

## Modular Data Centers: Alternative Solutions to Traditional Designs



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*Abstract: The following white paper is part of a quarterly series developed by Willdan Energy Solutions. The intent of the series is to provide the intelligence we have collected through implementation of data center energy efficiency programs nationally. We seek to identify technologies and strategies that can become actionable items in utility-run data center programs. This quarter's white paper focuses on the emerging technology of modular data centers. Modular data centers offer unique opportunities for savings, though they present their own challenges as well. These opportunities and challenges are presented along with an analysis of potential energy savings based on IT loads.*



*A Containerized Modular Data Center<sup>1</sup>*

Modular data centers are gaining popularity as one of the cutting edge technologies in the white space world and are projected to become a \$40 billion market by 2018<sup>2</sup>. Modular data centers are typically classified into two categories; self-contained or containerized solutions and custom modular data centers.

Containerized data centers have traditionally been modeled around the shape of an ISO (International Standards Organization) shipping container and can be ideal for present day data centers looking for scaled expansion, temporary supplemental capacity, or disaster recover mobility with wide variation in the type and functioning of IT equipment. This solution also provides data center operators the opportunity to adapt their legacy data centers with incremental capacity increases as the use of containers minimizes the mechanical cooling needs for the data center space since airside equipment is provided within the container. Combined with free cooling, containerized data centers can attain extremely efficient PUE values as low as 1.10 and have even been reported down to 1.02 in environments supporting extreme levels of economization<sup>3</sup>.

Custom modular data centers refer to the pre-engineered, pre-fabricated modules assembled, rather than built, on-site. Many providers offer this service which results in higher quality since components and rooms are factory assembled and commissioned before being shipped to the site in skids. This results in reduced construction schedules as construction of prefabricated modules can occur in parallel. One leading data center operator notes their pre-build of a typical pump room allows for a 75% reduction in on-site assembly<sup>4</sup>.

## Modular Data Center Operations

The modular data center looks like any other data center from the inside and consists of two main sections – air side and IT side. The airside consists of fans for air circulation while the IT side consists of hot and cold row arrangement with dedicated slots for servers. The chilled water to the data center is typically piped from an existing central plant at a specified temperature which is used to locally cool the servers inside the data center via the airside equipment. However, for temporary or remote deployment containerized solutions can also be coupled with a containerized chilled water plant or even integrate the cooling directly into the container for stand-alone cooling.

### Advantages:

1. **Energy Efficiency:** Issues of overcooling, air leaks, over pressurization, and recirculation are eliminated through high-quality construction in a controlled environment.
2. **Dynamic:** Better equipped to handle the dynamic and changing nature of the data center industry.
3. **Cost:** Compared to a traditional new construction build, custom modular data centers take advantage of construction efficiencies to reduce deployment costs up to 13-14%<sup>5</sup>.
4. **Customized:** Modular designs provide the customers with the unique opportunity to customize their own IT infrastructure.
5. **Security:** Containerized data centers can only be accessed by its designated owners/users. They look the same from outside.
6. **Ease of Installation:** Dedicated spaces for airside equipment, server racks, aisle containment are pre-engineered and designed into the solution. On-site construction time is greatly reduced and with containerized solutions, only power and cooling connections are required.
7. **Ease of Relocation:** Planning a data center move cannot be easier. Simply tow them away to the new desired location.

### Disadvantages:

1. **IT Capacity:** Limitations on the number of servers each containerized data center can host individually.
2. **Tenant Separation:** Rack flexibility and customer space allocation can be problematic.
3. **Scale:** Containerized solutions are limited in individual sizes and a large deployment for a permanent installation may not be practical.
4. **Compatibility:** Modular containers designed for a certain cooling strategy may not work with central plant specifications. Additionally, containerized solutions may favor the providers own IT equipment in the build out.

## Comparison

The table below lists a high level comparison of energy savings. Note that exact energy savings will depend on the actual project under consideration.

| IT Load (kW) | New Construction Baseline PUE <sup>A</sup> | Modular Data Center Hybrid PUE <sup>B</sup> (assumed) | Annual Hours of Operation | Energy Savings over baseline (kWh) |
|--------------|--|---|---------------------------|------------------------------------|
| 250          | 1.8  | 1.25  | 8,760                     | 1,204,500                          |
| 500          | 1.8  | 1.25  | 8,760                     | 2,409,000                          |
| 1,500        | 1.5  | 1.25  | 8,760                     | 3,285,000                          |
| 2,500        | 1.5  | 1.25  | 8,760                     | 5,475,000                          |

A. Energy Efficiency Baselines for Data Centers: Statewide Customized New Construction and Customized Retrofit Incentive Programs

B. Assumed PUE is a conservative estimate and includes the effect of free cooling

Sources:

1. <http://h18000.www1.hp.com/products/servers/solutions/datacentersolutions/pod/>
2. *Markets and Markets: Modular Data Center Market: Global Advancements, Market Forecasts & Analysis (2013-2018)*
3. *Modular/Container Data Center Procurement Guide: Optimizing for Energy Efficiency and Quick Deployment, February 2, 2011, Lawrence Berkeley National Laboratory on behalf of the General Services Administration*
4. *POD Architecture 2.0®: The Continuing Evolution of the Modular Datacenter, Digital Realty Trust*
5. *Assessing the Cost: Modular Versus Traditional Build, DCD Intelligence*