

Powering the Green Data Center

HOW RENEWABLE ENERGY GENERATES SUSTAINABLE RESULTS



DIGITAL REALTY

AARON BINKLEY
DIRECTOR OF SUSTAINABILITY

A DIGITAL REALTY WHITE PAPER



WHY YOU SHOULD READ THIS DOCUMENT

This planning guide looks at the importance of environmental concerns in the age of heightened corporate responsibility, and identifies the considerations for moving to a clean energy model for data centers, including:

- The growing importance of sustainability in the data center
- What is “clean” energy?
- How to source clean energy

According to IDC, there are more than 8 million data centers worldwide, and global demand for data centers continues to increase. IDC projects that data center space will grow from 1.6 billion square feet in 2013 to more than 1.9 billion square feet in 2018.¹

Digital Realty recognizes that, as with all enterprises, operating and expanding our business consumes resources. As such, we are working to create more sustainable environmental performance in our portfolio of over 130 data centers.

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THE GROWING IMPORTANCE OF SUSTAINABILITY

Data centers, the home to the physical infrastructure that underpins today's increasingly digital world, consume increasing amounts of energy. By 2020, U.S. data centers are projected to consume electricity equivalent to the output from 50 large coal-fired power plants.² This increase is driven by the rapid growth of the "digital universe" – the data we create and store every day. According to a joint study by IDC and EMC published in April 2014, the digital universe is doubling in size every two years, and by 2020 will reach roughly 44 trillion gigabytes.³

While efforts to improve the energy efficiency of data centers – such as free air cooling, hot/cold aisle containment, and operating data centers at higher temperatures – will remain an important area of focus, organizations are also capturing sustainability gains by switching to clean energy.

These efficiency and sustainability gains come at a time when organizations – especially those with large carbon footprints – are increasingly finding that their customers want to see greater transparency about corporate sustainability initiatives, paired with an appropriate and meaningful business response.

Quantifying this trend, Forrester Research has reported that 72 percent of companies in the S&P 500 published reports on their corporate responsibility or sustainability efforts in 2013, compared to only 20 percent in 2011.⁴

WHAT IS "CLEAN" ENERGY?

In broad terms, "clean" or "green" energy comes from renewable sources such as the sun (solar), wind, the movement of water in rivers and oceans (hydroelectricity), biofuels (fuel derived from organic matter), and geothermal activity.

The "brown" alternative is energy derived from finite fossil fuels, especially those that contribute most heavily to carbon emissions, such as coal, oil, and natural gas.

Nuclear power is classified as a non-renewable source of energy, due in part to environmental concerns about disposal of radioactive waste.

Leading data center operators are finding that clean power is becoming price-competitive with utility-sourced power in many markets.

²Whitney, Josh and Delforge, Pierre. "Natural Resources Defense Council, Data Center Efficiency Assessment; Scaling Up Energy Efficiency Across the Data Center Industry: Evaluating Key Drivers and Barriers", August 2014. <https://www.nrdc.org/energy/files/data-center-efficiency-assessment-IP.pdf>

³<http://www.emc.com/leadership/digital-universe/2014view/executive-summary.htm>

⁴Christopher McClean and Nick Hayes, "Meet Customers' Demands For Corporate Responsibility; How The World's Leading Businesses Address Corporate Responsibility In The Age Of The Customer," Forrester Research, December 9, 2014. <https://www.forrester.com/Meet+Customers+Demands+For+Corporate+Responsibility/fulltext/-/E-RES112563>



TECH GIANTS ARE FOCUSING ON RENEWABLES

Digital Realty, along with certain major technology companies and other pioneers, are showing that clean energy can be used to power even the largest and most high-performance data centers. And as more organizations consider moving from traditional to cleaner sources of power, they are also showing that renewable energy can be cost-effective.

For instance, 100 percent of the power used at Apple's data centers is now derived from renewable sources.⁵ Other sustainability leaders in technology – including Amazon Web Services,⁶ Facebook,⁷ Google,⁸ and Microsoft⁹ – are moving toward a 100 percent renewable energy supply. Several of these companies are also building on-site renewable projects – or signing long-term purchase agreements – to supply renewable energy to power their global operations.

It may not be a surprise that these companies are leading the market and reducing their carbon footprint, managing power costs, and bolstering their corporate reputations. Many other organizations outside of this circle may have the perception that procuring clean energy is a costly and complicated task. Fortunately, making the change to clean energy sources isn't as costly or difficult as many believe, and in some cases may offer a way to reduce power costs in the longer term.

DOES CLEAN ENERGY COST MORE?

Conventional wisdom has long held that renewable energy is much more expensive than traditional brown power. Leading data center operators, however, are finding that clean power is becoming price-competitive with utility-sourced power in many markets.

HOW DO ORGANIZATIONS SOURCE CLEAN ENERGY?

There are several ways to source clean energy to power a data center. These include:

- Purchasing green power from the local electric utility
- Purchasing renewable energy certificates
- Purchasing clean energy directly from a renewable energy project developer
- Constructing and operating on-site renewable energy equipment

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⁵ <http://www.apple.com/environment/our-progress/>

⁶ Finley, Clint, "Amazon Vows to Run on 100 Percent Renewable Energy", Wires.com, November 19, 2014. <http://www.wired.com/2014/11/amazon-vows-run-100-renewable-energy/>

⁷ "Facebook and Greenpeace Collaboration on Clean and Renewable Energy" Press Release, December 15, 2011.

⁸ Verge, Jason, "AWS Commits to 100% Renewable as Google Signs Big European Wind Deal", November 19, 2014. <http://www.datacenterknowledge.com/archives/2014/11/19/data-center-energy-google-buys-wind-amazon-commits-to-clean-cloud/>

⁹ Bernard, Rob, "Microsoft Announces Largest Wind Project to Date", Microsoft blog, July 15, 2014. <http://blogs.technet.com/b/msdatacenters/archive/2014/07/15/microsoft-announces-largest-wind-project-to-date.aspx>

The first, and often simplest approach, is to simply select the “green power” option from your local utility company, if such a program is offered. Utilities meet these clean energy obligations by purchasing power from clean energy projects and by purchasing renewable energy certificates on their customers’ behalf. Utilities charge a premium price for this clean energy product, often between \$0.01 and \$0.04 per kilowatt-hour, which contributes to the perception that clean energy is expensive.

An alternative pursued by many businesses is to purchase renewable energy certificates (referred to as RECs, which is pronounced “rex”) primarily from third-party aggregators. Each REC represents 1 megawatt-hour of energy generated from renewable sources.

Aggregators procure RECs from renewable power plants on behalf of their clients. This approach provides flexibility to specify the type of renewable energy, and to purchase RECs for facilities that do not have local utility green power options. Prices do vary but are typically a fraction of the cost of utility green power programs (see Texas data center case study).

Organizations can buy these third-party-verified and tracked RECs, knowing that the money will ultimately work its way back to those power plants that feed in energy from clean energy sources. A criticism of this approach is that while purchasing RECs provides a



continuing revenue stream for recently built projects, the impact of RECs in spurring the development of new renewable projects may be less direct or immediate.

A third route to procure clean energy is to purchase renewable energy directly from a power plant developer. This is increasingly the path pursued by technology companies such as Apple, Google, Microsoft, and others. These power purchase contracts commit the buyer to purchasing the power and RECs produced by a wind farm, solar installation, or other renewable project at a fixed price, typically for a period of 10 to 25 years.

These contracts, referred to as power purchase agreements (PPAs), provide direct “line of sight” from the

APPLE GOES 100 PERCENT RENEWABLE

Since 2010, Apple has gone from being criticized for its limited use of clean energy to becoming in 2013 the first major cloud services provider to power all its U.S.-based data centers exclusively from renewable power sources.¹⁰

This rapid transformation is not only an indicator of renewable energy’s newfound importance in the data center industry, but proof that large data centers can be cost-effectively powered exclusively by clean energy sources.

Apple’s actions are also an example of how a wide range of renewable energy sources can be deployed simultaneously. It is using vast fields of solar panels, wind, water diverted from irrigation canals, geothermal sites, and biogas fuel cells at its facilities.

¹⁰<http://www.apple.com/environment/our-progress/>



energy purchaser to the source where the clean energy is produced. These transactions often are for generally 50 to 100 megawatts or more of power capacity. Smaller organizations may not use sufficient energy to warrant this type of arrangement.

And finally, some companies may opt to build and operate their own renewable power plants by installing solar panels, wind turbines, or biogas-powered fuel cells at or near their data center. Companies that take this on-site approach are also often sourcing clean energy from some or all of the other options already presented.

Building renewable generation on-site is a less common tactic, in part because of the expertise required to manage them and also because the clean energy capable of being produced on-site tends to account for only a small portion of the data center's total energy need.

An increasing number of businesses are using one or more of the four approaches outlined in this article to supply their data centers with renewable energy. Each approach has its pros and cons, but with a careful study of the available options many businesses are finding that powering their data center with clean energy is more feasible than they had previously thought.

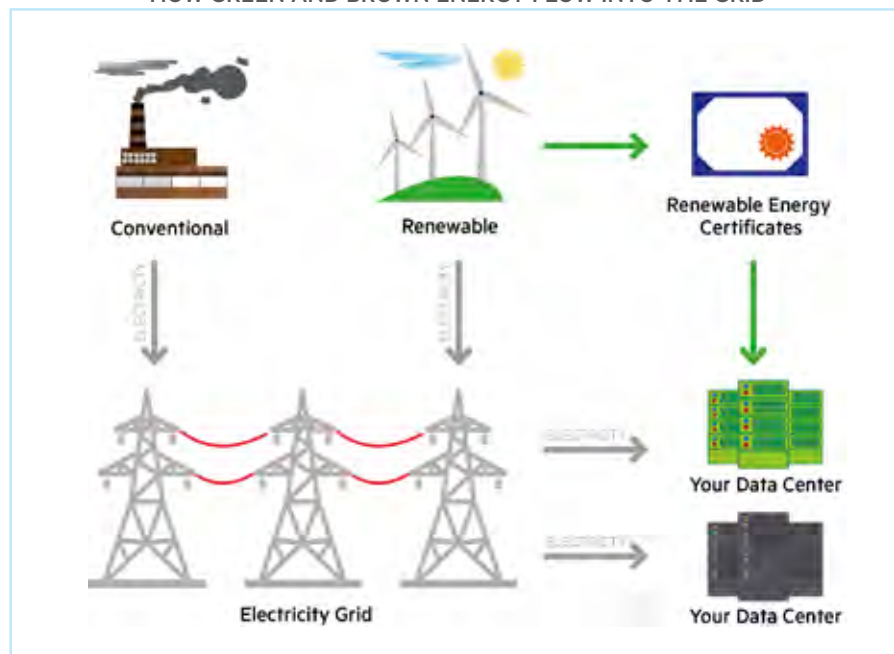
EXAMPLE: CLEAN ENERGY COST FOR A TEXAS DATA CENTER COSTS JUST 1.4 PERCENT MORE

Based on a recent clean energy analysis conducted by Digital Realty, the incremental cost of sourcing wind power in Texas was just 1.4 percent more than the cost of traditional brown power.

Findings/assumptions:

- Wind power costs approximately \$1 per megawatt-hour more than the cost of traditional brown power
- 2 megawatt-hour data center operated at 50 percent utilization with a 1.3 power usage effectiveness (PUE)
- Annual electricity consumption of 11.4 million kilowatt-hours
- Annual brown power cost of \$797,000
- Incremental cost to source green power = \$11,300 annually (1.4% increase)

HOW GREEN AND BROWN ENERGY FLOW INTO THE GRID



For more on the Digital Realty corporate sustainability program, visit www.digitalrealty.com/solutions-services/sustainable-innovation

ABOUT DIGITAL REALTY'S SUSTAINABILITY PROGRAMS

Digital Realty is the leading global provider of data center solutions, with a portfolio of more than 130 facilities across four continents. Its sustainability policy is aimed at minimizing the use of energy, water, and raw materials in its data centers, many of which have received high levels of environmental certification from relevant authorities.

Digital Realty was also one of the first data center providers to join the Better Buildings Challenge to reduce power consumption under the U.S. Government's Climate Action Plan.

Digital Realty also offers Clean StartSM, a global program that enables clients to switch to using clean energy in their data centers for a year at no incremental cost. Digital Realty invests in RECs for clients to match clients' energy usage.

Learn more about Digital Realty's innovative sustainability program here: <http://www.digitalrealty.com/solutions-services/sustainable-innovation>

ABOUT CLEAN START

Learn more about Clean Start: <http://demand.digital-realty.com/CleanStart2015LP>

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ABOUT DIGITAL REALTY

Digital Realty is known today as the premier provider of premium data centers, with over 130 globally connected data centers across four continents. Our approach features solutions that align your workloads to your infrastructure needs at a price that's in line with those needs. Our solutions are open and agile, designed to connect with your cloud deployments and your owned data centers. Digital Realty focuses on delivering the Right Workload, in the Right Place, at the Right Value.

SALES

T +1 877 378 3282
E SALES@DIGITALREALTY.COM

FURTHER READING

Green power: <http://www.epa.gov/greenpower/>

REC certification: <http://www.green-e.org/> and <http://www.recs.org/>

Sources of renewable energy: <http://listverse.com> and <http://www.ucsusa.org/>



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