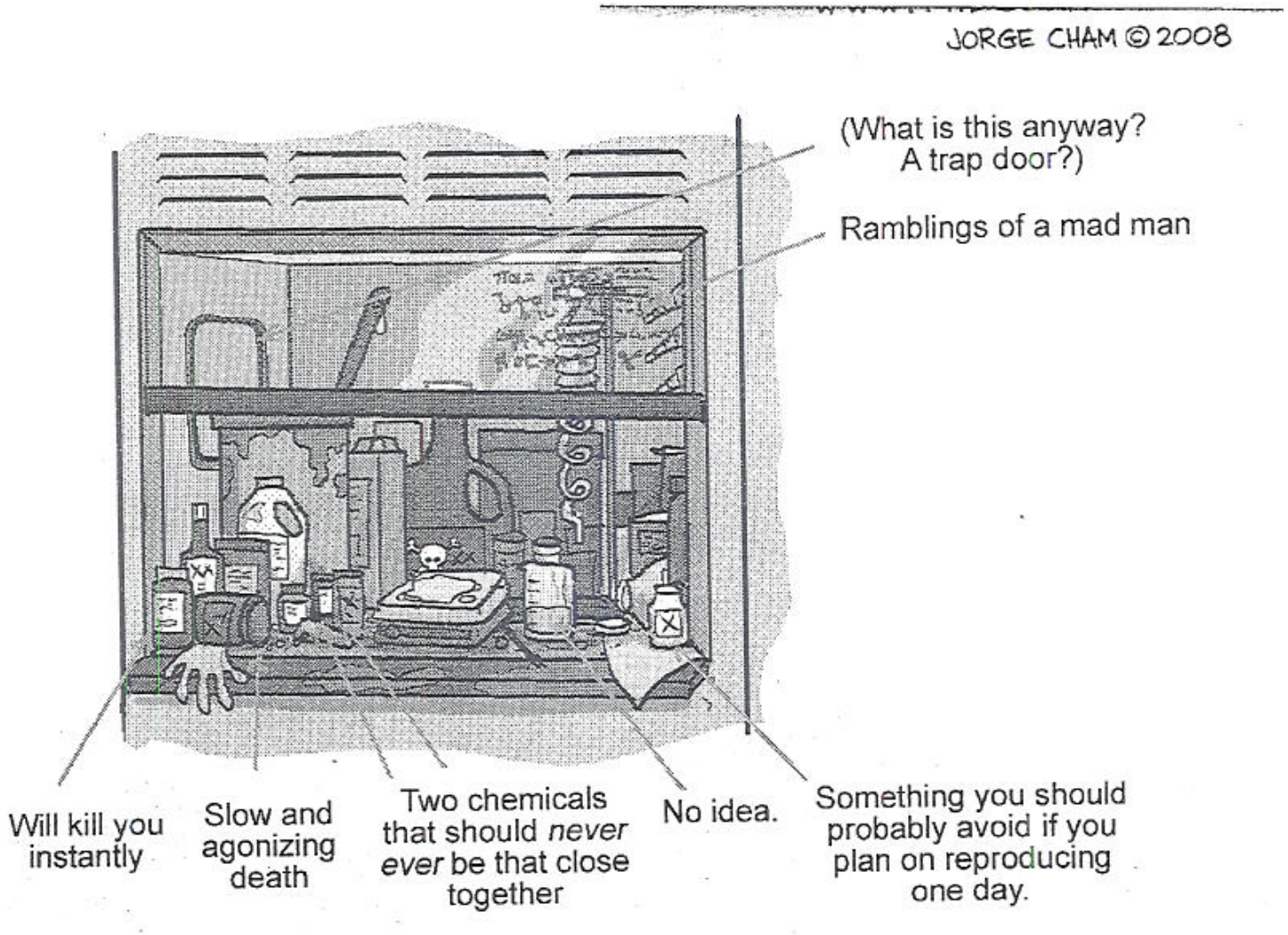
Fume Hood Hibernation at MIT



What is an Industrial Hygienist?

“…that science and art devoted to the anticipation, recognition, evaluation, and control of those environmental factors or stresses arising in or from the workplace, which may cause sickness, impaired health and well-being, or significant discomfort among workers or among the citizens of the community.”

Hierarchy of Controls

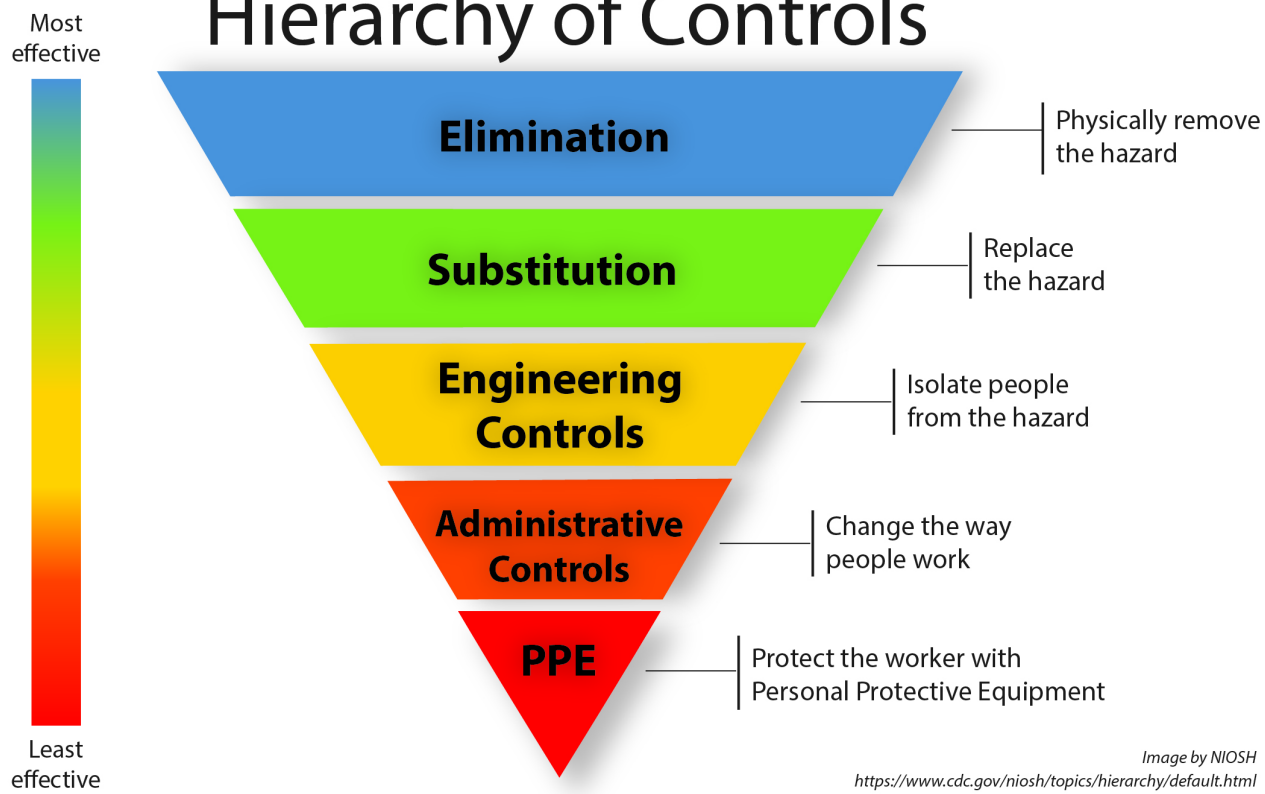


Image by NIOSH
https://www.cdc.gov/niosh/topics/hierarchy/default.html

Chemical Fume Hoods

- Generally run at all times
- Face velocity most common metric
- Exhaust a lot of air (standard 6 foot fume hood might average 800 cfm)

MIT at a Glance

- 190 Buildings
- 13 Million Sq. Feet Total
- 8 Million Sq. Feet for academic purposes
- Mix of old and new
- ~1200 chemical fume hoods
- ~2800 other exhaust capture devices

Ways to Save Energy in a Fume Hood

- Optimize the face velocity
  - employ “high performance” fume hoods
- If appropriate, make them variable air volume (VAV) hoods
- Optimize the minimum flow rate on VAV fume hoods
- “Hibernate” the hood

Optimize The Face Velocity

$$Q_{(ft^3/min)} = 100_{(ft/min)} \times A_{(ft^2)}$$

- Critical for proper containment
- Too high = turbulence
- Too low = insufficient draw to entrain contaminants.

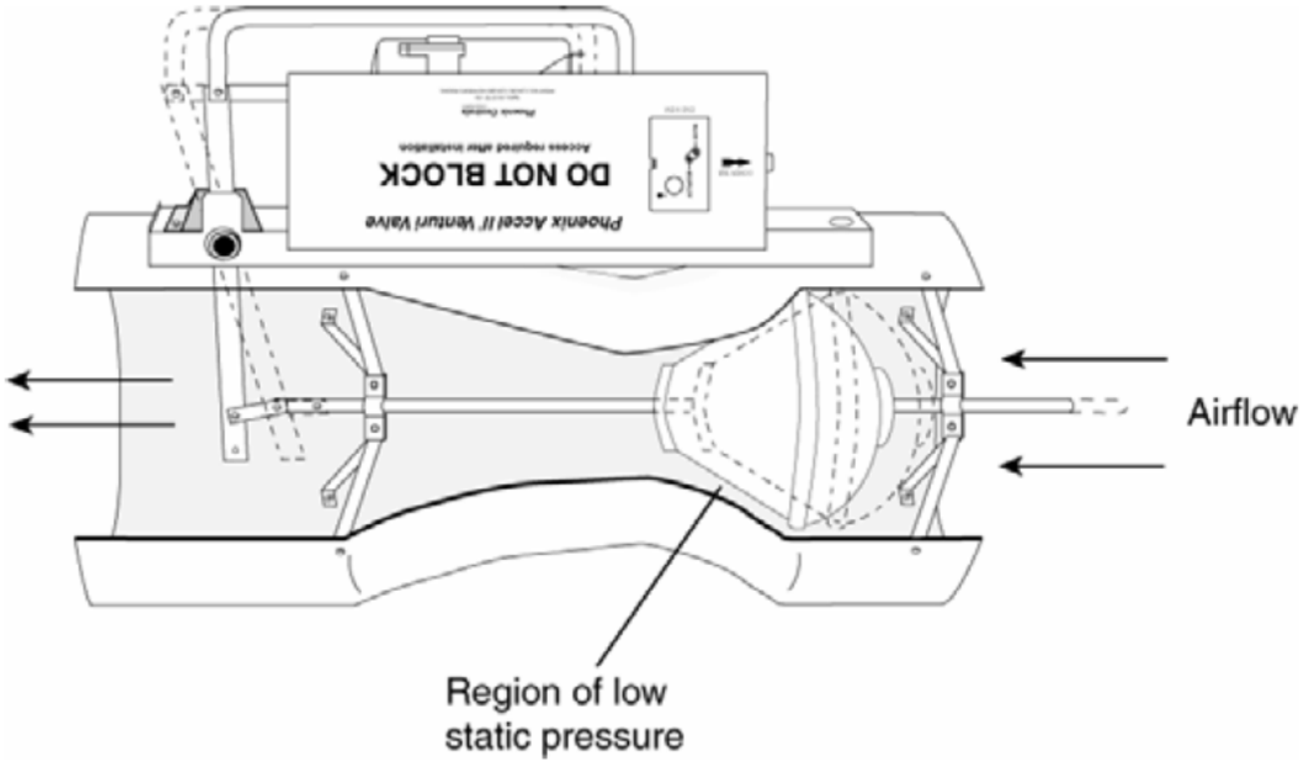
Convert the Hood to Variable Air Volume

$$Q_{(ft^3/min)} = 80_{(ft/min)} \times A_{(ft^2)}$$

- As the sash is closed, A decreases and therefore Q must decrease as well.

Pressure Independent Venturi Valve

Figure 4-1. Cutaway View of Venturi Valve

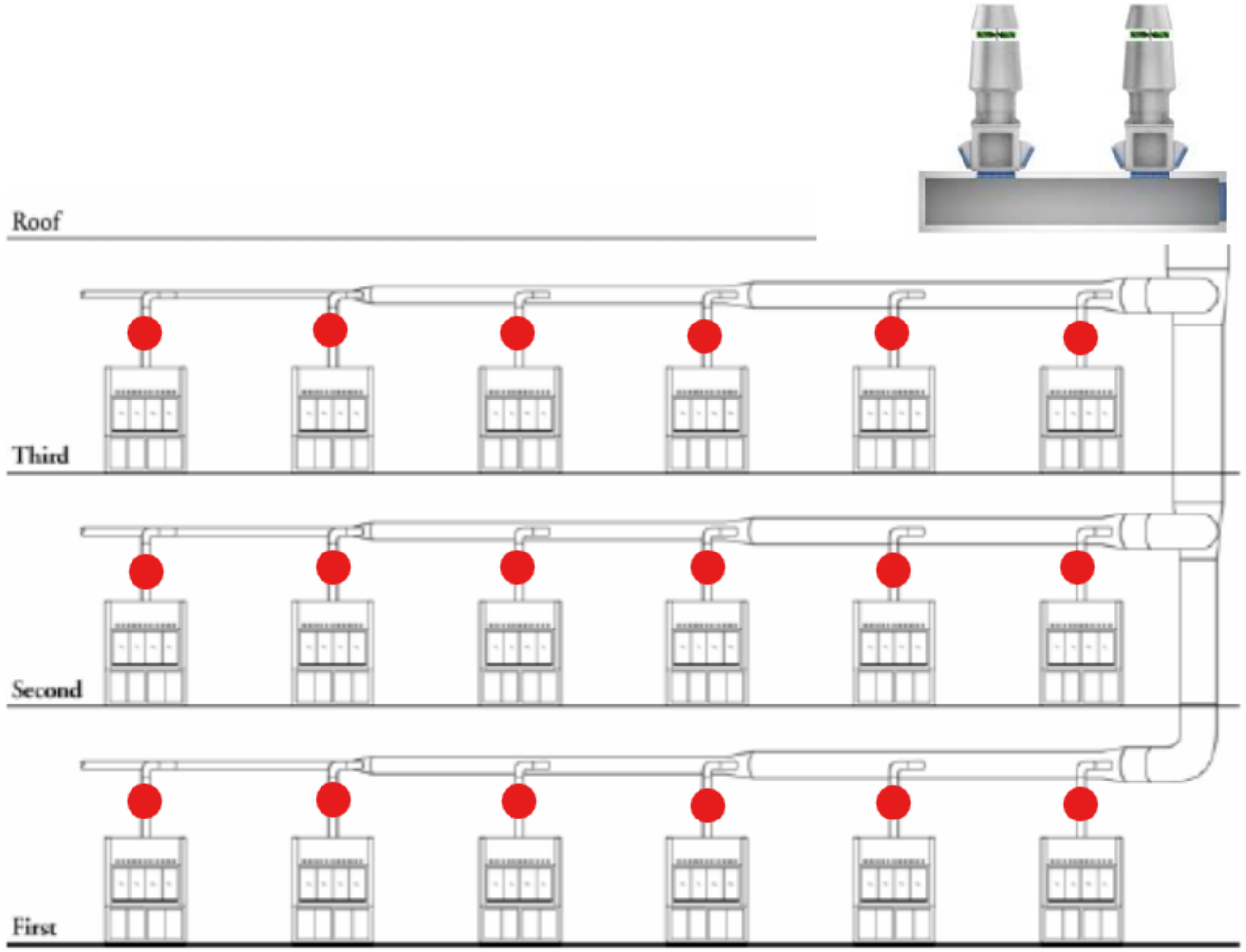


Constant Volume

Variable Volume

Constant Air Volume (CAV) Valve

- Isolate the fume hood from S.P. changes in the system
- Fast acting
- Reliable



Variable Air Volume (VAV) Valve

- Same as CAV but accept and react to external input
- Regulate flow based on sash heigh to maintain a constant face velocity

Optimize the Minimum Flow Rate

$$Q_{(ft^3/min)} = 80_{(ft/min)} \times A_{(ft^2)}$$

- As the sash is closed, A decreases and therefore Q must decrease as well.

Hibernate a hood???

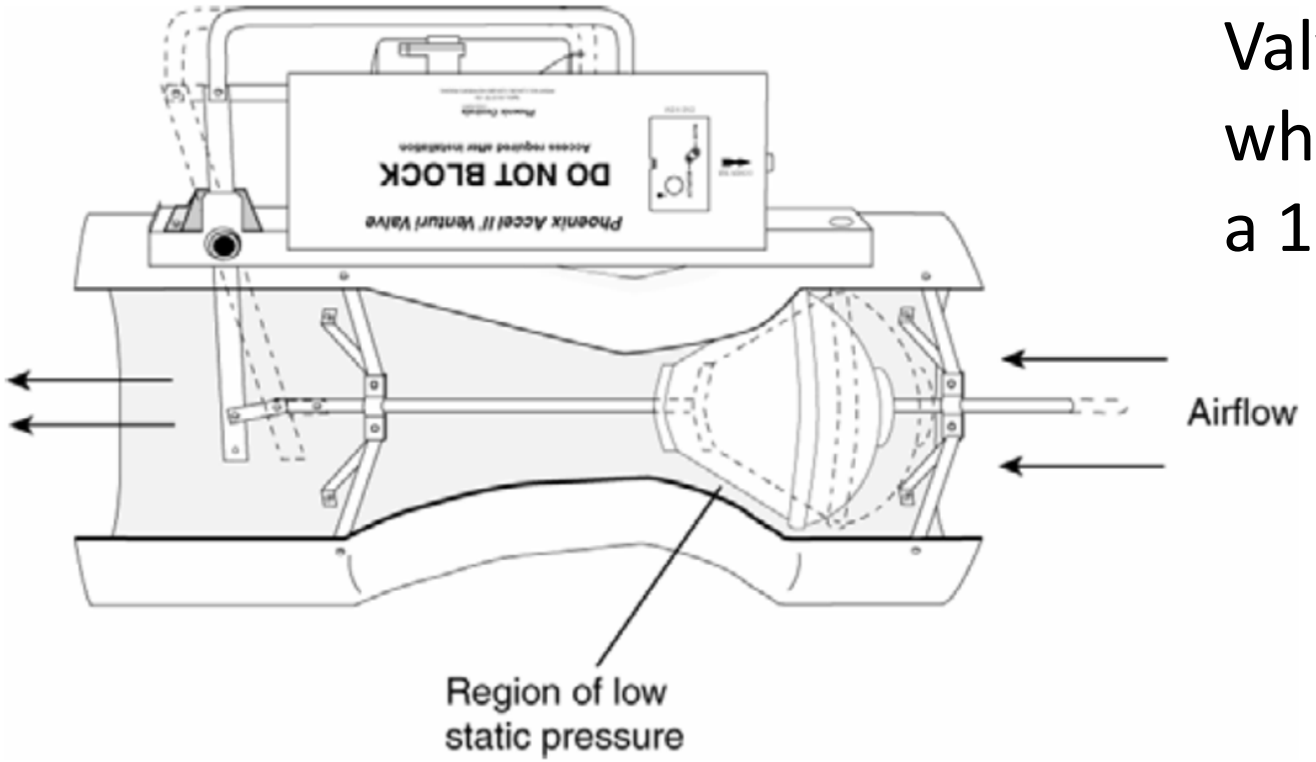
- Shutting off or minimizing the flow of air through the hood on a temporary basis

- Lots of considerations before doing
  - Remember- you also have to reduce supply air
  - Are you going to fall below safe minimum air change rates
  - What is the impact on pressurization
  - Cost (balancer, venturi valve vendor, recommissioning)
  - What is the payback duration of hibernation (how easy is that to calculate)

Ways to hibernate a hood

- Turn off the fan
- Close a blast gate
- Manually close venturi valve
- Close venturi valve through BAS
  - Once enable, can be easily done any time

Figure 4-1. Cutaway View of Venturi Valve



Valves still leak even when shutoff- 90 cfm on a 12 inch valve

Chemistry UGTL

- 69 Chemical fume hoods
- Face Velocity = 80 fpm
- Hood minimum optimized

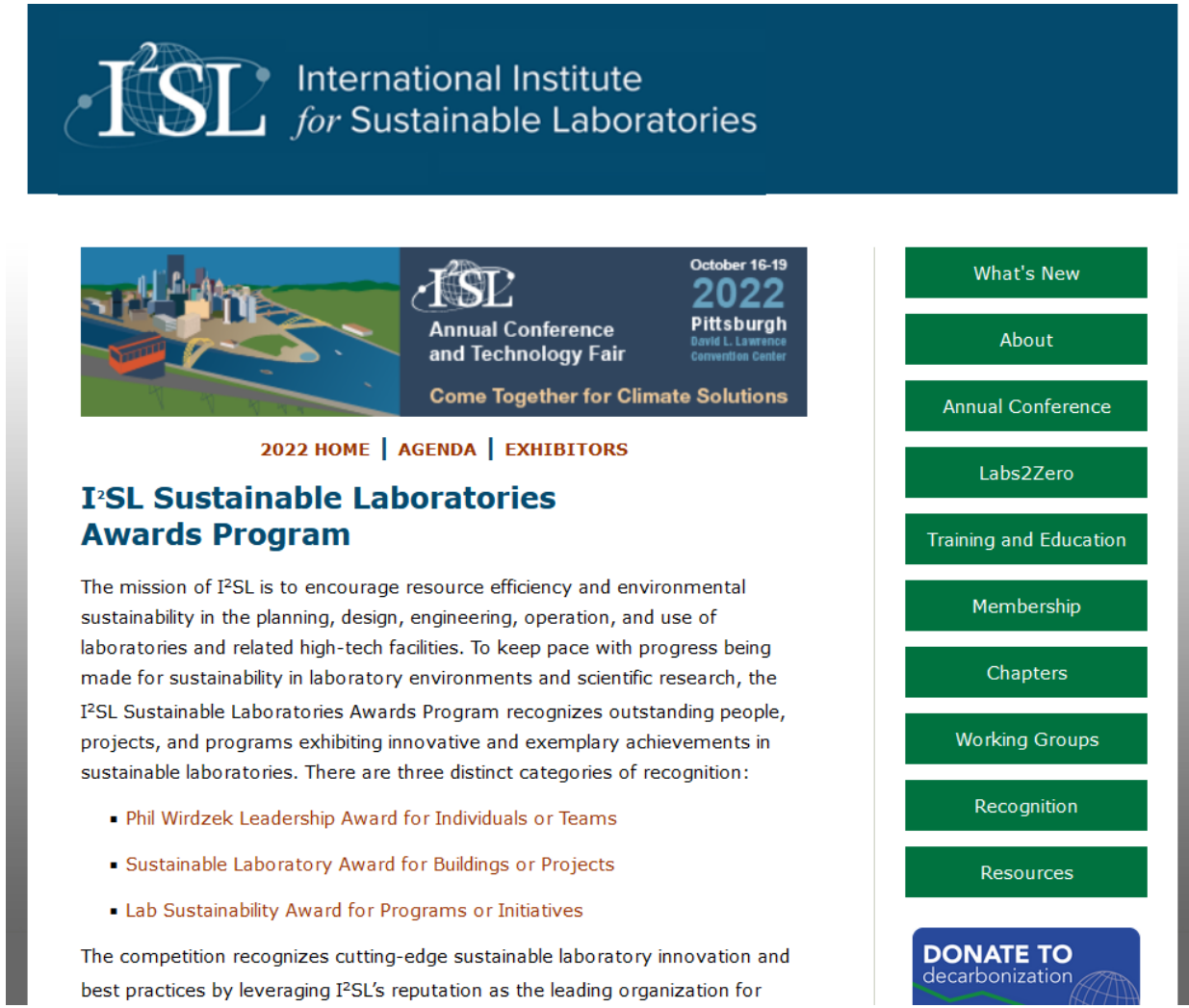
Stats

- 58 fume hoods go into hibernation based on a set schedule
- Opening any sash bring that hood out of hibernation
- Master override
- Hibernation reduces the flow to the valve minimum for 135 hours per week
- When all sashes are closed the lab averages 11 ACH
- In hibernation mode the lab averages 7 ACH

Words of Wisdom from an IH

- Plan ahead, much easier/cheaper to do this during the initial design and construction
- Consult your EHS department, your clients EHS department, or consider an IH consultant
- Hibernation that involves manual methods is expensive and requires a lengthy hibernation time to achieve payback

- During the 2022 I2SL's Annual Conference, the MIT Chemistry Undergrad Teaching Lab (UGTL) was awarded an I2SL Lab Sustainability Award.



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Thank you!

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