ESC CLEANROOMS
ENVIRONMENTAL SYSTEMS CORPORATION

Energy Efficient Design Solutions
Low Pressure Drop Design

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Why Energy Efficient Design?

- Cleanrooms & Laboratories are energy intensive!
- They consume 3 to 10 times the energy of a typical office building.
- They are typically not speculative projects, and have informed owners who are more likely to invest in lifecycle cost reductions when informed.

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Why Energy Efficient Design?

- Reduced operating costs.
- Improved maintenance and reliability
- Enhanced community relations
- **GREEN IS GOOD**

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Why Energy Efficient Design?

- What is a quality design - installation?
- There are many factors that effect the decisions at initial design.
- Life Cycle of the systems, how long will they operate.
- Flexibility for future change.
- Financial considerations.

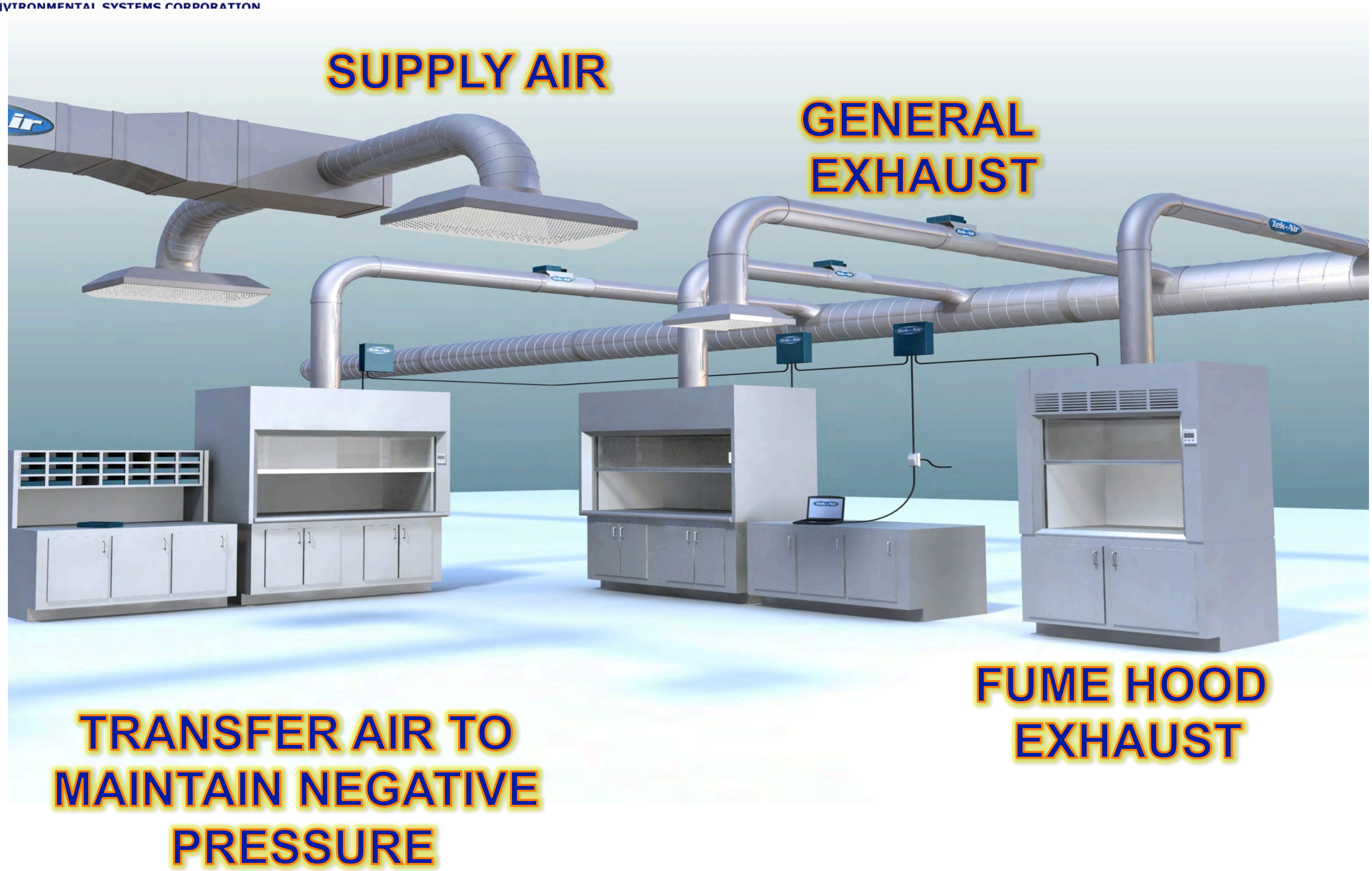
Energy Efficient Design through Integrated Project Delivery

- Owner / User Group
- Design Team – Architecture & Engineers
- Construction Team
- Environmental Health & Safety
- Facilities - Operations & Maintenance
- CFO

Cleanroom & Lab Control Priorities

1. Safety First - Worker Safety can not be compromised to avoid downstream liability
2. Product Quality Environment Requirements
3. Occupant Comfort - Associate comfort directly affects productivity and creativity
4. Energy Efficiency - This can be considered after the first three

Laboratory


SUPPLY AIR
GENERAL EXHAUST
FUME HOOD EXHAUST
TRANSFER AIR TO MAINTAIN NEGATIVE PRESSURE

Cleanroom


PROCESS
EXHAUST
RECIRCULATED
HEPA FILTERED AIR
MAKE UP AIR
PRESSURIZATION /
CONTAINMENT
AIR TRANSFER

REDUCE

- Exhaust
- Room Size
- Room Air Leakage
- Pressure Drop
- Simultaneous heating & cooling

INCREASE

- Fan System Efficiency
- Energy Recovery
- Temperature / Humidity Range
- Day lighting

Energy Efficient Design Concepts
REDUCE - Exhaust

- Reduction of Exhaust in initial design through optimization or operational considerations.
- Purchase of low flow energy efficient fume hoods, or VAV exhaust control.
- Remember to look at pressure drop when selecting VAV exhaust valves, as there are significant differences in valve design.

Energy Efficient Design Concepts
Ventilation Energy Use

To reduce energy use, we must change one of the variables in the equation below.

- REDUCE – Design CFM
- REDUCE – Airflow with Variable Volume
- REDUCE – System Air Pressure Drop
- INCREASE – Fan System Efficiency

$$\frac{\text{Airflow (CFM) X System Air Pressure Drop ("W.G.)}}{\text{6345 X Fan System Efficiency}} = \text{Fan Input Power (Brake HP)}$$

Energy Efficient Design Concepts
REDUCE – System Air Pressure Drop

- Air Handler Face Velocity Design
- Traditional coil face velocity is 500 Feet per Minute (FPM), which allows for a best first cost, not necessarily the best strategy for unit which operates 8,760 hours per year.
- Lowering Velocity to 250 FPM, reduces pressure drop by 75%, for the coil as well as filters and dampers.

Energy Efficient Design Concepts
REDUCE – System Air Pressure Drop

- The lower velocity also increases filter life
- Decreases bypass leakage through frames and media
- Improves aerodynamics through all elements

Energy Efficient Design Concepts
REDUCE – System Air Pressure Drop

- Duct Design – Short duct lengths – Minimum number of turns.
- Lower design velocities result in lower pressure drop.
- Recommended Maximum Industrial Supply Air Design is 3,000 FPM, which is 0.5” WC / 100’ of duct, reducing the FPM to 1,000 results in a pressure drop of 0.035” WC / 100’ of duct.

Energy Efficient Design Concepts
REDUCE – System Air Pressure Drop

- Velocity is the largest factor in pressure drop, however attention to design is critical.
- Long radius elbows reduce pressure drop.
- Proper design of turning vanes assists in lowering pressure drop.
- Better practice corresponds to eliminating the need for sound attenuation by appropriate duct design and layout.

Energy Efficient Design Concepts
REDUCE – System Air Pressure Drop

- **Fans with reduced differential pressure:**
- Require Lower Horsepower
- Have less vibration & noise
- **Resulting in:**
- Improved bearing life
- Smaller electrical components
- Reduced air leakage at doors

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Energy Efficient Design Concepts

- Look at Filter Pressure Drop
- Become more critical as efficiency increases

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Energy Efficient Design Concepts
REDUCE – System Air Pressure Drop

Component	Standard	Better	Best
Air Handler Coil Face Velocity	500	400	**300**
AHU Pressure Drop	2.7” W.G.	1.7” W.G.	**1.0” W.G.**
Energy Recovery	1.0” W.G.	0.6” W.G.	**0.35” W.G.**
VAV Control Devices	NA	0.6 – 0.3”W.G.	**0.1” W.G.**
SA / EA Pressure Drop	4.5” W.G.	2.25” W.G.	**1.1” W.G.**
Noise Control Silencers	1.0” W.G.	0.25” W.G.	**0.0” W.G.**
Total	9.2” W.G.	5.3” W.G.	**2.55” W.G.**
Approximate Fan Power Requirement (W/CFM)	2	1.2	**0.6**

LABS FOR THE 21ST CENTURY®

Energy Efficient Design Concepts

- A 100,000 CFM system and a reduction in pressure drop of 1½" WC is a savings of $450,000 over a twenty year life cycle @ $0.10 / kWH.

Resources

- ISPE - Baseline Guides
  Communities of Practice
  & So much More - www.ispe.org
- IEST - Recommended Practices & ISO Documents www.iest.org
- ASHRAE – Handbooks - www.ashrae.org
- Labs for the 21st Century - www.labs21century.gov
- International Institute for Sustainable Laboratories
  www.i2sl.org

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Energy Efficient Design Concepts

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ESC - Founded in 1983
Background in Industrial & Critical Environments
Temperature Humidity Control & Mechanical Systems

ESC CLEANROOMS
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ESC CRITICAL ENVIRONMENTS
ENVIRONMENTAL SYSTEMS CORPORATION

- **Cleanroom Design & Construction**
- **NO COMPROMISE SOLUTIONS**
  Critical HVAC/R System Design & Manufacturing

ALUMA1™
Modular Cleanroom Wall System

Tek-Air

Complementary Core Competencies

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