

# Toward Green Cleanroom Systems: Energy-efficient Fan-filter Units

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# Presentation Outline

- **Introduction**
- **Purposes**
- **Approaches**
- **Results**
- **Conclusions**
- **Recommendations**



# Energy-efficient Fan-filter Units

- **Introduction**

- Green cleanroom systems

- Challenges and benefits

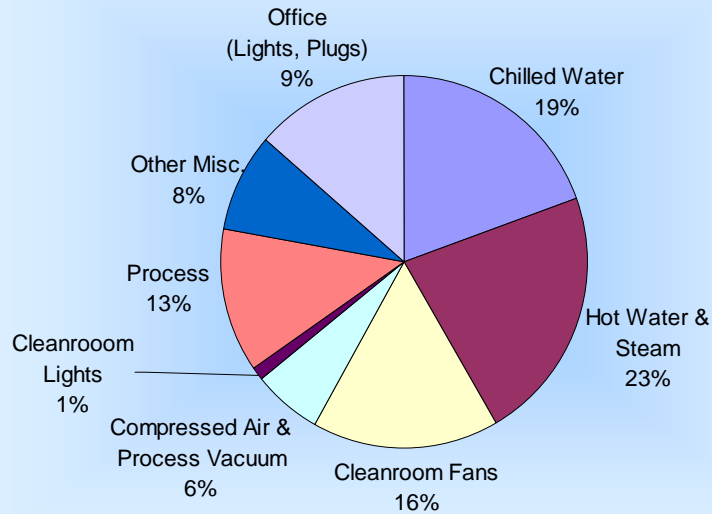
- Cleanroom energy performance

- Applications of fan-filter unit (FFU)
- Opportunities

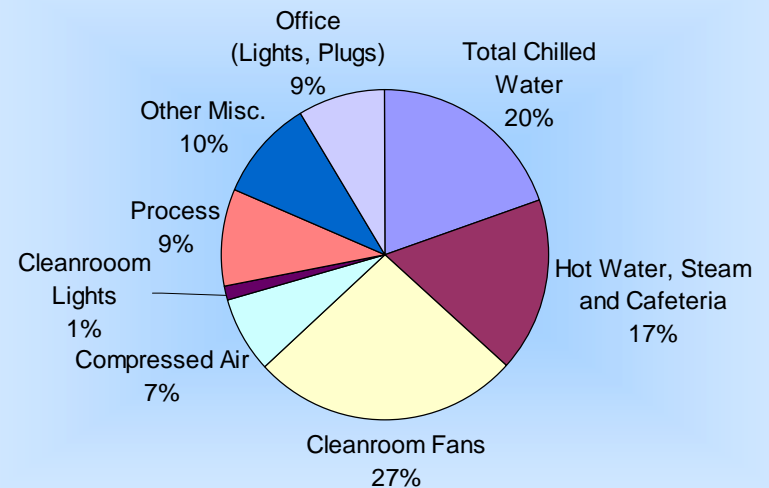


# Cleanroom Energy Use

## Facility 1



## Facility 2



# Energy-efficient Fan-filter Units

- **Purposes**

- Introduce the FFU testing standard and its integration with IEST Recommended Practice
- Evaluate energy performance of 20 FFUs tested at ITRI
  - Present laboratory-testing results
  - Compare unit performance



# Energy-efficient Fan-filter Units

- **Approaches**

- **Principle**

- Laboratory tests to obtain accurate measurements under various operating conditions

- **Control and Method**

- Ancillary fan and damper to control airflow rates across the FFU tested

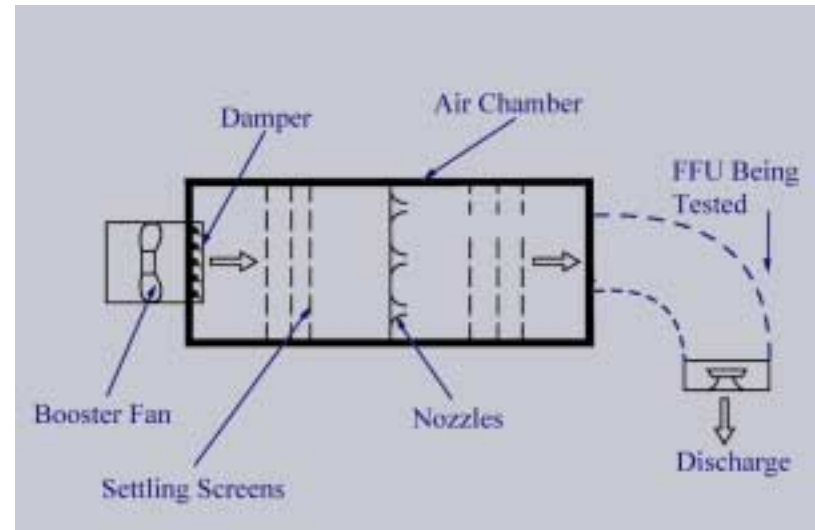
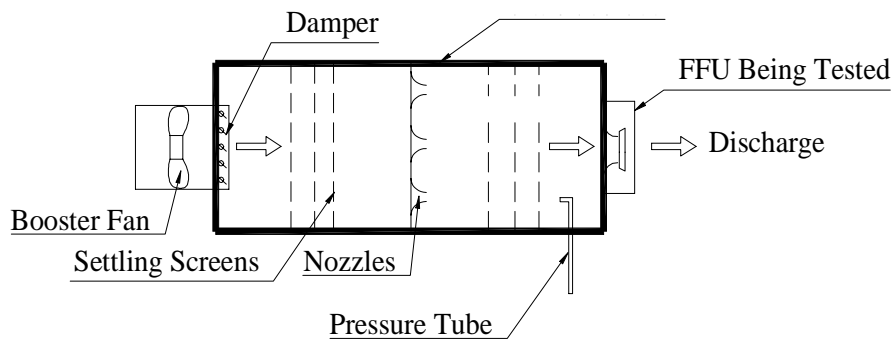
- **Device Layout**

- FFU to be mounted horizontally or vertically on the exit of the air chamber



# Energy-efficient Fan-filter Units

- **Approaches – Device Layout**



# Energy-efficient Fan-filter Units

- **Approaches - Partnerships**

- Industrial Technology Research Institute (ITRI)
- Institute of Environmental Sciences and Technology (IEST)
- Air Movement and Control Association International (AMCA)
- SEMATECH International
- Suppliers and users
- CA Energy Commission and utility companies





# Energy-efficient Fan-filter Units

- **Results**

- Performance Curves

- Airflow, pressure, total pressure efficiency

- Energy Performance Index (EPI)

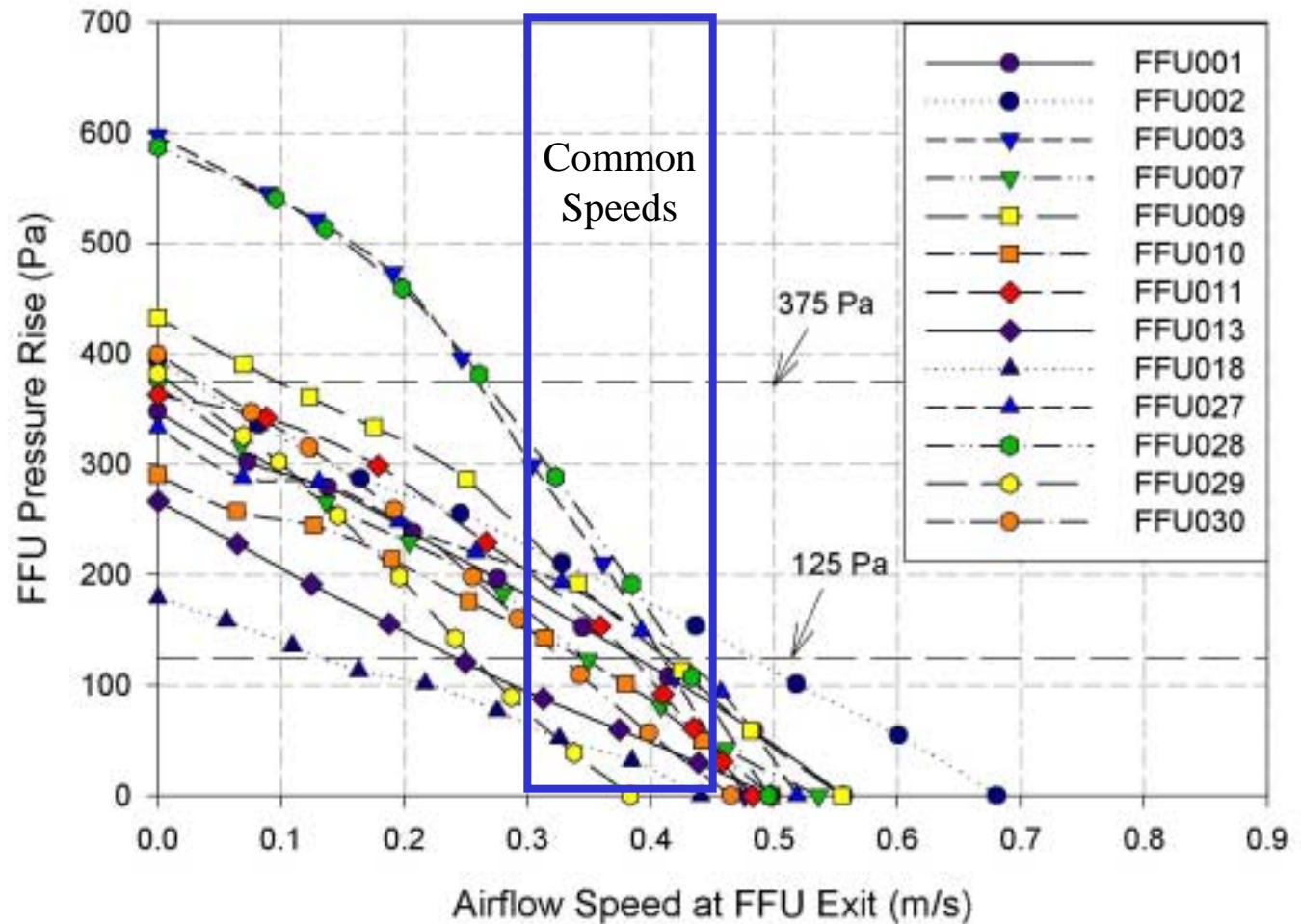
- Power usage normalized by the airflow rate through an FFU
- A lower EPI value indicates higher energy efficiency

- 4'x2' and 4'x4' FFUs



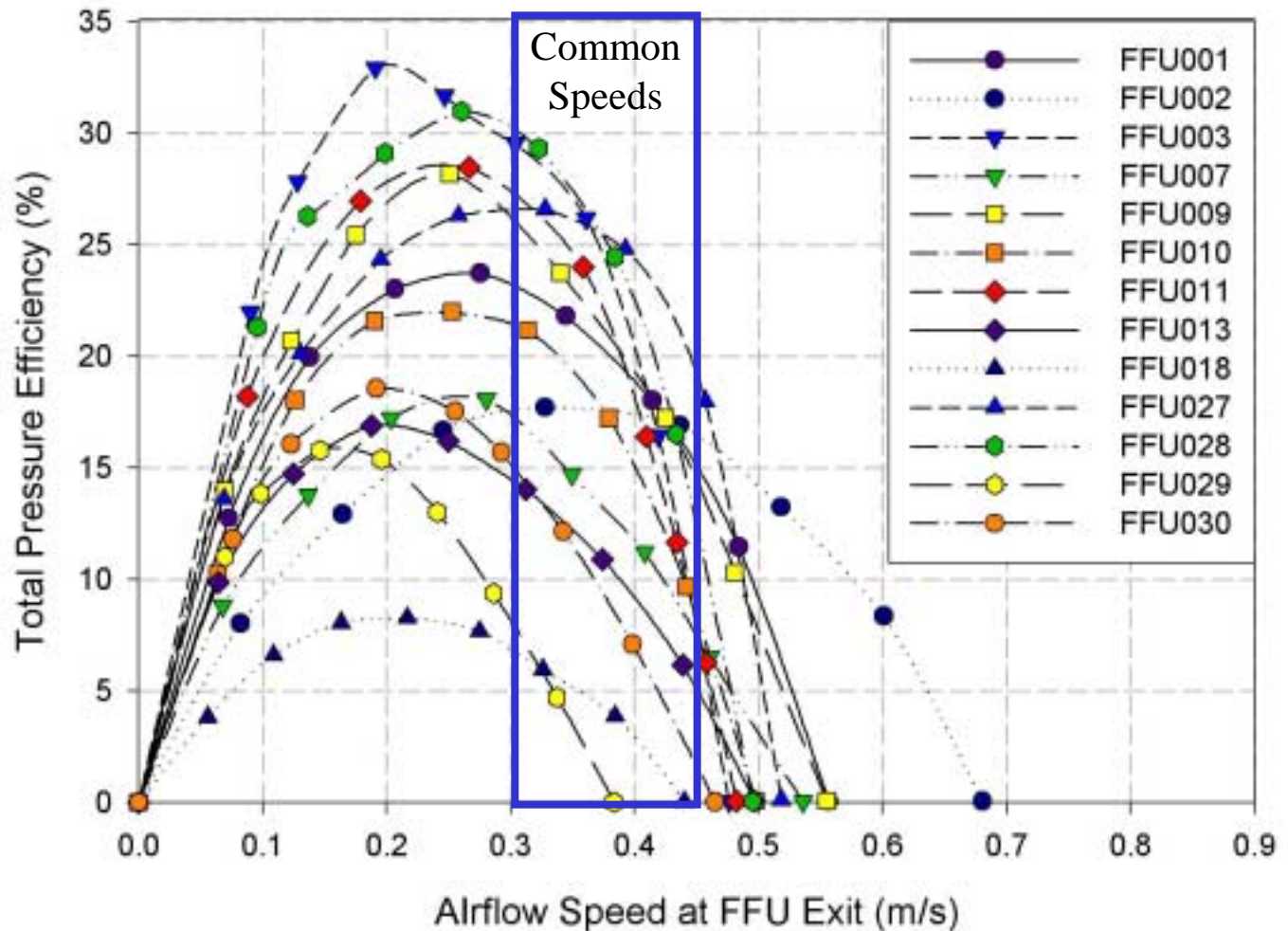
# Energy-efficient Fan-filter Units

4'x2'



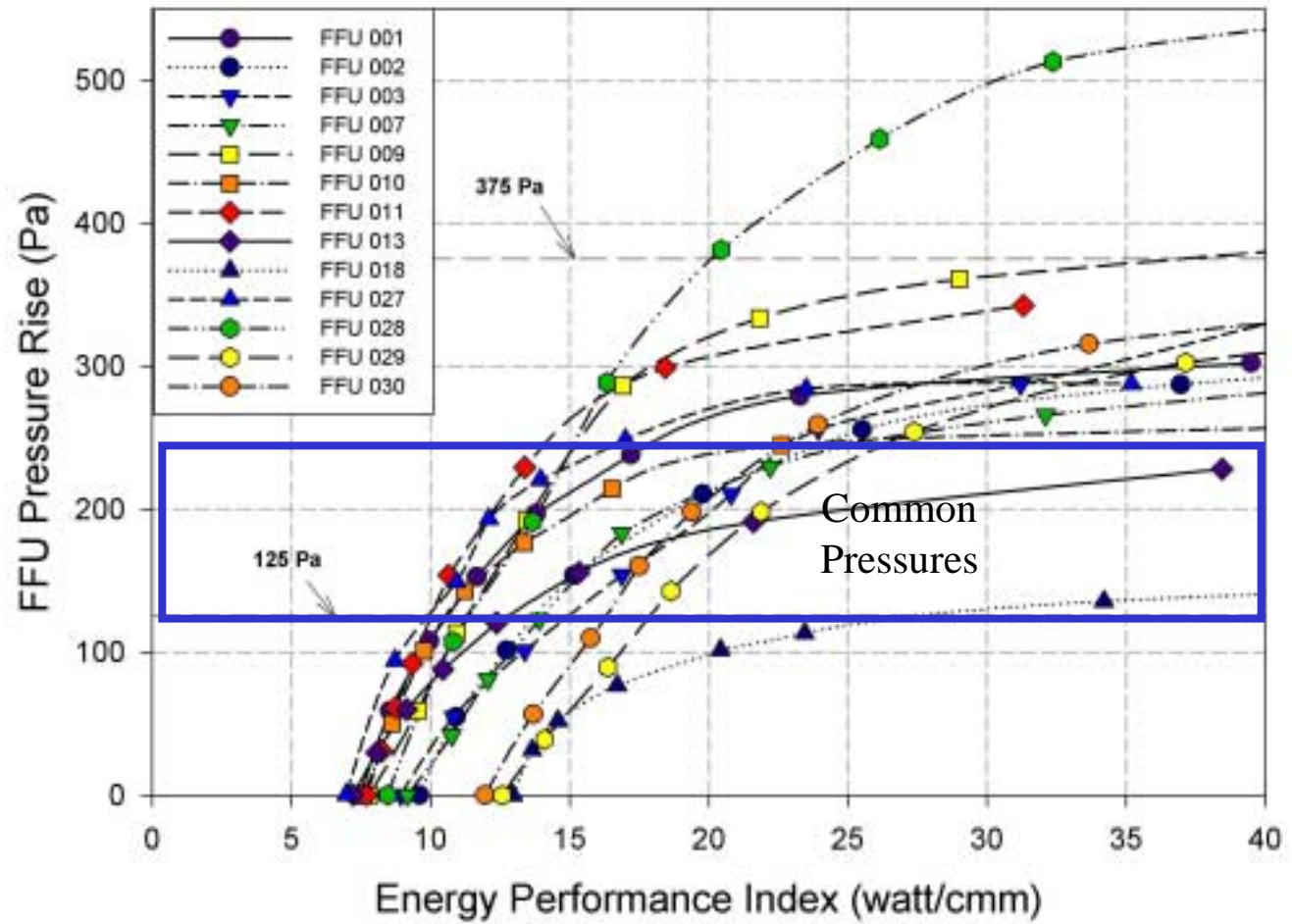
# Energy-efficient Fan-filter Units

4'x2'



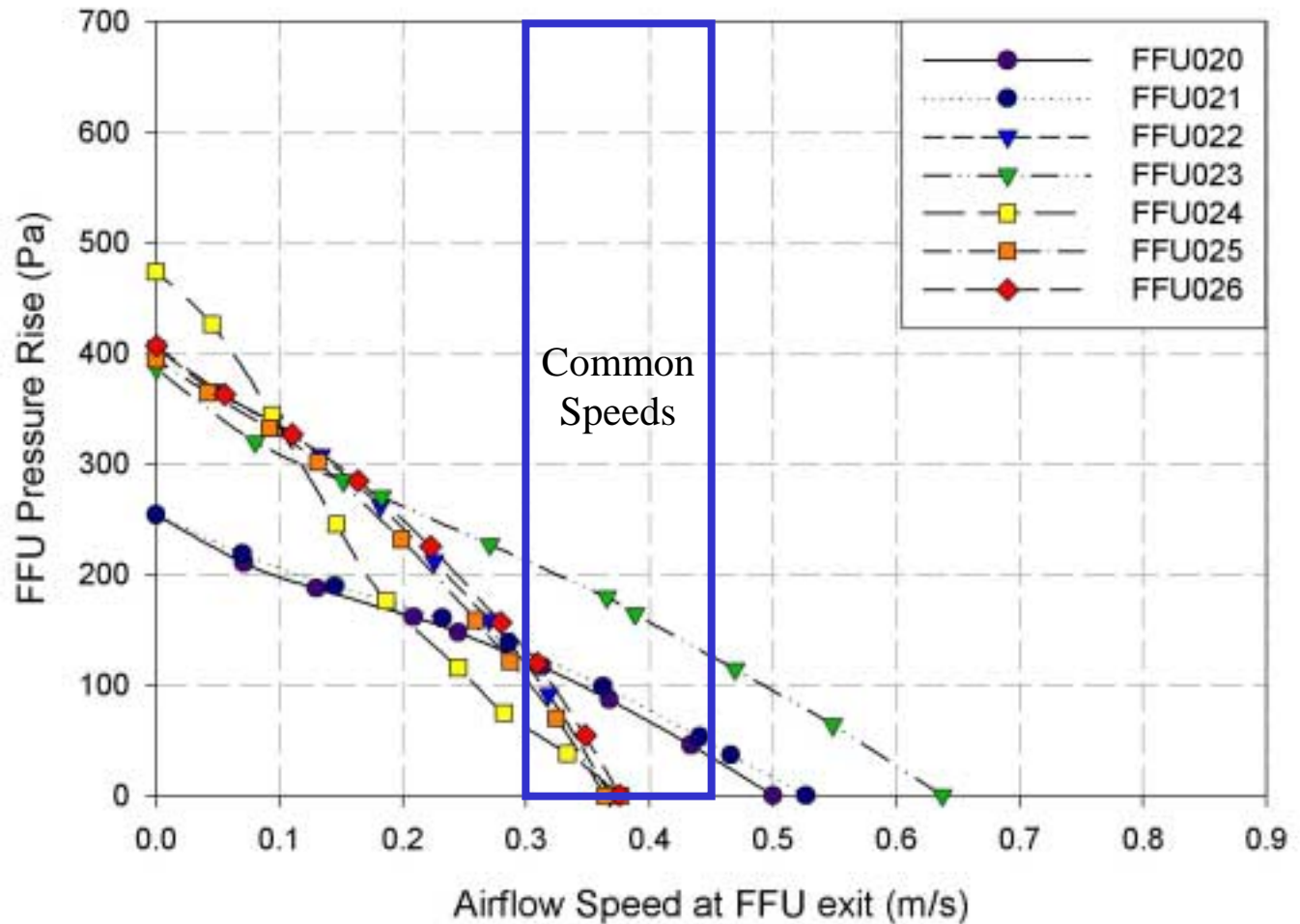
# Energy-efficient Fan-filter Units

4'x2'



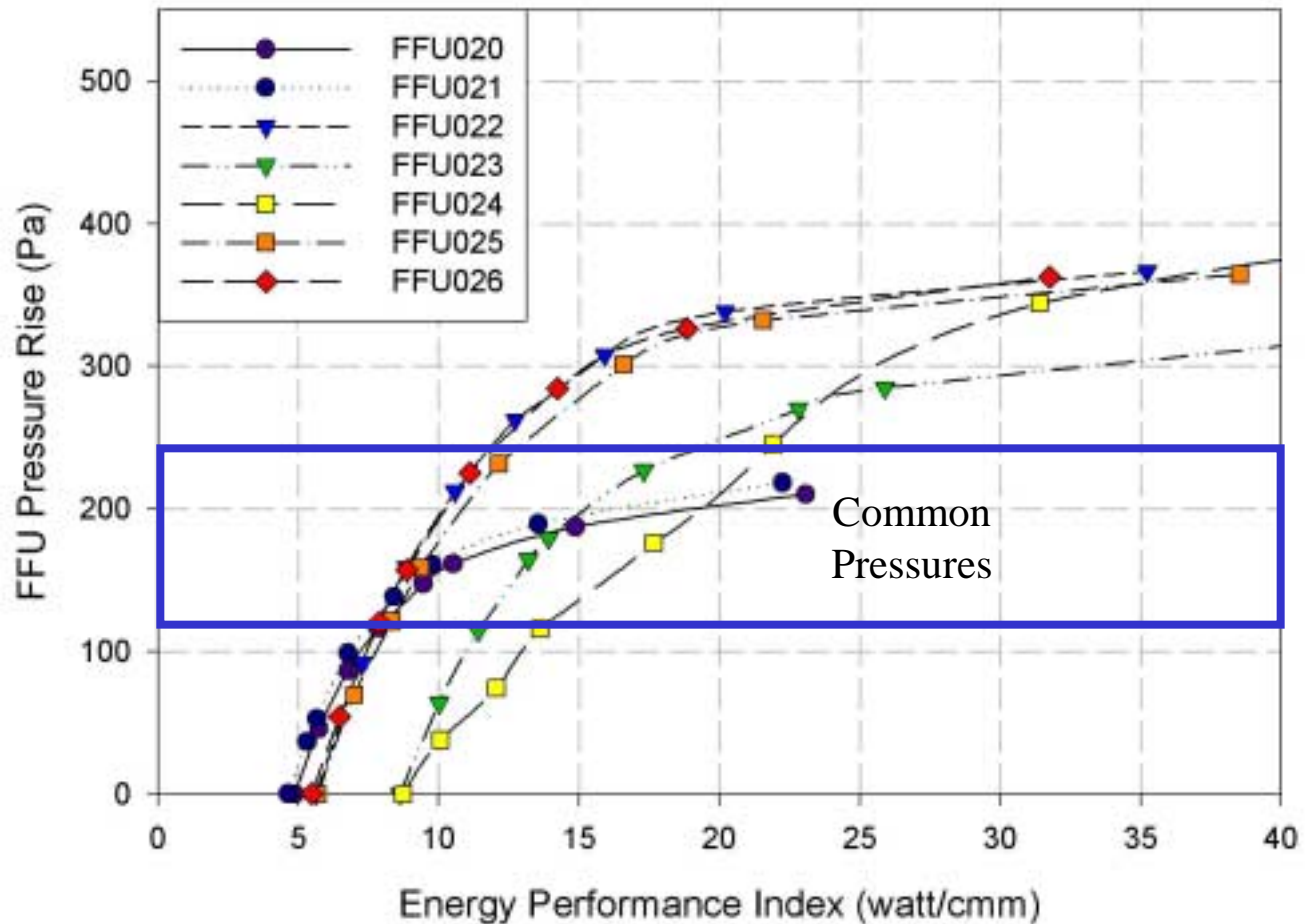
# Energy-efficient Fan-filter Units

4'x4'



# Energy-efficient Fan-filter Units

4'x4'



# Energy-efficient Fan-filter Units

- **Conclusions**

- Use of the procedure

- Provides comparable performance information
- Identifies most efficient and functional FFUs

- Benefits to the industry

- IEST RP development for FFU testing guideline
- Utility incentive programs for “greener” FFU systems





# Energy-efficient Fan-filter Units

- **Recommendations**

- Test additional FFUs
- Improve FFU designs such as motor types and fan wheels
- Develop baseline information for utility incentive programs to encourage using efficient FFUs
- Integrate LBNL procedure into IEST Recommended Practice guideline and establish an international standard

