Life Is On | Schneider Electric

Why Data Centers Must Prioritize Environmental Sustainability: Four Key Drivers

White Paper 64

Version 3

by Linda Zhang and Robert Bunger

Executive summary

Data center operators have focused on efficiency and sustainability over the last two decades. The four key drivers prompting data center operators to prioritize environmental sustainability are: 1) Customer requirements; 2) Government regulations; 3) Business value; and 4) ESG investment. Today, the focus is expanding beyond evaluating and measuring efficiency into environmental sustainability including renewable energy, greenhouse gas (GHG) emissions, water, waste, and land & biodiversity but impending reporting requirements are emerging. Governmental regulations are evolving from providing suggested metrics and guide data center owners on pathway to decarbonization to mandatory regulations and reporting.

RATE THIS PAPER ★★★★★

Introduction

Data centers represent 2%[1] of total global electricity consumption today. Digital transformation, automation and increasing adaptation of Artificial Intelligence (AI) requires more IT compute capacity and more data centers. This has drawn the attention of environmental groups and consumers concerned about climate change, the most pressing issue society faces today.

With data center operations at the core of their business, colocation providers are facing the most pressure to improve sustainability by reducing GHG emissions, water consumption, and energy use. Machine Learning and AI-supported software for data center management, like DCIM, enables bespoke decarbonization of the sector. According to the "Multi-tenant Datacenters and Sustainability" report from 451 Research, 43% of multi-tenant data center operators have a comprehensive sustainability program to improve the design, build, and operation of their data centers, and we believe this number will continue to grow. Figure 1 from this report shows that "customer requirements" is the most important driver of data center efficiency and sustainability initiatives, followed by "long-term operational resilience," "regulations," "cost saving", and "public opinion."

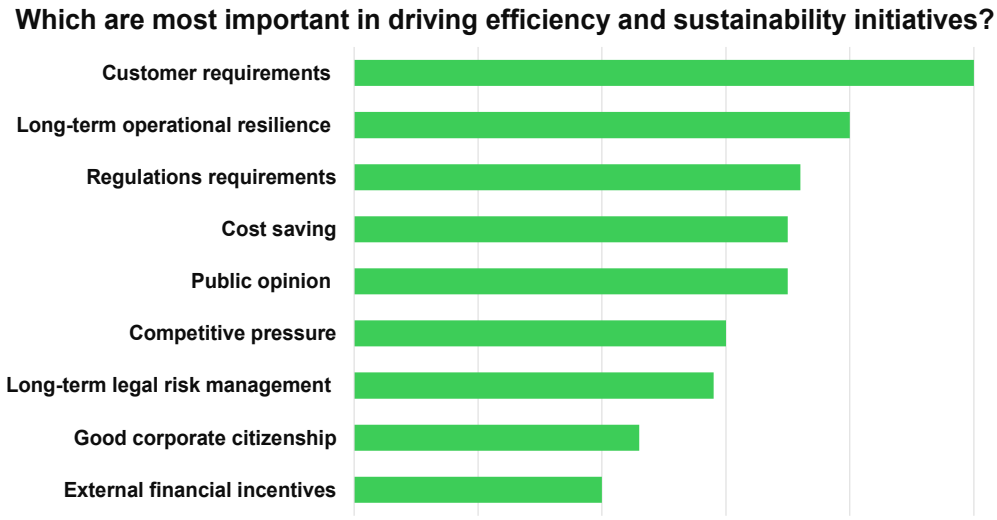


Figure 1
Report on drivers of sustainability initiatives

Efficiency improvement as a first step – The data center industry has been proactive by introducing the power usage effectiveness (PUE) metric, which focuses on improving electrical efficiency of the facility. This focus has garnered significant improvements over the years, reducing the average annual PUE of large data centers from 2.0 to 1.2. Furthermore, PUE values from some of the internet giant data centers (Google, Facebook, etc.) have been reported to be as low as 1.1[2]. However, sustainability is more than just electricity use. In 1987, the United Nations Brundtland Commission defined sustainability as: "Meeting the needs of the present without compromising the ability of future generations to meet their own needs." Sustainability includes three main categories: environmental, social, and governance (ESG). For colocation providers to thrive in this competitive market, sustainability programs are essential and the need for them is supported by four main drivers:

[1] Masanet, Shehabi, Lei, Smith, Koomey, *Recalibrating global data center energy-use estimates*, 2020

[2] *Google Data Center PUE performance*

1. Colocation tenant requirements
2. Government regulations
3. Business value
4. ESG investment

1. Colocation tenant requirements

Prospective customers of colocation providers are demanding contractual sustainability commitments as a condition for their business. According to the 451 Research report, as shown in **Figure 2**, nearly all respondents have customers asking them for sustainability commitments, with only 1% of respondents say none are required.

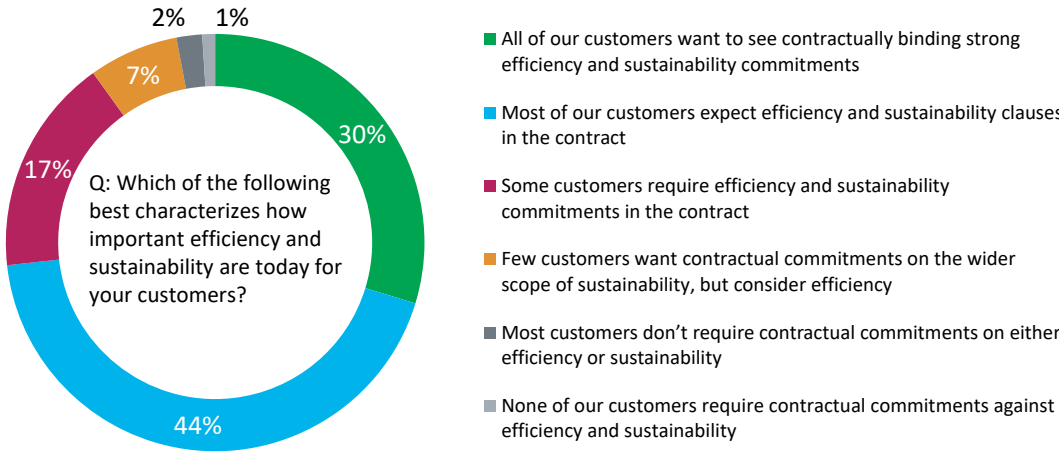


Figure 2
Importance of efficiency and sustainability to customers

Source: 451 Research

For example, some tenants ask data center owners to provide comprehensive sustainability program/plans and sustainability certifications (e.g. BREEAM[3] or EAC[4]) to validate their sustainability development. The following are examples of tenant requirements gathered from interviews with data center owners and other stakeholders.

Provide data center environmental sustainability reporting – Tenants rely on their colocation provider to deliver information on environmental sustainability goals and report on their progress. Internet giants and large corporations are pledging to reach net-zero emissions, but such starts to be present across the entire data center sector. Besides voluntary pledges, governments start to demand sustainability reporting with mandated list of parameters published and audited. To meet carbon neutrality goals, operators are required to disclose their GHG emissions as part of their own sustainability reporting. A colocation provider's Scope 1 and Scope 2 emissions are part of their tenant's Scope 3 emissions[5], so they need to collect the provider's carbon footprint data for their disclosure. Software savvy tenants ask their providers to offer monitoring software to provide real-time and trending carbon footprint data from data center infrastructure assets through an online portal or customizable application programming interface (API).

Use of circular economy practices –Tenants are also asking for circular economy practices from their providers' operations. For instance, specific recycling

[3] *https://www.breeam.com/*

[4] *https://energy-attribute-certificates.com/*

[5] According to the GHG Protocol and ISO 14064 standard, the actual physical weight of greenhouse gas emissions was specified using the term "Scope" falling into three categories: (1) Scope 1 – Direct GHG emissions, (2) Scope 2 – Energy indirect GHG emissions, (3) Scope 3 – Other indirect GHG emissions, such as business travel and the value chain.

programs may be required to help them improve their own waste diversion efforts. Data centers produce tons of waste annually through the disposal of end-of-life products (e.g. older servers, batteries), which can contain hazardous materials. Through circular practices, decommissioned servers can be dismantled into separate components and be reused instead of sent to a landfill. For example, Microsoft expects to increase its reuse of server parts by 90% by 2025[6].

Reduce Scope 1 and 2 GHG emissions – Tenants are choosing providers who are finding ways to reduce their GHG emissions from operations. This includes Power Purchase Agreements (PPAs) for renewables to finding alternatives to diesel backup generators. For example, natural gas generators, fuel cells, and other forms of long-term energy storage provide alternatives to diesel generators along with lower Scope 1 emissions. In addition, colocation providers need to mitigate direct GHG emissions from cooling (i.e., refrigerant leakage) and medium voltage switchgear (i.e., SF_6 leakage).

Reduce Scope 3 emissions – Scope 3 emissions make up the largest portion of data center's GHG footprint and they are widely under-reported today. More information on this topic see White Paper 53, *Recommended Inventory for Data Center Scope 3 GHG Emissions Reporting*. As more and more tenets are requiring complete GHG emission reporting and reduction measures, colocation providers must start putting in place programs to measure and report Scope 3 emissions before considering reduction initiatives. One way is to require all vendors to provide Type III Environmental Product Disclosures (EPDs)[7] that document, for example, the embedded carbon footprint of the purchased product. One example of an EPD is a Product Environmental Profile (PEP) as shown in **Figure 3**. PEP provides a summary of a full Life Cycle Assessment (LCA), extracting key data essential to documenting the full environmental impact of the product.

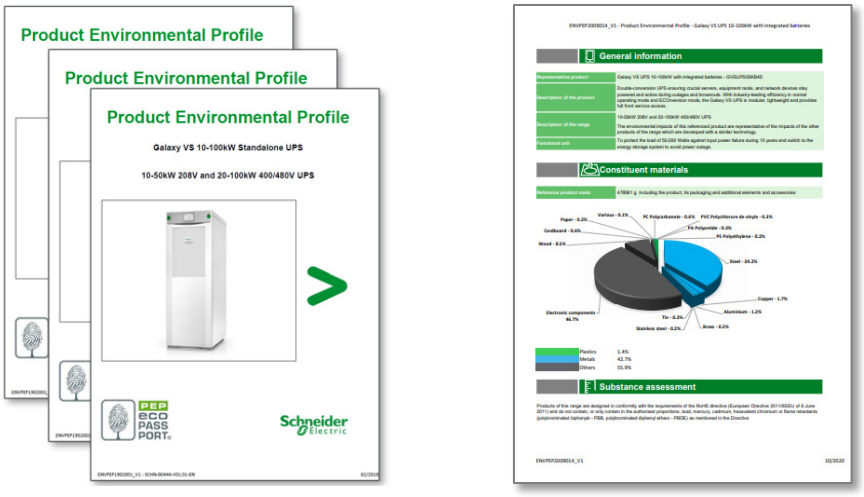


Figure 3
Examples of PEP documentation

We believe acting on these requirements is essential for colocation providers to retain current tenants while also attracting new ones.

2. Government regulations

The resource consumption and carbon footprint of data centers have attracted the attention of government and climate "watchdog" organizations. Lawmakers are increasingly acting to curb the environmental impact of data centers through regulation. Companies that don't comply with these regulations face revocation of

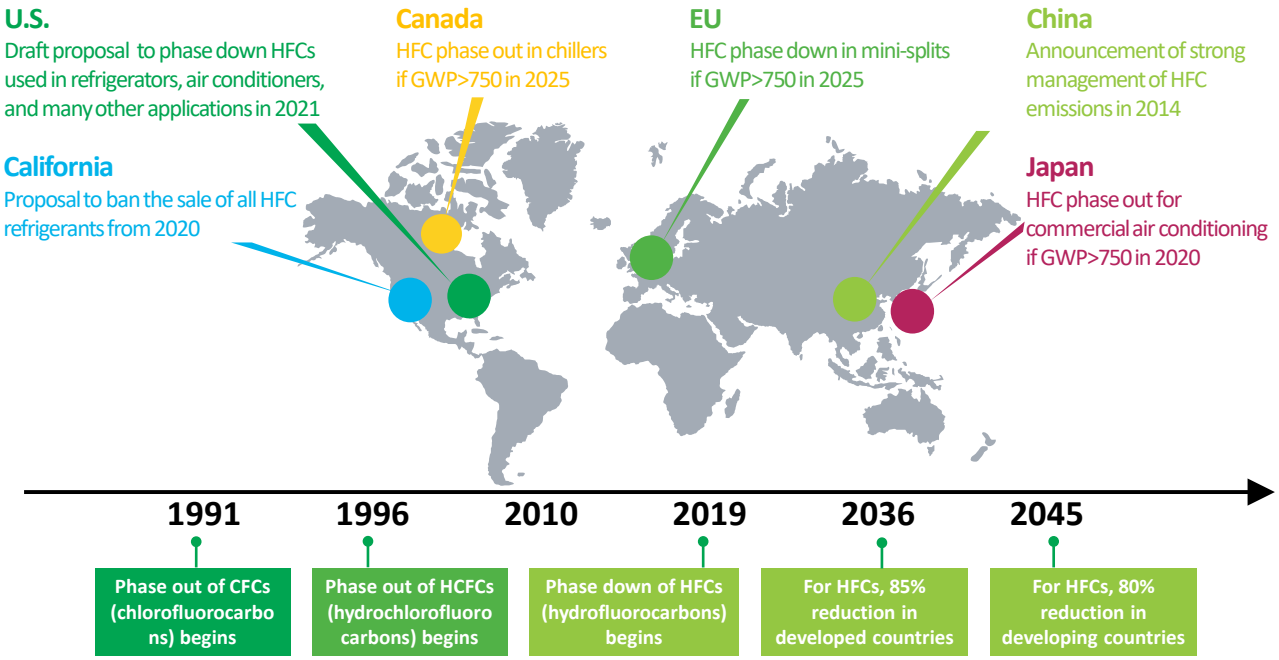
[6] Yevgeniy Sverdlik, *Microsoft Plans to Reuse More Server Parts with the Help of AI*, 2020

[7] Type III EDPs are independently verified as required by ISO14025

their license to operate. Increasing number of regions introduce mandatory ESG reporting in data center sector driving the focus towards decarbonization. In this section, we describe some examples of regulations that impact GHG emissions in the data center industry, and some areas of environmental sustainability that could be regulated in the future.

Figure 4

An example of regulations on the phase down or phase out of high global warming potential (GWP) refrigerants



**The Montreal Protocol has different timetables for developed and developing countries.*

A continued focus on refrigerants – Hydrofluorocarbon (HFC) refrigerants in the HVAC systems of commercial, residential, and industrial buildings are a potent source of GHGs. As such, countries have reached a consensus to phase-down or phase-out these refrigerants based on the Montreal Protocol. **Figure 4** demonstrates the regulatory timeline.

Phasing out SF_6 – One of the most potent GHGs, Sulfur hexafluoride (SF_6), is used as an insulation gas in electrical systems.[8] As a result, the California Air Resources Board (CARB) set the end of 2024 as a target date for the phase out of SF_6 from all equipment of 72 kV or less. The European Commission is considering a ban on SF_6 gas to take effect between 2025-2030.[9] China's State Grid Corporation is mandating that a percentage of its procurement must be SF_6-free switchgear. Vendors are developing SF_6-free MV switchgear to comply with government regulations. **Figure 5** shows an example of SF_6-free switchgear that uses air to eliminate GHG emissions.

[8] SF_6 is a popular insulation gas for arc extinguishing because its good characteristics from 1960s.

[9] Green Deal: Phasing down fluorinated greenhouse gases and ozone depleting substances.

Figure 5
An example illustrating air replacing SF_6 in medium voltage switchgear to comply with regulations in the future.

(Schneider SM AirSeT shown)

A variety of actions are being taken around energy efficiency, use of renewables, and even moratoriums on data center builds. Table 1 provides insight into potential future regulations that could impact data centers.

Table 1
Sustainability insights and regulations on data center environmental sustainability

Countries/regions	Potential impact on data center environmental sustainability

European Union	• The overarching policy initiatives **European Green Deal** released in January 2021 introduces controls on business, including data centers, and follows set of standards ISO/IEC 30134. Mandatory regulations are coming mainly from two directions:
	  ○ **Energy Efficiency Directive (EED)** in revised version was published in September 2023, coming into force in the same year.[10] Regulation breaks data center reporting into three categories of action with different thresholds and timelines.
	  ○ **Corporate Sustainability Reporting Directive (CSRD)** that evolves from Non-Financial Reporting Directive (NFRD) was adopted in June 2023. Regulation mandates detailed reporting with metrics following the European Sustainability Reporting Standards (ESRS). From 2024 data needs to be collected (and reported in 2025) by the first group of companies, and eventually reports must be audited.
	• Decarbonization pledges follow the Green Deal path:
	  ○ **European Code of Conduct for Data Centers (EU DC CoC)** is a voluntary initiative developed in 2008 by Joint Research Center (JRC) with PUE as a key metric used to assess efficiency.[11]
	  ○ **Climate Neutral Data Center Pact (CNDCP)** gathers data center operators that voluntarily commit to European Green Deal.[12] Initiative includes purchase 100% carbon-free energy, prioritize water use, reuse servers, recycle heat and set measurable targets.
	  ○ **Sustainable Digital Infrastructure Alliance** (SDIA) and **European Data Center Association** (EUDCA) are sector-driven initiatives grouping environment-cautious data center operators.
	• In July 2021 the EU released "Fit for 55" as a part of the Green Deal strategy, which recommends legislative policies to reduce carbon emissions by 55% by 2030.[13] General rules for the economy decarbonization (transport, buildings, adoption of renewable energy, etc.) come into power in 2024.
	• German government released in September 2023 the **Energy Efficiency Act (EEA)** that mandates data centers to have PUE of 1.2 by July 2026 and increase of heat reuse from 10% in 2026 to 20% in 2028.[14] Besides, a target of 50% renewable energy by 2024 and 100% by 2027 was set.
	• Dutch government released in 2022 the **National Spatial Strategy (NOVI)** that includes obligation for data centers to be established in areas with ready access to sustainable energy networks, heat reuse infrastructure and sufficient digital connectivity.[15]

[10] *Energy efficiency directive, 2023*

[11] *European Code of Conduct for Energy Efficiency in Data Centres, 2022*

[12] *Climate Neutral Data Centre Pact*

[13] *Fit for 55*, 2023

[14] Dentons, *How Germany's Energy Efficiency Act will impact data center operators*, 2023

[15] Stibbe, *Increasing control of data center locations*

Countries/regions	Potential impact on data center environmental sustainability
United States	• Office of Technology and Science Policy's (OTSP's) works on development of effective, evidence-based **environmental performance standards** to mitigate growth in data center energy consumption.[16] Three main areas will be addressed: o Minimizing emissions from crypto-mining operations, o Requirement for public reporting, o Promoting improvements and innovation in the sector. • Expected amendment of the Energy Independence and Security Act of 2007 (EISA) will **require reporting** from 100kW installed IT equipment data centers to the Energy Information Administration (EIA). • The US Department of Energy (DOE) in January 2023 introduced new national **HVAC regulations**.[17] **Further changes** and expansion of regulations are expected in 2024 from the US Securities and Exchange Commission (SEC), potentially requiring emissions reporting, evaluating climate-related risks, and demonstration of plan for action. • Washington's state legislature passed a "**cap-and-invest**" program in April 2021, coming into force in 2023 that initiates gradual reduction of pollution limits[18].
China	• Published in April 2023 and coming into effect July 2023 **Green Data Center**[19] regulation for procurement of data center equipment includes criteria like: o PUE below 1.4 form June 2023 and below 1.3 from 2025, o Annual water consumption per power consumption of IT equipment below 2.5 L/kWh, o Gradual increase of renewables in energy mix from 5% in 2023 to 100% in 2032, • Restrictions of plastics and chemicals use in IT hardware and batteries.
Singapore	• **Singapore Standard for Green Data Centers (SS 564)**[20] refers to reducing carbon emissions associated with data center operations. It is modeled after the ISO 50001 Energy Management Systems and address energy and water consumption and efficiency. • **Data Center Carbon Footprint Assessment (DC-CFA)** program introduced in July 2022 and adjusted in 2023, focuses on renewable energy usage, connectivity, compute capacity and economic commitments on pathway to decarbonize data center sector: o PUE equal or below 1.3, o new or expanded capacity certified under the BCA-IMDA Green Mark, o investment in innovative energy pathways • **Digital Connectivity Blueprint**[21] launched in June 2023 aims to optimize energy efficiency in data centers operating in tropical climate countries. • Industry overarching incentives like **Pioneer Certificate (PC)**, **Goods and Services Tax (GST)** or several **Import Duty Exemptions**[22] reward companies, including data center operators, with tax exemptions for introducing new hardware technologies like servers, networking gear, and cooling systems. • **Green Building Masterplan**[23] address energy consumption behaviors also in data center buildings.

Many of these regulations are coming into force soon and data center owners need to anticipate changes to ensure compliance.

3. Business value

"Marketing sustainability and sustainability reporting have become alternatives to traditional advertising techniques, for their ability to promote transparency, resulting in trust"[24]. Becoming sustainable can give companies a competitive advantage and have a material impact on reputation and brand value which, among other benefits, helps attract and retain current customers and investors. Data center owners can

[16] Uptime Institute, *First signs of federal data center reporting mandates appear in US*, 2023

[17] DCD, *The path to data center decarbonization starts now*, 2023

[18] U.S. News & World Report, *Washington Legislature Passes Carbon Pricing Measure*, 2021

[19] Liu Yake, China sets requirements for government procurement of data center equipment, 2023

[20] *Singapore Standard 564 for Green Data Centers*

[21] *IMDA introduces sustainability standard for data centers operating in tropical climates*, 2023

[22] *Singapore's Data Center Sector: Regulations, Incentives, and Investment Prospects*, 2023

[23] *Green Building Masterplans*

[24] Katrine Julie Heuer, *The Competitive Advantage of Sustainability Reporting*, 2017, p 2

improve their overall image and gain an advantage over competition through superior sustainability practices.

Deploy sustainable solutions to reduce costs – Energy sources like solar and wind can be built near a data center and have reasonable payback periods. Due to the high energy intensity of data centers, onsite installation of renewables typically covers only a fraction of the overall electricity needs but will still have a positive impact. Implementing a microgrid with energy storage provides opportunities for grid services like peak shaving and demand response. There are other programs with utility companies for revenue-earning opportunities. For more information, see White Paper 274, *Monetizing Energy Storage in the Data Center*.

Some investments in sustainable technologies are very economical. For example, cooling solutions like blanking panels, hot aisle air containment, and warmer chilled water supply temperature can result in substantial energy savings. Implementing air containment can save 43% in annual cooling system energy cost, corresponding to a 15% reduction in annualized PUE[25]. Liquid cooling technologies remove heat more efficiently and increase sustainability of data centers. For more information about this technology, see White Paper 265, *Liquid Cooling Technologies for Data Centers and Edge Applications*.

Avoiding or delaying large capital expenditures is another benefit. For example, a large European insurance company's data center used some best practices to free up power capacity, improve efficiency, and reduce capital cost. By implementing air management practices like cable brushes, blanking panels, and warmer operating temperature, the data center freed up over 1MW of critical power capacity, with about $40 million in CapEx savings by not having to build new capacity.[26] For more information on best practices to improve air flow for energy savings, see White Paper 49, *Avoidable Mistakes that Compromise Cooling Performance in Data Centers and Network Rooms*.

Improve competitiveness via investment in innovation – New, innovative technologies, such as high-efficiency uninterruptible power supplies (UPS), trim chiller cooling systems, and li-ion batteries, can help data center owners improve competitiveness with better performance. For example, 3-phase UPSs on the market today are capable of delivering 97% efficiency in double conversion normal mode and 99% in high-efficiency normal mode. For more information on the cost and benefit tradeoffs of high-efficiency normal mode see White Paper 157, *Eco-mode: Benefits and Risks of Energy-saving Modes of UPS Operation.*

Attract new customers via investment in new technologies – Investments in forward-looking technologies, such as liquid cooling, energy re-use systems, and hydrogen fuel cells, communicate a focus on sustainability. For example, one large tenant prohibited colocation providers from using diesel generators in a particular region and investigated hydrogen fuel cells as an alternative. However, as discussed in White Paper 513, *Making Sense of Hydrogen's Role in Reducing Greenhouse Gas Emissions*, the use of hydrogen has tradeoffs. Similarly, Google is piloting a li-ion battery energy storage system to replace the diesel generators in its Belgium data center[27]. These and other low- or zero-carbon technologies may result in faster permitting times and fewer community objections, especially in areas like California where regional regulations severely limit fossil fuel use.

[25] White Paper 135, *Impact of Hot and Cold Aisle Containment on Data Center Temperature and Efficiency*

[26] James Kaplan, Brent Smolinski, and Allen Weinberg, *Sharpening data center due diligence*, 2011

[27] Rich Miller, *Google Looks to Batteries as Replacement for Diesel Generators*, 2020

Retain talented employees – More sustainable and inclusive companies can foster increased workforce satisfaction and reduced costs related to employee turnover. Employees are proud to work for organizations admired for environmental sustainability.

Considering environmental sustainability as an integral part of a data center's business model can improve brand reputation, reduce TCO, improve competitiveness, retain talented employees, and increase brand value, which ultimately increases business value.

4. ESG investment

Directly aligning a business to ESG initiatives can open up investment capital and investment focus. Investors are increasingly evaluating companies based on specific ESG-related criteria and the subset focused on "responsible investments" continues to grow. Sustainability commitments and progress also protect against climate risk and investment risk.

Demonstrate sustainability-related commitments and progress – Investors are getting serious about sustainability and will require corporations to publish a statement of purpose and provide integrated financial and ESG reports showing not only a commitment but validated improvements they've made. According to the Governance & Accountability Institute, 90% of companies in the S&P 500 Index published a sustainability report in 2019, which shows public companies are adopting sustainability into their operating and reporting strategies[28].

Fund business growth – Investment vehicles, called green bonds, allow data center owners to raise capital based on the expectation of sustainable projects[29]. For example, some large, multi-tenant data centers are already deeply engaged in sustainable finance. Equinix, Aligned, and Digital Realty have all raised funds using green bonds or environmental sustainability-linked loans. In early 2019, Digital Realty issued its second green bond[30] and a follow-on offering totaling €1.08 billion in gross proceeds.

Some countries or regions have a sustainable innovation fund focused on improving energy efficiency and reducing carbon footprint. Governments typically provide grants, loans, or tax relief to support businesses that use less energy or provide evidence of their environmental sustainability efforts. Regional regulations start to mandate sustainability reporting, forcing operators to decarbonize data center operations. Businesses without sustainable development might be heavily taxed and left without access to "green funding". Subsidized incentives (i.e. tax breaks, rebates, etc.) can help pay for hardware cost, and with the added revenue from participating in utility programs, sustainable solutions can reach cost parity with non-sustainable solutions.

Investors with an ESG focus will only back organizations that set sustainability goals, provide transparent reporting, and demonstrate meaningful progress.

Conclusion

Environmental sustainability for data centers focuses on efficiency, renewable energy supply, greenhouse gas (GHG) emissions, water conservation, waste recycling, and land & biodiversity. **The focus on sustainability is becoming a "top of mind" concern for data center operators.** The four key drivers prompting data

[28] Mark Segal, *Why Should Fund Managers Embrace ESG?*, 2021

[29] Digital Realty, *Environmental Performance*

[30] Green bonds are standard bonds with green features, designed to support projects that have beneficial impacts on the environment compared to business as usual.

center operators to prioritize environmental sustainability are: 1) Customer requirements; 2) Government regulations; 3) Business value; and 4) ESG investment. Governmental regulations are evolving from providing suggested metrics and guide data center owners on pathway to decarbonization to mandatory regulations and reporting.

About the author

Linda Zhang joined Schneider Electric in 2011, with over 15 years of experience in data center industry. Before joining Schneider Electric, Linda worked as a data center design engineer and accumulated rich experience in electrical engineering and standards. Linda holds a bachelor's degree in Electrical Engineering Automation and her MBA from University of Science and Technology Beijing. She is also an Accredited Tier Designer (ATD) of Uptime Institute and a qualified engineer of power grid.

Robert Bunger is the Program Director within the CTO office at Schneider Electric. In his 23 years at Schneider Electric, Robert has held management positions in customer service, technical sales, offer management, business development & industry associations. While with APC / Schneider Electric, he has lived and worked in the United States, Europe, and China. Prior to joining APC, he was a commissioned officer in the US Navy Submarine force. Robert has a BS in Computer Science from the US Naval Academy and MS EE from Rensselaer Polytechnic Institute.

Acknowledgements

Special thanks to **Marcin Wegrzyn** for updating the content of this white paper.

Marcin Wegrzyn is Research Analyst for the Data Center Research Center at Schneider Electric. He publishes in areas of Data Centers, and Commercial and Residential Buildings. He holds Master of Polymer Technology degree, PhD in Industrial Engineering and Production and MBA. Marcin has over 10 years R&D research experience in academia and industry

RATE THIS PAPER

Resources

The Different Types of UPS Systems
White Paper 1

Avoidable Mistakes that Compromise Cooling Performance in Data Centers and Network Rooms
White Paper 49

Recommended Inventory for Data Center Scope 3 GHG Emissions Reporting
White Paper 53

Impact of Hot and Cold Aisle Containment on Data Center Temperature and Efficiency
White Paper 135

Eco-mode: Benefits and Risks of Energy-saving Modes of UPS Operation
White Paper 157

Liquid Cooling Technologies for Data Centers and Edge Applications
White Paper 256

Monetizing Energy Storage in the Data Center
White Paper 274

Making Sense of Hydrogen's Role in Reducing Greenhouse Gas Emissions
White Paper 513

Browse all white papers
whitepapers.apc.com

Browse all TradeOff Tools™
tools.apc.com

Note: Internet links can become obsolete over time. The referenced links were available at the time this paper was written but may no longer be available now.

Contact us

For feedback and comments about the content of this white paper:

Energy Management Research Center
dcsc@schneider-electric.com

If you are a customer and have questions specific to your data center project:

Contact your Schneider Electric representative at
www.apc.com/support/contact/index.cfm