Consensus Green IPO Underwriting Standard Interpretation

Data Center Carbon Pollution & Sustainability Assessment Elements

Sept. 10, 2024

Introduction. Data centers' greatly accelerating growth is summarized in the video at the following link showing their drain on energy, carbon pollution from their gas and other carbon pollution energy sources, tax burdens on the public for their electric infrastructure, and the highly inequitable taxpayer financial benefit / subsidy to the world's largest companies: https://www.pecva.org/our-work/energy-matters/data-centers-energy-demand/

The Washington Post highlighted these adverse carbon pollution impacts: https://www.washingtonpost.com/dc-md-va/2023/03/08/loudoun-data-centers-diesel/

At the same time, data centers are an indispensable cog in global commerce and security.

This Standard Interpretation was developed to improve data center sustainable performance though Green IPO cheaper capital and higher company valuations, increasing supply chain cashflow from sustainability. It identifies the following prerequisites and optional credits for Green IPO Certified Company Data Centers as an official Underwriting Standard Interpretation. This includes those attributes below increasing Certified Company cashflow. Green IPO Certification is to the data center company covering these components:

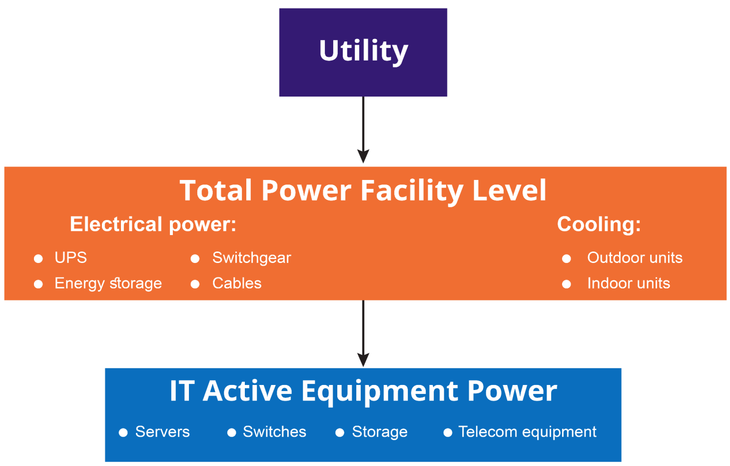
1. Data Center Building Energy Use Inventory
2. 60% carbon pollution reduction requirement from 2020 baseline for all Green IPO Certified Companies
3. Data Center Building % Onsite Wind or Solar Usage
4. Percent data center component products that are certified as sustainable
5. Credit for data center certified LEED green building or equivalent
6. Wind or solar renewable energy credit
7. Energy Efficiency credit
8. Battery, solar or wind backup power credit
9. Water use reduction percentage credit
10. Reuse / circularity is required for each certified company
11. The required company products' life cycle assessment includes human health and ecotoxicity
12. Eight fundamental social equity performance metrics are required
13. Data Center Sustainability Overview
14. Product platform Certification is allowed
15. Step-wise approaches are allowed
16. Recertification is required every three years
17. Company top management must execute legally-binding certification to FTC Green Guides
18. Thomson Reuters TrustLaw Determination that Standard adoption is not a conflict of interest

Supplemental information and contacts for further information

1. **Data Center Building Energy Use Inventory.**

- Prerequisite: Document 100% of production electrical and thermal energy requirements. Thermal energy is energy such as heat or steam for industrial, commercial, heating or cooling purposes, including through the sequential use of energy. For onsite generated energy, identify fuel type (e.g. wind, solar, natural gas, diesel oil, fuel oil, bauxite coal). For offsite generated energy (e.g. supplied electricity) document percent from clean renewable (wind and solar) versus non-renewable sources. Energy inventory can be completed through utility bills and other available company data.

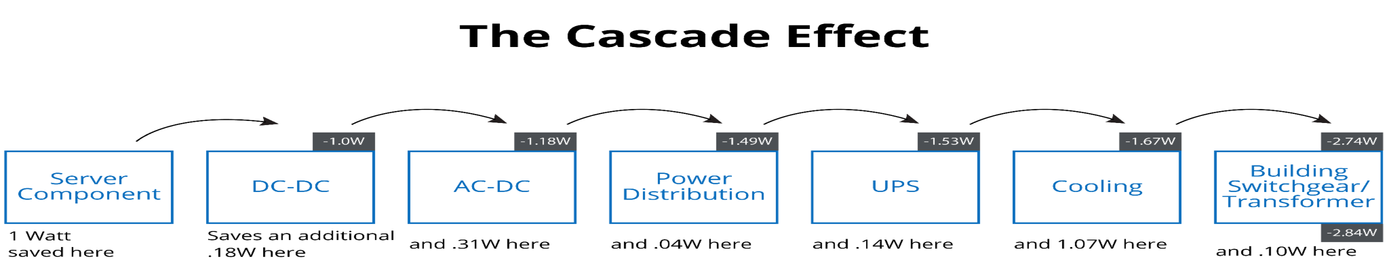
- Prerequisite: Power usage effectiveness (PUE) as an indicator of data center efficiency calculated as a ratio of the total electrical power consumed by the data center at the entry point to the average electrical power consumed by the IT equipment. The global average PUE is roughly 1.55, according to Uptime Institute reports. This allows a required carbon emission intensity measuring the amount of carbon emissions generated per unit of data center activity, as a uniform comparable metric.



$$PUE = \frac{\text{Total Power Facility Level}}{\text{IT Active Equipment Power}}$$

From Device42 Data Center Energy Efficiency Guide (2024)

Choosing appropriate rack power density and balancing across all racks, rows, and halls is paramount to optimal efficiency of the supporting structure, power train, and cooling. It is important to note that every watt saved in the rack facility will save 1.55 watts on average. However, in specific examples, the savings can be higher with cascading effects shown in the following figure:



1 Watt saved at the processor saves approximately 2.84 Watts of total consumption

The Cascade Effect shows how power savings and thus increased cashflow, can snowball.

From Device42 Data Center Energy Efficiency Guide (2024)

2. 60% carbon pollution reduction requirement from 2020 baseline for all Green IPO Certified Companies to achieve IPCC's 2030 840 gigaton / $30 trillion carbon pollution reduction requirement preserving commerce, national security, and a habitable Planet.

3. Data Center Building % Onsite Wind or Solar Usage including nearby wind or solar farms supporting the data center (increases cashflow). Prerequisite of 5% with added credit up to 100%.

4. Percent data center component products that are certified as sustainable like Eaton uninterruptable power system (UPS) Green IPO Certified back-up power systems (increases cashflow). Optional Credit.

5. Data center certified LEED green building or equivalent and how much carbon pollution does that reduce from operations (increases cashflow). Optional Credit.

6. Wind or solar renewable energy credits purchased as offsets must be within the State or adjacent State of data center location and independently certified by qualified professionals as in compliance with FTC truth in advertising Green Guides. Only onsite or nearby wind or solar farms increase cashflow, not RECs.

Implementing microgrids or decentralized energy systems within data centers allows for the integration of clean renewable energy sources at a local level. These systems can combine renewable energy generation, energy storage, and advanced energy management technologies to optimize energy usage and minimize reliance on non-renewable sources. Examples of data centers on 100% clean energy include:

- Facebook data center in Lulea, Sweden, is powered by a combination of hydroelectric and wind power. Hydroelectric power is derived from the nearby Lule River, which has multiple hydroelectric power plants, and the region has ample wind farms that supply clean energy. The Green IPO underwriting standard allows use of low impact hydro as clean energy.

- Microsoft data center in Cheyenne, Wyoming, is powered by a 237 MW wind farm located directly adjacent to the facility. The turbines provide all the electricity needed to operate the data center, making it completely powered by renewable energy.

- Apple's Maiden Data Center in North Carolina is one of the largest data centers in the world powered entirely by renewable energy. It utilizes a combination of on-site solar arrays and biogas fuel cells to generate electricity. The underwriting standard allows biogas from municipal or industrial solid waste, but not from wood as the energy source due to accompanying habitat destruction, illegal logging, and carbon pollution.

7. Energy Efficiency Credit from any demonstrated % efficiency increase of any combination of the following (increases cashflow): Optional Credit.

- **IT load management**: the processes running on specific components, such as servers or switches, yielding optimal facility-wide efficiency levels.

- **IT rack management**: the placement of servers and switches on racks optimized to reduce imbalances at the rack level and maintain uniform power distribution across all racks. Rack power density has a significant impact on the overall layout and the appropriate cooling strategy, so data center hardware optimization starts with rack optimization.

- **Overall load staging and balancing**: proper component power loading requires monitoring and adjusting all processes and data throughout the active IT infrastructure for current and future capacity.

- **Voltage level consideration**: appropriate voltage levels must be supplied from the point of connection (PoC) to the loads. Choose appropriate voltage levels, depending on the utility PoC voltage, and

  consider stepping down to a low voltage as close to the load as possible without endangering safety. Consider reducing the number of transformer stages to avoid transformation losses. Use higher voltage levels for longer parts of the transmission path to reduce efficiency losses which increase at lower voltages within cables.

- **Choosing UPS systems**: uninterruptible power supplies (UPS) can use a variety of technologies and operating modes, with UPS' ensuring high efficiency. Size each UPS so that it will be at approximately 65-90% of maximum load, which keeps its operation in the optimal range of the efficiency curve. Recent trends are for higher-capacity energy storage systems to save energy; some even have enough capacity to run a facility for many hours, meaning that generators are only needed in extreme scenarios.

- **Maximize use of storage:** by virtualization and networking functions reducing broadcast propagation and employing advanced traffic balancing and adaptive routing.

- **Efficient lighting**: optimizing the placement of very high efficiency LED lights, and using smart sensors minimizing energy losses.

- **Choosing cooling technology**: free cooling and other technologies must demonstrate higher energy efficiency. Cooling system selection must account for factors such as ambient temperature and humidity conditions at the data center location, water supply availability, rack power density, and the total power of individual IT rows and halls. Important considerations include using hot and cold aisles, avoiding thermal hot spots, and using proper cable management to ensure good airflow while reducing pressure losses. In a hot/cold aisle design, cold air circulates under the floor and rises through perforated floor tiles in the cold aisles. Hot air rises from equipment through perforated ceiling tiles and circulates to the chillers through the plenum (in the ceiling).

- **Hot /cold aisle and containment**: dividing the data center into hot and cold zones and using containment improving data center energy efficiency.

- **Liquid cooling** provides increased efficiency and reduced costs by lowering processor temperatures therefore reducing data solution times. It is quieter than air cooling and provides more control over how, when, and where specific targets are being cooled and to what degree. It also is about 4,000x more efficient at storing and transferring heat than air. Options include:
  - Immersion cooling is the most energy-efficient form of liquid cooling currently available. Single or two-phase immersion cooling systems submerge components within a rack in a thermally conductive dielectric fluid.
  - Direct-to-chip. This form of liquid cooling can be a good fit for data centers where using baths are prohibitive. This system type uses liquid cooling next to where the heat is generated.

Direct-to-chip cold plates sit on top of the board where processing is occurring. Through either single-phase or two-phase evaporation units, these systems eliminate approximately 75% of equipment-generated heat, leaving 25% for air-controlled systems.

- Rear-door heat exchangers. Like direct-to-chip solutions, rear-door heat exchangers are a stop-gap between partial and full liquid cooling systems. These exchangers replace the equipment's rear door with a liquid heat exchanger that operates in conjunction with air-cooling systems to service mixed rack densities.

- **Use of waste heat**: data center heat percent reuse documented by practices such as
  - Using it to keep the backup generator room and the generator itself warm to avoid cold starts,
  - Using waste heat in combination with the absorption chiller (if free cooling is not a preferred method of cooling), as absorption chillers utilize a thermodynamic process that relies on absorption and desorption cycles to provide cooling, rather than compression. Using absorption chillers in combination with cogeneration power plants, such as gas turbines, can increase overall power-cooling system efficiency.
  - Sell waste heat to adjacent and nearby local businesses or homes to gain revenue; this will not increase the facility's efficiency but provides offsite efficiencies and carbon pollution reduction.

- **Active monitoring**: Quick decision-making and constant optimization of the facility requires constant monitoring and data gathering on all equipment, especially IT components.

- **Regular maintenance**: preventive maintenance activities enhance the efficiency and uptime of individual components in the facility, with regular site auditing.

- **Data Center Infrastructure Management (DCIM)**: DCIM is a platform for data gathering and scheduling operational tasks increasing efficiency levels. DCIM software has rapidly moved from the "would be nice" category to "must have" because modern data centers are too large and complex to manage without sophisticated tools.

  DCIM enables successful data center operation, combining IT management, facility management, and automation. DCIM tools provide a single-point interface and management tool where all aspects of the data center infrastructure can be controlled, adjusted, and optimized. It allows for monitoring, measuring, and managing power use, cooling levels, space allocation, and asset utilization.

- **Energy efficiency summary overview:** Data center operation is a multidisciplinary task that involves many different stakeholders, including IT engineers, electrical and mechanical engineers, and other professionals.

  Four important parts of the data center infrastructure are: IT load, electrical, cooling systems, and automation and monitoring. Since everything starts with the IT equipment, it is important to improve the efficiency of IT loads, which will lead to cascading savings across the entire infrastructure. The electrical powertrain including servers is a discipline that requires balancing efficiency and uptime, necessitating careful design.

Cooling systems are responsible for much of the power use in a data center, so efficiency is particularly important here; optimization to reduce the use of power can be achieved through the smart selection of cooling technologies and the use of containment techniques. Active monitoring and automation provide relevant information about the whole data center and its components to ensure an accurate understanding of system state and enable continual improvement.

Finally, data center infrastructure management (DCIM) ties everything together. The main goal of DCIM use is to streamline all of the information gathered from the many different components of the data center, so it can be analyzed to enable decision-making to improve efficiency as an ongoing process.

These preceding energy efficiency concepts include data from Device42 Energy Efficiency for Data Centers (2024). Device42 is a configuration management database (CMDB) for hybrid cloud migration CMDB is a file that clarifies the relationships between the hardware, software, and networks used by an IT organization. The CMDB stores information on the configuration of items like hardware, software, systems, facilities, and even personnel.

8. **Battery or wind or solar backup power credit** (increases cashflow) and is a prerequisite in the 3.0 national consensus resilience standard for buildings, homes and infrastructure that. Incorporates by reference the Green IPO consensus standard. Additional credit awarded for backup power greater than one week.

9. **Water use reduction percentage** (increases cashflow). 5% minimum prerequisite with credit up to 100%.

10. **Reuse / circularity is required for each certified company** with at minimum an operable reuse system which can be contracted out to available reuse companies, with additional credit up to 100% reuse. 100% reuse has been achieved for certified sustainable products. (increases cashflow by providing revenue and reducing liability risk).

Global electrical component disposal including data center components is a severe contamination problem and a U.S. competitive economic priority, since China stopped accepting U.S. waste products with other countries likely to follow suit. In the U.S., electrical component disposal is stringently regulated including as hazardous waste due to toxic heavy metal components.

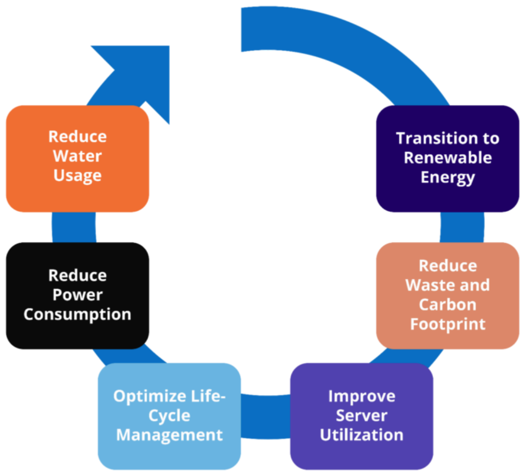
These U.S. statutes and rules are not effective for disposal for companies transporting electrical and other waste to other countries, accordingly, these Green IPO reuse requirements are effective for the certified companies' supply chain in any country and fill in this severe regulatory gap.

11. **The required company products' life cycle assessment for 10 major environmental impacts includes an inventory of the top 100 carbon pollutants** based on their global warming potential with SF6 being number 1, as standardized by the National Institute of Standards and Technology BEES Tool and EPA's TRACI, as set forth in the Green IPO Underwriting Standard which must include human health and ecotoxicity impacts.

12. **Eight fundamental social equity performance metrics are required** including no child labor, no warfare, worker rights, and community support for data center facility operations and suppliers.

13. Companies receive credit for their electric vehicles with more credit for electric vehicle fleets and for electric vehicle components certified as sustainable.

14. Data Center Sustainability Overview



Best practices in data center sustainability

15. Product platform certification is allowed where multiple data centers can be used with highly uniform environmental attributes, for company-wide credit.

16. Step-wise approaches are allowed where certification milestones over three years maximum are approved as conditions of certification and recertification.

17. Recertification is required every three years to account for any changes in data center operations affecting pollution including cashflow.

18. Company top management must execute legally-binding certification to FTC Green Guides truth in advertising, that the company information provided is accurate, not misleading, and qualified professionals are used. This eliminates unlawful greenwash which destroys economic value.

19. Due to the consensus Green IPO underwriting standard approved in five democratic national votes, Thomson Reuters TrustLaw issued a written Determination that nonprofits, governments, and companies can endorse and adopt the standard / Certified Green IPOs just like enacted legislation, with no conflicts of interest. This principle is why the consensus LEED green building standard has been adopted by 18 federal agencies, 34 States, over 200 cities and 200 universities, 64 countries and about 80% of the world's largest building portfolio owners. LEED's consensus nature just like the Green IPO underwriting standard, allowed LEED to globally certify about $1 trillion of properties per year for the last 15 years. The Green IPO underwriting standard approvals were in an American National Standards Institute (ANSI) Accredited Process as the unique National Consensus Standard.

Important standards, guidelines, and best practices for improving data center efficiency are:

Lawrence Berkeley National Lab Center of Expertise for Energy Efficiency in Data Centers Energy Efficiency Toolkit, & Data Center Energy Assessment Process Manual
Leadership in Energy and Environmental Design (LEED) certification
ISO 50001: Energy Management Systems
EPA ENERGY STAR Certification for Data Centers
Green Grid Data Center Maturity Model (DCMM)
US Department of Energy (DOE) Data Center Energy Efficiency Program (DCeP)
Electronic Product Environmental Assessment Tool (EPEAT) certification (excludes reuse / circularity)
Building Research Establishment Environmental Assessment Method (BREEAM) certification
EU Code of Conduct for Data Centers
EN 50600: European-wide transnational standard
TIA-942: Telecommunications Infrastructure Standard for Data Centers
Uptime Institute's Tier Standards
ASHRAE Standard 90.4
ISO/IEC 30134 series
BICSI-002
European Code of Conduct for Data Centers
TSI-EN50600

Green IPO Further Information

1-202-298-6556
mts@sustainableproducts.com
https://www.capitalmarketspartnership.com/copy-of-about

Green Initial Public Offerings (IPOs)

Certifying increased supply chain cashflow from sustainability