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# Modular Cleanrooms Offer "Green" Benefits

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High levels of environmental control have long driven design, purchasing, and operational decisions for cleanrooms. Today, sustainability issues - from energy efficiency to materials use to long-term adaptability - are also beginning to influence the conversation between those who operate controlled environments and those who design, build, and install them. Modular cleanrooms offer some distinct benefits for those trying to create more sustainable environments.

Though the U.S. lags in green building policy behind multiple Asian and European nations<sup>1</sup>, change is in the air. A major revision of LEED, the influential voluntary standard for sustainable buildings, is scheduled for release this year, with particular attention to environmental aspects of materials.<sup>2</sup> The American Society of Heating, Refrigerating and Air Conditioning Engineers recently released its first standard for high-performance buildings, not only addressing energy efficiency (a key aspect of existing ASHRAE standards) but also site sustainability, water, indoor environmental quality, materials, resources, and (eventually) possibly lighting.<sup>3</sup> As with LEED, ASHRAE standards are voluntary, but may become mandatory as they are referenced in building codes.

**Proper sealing of windows, doors and other penetrations may be more precise with modular construction, positively affecting consistent pressure and thus the efficiency of the HVAC system.**

***Photo: United Partition Systems***

Controlled environments are inherently energy- and resource-intensive. Achieving high levels



of cleanliness typically involves a large amount of infrastructure to ensure proper airflow (amount and direction), filtration, pressurization, temperature, and humidity. Air change rates (how many times per hour all the air in the space is replaced) are typically high (15 to 100 or more, compared with less than 10 for a science lab).

Mechanical and utility infrastructure for a complex cleanroom may require both under-floor and walkable ceiling space. Special attention must be paid to finishes and to the construction process (for instance, sealing penetrations). These features impact the "green footprint" of a cleanroom, since intensive construction types are less sustainable to build and operate.

## Materials and waste

Compared with permanent structures, modular cleanrooms tend to be lightweight. Frame-and-panel systems are generally less costly to transport than lumber, drywall, and concrete blocks, reducing their overall energy footprint. Panels are tailored to client needs, and both framework and panels may include a high percentage of recycled content.

"As more of our clients are focusing on sustainability objectives, we are focusing more of our product development efforts on modular systems that utilize less material. For instance, our new 2 in.-thick P2000 wall system has significantly less aluminum, and requires less energy to transport, yet still integrates with our pre-engineered 3 in.-thick wall systems," says Wayne McGee, president of PortaFab Modular Building Systems, Chesterfield, Mo.

Because a large amount of fabrication takes place at the factory, modular cleanrooms also offer relieve building owners of some waste-management headaches. In a renovation scenario, components such as aluminum frames may also be easier to recycle than conventional construction waste.

Traditional "stick-built" cleanrooms may always be required for large manufacturing operations, or labs doing extreme levels of nanotechnology, metrology, and related research. However, economic and technological trends are pushing building owners to become more nimble, and consider whether portable spaces can adequately meet changing objectives. A modular room can address a need within a larger facility operating at a lower level of cleanliness, or make it possible to adapt an existing facility that was not created to accommodate cleanrooms. Either way, modular construction can offer "green" advantages.

## Fitting the space to the need

One of the most significant sustainable aspects of modular cleanroom construction is its ability to help owners avoid overbuilding. Organizations may be tempted to create overly sophisticated facilities at the outset, worried that trends in business or technology will require more stringent classifications down the line. Overbuilt facilities are obviously more resource-intensive over time.

Organizations that recognize how modular construction can be part of their "tool kit" can feel more comfortable about their ability to meet future needs. Advancements in portable HVAC (heating/ventilation/air conditioning) equipment, filtration, and monitoring have allowed vendors to create modular facilities with high degrees of cleanliness. Many vendors offer cleanrooms up to Class 10 (ISO 4), with some providing systems that meet Class 1 (ISO 3) requirements.

"The energy costs involved in controlling air quality in a large area can be significant. Modular systems allow designers to utilize smaller cleanrooms knowing that they can be easily expanded in the future," says McGee.

### **Life-cycle flexibility**

Modular cleanrooms offer built-in life-cycle advantages. An axiom of green design is that it's more sustainable to reuse an existing building – which represents a considerable amount of "embodied" energy – than to build a new one. Often (not always), renovation is a greener choice than new construction.



**Modular cleanrooms can be configured in virtually any footprint or height, and offer significant sustainability benefits. Photo: United Partition Systems**

Panel systems take this concept one step further, allowing owners to change out panel types, reorganize doors and windows, and reconfigure space as needs change. "Prefabricated panelized wall systems allow modular rooms to be modified, expanded, or relocated with minimal expense or downtime," says Bryan Leisure, environmental applications specialist at United Partition Systems

Inc., Ontario, Calif. "Systems are almost 100% reusable."

Many building owners are familiar with portable enclosures' tax advantages, speed-of-completion, and reduced disruption associated with renovation. As concern about climate change is added to concern for the bottom line – with a growing likelihood for regulatory pressure – owners will increasingly prioritize sustainability. Modular structures can be a key tool for creating controlled environments that are not just clean, but also green.

## References

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3. American Society of Heating, Refrigerating and Air Conditioning Engineers, ANSI/ASHRAE/USGBC/IES Standard 189.1-2011: Standard for the Design of High-Performance, Green Buildings Except Low-Rise Residential Buildings. Retrieved Dec. 12, 2012, <http://bit.ly/UBIz4E>.

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