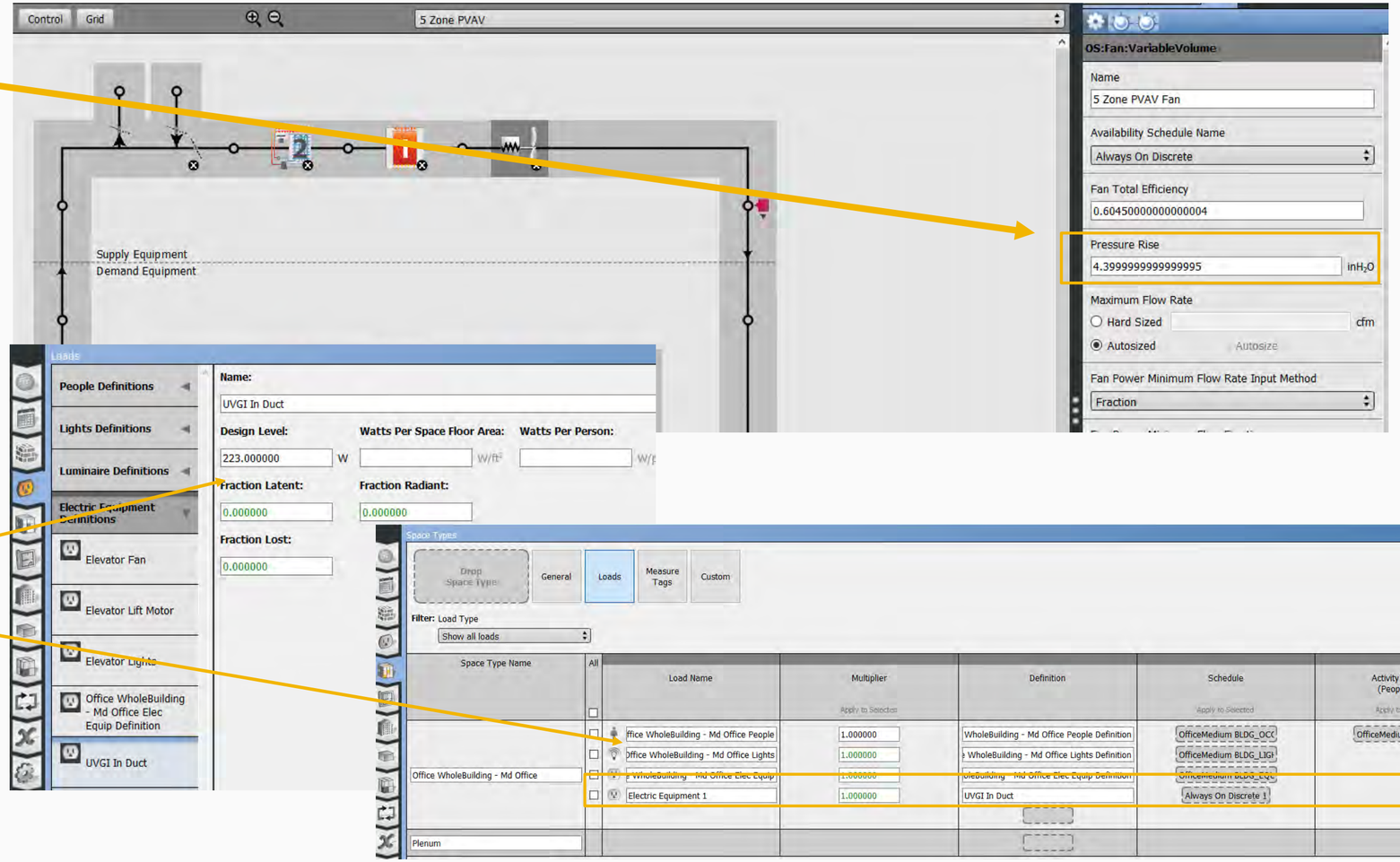


In-Duct UVGI

Model Parameters

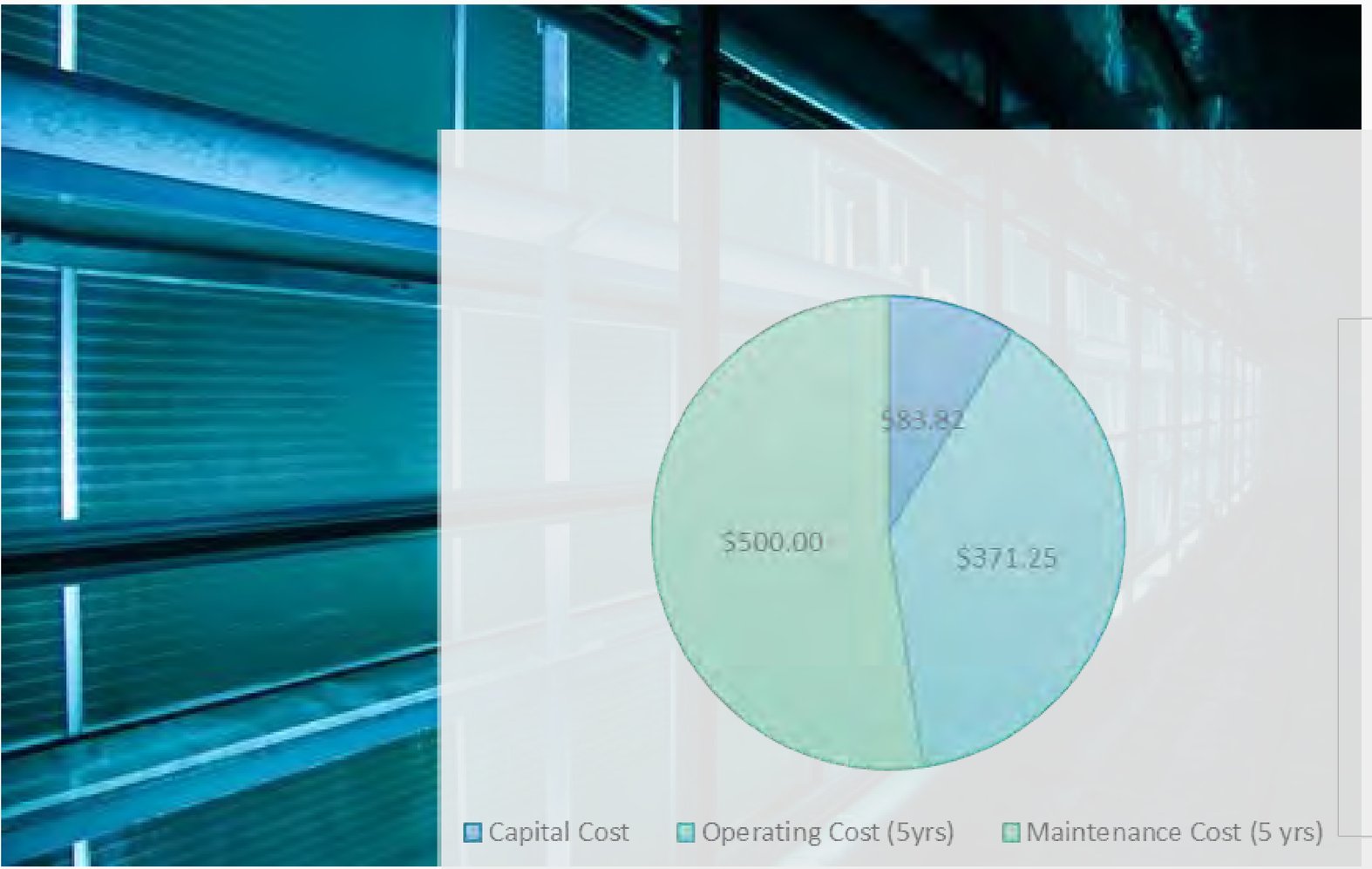
1. **20% Pressure Drop**

2. **0.02 W/CFM Plug Load**



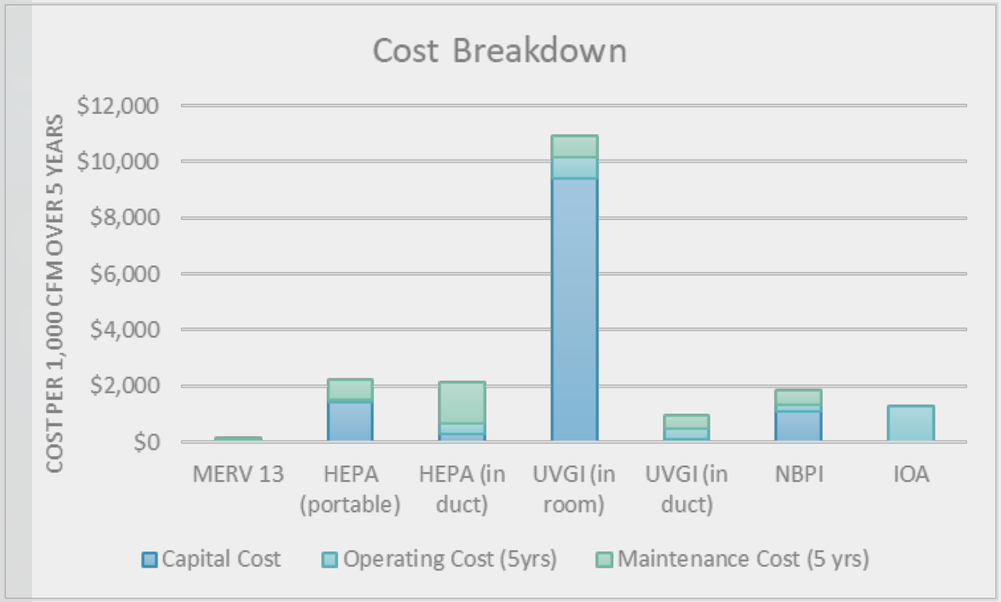
[1] J Firrantello, W Bahnfleth “Simulation and Monetization of Collateral Airborne Infection Risk Improvements from Ultraviolet Germicidal Irradiation for Coil Maintenance”, ASHRAE Science and Technology for the Built Environment (2018) 24, 135–148

[2] J Luongo, J Brownstein, and SL Miller, “Ultraviolet Germicidal Coil Cleaning: Impact on Heat Transfer Effectiveness and Pressure Drop”, Building and Environment(2107), 112, pp159-165

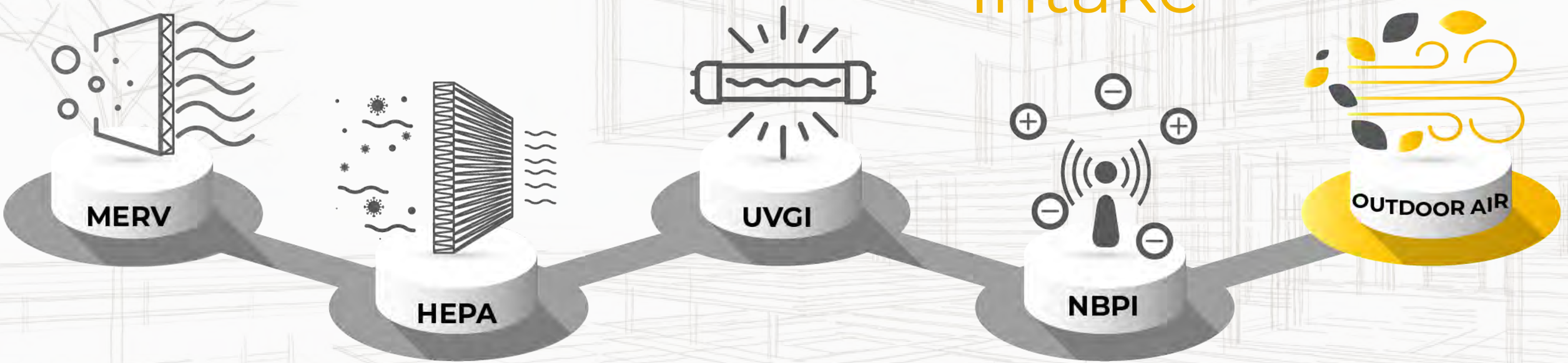


In-Duct UVGI

$83.82
$500.00
$371.25
Capital Cost
Operating Cost (5yrs)
Maintenance Cost (5 yrs)


Cost Breakdown
COST PER 1,000 CFM OVER 5 YEARS
$12,000
$10,000
$8,000
$6,000
$4,000
$2,000
$0
MERV 13
HEPA (portable)
HEPA (in duct)
UVGI (in room)
UVGI (in duct)
NBPI
IOA
Capital Cost
Operating Cost (5yrs)
Maintenance Cost (5 yrs)

Increase Outdoor Air Intake



Ventilation

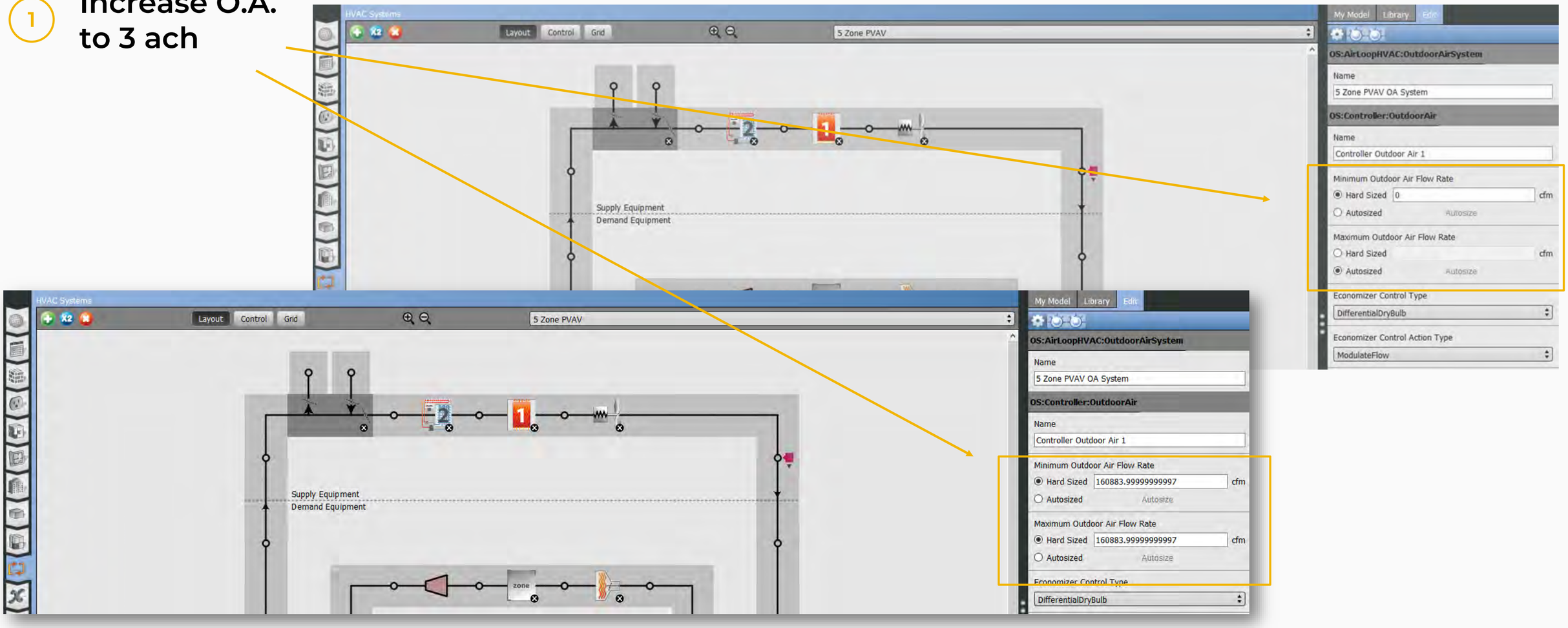
//

Ventilation needs to be clarified to mean ventilation with outdoor air. We dilute contaminants indoors by bringing in outdoor air that's virus-free.

-Bahnfleth

//

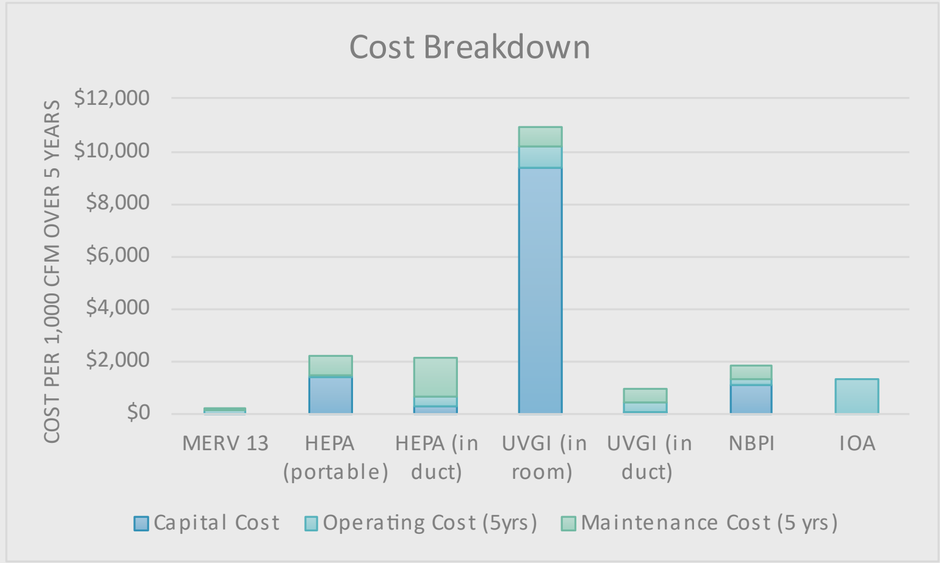
1 Increase O.A. to 3 ach



[1] ASHRAE. "ASHRAE Epidemic Task Force." *Core Recommendations for Reducing Airborne Infectious Aerosol Exposure* , 2021, Accessed 2021.

Increasing Outdoor Air Intake

Capital Cost Operating Cost (5yrs) Maintenance Cost (5 yrs)



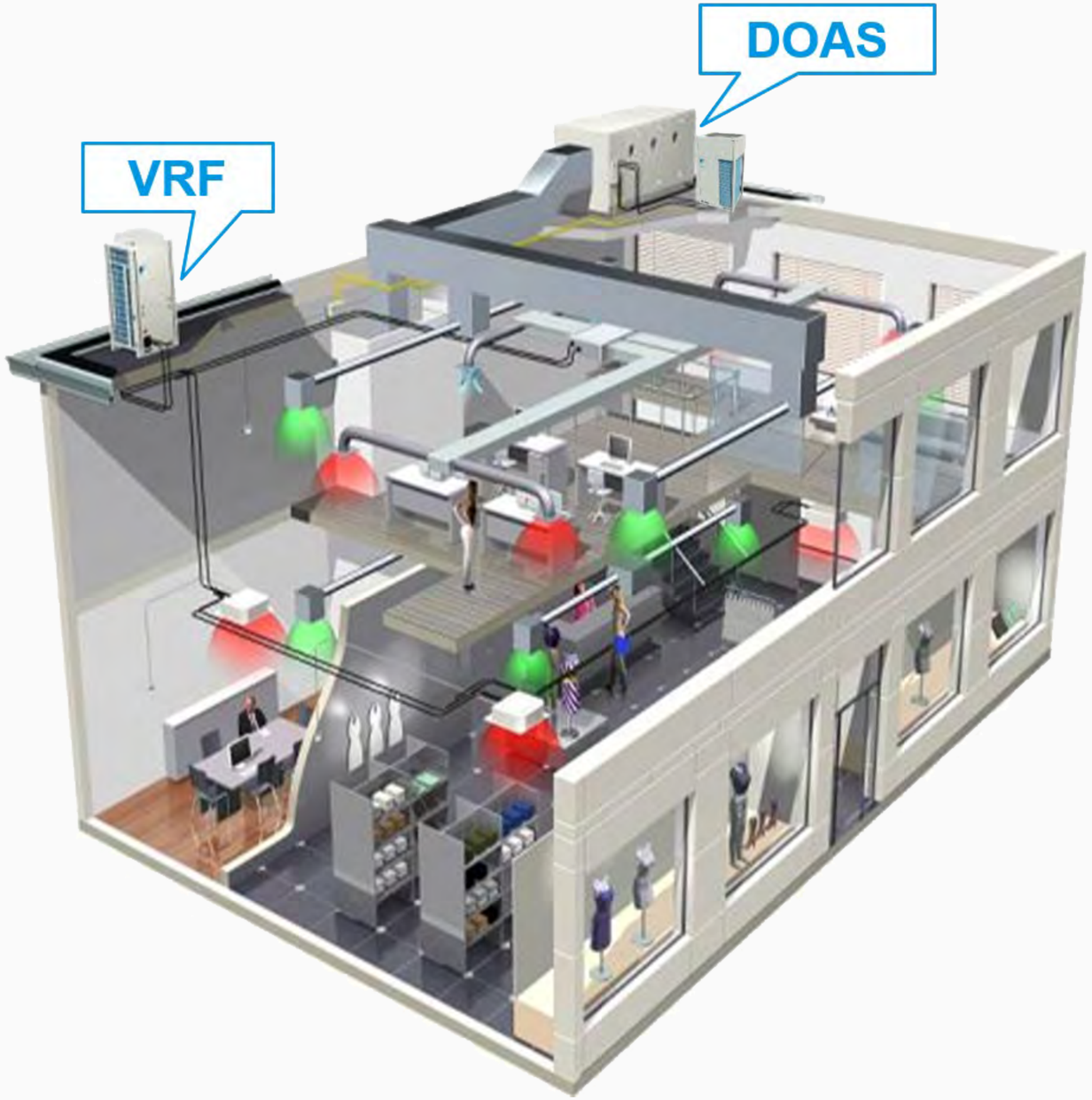
IOA

Design Guidelines

// Maintain humidity between 40-60%

// Maintain a clean cooling coil to increase heat transfer capabilities

// Flush spaces for a duration sufficient to reduce airborne particle by 95% (3-6 ach)

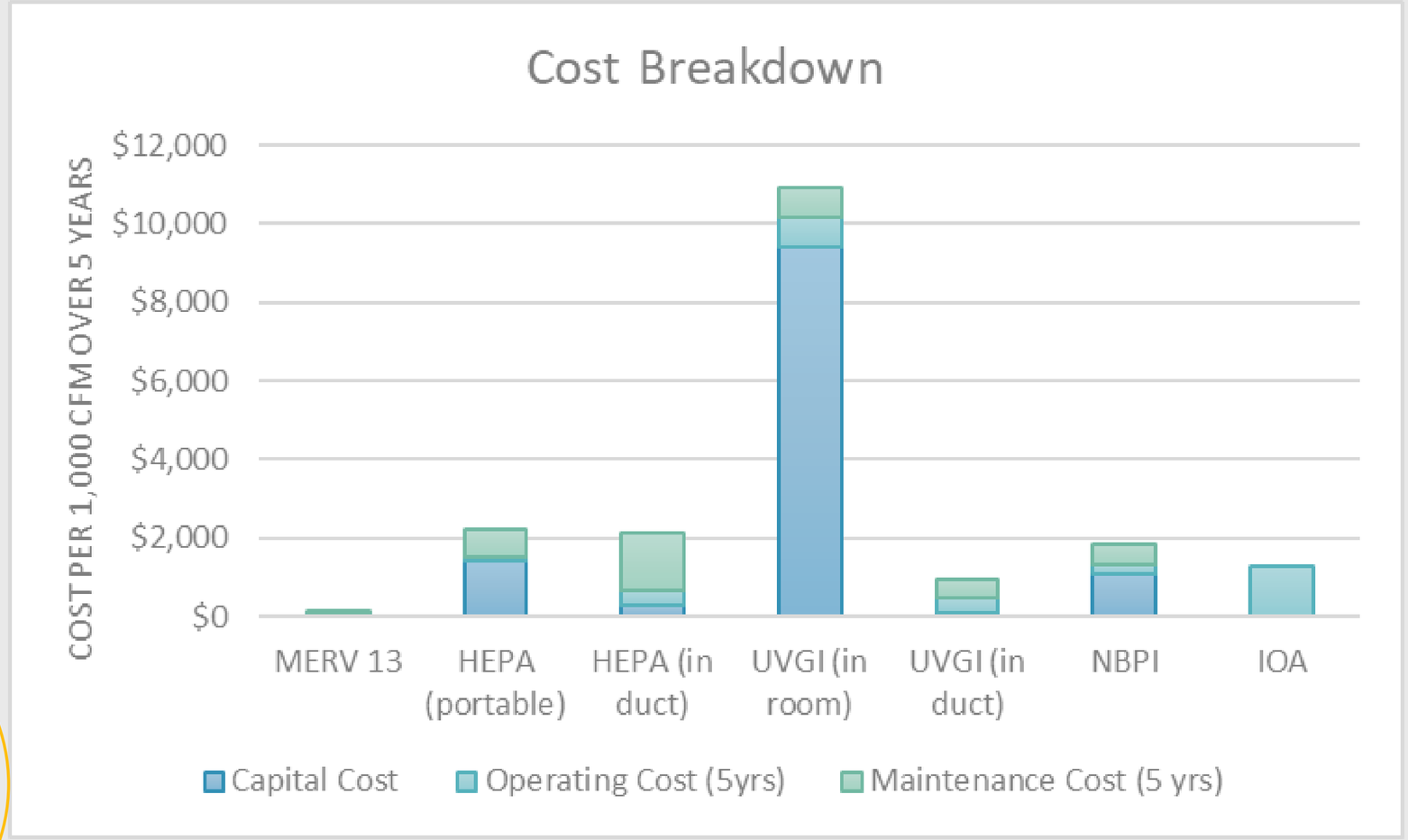


Building Readiness and Resiliency is Key!

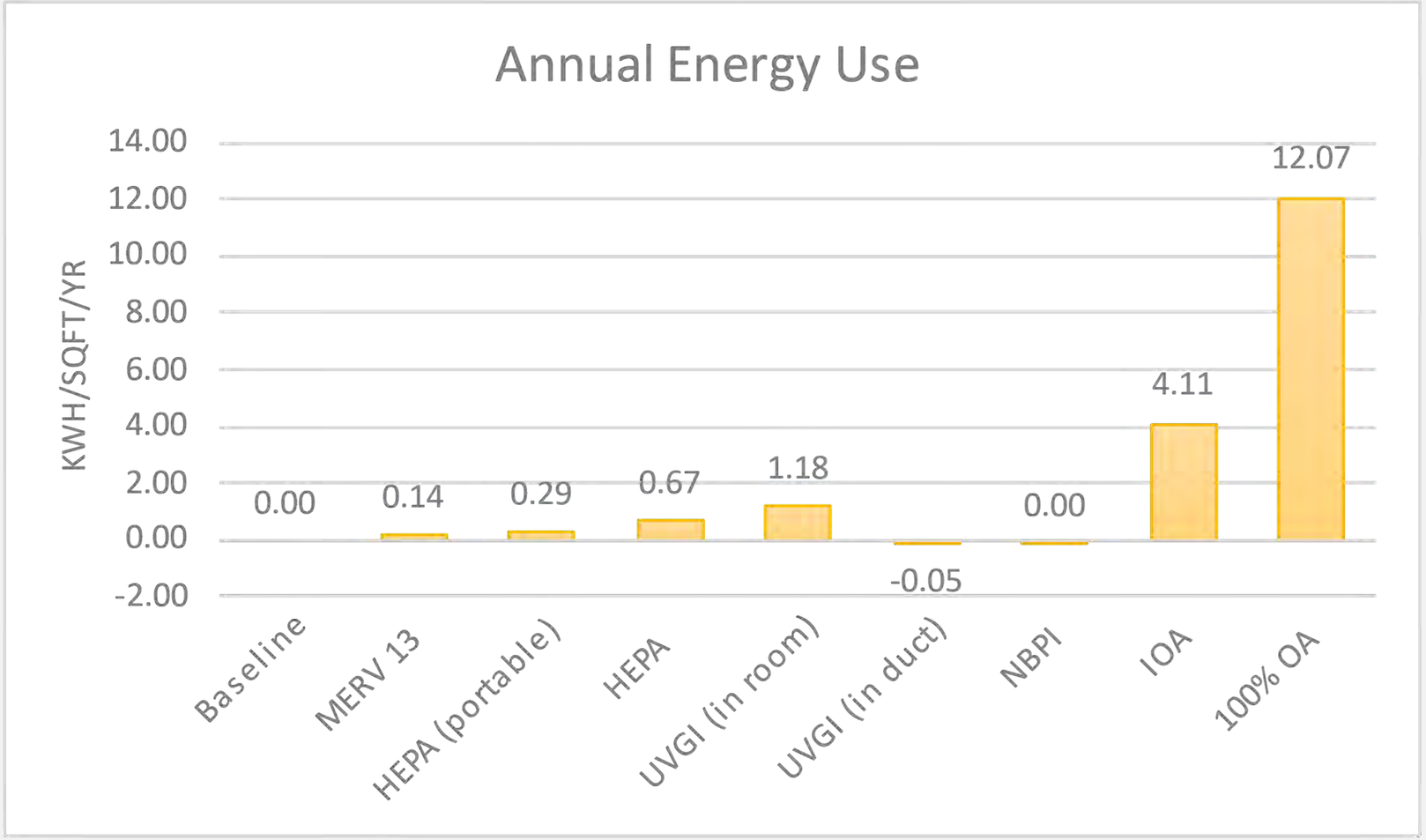
Biggest Capital Costs:
UVGI (in-room)
~ $9,394

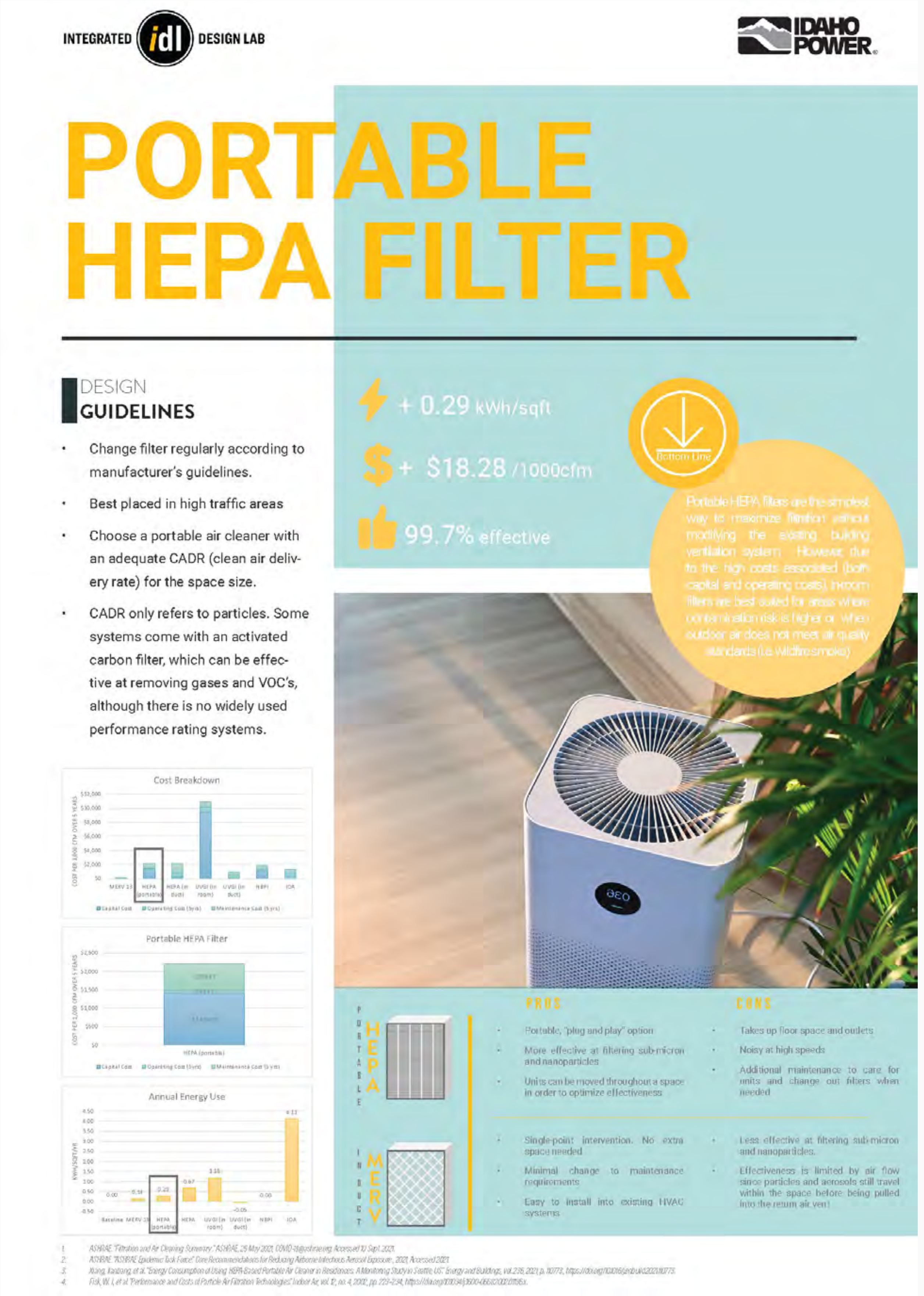
Biggest Annual Operating Costs:
Increasing Outdoor Air
~ $260 /1000cfm

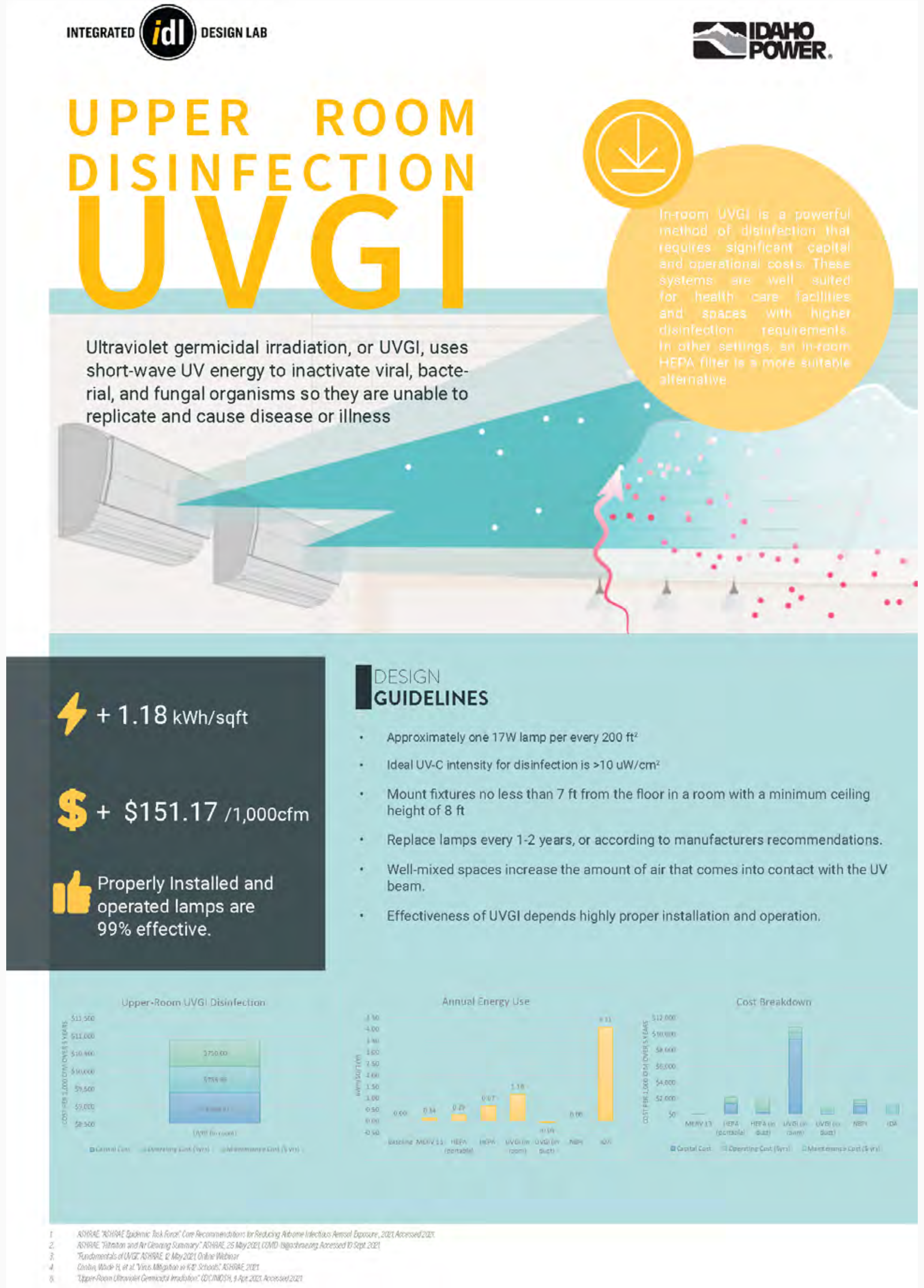
BiggestAnnual Maintenance Costs:
In-Duct HEPA
~ $300 /1000cfm



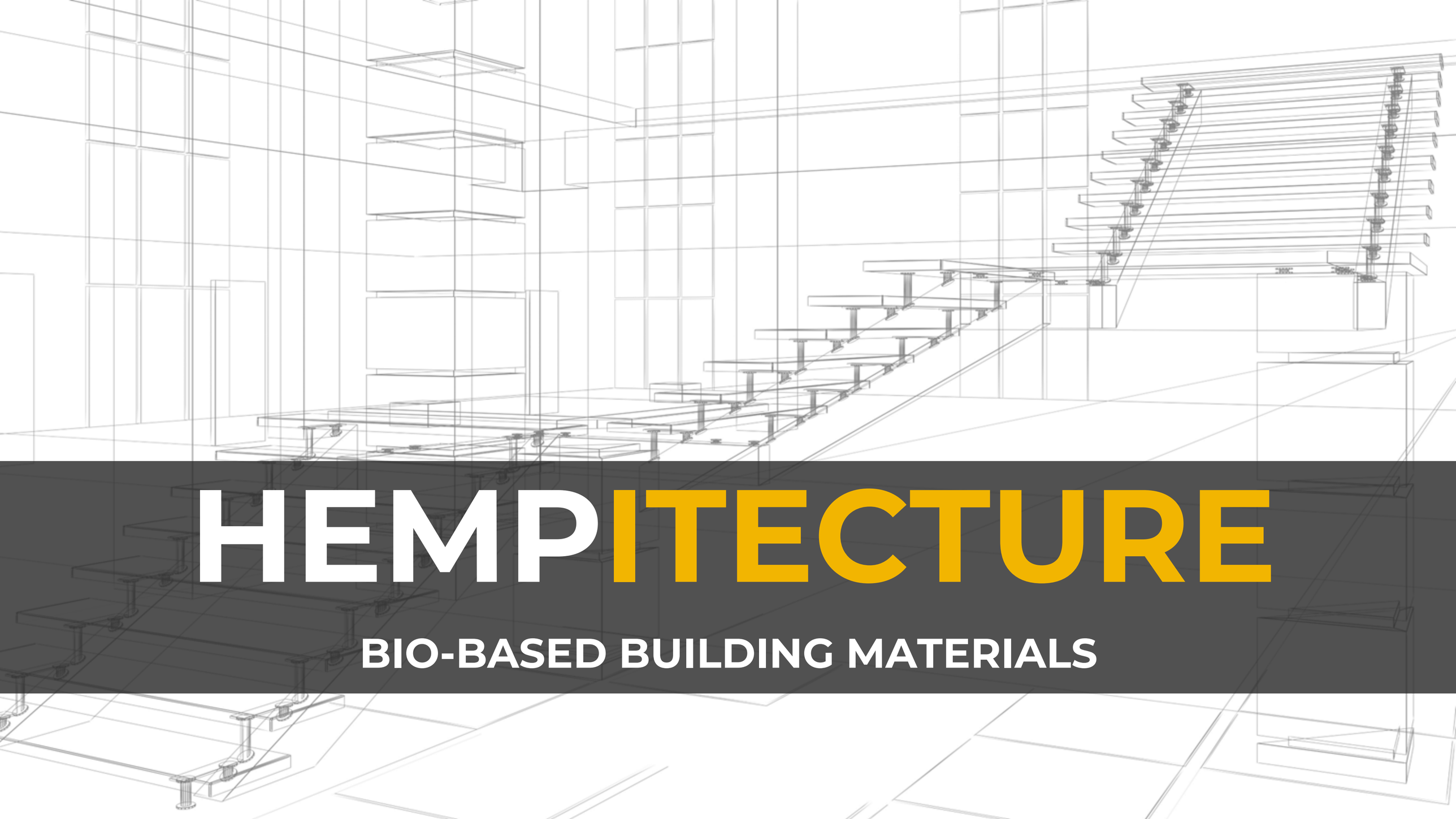
In-Duct UVGI has the potential for **energy savings!**







http://idlboise.com/content/design-tools



HEMPITECTURE

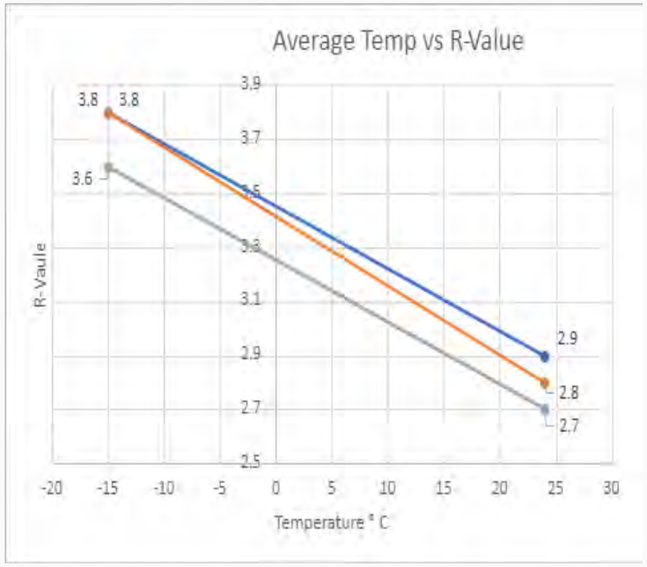
BIO-BASED BUILDING MATERIALS

Fire and Thermal Resistance Testing

1. Outfitted labs in Boise and Moscow for testing

2. Tested samples and benchmarked performance

3. Identified formulation that achieves “Class A” fire rating for products



Hempitecture IGEM Team

An Integrated Team

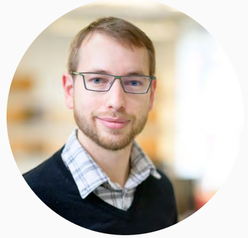
University of Idaho
Integrated Design Lab

+

hempitecture®

+

University of Idaho
College of Natural Resources



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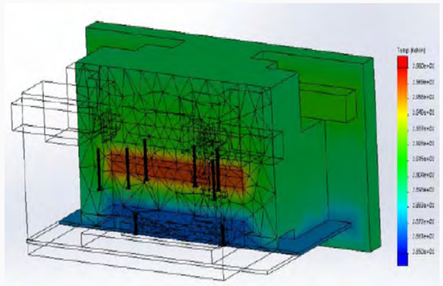
Tyler Schram
M.Arch Student

Abdulbaset Alayat, Ph.D.
Postdoctoral Researcher - CNR

Project Impacts:

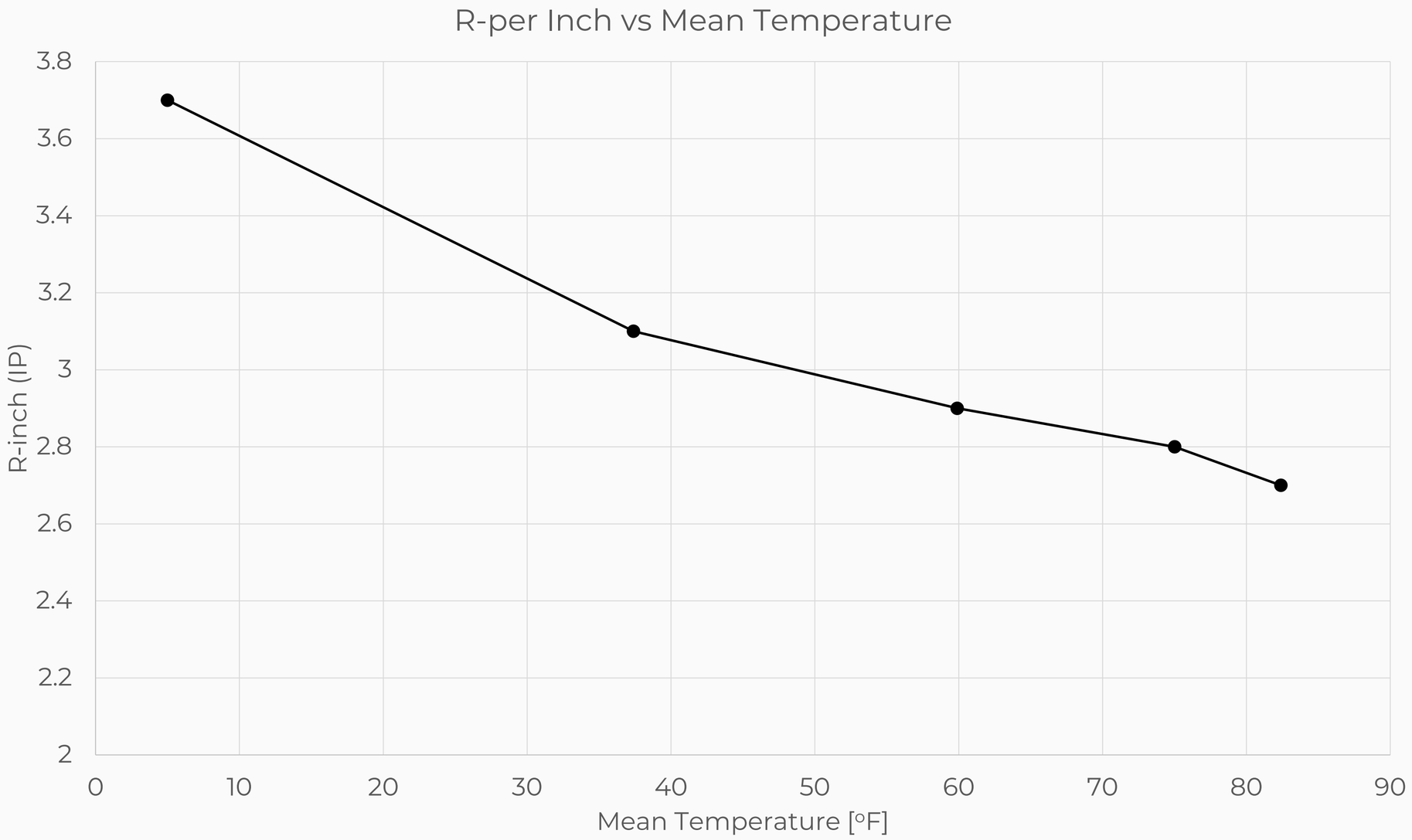
- Product testing and development.
- Manufacturing plant opening this month.
- Job creation in Idaho (manufacturing, farming, transportation, installation, etc.)



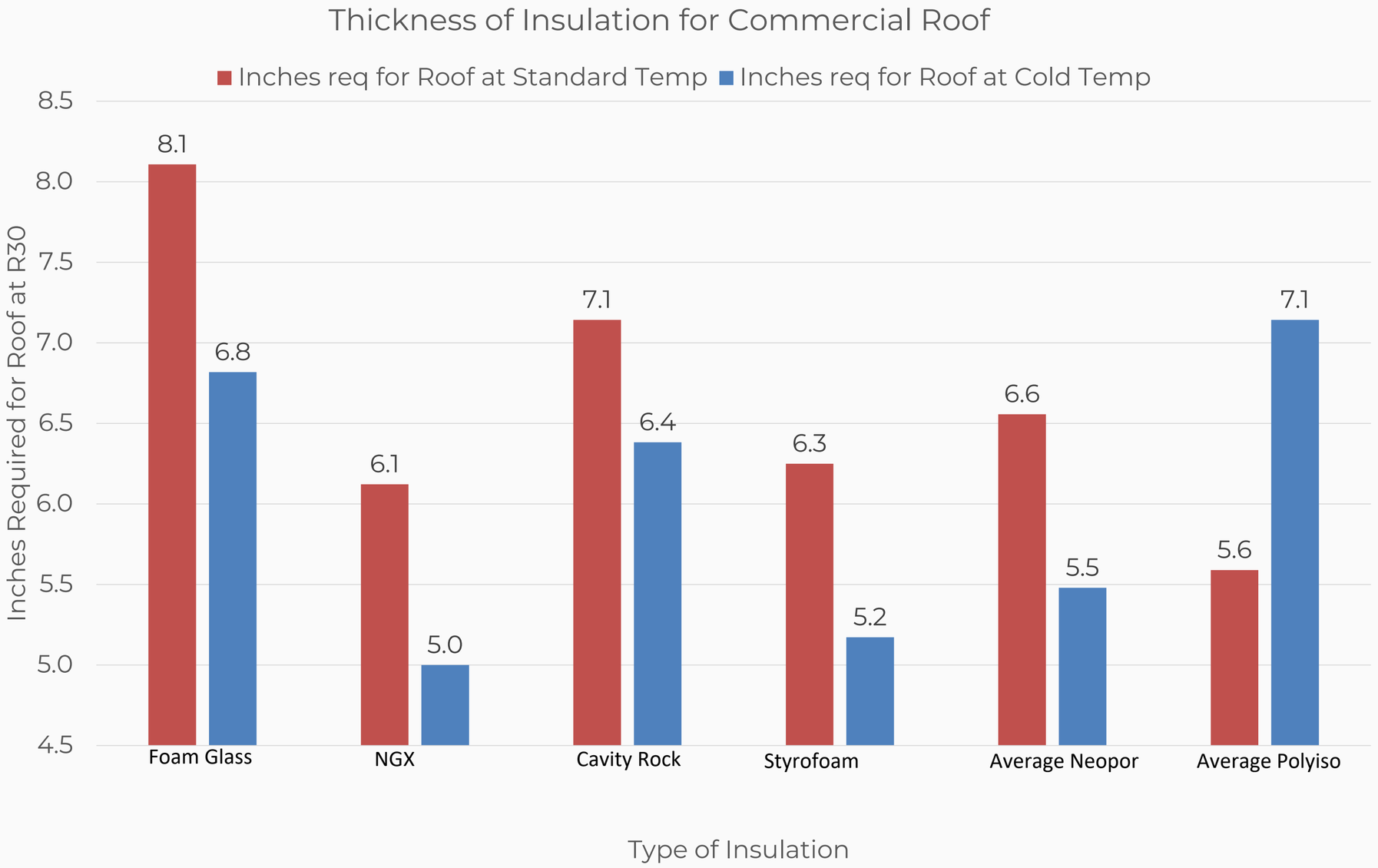
Commissioning the Manufacturing Plant:

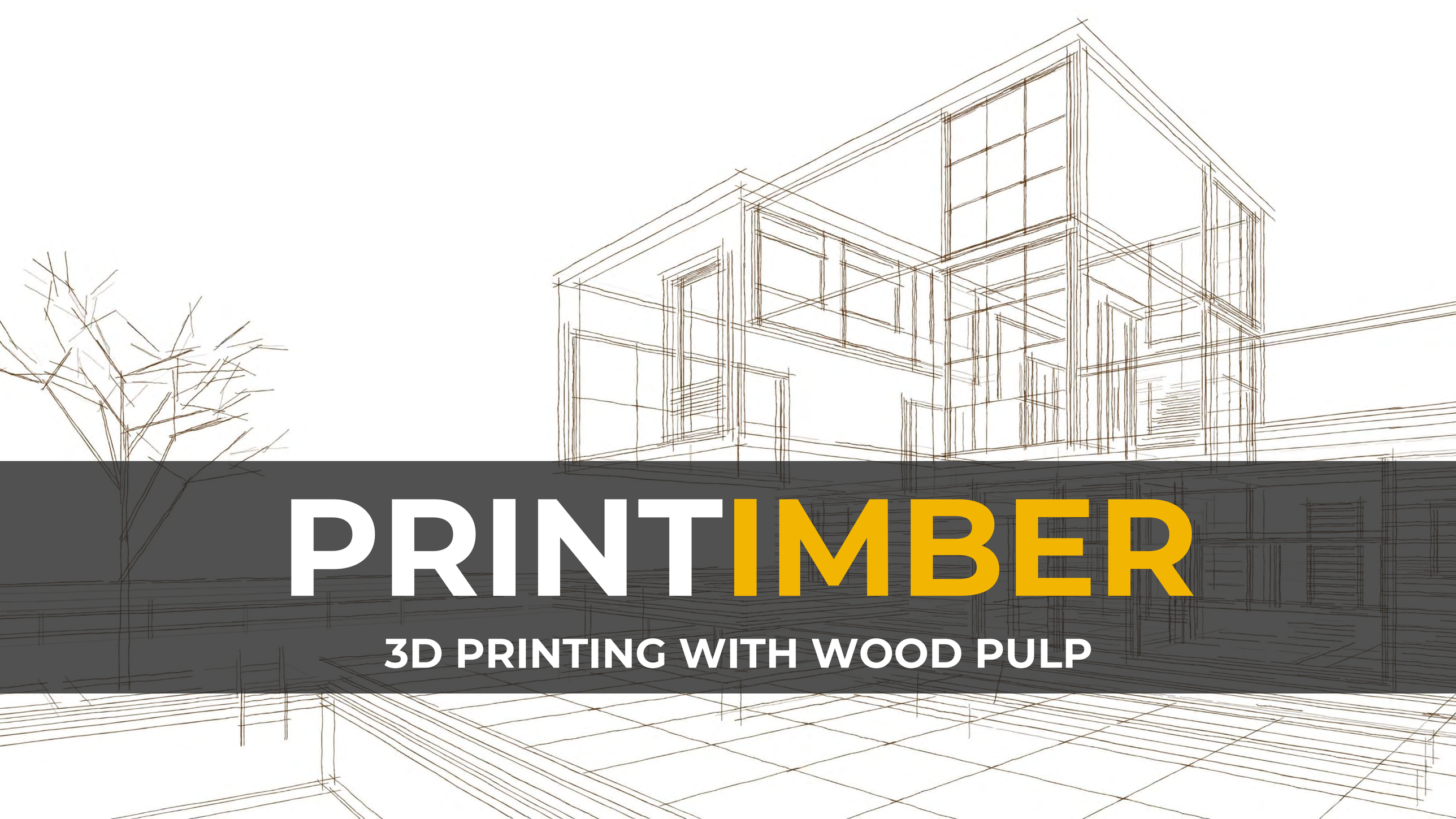
- Optimizing fire retardant application
- Considering additives and new product configurations
- Achieve higher R-value than current imports

Project Findings: Performance is temperature dependent



Project Findings: Performance is temperature dependent





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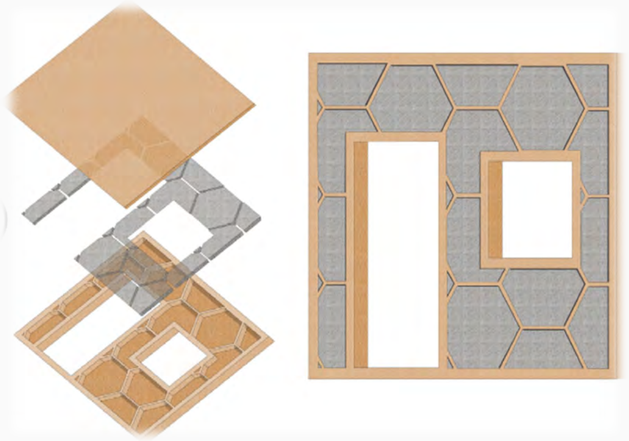
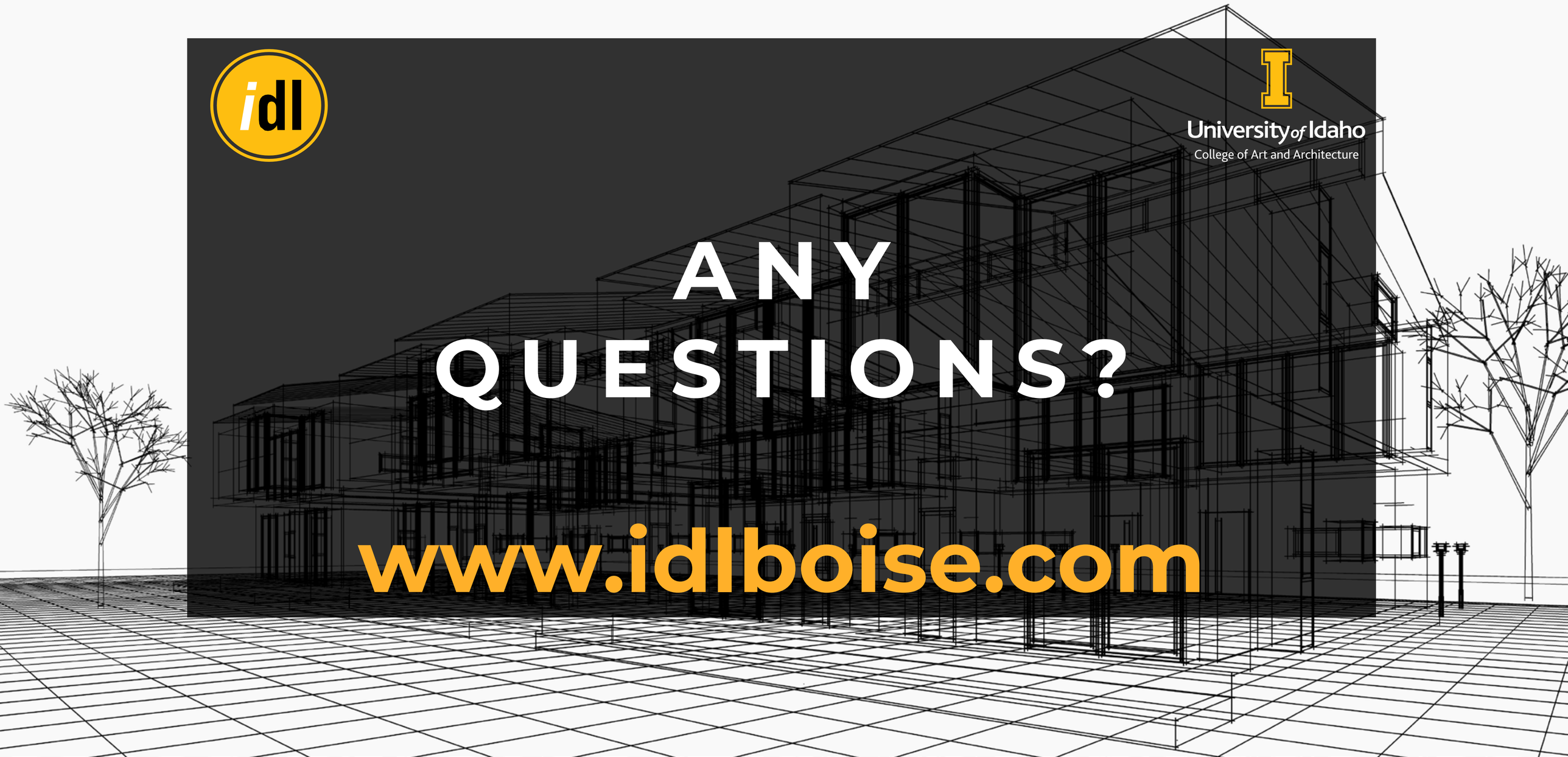
Using Bio-based Materials for the Future



https://printimber.org/

Other Lab Research Areas

1. Connected Communities
2. AI thermostats for DCV and lighting controls
3. Rural Energy Audit Program
4. Energy Code Training
5. Residential IAQ (wildfire smoke + Covid)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