HP FlexDC—A new approach to industrialized IT

Business white paper

Table of Contents

Introduction

If we briefly go back to the late 1960s and the advent of transistor, efficiencies and cycles of innovation in the world of electronics have increased according to Moore's law. However, data center facilities, which are an offshoot of this explosion in technology, have not kept pace with this legacy. With the magnitude of capital required and costs involved with the physical day-to-day operations of data centers, this existing paradigm could impede the growth of data center expansions, unless a new group of innovative solutions is introduced in the market place.

With sourcing capital becoming more difficult to secure, linked with potential reductions in revenue streams, an environment focused on cost reduction has been generated. The pressure to reduce capital expenditure (CAPEX) is one of the most critical issues faced by data center developers today. This is helping to finally drive innovation for data centers.

The key contributors which can reduce CAPEX and operational expenditure (OPEX) are typically modularity, scalability, flexibility, industrialization, cloud computing, containerization of mechanical and electrical solutions, climate control, expanding criteria for IT space, and supply chain management. All these factors come into play when planning a cost-effective approach to data center deployment. Every company that develops and operates data centers is attempting to embrace these features. However, businesses requiring new facilities usually do not explore all the strategies available. Generally, this is either due to lack of exposure to their availability or a perceived risk associated with changes to their existing paradigm. Emerging trends such as fabric computing further exacerbate the silo approach to strategy and design, where "what we know" is the best direction.

The recent adoption of design innovation focuses on increasing modularity, combined with appropriate levels of availability. Multi-tiered hybrid design sees pods with mixed levels of availability, and when coupled with trends towards cloud and converged infrastructures shows the advent of greater modularity beginning to appear in data center designs. Modular design trends are also being mixed with a more industrialized, factory-type environment typified by cloud Infrastructure-as-a-Service provisioning business model.

Given this convergence and the increasing economic pressures, traditional monolithic designs are becoming a thing of the past. This is also reflected in much closer cooperation and engagement between facilities and IT teams acting together to bring business advantage. Short-term demand for expansion and growth has been addressed with the containerized pods concept, but such rapid-response flexibility hasn't yet found its way into the brick-and-mortar facilities.

The inspiration for FlexDC

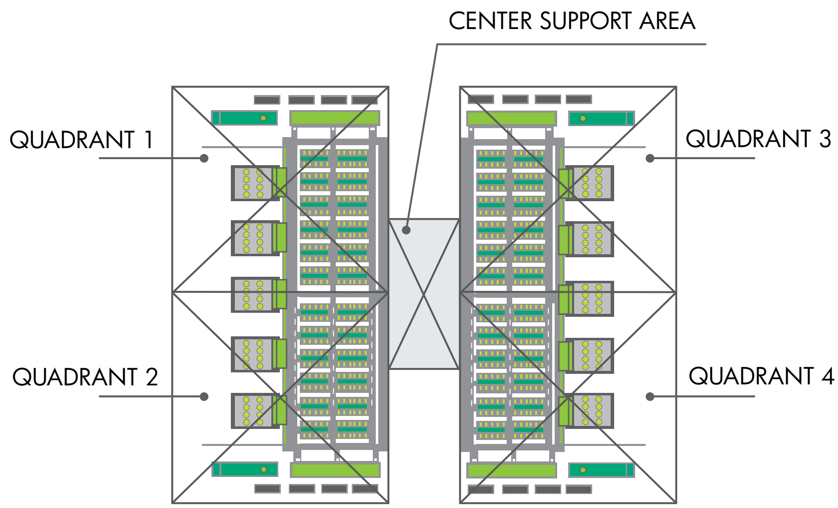
Data center strategy was a top-of-mind predicament two years ago, and it still prevails, post economic downturn. It has intensified with majority of the enterprises needing to take action with respect to their data center facilities. Else, they will remain squeezed in too little space, with insufficient power, and in an arrangement that threatens operational continuity. Also to consider is the build versus retrofit inflection point, disruption, and cost that weigh heavily in the decision-making process.

Until now, there has been no end-to-end solution provider with the ability to execute and offer a single product. However, with the innovation of FlexDC from HP—a vehicle now exists to introduce a new product to the market place. It provides an opportunity for a company to obtain a new turnkey data center with significant reductions in operational costs, enhanced time to market, reduced soft costs and a single point of contact to facilitate the process of building, provision, and commissioning their new data center. FlexDC wraps all of the aforementioned elements into one product offering.

So how was FlexDC conceived?

A typical legacy data center is costly, non-scalable, and is built with one goal in mind; therefore, it is limited with regards to flexibility. It, however, provides a very traditional environment with many creature comforts. Industrialized data centers take a very minimalist's approach, typically installing racks of computers in a containerized solution, this enables very rapid deployment of IT assets, while providing little or no creature comforts.

Figure 1: The "Butterfly" concept



HP Critical Facilities engineers, architects, and strategists focused on customer segments that typically have a higher requirement for greenfield data center facilities. After research and many detailed conversations with customers and global enterprises around the world, the task was to develop a solution to cover a variety of needs and situations with low installation and operating costs, and ease of deployment. Presenting concepts back to the customers, FlexDC has been accepted as a very compelling solution, responsive to growth requirements, flexible enough to meet the ever-changing aspect of technology, and a formulation of many ideas as a jump-off point for the next generation of data center design.

The goal was to find the right methodology and simplify elements with correct levels of sophistication to achieve the right balance of legacy to industrialized elements–simplexity. This balance starts with CAPEX allotments that are proportional to current needs, reducing future investments, while maintaining flexibility for unknown or unpredictable growth. The ability of HP to integrate scalability, modularity, cloud computing, rapid provisioning, and highly-efficient green solutions are some of the core elements that make up FlexDC. It is a middle ground greenfield solution starting at 800 Kilowatts (kW) scalable to a 3.2 megawatt (MW) modular solution that can be assembled in a campus configuration that can extend up to hundreds of megawatts. FlexDC fills the gap between a typical large legacy data center and the minimalistic-industrialized approach to a data center solution to meet the requirements of today's cost-driven environment. FlexDC includes a traditional IT equipment space, industrialized mechanical cooling and electrical power distribution solutions, customized availability, enhanced energy efficiency, and reduced total cost of ownership. It also provides traditional topologies such as: N, N+1, and 2N for the electrical and mechanical systems.

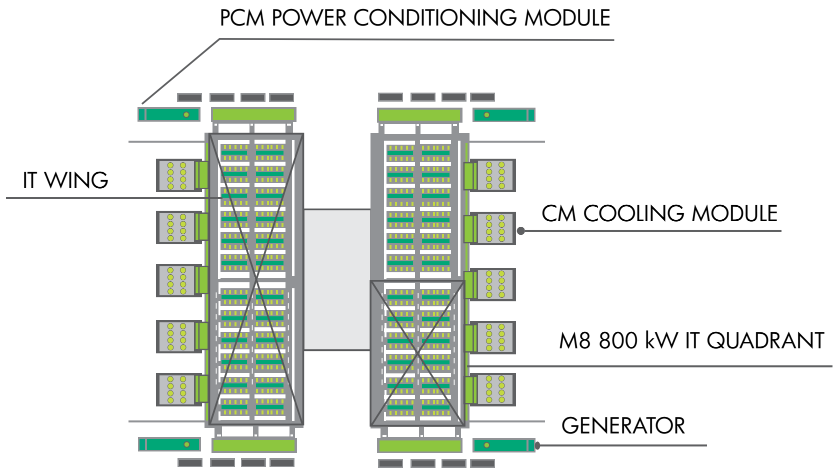
FlexDC provides a compelling option for vertical industries requiring a greenfield solution such as: financial, Internet, collocation operations, and cloud hosts. The simplicity of HP FlexDC is compelling in that it meets key metrics and challenges better than any other existing offering in the market, with a commissioned cost that's typically below $7 million per megawatt (MW).

FlexDC provides a solution that is above current industry standards. From the innovative power of HP and the chrysalis of invention comes a new standard in data center deployment nicknamed the "Butterfly".

The "Butterfly"

The Butterfly shape derives from the need for a construct that can account for unpredictable changes in technology that also provides an ability to defer remaining segments of the data center build-out. Figure 1 illustrates the modularity of the "Butterfly."

Figure 2: Main components



The buildings that comprise the "Butterfly" include four quadrants and a central support area. Each quadrant has a total critical load capacity of 800 kW. When four quadrants are constructed and fitted out the combined capacity of the facility is 3.2 MW of critical IT power. An entirely build out facility is known as an M32 module. Each wing consists of two quadrants, each quadrant is known as a M8 module. Each M8 basic module is 800 kW, which is slated to 700 kW for IT and 100 kW for network communications equipment. The core support space is configured to house various operations, security, shipping and receiving, telecommunications, and network connectivity. Power and cooling system are designated as follows: Power Conditioning Module (PCM), Cooling Module (CM), and Generator Module (GM). Please refer to Figure 2.

The FlexDC "Butterfly" design concept has been enhanced for simplicity, industrialization, supply chain management, speed to market, and cost through the use of standard components and options streaming the entire process, which provides a robust and adaptive selection of options for cooling and power distribution. Core design elements include:

- Prefabricated buildings
- Integrated security
- No mechanical chiller plants
- High-efficiency uninterruptable power supply (UPS) system
- No raised floors
- Scalability of one quadrant at a time
- Low power usage effectiveness (PUE)

The deployment strategy

This module can be deployed singularly or within a campus solution with ease as illustrated in Figure 3. The illustration displays eight "Butterfly" modules, which can be fed with dual feeds for power and communication, with a total critical power capacity of less than 37 MW for the entire campus.

One of the unique features built into the FlexDC environment is the ability to support data center consolidation efforts by segregating IT assets in a logical manner either by group, security level, or function type, for example software development, production, or disaster recovery. Given areas can be configured to utilize a multi-tier hybrid design approach, which can reduce infrastructure costs via strategic alignment of reliability and infrastructure requirements.

Figure 3: Campus with 8 Butterflies

Energy conservation strategies

FlexDC has been designed with more efficient energy usage in mind; this theme is paramount during the selection process of the cooling and power equipment. Equipment is selected with the lowest energy consumption possible with major focus on part-load operating conditions.

FlexDC is designed to work with the external environment. It obtains the majority of its cooling by using the local climate to absorb and dissipate the heat generated in the data center. The cooling systems used in FlexDC work in a majority of environments. Typical cooler, drier climates are best suited to use these cooling systems methodologies, but the cooling concepts used in FlexDC are changing that. Since FlexDC's cooling systems use mainly sensible heat transfer, they are not adversely impacted by humid climates and provide good performance within these climate zones.

Taking this principle through, FlexDC is more effective in locations that have large differences in the dry-bulb and the wet-bulb temperatures, known as the wet-bulb depression. These types of conditions are normally found in arid dry climates. This type of environment coupled with evaporative cooling produces the best results without using much, if any, mechanical refrigeration.

Typically, data centers use 1.90 liters of water per kWh of total electricity. A one-megawatt data center with a PUE of 1.50 running at full load for one year is expected to consume 13 million kWh and will consume 6.5 million U.S. gallons of water annually. FlexDC uses no water in some climates and dramatically reduces the consumption of water in others. Actual amounts can vary depending on system selection and local weather patterns.

FlexDC's ability to reduce energy and water usage creates an opportunity to reduce greenhouse gas (GHG) emissions and thereby reduce the facility's carbon footprint.

The mechanical system approach

FlexDC takes advantage of ASHRAE's expanded environmental standards within the data center, thereby utilizing cooling applications typically seen in industrial environments and adapting them to the data center environment. This adaptation of an industrial cooling approach includes the following cooling technologies: air-to-air heat exchangers with direct expansion (Dx) refrigeration systems; indirect evaporation air-to-air heat exchangers with Dx assist; and direct evaporation and heat transfer wheel with Dx assist. Each of these technologies tries to utilize the environment to its maximum potential and presents the highest known efficiencies. These technologies are able to maintain an environment in the data center that is within recommended limits. Also, they limit the potential to bring environmental contaminates into the data center, which can occur with typical outdoor air economizers. The Dx system can be sized as needed to carry data center cooling load entirely or partially. Air handlers are located on the exterior walls in industrial, prefabricated, and weatherproof packages.

The cooling system(s) become more efficient when the exterior environmental conditions are below 70° F (21° C) for extended periods of time. Locations that normally experience high humidity can still fully utilize the cooling systems present herein, because heat is transferred across an air-to-air heat exchanger, which provides isolation between the data center space and the local environment.

To obtain the maximum use of the environment, supply air temperature set points need to be set at the highest temperature possible and still remain within the warranty requirement range of the IT equipment. The next critical component is to control the temperature difference between the supply and return air streams to a minimum range of 25° F. This reduces the amount of air needed to cool the data center, thus reducing fan energy. The configuration of the data center in general must follow certain criteria in order to receive greater benefits available through the use of this concept, as follows:

- Server racks are configured in a hot aisle containment (HAC) configuration.
- There is no raised floor air distribution.
- The air handlers are distributed across a common header on the exterior of the building for even air distribution.
- Supply air diffusers are located in the exterior wall, connected to the distribution duct. These diffusers line up with the cold aisle rows.
- The room becomes a flooded cold aisle.
- The hot aisle is ducted to a plenum, normally created through the use of a drop ceiling. The hot air shall be returned via the drop ceiling plenum back to the air handlers.
- Server racks are thoroughly sealed to reduce the recirculation of waste heat back into the inlets of nearby servers.
- Server layout is such that the rows of racks do not exceed 18 feet in length.

The control for the air handlers shall maintain maximum temperature difference between the supply and return air distribution streams. The supply air temperature is controlled to a determined set point while the air amount is altered to maintain the desired temperature difference by controlling the recirculation rate in the servers.

The electrical systems approach

The building groups can be configured to form larger data centers in a scalable, modular fashion. The electrical configuration developed for FlexDC reflects various customer needs with regards to reliability levels and size of the data center. Each "Butterfly" quadrant has 800 kW of critical power. Each "Butterfly" consists of four quadrants or a total of 3.2 MW of critical load. The combinations of electrical topologies are:

- N Single utility source
- N+1 UPS
- 2N UPS

Lowering utility and distribution costs for the electrical systems means using more efficient equipment, especially the uninterruptable power supply systems. It also means eliminating equipment conversions and transformations in the power supply chain.

Traditional data centers have electrical distribution systems based on double conversion UPS with battery systems and standby generators. There are several UPS technologies offered within FlexDC, which expands the traditional options:

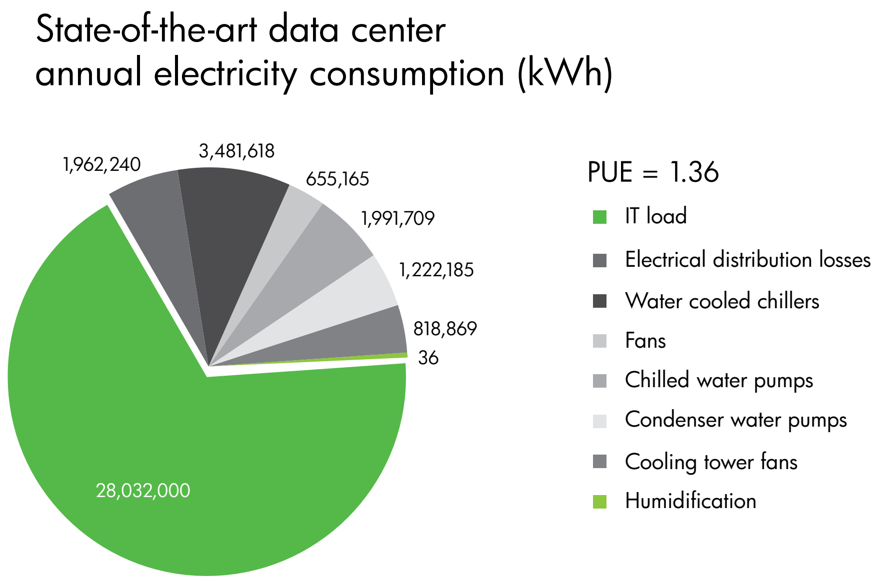
- Rotary UPS—94% to 95% energy efficient
- Flywheel UPS—95% energy efficient
- Delta Conversion UPS—97% energy efficient
- Double Conversion UPS—94.5% to 97% energy efficient
- Offline UPS—Low-voltage version for the 800 kW blocks, about 98% energy efficient

FlexDC not only specifies more efficient transformers as mandated by energy standards, it also uses best practices for energy efficiency. FlexDC receives power at medium voltage and transforms it directly to a server voltage of 415 V/240 V. This reduces losses through the power distribution unit (PDU) transformer and requires less electrical distribution equipment, thus, saving energy as well as saving on construction costs. An additional benefit is a higher degree of availability because of fewer components between the utility and the server.

Proper electric equipment selection enables lowering construction costs and speed of implementation as follows:

1. Close coupling of electrical equipment to shorten feeders and to lower losses.
2. Use of outdoor equipment—the goal is to preserve indoor space for IT equipment.
3. Underground construction is avoided with the power modules, which also helps with quicker deployment.
4. The sizes of the main equipment, mainly the UPS and standby generators are selected to be cost-effective in terms of cost/kW, size optimization, and delivery.
5. The generators are conservatively sized for a 1.5 PUE.
6. The voltage for the UPS and standby generators will be 415 V to minimize the amount of distribution equipment.
7. Within the server room, there will be no PDU.
8. There will be an option to utilize either remote power panel (RPP) at the ends of the server racks or an overhead bus.
9. Utilize best practices for energy efficiency during equipment selection and sizing based on the sweet spots for cost and equipment availability.

Figure 4: Shows state-of-the-art data center annual electricity consumption



Total cost of ownership

Energy analysis and life-cycle cost analysis

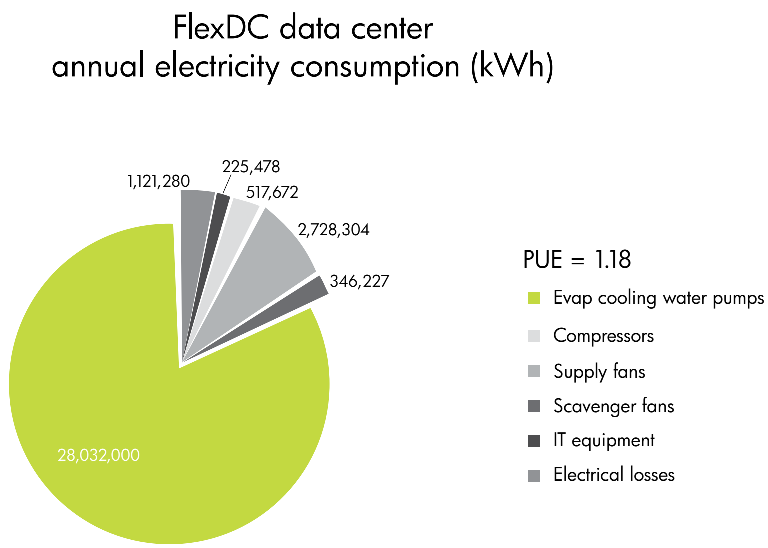
Energy analysis

The cooling and electrical distribution systems provide the greatest opportunity for energy savings between the brick-and-mortar data center and FlexDC. The FlexDC model lowers the PUE and water usage thereby reducing the center's carbon footprint, while maintaining a high level of reliability.

HP has developed a state-of-the-art energy evaluation program, which includes certified software programs and is staffed with trained engineers to perform a comprehensive review of the preliminary system selections made by the customer. This program provides valuable insight to the potential performance of the systems and is a valuable tool in final system selection process. The following illustrations are typical outputs for the example site located in Charlotte, North Carolina. This location was chosen due its very reliable utility infrastructure and its ability to attract mission critical type businesses. The illustrations compare a state-of-the-art designed data center using current approaches and HP FlexDC for the given location.

Traditional data center energy consumption
System attributes: cooling system—large chilled water plant with water side economizer. The cooling system takes advantage of free cooling when the outside air temperature is lower than the chilled water temperature [typically 50° F (10° C)]. Electrical distribution systems are static UPS, in an isolated redundant configuration.

Figure 5: Shows FlexDC data center annual electricity consumption



HP FlexDC data center energy consumption

System attributes: cooling system—indirect evaporation with air-to-air heat exchangers with (Dx) assist. The cooling system takes advantage of free cooling when the outside air temperature is lower than the supply air temperature [typically 75° F (24° C)] and it can operate on saturated wet-bulb conditions. The indirect evaporation system provides more hours of free cooling, saving additional energy with minimal water consumption. The units are located at the exterior of the IT space, decreasing fan losses.

A second component of the energy analysis process is to predict actual energy costs over a one year period. The illustrations are for the same location as noted above. The first illustration (figure 4) provides a comparison between the two styles of electrical distribution system and indicates there is a 14% reduction in annual cost using FlexDC. The second illustration (figure 5) indicates the saving associated with utilizing the indirect evaporation air-to-air heat exchanger cooling system.

Life-cycle cost analysis

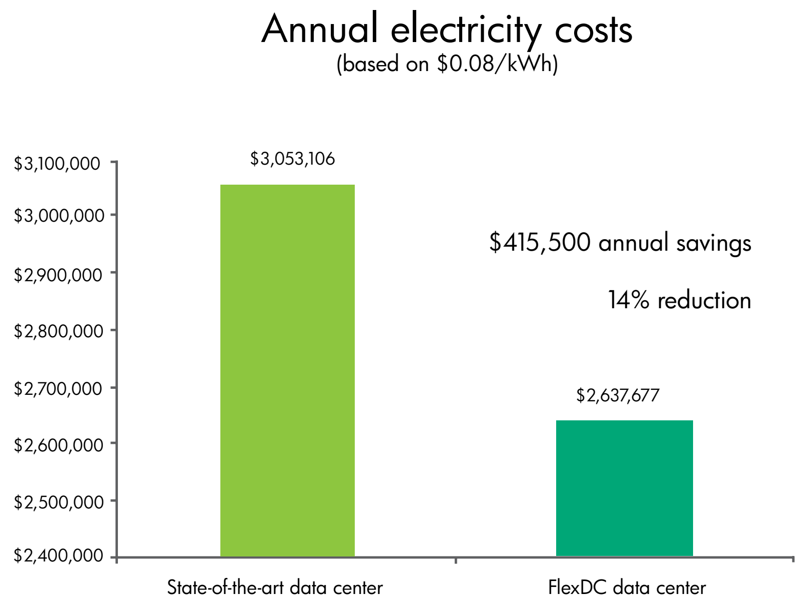
To fully understand how the FlexDC model can leverage its advantages in first cost (CAPEX) and operational costs (OPEX) over traditional brick-and-mortar constructed data centers, a life-cycle cost analysis (LCCA) was developed. Energy is the major cost component of data center OPEX; therefore, an energy analysis was completed to illustrate the savings associated with utilizing the FlexDC model.

The LCCA compares the fully-built FlexDC model to a comparable fully-built brick-and-mortar model looking at all real ownership costs over a period of 20 years and adjusts these costs to present value (PV) dollars. The ownership costs include site development and construction costs, annual energy costs, and annual maintenance costs. To simplify the model it was assumed that the end-of-cycle salvage value is zero. Although, the absolute values of the CAPEX vary based on land acquisition costs and taxes, it's assumed that these costs would be relatively the same for both the base case and the alternative scenario.

The PV analysis takes into account the time value of money, discounted accordingly to reflect interest and incorporates other factors such as investment risk. PV calculations are widely used in business economics to provide a standard means to compare cash flows at different times on a meaningful comparative basis.

To perform the LCCA, the Building Life-Cycle Cost computer program BLCC 5.3-08, MILCON non-energy projects module was used. The BLCC was developed by the National Institute of Standards and Technology (NIST) under sponsorship of Federal Energy Management Program of the Department of Energy (DOE/FEMP).

Figure 6: Shows annual total energy costs (includes IT energy)



The basis of the comparison:

Scenario A: Base case state-of-the-art brick-and-mortar data center.

A state-of-the-art legacy data center's shell is typically built with concrete reinforced walls. All of the cooling and electrical systems are located in the same shell. Traditional legacy data center cooling systems entail the use of large central chiller plants and vast piping networks and pumps to deliver cooling air handlers located in the IT spaces. Electrical distribution systems typically are dual-ended static UPS system with good reliability but low efficiencies due to part-loading conditions. PUE for a traditional data center with tier ratings of III and above are between 1.5–1.9.

Scenario B: HP FlexDC

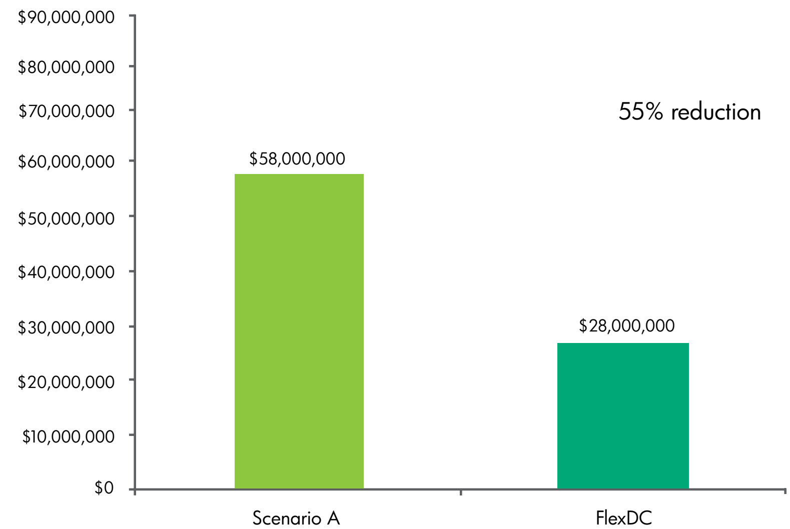
The reliability of the system configuration is equivalent to an Uptime Institute Tier III, distributed redundant. The total critical power available to the facility is 3.2 MW. The building is metal, using materials standard within the metal buildings industry. The electrical distribution system is a distributed redundant scheme based on a flywheel UPS system located in prefabricated self-contained housings. The standby generators are located on the exterior of the facility in prefabricated self-contained housing with belly tank fuel storage.

The mechanical cooling systems are prefabricated self-contained air handlers with air-to-air heat exchangers using Dx refrigerant cooling to assist during periods of the year when local environment is not capable of providing the total cooling for the data center IT space.

The IT white space is a non-raised floor environment. The IT equipment racks are arranged in a hot aisle containment configuration. The hot return air is directed into the drop ceiling above and returned to the air handlers.

The following life-cycle cost analysis matrix quantifies the CAPEX and OPEX costs and the resultant PV dollars for the base case and the alternative scenario.

Figure 7: Shows site and facility capital development cost (does not include land acquisition)



For each analysis the following was calculated:

1. Present value dollars: The time equivalent value of past, present, or future cash flows as of the beginning of the base year.
2. Savings to investment ratio (SIR): A relative measure of cost-effectiveness. It is a calculated ratio of energy and/or water savings plus additional operation and maintenance costs to the increased investment costs and/or replacement costs for an alternate system as compared to the base case. A project's alternative is generally considered economically justified relative to a base case project when the SIR is greater than one.
3. Adjusted rate of return (AIRR): A relative measure of cost-effectiveness and is the annual yield from the project over the study period, taking into account the investment of interim amounts. The calculated AIRR is economically attractive if this value is greater than the owner's minimum acceptable rate of return and is generally equal to the discount rate used in the analysis.
4. Simple payback period: A measure of the length of time required for the cumulative savings from the project to recover the investment cost and other accrued costs without taking into account the time value of money.

Included in the OPEX portion is energy consumption and cost breakdown for IT power and the supporting power and cooling energy. This breakdown provides an understanding of the energy reduction potential associated with the power and cooling portion. In addition, it can be seen that the water and sewer usage is dramatically reduced or eliminated for the FlexDC alternative. This is due to the elimination of condenser water blow-down and make-up water associated with a cooling tower application.

The LCCA results illustrate that the alternative PV dollars are reduced by 37% over the base case scenario. This is impressive and includes both CAPEX and OPEX savings. The SIR and AIRR represent a return on investment. In this analysis, the CAPEX and OPEX values for the FlexDC alternative are both less than the base case scenario, resulting in an obvious (no brainer) advantage for the alternative FlexDC scenario. The simple payback is less than one year again due to the CAPEX and OPEX costs being less for the FlexDC alternative as compared to the base case scenario.

Annual energy cost comparison; base case to the alternate

Life-cycle cost analysis matrix

Item	Attributes	Comparative Analysis		
		Scenario A: State-of-the-Art data center base case	Scenario B: FlexDC alternate	% Reduction (alternate/base)
Building to be evaluated based on a Tier III, 3.2 MW UPS capacity				
Site and facility development				
1	Total development costs (excludes land acquisition)	**$58,000,000**	**$26,000,000**	55.2%
Operation and maintenance				
2	Power usage effectiveness factor (PUE)	1.36	1.18	13.2%
3	Electrical power cost/kWh	$.08/kWh	$.08/kWh	
4	Annual IT electrical consumption (kWh)	28,032,000	28,032,000	0.0%
5	Annual IT energy costs	**$2,242,560**	**$2,242,560**	
6	Annual power and cooling electrical consumption (less IT) (kWh)	10,131,822	4,938,961	51.3%
7	Annual power and cooling energy costs (less IT)	**$810,546**	**$395,117**	
8	Total annual energy consumption (IT+power+cooling)	38,163,822	32,970,961	13.6%
9	Total annual energy cost (IT+power+cooling)	**$3,053,106**	**$2,637,677**	
10	City water usage cost	$2.73/1000 gal	$2.73/1000 gal	
11	Annual city water usage (gal)	24,703,200	2,717,330	89.0%
12	Total annual water cost	$67,440	$7,418	
13	City sewer usage cost	$5.76/1000 gal	$5.76/1000 gal	
14	Annual sewer usage (gal)	980,130	0	
15	Total annual sewer cost	$5,646	$0	
16	Maintenance cost (see note 1)	$1,152,110	$1,047,372	9.1%
17	Discount factor (typically between 4-7%)	7.00%	7.00%	
LCCA Results				
18	Carbon footprint reduction from the base case (see note 6)	14%		
19	Present value cost	$104,572,082	$65,833,492	37.04%
20	Savings to investment ratio (SIR)	The alternate FlexDC development costs less than the base case, therefore, the alternative offers the better value.		
21	Adjusted internal rate of return (AIRR)			
22	Simple payback occurs in year	one		

Notes:

1. Maintenance costs are estimated based on previous projects and may vary based on actual client requirements.
2. End of year discounting, current dollar analysis, and 7% discount factor were provided.
3. 20-year study period with no salvage value at end of life.
4. IT equipment CAPEX & OPEX are not included.
5. Development costs do not include land acquisition costs.
6. This is equivalent to 985 cars annually or 19,700 equivalent cars lifetime.

Supply chain management benefits

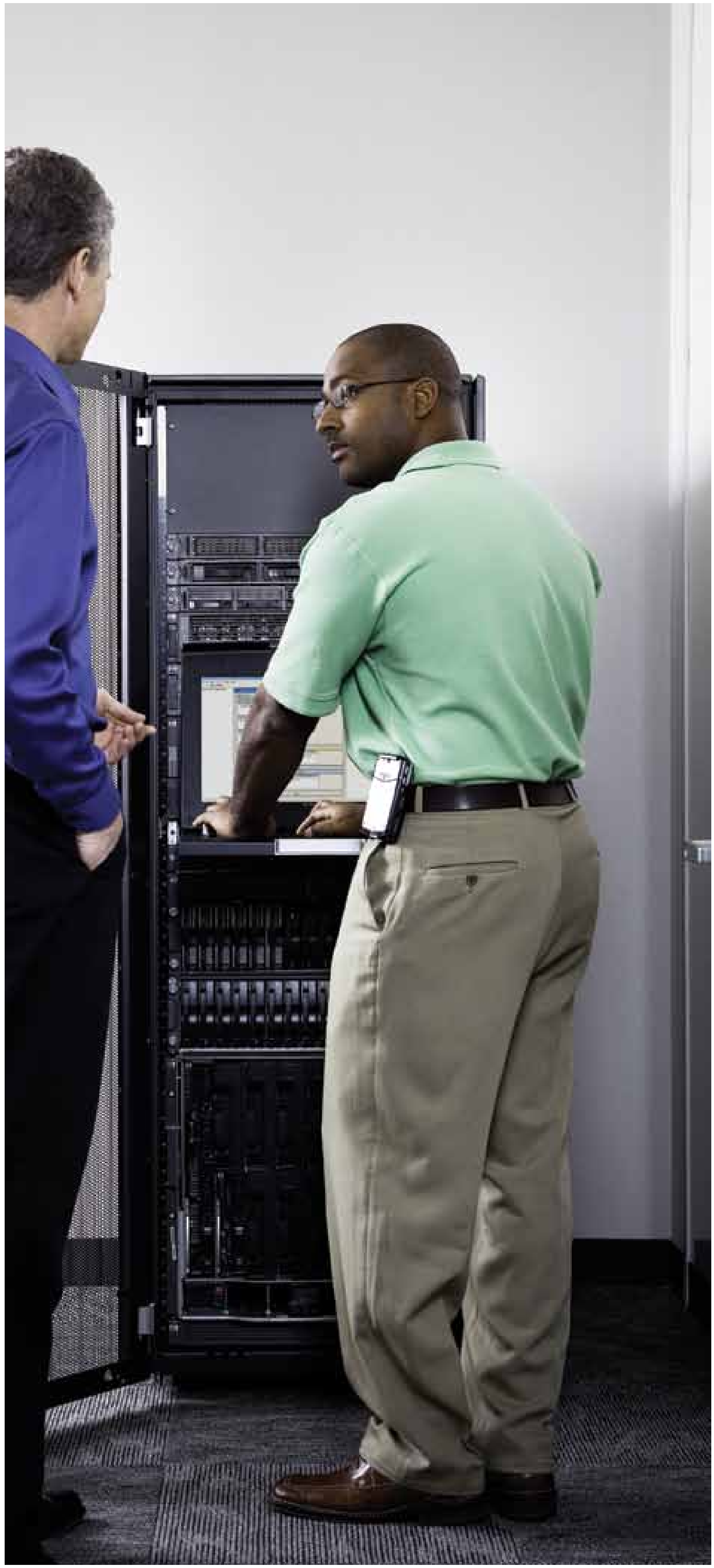
A compelling aspect of FlexDC is attained by providing significantly improved time-to-market strategies through simplifying the process of construction of the data center and allowing the process of engineering to be greatly reduced through standardization of all components. A key metric to providing cost reductions in any project is the ability to leverage volume purchasing power. This is not an area typically taken advantage of in building data centers, as volume discount is not normally achieved by building one or two data centers a year. Only few companies have the ability to capitalize and manage this effort. However, at HP we view this as commoditizing the data center build, similar to our efforts levied in building computers. Our vision is to make building a data center as easy as purchasing a laptop.

A menu-driven selection process will allow clients to select a building type, an electrical system, and a cooling solution that will be validated through an energy evaluation process to select the optimum solution for the prevailing climate zone.

FlexDC utilizes the benefit of existing supply chain management techniques from HP to reduce costs through purchasing agreements and volume purchasing.

Summary

Technology and design innovation has created a situation where there is only one conclusion—FlexDC. A data center providing the benefits of traditional data center, but with additional flexibility, modularity, and reduced time-to-market at half the capital cost. The business case is inescapable. If the customer is committed to building a greenfield data center, then the FlexDC option is cash neutral because the first cost is covered by the savings it generates.



The advantages don't stop here:

- Annualized PUE reduced by 13.2% (the benchmark for Energy Star ratings and potential inclusion within the golden threshold of top 25% of data centers)
- Energy costs reduced by 13.6%
- Water and sewerage costs reduced to an insignificant level.
- The LCCA shows that the life-cycle operating costs are significantly reduced.
- Maintenance costs reduced by circa 10%
- Carbon footprint reduced by 14% or the equivalent of 19,700 motor vehicles over the measured 20-year life of the data center
- Ultimately a 20-year total cost, calculated with present value, reduced by 37%

HP FlexDC is a product that has the potential to revolutionize how data centers are purchased and constructed through standardization and incorporation of cost-effective approaches into one product. The time consuming and strenuous task normally associated with an owner-builder concept (building a data center is not a regular occurrence) will no longer be a main consideration for the owner. It will become far simpler to purchase a completed product, working with HP rather than to go through the process themselves and having to maintain a staff of trained individuals to get the work done.

The recent evolutionary approach to modularity and warehouse-type data centers is packaged together in FlexDC, which provides businesses:

- Cost-effective data center to build and own
- Quicker time-to-market to commission the unit
- Higher levels of flexibility and appropriate availability

To see how FlexDC helps you build a cost-effective data center, visit: **www.hp.com/services/flexdc**

Share with colleagues

Get connected

www.hp.com/go/getconnected

Get the insider view on tech trends, alerts, and HP solutions for better business outcomes

4AA2-1533ENW, Created July 2010