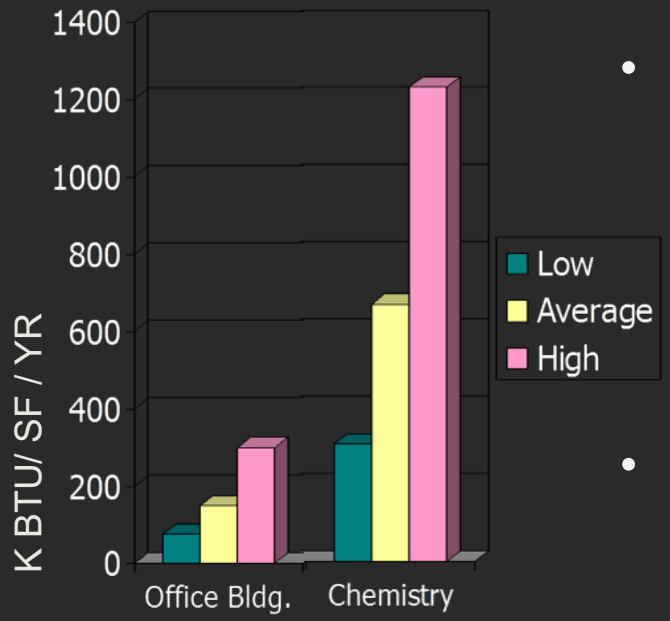
Emerging Energy Saving Technologies for Laboratories

Topics

- Issues, Challenges and Drivers
- Emerging Technologies
- Spotlight:
  - Filtered Chemical Fume Hoods
- Process of Implementation
  - Safety & application
  - Validation of use
  - First costs / Operating & maintenance
- Case Study:
  - Framingham State University Science Building

What are the challenges?



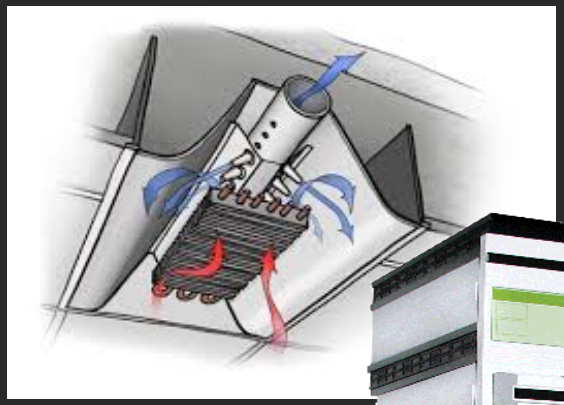
Total Annual Energy Consumption Lab Buildings vs. Non-Lab Buildings

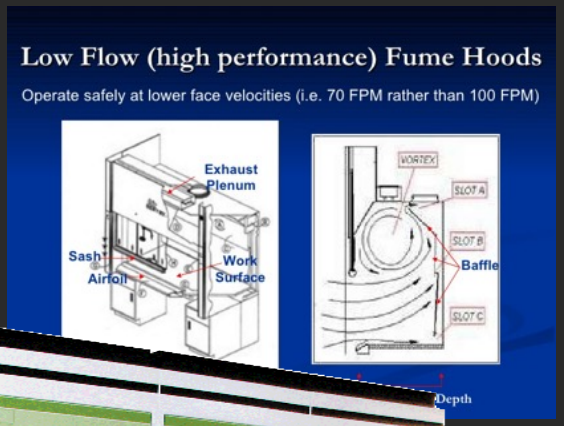
- Buildings account for over 40% of all energy consumed use in the US today.
- Lab buildings are currently among the largest energy consumers
  - *Without adequate measures, the average laboratory building could consume 3 – 5 time the energy of an average office building*.
- Design Labs to the meet or exceed environmental health and safety requirements and achieve a high level of performance and sustainable design.
- Justify first cost vs. life cycle cost paybacks.

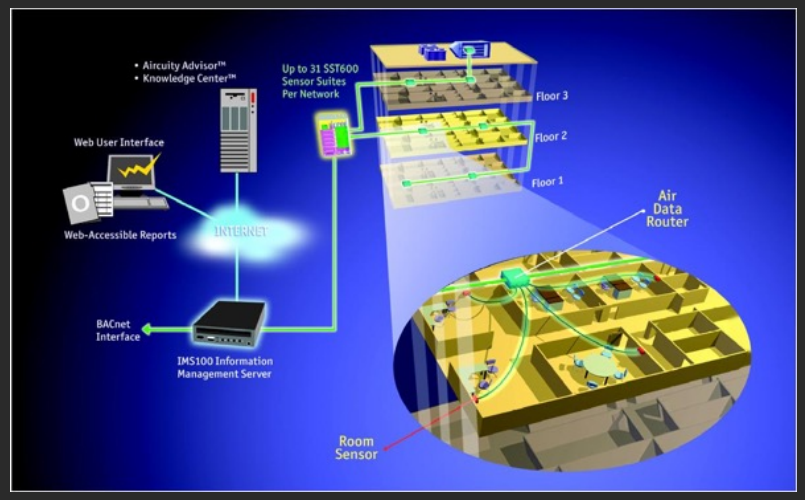
What are the drivers in lab buildings?

- High air change rates (Air Changes per Hour) & Once-through air systems
- Heavy equipment loads and a historically conservative approach to plug load design
- Use and/or misuse of chemical fume hoods and other ventilated enclosures and systems
- Ever-increasing energy costs and concerns for the environment

Emerging Technologies - What are our options?







Filtering Chemical Fume Hoods

	Traditional Fume Hood	VAV or Low Flow Fume Hood	GFH with Neutrodine Technology	Comments
Energy Costs	Your results here	Your results here	**$293/yr**	Aside from a bit of electricity, only 3,737 Kwh/year on average, GFH with Neutrodine Technology consumes virtually no energy
Operating cost	Your results here	Your results here	**$1480/yr**	Even when taking into account filter changes, operating costs for GFH with Neutrodine Technology
Ductwork cost	Your results here	Your results here	**$0**	HVAC, smaller handlers, less infrastructure,
Ease of planning	Your results here	Your results here	**Extreme**	gured into a
Adaptability	Your results here	Your results here	**Total**	me hood that can
Usag			**Large**	dle 99.9% of

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Traditional Ducted Chemical Fume Hoods

Today there is estimated to be over 750,000 chemical fume hoods in operation across the U.S.

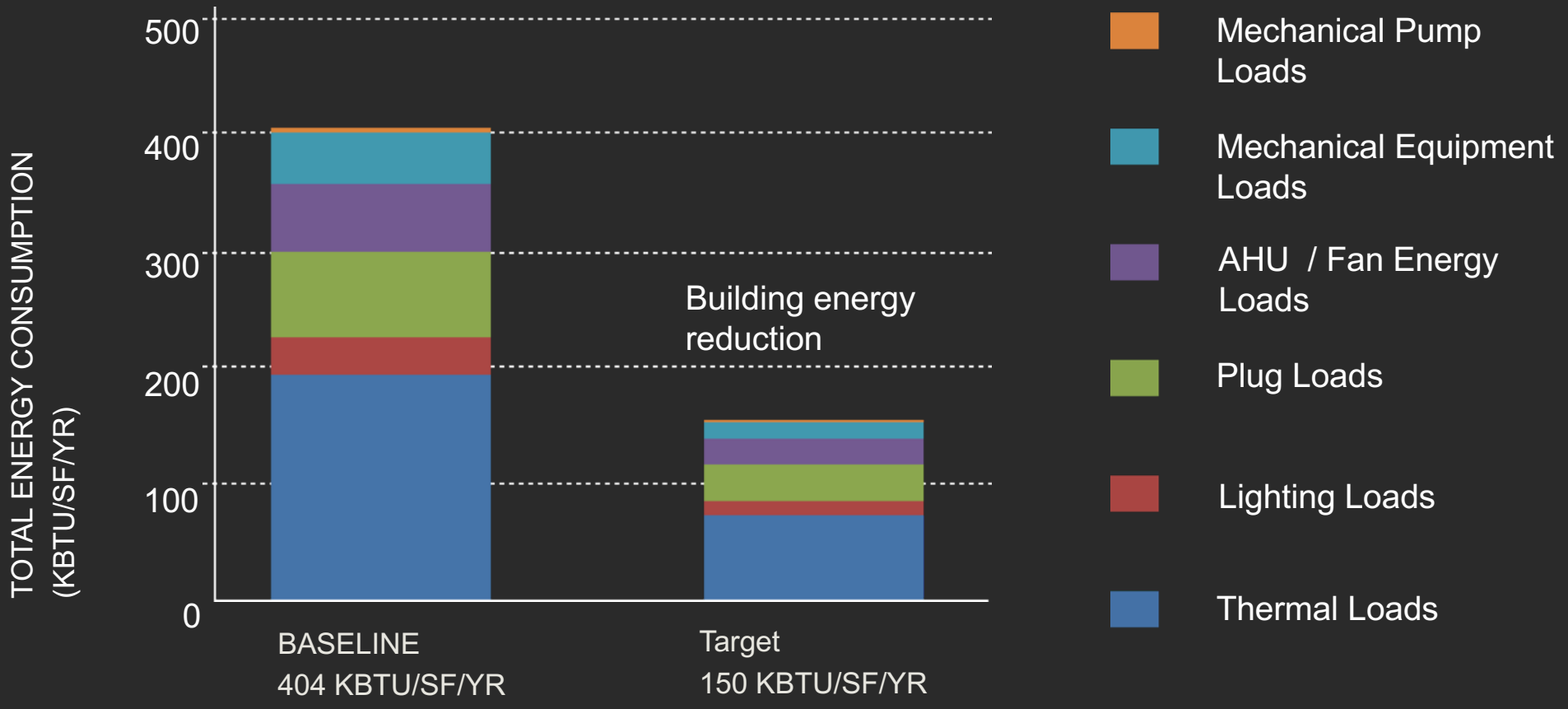
- *$5,600 in annual energy costs per CFH*
- *Emitting an average of 20 tons of carbon dioxide per CFH*
- *Emitting an average of 150 lbs of hazardous chemicals into our atmosphere per CFH*

Traditional Ducted Chemical Fume Hoods

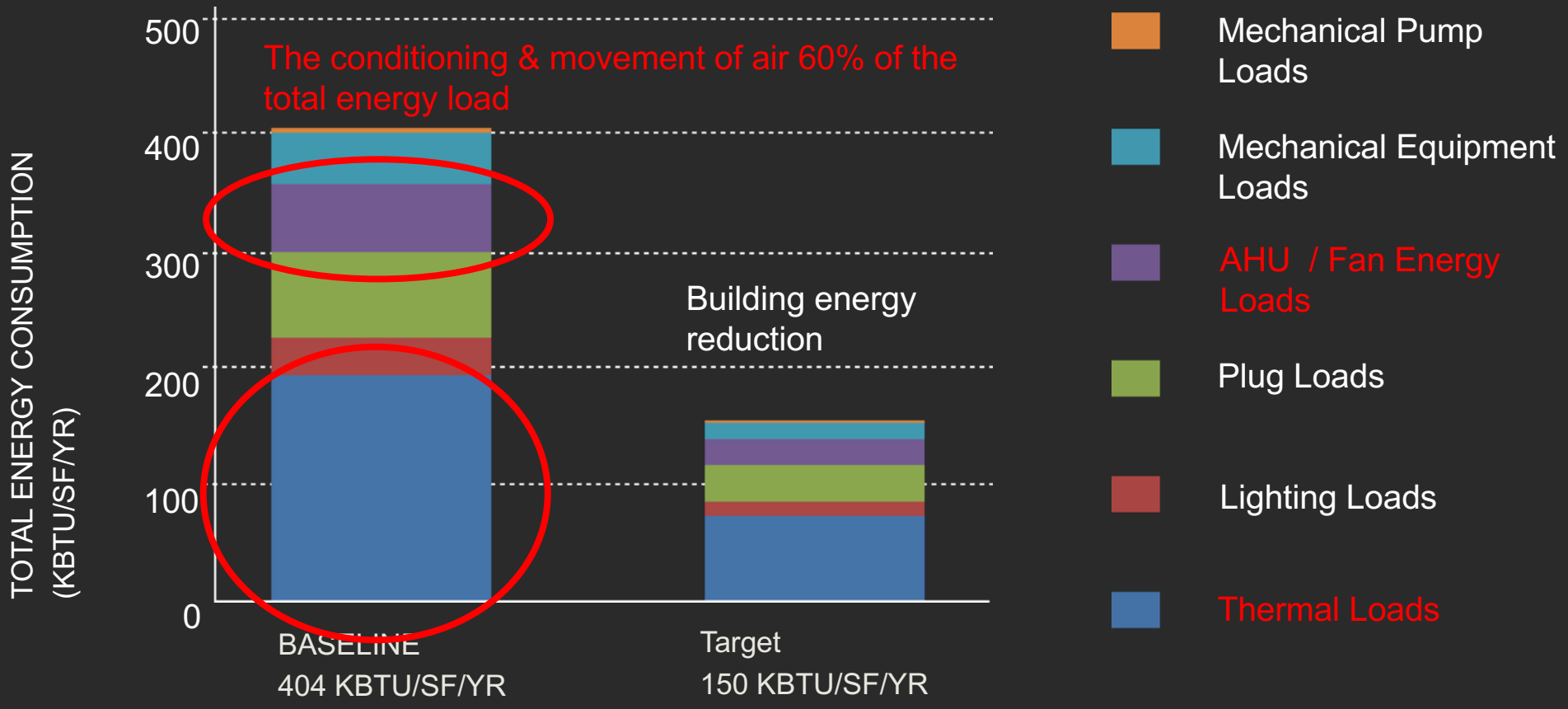
Today there is estimated to be over 750,000 chemical fume hoods in operation across the U.S.

- *$4.2M in energy costs*
- *15,000 tons of carbon dioxide emissions*
- *56 tons of hazardous chemicals into the atmosphere*

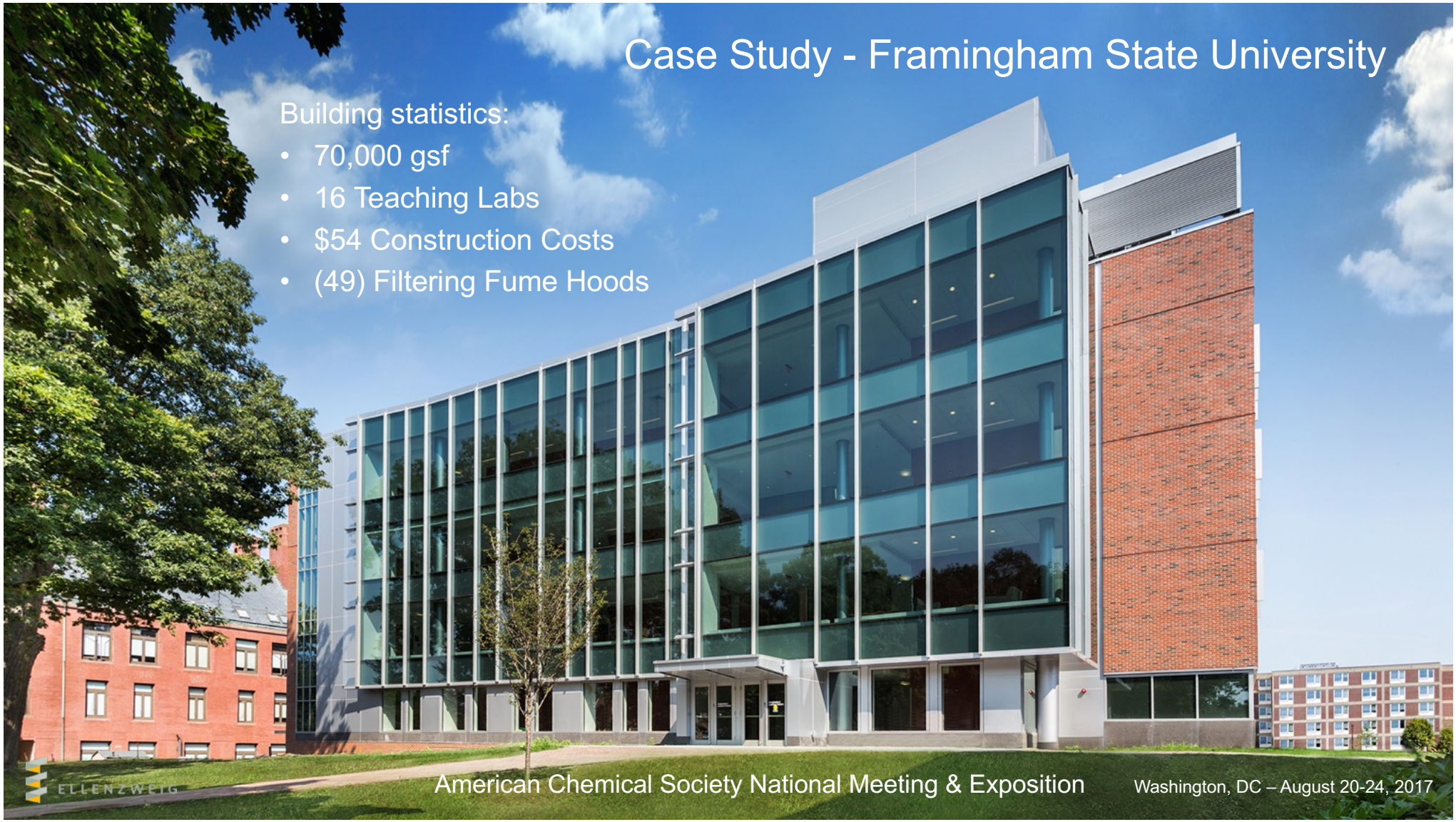
Building Energy Drivers



Building Energy Drivers



Case Study - Framingham State University

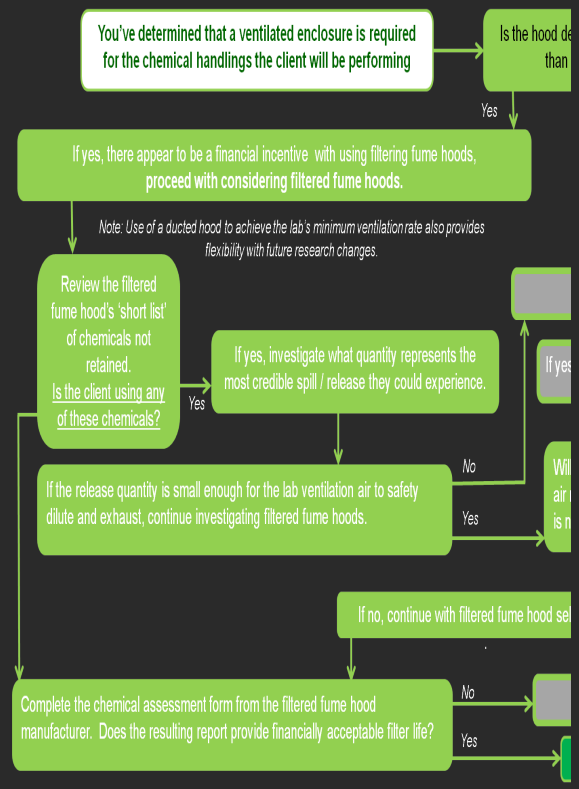


Building statistics:

- 70,000 gsf
- 16 Teaching Labs
- $54 Construction Costs
- (49) Filtering Fume Hoods

What is the process?

Framingham State University

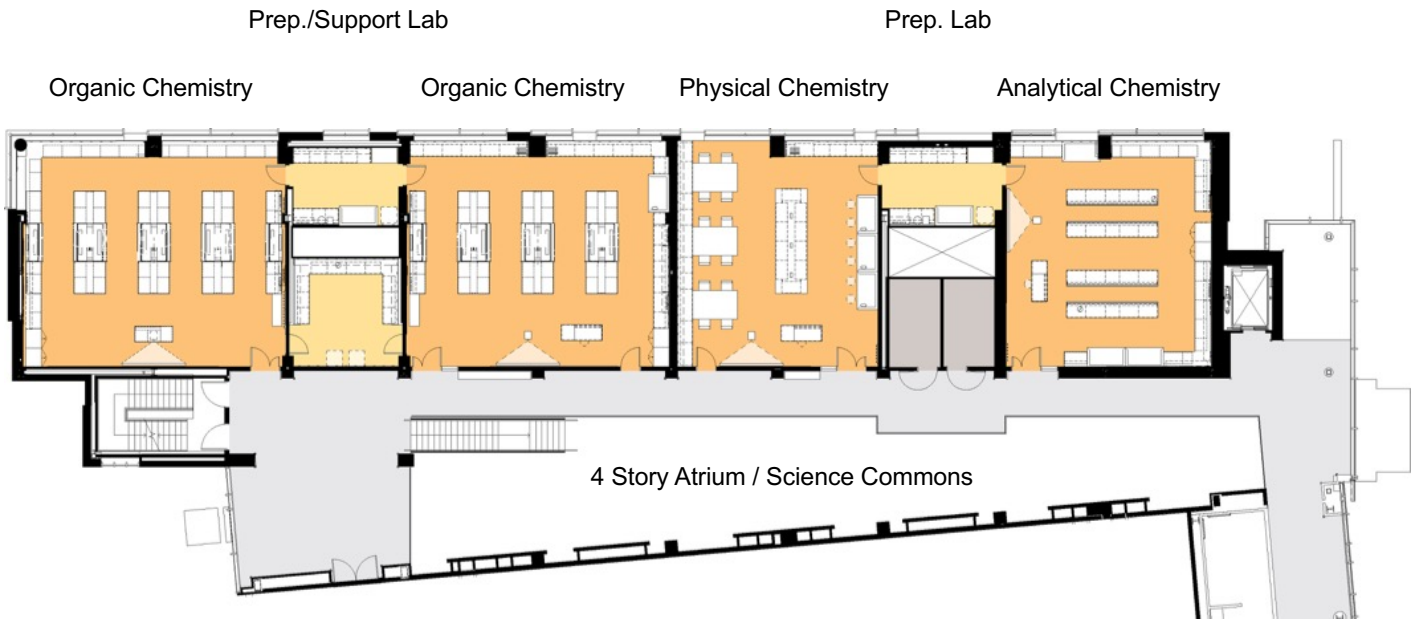


- Institutional Commitment to both safety & energy efficiency is critical
- Build level of understanding, comfort and consensus with Faculty, EH&S and Facilities Planning, Operation & Maintenance
- First step: Develop a survey of existing and future chemical use within the labs.
- Next step: Detailed analysis to determine
  - Suitability of filtration for intended use
  - Frequency of anticipated filter & sensor changes
  - Cost benefit analysis

Framingham State University Science Building

Level 4 Program:

- Organic Chemistry
- Physical Chemistry
- Analytical Chemistry



Traditional Ducted Fume Hood

Framingham State University

Framingham State University
Science Building

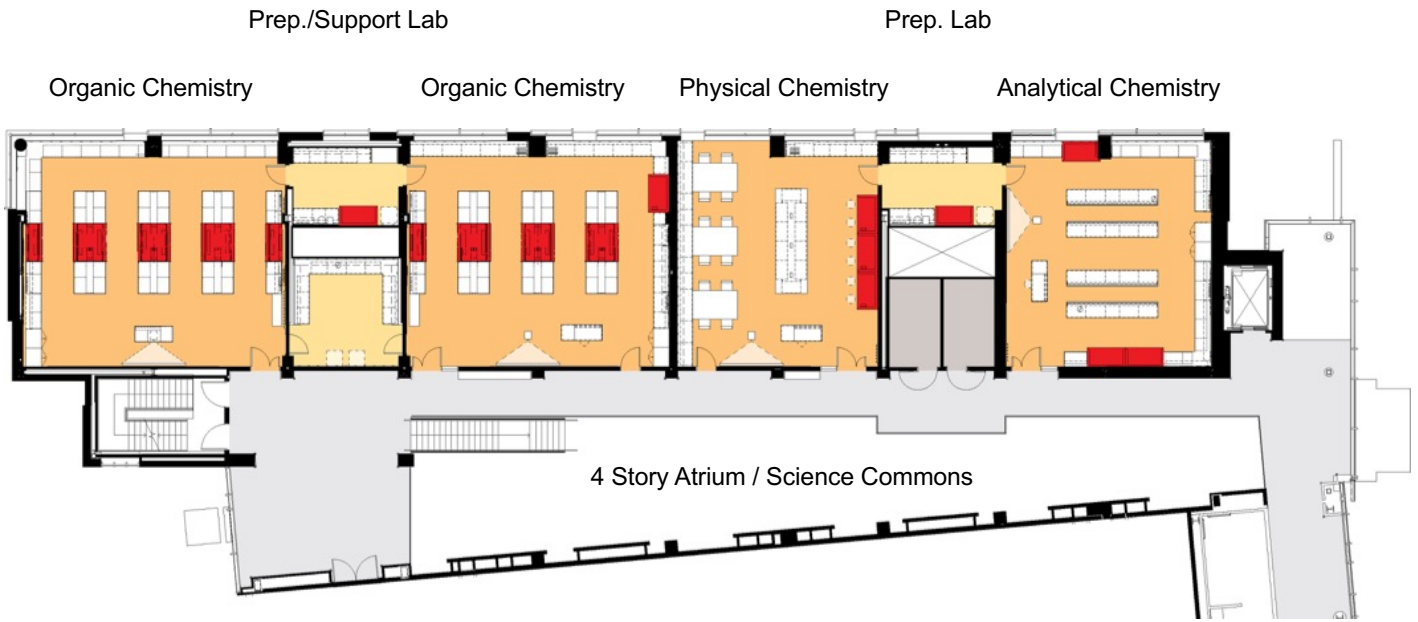
Level 4 Program:

(24) 6’-0” VAV Ducted Chemical Fume Hoods

Estimated first cost / hood:
$12,000

Estimated annual energy & maintenance cost / hood:

$2,700 (Assume 40hr/wk)



Framingham State University Science Building

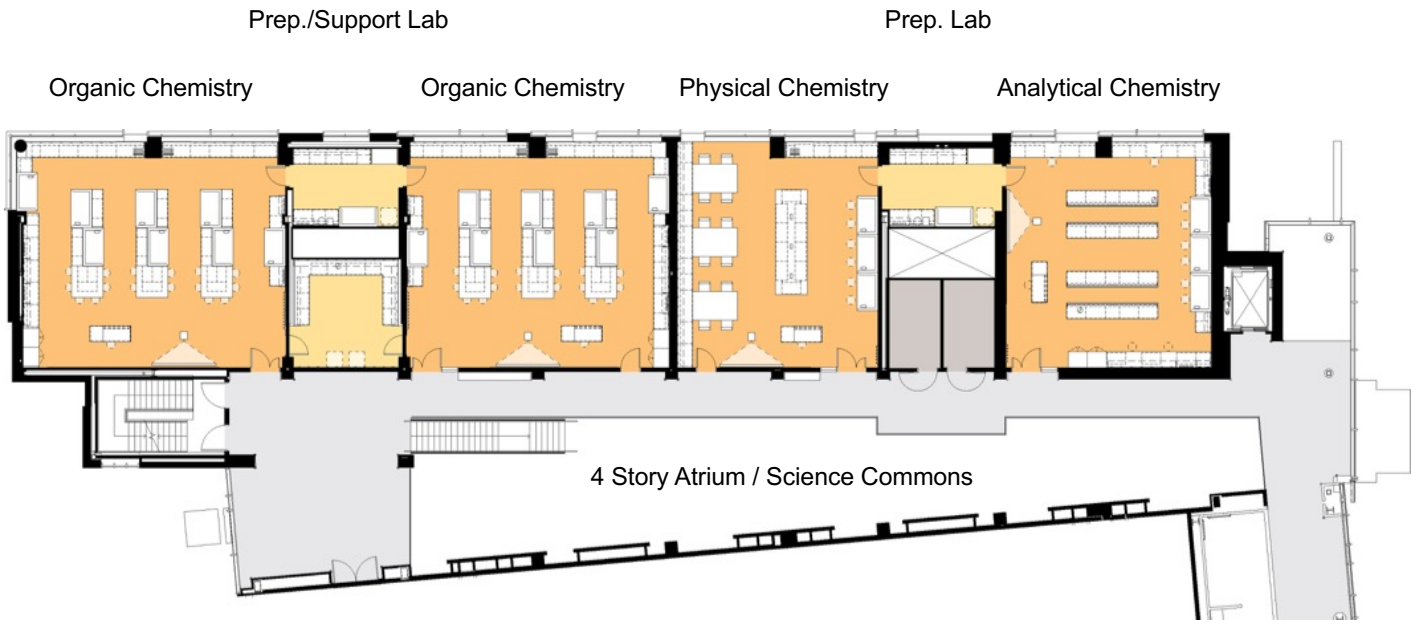
Level 4 Program:

(24) 6’-0” Filtering Chemical Fume Hoods

- Organic Chemistry Labs
- Physical Chemistry Lab
- Analytical Chemistry Lab

Challenge: Filtering fume hoods are larger than ducted hoods

Structural grid was set / Offset design concept



Framingham State University Science Building

(24) 6'-0" filtered hoods

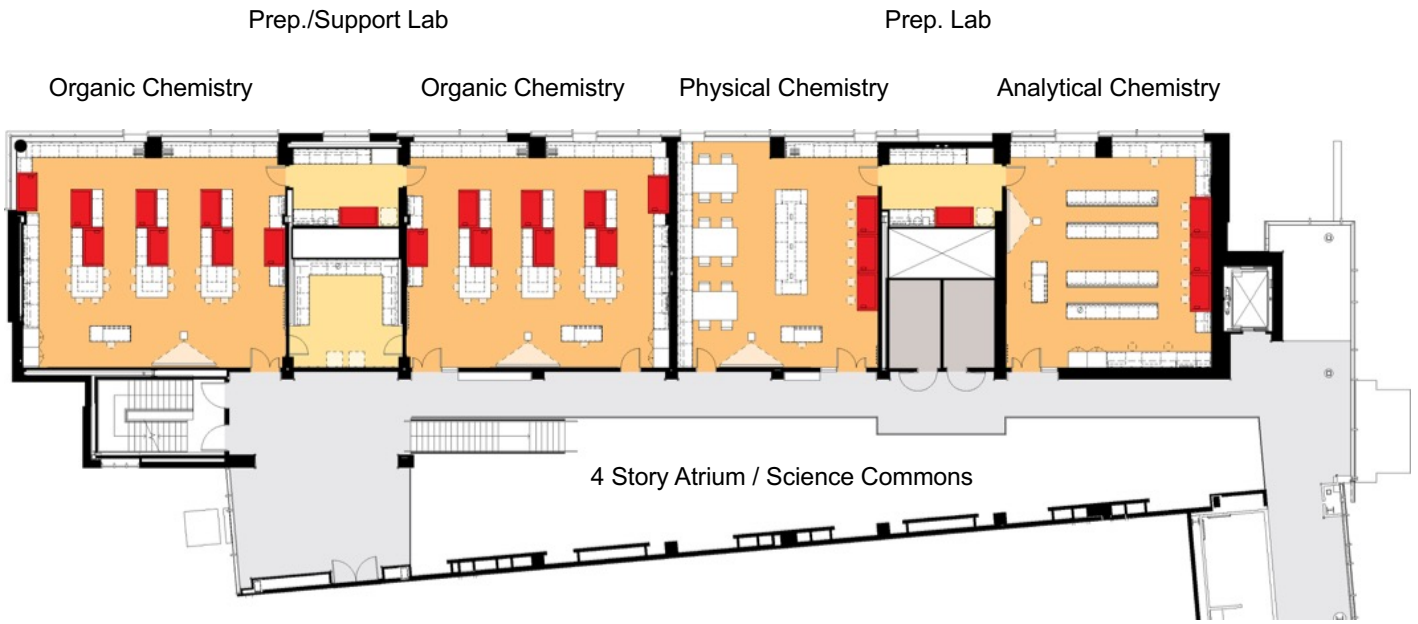
Estimated first cost / hood:
$25,000

Estimated annual energy & maintenance cost / hood:
$1,900 (Assume 40hr/wk)

Delta:

Filtering Fume Hood:
+$13K/hood

Energy/Maint. Per hood:
- $800-$1,000 annually



HVAC - Ducted Chemical Fume Hoods

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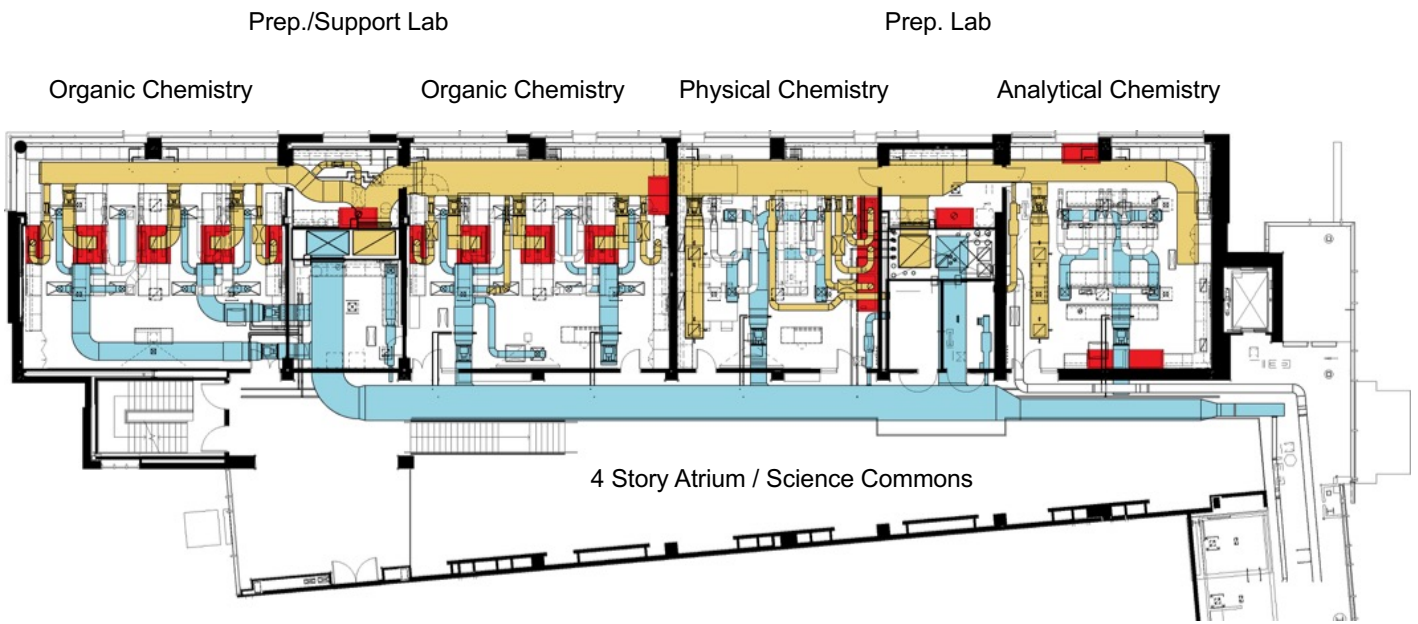
Framingham State University Science Building

VAV Ducted Chemical Fume Hoods

- Before Value Engineering



HVAC - Filtering Chemical Fume Hoods

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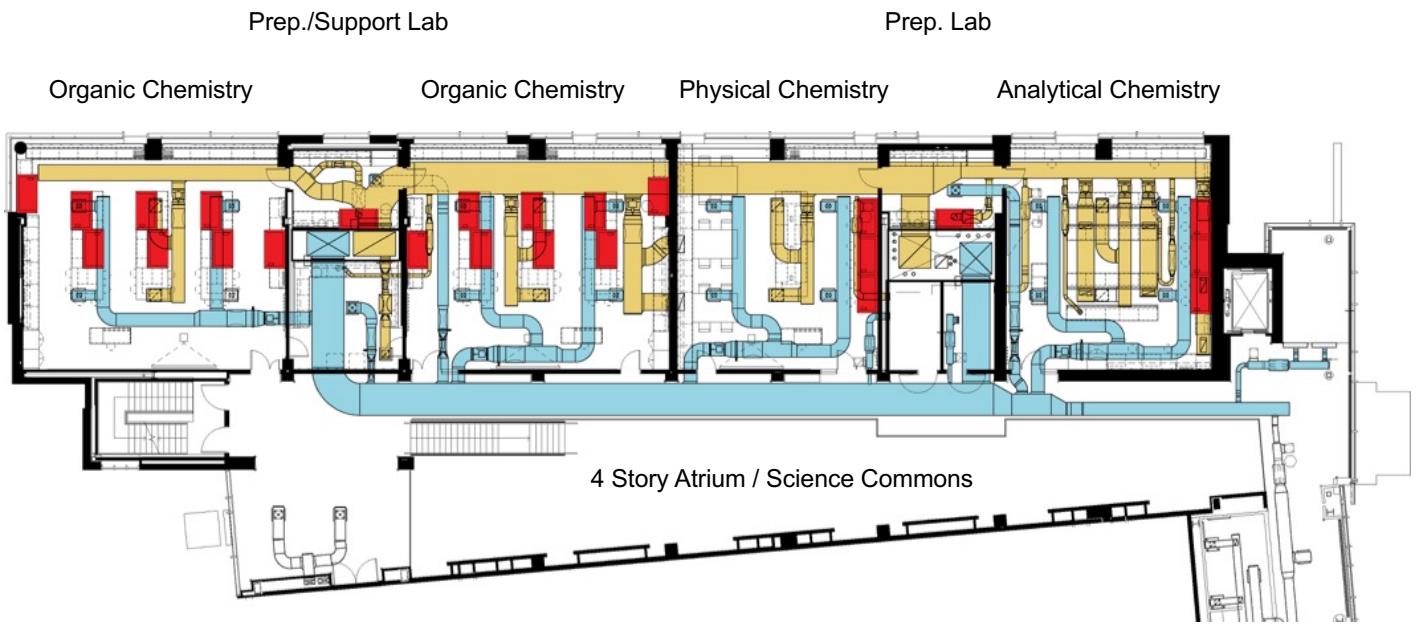
Filtering Chemical Fume Hoods

After Value Engineering

25% reduction in the mechanical infrastructure

- Supply AHU capacity
- Exhaust AHU capacity
- Reduction in chiller capacity
- Reduction in exhaust valves, ductwork and controls

- $800K first cost savings ***



Comparative Analysis

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Comparison First Cost NC Ducted vs. Filtered,	CV	VAV	VAV HP/LF	Filtering
Fume Hood, 6Ft, Vertical Sash [1,2]	$8,000-$10,000	$8,000-$10,000	$12,000	$25,000
Building Infrastructure: M-E-P, Lab Services & Data [0,3]	$20,000	$25,000	$25,000	$2,000
Total First Costs	**say $30,000**	**say $35,000**	**$37,000**	**$27,000**
Energy Costs/Year				
Exhaust Fans[4]	$1,367	$911	$711	$293
Make-up Air ($5/cfm) [5]	$6,000	$4,000	$3,120	$0
Maintenance Costs/Year	$1,200	$1,500	$1,500	$1,800
Total Operating & Maintenance/Year	**$8,567**	**$6,411**	**$5,331**	**$2,093**

Cost comparison data prepared by Ellenzweig Architects in collaboration with BR+A Consulting Engineers, R.W. Sullivan Engineering and Vanderweil Engineers.


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Organic Chemistry
American Chemical Society National Meeting & Exposition
Washington, DC – August 20-24, 2017


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General Chemistry
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Emerging Energy Saving Technologies for Laboratories

Lessons Learned

- Investigate / Decide early in the design phase;
  - Lost opportunity - Floor height reductions
  - Planning challenges – Increased hood depth
- Be conservative:
  - If there is uncertainty about types of chemicals, or frequency of use, plan for a ducted hood as a back-up
- Just like any other pierce of lab equipment, the users need to be properly trained (Not a conventional CFH)

Questions?