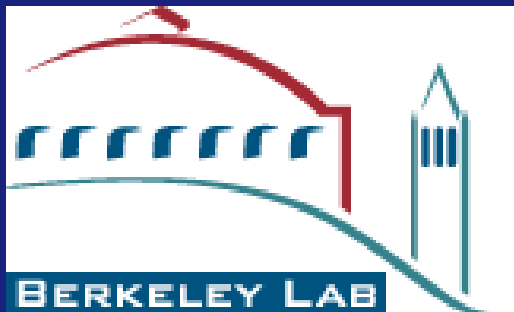


ASHRAE Winter Meeting

Energy Reduction Opportunities in Pharmaceutical Clean Rooms



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January, 2006

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Overview

- ◆ How we looked for efficiency opportunities
- ◆ Using benchmarking process to identify 'best practices'
- ◆ Example of a best practice dilemma
- ◆ What's next - environmental performance criteria for cleanrooms

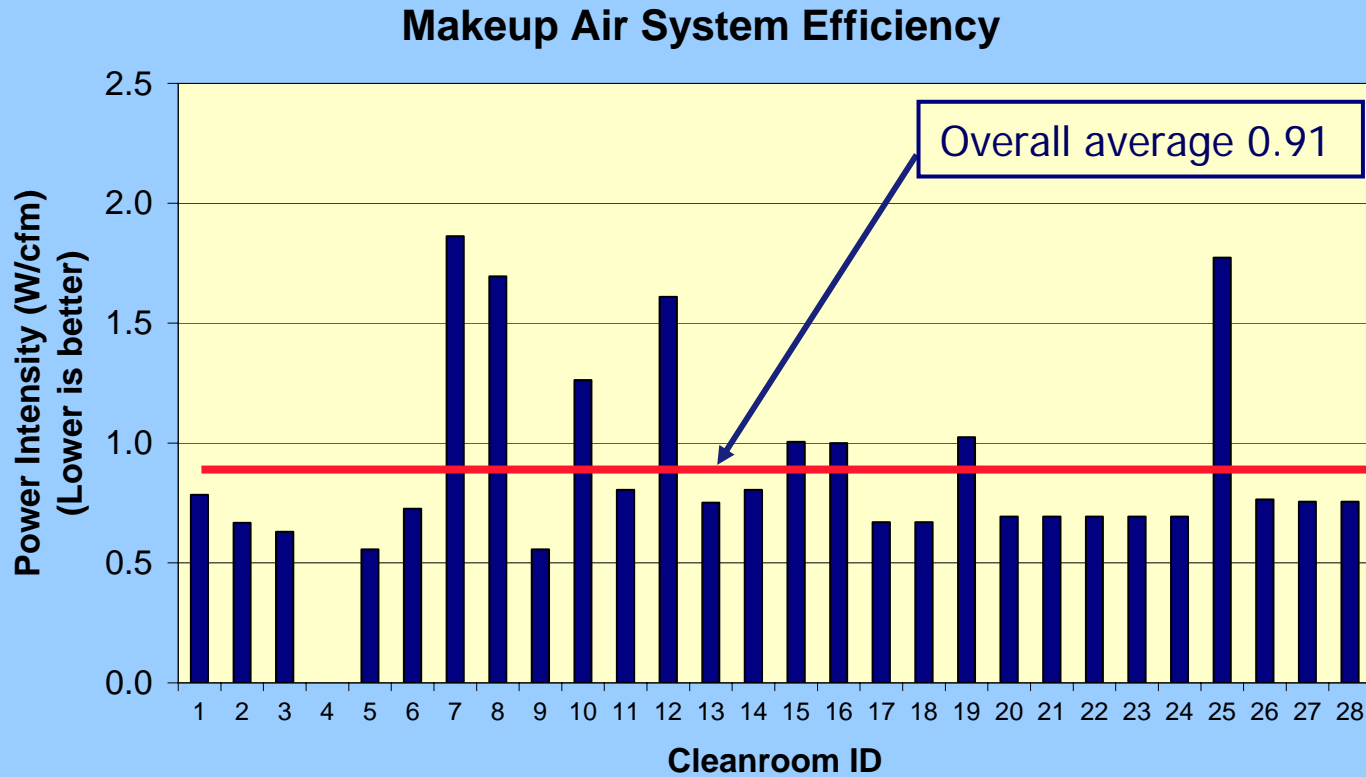
Finding efficiency opportunities

- ◆ Opportunities unique to cleanrooms
- ◆ Cross-cutting opportunities for any facility
- ◆ Opportunities unique to process
(not addressed here)

Using benchmarking to point to best practices

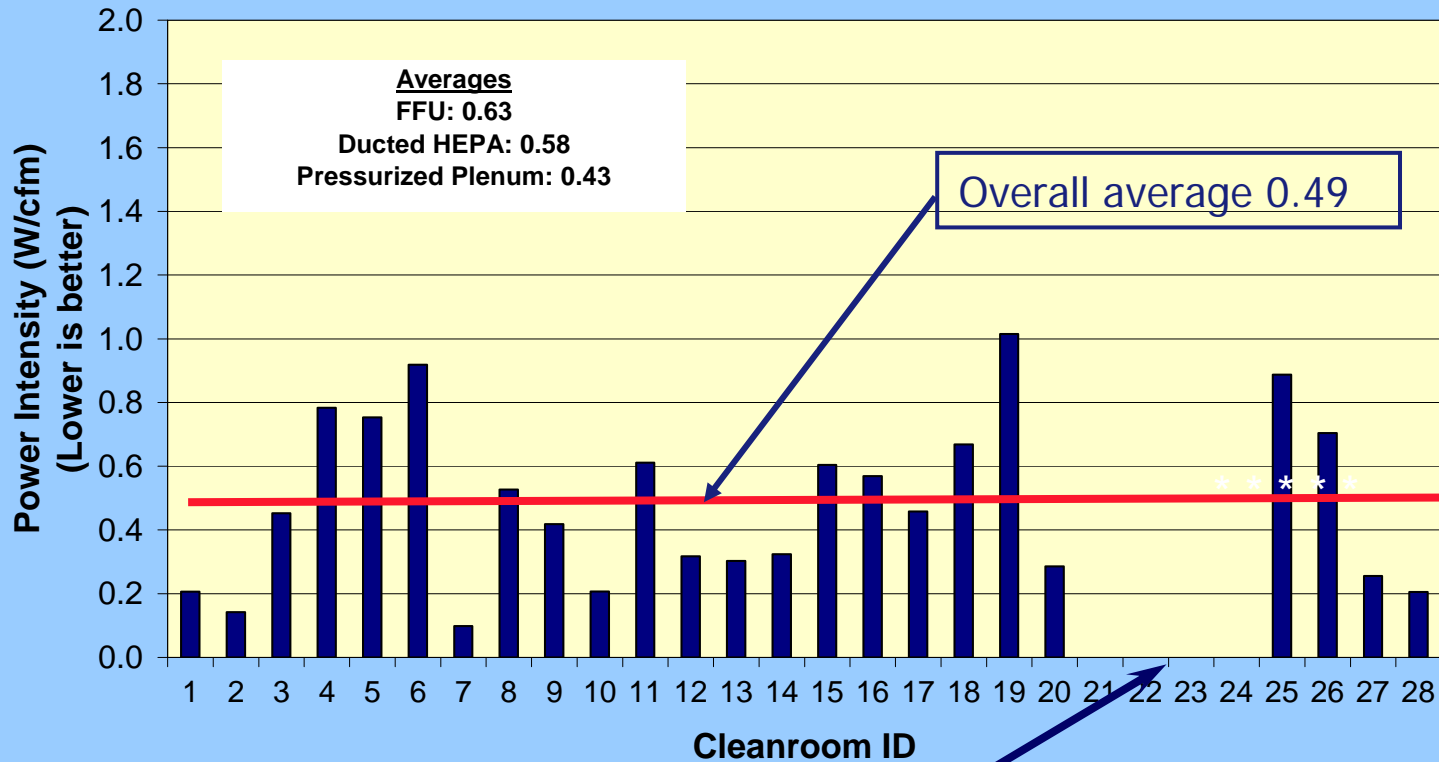
- ◆ Better performing systems can be identified
- ◆ Apples to apples system performance.
e.g.:
 - kW/ton
 - kW/cfm
 - kW/gpm
 - air change rate
- ◆ No impact on production

Make-up air system benchmarks



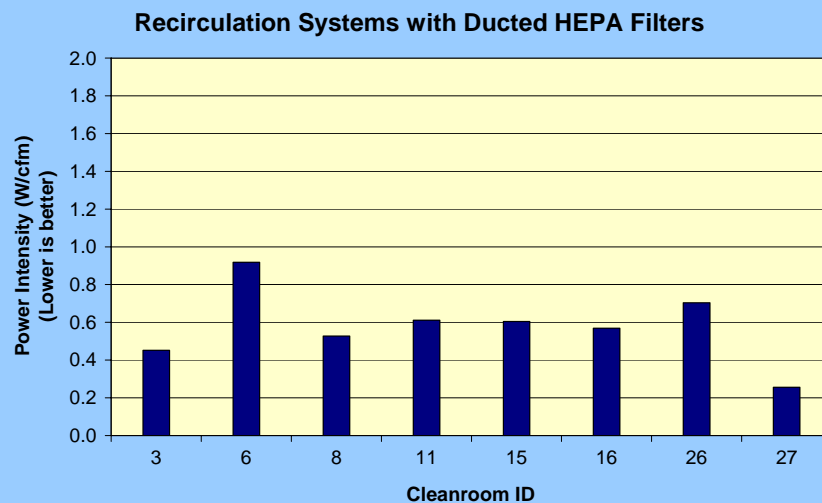
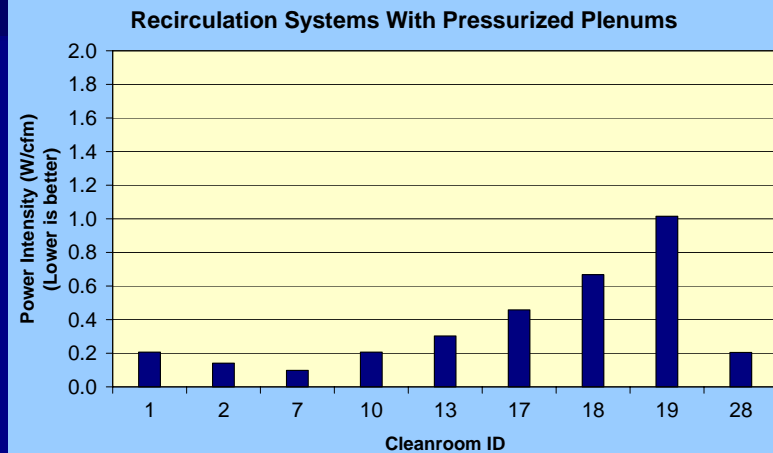
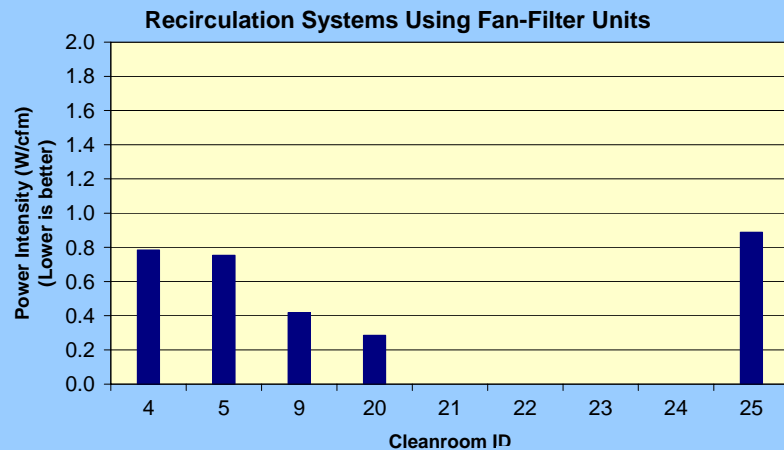
Recirculation system benchmarks

Recirculation System Efficiency



* Recirculation efficiency could not be measured for 21-24. System consisted of central air handler and fan-filter units cascading through four rooms.

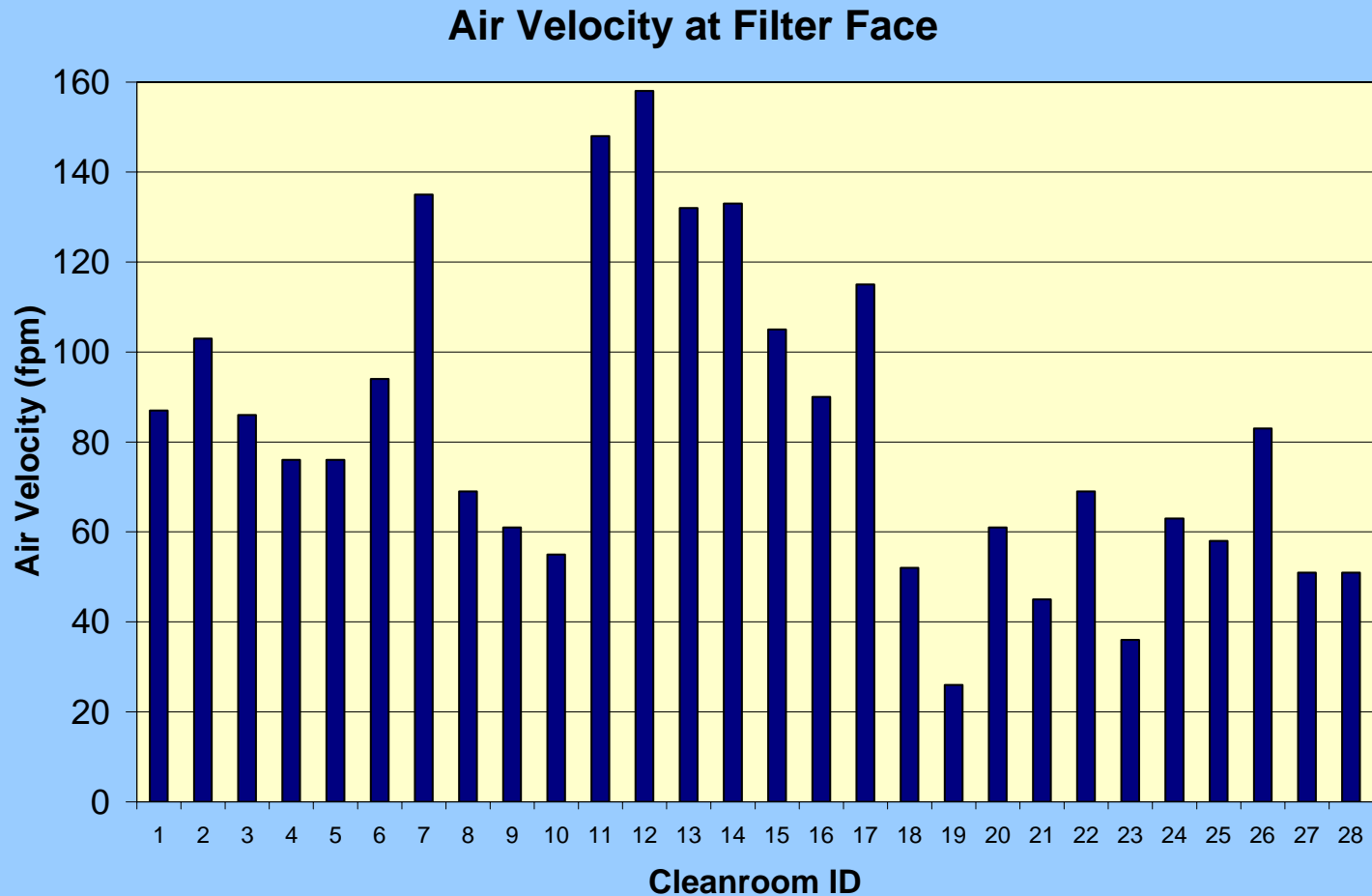
Examining similar systems



Data mining

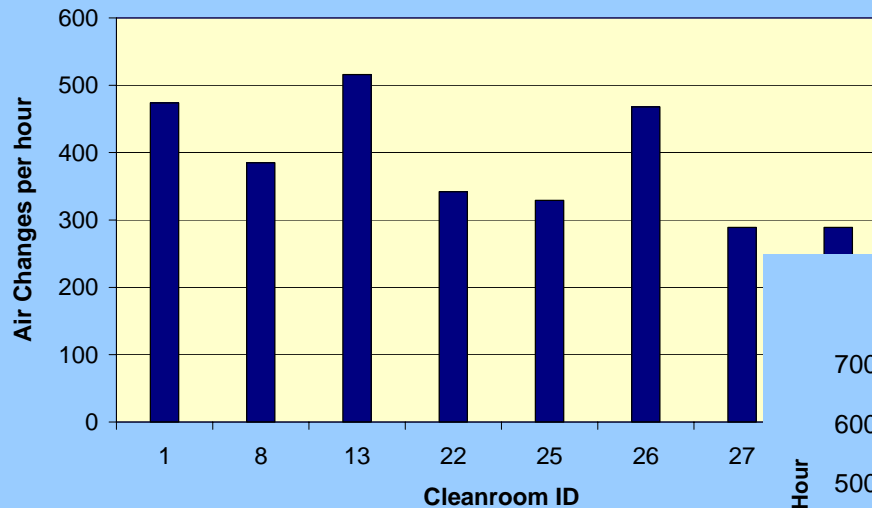
- ◆ Look at other indicators
- ◆ How can similar processes be supported with less energy
- ◆ Examples:
 - Velocities
 - Air Change rates
 - Filter coverage

Air velocity – large variations

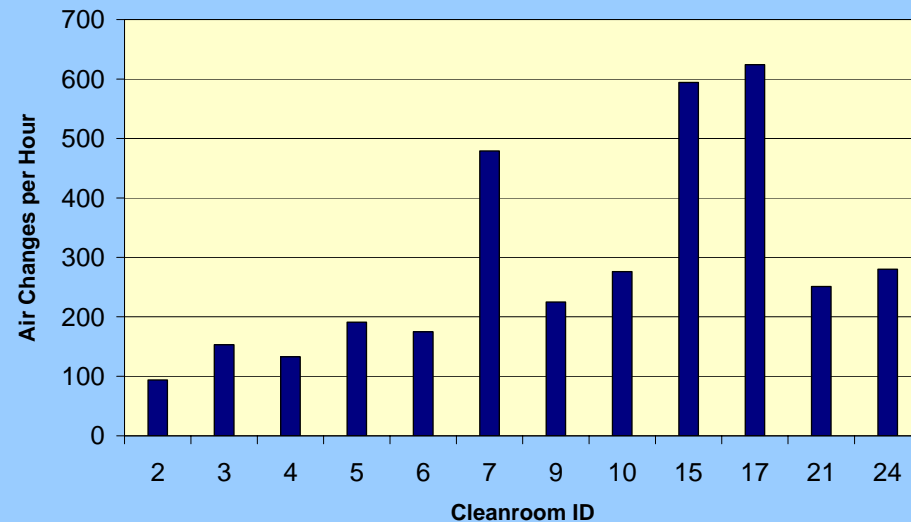


Air change rates by cleanroom class – again, large variations were found

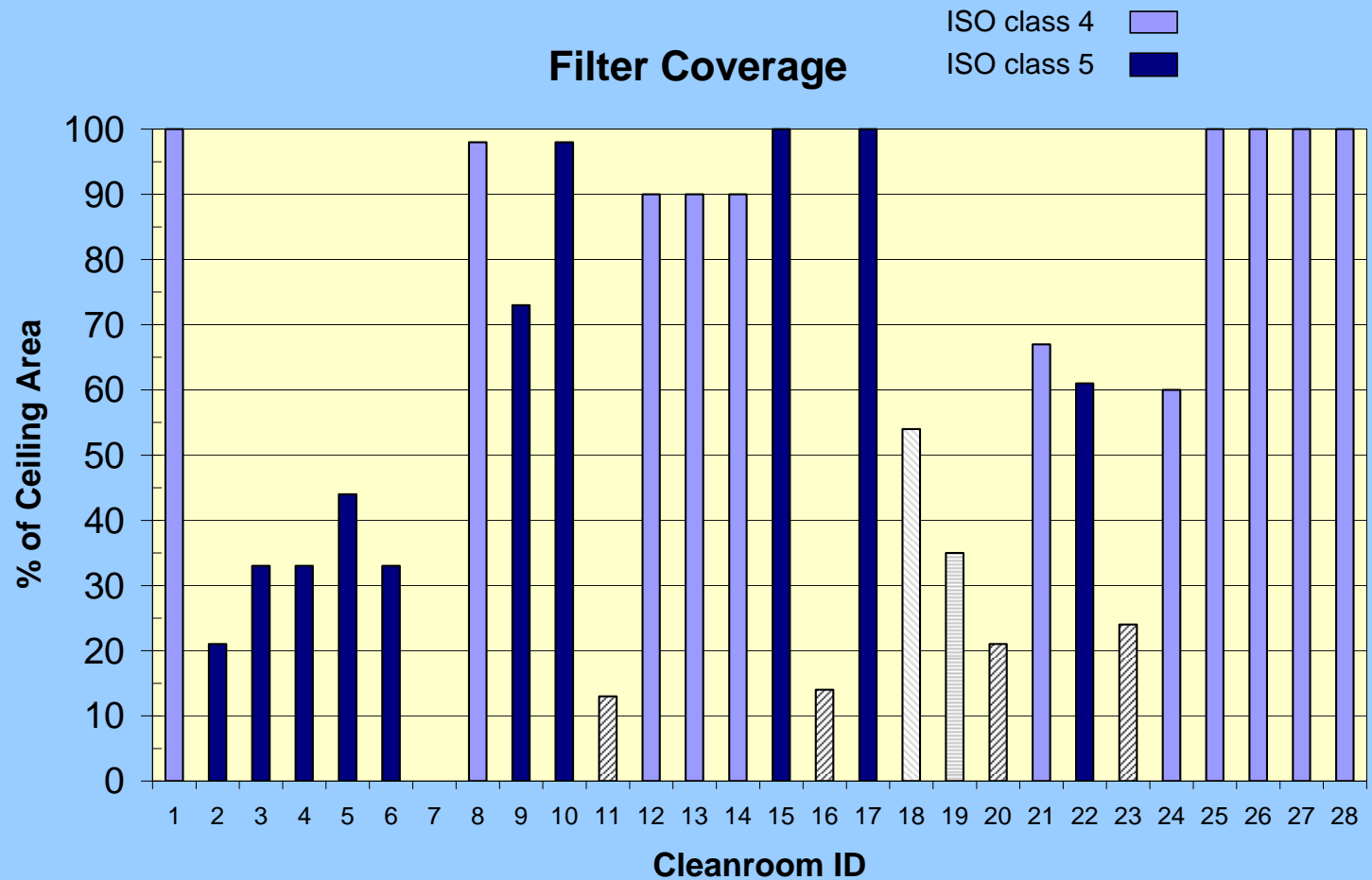
ISO-Class 4 Cleanrooms



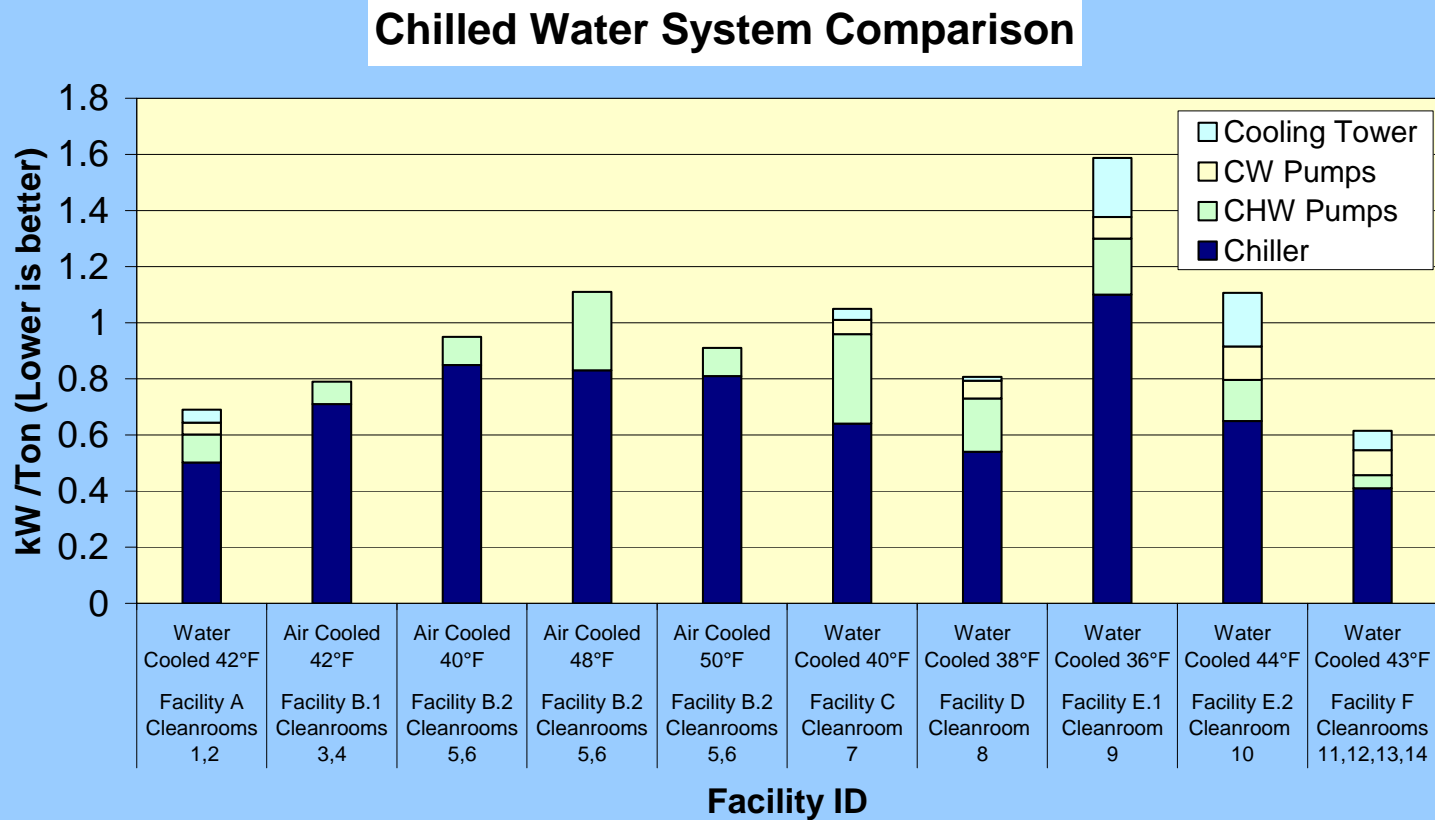
ISO Class 5 Cleanrooms



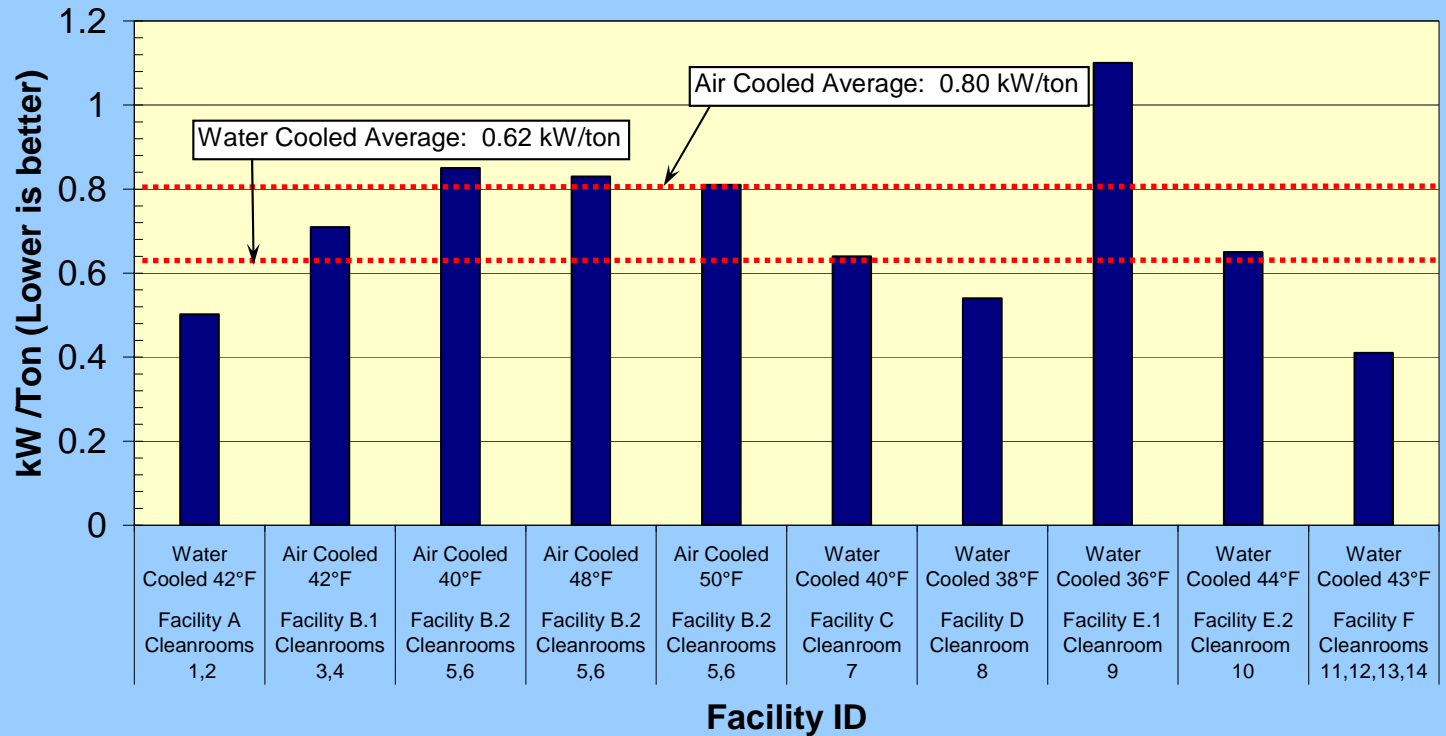
Ceiling filter coverage – an art, not a science



Chilled water systems – similar variations can be noted

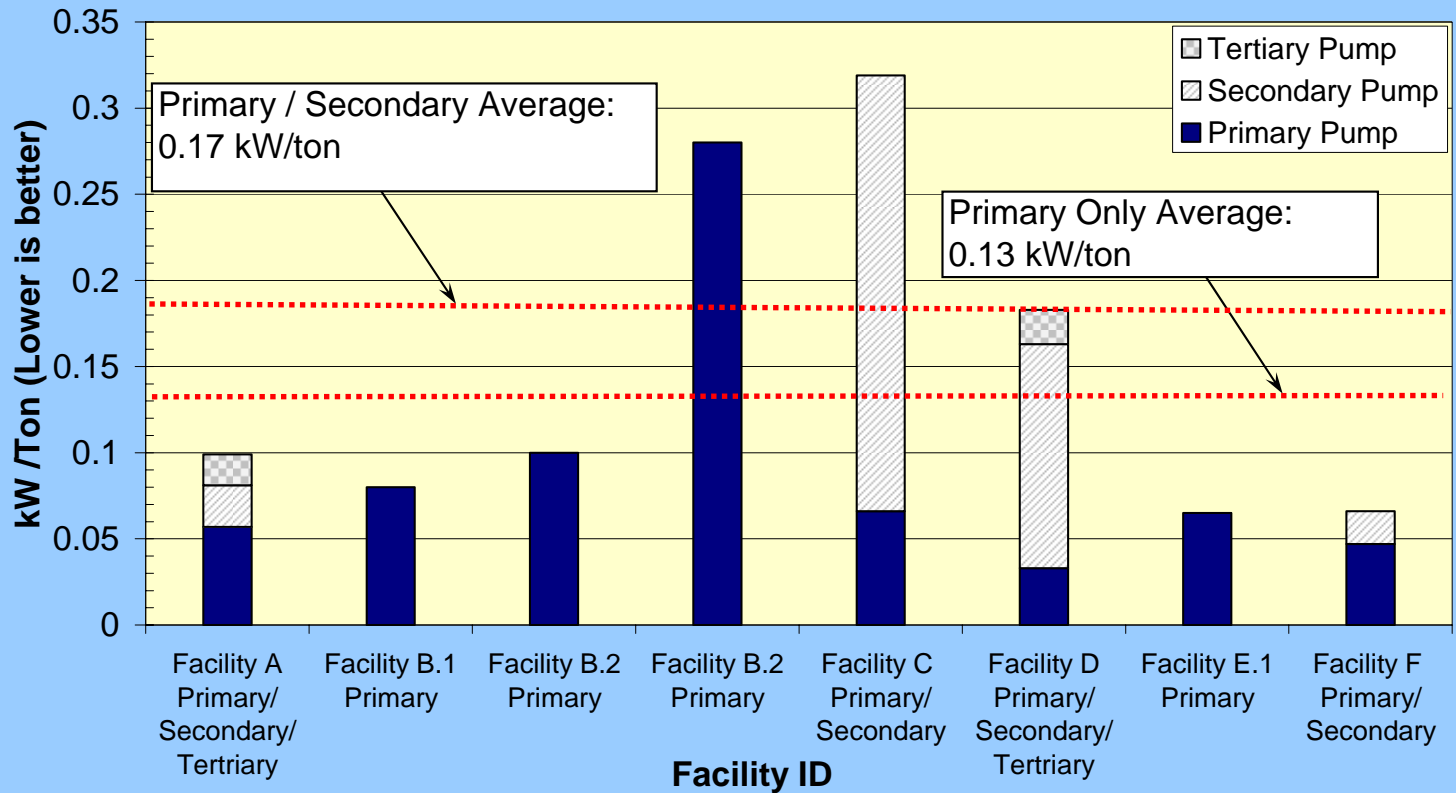


Air Cooled vs. Water Cooled Chillers



Types of equipment can be compared

Chilled Water Pumping Comparison



Pumping systems can be compared

Examining the data pointed us to best practices. Best practices were identified and descriptions prepared. Topics were organized by:

- ◆ HVAC – air side
- ◆ HVAC – water side
- ◆ Electrical systems
- ◆ Process systems
- ◆ Cross-cutting



HVAC - air systems topics

- ◆ Low pressure drop systems
- ◆ Recirculation system type
- ◆ Air recirculation rates
- ◆ Demand controlled filtration
- ◆ Fan efficiency
- ◆ Fan-filter efficiency
- ◆ Exhaust optimization



HVAC - water systems topics

- ◆ Variable speed chillers
- ◆ Cooling tower/chilled plant controls
- ◆ Cooling tower/condenser optimization
- ◆ Free cooling
- ◆ Variable speed pumping
- ◆ Dual temperature cooling loops

Opportunities not unique to cleanrooms

- ◆ Use of high efficiency motors
- ◆ Optimization of steam systems
- ◆ Use of variable speed drives
- ◆ “Right sizing” systems
- ◆ Energy efficient lighting
- ◆ Heat recovery
- ◆ Commissioning/maintenance/operations

Challenge for Pharmaceutical cleanrooms

- ◆ Lower air change rates have been shown to be acceptable
- ◆ Industry reluctant to change since previous cGMP designs were accepted with higher air flows.
- ◆ Regulatory process allows for alternative solutions
- ◆ But the cost and risk are higher.

What's next – Environmental performance criteria for cleanrooms

- ◆ Point based system to supplement existing point based systems
- ◆ Possible additional credits or heavier weighting of environmental criteria
- ◆ Appropriate for energy intensive cleanrooms
- ◆ New construction first, then retrofit

Environmental performance criteria for cleanrooms

Possible areas:

- ◆ Reduced air change rates
- ◆ Modeling for energy and airflow
- ◆ Energy efficient UPS
- ◆ Limited use of reheat
- ◆ Efficient chilled water plant
- ◆ Low pressure drop design

Thank You.

Questions???