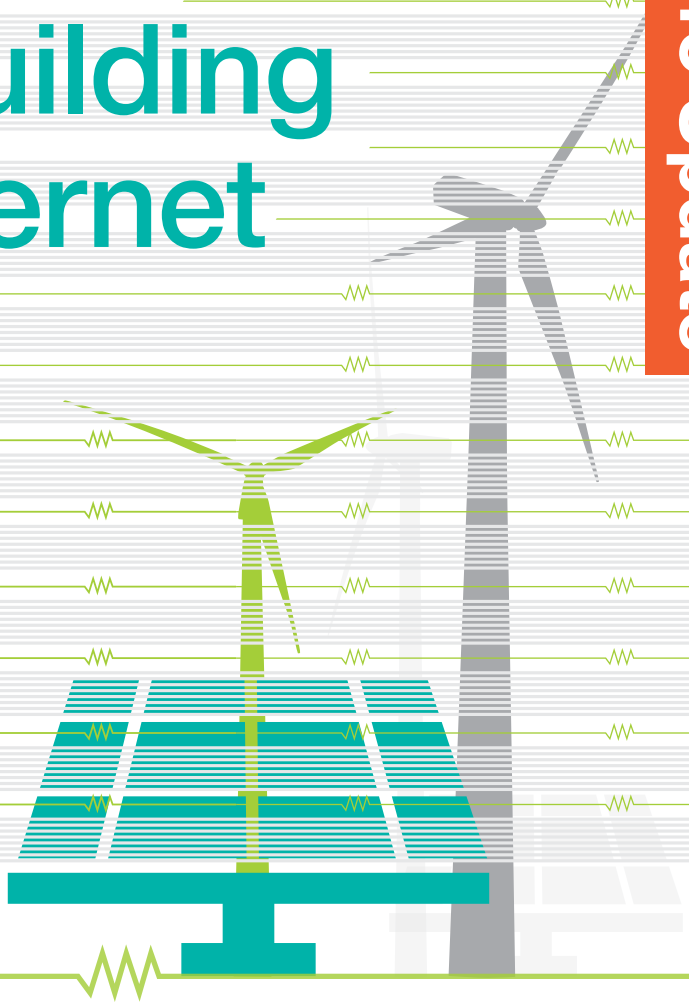
Clicking Clean: A Guide to Building the Green Internet

2015 Update

May 2015



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UTP structure wiring in Data centers.

Executive Summary

The internet is rapidly working its way into nearly every aspect of the modern economy. Long unshackled from our web browser, we now find the internet at every turn, and ready to play a bigger role in our lives with each passing day. Today, the internet is rapidly transforming how you watch TV. Tomorrow, the internet may be driving your car and connecting you to high-definition video from every corner of the planet via your watch.

The magic of the internet seems almost limitless. But each new internet enabled magic trick means more and more data, now growing over 20% each year.[1] The emergence of cheap smartphones means that internet traffic from mobile devices will soon exceed what is delivered over wired connections. Global mobile data was estimated to increase by a whopping 69% in 2014, and is expected to maintain its breakneck growth through at least 2019, due to the rapid increase of video streaming to mobile devices and as more of the world's population gains basic access to the internet via smartphones. The online population topped 3 billion in 2014, and mobile broadband subscriptions are expected to jump to a staggering 7.6 billion by 2020.[2]

While there may be significant energy efficiency gains from moving our lives online, the explosive growth of our digital lives is outstripping those gains. Publishing conglomerates now consume more energy from their data centers than their printing presses. Greenpeace has estimated that the aggregate electricity demand of our digital infrastructure back in 2011 would have ranked sixth in the world among countries.[3] The rapid transition to streaming video models, as well as tablets and other thin client devices that supplant on-device storage with the cloud, means more and more demand for data center capacity, which will require more energy to power.

The transition to online distribution models, such as video streaming, appears to deliver a reduction in the carbon footprint over traditional models of delivery. However, in some cases, this shift may simply be enabling much higher levels of consumption, ultimately increasing the total amount of electricity consumed and the associated pollution from electricity generation. Unless leading internet companies find a way to leapfrog traditional, polluting sources of electricity, the convenience of streaming could cause us to increase our carbon footprint.

"If having the audacity to rely on grid power now puts a company at risk for public shaming, then the day is coming when every company's energy usage will be viewed through a moral filter – similar to how its labor practices and foreign investments are viewed today."

David Crane, NRG CEO[4]

The Internet Can and Must Be Green

The internet has already enabled positive changes and better lives for people around the world, and has the potential to serve as a critical foundation for sustainable economic growth, but we cannot make the transition to a renewable powered society fast enough to avoid catastrophic climate change unless the internet is also a platform to transition the world toward a renewable energy future.

The good news is that a growing number of companies have begun to create a corner of the internet that is renewably powered and coal free, with over a half dozen major internet companies now committed to being 100% renewably powered, including major operators such as Apple, Facebook and Google. Renewable commitments by internet companies have had a big impact in driving renewable power in several key markets, as a growing number of utilities have begun to shift their investments to renewable energy to meet this new demand.

A second tier of major data center operators and internet companies have now begun to explore options for increasing their renewable energy supply. While colocation data center operators still lag far behind consumer facing data center operators, several have begun to shift to explore how they can best increase their supply of renewable electricity, as an increasing number of their customers are asking that their cloud be powered by renewable energy.

Holding The Green Internet Back

Monopoly electric utilities which sell electricity that's powered by mostly coal, and very little renewable energy, are the sole energy providers to several critical data center hubs, which continue to attract significant new data center investment. Prominent examples of such utilities - including Duke Energy (North Carolina), Dominion Resources (Virginia), and Taiwan Power Company (Taiwan) - have all recently established green electricity tariffs to provide a renewable electricity option for their large customers, but they have not yet attracted customers due to their poor design and locked-in price premium, even though renewable energy is increasingly at parity with, if not superior to, traditional sources of generation. These utilities represent the biggest obstacles to building a green internet, and will require collaborative pressure from data center operators and other electricity customers to secure the policy changes needed to open the market up to competitors that offer meaningful options for renewable energy.

"An energy efficient facility is good, but a 100% renewable energy facility is better."

Apple Environment report[5]

Key Findings:

- Apple continues to lead the charge in powering its corner of the internet with renewable energy even as it continues to rapidly expand. All three of its data center expansions announced in the past year will be powered with renewable energy. Apple is also having a positive impact on pushing major colocation providers to help it maintain progress toward its 100% renewable energy goal.
- Colocation companies continue to lag far behind consumer-facing data center operators in seeking renewable energy to power their operations, but Equinix's adoption of a 100% renewable energy commitment and offering of renewably hosted facilities is an important step forward.
- Google continues to match Apple in deploying renewable energy with its expansion in some markets, but its march toward 100% renewable energy is increasingly under threat by monopoly utilities for several data centers including those in North and South Carolina, Georgia, Singapore and Taiwan.
- Amazon's adoption of a 100% renewable energy goal, while potentially significant, lacks basic transparency and, unlike similar commitments from Apple, Facebook or Google, does not yet appear to be guiding Amazon's investment decisions toward renewable energy and away from coal.
- The rapid rise of streaming video is driving significant growth in our online footprint, and in power-hungry data centers and network infrastructure needed to deliver it.
- Microsoft has slipped further behind Apple and Google in the race to build a green internet, as its cloud footprint continues to undergo massive growth in an attempt to catch up with Amazon, but has not kept pace with Apple and Google in terms of its supply of renewable electricity.
- Data center operators committed to renewable energy goals will need to redouble their efforts to work together to push policymakers for changes that allow them to procure renewable energy, overcoming the resistance of monopoly utilities.

Company Scorecard

	Clean Energy Index	Natural Gas	Coal	Nuclear	Energy Transparency	Renewable Energy Commitment & Siting Policy	Energy Efficiency & Mitigation	Renewable Energy Deployment & Advocacy
Akamai	24%				A	C	A	C
amazon.com web services	23%	21%	27%	26%	F	C	D	D
	100%	0%	0	0	A	A	A	A
ebay	10%	51%	29%	9%	B	D	B	C
	49%	10%	25%	14%	A	A	A	B
Google	46%	15%	21%	13%	B	B	B	A
hp	22%	26%	41%	11%	C	D	B	C
IBM	24%	27%	30%	17%	B	B	B	C
Microsoft	39%	19%	30%	10%	C	C	C	C
ORACLE	17%	18%	50%	11%	D	F	D	D
rackspace the open cloud company	25%	21%	33%	21%	C	B	B	C
salesforce	23%	20%	25%	26%	A	B	C	C
YAHOO!	73%	6%	11%	8%	C	B	A	B

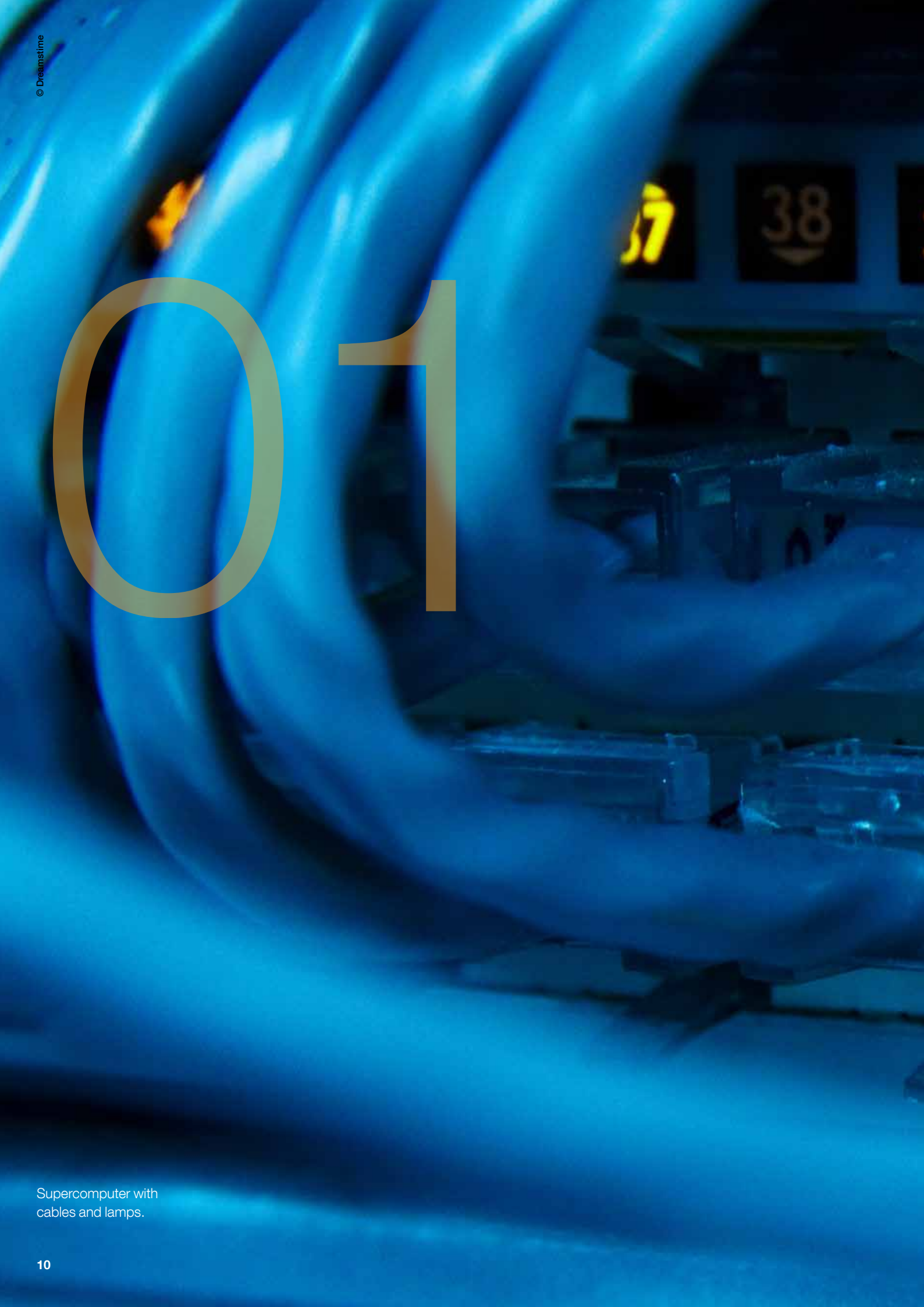
Colocation Companies

DIGITAL REALTY Data Center Solutions	18%	30%	28%	20%	C	D	C	D
	6%	25%	32%	34%	D	F	D	F
EQUINIX	15%	29%	29%	20%	B	B	B	D
TelecityGroup	18%	27%	27%	15%	C	D	C	D

(a) Clean Energy Index and Coal Intensity are calculated based on estimates of power demand for evaluated facilities. See Appendix III: Facilities Table. **(b)** Akamai's energy consumption is spread across 1,300 data centers around the world, making individual tracking difficult. Regional demand and renewable energy data are from CDP data and information provided by company. **(c)** Greenpeace provided AWS with facility power demand estimates to review. AWS responded that the estimates were not correct, but did not provide alternative data. Using conservative calculations based on public records, Greenpeace has used the best information available to derive power demand. See Appendix II: Methodology, for more information. Greenpeace invites AWS to provide more accurate data for its facility power demands.

© Frank van biemen / EvoSwitch / Greenpeace

EvoSwitch data center uses green energy to power the system. This energy efficient data center hosts providers, public institutions and private corporations.



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01

Supercomputer with
cables and lamps.

Cloud Power: Streaming Video on the Rise

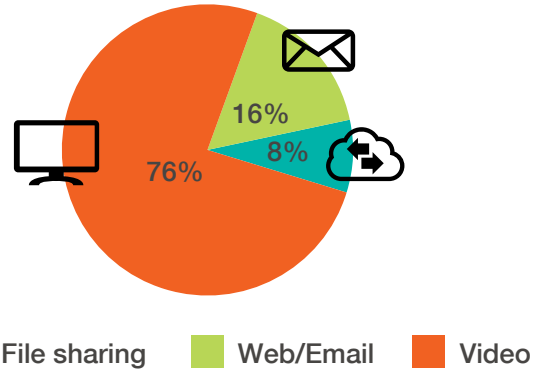
01

Cloud Power: Streaming Video on the Rise

From the now omnipresent fields of streaming music and video, to the nascent "Internet of Things," our online world continues to transform our offline lives with ever increasing speed. Internet data is now growing at 20% per year.[6] Big data's massive growth is expected to continue with the emergence of cheap smartphones: nearly 80% of the planet's adult population will be connected to the internet by 2020, and the total number of devices connected to the internet will be roughly twice the global population by 2018. Internet traffic from mobile devices increased 69% in 2014 alone with the rapid increase of video streaming to mobile devices, and mobile traffic will exceed what is delivered over wired connections by 2018. The primary engine behind all of this growth is consumer traffic, which represents more than 80% of internet traffic currently, and is expected to maintain this high share through 2018.[7]

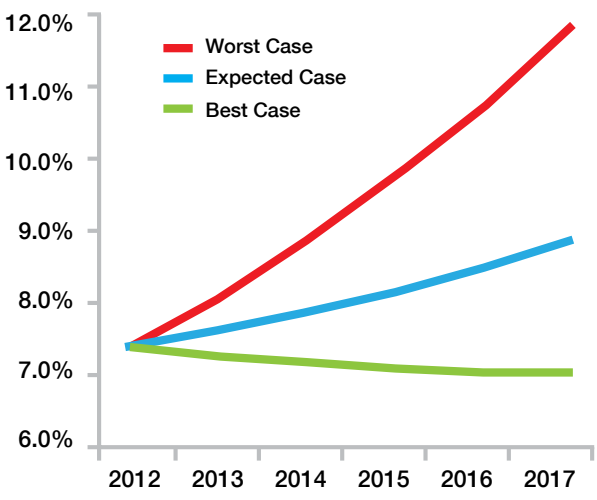
By far and away, the biggest driver of that consumer internet data is online video. Consumers bought nearly 100 million internet connected TVs in 2014, and the steady increase of video-enabled mobile devices has dramatically changed how and where we watch TV and movies. YouTube, Netflix, Hulu and other video streaming services that have suddenly become a regular staple in our daily lives already make up more than 60% of consumer internet traffic, and that number is expected to grow to 76% by 2018.[8]

Expected internet consumer traffic: 2018[7]

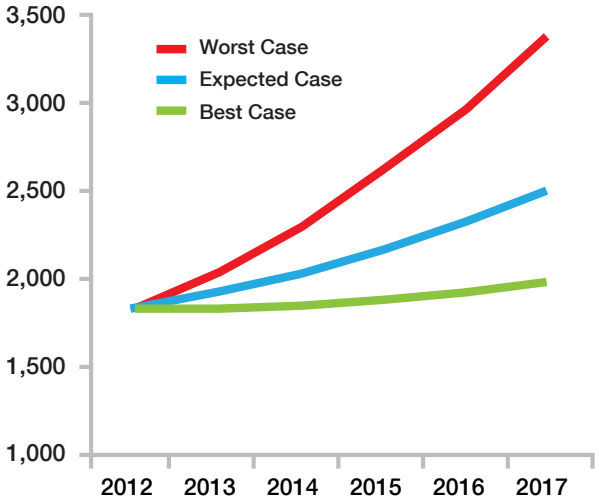


Cisco Visual Networking Index: Forecast and Methodology, 2013–2018.

Electricity demand growth of the ICT sector

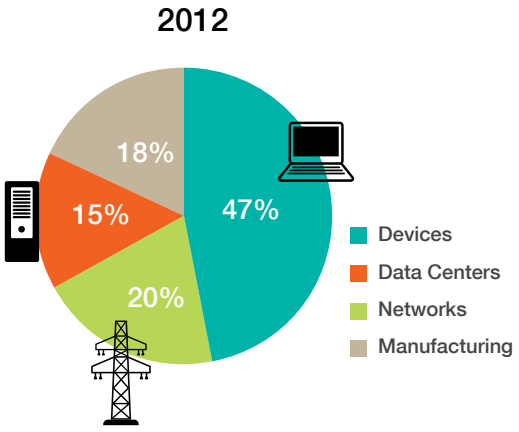


Percentage of global electricity consumption due to CE-ICT for best/expected/worst case scenarios. From "Emerging Trends in Electricity Consumption for Consumer ICT"

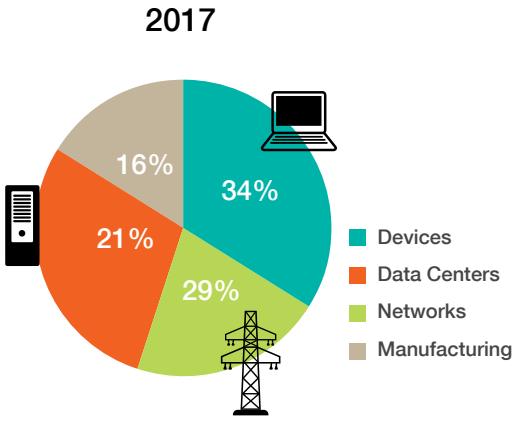


Global electricity consumption in TWh/yr for best/expected/ worse case scenarios. From "Emerging Trends in Electricity Consumption for Consumer ICT"

Main components of electricity consumption for the ICT sector



Main components of electricity consumption for the IT sector, 2012. From "Emerging Trends in Electricity Consumption for Consumer ICT"



Main components of electricity consumption for the IT sector, 2017 estimate. From "Emerging Trends in Electricity Consumption for Consumer ICT"

While there may be some significant environmental and carbon benefits from moving much of our lives online, this explosive growth in our digital lives requires massive amounts of electricity, particularly for the data centers that serve as the factories of the digital economy. International Data Corporation predicts that the total number of data centers is expected to decline slightly by 2017, as more businesses shut down their smaller data centers and shift to the cloud, and larger data centers tend to be significantly more efficient. However, the shift by consumers to smart phones and tablets that depend on constant access to the cloud will increase the overall energy required to deliver these services, outweighing any efficiency gains realized by shifting to the cloud. The number of larger data centers is expected to increase dramatically, with mega data centers accounting for more than 70% of data center construction in 2018.[9]

Good data on the energy demand of data centers and the other infrastructure behind our digital world has been few and far between. Despite significant improvements in transparency from some companies since 2012, estimates of the energy demand of our growing number of electronic devices and the online world to which they are connected have varied widely in their methodology and scope. Recent studies estimate that the collective electricity consumption of our devices, data centers, and networks will jump from 7.4% of global electricity consumption in 2012 to between 7% and 12% by 2017.[10]

Fiber optical
background
with light spots.

Renewable Power for the Cloud: Drivers and Barriers

02

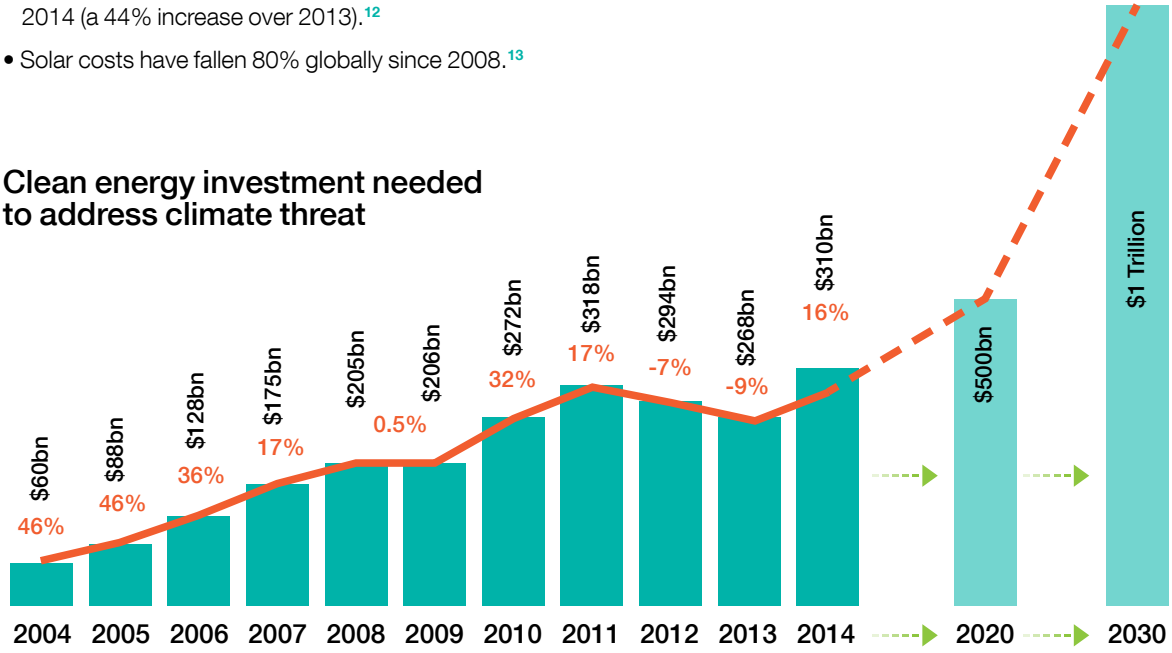
The transition to a clean energy economy is underway, driven by the increasingly competitive price of renewable electricity. Electricity is by far the biggest cost for data centers, and concerns about long-term energy costs, along with brand or customer driven concerns about the environmental impact of online services, is driving data center operators to consider renewable energy alongside energy efficiency as the core strategies for meeting their data center electricity needs. Among North American data center operators, 84% recently identified the need to consider renewable energy for meeting future energy needs.[11]

Evidence of Renewable Energy's Recent Rise

- 51,000 MW of wind was added globally in 2014 (a 44% increase over 2013).[12]
- Solar costs have fallen 80% globally since 2008.[13]
- Solar and wind provided 55% of new electricity generation capacity in the US during 2014.[14]
- China invested $90B USD in renewable energy in 2014, a 32% increase over 2013.[15]

Despite this dramatic growth in renewable energy, significantly higher levels of investment are needed if we are to transition away from fossil fuels in time to limit the amount of global warming to 2 degrees Celsius and avoid the worst effects of climate change. While global clean energy investment rebounded in 2014 to reach $310 billion in 2014,[16] according to the IEA, clean energy investment levels need to exceed $500 billion annually by 2020, and double to $1 trillion each year by 2030, to keep us within the 2 degree envelope that scientists say is required to avoid catastrophic climate change.[17] Unfortunately, it has become clear that most electric utilities are not leading this charge, so it is critical that large energy-consuming corporations step forward to help shift energy policy and increase the market demand for renewable energy to help close the gap.

Clean energy investment needed to address climate threat



Historical data from Bloomberg New Energy Finance, future estimated necessary investment from Ceres: "Investing in the Clean Trillion"

Highlights of IT sector renewable energy deals in 2014 and 2015

Google[18]	Apple[19]	BT[20]	Microsoft[21]	YAHOO![22]
Finland/Sweden	US (Oregon)	UK	US (Illinois)	US (Kansas)
Jan 2014	**Apr 2014**	**June 2014**	**July 2014**	**Oct 2014**
Contracted for output of 59 MW of wind energy for 10 years to cover the electricity consumption of Finland data center. **Benefits** Drives new wind project in the region rather than relying on old hydropower.	Purchased micro-hydro project to power data center **Benefits** Addition of sustainable hydro to grid, as alternative to large scale hydro.	Signed £440m power purchase agreements for wind energy, securing funding for construction of 2 new UK wind farms. **Benefits** Directly secured 100MW of new wind energy in the UK.	Signed 20-year PPA for 175 MW of wind energy for Chicago data center. **Benefits** Drives wind energy investment in a region primarily powered by nuclear and coal.	Signs PPA for half of 48MW wind project to power Nebraska data center. **Benefits** Developed with community & local ranch.

Key Renewable Energy Drivers

(1) Government Renewable Goals

Government goals for renewable energy have been a key driver of renewable energy in many parts of the world, providing the critical conditions to drive investment in real energy solutions. In many areas of the world, governments are now moving to strengthen such goals, with Germany as the biggest economy with ambitious renewable energy goals as it aims to power with 80% renewable energy by 2050 under the Energiewende, or German energy plan.[31] Denmark also stands out for its ambitious plans; wind will produce half of its electricity by 2020, and by 2030 Denmark will phase out coal entirely.[32]

Although the US does not have a federal renewable portfolio standard (RPS), state level mandates have been a key driver for renewable energy growth in the US. In leading states, utilities are close to hitting or exceeding current targets, with higher targets now under discussion. In other parts of the US, however, RPS laws have been under regular attack by the fossil fuel industry, and utilities are resisting efforts to increase them further.[33] Data center operators, many of which carry major influence with state and national policymakers, have a key opportunity to push for stronger mandates that will help them meet their renewable energy targets, while creating a greener grid for the broader public as well.

Google [23]	NTT Communications [25]	amazon.com web services [26]	[27]	[28]	[30]
Netherlands	India	US(Indiana)	Denmark	US (Arizona)	US (California)
Nov 2014 Purchased output of a new 62 MW Eneco wind farm near new E600m data center. **Benefits** Avoids using power from controversial new coal power plant being built by RWE in Eemshaven.[24]	**Dec 2014** Wind power deal for India data center. **Benefits** Power is 11-13% cheaper than grid power	**Jan 2015** Signed 150 MW wind power PPA for 13 years. Currently unclear which Amazon facility this deal will power.	**Feb 2015** Not finalized, but reaffirmed commitment to 100% RE. **Benefits** Waste heat delivered for residential heating to nearby town.	**Feb 2015** Announces new data center, to be 100% powered by 70MW solar. **Benefits** Major solar deal with a utility that has been otherwise been hostile to solar development. [29]	**May 2015** $850M power purchase agreement for 130MW of solar power for HQ and CA data center. **Benefits** Helped to leverage additional 150MW as part of larger project.

(2) Private Sector Renewable Purchases & Investments

Voluntary corporate purchases of renewable electricity have been a critical driver of renewable energy investment, particularly in parts of the US and EU that give some form of supplier choice to electricity customers.

The decrease in renewable energy costs, projected increase of fossil fuel costs, and new innovations in renewable energy financing have all contributed to rapid growth in voluntary renewable energy purchases.[34]

Both federal and state renewable energy investment tax credits in the US have also played a major role in driving corporate investments in renewable electricity, though it appears that the US Congress may allow the tax credits to expire.

IT companies continue to be a major driver in renewable energy deployment, and more and more companies are making major commitments to power their operations with renewable energy.

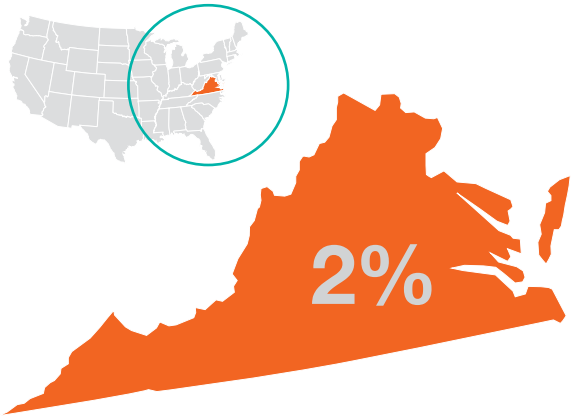
Barriers to Renewable Energy: Monopoly Utilities

While data center operators have been successful in purchasing renewable electricity in an increasing number of markets in the EU and US, the lack of access to renewable energy in key data center markets served by monopoly utilities remains a significant barrier to building a renewably powered internet.

Many monopoly utility markets, such as North Carolina (Duke Energy), Virginia (Dominion Power) and Georgia (Southern Company) in the US, or Asian utilities such as Taipower in Taiwan, rely heavily on coal and other dirty generating capacity, with very little renewable energy in their generation mix. Although several utilities have recently enacted renewable energy tariff programs to address the desire for renewable electricity by large customers, most of these programs have not been embraced by data center operators due to their price design of always including a premium, rather than passing along cost savings from renewable sources.

"Quite frankly, we are doing this because it is right to do, but you may also be interested to know that it's good financially to do it. We expect to have a very significant savings because we have a fixed-price for the renewable energy, and there's quite a difference between that price and the price of the brown energy."

Tim Cook, Apple CEO[35]

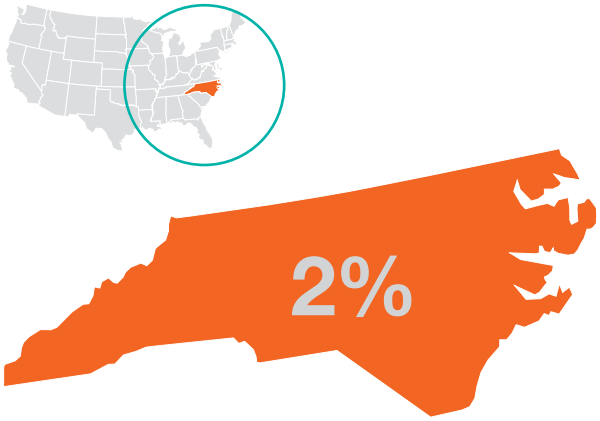


Ground Zero for the Dirty Internet: Dominion Energy (Virginia)

Virginia remains the epicenter of data center growth in the US. Loudoun County, in Northern Virginia, boasts that up to 70% of global internet traffic passes through its borders on a daily basis.[36] That amount of data traffic requires massive amounts of electricity, and most of it is generated by Dominion Resources, a utility that continues to rely almost exclusively on dirty sources of generation, and plans to well into the future. Dominion's latest long-term plan that it submitted to regulators shows that it does not intend on making any significant increase in its investment in renewable energy over the next 15 years, and will continue to maintain a high reliance on coal.[37]

Dominion's continued reliance on dirty sources of electricity presents a significant challenge to a number of major data center operators, particularly for Amazon and DuPont Fabros Technology, which have more than half of their data center operations based in Dominion territory.[38] While commercial electricity customers in Virginia are technically able to opt out of Dominion's service and choose a different supplier, Dominion makes this as painful as possible, denying the ability to return as a customer for five years. Dominion recently established Schedule RG, a pilot renewable tariff for large customers.[39] But similar to Duke Energy's program in North Carolina, no customers have yet chosen to take part in the program due to the price premium and risk allocation among parties.[40]

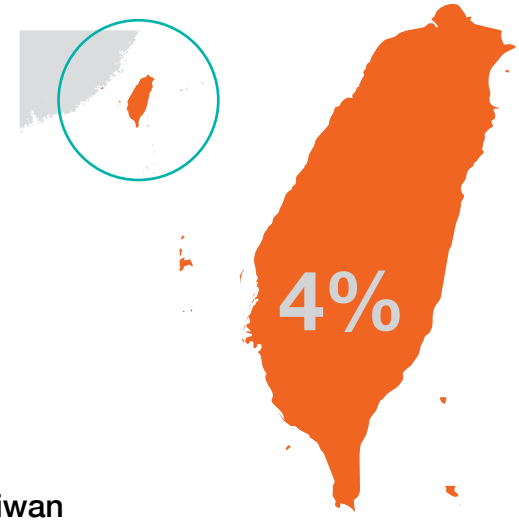
Data center operators evaluated in this report represent six of Dominion's twenty largest customers in 2014.[41] If these operators send a strong collective signal to Dominion and to policymakers in Virginia that they want to power their growth with renewable energy, it would be very difficult to ignore.



The persistence of the Dirty Data Triangle: Duke Energy (North Carolina)

As a result of heavy recruitment by the monopoly utility Duke Energy, North Carolina has become home to some of the biggest and best-known data center operators, including Apple, Facebook, and Google. Duke Carolinas relies heavily on coal and other dirty generation, with very little planned in the way of renewable energy far into the future.[42] However, since establishing operations in North Carolina, all three of these leading brands have committed to power their data centers with 100% renewable electricity. Achieving that goal represents a significant challenge, as Duke Energy only generates 2% of its electricity from renewable sources currently, and North Carolina law prevents customers from buying power from anyone other than Duke Energy. Duke's goal for as far out as 2029 increases its renewable energy share to a mere 4%.[43]

Apple has taken the most direct approach to securing its renewable electricity supply by building three separate solar farms and on-site fuels cells. Facebook and Google focused on getting Duke to provide to large customers the option to buy renewable energy, which Duke ultimately agreed to do in 2013. While this appeared to be a breakthrough at the time, the design and price structure for the Green Rider Tariff imposed by Duke have been such a barrier that thus far no companies have agreed to purchase renewable energy under the program.[44] Both Google and Facebook's North Carolina data center operations have grown substantially in the past two years, with both now ranking among Duke Energy's 20 largest customers in 2014,[45] but they currently lack a clear path for securing renewable energy. Legislators are making some efforts in North Carolina to increase the options for consumers to buy renewable energy from parties other than Duke.[46]



Taiwan

Taiwan has long been a hub for the electronics manufacturing sector, but has recently been put on the data center map, most notably with the decision by Google to significantly expand its data center operations there.[47] Taiwan presents an attractive option due to its proximity to China and the low electricity rates offered by Taiwan Power Company (Taipower), the monopoly electricity provider in Taiwan, which is 95% owned by the national government. Taipower offers very little renewable electricity however, with renewable sources accounting for only 4% of its generation mix, while fossil fuel represents 76%.[48] Similar to monopoly utilities elsewhere in Asia and in parts of the US, customers are prohibited from buying electricity from anyone other than Taipower. Taipower has recently established a renewable energy tariff program, but like those created by Duke Energy and Dominion Power, it is designed with a built- in premium over current rates.[49] The Taipower tariff also offers no assurances that it will actually result in additional renewable energy being added to the national grid.

"When we decide to work in a certain location, we analyze the makeup of the energy content on the grid, and then we work with the power providers, and they all know, I can guarantee you, all of them know very well what our priorities are in terms of driving renewable energy onto the grid. This sometimes is in direct conflict with their current business, but we've made great strides."

Joe Kava, Google VP of Data Centers.[50]

Barriers to Renewable Energy: Utilities undermining renewable energy polices

European Union

European data center hubs in countries like the Netherlands, UK and Germany continue to grow as companies aim to improve their services to customers in those markets. While some European countries, like Germany, offer electric grids with higher percentages of renewable energy than the US average, rapid movement toward 100% renewable energy in Europe is stymied by utilities, just as it has been in other regions.

Between 2000 and 2008, the largest European utilities made huge investments in expanding conventional coal and gas plants and extending the lifetimes of Europe's aging nuclear fleet. This strategy was based on assumptions of increasing electricity demand (which in fact hasn't recovered since the 2008 financial crisis) and that renewable energy would not be a profitable investment.[51] The investments have failed spectacularly, leading to losses in the EU utility sector of more than half a trillion euros.[52]

Instead of admitting past mistakes and making necessary strategic adjustments, major European utilities have chosen to blame the growth of renewable energy and supporting policies for their losses and asked for policy support to maintain profits from coal, gas and nuclear plants. In March 2014, 10 utilities including GDZ Suez, E.ON, RWE, Ibedrola, and Enel formed the Margritte Group[53] to lobby against EU targets for renewable energy and energy efficiency.

By contrast, the Netherlands' Eneco has adopted the most progressive advocacy position of all European energy utilities by supporting specific and ambitious renewable energy and energy efficiency targets for the EU.[54] Eneco agreed in 2014 to supply the national Dutch railway company NS with 100% wind energy by 2017, supplied by new wind farms mostly in the Netherlands and Belgium. Eneco also supplies wind power to large companies such as KPN and Belgacom.[55]

Companies like Apple and Google have been successful at sourcing renewable energy in Europe, but achieving broader progress toward a renewably powered internet will require breaking through utility barriers there.

United States

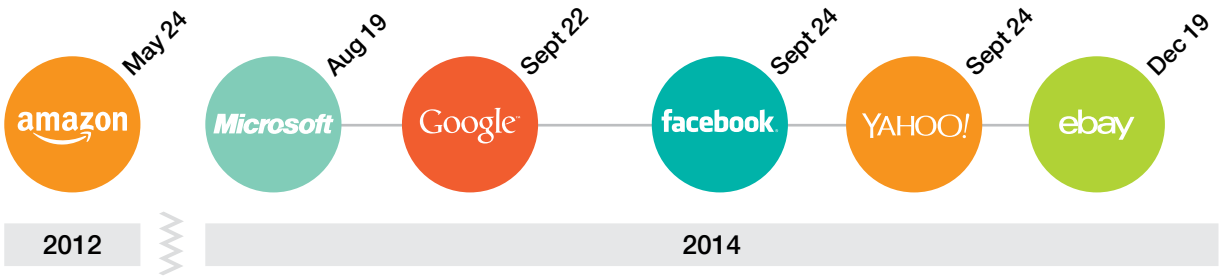
Faced with the rapid growth of distributed renewable energy, US utilities have sought to stem the growth at several levels, relying on trade associations to do their dirty work whenever possible.

Edison Electric Institute (EEI)

EEI represents the majority of investor owned utilities in the US, and has been sounding the alarm regarding the threat that distributed energy sources like rooftop solar poses to the profitability of the sector. EEI has embraced a strategy to slow the growth of distributed solar by urging state lawmakers and utility commissions to pursue policies that would increase its costs. Although EEI claims its attacks on solar power are motivated by concerns for ratepayers, EEI board documents[56] show that utility executives were actually concerned about lost earnings, as the growth of distributed solar shrinks their customer base and obviates the need to build additional centralized generation capacity, which serve as a major source of their profits.[57]

While distributed renewable energy policies may have less immediate relevance to large-scale electricity consumers like data centers, EEI's attacks on rooftop solar (and attacks by many of its member utilities) still present a major long-term barrier to IT companies' ambitions to power their operations renewably. Any scenario for a 100% renewably powered grid involves a high degree of distribution; IT companies with commitments to be powered by renewable energy are best served by that type of progress, since it will close the amount of ground they need to cover to procure renewable energy beyond what's offered by the grid. Facebook and others have acknowledged as much, noting that their goal is to green the entire grid, not just their own operations.[58] EEI's attacks on distributed renewable energy undermine that goal.

IT Companies That Have Left ALEC



American Legislative Exchange Council [ALEC]

ALEC is actively collaborating with many of the nation's worst polluters to kill clean energy and climate policies around the country. In 2013, ALEC pushed model legislation to repeal renewable energy portfolio standards in over a dozen states, failing across the board. The group's 2014-15 agenda included continued assaults on renewable energy laws, plus a new effort to attack net metering policies, which encourage the growth of decentralized solar energy by allowing solar customers to be fairly compensated for extra electricity they sell back to the grid. ALEC is also targeting the Environmental Protection Agency's effort to limit global warming pollution from coal-fired power plants.[59]

To the IT sector's credit, in response to stakeholder pressure and their own growing disenchantment with ALEC's positions attacking renewable energy and climate change science, most major IT companies finally withdrew their affiliation with ALEC in the past year,[60] including Ebay, Facebook, Google, Microsoft and Yahoo.

Policy Advocacy: Tech Companies vs Utilities

The utility sector is currently undergoing huge changes, as both large-scale renewable installations and distributed generation from rooftop solar are rapidly upending long-held assumptions of steadily rising electricity demand and the lack of profitability from renewable electricity. Exactly what a successful, modern utility business model will look like is not entirely clear to many utilities. While utilities are certainly not going to disappear overnight, the rapid change in the marketplace has many utilities looking for ways to slow down the renewable energy revolution so they can have time to adapt, rather than following in the footsteps of landline telecommunications companies.

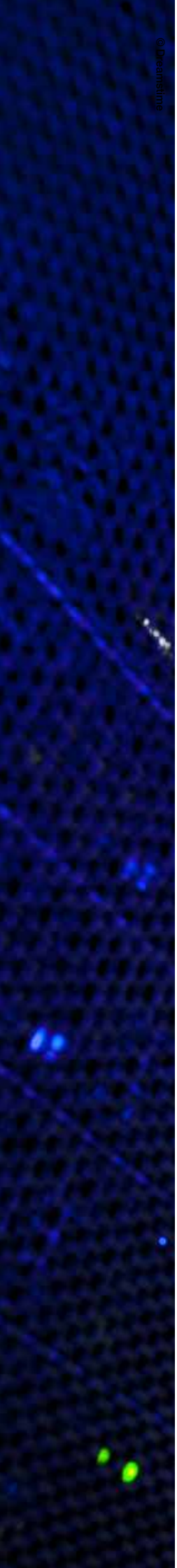
Recognizing that most electricity markets are not moving fast enough to meet their ambition for increasing amounts of renewable electricity, a number of leading data center operators have become active in letting regulators and utility decision-makers know that they support greater investment in renewable energy, and want better options from the market to allow them to buy it.[61]

Companies should not limit their support for renewable energy solely to increasing their options to purchase renewable energy for themselves. Supporting the policies to deliver a grid that is designed to support a diversity of renewable energy sources from a much broader range of generators is in the interest of all classes of customers, both in terms of long-term cost and energy security.

Greening the broader grid will take time, but it is critical that companies who want affordable renewable electricity work together with consumers to deliver the policy changes needed to drive this transition. Internet companies and grassroots activists have recently worked together to great success in the US and elsewhere to secure policies to protect "net neutrality," over the objections of another once seemingly mighty monopoly utility class in the telecommunications sector. We need an electricity grid that makes renewable energy available for everyone, not just those users who can afford a "clean lane" of electricity, and we need internet operators to become much more active in legislative and regulatory decision-making to overcome the strategy of utilities to maintain the dirty energy status quo.

03

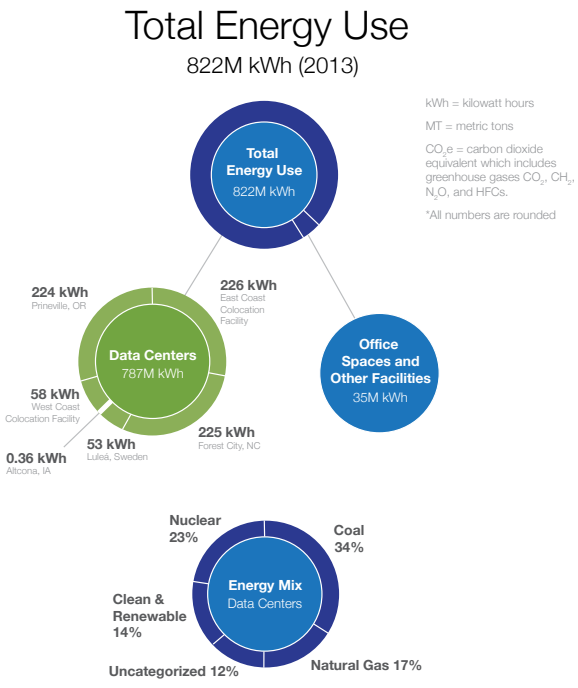
Server rack cluster
in a data center



Road Map to a Green Internet

03

When considering how to power a data center with renewable energy, it is often difficult for data center operators or customers to identify where to begin and which pathways will be most impactful. While the options available can vary dramatically for any one particular site based on the energy policy and market conditions of the jurisdiction, the following roadmap provides an updated look at best practices in the sector, and offers guidance for developing a successful long-term roadmap.



Screenshot from Facebook's page detailing its carbon and energy impact.

1) Energy Transparency

Customers need clear, reliable data to evaluate the environmental performance and carbon footprint of their IT vendors and suppliers.There has been a significant improvement in transparency among leading companies in the past three years, and general improvement across a broader segment of the sector. But many major internet companies, most notably Amazon Web Services, continue to refuse to provide even the most basic information on their energy and carbon footprint. The lack of transparency from Amazon and others makes it impossible for both individual and corporate consumers who value sustainability to effectively benchmark their options.

To evaluate a company's progress toward becoming 100% renewably powered, two levels of detail are essential: (a) baseline data on annual energy consumption, energy mix and greenhouse gas emissions, including location-specific information for all significant facilities, and (b) details on the nature of any on-site generation or market purchases of electricity made directly or on the company's behalf.

While there are a number of energy performance metrics that have been developed specifically for data center operators, few operators have moved beyond the adoption of Power Utilization Effectiveness (PUE), which does not provide any insight into the environmental impact of a data center. The level of reporting of market-based renewable electricity purchases has varied widely, and often does not reflect the actual impact of what has been purchased.

However, the recent Scope 2 Guidance update to the WRI/WBCSD Greenhouse Gas Protocol will hopefully drive more consistent and transparent reporting of electricity data.[62] The updated Scope 2 Guidance includes a new requirement for dual reporting of (1) the energy mix associated with the local grid; (2) details on what market-based purchases of electricity have been utilized, including details on the resource type of the supplying facility, facility location, and facility age.

Right Turns: 

-Apple, for publishing:

- Facility level-detail on energy consumption.
- Impact associated with its on-site renewable energy deployments and market purchases.

Wrong Turns: 

Amazon Web Services—for providing only partial details on its renewable energy purchases, but no details on its underlying energy footprint. Without knowing the details of Amazon's energy footprint, it's difficult for customers to take its recent commitment to 100% renewable energy[63] seriously. Amazon is one of the last large IT companies not to disclose any information about its energy use or carbon footprint.

2) Renewable Commitment & Siting/Procurement Policy

The number of companies that have made a commitment to be 100% renewably powered jumped again in the past year, both inside and outside the data center sector. These long-term commitments send a powerful signal to the marketplace that greater access to renewable energy and the desire to grow sustainably is of growing importance to the business sector, and is only increasing.

Given the significant growth in energy demand among data center operators, these commitments tell current and potential electric utilities that if they want to do business with renewable energy-committed companies, they must be able to offer a renewable product.

To ensure such commitments have the intended impact in the market, long-term commitments by data center operators should also include: (1) adequate energy transparency [see Energy Transparency, page 23]; (2) interim targets & a renewable energy strategy to ensure companies are maximizing their impact [see Strategy for Increasing Renewable Energy Supply, page 25]; (3) a siting policy that includes access to renewable energy.

Location matters: Site selection is a critical decision for determining at least the near-term sustainability of a facility, whether a company is building or renting data center space. What options are available to manage a facility's energy footprint are heavily impacted by location, with the ability to leverage outside air cooling and access to renewable electricity the most significant factors.[64] Companies have the greatest amount of leverage with local utilities and policymakers prior to committing to a new location or expansion of a facility, and they can use that leverage to secure the necessary access to renewable energy, or tax incentives to help defray any additional costs for securing renewable energy.

Right Turns: 

- Apple and Google negotiated to ensure recent data center expansions in Arizona and the Netherlands respectively will be powered by renewable energy from nearby projects as soon as the facilities come online.
- Facebook developed an interim goal for its 100% renewable energy commitment, with an aim to be 25% renewably powered by end of 2015, and is set to meet that benchmark.[65]

Wrong Turns: 

Amazon Web Service's plans to build yet another data center in fossil fuel dependent Virginia were revealed in early 2015, with no evidence that the company will purchase renewable energy for its operation.[66] Microsoft similarly announced a significant expansion of data center operations in Virginia in 2014 with an expansion of its data center in Boydton and a significant sublease of wholesale colocation space from Yahoo.[67]

3) Energy Efficiency & Greenhouse Gas Mitigation

Significant improvements in data center design to reduce cooling costs and improve utilization of data center compute resources have been a key factor in curbing the rapid growth in energy demand of the sector to date, though much more widespread adoption of best practices is certainly needed. The Open Compute collaboration has played an important role in sharing energy efficient data center and server design, and further innovations in energy savings and compute utilization must continue to accelerate if a renewably powered internet is to be realized.

In addition to best practices, data center operators and customers should regularly report their energy performance and establish transparent energy savings targets.

Right Turns:

Akamai's energy performance target for delivered data, on which it updates performance regularly.

Wrong Turns:

Microsoft's shift away from its previous energy intensity goal to carbon neutrality claims, which it meets only by the purchase of carbon offsets.

4) Strategy for Increasing Renewable Electricity Supply

Transitioning our online world to being 100% renewably powered will certainly not happen overnight. Though it is possible in some markets for a company to write a check for enough paper renewable energy credits to allow it to claim to be a 100% renewable company, such claims are in name only, and unlikely to have any impact on the supply of electricity powering its facilities.

Those companies interested in actually changing their electricity supply and supporting more green electricity on the grid for everyone must avoid such shortcuts. To help companies resist an increasing array of tempting renewable energy "solutions" that are being offered to data center operators, they should adhere to three key principles in evaluating options for securing a renewable supply of electricity:

1) Additionality

Internet companies should ensure that their renewable electricity commitment is directed in a way that it will have real impact, supporting the addition of new renewable electricity onto the grid that displaces dirty electricity demand. Unbundled renewable energy credits do not drive new renewable energy development.

2) Sustainable Sources

The definition of renewable electricity varies slightly depending on the country or state. Companies should ensure the source of renewable electricity is truly renewable (see Is It Green?, page 26), and provide details about what it considers renewable to customers and stakeholders.

3) Local

Related to the additionality principle, companies should work to have their renewable electricity supply come from as local a source as feasible, to drive greater investment in renewable energy by utilities in the same area of the grid in which a company's facilities have added demand, in order to displace demand from local fossil generation sources. Leading companies such as Apple and Google have established purchasing and policy design principles to guide their own company's path toward 100% renewable electricity.

Right Turns:

Both Google and Apple document in detail their commitment to using additional energy that displaces dirty sources from the same grids from which they have demand.[68,69.] Apple has aggressively pursued its strategy across its operations, managing to pursue local, additional and renewable energy across its full data center footprint.

Wrong Turns:

While Microsoft has procured renewable energy on the same grid as two of its data centers via power purchase agreements for wind energy, it continues to rely on unbundled renewable energy credits (RECs) and carbon offsets to support its claim of carbon neutrality.[70]

Amazon has provided no evidence for how its "carbon neutral" claims for its data centers in Oregon or Germany are additional or local.[71]

Is it green?

Nuclear

Nuclear power plants create unacceptable risk to the environment and human health and are an expensive diversion from the deployment of renewable energy and energy efficiency required to stave off the worst impacts of global warming. Efforts to revive the nuclear industry in the US have largely failed due to the impossibly high costs of building and maintaining nuclear power plants – that money is best spent on renewable sources of power.[72]

Hydropower

Hydropower is the most established baseload clean energy source. Sourcing energy for a data center from existing hydropower reduces carbon emissions and is more environmentally friendly than powering from a predominantly coal, gas, or nuclear powered grid. However, using existing hydropower does not lead to investment in new renewable energy capacity, and large hydropower projects can have detrimental effects on local environments. In many parts of the US, existing hydropower is fully subscribed, which means that increasing demand in hydropower-heavy grids could ultimately lead to new fossil fuel investment if companies do not demand renewable energy.

Well-planned and managed small-scale or microhydro power projects have much less impact on river ecosystems, and have the potential to provide a scalable baseload power source for data centers.

Geothermal

Geothermal energy is a consistent and renewable source of power in areas of the world where it can be found. It provides significant and growing electric generation in countries like the US, Iceland, and Indonesia. In 2014, 620MW of new geothermal power were added globally, with developing countries like Kenya and the Philippines leading the way.[73]

Biogas

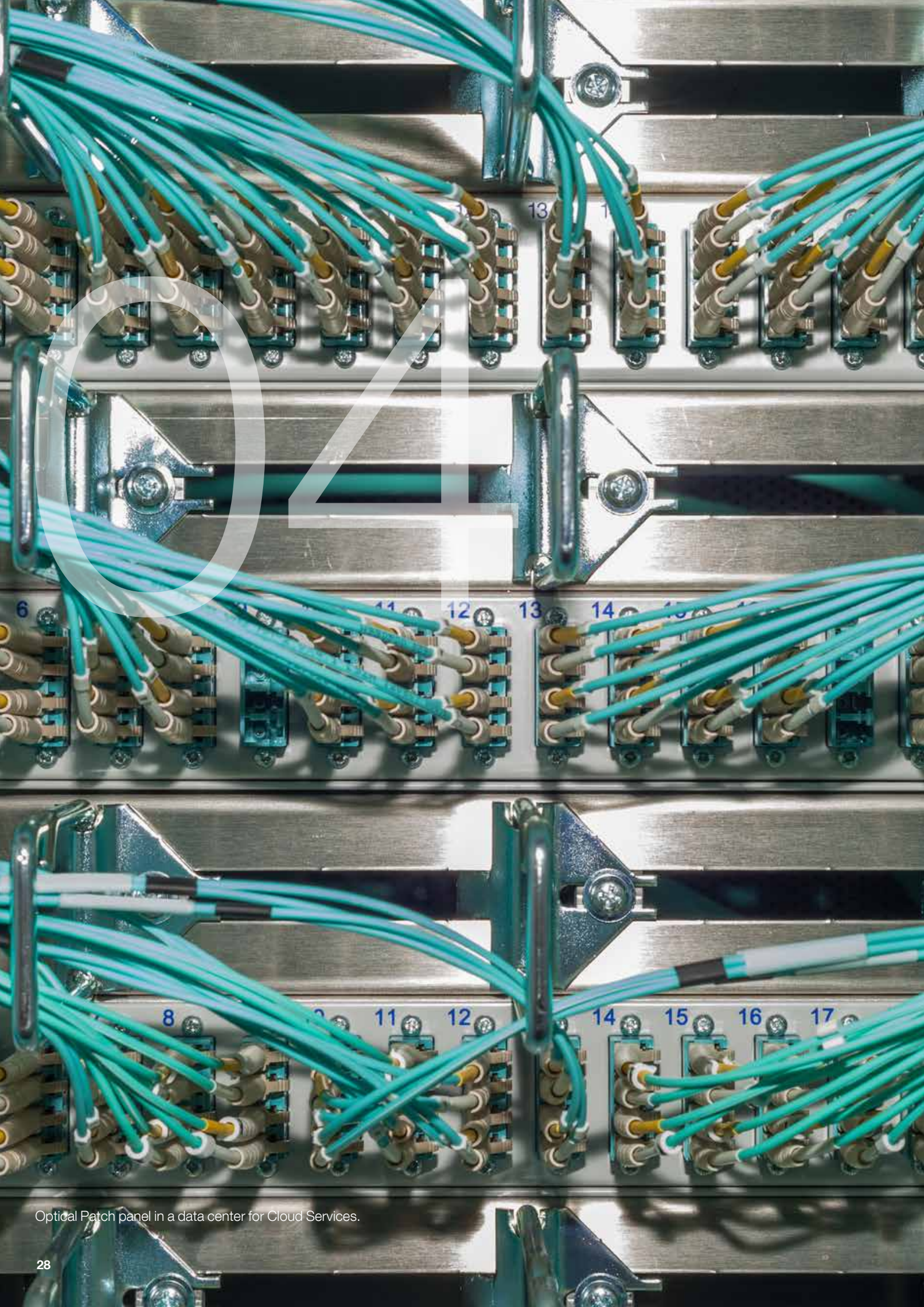
Biogas can come from many sources; methane from landfill sites and anaerobic digestion of farm waste or sewage sludge are the most common. The environmental benefits of biogas vary widely depending on the source.

Biomass

Large-scale biomass used for electricity generation can create significant environmental problems, as the source of biomass is likely to come from unsustainable sources. Wood pellets from the southeast US are currently being shipped to the UK and other parts of the EU, simultaneously driving deforestation and undermining climate protection goals in both countries.[74]

Fuel cells

A small but increasing number of data center companies are deploying natural gas-powered fuel cells on site as both primary and backup power supplies. Fuel cells can be a good mitigation strategy when used as a primary power source to unplug a data center from a coal-fired grid. Nonetheless, natural gas is not a renewable energy source, even when used in fuel cells.



04

Optical Patch panel in a data center for Cloud Services.

Powering Data Centers with Renewable Energy: A User Manual

04

As companies increasingly recognize the financial, environmental and reputational benefits of powering their digital operations with renewable energy, they face a range of different options for how to procure electricity from renewable sources: some companies are buying wind energy via long-term contracts, while others are installing solar farms on or near their property. Some companies have subscribed to a utility green tariff program, while others are lobbying regulators for more options. These and other options have different impacts, offer different benefits, and are not mutually exclusive. The right course depends on the details of a company's footprint, and should keep fidelity to the principles of additionality, attachment to local demand, and sustainability as described above.

(A) Market Solutions

(1) On-site investment

On-site or near-site deployments of renewable energy are the most straightforward to assess for their impact, since on-site renewable energy investments are inherently additional and local. However, given the energy density of data centers, on-site renewable installations such as solar may only be able to provide a small percentage of the total facility power demand. Apple has led the charge in deploying on-site or nearby renewable energy investments, but other data center operators are increasingly exploring on-site renewable energy as utilities continue to drag their feet in providing renewable energy. On-site or near-site renewable developments also send an unambiguous signal to power companies that they risk losing their customers' money if they do not respond to their demands, giving teeth to customers' demands for a greener offering.

(2) Power Purchase Agreements (PPAs)

Secure, long-term (10-20 year) power purchase or utility contracts between leading data center companies and renewable energy developers have served as an important engine in financing new renewable energy projects, particularly in the US. By providing a guaranteed buyer of both the underlying electricity and the renewable electricity credits ("bundled" renewable electricity), the data center operator serves as a committed and credit worthy offtaker, or purchaser of the energy. This commitment allows the energy developer to secure financing, driving additional renewable development. For the data center operator, long term PPAs can deliver a guaranteed price of electricity, providing protection against future increases in the price of traditional grid power.

Virtual PPAs

It is possible to enter into a "Virtual" or "Synthetic" PPA that does not require the actual delivery of electricity to the buyer; instead, the electricity is resold to the open market, with the buyer keeping any underlying RECs, which can then be retired. If a company executes a virtual PPA in the same electricity market in which it operates a data center, then a virtual PPA can still be a credible way to add renewable energy and displace demand for dirty energy on the same grid.

(3) REC & GOO Only Purchases

Renewable energy credits (RECs) - or their European equivalent, guarantees of origin (GOOs) - are products created when renewable energy is generated, used to confer the environmental attributes of the renewable energy to the REC owner. In many markets, companies can buy and sell these credits, unbundled from the electricity itself.

There have been a flood of RECs onto the market in both the US and the EU, driving the price of renewable credits not needed for compliance purposes to record lows. Many of these credits originate from projects that have been in existence for many years, and the minimal additional revenue generated from their sale does little to drive additional renewable generation capacity, or displace demand for dirty sources of electricity.

Due to the lack of impact in displacing fossil fuel generated electricity from the grid, and the lack of any benefit in the form of a hedge against rising electricity prices to the buyer, most IT companies have shifted away from pursuing unbundled REC products as a central strategy, and shifted to more impactful approaches. The voluntary unbundled REC market stopped growing for the first time in 2014, so customers broadly may be moving away from these low-impact products as higher-impact renewable options with greater upside become cheaper by the year.[75]

There are notable exceptions in the IT sector, however, most notably Intel and Microsoft, which continue to rely primarily on buying large amounts of unbundled RECs and GOOs to allow them to claim to be 100% renewable powered, and in the case of Microsoft, "carbon neutral." While this strategy does earn Microsoft and Intel top spots in the US EPA's Green Power Partner rankings,[76] the electricity the companies actually buy is mostly whatever electricity mix is available from the local grid. As illustrated by Microsoft, which recently expanded its data center operations in both Virginia (37% coal, 2% renewable) and Wyoming (64% Coal, 8% renewable), the PR value to the company would appear to be their strategy's greatest impact.[77]

If companies do buy unbundled REC/GOOs, they should at a bare minimum buy RECs that demonstrate strong additionality, and are in close proximity to the facilities they wish to claim are renewable. Before doing so, they should also evaluate what opportunities there may be to make more direct investments in renewable energy or push utility and government policymakers to add more renewable energy to the grid and increase the options for customers of all classes to have the ability to choose a clean electricity supply.

(4) Utility Choice /Direct Access

Many markets in the EU and US have full retail choice in terms of electricity supplier, allowing the data center operator to choose from a range of electricity providers and products. In the US, Direct Access (DA) programs exist where the market is not fully deregulated at the retail level, but DA allows a customer to purchase electricity from an electricity supplier other than the local utility, potentially creating stronger options for securing a renewable electricity supply. Direct Access is not available in every jurisdiction, and is often restricted to a small number of customers (California) or has a limited number of eligible providers (Oregon).

5) Utility Green Energy Tariffs

Data center operators aiming to procure renewable energy might prefer to have electric utilities simply offer them a 100% renewable energy product, avoiding some of the transactional costs of third-party deals, as well as the obstacle that such deals aren't legal in many countries and US states.[78]

Within the last three years, utilities have begun to respond to that demand by offering what are commonly known as "green tariffs," or rate structures that sell 100% renewable energy to large customers. Some kind of green tariff program was available in at least 10 states as of August, 2014.[79] The IT sector was instrumental in catalyzing these tariffs,[80] with Google publishing a white paper outlining what it wanted to see in a successful tariff, but as utilities have started making these offerings, the results have been a mixed bag at best.

In Nevada, Apple helped develop NV Energy's GreenEnergy Rider, which it used to co-develop with the utility an 18-20 MW solar array.[81] The Nevada Rider's rate features no additional administrative fees and is designed to reflect the cost of the renewable resource.[82] In Arizona, an experimental renewable energy tariff offered by the utility Arizona Public Service (APS) contains some premiums and other stumbling blocks for customers,[83] but at least has found a data center customer in IO, a colocation company which was able to procure renewable energy from APS for its customers with no additional mark-up. APS officials said the deal helped keep IO as a customer.[84]

Unfortunately, the Apple and IO examples have been more the exception than the rule, as it has seemed that most utilities' green tariff options have not reflected what large customers have said they want and need. In the places where green tariffs have the most potential to help companies clean up their electricity supply – monopoly utility markets like North Carolina, Virginia and Taiwan – they have been ineffectual. Duke Energy (North Carolina) and Dominion (Virginia) have yet to sign up a customer for their programs.[85]

The lack of interest should not be surprising given that neither program was designed to meet customers' interests. Google's 2013 paper calling for green tariff options suggested that "costs associated with the procurement and delivery of renewable energy should be passed on to participating customers at a rate reflecting the actual cost of service."[86]

Instead, both Duke and Dominion's programs charge significant "administrative fees" on top of any incremental costs of renewable energy generation. Dominion charges an additional .006 or .007 cents/kWh, with Duke charging even more, at .02 cents/kWh.[87] On top of the premiums, Dominion's offering for individual customers is capped at 24,000 MWh per year; for perspective, Apple's solar and fuel cell installations at its North Carolina data center generated seven times that amount of electricity in 2013.[88] Many single data centers in Dominion's territory demand far more energy than that cap, meaning that customers can't take full advantage of economies of scale by pursuing larger renewable energy deals.

B) Clean Energy Advocacy

In many markets, companies' ability to power with renewable energy will remain severely limited without policy changes. Even in more liberalized markets, it behooves companies to advocate for policies that will green the broader grid, narrowing the ground that they need to cover to power with 100% renewable energy.

Companies can and must become advocates with the regulators and policymakers who ultimately have the power to change markets in ways that will allow companies to achieve their renewable energy goals. State policymakers covet data center investments, offering significant tax incentives to companies to lure them into their borders.[89] Companies could compel a similar race to the top on renewable energy.

Some companies have begun to exercise their political and market clout to demand more and better renewable energy options and policies:

- Facebook and Microsoft advocated on behalf of distributed energy generation to the Iowa Utilities Board in 2014.[90]
- Google submitted strongly pro-renewable energy comments to the EPA in response to its Clean Power Plan in 2014, even calling for EPA to increase its "modest" and "conservative" renewable energy goals.[91]
- Major electricity consuming companies banded together in 2014 to form the "Corporate Renewable Energy Buyers' Principles" which call on regulators and utilities to expand access and options for corporations to pursue renewable energy. IT companies that signed the principles include Facebook, eBay, Cisco, Adobe, EMC2, io, Salesforce, Yahoo and Intel.[92]

Road Map for Companies:
How to Green Your Corner of the Internet

Start
Do you Want to Make Your Corner of the Internet Green?

2
Commit to a goal of powering with 100% renewable energy.

3
To ensure new growth is green…

4
For new data centers you will build and own…

5
If you're expanding your colocation footprint…

6
If you're expanding your footprint in the cloud…

7
Establish a siting policy requiring access to renewable energy

8
Establish a procurement policy for providers to offer access to renewable energy.

9
To ensure existing infrastructure is green…

10
Determine how clean your cloud is right now (electricity use, energy supply and carbon data).

11
If in the cloud, request energy data from cloud providers.

12
If in colocation facilities, get energy data from colocation providers.

13
If you own the data center, get energy data from the utility.

16
Set energy efficiency performance targets and publish the results.

PUBLISH your GOALS, STRATEGY and SUCCESSES to customers as you make progress. REFINE with interim goals and benchmarks.

Choose your STRATEGIES to become renewably powered.

17
Simply purchasing unbundled RECs?

18
STOP. RECs don't make your corner of the internet greener, and aren't a good primary strategy. Identify options for a better strategy.

19
My provider refuses to tell me energy data, or let me disclose it.

20
Switch providers. Others may be more cooperative.

or

21
Find allies. Approach provider jointly with peer customers to increase pressure.

22
If you own your data center…

23
If you're in colocation data centers or in the cloud…

24
Can you provide your own renewable energy via an on-site installation?

25
Can you buy renewable energy directly from a developer via a PPA or virtual PPA?

26
a PPA or virtual PPA? Can you procure 100% renewable energy from the utility?

27
Will your colocation or cloud vendor provide you with renewable energy?

or

28
Can you switch to a region from your provider that's powered by 100% renewable energy?

29
If yes...

30
If no...

31
If no...

32
LOBBY POLICY-MAKERS to change the rules to allow you better options to procure renewable energy, approaching them jointly with allied companies if necessary.

31.5
If yes...

For footprint with cloud computing providers
For footprint in colocation space
For footprint in owned data centers

Unfortunately these examples are still limited, as companies are not using their political clout to the extent that they have to lobby for tax breaks. Especially in the places where utilities present the most difficult obstacles to renewable energy – markets like North Carolina, Virginia, or Taiwan – IT companies have yet to weigh in with policymakers to the degree necessary to create significant change. Opportunities abound for companies to push for pro-renewable energy policies:

- In North Carolina, many of the same legislators currently aiming to offer data center operators tax breaks on electricity sales[93] are also weighing a bill that would allow customers the ability to buy renewable energy from third parties other than local monopoly utility Duke Energy.[94] The state is one of only five in which the practice, considered crucial to renewable energy expansion, is expressly illegal.[95] Data center companies that are committed to renewable energy and have been unable to procure it from Duke Energy, like Facebook and Google, could benefit from the passage of third-party sales legislation. State tax incentives for renewable energy, which could materially benefit data center operators in the state that wish to install on-site solar power as Apple has done, are also set to expire at the end of 2015.[95]
- In California, legislators are submitting bills to increase the state's renewable energy portfolio to 50% by 2030.[97] Many IT companies have headquarters in the state, or Santa Clara-area data centers, which give them standing to advocate for these policies that will help them become more renewably powered.
- Virginia, which hosts one of the most concentrated data center hubs in the world, currently prohibits customers from making third-party power purchase agreements for over 1 MW of electricity.[98] The cap, instituted as part of a settlement by Dominion Energy, makes even this pilot program allowing PPAs essentially useless for large electricity customers like data centers. The program is up for review in 2015 by the State Corporation Commission, and data center companies like Amazon and Equinix that are committed to renewable energy could use the opportunity to weigh in on behalf of a PPA program that allowed them to pursue renewable energy.
- In Oregon, another data center hub, legislators have introduced a bill to eliminate the coal-fired electricity that forms roughly one-third of the state's electricity mix and replace it with renewable power.[99] While some of Oregon's data centers are powered by hydroelectric power, which can make the state a better choice than coal-fired locations like Virginia, power demand in the Northwest has finally exceeded the limits of the region's hydropower.[100] The region's growing data center sector is driving power demand growth, and new tax breaks to welcome data centers have companies like Amazon saying that it will build as many as 11 new data centers in the state.[101] This new electricity demand will be met by either renewable resources or fossil fuels (most likely gas power) and data center companies that are committed to renewable energy have the opportunity to lobby aggressively for policies that will make it easier for them to meet their goals.

Colocation Operators: The Landlords of the Internet

While the data centers of the major internet and cloud companies generally get the greatest attention from the public, a major chunk of the internet is hosted by "colocation" data center operators, which serve as the digital landlords of our online world. Most colocation companies, even the largest, are not well known outside the data center sector, though electric utilities are keenly aware of their large electricity needs.

Given the significant percentage of our online world that is hosted by either retail or wholesale colocation providers, colocation data center operators have a critical role in building a renewable powered digital world. But as a class of data center operators, colocation companies have thus far lagged far behind consumer-facing brands in efforts to deliver energy efficient and renewably powered data centers.

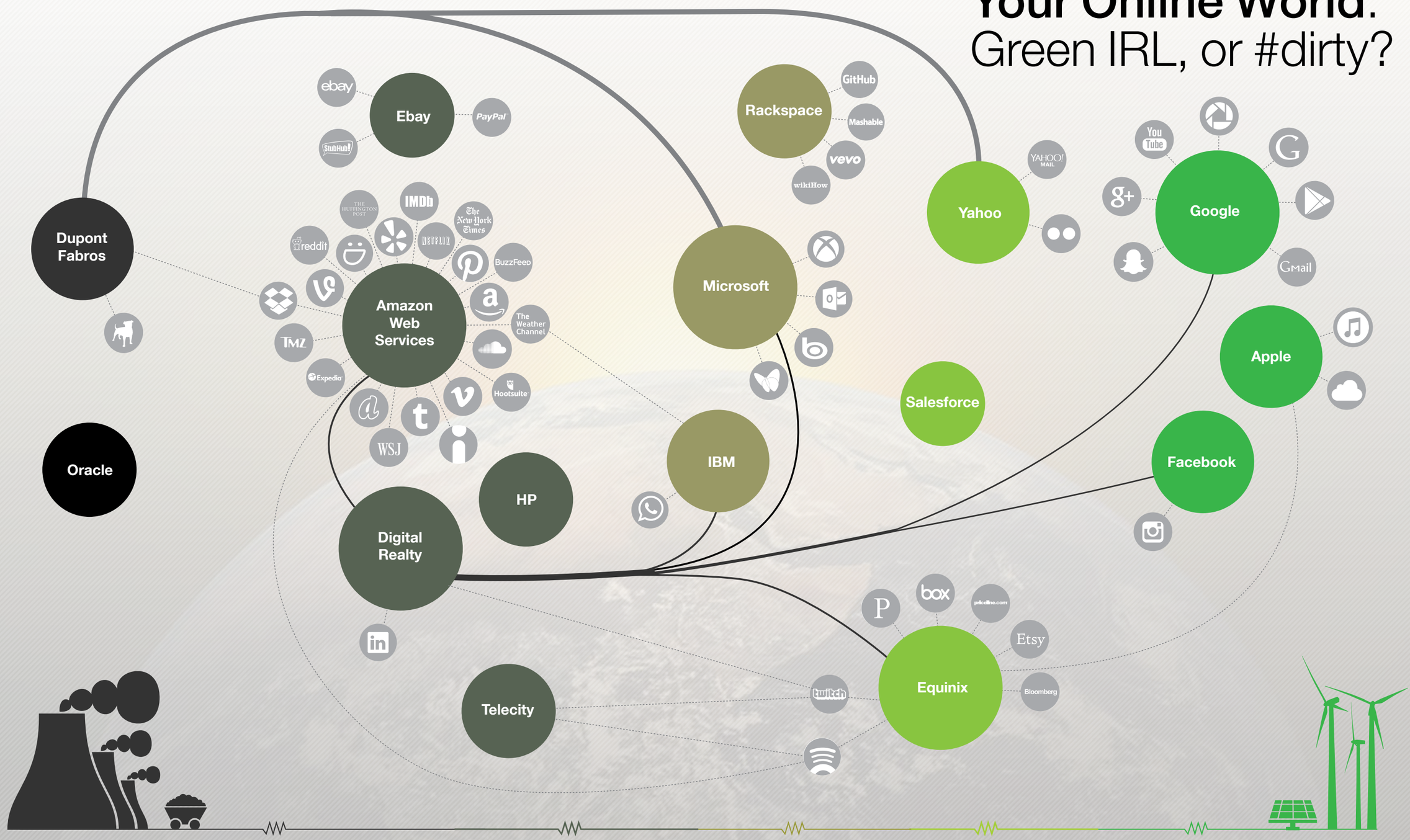
This has begun to change in the past year, as colocation customers both large and small have begun to make commitments to be renewable powered, demanding the ability to power their servers with renewable electricity. The recent commitment by retail colocation giant Equinix to become renewably powered,[102] and its related announcement that it would begin offering meaningful renewable energy options to customers marks a significant shift. But other companies have only begun to realize that not having any renewable offerings will soon become a significant competitive disadvantage.

Additional signs of change among colocation data center operators include:

- In response to customer demand, IO worked to get a special renewable tariff from the local utility for its Phoenix data center by aggregating customer demand and offering renewable electricity on a pass through basis with no premium beyond the cost of the energy resource.[103]
- Wholesale colocation giant Digital Realty Trust established a renewable electricity offering, with a year's worth of free renewable energy credits (RECs) as a way to entice customers to sign a new lease.[104] However, simply providing unbundled RECs or facilitating their purchase is not an impactful option or enticement for those companies who want to legitimately power their operations with renewable electricity in a way that meaningfully improves their electricity supply. Digital Realty Trust should expand its menu and help facilitate more impactful purchases of renewable electricity for its customers.

Rather than offer to facilitate unbundled REC purchases for customers that provide little value or impact, Digital Realty Trust and other major colocation operators should prioritize efforts to aggregate customer demand and offer bundled, additional renewable energy to customers for their campuses where renewable energy is easiest to procure now. For operations in regulated monopoly markets where no value-added renewable energy options exist, colo operators should work in partnership with interested customers and other data center operators to lobby utilities, regulators, and legislators as necessary to open the market to renewable electricity providers. Northern Virginia, a major colocation data center hub where the energy mix is overwhelmingly powered by fossil fuels, provides an excellent test case for colocation companies to collaborate with their customers to bring more renewable energy to their operations and the broader electricity grid.

Your Online World: Green IRL, or #dirty?



While the companies assessed in this report own or operate their own data centers, most companies either rent server space in colocation facilities, host their operations with cloud computing vendors and content delivery networks, and many employ some combination of these options.

While these customers may not operate the mega data centers that Google, Amazon and Microsoft do, their role in building a greener internet is just as important. Data center operators and cloud computing vendors will prioritize powering with renewable energy only when their customers demand it, and those customers need to step up to the challenge.

Outside of the colocation companies, no company could do more to make our favorite sites green than Amazon Web Services. AWS is the dominant player in cloud computing, owning over one fourth of the market by one estimate, over triple the market share of Microsoft, its nearest competitor.[105] AWS customers should push the company to become more transparent about its energy footprint, and to make clear what strategies and principles it is using to reach its 100% renewable energy goal, particularly in its dirtiest regions, like Virginia.

The graphic on this page offers a sampling of where some of the internet's most popular sites and services are being hosted – and the relative greenness of the energy that those data centers are using. Energy demand symbols are not drawn to scale and are meant to offer a relative indication.

Appendix 1
Methodology

Clean Energy Index Methodology (Column 2)

Greenpeace has established the Clean Energy Index as a response to the lack of useful metrics and publicly available data to evaluate and compare the energy footprints of major cloud providers and their respective data centers.

This lack of data is not due to the fact that data does not exist. However, many companies remain unwilling to provide basic information about both the amount and source of their growing electricity consumption. Despite a proliferation of metrics created by the industry (such as PUE) that attempt to quantify how green a data center is as measured by energy efficiency, very few companies report under newer metrics (such as Green Energy Coefficient, GEC) that could shed any light on the basic question: how much dirty energy is being used, and which companies are choosing clean energy to power the cloud?

The Clean Energy Index attempts to provide a basic answer to this question, based on what is provided by companies or gleaned from the limited information available, and focusing on recent data center investments of select brands and the current clean energy supply associated with each investment.

Starting with an initial set of some of the largest cloud providers, Greenpeace has attempted to identify two main inputs from a representative sample of their most recent (five years or less) infrastructure investments.

Those inputs are:

(1) Estimated size of electricity demand of each facility (in megawatts);

(2) Amount of renewable electricity being used to power it (by percentage).

This information is then used to approximate, initially on a facility level, the number of megawatts of clean energy the facility will consume. Having calculated a facility-level Clean Energy Index for a representative sample of data centers, Greenpeace derives a company average of clean energy percentage across its facilities.

In compiling the information included in this report, Greenpeace contacted all companies featured here and asked for information regarding their data center facilities, and for information on their energy commitment and infrastructure siting, energy efficiency and mitigation efforts, and renewable energy deployment and advocacy. Where clear and consistent information is not provided by the company, Greenpeace made estimates of data center power demand available to companies for comment in advance of publication, and issues raised by the companies are highlighted in footnotes on the scorecard.

The above inputs are taken from the following sources:

- Submissions by companies directly to Greenpeace
- Public submissions by companies to reporting entities or stakeholder publications
- As defined by company when announcing investments
- As reported by the media (in stories on the investments or construction of facilities, etc.)
- Electricity demand is derived by taking the announced size of investment and deriving total number of MW, using industry average cost per IT load ($15m U.S. dollars per MW) multiplied by publicly available PUE for facility or, if not available, 1.5 for new facilities.
- For Amazon Web Services, which does not report any energy information on its data centers, Greenpeace estimated facility capacity using a combination of publicly reported investment data, backup generator permits filed with state or national regulators, and independent estimates of Amazon's EC2 servers counts by region, found here: http://huanliu.wordpress.com/2014/02/26/amazon-ec2-grows-62-in-2-years/
- When using backup generator permits, Greenpeace made conservative assumptions regarding the total power the generators are needed to cover, as well as the number of generators deployed for redundancy.
- If not reported by the company, the generation mix of the electricity is taken from one of the following sources, as available, in declining order of preference:
- The most recent published generation mix of the local utility
- In the U.S., the 2010 eGrid State level generation mix (9th Edition) as reported by U.S. EPA, or if not applicable, reported subregional egrid generation mix
- Outside the U.S., national data, then European Commission data, and then International Energy Agency 2010 - 2012 statistics.

Important Note: This analysis does not attempt to represent itself as a comprehensive snapshot of how much clean energy is being consumed on a company-wide level. Only the companies can properly provide that.

Greenpeace would welcome the opportunity to incorporate more detailed data to inform our analysis, as that would likely provide a more complete and refined picture of cloud providers' energy use. As companies provide better data, Greenpeace will incorporate this into our evaluation and encourage other companies to follow.

For those companies who have adopted 100% renewable energy targets and provide facility level energy details, Greenpeace uses current consumption and renewable procurement data provided by the company instead of ultimate facility capacity.

Coal, Nuclear and Gas Intensity (Column 3)

A company's coal intensity is a simple calculation of the approximate total percentage of coal-generated electricity powering the company's data centers. A company's nuclear and gas intensities are similar: simple calculations of the approximate total percentages of nuclear- and gas-generated electricity powering the company's data centers.

This is calculated initially on a facility level, based on the estimated maximum power demand of the facility and the percentage of coal and nuclear-generated electricity supplied by the contracting utility or the local grid.

The company-level intensity of coal, nuclear and gas energy is rendered by adding the total MW of estimated maximum power from coal, nuclear and gas generation across the sample data center fleet, divided by the total estimated MW maximum power demand of the same sample data centers.

Energy transparency methodology (Column 4)

Companies are evaluated on the scope and level of detail made publicly available on energy consumption of IT infrastructure that allow stakeholders and customers to evaluate the energy-related environmental performance and impact at corporate, product, and facility level. Public information includes information from a company's website, annual reports, submissions to regulatory agencies or information clearinghouses such as the CDP.

- For corporate and facility-level reporting, key elements of information include: location and size of facilities; size of electricity demand; generation mix and associated carbon content (including power purchase agreements specific to the facility), and carbon intensity of data delivery and storage. Reporting should include both owned and rented facilities.
- For customer level reporting, companies should provide regular energy and carbon footprint information (pre-offset) associated with the customers' consumption, reported in a manner consistent with established reporting protocols.

Renewable Energy Commitment & Infrastructure Siting methodology (Column 5)

Companies are assessed on the strength of their commitment to powering their data centers with renewable energy, including infrastructure siting criteria and investment decisions that enable the development of the company's IT infrastructure to maximize the use of clean sources of energy, and avoid an increase in demand for coal or nuclear power to meet the growing demand for electricity from their operations. High scoring companies demonstrate:

- Adoption of a 100% renewable energy commitment
- Renewable energy procurement guidelines that prioritize high impact methods of powering with renewable energy that demonstrate additionality, proximity to demand, and sustainability, as opposed to purchase of unbundled renewable energy credits or carbon offsets.
- A clean energy siting policy to prioritize IT infrastructure investments or procurements that rely primarily upon renewable energy as a source of electricity and discriminate against coal and nuclear power to meet infrastructure electricity demand.
- Consistent patterns of major infrastructure investment decisions that increase or shift electricity demand to renewable sources of electricity.
- Commitment to eliminate coal, nuclear and gas energy from powering company infrastructure.

Energy Efficiency & GHG Mitigation Strategy methodology (Column 6)

Companies are evaluated on the strength of their strategies and measurable progress to mitigate the demand for dirty energy generated by their IT infrastructure. The effectiveness and strength of a company's mitigation strategy is measured along the following guidelines:

- Companies with absolute emission reduction goals will be rated higher than those companies who adopt an intensity-based target.
- Companies are credited for participating in open-source sharing of energy efficient design and equipment specification to enable further learning & improvement within sector.

Renewable Energy Deployment & Political Advocacy methodology (Column 7)

Companies are evaluated on the strength of their measurable progress and commitment to renewable energy investments, as well as actions taken to advocate for ambitious policies at all levels of government that encourage wide-scale renewable energy generation and use. In reporting their renewable procurement, companies should follow the guidance established in the recently adopted Scope 2 Guidance of the Greenhouse Gas Protocol, which established clear reporting requirements for reporting market based purchasing of renewable electricity. High scoring companies also demonstrate:

- Efforts to meet electricity demand with the direct installation of renewable energy, and reduce emissions through higher efficiency will receive the highest marks.
- Investments in clean energy supply and local energy efficiency mechanisms. Greenpeace ranks those investments higher than the purchase of offsets and renewable energy credits to reach established environmental goals.
- Proof of long term commitment to renewable energy electricity through local renewable energy developers.

Appendix 2
Company scores explained

Akamai is one the largest global content distribution networks (CDN), helping online content providers deliver their content faster to users around the world. Akamai continues to expand with the rest of the internet, delivering between 15% and 30% of internet traffic through its network. As a CDN, Akamai's network is highly distributed, with over 170,000 servers spread across 1,300 data centers in 101 countries.[106] Akamai's distributed business model and relationships with data center operators around the world put it in a unique position to be a catalyst for a renewably powered internet.

Energy Transparency: A

Akamai continues to provide detailed submissions of its emissions profile and performance toward reducing its energy footprint through the CDP, including reporting its network's use of electricity and renewable energy by region of operation. Akamai will also provide to its customers upon request a monthly carbon footprint associated with content delivery through the Akamai network servers. Akamai provides the results of its annual sustainability survey back to its vendor network, providing a benchmark to assist data center colocation operators to understand how well they are performing in relationship both to their customers' expectations, and to the competition.

Renewable Energy Commitment & Siting Policy: C

As a CDN, Akamai's siting options are quite different than the data center operators that are the primary sources of online content. Because of its distributed nature, Akamai has business relationships with a broad range of colocation operators, and has at least been leveraging its influence with data center operators through an annual sustainability survey, and providing anonymous results to each vendor to inform them on how they compare with operators. However, given the tremendous amount of internet traffic Akamai is delivering, particularly streaming video traffic, simply measuring energy performance without using the data to guide procurement toward specific goals is no longer sufficient. If Akamai were to set a long-term goal toward being 100% renewably powered, with steady benchmark goals along the way that it then asked its colocation providers to work with it to achieve, this would have a tremendous reach into a range of colocation data center operators. Akamai is currently developing a renewable energy strategy for its network, which it hopes to release in the coming year.

Energy Efficiency & Mitigation: A

Akamai has maintained an annual target to reduce the carbon and energy intensity of traffic on its network by 30% each year since 2009, and with the exception of 2011, has exceeded this annual goal. For 2013, Akamai actually achieved an absolute reduction in greenhouse gas emissions despite steadily increasing peak traffic, an accomplishment attributable to shifting to more efficient colocation data centers and also shifting its development lab from Texas to a data center in the Pacific Northwest largely powered by hydroelectric power.

Renewable Energy Deployment & Advocacy: C

Because of its distributed model, Akamai cannot take advantage of the economies of scale associated with purchasing renewable energy directly to meet a concentrated demand for electricity. However, Akamai should be demanding that its colocation vendors work with it to provide more renewable energy, and continue to be proactive in taking opportunities to engage other internet companies on how to increase their use of renewable energy to power their data centers, through either direct purchase or policy advocacy. Akamai has become more active in supporting federal climate and clean energy policies, which is to be commended.[107]

Amazon Web Services (AWS), owned by Amazon.com, continues to dominate the cloud computing market, providing all or part of the digital infrastructure behind many of the best known and fastest growing online brands, including Netflix, Pinterest, Imgur and Reddit. While AWS remains highly competitive on price for its cloud infrastructure, a number of AWS customers have privately expressed concern over the lack of data and attention being paid to the environmental footprint associated with the AWS cloud. AWS did adopt a long-term commitment to 100% renewable energy for its footprint in November of 2014, and followed this up with its first direct purchase of renewable energy in Indiana in January 2015. AWS recently took an additional step of announcing a goal to be at least 40% renewably powered by 2016,[108] and also announced a small pilot of Tesla energy storage batteries at one data center, citing their potential to enable greater use of renewable energy.[109] Despite these potentially significant shifts, the continued lack of transparency on the energy performance of the AWS cloud, combined with significant expansion of its infrastructure in utility territories that have little to no renewable energy capacity, would appear to indicate that AWS has not yet determined how it is going to make its commitment to renewable energy become real.

Energy Transparency: F

By continuing to refuse to provide any information on the energy consumption or greenhouse gas footprint of its data centers and other infrastructure, Amazon falls further out of step not only with its IT sector competitors, but also with the rest of major global corporations. Amazon was among the three largest public corporations in the world that failed to report basic climate change data to CDP.[110] Although several AWS customers have reported that they have recently been provided energy footprint data for their use of AWS, the data has been provided under non-disclosure agreements,[111] which prevents customers for using it in their own public reporting. With over sixty percent of the Fortune 100 having both carbon and renewable energy goals in place. AWS's continued lack of transparency is a problem that will likely become a bigger concern to its customers.[112] AWS has recently stated that its is currently 25% renewably powered, but with no additional detail provided.[113] As it stands currently, neither customers nor stakeholders have an effective basis of evaluating AWS energy performance, or the context to properly assess the impact of any positive steps toward renewable energy the company may take, as recently evidenced by the recent wind contract AWS signed with Pattern Energy.[114]

The challenge posed by AWS' lack of transparency for customers is on display in Europe, where AWS says its Frankfurt facility is "carbon-free" but offers no explanation for how. Meanwhile, AWS has told Greenpeace that its Ireland region is powered by 50% renewable energy. Customers aiming to make siting decisions informed by sustainability may be left wondering which location is actually greener.

Renewable Energy Commitment & Siting Policy: C

AWS's adoption of a long term commitment to be 100% renewably powered is a potential big milestone in realizing a renewably powered internet. Unfortunately, unlike other major cloud and internet brands that have adopted similar commitments, such as Google[115] and Apple,[116] AWS has not elaborated on how it intends to go about achieving this goal, including any principles for securing a greater supply of renewable energy that it has it put in place. Given the lack of transparency noted above, it is also impossible to establish a baseline from which stakeholders and customers can track AWS's progress. AWS continued to rapidly expand its operations in Virginia in 2014. Greenpeace estimates that AWS added 200 MW of new data center capacity in Virginia in the past year, with four new facilities and a significant expansion at a fifth.[117]

Energy Efficiency & Mitigation: D

AWS proudly proclaims that cloud computing "is inherently more environmentally friendly than traditional computing," a claim that is made by other major cloud operators. Unlike Google and a number of other studies, AWS unfortunately does not contribute any data from its own operations to help establish its claim, or the extent to which it meets or exceeds the performance of on-site, hybrid, or other cloud platforms. AWS professes to have much higher utilization rates, and offers products designed to increase utilization by offering below-market cost server capacity at off-peak hours, which would certainly improve energy performance.

Renewable Energy Deployment & Advocacy: D

Unless AWS identifies a path to significantly alter the amount of renewable energy powering its US East availability zone in Northern Virginia, estimated to be home already to over half of AWS servers, AWS's continued expansion there will only make AWS and its customers more dependent on dirty energy. AWS maintains that it has three regions that are "carbon neutral": Frankfurt; US West (Oregon) & AWS GovCloud (US);[118] the latter two are housed on the same data center campus in Oregon.[119] Though AWS does not make public how it is able to make these facilities "carbon neutral," European AWS customers have been told privately at least that the Frankfurt facility is using renewable Guarantee of Origin (GOO) certificates, which are the EU equivalent of unbundled renewable energy credits in the US.[120] (see REC & GOO Only Purchases, page 29). AWS's first purchase of 150MW of renewable energy in Indiana, however, is a positive sign for the company's level of ambition going forward.[121] Although AWS has not indicated how this renewable energy will power its data center infrastructure, the announcement of a new AWS data center in Ohio is one possibility. This could have a high impact on AWS's growing footprint, potentially displacing the additional demand on the grid in that state, where the electricity is 70% coal powered and less than 2 % renewable.[122] It should be noted that Amazon was over two years ahead of the rest of the sector in withdrawing from the American Legislative Exchange Council (ALEC), the group that was a key obstacle to renewable energy and climate policy at the state level (see page 21).[123]

Apple continues to lead the charge in the race to build a green internet, and has significantly increased its impact as a change agent driving renewable energy in the past year. Apple's public commitment to be an environmentally responsible company and specifically to renewable energy has been significantly elevated since Greenpeace's last report, and embraced directly by its CEO Tim Cook on several occasions. Evidence of the strength of Apple's ongoing commitment to a renewably powered iCloud was strongly demonstrated in the past year as it underwent dramatic growth in its data center infrastructure in both the US and the EU; growth that it matched with an equal increase in renewable electricity. Apple's commitment to a 100% renewable cloud appears to be driving change not only among Apple's utility sector partners, but also among other major data center operators that play a supporting role in the delivery of Apple's online products.

Energy Transparency: A

Apple has steadily improved the amount of information it provides on the amount of electricity consumed at each of its data centers, and the source of electricity used to power each. In April 2014, Apple published a detailed breakdown on its progress toward 100% renewably powered data center operations, setting a high bar for other companies to match, including facility level information of renewable energy supply and the impact its renewable investments and procurement had,[124] in keeping with the spirit of the dual track reporting under the recently adopted Scope 2 Greenhouse Gas Protocol.[125] Apple also submitted an emissions report to CDP for the first time since 2010, scoring in the top percentile.[126]

Renewable Energy Commitment & Siting Policy: A

Apple's 2012 commitment to power its data centers with renewable electricity has proven to be a major driver in its siting of data centers. Apple announced three new data centers in the past year in Arizona, Ireland, and Denmark, and with each facility, made clear that it would be able to deliver renewable energy to power its operations. Apple's success in gaining the cooperation of Salt River Project, the utility for its newest data center in Arizona, as a partner for solar is particularly notable given the utility's hostility to solar growth among its residential customers. Apple has also continued to follow its commitment to prioritize delivering renewable electricity from either on-site or local sources for its data center operations.

Energy Efficiency & Mitigation: A

Apple continues to be aggressive in reducing its energy and carbon footprint for all of its operations, and recently achieved its 2014 reduction targets.[127] Apple has maintained a high level of transparency on its efforts to mitigate its carbon and energy footprint for each of its data centers, including in both its 2014 Environmental Progress report and also in its CDP submission. Apple's commitment to mitigate the energy footprint of its data center in North Carolina has been particularly impressive to date, but will demand regular investment as that facility continues to grow. Apple's recently announced data center in Viborg, Denmark will be designed to capture any excess heat from the data center and pipe it into the town's district heating system, heating other buildings.[128] Apple also recently announced its decision to join the Open Compute Project, which facilitates the sharing of design and other best practices among major data center operators.[129]

Renewable Energy Deployment & Advocacy: A

Apple remains the most aggressive among major internet companies in deploying renewable energy to power its corner of the internet. In North Carolina, while other data center operators like Facebook and Google have remained stymied in their effort to secure a supply of renewable electricity from Duke Energy, Apple has moved forward with its 3rd major solar installation in North Carolina to power its growing data center in Maiden.[130] Similarly in Oregon, while a number of data centers in the region have tapped into electricity from large-scale dams, Apple has also shown its willingness to invest in a micro-hydro project to deliver a sustainable supply of hydroelectric power for its Oregon data center.[131] Apple also announced an $850 million contract to buy over 250MW of solar for its Cupertino Headquarters and its Newark, California data center.[132] Apple's impact as a change agent among US monopoly utilities expanded this past year, as it was able to secure a commitment to jointly develop 70 MW of solar capacity with Salt River Project (SRP), the local utility for its data center now under construction in Mesa, Arizona.[133] SRP currently produces over 50% of its electricity from coal.[134] Apple has increased its public support for renewable energy and climate policy, as both CEO Tim Cook and Senior VP for Environmental Affairs Lisa Jackson have spoken with increasing frequency on the threat posed by climate change.

Operating from a recent starting point of having each of its three primary data centers powered by utilities with very little renewable energy supply and a high percentage of coal, eBay continues to take steps to reduce its data center energy footprint, both by changing the supply of electricity to cleaner sources and reducing its net energy footprint. eBay continues to earn high marks for its transparency, but while its strategy to date has been effective in limiting the growth of its greenhouse gas emissions, eBay must look to move from "cleaner" sources of electricity toward securing greater amounts of renewable electricity that are actually clean.

Energy Transparency: B

To eBay's significant credit, despite having a fairly high carbon electricity supply for its data centers with a relatively low amount of renewable energy; eBay has resisted the temptation to retreat behind a fog of "carbon neutrality," in which it simply buys carbon offsets and unbundled renewable energy credits, and has instead continued to improve upon its energy transparency, including sharper reporting in its 2014 CDP submission.[135] eBay's Digital Service Efficiency Dashboard continues to provide an important model for other data center operators on the value of providing clear metrics on its energy performance in a way that is integrated into important business performance metrics.[136]

Renewable Energy Commitment & Siting Policy: D

eBay is still managing the carbon implications of decisions taken in 2008 to shift primarily from colocation facilities to data centers it owns and operates in locations where the grids are powered primarily by coal. These siting decisions were a major factor in eBay's failure to meet its 2012 greenhouse gas reduction target of 15% below 2008 levels, instead coming in 224% above the target. While eBay can perhaps be forgiven for not wanting to have a repeat failure in achieving its environmental performance target, eBay should look for clearer and more transformational goals than the recently adopted goal of powering with at least 8% "cleaner" energy by 2015. Establishing a long-term goal for 100% renewable energy, as other sector leaders have done, with mid-term achievable milestones, would help drive critical conversations with eBay's electricity and colocation vendors on how they can help eBay become renewably powered. Those steps would finally help put eBay on a path toward reaching its long-term goal of becoming the "leading global engine for greener commerce."

Energy Efficiency & Mitigation: B

Although eBay reported a 10% increase in its GHG footprint in its 2014 CDP submission, this figure would certainly have been much higher if it were not for eBay's aggressive efforts to mitigate the dirty electricity supply of its Salt Lake City data center, where it has deployed an innovative combination of fuel cells and electricity produced from a nearby combined heat and power project.

Renewable Energy Deployment & Advocacy: C

eBay's early success in changing the law in Utah to allow companies to buy directly from renewable energy developers continues to serve as a compelling example of how motivated companies have the ability to change the rules needed to deliver a renewably powered grid.[137] Having opened the door, eBay needs to fully take advantage of options it has in Utah, as well as emerging options in both Nevada and Arizona; Apple has been successful in those states at opening policy options and setting new precedents for partnerships with local utilities to supply scalable renewable electricity. The extension of the NV Energy GreenEnergy Rider to the southern part of that utility's territory provides a fresh opportunity for eBay and other motivated customers who operate from the massive Switch NAP facility in Las Vegas to explore options for securing renewable electricity for this facility.[138] eBay's advocacy at the national and state level in the US has also recently picked up, supporting the CERES-led US Climate Declaration,[139] the CERES- led Oregon State Declaration,[140] and the Corporate Renewable Buyers Principles, which have the potential to lay the groundwork for better renewable energy supply options from utilities.[141] eBay also joined the tech sector exodus from the American Legislative Exchange Council (ALEC), the group that was a key obstacle to renewable energy and climate policy at the state level (see page 21).[142]

As the first major internet company to commit to be 100% renewably powered, Facebook plays an important leadership role within the sector in defining best practices in building a green internet. Facebook's establishment of the Open Compute Project continues to be an important catalyst in driving energy efficiency hardware design and software best practices for data center operators. Facebook's success in using the leverage of data center site selection for securing a 100% renewable energy supply for its fourth data center in Iowa was a critical breakthrough not just for Facebook, but also for other operators hoping to secure stronger partnerships with utilities to deliver renewable energy to their facilities. However, Facebook still faces significant challenges securing renewable energy for its first two data centers in North Carolina and Oregon, as well as it northern Virginia colocation space, challenges that will likely be solved only through sustained policy advocacy, direct investment similar to what Apple has done, or both. As it continues to expand its infrastructure to support Instagram, and Whatsapp, and its own social network, Facebook must continue to focus its efforts on high impact opportunities that will move its corner of the internet toward renewable energy for the long haul, and continue to resist the temptation to pursue short cuts that do not directly impact its electricity supply.

Energy Transparency: A

Although Facebook does not submit its energy and greenhouse footprint to CDP, it does provide a clear and easily accessible snapshot on its "Green on Facebook" page,[143] which allows for easy comparison of Facebook's energy footprint dating back to 2011, including facility-level energy data and data for Facebook's electricity demand in colocation centers.

Renewable Energy Commitment and Siting Policy: A

Facebook's latest data center in Altoona, Iowa, which came online in late 2014, is the strongest and most tangible evidence of Facebook's commitment to renewable energy to date. Facebook had set an interim goal of 25% renewable energy by 2015, a target it still has a good chance of reaching as the renewably powered Iowa data center ramps up. As the Virginia based colocation leases get closer to term, whether viable options can allow Facebook and its wholesale colocation providers to directly purchase renewable energy should be a critical criteria for any decision to renew these leases.

Energy Efficiency & Mitigation: A

Facebook's leadership in establishing and driving the growth of the Open Compute Project is making a significant contribution to improving the efficiency not just of Facebook's data centers, but of other major operators as well. As it looks to move beyond its initial 25% renewable goal, Facebook will face critical decisions in the not too distant future whether to renew the leases of significant colocation space in Northern Virginia, which is dependent on a dirty energy supply from Dominion Energy.[144] Yahoo recently shifted operations out of a Virginia wholesale colocation space owned DFT, causing its emissions to decrease significantly.[145]

Renewable Energy Deployment and Advocacy: B

Facebook has been pushing the utilities serving its North Carolina and Oregon data centers to create new options for purchasing renewable electricity, allowing it to replace the coal-heavy electricity mix currently powering both facilities, and a process is underway for developing a new tariff in Oregon. In North Carolina, Duke Energy established a new green energy tariff for large users in 2014, but no companies have signed up for the service as of yet. If Facebook is not able to secure renewable energy directly from Duke Energy, a more direct approach may be necessary, such as the onsite and nearby generation of renewable energy pursued by Apple. In addition, Facebook should use its influence as one of the top electricity consumers in North Carolina[146] to advocate with Duke's regulators or the state legislature to create new options that will increase access to a renewable electricity supply. Facebook has been actively engaged in the development of the Corporate Renewable Energy Buyers principles.[147] Facebook, along with Google, Microsoft, Yahoo, and eBay, withdrew from the American Legislative Exchange Council (ALEC), the group that was a key obstacle to renewable energy and climate policy at the state level (see page 21). [148]

Google remains a leader within the sector on the deployment of renewable energy, with a strong combination of procurement, investment, and policy advocacy helping to green the grid even in areas where Google does not have data center operations. Google continues to make progress towards its commitment to be 100% renewably powered, and has outlined clear principles for how it will seek to expand its supply of renewable energy as it continues to grow. Google will need to redouble these efforts in several markets, however, as its ability to access renewable energy is being restricted by monopoly electric utilities in parts of the US as well as in new markets abroad as it continues to expand its global cloud infrastructure.

Energy Transparency: B

Google provides adequate reporting of greenhouse gas emissions and energy consumption at a corporate level through CDP as well as the Google Green website.[149] Google also provides useful white papers that share best practices and principles guiding its renewable energy purchases, as well as details on both its purchase agreements and renewable energy investments. However, Google's transparency on its energy footprint has stagnated in the past year while the sector as a whole has improved. Apple, Equinix, Facebook and Rackspace all provide facility-level data for their data center operations. Google still offers greater transparency than peers such as Microsoft, as Google provides a clear breakout of current progress toward its 100% renewable goal, indicating what percentage is a result of specific market purchases.[150] Google will need to improve its facility-level energy mix reporting if it wants to keep pace with Apple, Facebook, and other sector leaders.

Renewable Energy Commitment and Siting Policy: B

Google remains committed to a long-term goal of being 100% renewably powered, and has continued to make progress toward this goal even as its operations steadily expand. Google's recently announced data center in Eemshaven, NL was a successful illustration of its ongoing commitment to make its data centers renewably powered, as Google was able to secure a supply of renewable electricity from a nearby wind resource that will be online when the facility opens in 2016.[151] Google has struggled to keep its renewable energy supply increasing in others parts of the world, including parts of the Southeast US and Asia, where choices of electricity supply are much more limited.

Energy Efficiency & Mitigation: B

Google continues to demonstrate best practices in the information it provides detailing the performance of its data center operations, and recently published a paper outlining efficiency gains achieved through the use of machine based learning.[152] However, Google has not published more detailed emissions targets for data centers beyond its long-term goals of being 100% renewably powered and carbon neutral. The lack of facility-level reporting and more useful near-term targets makes it difficult to assess where Google is succeeding and where it needs to redouble its efforts.

Renewable Energy Deployment & Advocacy: A

Google continues to use an effective mixture of strategies to increase the amount of renewable energy coming onto the grid to power its operations; it now reports to be 35% renewably powered. Google signed three additional PPAs for renewable energy in the past year, bringing the total to nine, helping to green its data center in Iowa (407MW)[153], the Netherlands (62MW)[154] and its headquarters in California (43MW).[155] Google has also continued to put its significant cash reserves to good use, making four additional sizeable investments in renewable energy separate from its operations, including a $300M investment with SolarCity to fund residential solar projects.[156] Google has invested over $2 billion in renewable projects, bringing over 2.5 gigawatts of new clean energy capacity onto the grid.[157]

Google has also remained the most active in advocating for policies that will increase renewable energy investments and reduce US dependence on coal and fossil fuels, including comments supporting and recommending the strengthening of the US EPA Clean Power Plan, which will require utilities to reduce carbon emissions from electricity generation.[158] Google also unsuccessfully sought to shift the energy policies of the American Legislative Exchange Council (ALEC) (see page 21), and ultimately did not renew its membership when ALEC proved unmovable. Google has been supporting renewable energy policies at the state level in several US states, including advocating for the creation of a renewable energy tariff program in Oklahoma, where it has invested over $700M in its data center.[159] Google has also renewed a grant to support renewable policy advocacy,[160] and has joined the Wind Coalition, which is active in supporting state and federal policies in the US.[161]

Despite significant success in renewable energy procurement for a number of its data centers, Google has recently found itself stymied by monopoly utilities in several locations where it has sizeable data center operations, particularly in the Southeast US (Georgia, North Carolina, and South Carolina), and increasingly in Asia as it expands it operations in Taiwan and Singapore. Google and other major IT companies in North Carolina supported the adoption of a viable renewable energy tariff for large customers, but Google has not signed up to this program, and has seen its dirty energy consumption continue to increase as a result. To overcome these entrenched monopolies, Google will need to invest in stronger policy advocacy to expand the options available to companies who want to be renewably powered, as well as consider establishing its own renewable generation capacity to increase the pressure on the utility.

Hewlett-Packard (HP)

HP both provides hardware to internet companies and is rapidly expanding its own cloud business to compete in the enterprise market. The company maintains an impressive level of corporate-wide transparency and accountability on reducing its emissions, but it could improve public disclosure on how it is reducing the energy footprint of its data center fleet. HP does have a corporate-wide emissions reduction target for 2020 that includes data centers,[162] and the company is slowly increasing its purchasing of renewable energy via a limited number of on-site solar installations and a mixture of direct purchasing and renewable energy credits. However, HP is not showing the overall leadership needed to ensure its cloud expansion is driving demand for clean energy.

Energy Transparency: C

HP has maintained a very high level of transparency on a company-wide level, but this has unfortunately not translated over to HP's data center operations. HP does not provide any specific disclosure of its own data center operations on its website, and did not answer ICT-specific data requests in its submission to CDP.[163] This lack of transparency about its own data center footprint means that current and potential future customers of HP data centers are unable to compare HP's services to others, and is far behind what other internet and cloud leaders are providing.

Renewable Energy Commitment & Siting Policy: D

HP currently has a relatively narrow corporate commitment of 10 MW of self-generated renewable energy by 2017.[164] Even though HP is increasing the amount of renewable energy purchased from the marketplace, much of this has been through the purchase of unbundled RECs, with the exception of its UK data center.[165] The continued growth of HP's data center fleet underlines the importance for the company to implement stronger prioritization of renewable energy in order to achieve its targets for greenhouse gas mitigation.

Energy Efficiency & Mitigation: B

HP has been able to demonstrate significant energy savings in its data center operations in the past year, particularly through the broader deployment of its Ecopods in three of its data centers.[166] HP is also an active contributor to the Open Compute initiative, and recently announced a line of rack mounted servers built to the Open Compute performance specifications.[167] HP Project Moonshot high-efficiency server products do have significant potential to reduce server energy demand, but to date there is limited data available on their adoption.

Renewable Energy Deployment & Advocacy: C

HP has been a driver in increasing sector engagement around renewable energy purchasing, including the Renewable Energy Buyers Principles, and has presented these views to utilities in the US.[168] However, despite this advocacy, HP continues to have deployed low levels of renewable energy to power its cloud, the primary exceptions being its UK facility and a portion of its Austin, Texas data center. As a result, HP continues to fall farther behind as other major cloud companies are executing their renewable energy strategies at a much greater scale.

IBM has become more aggressive in its investments to stay in the top tier of global cloud companies, aiming to compete with Amazon Web Services both for new startups as well as major government accounts. Despite an impressive track record in reporting and reducing greenhouse gas emissions across IBM for the past twelve years, the same level of transparency has not yet carried over to IBM's data center operations. Recent commitments to increase the amount of renewable energy powering its operations to 20% by 2020 are a promising sign that IBM is committed to making a "Smarter Planet"™ one that is renewably powered.

Energy Transparency: B

Like HP and Microsoft, IBM produces a fairly thorough carbon and energy report at the corporate level. IBM does not report on the number of data centers it operates, nor does it provide energy consumption for individual locations, though it does indicate purchases of renewable energy for select locations. IBM also indicates that it can supply data to customers on their energy footprint from the IBM cloud upon request.[170] Cloud platform Softlayer, which IBM acquired in 2013, is unfortunately not yet included in IBM's energy and sustainability reporting, and has not otherwise published any data on its energy performance or greenhouse gas emissions.

Renewable Energy Commitment & Siting Policy: B

In March 2015, IBM made a new commitment to be 20% renewably powered by 2020 for its global operations, to total over 800 gigawatt hours of renewable energy each year.[171] While this appears to be only a modest increase in the 17% renewable level it had already reached in 2013, IBM also added a critical principle to how it would procure renewable energy: "We intend to match our purchased renewable electricity directly to our operations as opposed to purchasing renewable energy certificates as offsets, making a clear connection between our purchases and our consumption." [172] That approach by IBM to meeting renewable energy targets is stronger and more impactful than what's been articulated to date by competitors such as Microsoft and AWS.

Energy Efficiency & Mitigation: B

Having already achieved considerable success over the past 12 years in reducing greenhouse gas emissions across its operations, IBM has recently established a third round of emissions targets, this time 35% below 2005 levels by 2020.[173] However, IBM's lack of transparency surrounding its data center energy demand withholds critical context needed to appreciate how the company is achieving its targets within its data centers.

Renewable Energy Deployment & Advocacy: C

IBM claims to already have purchased renewable energy for 17% of its operations in 2013. IBM claims that over 40% of its cloud data centers have some or all of their electricity provided by renewable sources of electricity, but again, the lack of facility level consumption or supply information make proper evaluation and comparison difficult.[174] Despite a significant and rapidly growing data center footprint in several parts of the US that have poor access to a supply of renewable electricity, including North Carolina (see p.19), IBM continues to remain on the sidelines of the energy policy debate.

Microsoft

Nearly three years after adopting a commitment to be "carbon neutral," Microsoft has begun to take some concrete steps to power its existing data center infrastructure with renewable energy. The recently announced purchase of 175MW of wind power for its Chicago data center is a clear step in the right direction.[175] However, Microsoft has undergone a rapid expansion of its Azure cloud platform to close the gap with Amazon Web Services (AWS), and now operates 19 regional data centers with the capacity for nearly 12 million servers.[176] Microsoft's strategy for reaching its "carbon neutral" commitment remains primarily reliant on the purchase of unbundled renewable energy credits and carbon offsets, which have little if any impact on the energy powering its data centers. The continued lack of a meaningful strategy to guide its rapidly growing fleet of data centers with renewable energy leaves Microsoft falling further behind Google and Apple, and on a path similar to AWS not only in terms of its growth, but also in its being predominantly powered by dirty sources of electricity.

Energy Transparency: C

While Microsoft continues to provide fairly high levels of reporting of its overall corporate energy and greenhouse gas footprint to CDP, and annually through its Global Citizenship report, it continues to provide far less detail on its data center energy footprint than its peers. Without appropriate context, even clearly additional actions such as the two recent contracts for wind in Illinois and Texas to power its data centers in those states, are difficult to properly evaluate. In addition, Microsoft continues to tout how sustainable its data centers are to its customers, including highlighting significant carbon benefits that can be achieved by shifting to the Microsoft cloud,[177] but it still refuses to provide any actual data to support these comparative claims. This is a critical gap, as other studies that have measured the carbon impact of cloud computing have shown that the efficiency gains in CO2 terms of a cloud computing platform can be easily lost if cloud platforms are powered by high carbon sources of electricity.[178]

Renewable Energy Commitment & Siting Policy: C

Since 2012, Microsoft has maintained an ongoing commitment to being "carbon neutral." Microsoft currently relies heavily on the purchase of unbundled renewable energy credits (RECs) and carbon offsets to make good on that claim. In 2015, Microsoft added a slightly more specific commitment to "meeting our 100 percent renewable energy commitment by matching the total amount of kwh consumed with the equivalent volume of renewable energy purchased." [179] Microsoft does articulate an ordered preference for acquiring renewable energy by (1) direct purchase, (2) signing long-term purchase agreements for renewable energy, and (3) buying renewable energy credits. However, it is not clear whether this commitment to be 100% renewable is a longer-term ambition, which would gradually guide its growth to areas where renewable electricity is accessible, or one that is simply an extension of its commitment to being "carbon neutral" and can thus be met by unbundled REC purchases or equivalent instruments that have little impact on its actual energy supply. Microsoft would be better served to focus on a longer term commitment to 100% renewable energy that it steadily meets over several years, rather than making the same commitment on a near term basis, and meeting it only with paper instruments that do not change the source of electricity powering their operations.

Energy Efficiency & Mitigation: C

Microsoft continues to maintain its internal carbon tax to help incentivize energy efficiency and greenhouse gas mitigation efforts across a broad array of decision makers in the company, and has published a white paper outlining its approach for the benefit of other companies,[180] although it has not revealed what amount has been captured and reinvested. Microsoft staff have articulated the importance over time for greater (1) distributed generation; (2) new renewable energy sources; and (3) research into the next generation of energy technology. Microsoft is investing in alternative energy prototypes, such as in-rack fuel cell deployments, although these have not been deployed at production scale as yet.

Renewable Energy Deployment & Advocacy: C

Microsoft's 2014 decision to purchase 175 MW of renewable electricity to power its Chicago data center was the company's second major power purchase agreement for renewable energy, following its 2013 purchase of wind energy in Texas. While these are important steps forward to address the power demands of Microsoft's existing data centers, Microsoft's rapid growth needs to be guided by the ability to match its data center expansion with an expansion of its renewable electricity supply. Microsoft is still not fully exploring its ability to secure renewable electricity for data centers in locations like Iowa, where peers such as Google and Facebook have been successful in buying renewable energy. Microsoft deserves credit for withdrawing from the American Legislative Exchange Council (ALEC), the group that has been a key obstacle to renewable energy and climate policy at the state level. Strong proactive advocacy is also needed however to change the investment landscape firmly toward renewable energy, particularly in locations like Virginia, which hosts one of Microsoft's largest data centers. Microsoft has a significant amount of political influence in its home state of Washington, and although it did sign onto a general call for climate action,[181] Microsoft remains oddly silent on a bill introduced by Governor Inslee to put in place a statewide carbon cap. Microsoft should be willing to champion a carbon price given that it has placed an internal one on its own operations.

ORACLE

Oracle provides enterprise-scale software products and computer hardware systems to the world's largest corporations. Like others in this space, Oracle is now making a bigger play for cloud-based offerings, even partnering with Amazon Web Services to offer some of Oracle's products via the AWS cloud. Oracle powers its own cloud services and solutions through its three main data centers in Texas, Colorado and Utah, with ten smaller facilities elsewhere. Like others, Oracle has focused on efficiency in its servers and data centers, but it lags behind sector leaders in building a renewably powered digital economy.

Energy Transparency: D

Oracle reports the standard level of detail on the company's greenhouse gas emissions and energy consumption to the Carbon Disclosure Project, and reports aggregate energy and greenhouse gas emissions from its existing 12 data centers, reflecting 24% of its total energy consumption and 27% of greenhouse gas emissions. Oracle's website claims that its uses 100% renewable energy at 25 sites in Europe, but its CDP submission only support claims for renewable energy purchases for it Austin data center. Oracle does not disclose its corporate-wide or data center energy mix, nor does it indicate that it shares the carbon footprint of its services with consumers.[182]

Renewable Energy Commitment & Siting Policy: F

Having previously consolidated its data center operations, Oracle is now undergoing a significant expansion, announcing its intention to operate 17 data centers globally. Lacking a meaningful commitment to renewable energy,[183] in contrast to competitors Rackspace, Google and Salesforce, Oracle is likely to continue to fall further behind industry leaders as it undergoes its expansion.

Energy Efficiency & Mitigation: D

With regard to data center operations, Oracle only has in place a Power Usage Effectiveness-based reduction goal of 6% over its 2010 base year by 2016.[184] Oracle does report that its data center related greenhouse gas emissions increased by 11% from 2013-2014.[185] Oracle had previously established a renewable electricity goal for its data centers, but has not renewed that goal since it expired in 2010.[186] Oracle needs to reestablish energy performance and renewable energy goals that are applicable to its data center operations.

Renewable Energy Deployment & Advocacy D

Having let its previous renewable electricity goal for its data center expire, Oracle purchases only 5400 MWh of renewable energy credits in 2013, primarily for its Austin data center's electricity demand, or roughly 0.7% of Oracle's global electricity demand.[187]

Rackspace has been rapidly evolving its business model from one of "managed hosting" to be a "managed cloud" company, a pivot that has been well received at least among its investors over the past year. Though it operates a smaller footprint than cloud giants such as Amazon, Google, and Microsoft, Rackspace now has nine data centers, and remains a significant player within the cloud and hybrid cloud markets. Rackspace was one of the first cloud companies to embrace a 100% renewable energy target.

Energy Transparency : C

Rackspace continues to provide basic information on the location and aggregate percentage of renewable energy being used by its data centers.[188] Rackspace also updates the total amount of power it currently has under contract across its data centers each quarter, as well as the full capacity under reserve.[189] However, Rackspace does not yet publish a more detailed breakdown of its energy performance that would allow customers and stakeholders to track its progress toward its 100% renewable commitment in greater detail, or participate in the Carbon Disclosure Project that would similarly help facilitate year-over-year tracking.

Renewable Energy Commitment & Siting Policy: B

Rackspace's Global Energy Policy, adopted in 2012, establishes its goal to be 100% renewably powered across all of its operations.[190] The policy provides a solid framework for guiding the company's journey to becoming a leader in building a sustainable digital economy, identifying energy efficiency, renewable energy, and energy advocacy as critical pieces of the company's long-term strategy. This policy and recently adopted green leasing guidelines appear to be informing Rackspace's most recent expansion, as it has been able to secure bundled renewable energy certificates in its supply agreements with its colocation providers in both Texas and the UK.[191]

Energy Efficiency & Mitigation: B

Rackspace's newest data center in London has a design PUE of 1.15, and Rackspace has recently adopted shorter-term energy performance targets for both its offices and data centers; Rackspace has also established a goal to increase its renewable energy supply 5% each year as it moves toward its 100% goal.[192] With increased reporting and transparency, these benchmarks can provide a solid framework for Rackspace's investors and stakeholders to evaluate its energy performance as it continues expanding. Rackspace has been an advocate for open-source development of technology across several areas of its operations, particularly those geared toward improving the design and operation of a data center as measured by energy performance, such as OpenCompute and OpenPOWER.

Renewable Energy Deployment & Advocacy: C

Rackspace currently claims that it has increased its renewable electricity supply to 40%, in line with its minimum 5% yearly increase.[193] While some of that claim comes from buying a greater supply of bundled renewable energy to meet the needs of its UK data centers, a significant portion of this, particularly within its US footprint, is through the purchase of unbundled renewable energy credits (RECs). Rackspace has indicated that it hopes to sunset its REC-only purchases, as it continues to explore more impactful purchasing options suitable to its relative energy demand.[194]

Salesforce continues to experience dramatic growth from its traditional CRM products and more recently its Cloud Analytics business model. The company has significantly expanded its data center operations to support this growth, including announcing two new leases in Europe. Salesforce's emissions and energy footprint appear to be closely tracking this growth, with its reported greenhouse gas emissions increasing 30%, while its data center greenhouse gas emissions increased by double that, nearly 70%.[195] Salesforce has made some progress in powering that growth with renewable energy for its most recent data center in the UK,[196] but has not yet meaningfully translated its commitment to a 100% renewable electricity supply to the US, where it has the majority of its data center footprint.

Energy Transparency: A

Salesforce significantly improved its reporting of its energy related footprint in the past year with the publication of its 2013/2014 Sustainability Report,[197] which provide easy tracking of progress and a clear delineation of its emissions profile and energy consumption between data centers and other areas of its operation, and how it is accounting for its renewable energy supply. Salesforce also provides clear reporting of energy data via its submission to the CDP, including facility-level energy data. Upon request, Salesforce will provide carbon footprint information to its customers who wish to track their energy and greenhouse gas impact as a result of using the Salesforce cloud.[198]

Renewable Commitment and Siting Policy: B

Given Salesforce's rapid growth in its business, Salesforce's long-term commitment to be 100% renewably powered is critically important.[199] Though Salesforce does not currently own or operate its own independent data centers, it is a very important customer to the colocation data center companies. As seen with its latest data center in London,[200] vendors that have the ability to offer a renewably powered data center will hold a competitive advantage for Salesforce and other companies who are committed to powering their growth with renewable energy.

Energy Efficiency & Mitigation: C

Salesforce has historically operated its platform on a relatively small base of servers, though with its continued rapid growth, data center energy demand is rapidly increasing. Although Salesforce continued to report a consistent level of CO_2 per transaction carried out on its platform in the past year,[201] greenhouse gases from its data centers grew at 70%, faster than its transactions, which grew at 52%. To ensure that its energy performance and renewable energy supply are tracking toward its goal of powering its data center with 100% renewable energy, Salesforce should adopt clear near-term energy performance and renewable energy goals.

Renewable Energy Deployment and Advocacy: C

Despite success in securing a renewable supply of electricity for it UK data center,[202] Salesforce has thus far not yet successfully increased its renewable electricity supply in the US. Salesforce continues to demand renewable energy from colocation operators, as well as explore options that would allow it to meaningfully drive renewable power onto the same grids where Salesforce operates its data centers.

YAHOO!

Yahoo has been steadily expanding its online presence through acquisitions such as Tumblr, and also through an expansion of its curated news and entertainment channels. Yahoo has been among the top performers in percentage of clean energy since Greenpeace began evaluating internet companies, and regained some of its momentum in the past year with the announcement of a 25 MW wind energy purchase from a community wind farm development in Kansas, helping to power its Nebraska data center with renewable energy. Yet despite its relatively strong performance in securing a clean supply of electricity, Yahoo continues to limit the details of its energy performance to it annual CDP submission.

Energy Transparency: C

Yahoo has regularly updated it energy footprint and sustainability efforts through its annual submission to CDP, providing clear and detailed consumption and energy performance data for its data centers. However, Yahoo has fallen far behind other sector leaders in providing accessible information on its energy performance outside of CDP, making it extremely difficult for its users to find useful information on its operations from its own website and search engine.

Renewable Energy Commitment & Siting Policy: B

Yahoo has maintained since 2009 its intention to become sustainable through a long-term focus on energy efficiency and renewable energy. Despite not having a goal to be 100% renewable as many of its peers have now adopted, Yahoo has the second-highest percentage of renewable energy powering its operations, after only Apple.

Energy Efficiency & Mitigation: A

Yahoo established a target to reduce carbon intensity of its data center operations by 40% from 2007 levels by 2014 and reduced its total greenhouse gas emissions from data centers by nearly 5% percent in 2014.[204] Yahoo reached that goal through improvements in energy efficiency, and by shifting a significant portion of its data center space from a long-term lease in coal-heavy Virginia to its own data centers, including its facility in upstate New York, where it has secured an allotment of hydroelectric power.

Renewable Energy Deployment & Advocacy: B

Yahoo's biggest step to date in making its corner of the internet green was the recent announcement of a Power Purchase Agreement for 25 MW of wind power in Kansas, which can be used to power its Nebraska data center. Having already withdrawn its operations from Virginia in 2013, Yahoo's Nebraska data was by far its biggest source of dirty energy supply. Yahoo has also been engaged in the support of significant US policies to increase renewable energy growth in the US, and has recently signed the Corporate Buyers' Principles for Renewable Energy.

Colocation Companies

Digital Realty Trust

Digital Realty is the largest digital landlord in the world, with 131 data centers worldwide, roughly three-fourths of which are located in the US, 18% in Europe and 4% in Asia, totaling over 24 million square feet of rental space. Digital Realty operates on the wholesale end of the colocation spectrum, providing entire data center properties to large online brands, many of which now have adopted long-term commitments to be 100% renewably powered, including Facebook, Rackspace, Salesforce, Google, and very recently Equinix and Amazon Web Services. In response, Digital Realty has recently made some moves to address this demand, including much greater energy transparency, the adoption of a sustainability policy, and the creation of a new program to facilitate the purchase of renewable energy credits (RECs) for clients that sign a new lease with Digital Realty. While these moves acknowledge the need to provide a renewable energy product for its customers, Digital Realty's first offering falls far short of what most companies are seeking in terms of additionality; Digital Realty should look to the policy recently adopted by Equinix for a stronger model among colocation operators.

Energy Transparency: C

Digital Realty has significantly improved its energy transparency in the past year, with clear reporting of energy mix across its portfolio, and overall electricity consumption. Unlike Equinix, it does not provide a regional breakdown of the energy mix, or provide any detail on the source of its renewable electricity supply.[205]

Renewable Energy Commitment & Siting Policy: D

Digital Realty recently adopted an Environmental Sustainability Policy,[206] which acknowledges at the very broadest levels that data centers consume increasing amount of energy, and the need to increase efficiency and improve transparency with stakeholders. However, the policy does not articulate an ambition for any particular outcome, or any basis upon which Digital Realty could be held accountable to the policy. While a beginning, Digital Realty's statement falls far short of what other leading data center operators have put in place, including most recently Equinix. As a wholesale colocation provider, Digital Realty's pathway will need to be more customer led than even retail operators such as Equinix, but Digital Realty could certainly afford to state unambiguously that increasing access to renewable electricity is a fundamental part of becoming a provider of sustainable data center solutions.

Energy Efficiency & Mitigation: C

As part of joining the US Department of Energy's Better Building Challenge, Digital Realty has adopted a goal to make its U.S. buildings 20% more energy efficient by 2020, and has also agreed to energy reduction targets for its UK data centers.[207] More specific performance targets, including renewable energy or carbon goals such as those adopted by Telecity and Equinix, are needed to better define where Digital Realty wants to go and how it plans to get there.

Renewable Energy Deployment & Advocacy: D

Digital Realty has at least made a first step toward driving renewable energy deployment with the creation of its Clean Start program,[208] which is offered only to customers that sign a new lease with Digital Realty: Digital Realty will provide enough unbundled RECs free of charge to cover both their IT energy demand and any associated cooling or other mechanical energy demand for at least the first year. Given the size of Digital Realty's data center portfolio, and the number of major customers that have already made 100% renewable commitments, Digital Realty should be able to offer a much more impactful program. Digital Realty is one of the largest electricity customers of Dominion Energy in Virginia,[209] which has very little renewable energy (see Ground Zero for the Dirty Internet: Dominion Energy, page 18). Digital Realty, potentially in collaboration with some of its largest customers, could play a critical role in identifying a pathway to bringing a meaningful amount of renewable energy to that state, either by working with Dominion if possible, or working around them if not. Digital Realty, along with some of its biggest customers such as Facebook and Yahoo, has also signed the Corporate Renewable Energy Buyers' Principles.[210]

DuPont Fabros Technology (DFT) is one of the largest wholesale data center colocation providers in the US, providing large blocks of data center capacity to a range of customers in several major markets, including companies like Facebook and Microsoft that also build their own data centers. By a very large margin, DuPont Fabros Technology's largest market is Northern Virginia, with upwards of 200 MW in data center capacity built or under construction there, making DuPont Fabros Technology one of Dominion Energy's largest customers.[211] Dominion's refusal to offer meaningful options to buy renewable electricity represents a significant long-term risk to DuPont Fabros Technology. Many of its largest customers have adopted goals to be 100% renewably powered, and as their leases in DuPont Fabros Technology Virginia spaces come up for renewal, many may take the opportunity to quickly achieve significant carbon reductions and increase their options to buy renewable energy by moving out of Virginia, as evidenced by Yahoo's decision to leave its lease with DuPont Fabros Technology early.[212]

Energy Transparency: D

DuPont Fabros Technology does report on its website the power demand and energy performance of its cloud computing service at the facility level.[213] However, DuPont Fabros Technology does not participate in the Carbon Disclosure Project or otherwise report its total energy or carbon footprint. DuPont Fabros Technology states that it will provide the carbon and energy footprint data upon request by its customers.

Renewable Energy Commitment & Siting Policy: F

DuPont Fabros Technology does not state a public preference for renewable energy supply when it sites its data centers, nor has it set a renewable energy target for future investments. Its many data centers in Northern Virginia are powered by the local utility, Dominion Energy, whose electricity is generated by a mix of coal, gas and nuclear energy, with no plans to increase its minuscule usage of renewable power to significant levels.[214] Surprisingly, despite this significant deficiency that is holding many of its biggest customers back from achieving goals of being 100% renewable powered, DuPont Fabros Technology was quick to praise Dominion for receiving a "Utility of the Year" award from a utility trade publication.[215]

Energy Efficiency & Mitigation: D

As a wholesale colocation provider, DuPont Fabros Technology's primary opportunity for driving efficiency across its data centers is in the design and management of the facility, as ably demonstrated with the highly efficient ACC-7 facility.[216] However, DuPont Fabros Technology's competitor Digital Realty Trust has recently established fleet-wide performance targets for its US facilities, something that would benefit both DuPont Fabros Technology's customers and its own bottom line.

Renewable Energy Deployment & Advocacy: F

DuPont Fabros Technology does not have a stated goal or vision to power its data center infrastructure with renewable energy. The company did install 2.7 MW of solar arrays on the roof of its New Jersey data center.[217] Unfortunately, the company currently has no further plans to invest in renewable energy for any of its other 10 facilities.

Equinix is home to a significant chunk of the internet, with well over 100 data centers spread around the world. Equinix collectively consumed 2,200 GWh of electricity in 2014, the equivalent to 200,000 average U.S. homes.[218] Equinix's adoption of a long-term commitment to be 100% renewably powered[219] is by far the most significant change since Greenpeace last benchmarked the data center sector in 2014, and sets an important new bar that other colocation providers will need to meet as more and more of their customers make greenhouse gas and renewable energy commitments. At least for the short term, Equinix has established a clear competitive advantage.

Energy Transparency: B

Equinix continues to lead the colocation market in energy transparency. Though not yet at the same level as Apple and Facebook in its energy transparency, Equinix has begun to regularly update its website to provide a snapshot of its energy demand and related greenhouse gas footprint, as well as its total electricity mix at both a global and regional level.[220] That makes Equinix by far the most transparent of the colocation providers, but the company needs to go beyond the regional level in its reporting, and report through such mechanisms as CDP to facilitate year-over-year benchmarking.

Renewable Energy Commitment & Siting Policy: B

Equinix has taken a major step forward by becoming the first major colocation provider to adopt a commitment to be 100% renewably powered. Given the breadth of Equinix's operations, this is potentially a giant step forward for building a renewably powered internet. Equinix's 100% renewable commitment, which includes an adjustment to its data center siting policy to seek locations with favorable renewable energy policies, is a powerful signal both to utilities and policymakers that locations that provide access and investment conditions supportive of renewable energy will have a competitive advantage to win Equinix's business.

Energy Efficiency & Mitigation B

Equinix's recently adopted energy efficiency design targets for all new data centers and major expansions is also an important step forward. Equinix has set regionally differentiated PUE targets: Americas 1.30-1.40, Asia Pacific (including Oceania) 1.33-1.43, EMEA 1.29-1.42, based on annual average Power Usage Effectiveness (PUE) at full load. Equinix should take the next step and consider setting appropriate performance targets for existing facilities, and should set near-term benchmarks for tracking its progress toward becoming 100% renewably powered.

Renewable Energy Deployment & Advocacy D

Equinix claims a 30% renewable energy mix at the global level,[221] most of which is currently associated with the purchase of Renewable Energy Credits (RECs) and Guarantees of Origin, many of these credits are unbundled from the underlying electricity. With the adoption of Equinix's 100% renewable commitment and guiding principles, Equinix should be expected to pursue increasingly more impactful strategies, either directly or in collaboration with key customers. Equinix has already begun to pursue renewable energy for a select number of leading customers, and those efforts should steadily increase as it begins to offer bundled renewable energy for interested customers. Given Equinix's significant electricity demand in key markets, including Virginia, Equinix should also use its standing as a major customer to convince Dominion Energy and other utilities to increase their investment in renewable energy.

Telecity is one of the largest retail colocation providers in Europe, operating in 12 major markets across the continent and providing a European home for major online properties such as streaming music platform Spotify and professional social network Xing, as well as other companies evaluated in this report, including Akamai, Facebook, Amazon Web Services, and Microsoft. Telecity is currently proposing to merge with Interxion,[222] another major data center operator in the EU, but the evaluation here is based on Telecity's policies and performance pre-merger.

Transparency C

Telecity provides annual reporting of its overall greenhouse gas footprint and is one of the few companies, and the only major colocation operator, to report and benchmark its Carbon Usage Effectiveness (CUE). Telecity's annual report does not break down emissions on a facility or even a country basis, though it does note that higher carbon grid mixes in certain countries are impacting its ability to achieve its emissions performance targets. Telecity falls just short of the level of transparency shown by one of its main competitors, Equinix, which provides a snapshot of its energy demand and discloses its electricity supply mix at the regional level.

Renewable Energy Commitment & Siting Policy: D

Telecity recently updated its environment policy in January 2015,[224] but unlike policies recently adopted by Equinix, Rackspace and an increasing number of major corporations, surprisingly does not set any long-term ambition to increase its use of renewable energy, or even recognize access to renewable electricity as a priority. This deficiency is a significant disadvantage to Telecity's ability to compete for customers who want to be assured that their hosting provider is working to power its online operations with greater amounts of renewable electricity.[225]

Energy Efficiency & Mitigation: C

Telecity annually reports its CUE performance and is the only company with a target to improve its CUE on an annual basis.[226] Telecity does highlight its recertification of its UK operations under the UK Government's Carbon Trust standard, having achieved a 17.5% reduction of carbon intensity across its UK facilities.[227] Telecity has established a goal of improving its CUE 3% each year, although it saw its CUE increase 2% in 2014, which it attributes to a worsening grid mix in several countries, specifically the UK, Bulgaria, Turkey, and Poland.[228] Telecity has set a new 3% reduction goal of its CUE for 2015, though with significant caveats that it may not be possible to achieve.[229]

Renewable Energy Deployment & Advocacy: D

Telecity acknowledges that sourcing its data centers with renewable energy is is increasingly important, and claims that "a number" of data centers purchase renewable energy, though it does not provide any further details.[230] Telecity reports that the "deterioration" of the grid mix is outside of its control, and purchasing renewable electricity could put itself at a competitive disadvantage in some markets due to higher cost.[231] Telecity's approach to renewable energy falls far short of sector leaders, and even below what Equinix is offering its customers in European markets.

Appendix 3 Company Data Center Facilities and Estimates of Power Demand

CLEAN ENERGY INDEX 24%

NATURAL GAS -% / COAL -% / NUCLEAR -%

Facility Location	Estimated Nameplate Power Capacity	% of Clean Energy Supply to Data Center	Resource Mix of Local Utility			Akamai's energy consumption is spread across 1,300 data centers around the world, making individual tracking difficult. Regional demand and renewable energy data from CDP and information provided by company.
			Natural Gas	Nuclear	Coal	
Africa	0.1	0%				
Asia	5.1	4%				An increase in consumption of 5x from 2013
Europe	13.2	39%				An increase in consumption of nearly 3x from 2013
North America	30.4	20%				An increase in consumption of nearly 2x from 2013
Oceania	0.9	8%				
South America	1.1	43%				

amazon.com web services

CLEAN ENERGY INDEX 23%

NATURAL GAS 21% / COAL 27% / NUCLEAR 26%

Facility Location	Estimated Nameplate Power Capacity	% of Clean Energy Supply to Data Center	Resource Mix of Local Utility			Amazon Web Services does not provide data about its electricity demand. Greenpeace estimated data using a combination of publicly reported investment data, backup generator permits, and independent estimates of Amazon's EC2 servers counts by region, found here: http://huanliu.wordpress.com/2014/02/26/amazon-ec2-grows-62-in-2-years/
			Natural Gas	Nuclear	Coal	
Ashburn, Virginia (IAD6, IAD13, IAD54)	62	2%	23%	37%	37%	This three building campus has received permits for 99 MW of backup generator capacity.
Ashburn, Virginia (IAD50 & IAD60)	71	2%	23%	37%	37%	This facility received permits for 103 MW of backup generator capacity in 2014. (Under Construction following fire in Jan 2015)
Chantilly, Virginia (IAD1 & IAD9)	26	2%	23%	37%	37%	One of the older facilities in US-East, has been issued permits for just under 40 MW of backup generator capacity.
Haymarket, Virginia (IAD 55)	42	2%	23%	37%	37%	New facility, issued permits for 75 MW of backup generator capacity in 2014.
Manassas, Virginia (IAD7, IAD11, IAD24)	53	2%	23%	37%	37%	This facility has been issued permits for 79 MW of backup generator capacity.
Manassas, Virginia (IAD14, IAD52, IAD59)	71	2%	23%	37%	37%	This facility has been issued permits for 132 MW of backup generator capacity.
Sterling, Virginia (IAD 10 & IAD 32)	32	2%	23%	37%	37%	This facility has been issued permits for over 50 MW of backup generator capacity.
Sterling, Virginia (IAD12, IAD 15, IAD16)	69	2%	23%	37%	37%	This facility has been issued permits for 117 MW of backup generator capacity.
Sterling, Virginia (IAD51 & IAD56)	26	2%	23%	37%	37%	This facility was issued permits for 56 MW of backup generator capacity in 2014.
Sterling, Virginia (IAD57 & IAD58)	48	2%	23%	37%	37%	This facility has been issued permits for 90 MW of backup generator capacity.
Boardman, Oregon (PDX1)	23	85%	0%	10%	0%	AWS claims its Oregon region (US West-Oregon & AWS GovCloud) is one of two that are "carbon neutral." This facility has been issued permits for 33 MW of backup generator capacity.
Umatilla, Oregon (PDX2)	22	85%	0%	10%	0%	AWS claims its Oregon region (US West-Oregon & AWS GovCloud) is one of two that are "carbon neutral." This facility has been issued permits for 33 MW of backup generator capacity.
Boardman, Oregon (PDX4)	20	85%	0%	10%	0%	AWS claims its Oregon region (US West-Oregon & AWS GovCloud) is one of two that are "carbon neutral." This facility has been issued permits for 32 MW of backup generator capacity.
Hayward, California (SF01)	20	28%	28%	22%	0%	This facility has been issued permits for approximately 34 MW of backup generator capacity.
Santa Clara, California (SF02)	16	41%	44%	0%	8%	This facility has been issued permits for approximately 24 MW of backup generator capacity.
Columbus, Ohio (CHM)	57	100%	0%	0%	0%	Facility under development. Amazon has purchased 150 MW of wind energy in adjacent state of Indiana. Greenpeace is exploring the size of AWS's facility in Ohio, but assumes here that AWS will power the facility with 100% wind energy as it grows, barring further info from AWS.
Dublin (DUB8)	24	50%	19%	0%	22%	Amazon's Irish subsidiary has been issued greenhouse gas permits for approximately 30 MW of backup generator capacity, assuming a generator size of 2 MW. Resource mix provided by AWS.
Dublin (DUB9)	22	50%	19%	0%	22%	Amazon's Irish subsidiary has been issued greenhouse gas permits for approximately 28 MW of backup generator capacity, assuming a generator size of 2 MW. Resource mix provided by AWS.
Dublin (DUB10)	19	50%	19%	0%	22%	Amazon's Irish subsidiary has been issued greenhouse gas permits for approximately 28 MW of backup generator capacity, assuming a generator size of 2 MW. Resource mix provided by AWS.
Frankfurt, Germany (FRA1)	?	?	0%	0%	0%	Amazon claims its Frankfurt facilities is one of two regions that are "carbon neutral." Greenpeace is currently exploring AWS's footprint in Germany.
Frankfurt, Germany (FRA2)	?	?	0%	0%	0%	Amazon claims its Frankfurt facilities is one of two regions that are "carbon neutral." Greenpeace is currently exploring AWS's footprint in Germany.
Asia Pacific (Tokyo)	14	9%	38%	2%	29%	Energy demand based on independent assessment of EC2 server count in 2014
Asia Pacific (Singapore)	8	0%	95%	0%	0%	Energy demand based on independent assessment of EC2 server count in 2014
South America (Sao Paulo)	2	61%	7%	2%	2%	Energy demand based on independent assessment of EC2 server count in 2014

CLEAN ENERGY INDEX 100%

NATURAL GAS 0% / COAL 0% / NUCLEAR 0%

Facility Location	Estimated Nameplate Power Capacity	% of Clean Energy Supply to Data Center	Resource Mix of Local Utility			
			Natural Gas	Nuclear	Coal	
Athenry, Ireland	?	100%?	48%	0%	22%	Facility scheduled to open in 2017. Apple has pledged to secure 100% renewable electricity
Maiden, North Carolina	23	100%	9%	51%	38%	Due to continued growth, Apple has relied on in-state RECs for 25% of its renewable supply. However, Apple has a third solar farm (18MW) coming on line in 2015, which will bring its renewable supply back to effectively 100%
Mesa, Arizona	?	100%?	12%	19%	55%	Apple announced ne a center and commitment to be 100% renewably powered, beginning with 70 MW of solar to be done in partnership with local utility
Newark, California	15	100%	28%	22%	0%	Apple is currently using direct access for wind energy. Apple announced a PPA for 130MW of solar power that will replace that current supply.
Prineville, Oregon	2	100%	14%	0%	64%	Powered by Apple owned micro-hydro facility and by wind secured through state direct access program.
Reno, Nevada	5	100%	48%	1%	36%	Apple is partnering with its utility to provide renewable energy for 100 % of the 2013 load of its Reno facility.
Viborg, Denmark	?	100%?	7%	3%	30%	Facility scheduled to open in 2017. Apple has pledged to secure 100% renewable electricity

CLEAN ENERGY INDEX 10%

NATURAL GAS 51% / COAL 29% / NUCLEAR 9%

Facility Location	Estimated Nameplate Power Capacity	% of Clean Energy Supply to Data Center	Resource Mix of Local Utility			
			Natural Gas	Nuclear	Coal	
Salt Lake City, UT	21	7%	14%	0%	64%	54% of Utah data center load is powered by on-site natural gas fuel cells, 1% onsite solar, and the rest from the local grid
Las Vegas, NV	22	13%	65%	1%	21%	
Phoenix, AZ	17	10%	22%	30%	38%	

CLEAN ENERGY INDEX 49%

NATURAL GAS 10% / COAL 25% / NUCLEAR 14%

Facility Location	Estimated Nameplate Power Capacity	% of Clean Energy Supply to Data Center	Resource Mix of Local Utility			
			Natural Gas	Nuclear	Coal	
Prineville, OR	70	14%	14%	0%	64%	
West Coast (Colo)	21	41%	44%	0%	8%	
Forest City,NC	70	1%	9%	51%	38%	Like Google, Facebook is now a top 20 electricity of Duke Energy in NC following the expansion of its Forest City data center. Despite pushing Duke for a green energy tariff, Facebook has not signed up to buy renewable electricity from Duke, even though Duke generated more electricity from coal than the previous year.
East Coast (Colo)	27	2%	23%	37%	37%	
Lulea, Sweden	70	100%	1%	38%	1%	Facebook is powering its Sweden facility with 100 % hydropower
Altoona, IA	70	100%	19%	6%	45%	Facebook has co-developed a new wind project nearby its Altoona Data center with its utility to provide renewable energy for the first phase of this facility.

Google CLEAN ENERGY INDEX 46%

NATURAL GAS 15% / COAL 21% / NUCLEAR 13%

Facility Location	Estimated Nameplate Power Capacity	% of Clean Energy Supply to Data Center	Resource Mix of Local Utility			
			Natural Gas	Nuclear	Coal	
Douglas County, GA	38	3%	39%	23%	35%	Google recently announced additional $300 million investment in its Georgia data center
Berkeley County, SC	84	0%	14%	8%	61%	Similar to Duke Energy Carolinas, Santee Cooper has increased its reliance on coal in the past year
Lenoir, NC	84	1%	9%	51%	38%	Like Facebook, Google is now a top 20 electricity customer of Duke Energy in NC following the expansion of its Lenoir data center. Despite pushing Duke for a green energy tariff, Google has not signed up to buy renewable electricity from Duke, even though Duke generated more electricity from coal than the previous year.
Council Bluffs, IA	105	100%	19%	6%	45%	Google has a PPA for wind energy associated with its Iowa facility.
Dalles, OR	84	89%	2%	3%	6%	
Pryor, OK	49	100%	29%	0%	52%	Google has multiple PPAs for wind energy associated with its Oklahoma Facility, and has also been lobbying in Oklahoma for the creation of a renewable electricity tariff
Eemshaven, Netherlands (Google Owned)	31	100%	55%	3%	27%	Google has signed a PPA with Eneco for 62MW wind farm nearby the data center.
Eemshaven, Netherlands (Colocation)	36	12%	55%	3%	27%	
Dublin, Ireland	7	10%	48%	0%	22%	
Singapore	8	0%	95%	0%	0%	
Taiwan	42	4%	32%	19%	38%	
Hamina, Finland	19	100%	0%	23%	6%	Google has two PPAs for wind energy for its Hamina facility.
St. Ghislain, Belgium	24	5%	29%	57%	0%	
Quilicura, Chile	11	29%	18%	0%	36%	

CLEAN ENERGY INDEX 22%

NATURAL GAS 26% / COAL 41% / NUCLEAR 11%

Facility Location	Estimated Nameplate Power Capacity	% of Clean Energy Supply to Data Center	Resource Mix of Local Utility			
			Natural Gas	Nuclear	Coal	
Wynyard, England	10	100%	27%	20%	36%	
Atlanta (Alphareetta), GA	12	3%	39%	23%	35%	
Atlanta (Suwanne),GA	15	3%	39%	23%	35%	
Austin, TX	30	37%	20%	25%	33%	2 facilities. HP has contracted for 21% renewable electricty, with the balance coming from the grid.
Houston, TX	30	11%	41%	12%	36%	2 facilities
Colorado	22	12%	24%	0%	64%	
Tulsa,OK	20	17%	22%	3%	57%	
Sydney, Australia	10	14%	12%	0%	74%	

IBM CLEAN ENERGY INDEX 24%

NATURAL GAS 27% / COAL 30% / NUCLEAR 17%

Facility Location	Estimated Nameplate Power Capacity	% of Clean Energy Supply to Data Center	Resource Mix of Local Utility			
			Natural Gas	Nuclear	Coal	
Bogota,Colombia	2	79%	15%	0%	6%	
Boulder, Colorado	16	22%	25%	0%	53%	
Ontario,Canada	5	28%	11%	58%	2%	
Querétaro,Mexico	2	14%	51%	3%	12%	
Hong Kong	1	0%	22%	23%	53%	
Dublin, Ireland	2	10%	48%	0%	22%	IBM purchases electricty from biomass powered generation, which it indicates would fulfill approximately 60% of the facility's energy demand. However, IBM did not provide further details on the biomass feedstock, so this purchase was not included in CEI calculations.(see page 26)
Research Triangle Park, North Carolina	17	1%	9%	51%	38%	IBM purchased electricty from landfill gas, which fulfilled 5% of the facility electricty demand. Greenpeace did not count this purchase as renewable, but as additional natural gas consumption.
Auckland,New Zealand	4	74%	19%	0%	5%	
Ehningen,Germany	4	36%	11%	15%	46%	IBM purchased renewable electricity which fulfilled approximately 36% of the electricity needs for this facility.
Dallas, TX	20	29%	41%	12%	36%	6 facilities. IBM reports that it has purchased 100% renewable electricity for two Dallas facilities.
Houston, Texas	4	48%	41%	12%	36%	IBM purchased renewable electricity which fulfilled approximately 48% of the electricity needs for this facility.
Melbourne, Australia	5	14%	12%	0%	74%	
San Jose, California	5	41%	44%	0%	8%	
Seattle, Washington	4	94%	0%	5%	1%	
Washington DC	4	3%	16%	35%	44%	
Amsterdam, Netherlands	5	12%	55%	3%	27%	
London, UK	3	15%	27%	20%	36%	
Paris, France	3	17%	4%	73%	4%	
Tokyo, Japan	3	8%	38%	2%	29%	
Singapore	5	0%	95%	0%	0%	

Microsoft CLEAN ENERGY INDEX 39%

NATURAL GAS 19% / COAL 30% / NUCLEAR 10%

Facility Location	Estimated Nameplate Power Capacity	% of Clean Energy Supply to Data Center	Resource Mix of Local Utility			
			Natural Gas	Nuclear	Coal	
Chicago, Illinois	73	100%	17%	34%	43%	Microsoft signed a PPA for wind power for its Chicago data center, totaling 175MW.
Dublin, Ireland	37	10%	48%	0%	22%	
San Antonio, Texas	27	100%	12%	32%	47%	Microsoft buys wind power through a long-term PPA to power its San Antonio facility.
Quincy, Washington	46	89%	2%	3%	6%	
Boydton, Virginia	95	2%	23%	37%	37%	Microsoft increased investment in Virginia data center by $350 million in 2014
W Des Moines, Iowa	140	30%	19%	6%	45%	Microsoft announced a major expansion in Iowa, a with a new $1.1 billion data center, bringing its total data center investment in the state to over $2 billion.
Cheyenne, Wyoming	24	14%	14%	0%	64%	Microsoft expanded Wyoming data center by at least $200 million in February 2015.
Amsterdam, Netherlands	18	12%	55%	3%	27%	
Australia	10	14%	12%	0%	74%	Microsoft has announced the opening of two data centers in Australia, but has not announced any details on size, so Greenpeace assumed a 5MW energy demand for each facility.
India	15	24%	9%	2%	60%	Microsoft annonced investment in three data centers in India, totaling approximately $220 million USD.
Tokyo	5	9%	38%	2%	29%	Microsoft has announced the opening of a new data center in Tokyo, but has not announced any details on size, so Greenpeace assumed a 5MW energy demand.
São Paulo	5	61%	7%	2%	2%	Microsoft has announced the opening of a new data center in São Paulo, but has not announced any details on size, so Greenpeace assumed a 5MW energy demand.
Singapore	5	0%	95%	0%	0%	Microsoft has announced the opening of a new data center in Singapore, but has not announced any details on size, so Greenpeace assumed a 5MW energy demand.
Santa Clara, California	15	41%	44%	0%	8%	Microsoft expanded colocation lease with DuPont Fabros Technologies by 6 MW.
Reston, Virginia	20	2%	23%	37%	37%	Microsoft subleased 13.65MW of colocation space from Yahoo in 2014, with assumed PUE of 1.5

ORACLE CLEAN ENERGY INDEX 17%

NATURAL GAS 18% / COAL 50% / NUCLEAR 11%

Facility Location	Estimated Nameplate Power Capacity	% of Clean Energy Supply to Data Center	Resource Mix of Local Utility			
			Natural Gas	Nuclear	Coal	
Austin, TX	7	22%	20%	25%	33%	
West Jordan, UT	8	14%	14%	0%	64%	
Colorado Springs, CO	2	12%	24%	0%	64%	
Linlithgow, UK	2	15%	27%	20%	36%	

rackspace the open cloud company CLEAN ENERGY INDEX 25%

NATURAL GAS 21% / COAL 33% / NUCLEAR 21%

Facility Location	Estimated Nameplate Power Capacity	% of Clean Energy Supply to Data Center	Resource Mix of Local Utility			
			Natural Gas	Nuclear	Coal	
Chicago, IL	15.0	3%	17%	34%	43%	
Dallas, TX	12.0	11%	41%	12%	36%	2 facilities
London, UK	10.0	100%	27%	20%	36%	Rackspace has arranged to procure 100% renewable electricity to meet the demand of its existing London facility.
Virginia	9.0	2%	23%	37%	37%	3 facilities
Hong Kong	1.0	0%	22%	23%	53%	
Sydney, Australia	2.0	14%	12%	0%	74%	

salesforce CLEAN ENERGY INDEX 23%

NATURAL GAS 20% / COAL 25% / NUCLEAR 26%

Facility Location	Estimated Nameplate Power Capacity	% of Clean Energy Supply to Data Center	Resource Mix of Local Utility			
			Natural Gas	Nuclear	Coal	
Slough UK	2	89%	27%	20%	36%	Salesforce is powering its UK data center, built by NTT, with 100 % renewable energy, 11% of which was biomass, which is not counted as renewable (see page 26)
California	3	28%	28%	22%	0%	
Chicago, Illinois	2	3%	17%	34%	43%	
Phoenix, Arizona	4	10%	22%	30%	38%	
Virginia	3	2%	23%	37%	37%	

YAHOO! CLEAN ENERGY INDEX 73%

NATURAL GAS 6% / COAL 11% / NUCLEAR 8%

Facility Location	Estimated Nameplate Power Capacity	% of Clean Energy Supply to Data Center	Resource Mix of Local Utility			
			Natural Gas	Nuclear	Coal	
Omaha, Nebraska	23	52%	1%	30%	57%	Yahoo signed a PPA for 23MW of wind power in Rush County, Kansas in 2014
Lockport, New York	23	100%	47%	28%	4%	Yahoo negotiated to expand its allotment of hydropower to 100% for its Lockport facility.
Avenches, Switzerland	7	58%	0%	31%	10%	
Singapore	4	0%	95%	0%	0%	
Quincy, Washington	21	89%	2%	3%	6%	

Colocation Companies

DIGITAL REALTY
Data Center Solutions

CLEAN ENERGY INDEX 18%

NATURAL GAS 30% / COAL 28% / NUCLEAR 20%

Facility Location	Estimated Nameplate Power Capacity	% of Clean Energy Supply to Data Center	Resource Mix of Local Utility			Data Source for power demand: www.digitalrealty.com and from Digital Realty directly.
			Natural Gas	Nuclear	Coal	
Amsterdam	38	12%	55%	3%	27%	
Atlanta	58	3%	39%	23%	35%	
Boston	42	14%	46%	33%	6%	Generation mix provided by the company.
Charlotte	10	1%	9%	51%	38%	
Chicago	133	3%	17%	34%	43%	
Dallas	133	11%	41%	12%	36%	
Hong Kong	26	0%	22%	23%	53%	
Houston	25	0%	55%	10%	35%	
London	151	57%	13%	0%	27%	Digital Realty reports buying sufficient Levy Exempt Certifcates (LECs) to cover 100% of its electricity demand in London. However, the generation breakdown of the generation mix associated with the LECs shows Biomass (27%) and waste gas (13%). These have been allocated to coal and natural gas respectively, given their similar carbon profiles.
Los Angeles	40	25%	28%	9%	23%	
Northern Virginia	145	2%	23%	37%	37%	
New York Metro	96	14%	45%	25%	13%	Generation mix provided by the company.
Paris	29	4%	4%	73%	4%	
Phoenix	74	10%	22%	30%	38%	
San Francisco	71	28%	28%	22%	0%	
Silicon Valley	91	41%	44%	0%	8%	
Singapore	21	0%	95%	0%	0%	
Sydney	6	14%	12%	0%	74%	

CLEAN ENERGY INDEX 6%

NATURAL GAS 25% / COAL 32% / NUCLEAR 34%

Facility Location	Estimated Nameplate Power Capacity	% of Clean Energy Supply to Data Center	Resource Mix of Local Utility			Data Source for facility power capacity: www.dft.com/data-centers/location-information
			Natural Gas	Nuclear	Coal	
Ashburn, Virginia (ACC2)	19	2%	23%	37%	37%	
Ashburn, Virginia (ACC3)	18	2%	23%	37%	37%	
Ashburn, Virginia (ACC4)	51	2%	23%	37%	37%	
Ashburn, Virginia (ACC5)	47	2%	23%	37%	37%	
Ashburn (ACC6)	34	2%	23%	37%	37%	
Ashburn, Virginia (ACC7)	48	2%	23%	37%	37%	
Chicago, Illinois (CH1)	47	3%	17%	34%	43%	
Chicago (CH2)- Under Construction)	33	3%	17%	34%	43%	
Piscataway, New Jersey (NJ1)	47	0%	30%	55%	13%	
Santa Clara, California (SC1)	46	41%	44%	0%	8%	
Reston, Virginia (VA3)	18	2%	23%	37%	37%	
Bristow, Virginia (VA4)	13	2%	23%	37%	37%	

EQUINIX

CLEAN ENERGY INDEX 15%

NATURAL GAS 29% / COAL 29% / NUCLEAR 20%

Facility Location	Estimated Nameplate Power Capacity	% of Clean Energy Supply to Data Center	Resource Mix of Local Utility			Data Source for facility power capacity: www.equinix.com/#
			Natural Gas	Nuclear	Coal	
Seattle	15	94%	0%	5%	1%	2 facilities
Silicon Valley	65	38%	44%	0%	8%	7 facilities
Los Angeles	38	25%	28%	6%	6%	4 facilities
Denver	2	17%	25%	0%	53%	
Dallas	13	9%	41%	12%	36%	5 facilities
Chicago	33	3%	17%	34%	43%	4 facilities
Atlanta	11	1%	39%	23%	35%	3 facilities
Miami	9	0%	70%	17%	5%	2 facilities
Boston	2	13%	37%	28%	6%	
New York Metro	80	3%	21%	34%	40%	8 facilities
Philadelphia	1	4%	18%	35%	44%	
Northern Virginia	121	2%	23%	37%	37%	10 facilities
Brazil	19	78%	7%	2%	2%	4 facilities
Toronto	3	62%	11%	58%	2%	
Netherlands	50	12%	55%	3%	27%	5 facilities
London	18	15%	27%	20%	36%	5 facilities
Paris	40	13%	4%	73%	4%	4 facilities
Switzerland	28	57%	0%	36%	0%	7 facilities
Germany	62	22%	11%	15%	46%	10 facilities
Dubai	5	0%	99%	0%	0%	

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EQUINIX

CLEAN ENERGY INDEX 15%

NATURAL GAS 29% / COAL 29% / NUCLEAR 20%

Facility Location	Estimated Nameplate Power Capacity	% of Clean Energy Supply to Data Center	Resource Mix of Local Utility			
			Natural Gas	Nuclear	Coal	
Japan	40	10%	38%	2%	29%	5 facilities
Shanghai	10	19%	2%	2%	76%	4 facilities
Hong Kong	43	0%	22%	23%	53%	3 facilities
Singapore	48	1%	95%	0%	0%	2 facilities
Australia	38	10%	23%	0%	49%	4 facilities

TelecityGroup

CLEAN ENERGY INDEX 18%

NATURAL GAS 27% / COAL 27% / NUCLEAR 15%

Facility Location	Estimated Nameplate Power Capacity	% of Clean Energy Supply to Data Center	Resource Mix of Local Utility		
			Natural Gas	Nuclear	Coal
Amsterdam, Netherlands	21	12%	55%	3%	27%
Dublin, Ireland	9	10%	48%	0%	22%
Frankfurt, Germany	11	16%	11%	15%	46%
Helsinki, Finland	6	14%	9%	33%	16%
London, UK	31	15%	27%	20%	36%
Manchester,UK	6	15%	27%	20%	36%
Milan, Italy	4	13%	43%	0%	18%
Paris, France	9	17%	4%	73%	4%
Stockholm, Sweden	11	52%	1%	38%	1%
Sofia, Bulgaria	2	9%	4%	32%	54%
Warsaw, Poland	1	3%	4%	0%	84%

Endnotes

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