Optimizing Energy Efficiency and First Cost in Semi-conductor Manufacturing Cleanrooms

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A key concern during every new fab project is lowering first cost and reducing energy consumption. The following ideas have been implemented or studied. We attack both first cost and energy reduction using a net present cost model.

Ideas fall into the following categories -

Win-win (reduce energy usage, favorable life cycle cost):

- Heat recovery from chiller condenser loop and air compressors for virtually all heating requirements
- High pressure (1000 psig) atomizing humidifier in lieu of either steam or air atomized, low pressure humidifier
- Reduced filter coverage and air flow in the clean bays as low as 50% in bay/ chase fabs (28% overall cleanroom average) and 33% in flow through fabs
- Optimized air velocity through outside air handlers
- Improved mixing of outside air with cleanroom recirculation air to minimize reheat
- Variable speed control on all pumps and fans

Win-lose (favorable life cycle cost, use more energy):

- Pushing velocity in secondary cooling systems larger than 20 inch diameter
- Single chilled water system at 39F vs. two at 39 degF and 44 degF
- Increased velocity up to 3000 ft/min for exhaust duct mains and up to 2100 ft/min for laterals
- Mix of rotary screw and centrifugal air compressors to neutralize turn-down limitations of centrifugal compressors
- Fan filter units rather than recirculation air handlers

Value engineering ideas (no energy implications):

- Increased use of grooved and crimped pipe connectors for hydronic systems.
- Measuring tool power consumption; driving tool suppliers to provide accurate nameplate data, eliminating over sizing electrical distribution.

The paper will provide details.