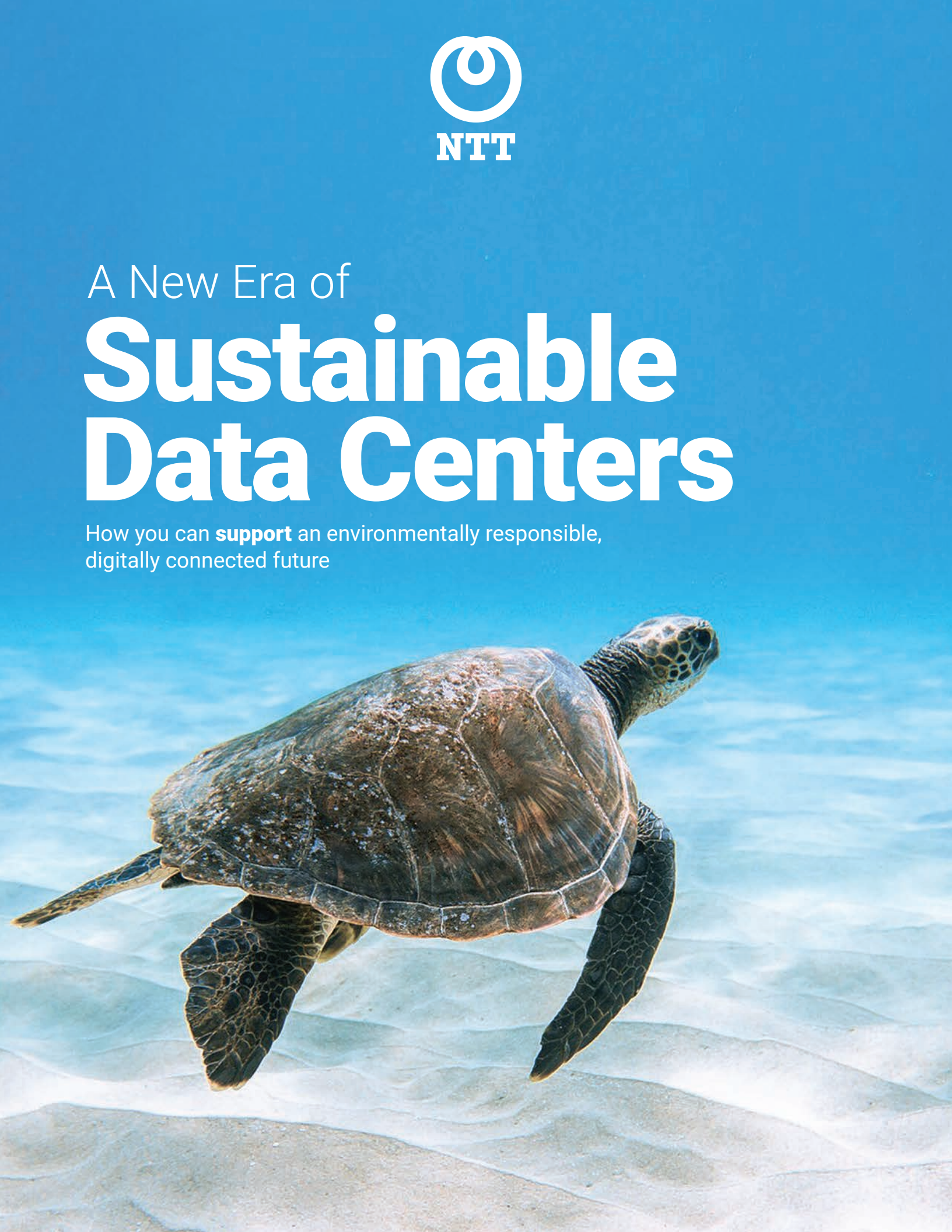
NTT

A New Era of

Sustainable Data Centers

How you can **support** an environmentally responsible, digitally connected future



Why is sustainability important in data centers?

> The energy footprint of the IT sector consumes approximately **7% of all the electricity** used around the world.

Within the IT sector, data centers consume a massive amount of power. In the U.S., data centers use more than 70 billion kilowatt-hours of electricity a year, which is equivalent to approximately 2% of all electricity use in the country.

The energy footprint taken up by data centers will certainly increase as our reliance increases on artificial intelligence, machine learning, Internet of Things, and 5G. Another factor driving even more data use is that the world's population will continue to increase, necessitating more devices, connectivity, etc.

But there is only so much that our planet can take. If our growing digital infrastructure increases the demand for electricity from coal and other dirty sources of energy that are changing our planet's climate, we may soon wind up effectively destroying millions of species -- including ourselves.

Fortunately, data centers have the space, technology, and expert staff to evolve in ways that meet the power demands of today and tomorrow without contributing to destructive climate change.

In this paper, we will discuss what power providers are currently offering in key data center markets, what data centers are doing to be as efficient as possible, and how data center customers can support sustainability.

***Global data will grow** from 33 zettabytes in 2018 to an astounding 175 zettabytes by 2025.*

– IDC

Source: https://www.seagate.com/files/www-content/our-story/trends/files/idc-seagate-dataage-whitepaper.pdf

What kind of power is available?

> While non-renewable power is still the norm, utilities do offer options for customizable packages of **clean, reliable power.**

By working with utilities, data centers can identify the best options to bring 100% renewable energy to existing campuses, while building new campuses that are “100% green energy ready”. For hyperscale data center clients, renewable energy packages can be tailored to specific needs in increments of one megawatt or more.

An important point to remember here is that in general, the price differences for clean energy vs. non-renewable energy are decreasing. The National Renewable Energy Laboratory projects utility solar costs will decline 60% by 2050 under mid-level forecasts assuming continued industry growth, and technological breakthroughs could cut costs up to 80% by 2050. Similarly, its onshore wind analysis forecasts a 30% cost decline by 2050, which could be up to 64% with breakthroughs.

What kind of power is available?

This table shows the current state of renewable energy options across several key data center markets that we have facilities in. While some providers are able to offer 100% green energy today, some still have a ways to go.

MARKET	POWER PROVIDER & ENERGY MIX	PROVIDER GOALS
Sacramento, Calif.	**SMUD** 100% solar (as a Greenergy partner, as per https://www.smud.org/-/media/Documents/Corporate/Environmental-Leadership/PowerContentLabel.ashx)	SMUD offers clients energy from renewable sources including wind, solar, biomass, and small hydroelectric. In 2020, SMUD's solar panels will generate enough electricity to power over 45,000 homes. Over 100 wind turbines will power 82,000 homes.
Ashburn, Virginia	**Dominion Energy** Nuclear 33.8%, Natural Gas 33.6%, Coal 26.5%, Renewable 5.6%, Oil 0.5% (https://www.dominionenergy.com/company/making-energy)	Dominion's goal is to provide 15% renewable power by 2025 in Virginia through renewable resources, developing new renewable energy, and purchasing renewable energy certificates. Dominion is also building a 1,500-acre solar farm in southern Virginia that will generate 120MW, as well as what will be the largest offshore wind turbine project in the U.S., with three phases each producing 880MW for a total of 2,640MW. The three phases are scheduled to come online starting in 2024 and finishing in 2026.
Dallas, Texas	**Garland Power & Light** 100% solar and wind (as part of the Green Choice program, as per https://www.gpltexas.org/residential/residential-rates/green-choice)	Because the ERCOT electricity grid is sustained by a variety of power resources, the electricity that actually arrives at a business is a blend of the power available on the grid at any given time. GP&L ensures that annual renewable wind and solar energy delivered to the grid from GP&L's renewable power purchase agreements is sufficient to fully offset the amount of electricity used annually by Green Choice customers.
Hillsboro, Oregon	**Portland General Electric** Natural Gas 33%, Purchased Power 30%, Coal 14%, Hydro 14%, Wind 9% https://www.portlandgeneral.com/our-company/energy-strategy/how-we-generate-electricity	PGE's goal is to provide 50% of electricity from qualifying renewable sources by 2040. PGE owns two wind farms and five hydroelectric plants.
Santa Clara, Calif.	**Silicon Valley Power** Natural Gas 34%, Unspecified 23%, Renewable 32%, Hydro 11% https://www.siliconvalleypower.com/svp-and-community/about-svp/power-content-label	SVP's goal is to meet the goal that eligible renewable energy resources and zero-carbon resources must supply 60% of retail electricity sales in 2030 and 100% in 2045.

What are the barriers to renewable energy?

> For renewable energy usage to grow in the future, **certain obstacles must be overcome.**

In many cases, price-related barriers to expanding renewable energy are regulatory and are therefore within state control.

Some examples include:

Utility Rate Structures

Unless carefully monitored to encourage the development of distributed generation, rate structures can increase the cost of renewables (e.g., through stand-by rates, lack of net metering) or prohibit connection to the electrical grid.

Lack of Interconnection Standards

The absence of standard rules, procedures and requirements for connecting renewable energy systems to the electric utility's grid, can hinder adoption. Six states do not have any interconnection standards at all, while the other states all have different standards relating to the type of renewable energy used and the size in kW or MW of the system.

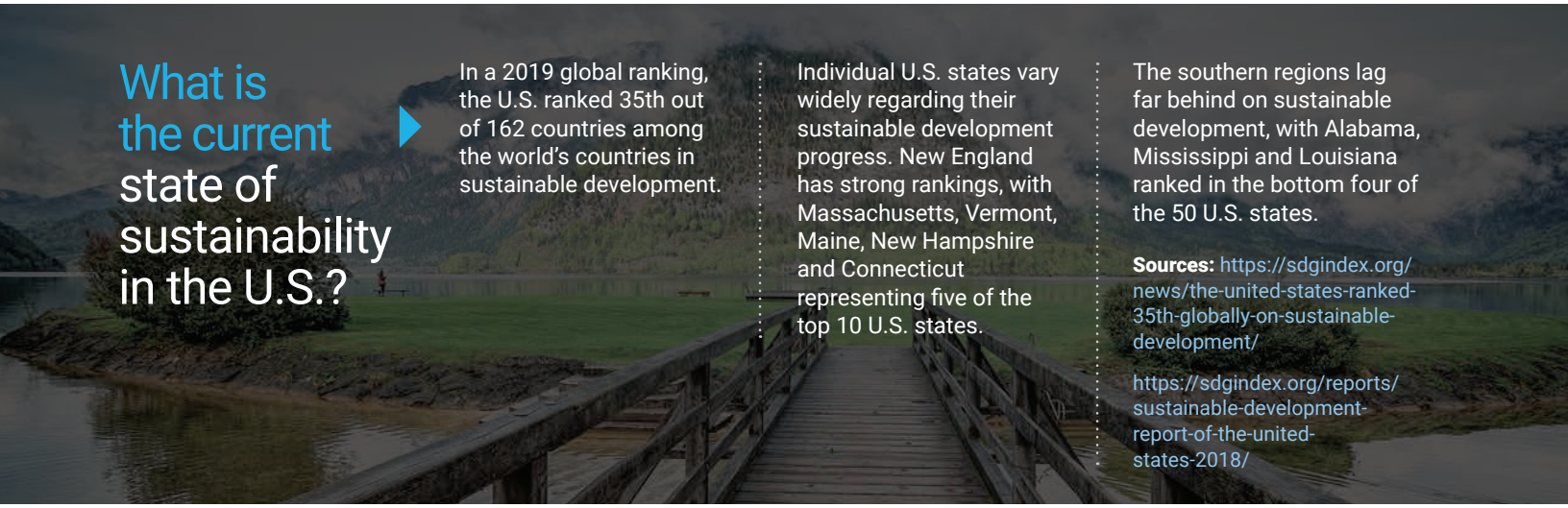
Barriers in Environmental Permitting

Large-scale renewable energy technologies can face permitting hurdles until permitting officials are familiar with the environmental effects of the generation processes. Permit criterion, application, and review processes are inconsistent across municipalities, counties, states, and the federal government. A wind farm proposal, for example, could fall to various federal agencies, leading to confusion and project delays.

Lack of Transmission

Many renewable resources are located in remote areas that lack ready or cost-effective access to transmission. Some states do not reimburse investments in transmission, and do not have coordinated planning and permitting processes, and are thus slowing the development of utility-scale renewable projects in their territory. New transmission line proposals by renewable energy developers and utilities sometimes are delayed or blocked by landowners and environmental groups.

Source: https://www.epa.gov/statelocalenergy/state-renewable-energy-resources#Barriers%20to%20Renewable%20Energy



What is the current state of sustainability in the U.S.?

In a 2019 global ranking, the U.S. ranked 35th out of 162 countries among the world's countries in sustainable development.

Individual U.S. states vary widely regarding their sustainable development progress. New England has strong rankings, with Massachusetts, Vermont, Maine, New Hampshire and Connecticut representing five of the top 10 U.S. states.

The southern regions lag far behind on sustainable development, with Alabama, Mississippi and Louisiana ranked in the bottom four of the 50 U.S. states.

Sources: https://sdgindex.org/news/the-united-states-ranked-35th-globally-on-sustainable-development/

https://sdgindex.org/reports/sustainable-development-report-of-the-united-states-2018/

Benefits
of sustainable
data centers

On a global scale, data centers must apply best practices for efficiency – while still offering affordable service.

The roads of sustainability and affordability don't always run in parallel, but more and more innovations are being rolled out to deliver both of those objectives to give clients the best of all worlds.

With these breakthroughs, companies that take advantage of the technology in optimized data centers can count on benefits including:

Cost savings – The same technologies that save energy typically save money as well.

Reliable network performance – An optimized environment enables data centers to offer 100% uptime service level agreements.

Room to grow – Efficient data centers enable clients to take up as little space as possible, meaning there is room to grow if needed in the future.

Pride of being a good corporate citizen – Your company's customers and employees will appreciate the choices your enterprise makes to support global sustainability.

82%

of people say that it is important that their service providers have a robust environmental sustainability program

– STO Building Group survey on sustainability, wellness, and resilience

Power Usage Effectiveness (PUE) results from precise monitoring

Data centers can help clients monitor and improve their energy efficiency and improve the Power Usage Effectiveness (PUE) ratio at each facility. By implementing a wireless data center environmental monitoring system, data centers can provide a more detailed thermal map of the data floor. That technology enables data centers to make more precise temperature and humidity adjustments to save cooling energy.

In addition, more and more data center clients are realizing they can run their infrastructure at ASHRAE-Allowable temperature ranges rather than ASHRAE-Recommended. There is no discernible difference in reliability when operating in the ASHRAE-Allowable window, however there can be significant gains in efficiency and reduction of energy usage. While our data centers still offer the capability to meet ASHRAE-Recommended environmental conditions, we are capable of operating at any data points desired in order to improve PUE and reduce energy costs.

How ASHRAE-Allowable ranges save energy vs. ASHRAE-Recommended

According to ASHRAE's committee 9.9 for mission critical facilities, a class A1 data center can range in temperature from 59°F to 89.6°F and in relative humidity from 20% to 80%.

Operating at higher temperatures save on cooling costs, and running at the minimum relative humidity saves energy at the humidifier as well as the cooling coil. If the dewpoint of the space can be reduced below the supply air temperature, this can eliminate the latent load at the cooling coils, saving significant cooling as well as humidification energy.

Source: https://www.energy350.com/ashrae-releases-new-data-center-standards/

Water Usage Effectiveness (WUE) highlights conservation of resources

As a rule, data centers should leverage the right cooling technology for the right environment. Using a closed loop chilled water system can eliminate the need for makeup water (thus Water Usage Effectiveness can be 0.0). By using no water, data centers become immune to potential drought water restrictions such as those on the Colorado River that could impact data center providers. In some areas, reclaimed water can be utilized instead of using freshwater resources.

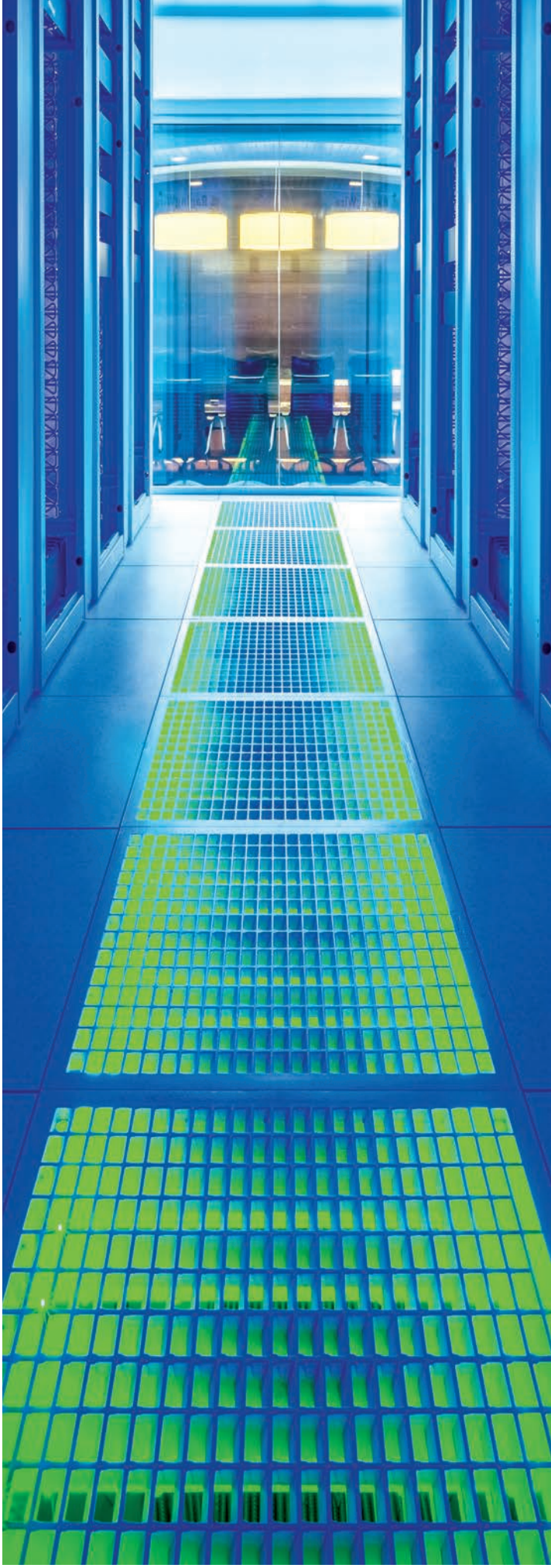
In locations such as Ashburn and Dallas where we have large data center campuses, large closed-loop (non-evaporative) mechanical systems provide the most efficient cooling. In other environments, using water for cooling may be the most efficient use of local resources, especially high temperature chilled water which uses less energy to achieve the desired result.

Temperature controls generate energy efficiency

Data centers maintain a tight hot aisle/cold aisle rack configuration, while supply air temperature is set to ASHRAE TC 9.9 standards. To further isolate and contain the hot aisle side of the IT network and equipment racks, we install blanking panels wherever open server spaces exist. Extended return air ducts are installed on CRAH unit air intakes to prevent cold air from short-cycling back into the CRAH intake. The resulting increase in return air temperatures further increases CRAH unit efficiency. In addition, our data center infrastructure is monitored and controlled by our custom-designed N-Matrix™ infrastructure management system.

Airside economization can lead to energy-free cooling

Airside economizers can leverage favorable outside temperatures during cooler seasons. Intelligent automation and switchover help maximize economizer usage. As an overall system, data center cooling technology is designed to handle a 20-year occurrence of extreme weather that can be expected at every geographic location. For instance, our data center infrastructure management (DCIM) software is tuned to take advantage of the 5,000+ hours of free cooling/year expected at our data center in Dallas.



High-efficiency motors minimize energy usage

Data centers use variable frequency drive (VFD) motors on mechanical cooling pumps, chilled water pumps, and air handlers. Intelligent automation adjusts fan speed depending on the IT load, saving significant amounts of power.

Smart buildings save energy and extend light bulb life

According to the U.S. Department of Energy (energy.gov), widespread use of LED lighting has the greatest potential impact on energy savings in the U.S. By 2027, use of LEDs could save about 348 TWh (compared to no LED use) of electricity. This is the equivalent annual electrical output of 44 large electric power plants (1,000 megawatts each), and a total savings of more than $30 billion at today's electricity prices. That is why we use LED lighting in our data centers. All of our data halls are equipped with motion-activated lighting that reduces power usage when not needed. Also, motion-activated lighting and occupancy sensors generate less heat, which is specifically important in data halls.

Recycling is the core of sustainability

These materials make up the majority of material, by weight, in a typical data center.

Plastics: Traditional plastics production is energy intensive and has been estimated to account for 1 percent of total greenhouse gas emissions. The carbon footprint of recycled plastics is a mere fraction of that of virgin plastics.

Aluminum: Traditional aluminum production uses a large amount of electricity. Recycling aluminum saves 90-95 percent of the energy needed to make aluminum from bauxite ore. There is no limit to how many times aluminum can be recycled.

Steel: Recycling one ton of steel saves 2,425 pounds of iron ore, 1,389 pounds of coal, and 121 pounds of limestone. Steel recycling uses 74 percent less energy, 90 percent and 40 percent less water than virgin steel production. It also produces 76 percent fewer water pollutants, 86 percent fewer air pollutants, and 97 percent less mining waste. (Source: https://www.simsrecycling.com/resources/white-paper-data-center/)

Along with our waste disposal partner, we recycle 100% of the cardboard, steel, copper, glass, plastic, aluminum, and other eligible materials we use at our operating facilities, as well as at facilities under construction. In addition, we recycle 100% of our lead acid and VRLA batteries, and we recycle the electronic waste from both our own company use and as a free service for our clients.

How data centers help customers support sustainability

> By leveraging their buying power with utilities, data centers can offer their clients **reliable, renewable energy** at very competitive rates.

For instance, as a result of our partnership with the utility provider SMUD, clients at our three Sacramento data centers receive renewable energy while being protected from market fluctuations in the real-time energy market, which can vary greatly on a month-to-month basis.

Outside the data center, companies can shop various electricity service providers for “competitive” products or “green marketing” products. These options are available in competitive or deregulated markets, and enable customers to procure bundled renewable electricity from their default utility supplier, or from an alternative competitive electricity supplier.

Another green power product only available in traditionally regulated markets are “green tariffs”, which are bundled green power products from specific renewable energy projects procured through special utility tariff rates.

NTT is looking into many options to improve sustainability and is very excited about the future. There could soon be solar options for our customers from the utilities that service our data centers, such as Dominion Energy’s 5MW solar farm for our Ashburn customers. In addition, we are monitoring the progress of battery storage capacity as well as new ways to minimize energy usage.

Renewable energy options for data centers

Generating renewable energy on-site using a system or device at the location where the power is used (e.g., photovoltaic panels on a state building, geothermal heat pumps, biomass-fueled combined heat and power, building an on-site solar farm).

Purchasing renewable energy through renewable energy certificates (RECs) – also known as green tags, green energy certificates, or tradable renewable certificates. These represent the technology and environmental attributes of electricity generated from renewable resources. For instance, Dominion Energy offers commercial customers the option to buy RECs at a cost of 1.3 cents per kilowatt hour (kWh), so for example 1,000 kWh would cost $13. There is no minimum purchase.

Purchasing renewable energy from an electric utility through a green pricing or green marketing program, where buyers pay a small premium in exchange for electricity generated locally from renewable energy resources.

Applying RECs associated with clean energy generated in one place to whatever grid energy is consumed in another, making that grid energy "carbon-neutral." This is considered a "Virtual Power Purchase Agreement."

Source: https://www.epa.gov/statelocalenergy/state-renewable-energy-resources

The future looks bright and renewable

> Around the world, the day may come when nearly **100% renewable energy usage** is not just a wish, but a reality.

A study titled **"Global Energy System Based on 100% Renewable Energy – Power Sector"** states that renewable energy potential and technologies, including storage, will be able to generate enough secure power to cover the entire global electricity demand by 2050, with a mix of solar (69%), wind (18%), hydropower (8%) and bioenergy (2%), with the remaining 3% coming from various non-renewable sources. The authors conclude that energy transition is no longer a question of technical feasibility or economic viability, but of political will.

Sustainability questions you should ask

Ask your company's executives:

- As a data center decision-maker, how can I support our company's sustainability goals?

Ask colocation data center providers:

- Do you publicly report your carbon footprint and energy usage?
- Do you offer renewable energy to clients at your data centers?
- As a data center client, can we get credit for green energy we buy at the data center?
- What other sustainability initiatives have you undertaken?
- What are your future plans for sustainability programs?

For more info to guide your green power procurement decisions, go to: https://www.epa.gov/greenpower/green-power-procurement-considerations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