BIG ASS SOLUTIONS

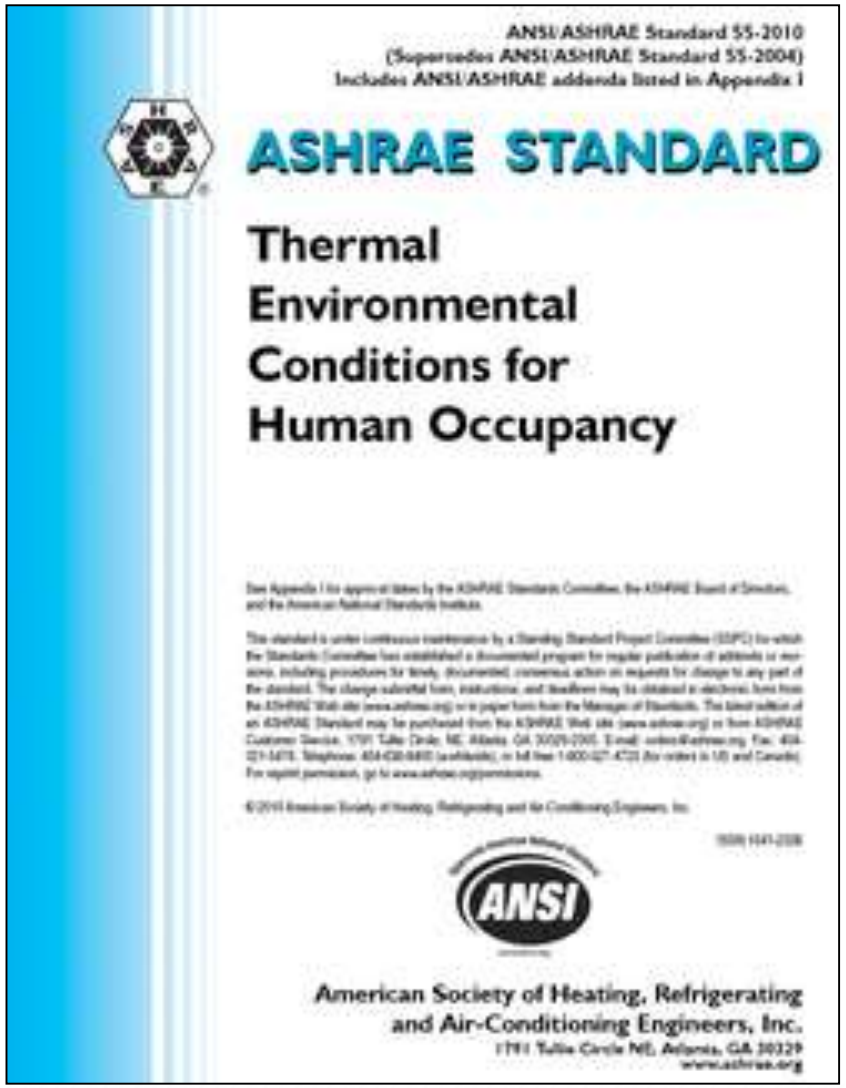
Air Movement for Energy-Efficient Comfort in Conditioned Spaces

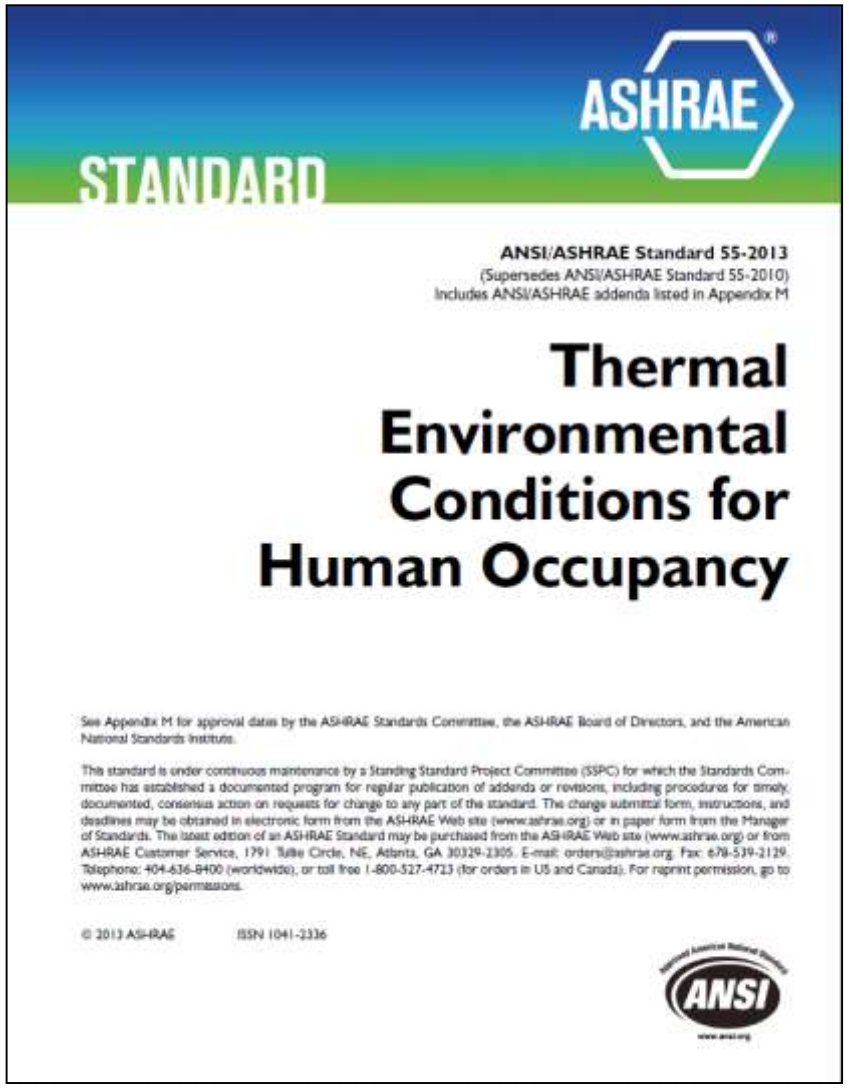
CONTINUING EDUCATION AIA

GBCI CMP

RCEP REGISTERED CONTINUING EDUCATION PROGRAM

ASHRAE Standard 55-2010: Thermal Comfort



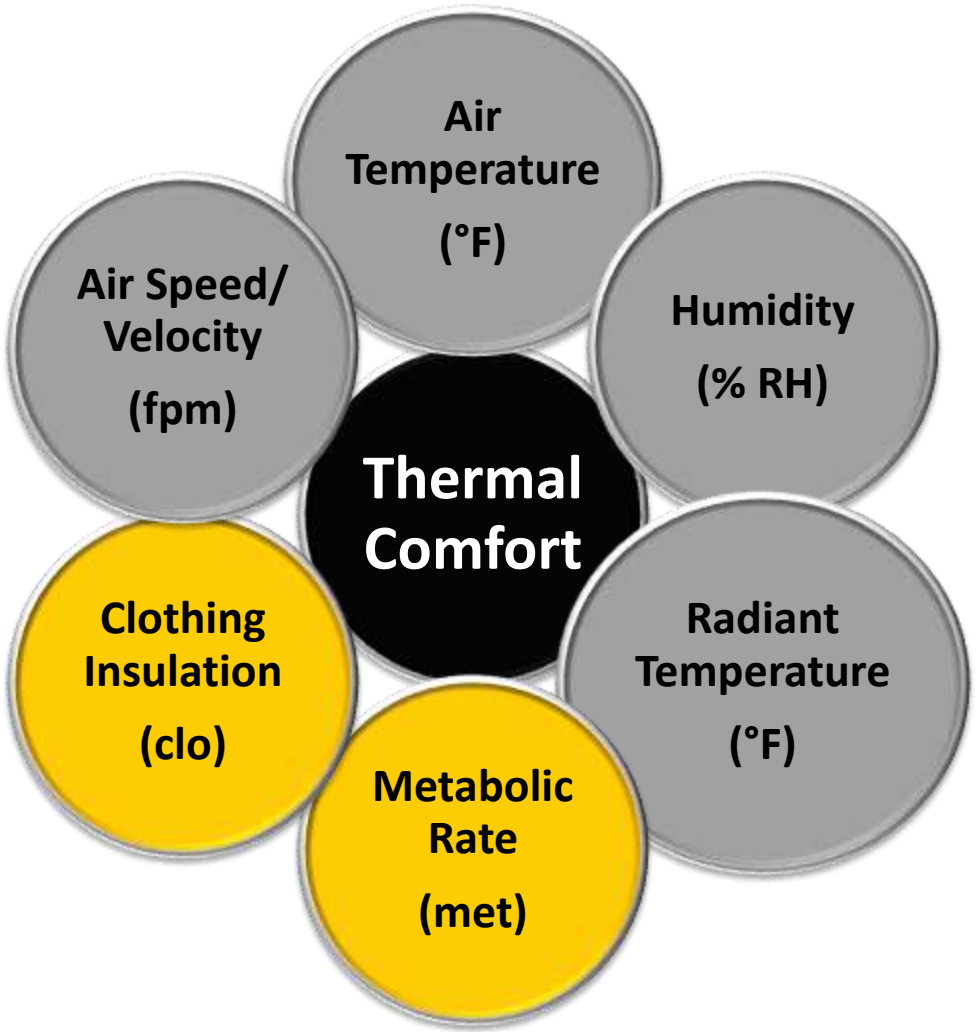


“Specify the combination of indoor thermal environmental factors and personal factors that will produce thermal environmental conditions acceptable to a majority of the occupants…”

Said another way:

Quantify comfort for most

Thermal Comfort: What Affects It?



Environmental Factors

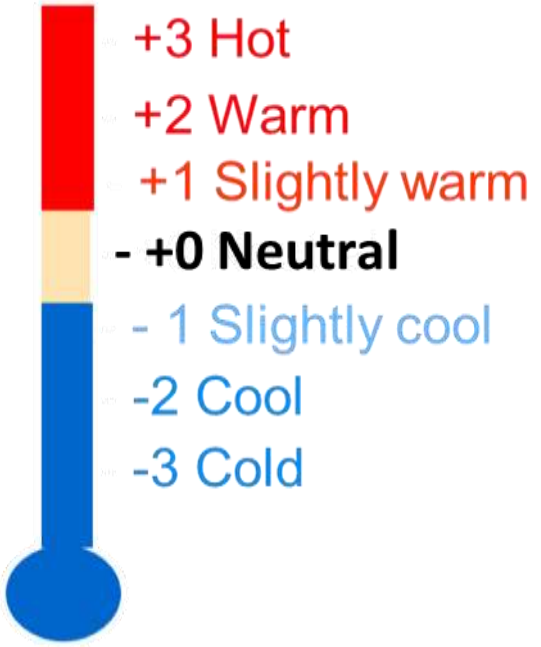
Personal Factors

Definitions

Predicted **P**ercentage of **D**issatisfied (PPD)

Predicted **M**ean **V**ote (PMV)

Operative Temperature

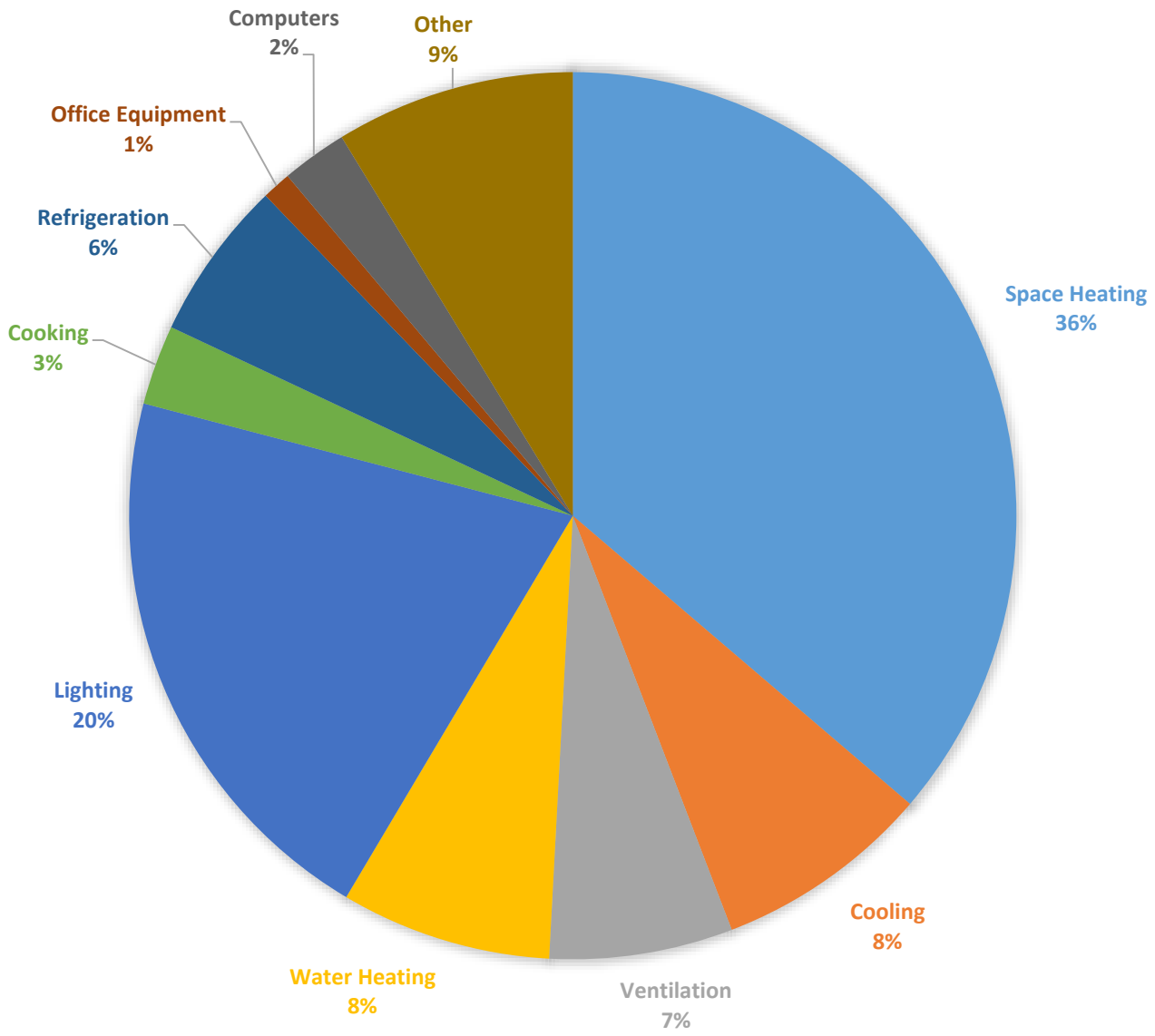


Comfort Zone

PMV: -0.5 to +0.5

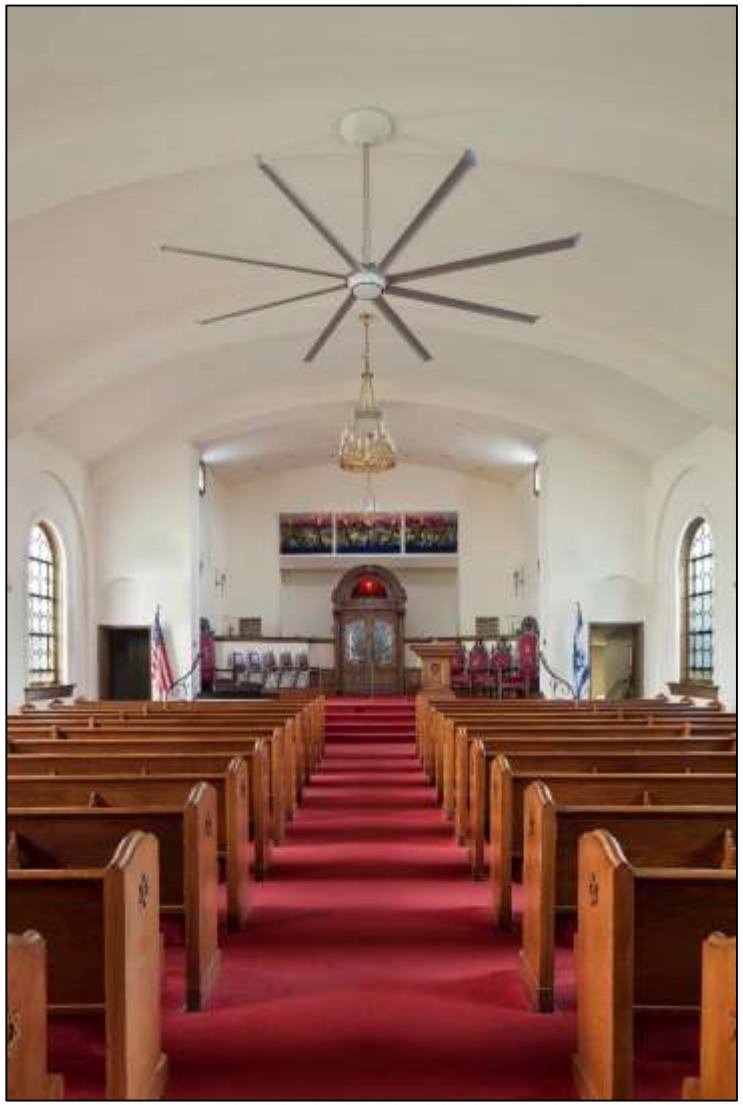
PPD < 10%

MAJOR FUEL CONSUMPTION (BTU) BY END USE FOR ALL BUILDINGS, 2003



EIA CBECS 2003

Air Movement for Summer Cooling



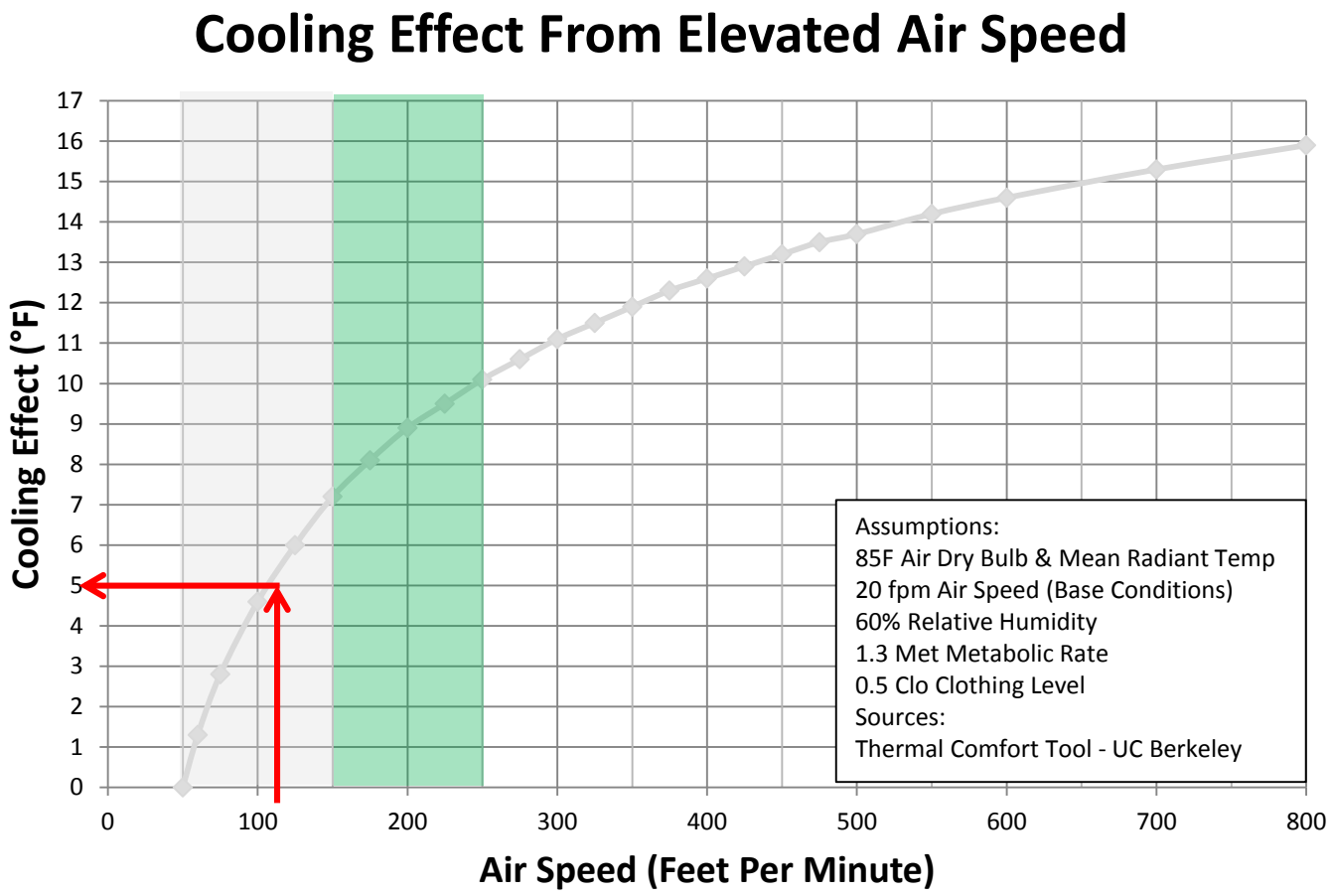
Designing for Thermal Comfort: Cooling

Typical Cooling Values

- Air temperature (75 °F)
- Humidity (50% RH)
- Metabolic rate (1 met)
- Radiant temperature (75 °F)
- Clothing insulation (0.5 to 1.0 clo)
- Air speed (40 fpm or less)

	Typical
PPD	8%
PMV	-0.39

Air Speed and Thermostat Offset



100 - 250 fpm best cooling per Watt

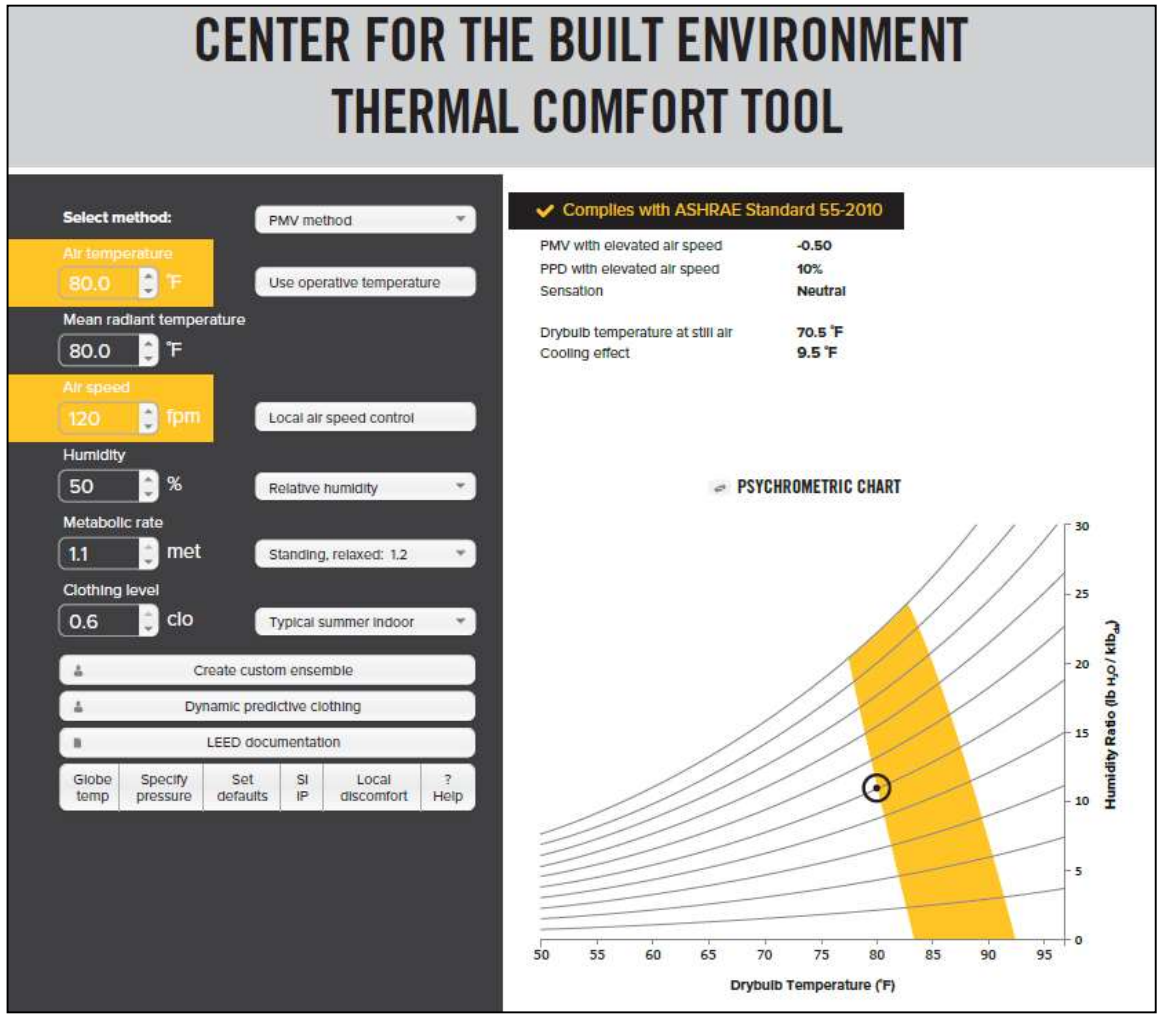
ASHRAE Thermal Comfort Tool

Designing for Thermal Comfort: Cooling

Alternate Cooling Values

- *Air temperature (80 °F)*
- Humidity (50% RH)
- Metabolic rate (1.1 met)
- Radiant temperature (80 °F)
- Clothing insulation (0.5 to 1.0 clo)
- *Air speed (120 fpm)*

	Alternate
PPD	5%
PMV	-0.05



Savings from Temperature Offset

According to the U.S. EPA and D.O.E. Energy Savings Calculator*, each degree of this thermostat offset saves 3% to 6% of cooling energy.

*U.S. EPA and D.O.E. Energy Savings Calculator

Shifting the Concept of Thermal Comfort

- $18.6 billion on residential AC in the US
- 63% rise in the cost of electricity since 2003
- The energy consumed by residential AC in the US doubled between 1993 and 2003

Shifting the Concept of Thermal Comfort

If every home in the US raised its thermostat setpoint 6F, we would eliminate 78 billion pounds of carbon

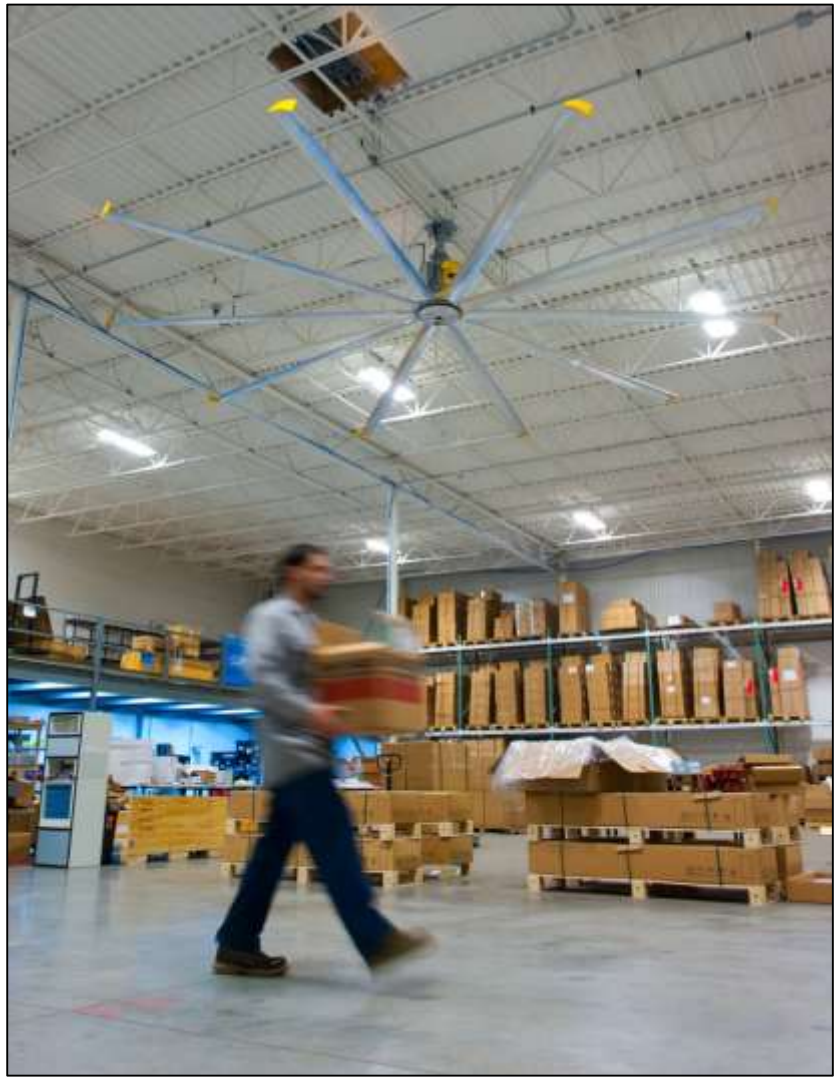
Park 7.4 million vehicles for a year

Switch 925 million incandescent lamps to CFL bulbs

9 coal-fired power plants for a year

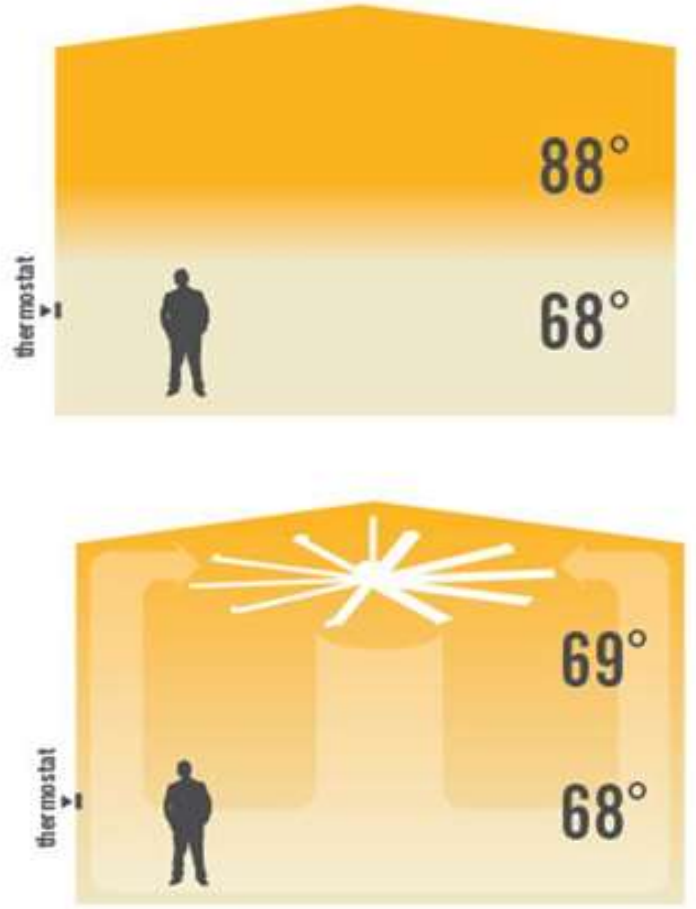
Carbon sequestered by 29 million acres of US forests in one year

Air Movement for Winter Energy Efficiency

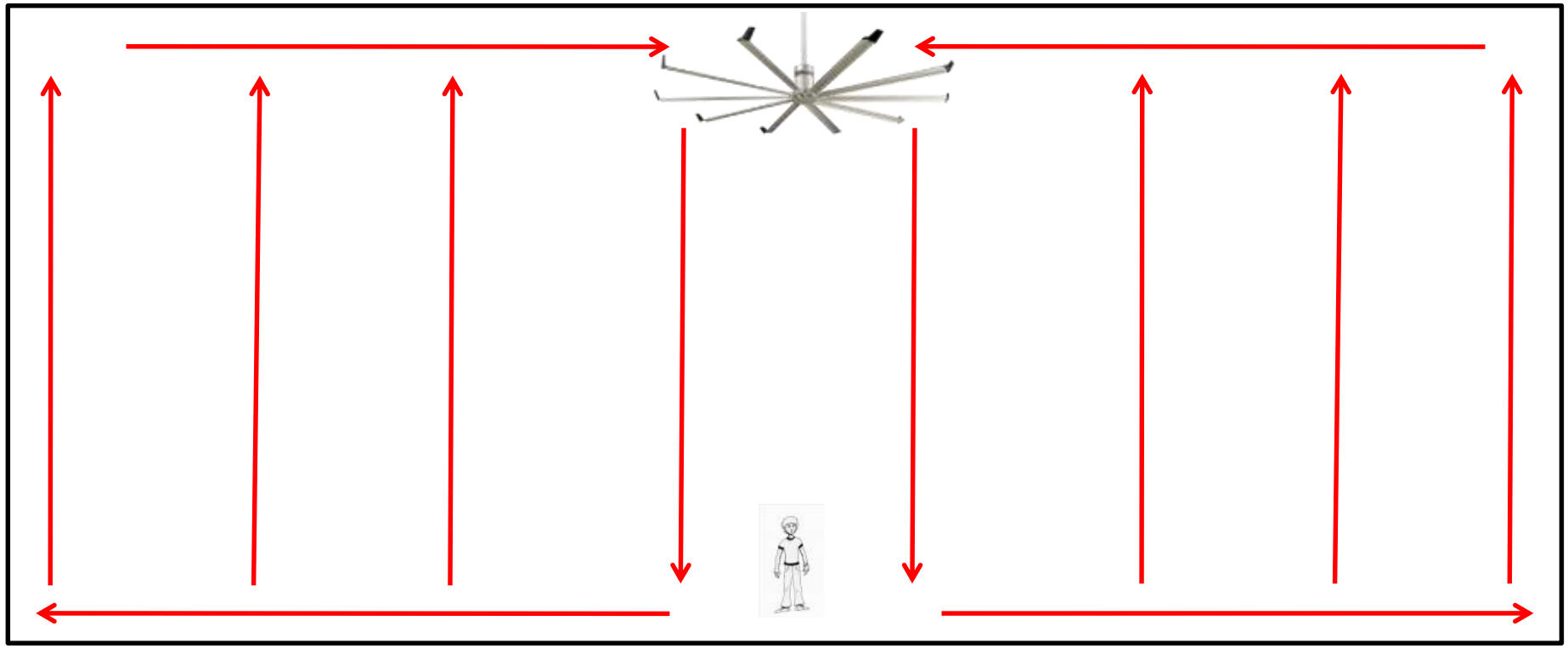


Stratification in Heating Mode

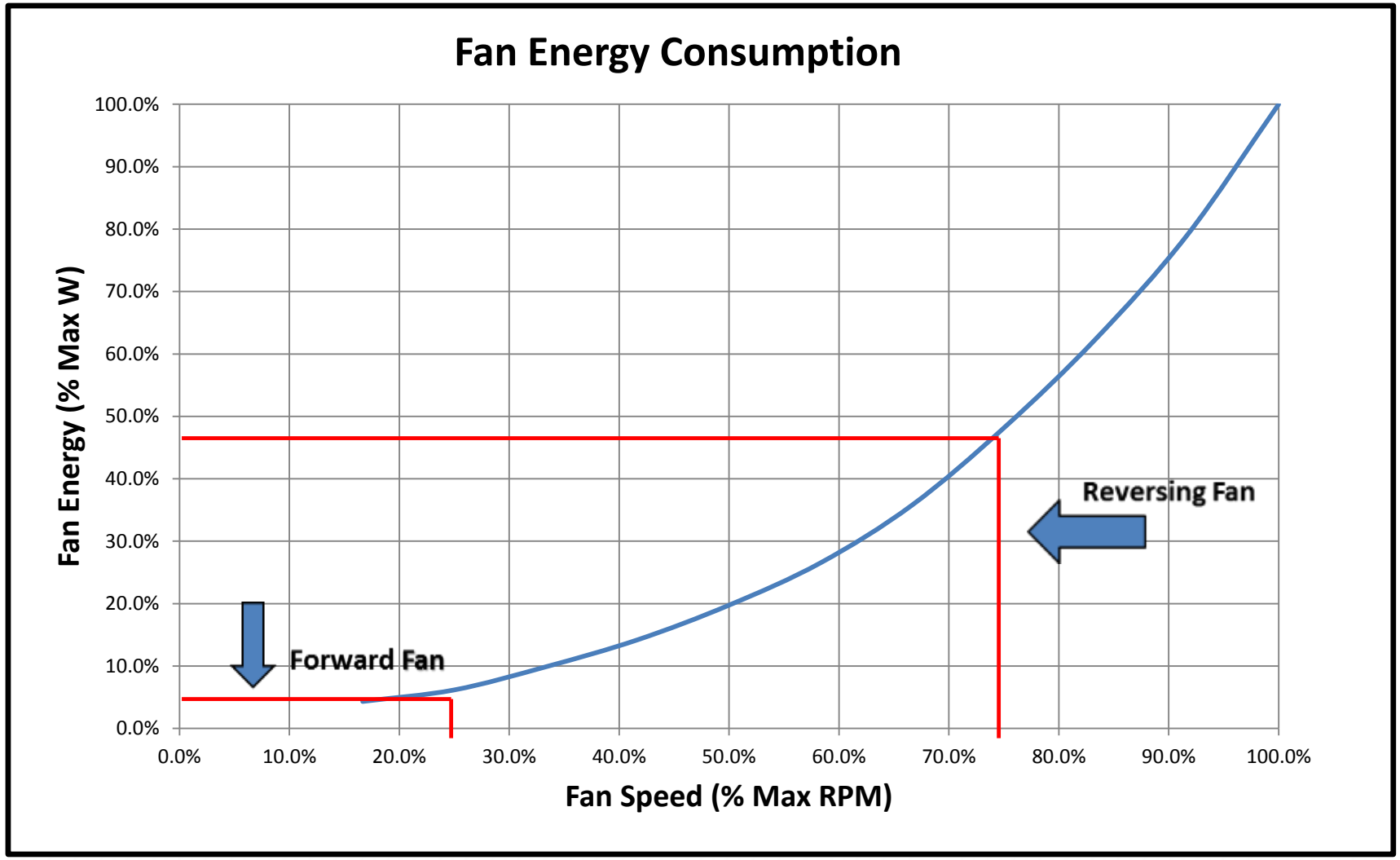
- Hot air rises
- Difficult to get uniformity
- Stratification of 0.5 – 1.0°F/ft.
- Higher average space temperature, heat loss, equipment runtime



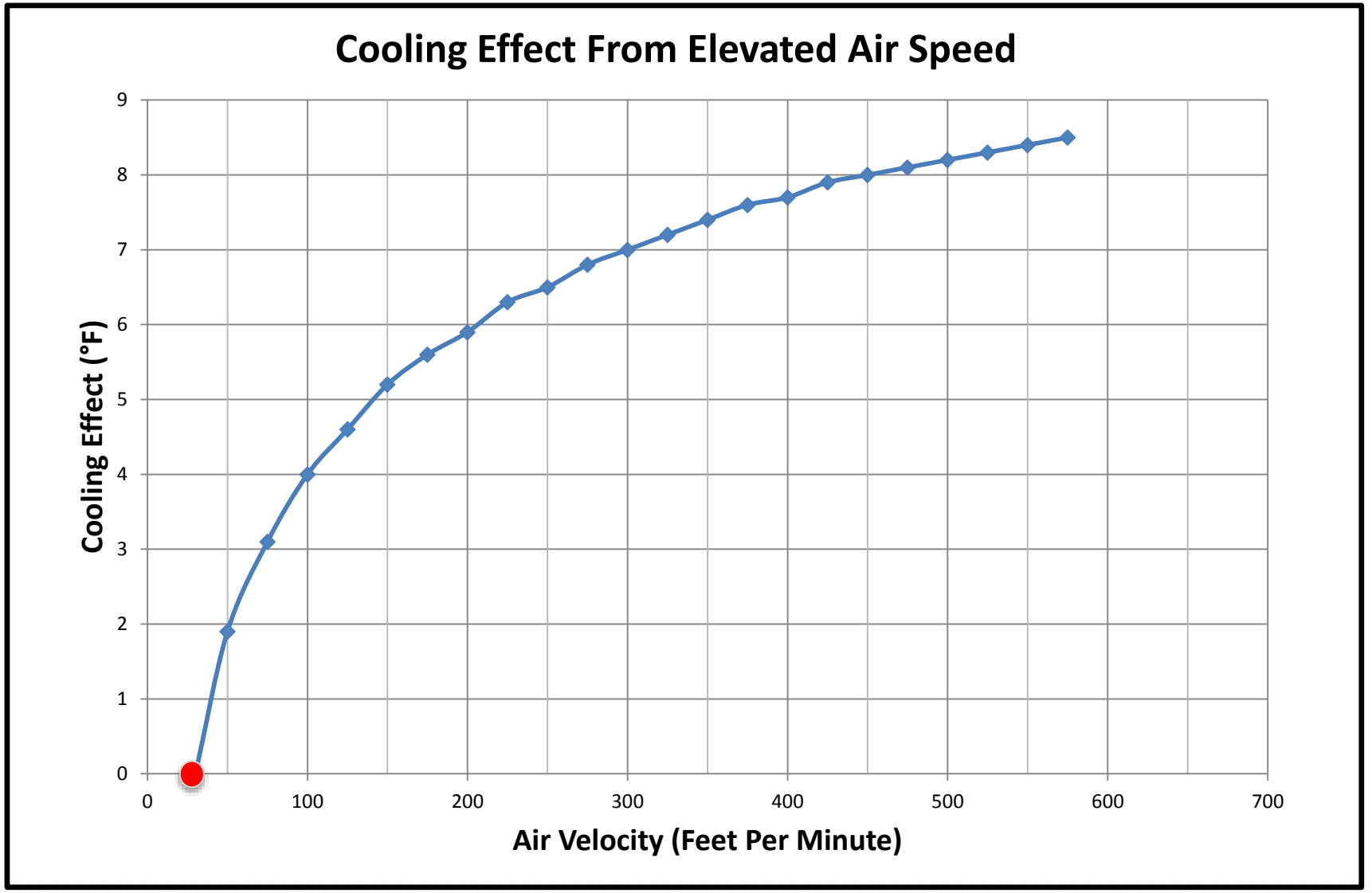
Fan Jet Requirement



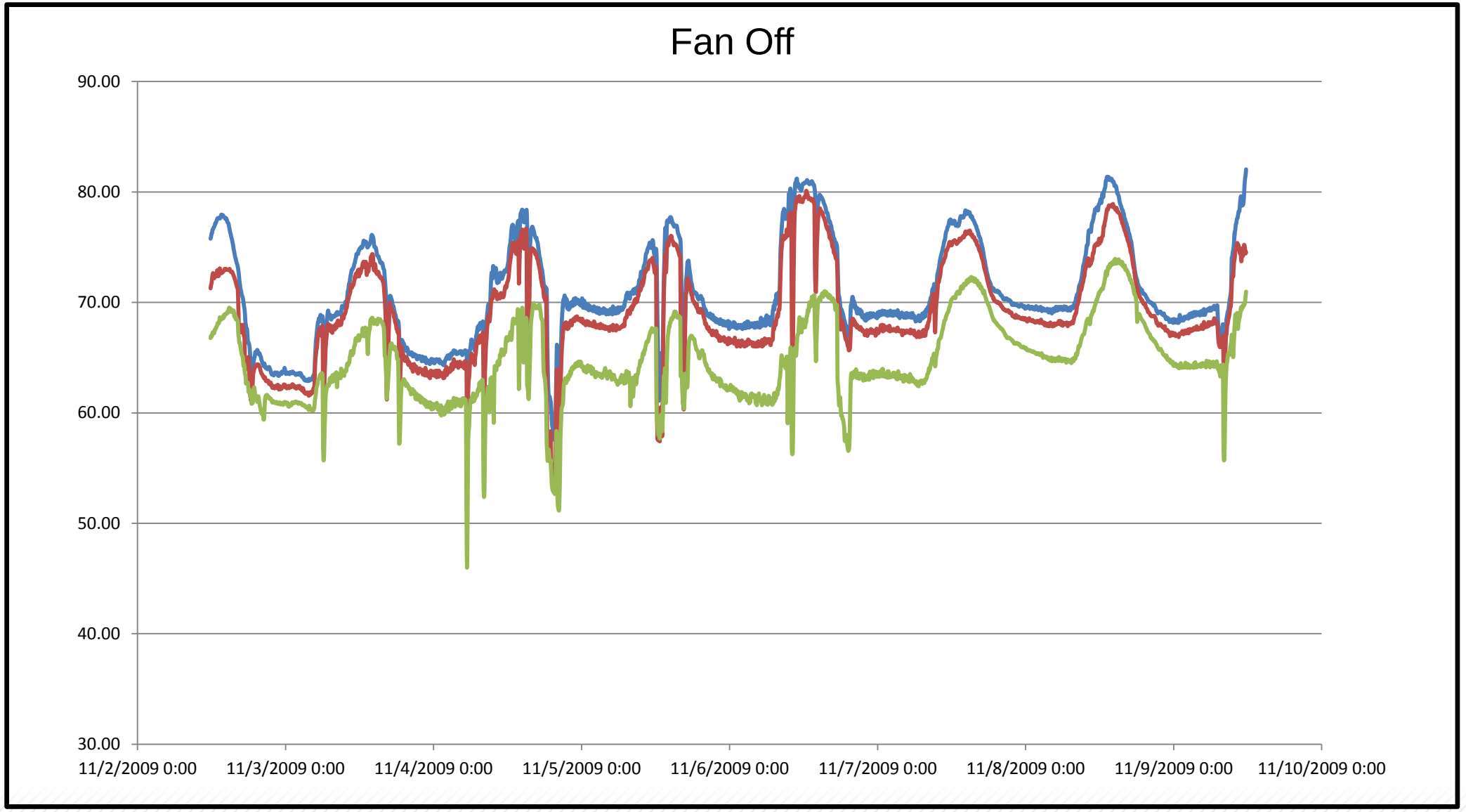
Forward Operation (No Reverse)



No Drafts


Cooling Effect From Elevated Air Speed
Cooling Effect (°F)
0
1
2
3
4
5
6
7
8
9
0
100
200
300
400
500
600
700
Air Velocity (Feet Per Minute)

Destratification: Kentucky Guard Hangar



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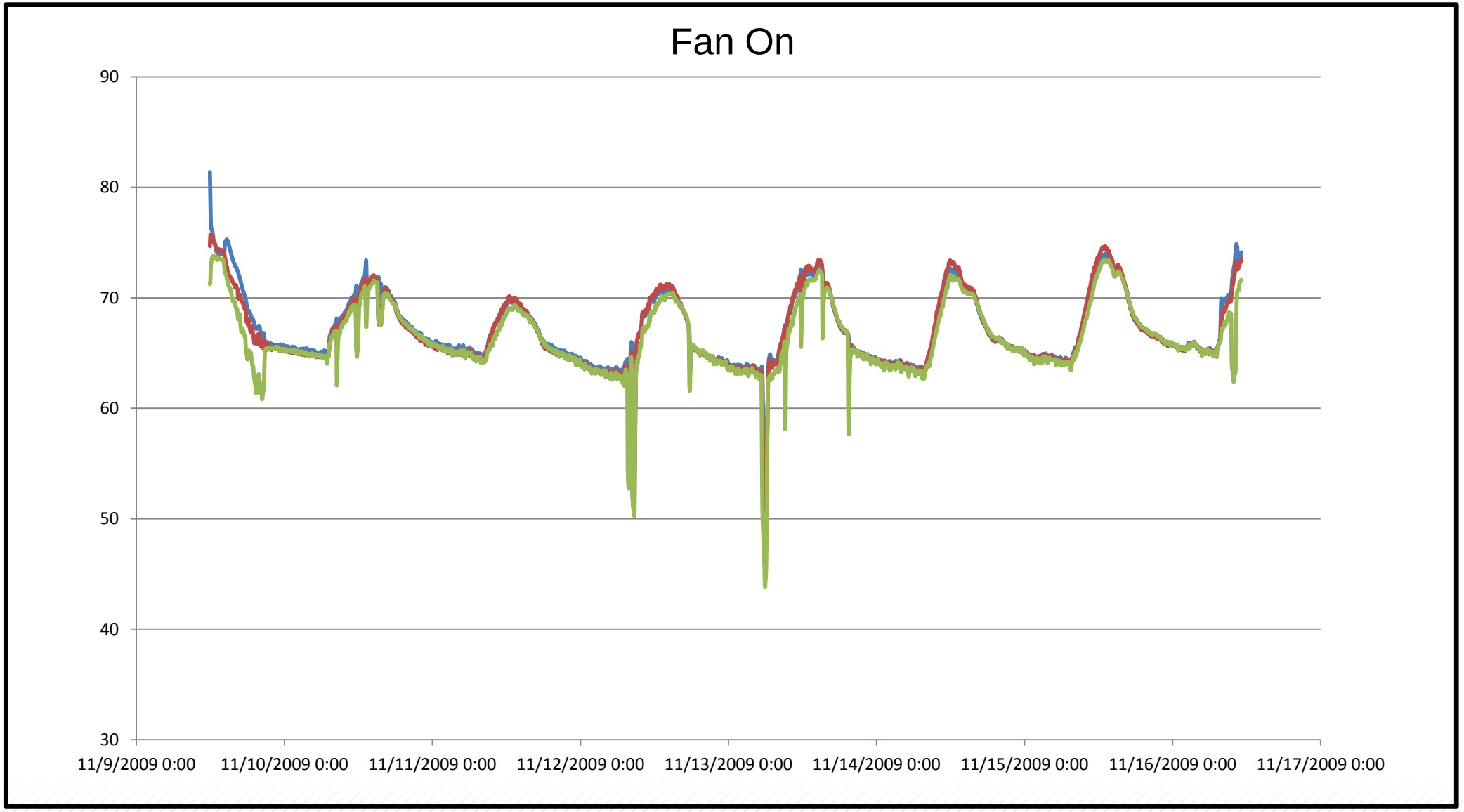


Destratification: Kentucky Guard Hangar

Gas savings: 272,247 ft^3 = 272.2 MCF per year

	Cost savings:	$2,714 per year
–	Fan electricity:	$37
	Net savings:	**$2,677**

Air Movement and Green Building Standards

LEED BD+C

- EA Prereq 2 Minimum Energy Performance
- EA Credit 2 Optimize Energy Performance
- EA Credit 4 Demand Response
- EA Credit 6 Enhanced Refrigerant Management

Questions?

877-BIG-FANS

Industrial

Auto Dealerships

Aircraft Hangars and Terminals

Government and Military

Public Spaces

Health Club and Recreation Centers

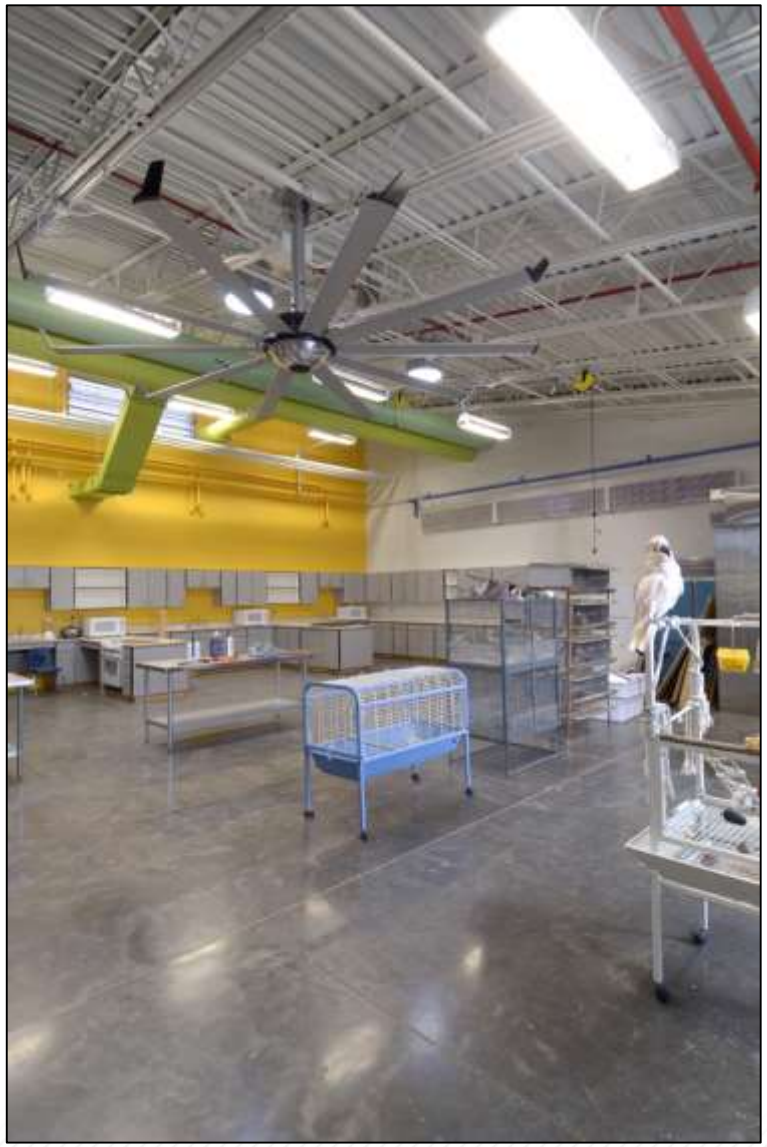
Schools: K-12 and Universities

Worship Facilities

Outdoor Covered Areas

Residential Spaces

Locust Trace High School



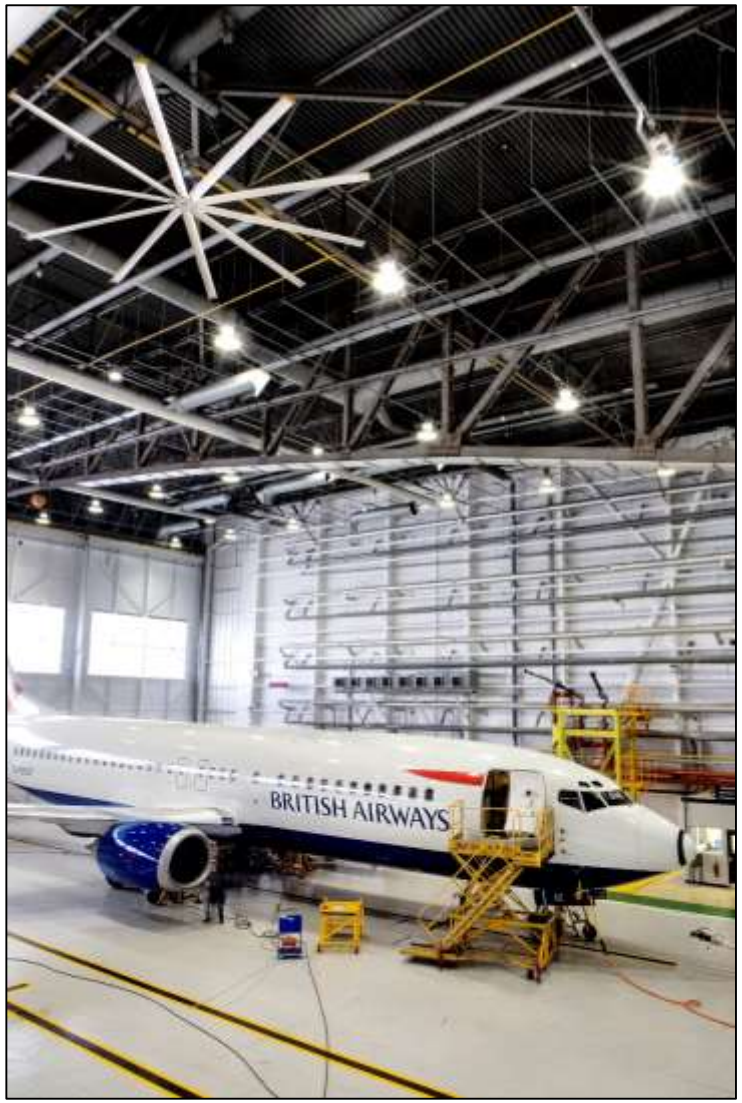
Locust Trace High School

Oakland Unified School District

Oakland Unified School District

Oakland Unified School District

British Airways' Hangar 6



Big Ass Solutions Testing Facility