Environmental Performance Criteria

Guide for New Data Centers

DRAFT based on LEED NC 2.2
23 December 2008

FOREWORD

The project to develop this Environmental Performance Criteria (EPC) Guide for Data Centers is a Lawrence Berkeley National Labs (LBNL) project funded by the California Energy Commission (CEC) program. The goal of the project was similar to a previous LBNL/CEC project to develop an EPC for laboratories for subsequent submission to the US Green Building Council (USGBC) for consideration and adoption.

The CEC commissioned LBNL to customize a data center specific Environmental Performance Criteria because data centers present both a challenge and an opportunity in the development and implementation of sustainable design, construction and operation practices. Issues such as mission critical 24/7 operations; energy and water use intensity in data centers; are not addressed adequately in the current USGBC, LEED NC 2.2 Guideline to adequately meet the data center sector's requirements for quantifiable sustainable and energy efficient design.

The project goal is to build flexibility into this Guide to allow users to consider the whole building life cycle, regional climatic issues, partial and full-load design and specific innovation and design concepts applicable to data centers. The document is not intended to establish regulatory requirements, but is designed to serve as a voluntary guide for early adopters of sustainable data center design, construction and operation practices, to encourage continuous improvement in the data center sector, and to provide the industry's collective knowledge and guidance to the USGBC in their development of a data center specific LEED NC standard. Although this guide is intended for new data center design and construction, many of the ideas are directly applicable to existing data centers.

The application intent of this EPC is for both purpose-built stand alone buildings and a new or data center renovation within a larger overall building. If is also envisioned that this EPC will apply to different types of data centers, including enterprise, co-location, Telco, web-hosting, etc. When applying the EPC to a new construction data center within a larger overall building, the intent would be to apply the EPC checklist and ASHRAE 90.1 model to the only the data center and the direct mechanical and electrical support systems as described in the EPC based upon its percent of energy use.

LEED NC 2.2 as currently written would be used for the office or commercial space in the building, including the existing LEED credits related to occupant comfort and environmental impact due to higher occupancy per square foot such as alternative transportation, etc. which are not applicable to the data center space. In mixed-use buildings where the non data center space is <10% of the total building space, at the Owner's discretion, the Data Center EPC may be used for the entire building.

Where the non data center space is >10%, than the prorate methodology using both the EPC and LEED NC 2.2 shall be used. Where both share a common facilities infrastructure such as a central cooling system, the central cooling energy would be allocated based upon their respective energy use.

By requesting the USGBC to apply building use specific checklists and standards to mixed-use buildings in this way enables the credits to be specific to the energy and environmental impact of the building type. The level of LEED certification that the overall building would achieve would be determined by the score achieved for both the data center and the rest of the building based upon the ratio of overall building energy use.

In keeping with the both the California Energy Commission's goal to enlist industry involvement and collaboration in the development of the EPC, LBNL reached out to the key data center industry organizations, including ASHRAE TC9.9, The Green Grid, The Uptime Institute, 24x7, the European Commission, the Critical Facilities Roundtable, and the Silicon Valley Leadership Group.

Each of these organizations assigned key members of these technical committees to contribute to the core EPC draft development team and following completion of the draft, submit it for formal review and comments. Each organization has agreed to complete their formal review by January 31, 2009. Following the review process by the sponsoring organizations, LBNL will complete a final consensus draft for formal adoption by each of the member organizations for submission to the USGBC.

Following adoption of the final draft standard, each organization has also agreed to encourage their member companies to voluntarily trial-run this standard as a guideline in the design and development of new data centers, including comparing and where applicable, publically releasing the building's score against both the LEED and EPC checklists. This industry information will be extremely valuable in the final drafting of a LEED standard for data centers.

By working together collaboratively, the key stakeholders in the data center industry will provide a common voice to encourage the USGBC to move forward with a data center specific LEED NC standard in 2009.

The California Energy Commission has expressed their interest in continuing their support of this collaborative industry effort by sponsoring a follow-on effort to develop a similar EPC for existing data centers.

NOTES:

- This DRAFT is in development and is available for informational purposes only. It is not an official release of the United States Green Building Council, (USGBC).
- This draft only contains credits and prerequisites that are being modified or added to LEED NC Version 2.2. All other credits and prerequisites will remain the same.
- This draft does not contain submittals.
- This draft was developed by the drafting committee by reviewing the current LEED design criteria for new commercial buildings and deleting credits considered not applicable to data centers; accepting credits deemed applicable as currently written; modifying credits as required to make them applicable; or by adding new credits applicable specifically to data centers. This draft includes a "rationale" for deletion, modification and additions of credits and prerequisites. The rationale will be included in the final document submitted to the USGBC for review and consideration for informational purposes only.

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List of New and Modified Credits

Sustainable Sites

Credit 4.1 Alternative Transportation, Public Transportation Access *(deleted)*
Credit 4.2 Alternative Transportation, Bicycle Storage and Changing Rooms *(deleted)*
Credit 4.3 Alternative Transportation, Low-emitting and Fuel-Efficient Vehicles *(deleted)*
Credit 4.4 Alternative Transportation, Parking Capacity *(deleted)*
Prerequisite 2 Fuel Storage and Handling, Storm Water Discharge Protection *(added)*
Credit 5.3 Site Development, Impacts to Local Infrastructure (Power Grid), Sewage (Cooling Tower) *(added)*
Credit 5.4 Site Development, Noise Impacts (Generators, Cooling Towers) *(added)*
Credit 5.5 Site Development, Air Quality & Emissions Impacts *(added)*

Water Efficiency

Credit 2.0 Innovative Wastewater Technologies *(changed)*
Credit 3.3 Water Use Reduction, 20%> Total Building Water Use *(added)*

Energy & Atmosphere

Prerequisite 1 Fundamental Commissioning & Energy Efficiency Validation *(changed)*
Prerequisite 4 Minimum Energy Metering & Reporting of DCiE Metric *(added)*
Credit 1 Enhanced Energy Sub-Metering & Automated Reporting of Metrics of Performance *(added)*
Credit 2 Optimize Infrastructure Energy Performance, Above ASHRAE 90.1 *(changed)*
Credit 3 On-Site Renewable Energy *(changed)*
Credit 4 On-Site Generation, Based upon Reduction in Source Energy *(added)*
Credit 7, Enhanced Environmental Measurement & Verification *(changed)*
Credit 8, Green Power *(changed)*

Materials and Resources

Credit 6 Rapidly Renewable Materials *(deleted)*
Credit 7 Certified Wood *(deleted)*

Indoor Environmental Quality

Prerequisite 2 Environmental Tobacco Smoke (ETS) Control *(deleted)*
Credit 2.0 Increased Ventilation *(deleted)*
Credit 4.3 Low-Emitting Materials: Carpet Systems *(deleted)*
Credit 4.4 Low-Emitting Materials: Composite Wood & Agrifiber Products *(deleted)*
Credit 5 Indoor Chemical and Pollution Source Control *(deleted)*
Credit 6.2 Controllability of Systems: Thermal Comfort *(deleted)*
Credit 7.0 Acoustic Environment *(added)*
Credit 7.1 Thermal Comfort, Design *(deleted)*
Credit 7.2 Thermal Comfort, Verification *(deleted)*
Credit 8.1 Daylighting and Views: Daylight for 75% of Spaces *(deleted)*
Credit 8.2 Daylighting and Views: Views for 90% of Spaces *(deleted)*

Innovation in Design

Credit 1.1 Innovation in Design *(Changed)*
Credit 1.2 through 1.8 Innovation in Design *(Changed)*

Sustainable Sites

Credits 4.1 – 4.4 Alternative Transportation *(deleted credits)*

Rationale for Deletion

Data centers are designed to house computing equipment and have a very small number of building occupants per square foot as compared to commercial buildings. Therefore, the transportation impact of the occupants is not significant when compared to the data center building energy usage, hence the reason for deleting these commuting impact credits.

Credits 4.1 – 4.4 Alternative Transportation *(deleted credits)*

Rationale for Deletion

Data centers are designed to house computing equipment and have a very small number of building occupants per square foot

Prerequisite 2 Fuel Storage & Handling, Storm Water Discharge Protection
(new prerequisite)

Intent

Prevent the release of hydrocarbons and other pollutants from oil spills or leaks that may occur during re-fueling of all on-site storage into the soil, ground water and storm system.

Requirements

Means to prevent leaks or spills of all oils from being released into the storm drain system or back into the environment. Oils are as defined by the US EPA CFR Title 40 Parts 110 and 112.

Potential Technologies & Strategies

Consider the installation of shut-off valves and filter media inserts in storm water catch basins that require storm events to be filtered to capture hydrocarbons and other fine pollutants, oil/water separators and designs to capture vent pipe overflows during filling or running operations.

Credit 5.3 Site Development, Impacts to Local Infrastructure *(new credit)*

Intent

To incent the consideration of the impact to local infrastructure during the data center center site selection and development process. As a minimum, impacts to be considered shall include site source energy generation emissions and transmission losses; municipal water supply, sewage and waste water treatment systems.

Requirements

As part of the site selection process, the data center design team shall assess the potential sites and compare the impact to local infrastructure including the need for additional utility sub-station and transmission capacity, water and waste water storage and pumping stations and waste water treatment capacity.

In addition, the design team shall calculate the equivalent GHG emissions for each site based upon the data center's proposed total source energy requirement, using the ENERGY STAR CO2e emission factor, Table 8.1.1 –A for each fuel in the data center's total annual energy fuel mix. The data center may use up to 25% of off-site renewable electricity; (renewable energy certificates or "green power") and may subtract the associated CO2e emissions from the total CO2e emissions for the building, provided the contracts have duration of at least 2 years.

To apply for this point, the data center developer shall include this comparison in their application along with a justification of how the site selected provided the least impact to local infrastructure and the environment, based upon total source GHG emissions from energy generation and transmission.

Potential Technologies & Strategies

Consider sites with higher percentages of energy generated from renewable sources, including solar and wind power; hydroelectric; and geo-thermal. Also consider sites with existing local infrastructure, such as the ability to use waste heat and adequate electric sub-stations and power transmission, water and sewage lines.

Rationale for Addition

Data centers consume up to 100 times more energy per square foot than commercial buildings and may create a significant impact to both local infrastructure and the resulting GHG emissions depending upon where they are sited. Reducing the need for construction of power and water infrastructure and selecting a site where the source energy is generated and delivered at the lowest GHG emissions should be encouraged.

Credit 5.4 Site Development, Noise Impacts *(new credit)*

Intent

To incent the consideration of the noise impact of the data center in the site development process. As a minimum, impacts to be considered shall include the site noise from stand-by generators, exhaust fans, air-cooled chillers, cooling towers or evaporative coolers. One point each is available for normal and emergency operations of the data center for reducing the sound level below the locally mandated requirement by a minimum of 10%.

Requirements

As part of the site development process, the data center design team shall assess the potential noise impact to neighbors including evaluating alternatives for equipment placement on the building or site, sound barriers, etc. to not increase the noise levels adjacent to the site from current levels before development.

To apply for these points, the data center developer shall include calculations by the designer which show sound levels at the property line are less than required by the local planning authority. Where the existing sound levels at the property line already exceed the level required by the local planning authority, the design team needs to demonstrate that no additional noise is added to the surrounding environment either during normal and emergency operation of the facility at its full connected load design capacity. In addition where the sound level from offsite noise is above the level required by the local planning authority at the site boundary, the building itself should be sited and the spaces within the building acoustically located to provide isolation from outside noise.

Potential Technologies & Strategies

Consider locating engine generators, cooling towers or evaporative coolers inside the facility and/or the use of sound barriers or retaining walls, attenuators, or other means to reduce the noise impact of the equipment to the environment from engine exhaust systems, as well as the radiator fans on the engine and the fans in cooling towers or evaporative coolers. Consider the use of slower speed or more sound efficient fans. Consider ground source well water to cool engine generators which eliminate the radiator fans. Consider alternative sources of engine generator power such as fuel cells or energy storage systems.

Rationale for Addition

Data centers, especially during emergency operations where they are running large diesel generators for extended periods of time, or those that utilize combined heat and power generation systems may create a significant noise impact to the surrounding environment, depending upon where they are sited and how the equipment is selected or attenuated. Cooling tower or evaporative cooler fans can be extremely noisy, especially on the hottest days when the fans run at their highest speed. Reducing the noise impact beyond the site property line should be encouraged.

Credit 5.5 Site Development, Air Quality and Emissions Impacts *(new credit)*

Intent

To incent the consideration of the air quality and emissions impacts of the data center in the site development process. As a minimum, impacts to be considered shall include the emissions from engine generators and on-site power generation systems. Consideration of alternative low emission impact power systems such as solar and fuel cells should be encouraged.

Requirements

As part of the site development process, the data center design team shall assess the potential air quality impact to the environment including evaluating alternatives for equipment selection, emissions reduction, on-going maintenance and testing, etc. to minimize the air quality and emissions impact of the facility.

To apply for this point, the data center developer shall include calculations by the designer that show that the Nitrogen Oxide (NOx) or Carbon Monoxide (CO) emissions are a minimum of 10% better than the local code requirement, unless the local code requirement is equal to the Bay Area Air Quality Management District emission limits, effective 1/12/2012 for all stationary internal combustion engines, Regulation 9, Rule 8. In these locations, the designer need only demonstrate that the proposed emissions will meet this level vs. exceeding the local code in order to apply for this credit. The designer shall also assure that the emissions of the equipment selected meets or exceeds EPA Tier 2 standards.

Potential Technologies & Strategies

Consider selecting standby generators and power generation systems and emissions reduction systems that exceed the current requirements or use other means to improve the air quality and reduce the emissions impact of the data center to the environment.

Institute a management operation procedure to only perform monthly testing of generators during morning hours and on good air days, including verification methodology such as generator run log and/or owners written operating procedures.

Rationale for Addition

Data centers, especially during emergency operations where they are running large diesel generators for extended periods of time, or those that utilize on-site power generation systems may create a significant air quality or emissions impact to the surrounding environment, depending upon where they are sited and how the equipment is selected or the emissions are treated. Reducing the air quality and emissions impact to the environment should be encouraged.

12-23-08

Water Efficiency

WE Credit 2: Innovative Wastewater Technologies *(changed credit)*

Intent

Reduce generation of wastewater and potable water demand, while increasing the local aquifer recharge.

Requirements

Options 1 or 2 may be used when applying for this credit, but the following change to the calculation of total building use to include other than potable water is required. Calculate and document baseline of annual total building water and wastewater use and on-site irrigation water use. The baseline for the proposed facility must include the total building water usage excluding evaporated water if utilized in calculations of wastewater and potable water demand for credit. The method used to develop the baseline must be included with documentation of this credit.

Rationale for Change

Central cooling systems in data centers, especially those using cooling towers utilize a significant amount of water for blow-down and should be included in the total building water calculations.

WE Credit 3.3:   Water Use Reduction: 20% or Greater Reduction *(new credit)*

Intent

Maximize water efficiency within the data center to reduce the burden on municipal water supply and wastewater systems.

Requirements

Calculate and document baseline of annual total building water use wastewater. The baseline for the proposed facility must include the total building water usage including evaporated cooling system water usage, including cooling tower blow down, if utilized in calculations of wastewater and potable water demand for credit. The method used to develop the baseline must be included with documentation of this credit and the base and proposed building design must maintain the same level of minimum water solubility.

Employ strategies that in aggregate use less water than the total building water use baseline calculated for the building (not including irrigation).

% Reduction	Water Efficiency Points
20%	2
30%	4
40%	6

Potential Technologies & Strategies

Consider reuse of storm water and grey water for non-potable applications such as cooling tower makeup, emergency storage, etc. Consider condensate re-use and rainwater reclamation. Consider equipping cooling tower(s) with drift eliminators. Design cooling tower systems to limit the amount of water used for blow down by using other means other than chemical treatment to prevent equipment scaling while achieving higher number of cycles of concentration for makeup water or discharge conductivity. Consider airside free cooling technologies which reduce water consumption where climatic conditions are favorable. Also consider ground source cooling technologies such as wells, buried ground loops, lake and river cooling where appropriate.

Assure that the building water systems provide for turn down of water use as energy efficiency of the mechanical systems is improved. Design the central water cooling system to use less water than the standard design by selection and integration of the equipment, controls and piping.

Consider alternative heat rejection systems such as dry-coolers, glycol, etc. that eliminate the requirement for cooling towers.

Rationale for Addition

Cooling system water use can be very significant in data centers depending upon location and climate. Reducing water use and the resulting pumping energy and the energy, chemicals and resources required to treat the resulting wastewater discharge should be encouraged. Combining this credit with the domestic water efficiency credit did not seem feasible because:

- There is no way to document the baseline usage in a similar manner to domestic water fixtures (which uses the minimum specifications in the 1992 Energy Policy Act).
- The two points available for the domestic water credit does not sufficiently reward the effort to reduce cooling system water use in data centers. Data centers are very technical facilities that have a variety of possible options to design a sustainable project that this credit rewards.
- The methods, strategies and technologies for domestic and process water use are different.

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Energy & Atmosphere

Prerequisite 1: Commissioning & EPC Validation of the Building Energy Systems *(Modification of the existing LEED prerequisite)*

Intent

Verify that the data center's energy related systems are installed, calibrated and perform according to the owner's project requirements, basis of design, construction documents and that they meet the minimum ASHRAE 90.1, 2007 standards for cooling system energy coefficient of performance (COP); adjusted sensible coefficient of performance (ASCOP) requirements and minimum requirements for electrical systems including but not limited to the primary and distribution transformers, Uninterruptible Backup Power Systems and batteries or other energy storage system, Power Distribution Units (PDU) equipment. Commissioning and energy efficiency validation will also address all mechanical equipment including chillers or air conditioning compressors, heat rejection equipment including dry coolers or cooling towers, thermal storage systems, computer room air conditioning units, and all associated pumps, heat exchangers, air or water economizers, make-up air handlers or humidification systems, control air compressors and automation and control systems required for building and computer room heating, ventilation and air conditioning. Fundamental commissioning will also address lighting and all other energy consuming systems required for building operation.

Benefits of Commissioning & Energy Efficiency Validation

Benefits of commissioning and energy efficiency validation include reduced energy use, lower operating costs, and verification that the systems perform in accordance with the owner's project requirements and that the energy efficiency design objectives have been met.

Requirements

The following commissioning and energy efficiency validation process activities shall be completed by the commissioning/validation team, in accordance with the Data Center EPC for New Construction 2.2 application guide.

1. Designate an individual as the Commissioning/Validation Authority (CVxA) to lead, review and oversee the commissioning/validation process activities.
    a. The CVxA shall have documented commissioning and energy efficiency validation authority expertise in at least two data center projects of comparable scale or larger.
    b. The individual serving as the CVxA shall be independent of the project's design and construction management though they may be employees of the firms providing those services. The CVxA may be a qualified employee or consultant to the Owner.
    c. The CVxA shall report results, findings and recommendations directly to the Owner.
2. The Owner shall document the Owner's Project Requirements (OPR). The design team shall develop the Basis of Design (BOD). The CVxA shall review these documents for clarity and completeness. The Owner and design team shall be responsible for updates to their respective documents.
3. Develop and incorporate commissioning and validation requirements into the construction documents using the current ASHRAE/NIBS Guideline 0-05: Article 5,6 and 7 for the following systems at a minimum:
    a. The mechanical plant, including chillers, heat rejection, thermal storage, pumps, air handlers, make-up air and humidification system, and cooling units for the computer and data processing room; mechanical and electrical support rooms and any other general administrative spaces
    b. The electrical power transformation and distribution systems including on site utility sub-station equipment, building transformers, engine generators, uninterruptible backup power systems, and PDUs.
    c. The building lighting system.
    d. Renewable energy systems (solar, wind, etc.)
    e. On-site power generation systems (cogeneration, fuel-cell)
4. Develop and implement a commissioning and validation plan.
5. Verify the installation and performance of the systems to be commissioned and validated at multiple load points to verify energy efficiency performance to design criteria during normal utility operations, maintenance operations and failure conditions.

6. Include in the final commissioning/validation report the data centers DCiE (including all energy sources) at partial (25%, 50%, and 75%) and full design load conditions. Use artificial loads to simulate computer equipment load. For each load point, allow environmental conditions to stabilize for at least one hour before moving to the next partial load point. Identify computer room temperature and relative humidity conditions at representative cold aisle inlet at the top of the planned IT equipment racks for at least two points in each cold aisle in the data center, supply and return temperature and humidity if applicable at each computer room air handling unit. If measured conditions are different than design assumptions, project the energy required to achieve design conditions. Identify outside weather conditions during commissioning and the effect of any free-cooling benefit.
7. Project the anticipated annual DCiE based on historical average weather conditions for the site, including component DCiE data for the mechanical and electrical systems components, including as a minimum: central cooling plant; including all chillers, heat rejection system (cooling towers or dry coolers), heat exchangers, and pumps); computer room or air handler fans; electrical transformation, storage and distribution losses; and on-site energy and power generation systems if applicable. The DCiE and its component constituents will be used for verification and acceptance by the Owner that the design and construction of the building's energy systems meets the project requirements.
8. Prior to commissioning and validation, the CVxA shall review the operations and maintenance manuals provided by the Construction Manager for all mechanical, electrical, energy and power generation systems and following commissioning and validation provide written comments where systems operating conditions were found to be different than designed or documented in the manuals.

Rationale for Modification

Data centers are very technical facilities that have complex and interacting mechanical and electrical systems that are unique to the building type and that need to be commissioned and validated for sustainable projects that this credit rewards.

Prerequisite 2: **Minimum Energy Performance Required** *(Modification of the existing LEED prerequisite)*

Intent

Establish the minimum level of energy efficiency for the proposed building and systems.

Requirement 1:

Design the building project to comply with —

(a) The mandatory provisions (Sections 5.4, 6.4, 7.4, 8.4, 9.4 and 10.4) of ASHRAE/IESNA Standard 90.1-2007 (without amendments); and

(b) The prescriptive requirements (Sections 5.5, 6.5, 7.5 and 9.5) or performance requirements (Section 11) of ASHRAE/IESNA Standard 90.1-2007 (without amendments).

Requirement 2:

A team shall be formed and shall meet regularly as required over the planning, design, construction and commissioning of the data center project. The team shall be comprised of the following functions:

- Owner's representative responsible for site selection and development for the project.
- Owner's representative responsible for source and site energy utilization and green house gas emissions for the project.
- Owner's representative responsible for the design and construction of the project.
- Owner's facilities engineering and operations representative who will be responsible for operation of the mechanical and electrical plant for the project.
- Owner's IT end-user group(s) and data center IT operations team who will own and operate the IT equipment in the data center.
- One or more members of the Architectural/Engineering (A/E) and Construction Management team who will design and build the project.
- Commissioning and Energy Efficiency Validation Authority who will independently evaluate the operational performance of the building, mechanical and electrical systems to the design.

Each function shall be represented by an individual who independently and conscientiously represents the availability, performance, cost, schedule and environmental impact interests of their function.

The team shall, at a minimum, do the following:

- Determine and document the initial (1 year), near term (3 year) and ultimate required power and cooling requirements of the IT equipment to be housed in the data center. Because name plate data for IT equipment heat load is typically based upon the peak power requirement for the maximum available equipment configuration, where possible bench test the equipment the data center intends to house and use the measured power data at 100% utilization when calculating the total initial load requirements for computing and storage equipment power.
- Because name plate or published efficiency data for mechanical and electrical systems is typically based upon full and not partial load, where possible measured data from a similar data center for the type of equipment the data center is intended to house, should be used for estimating system efficiency at the initial, near term and ultimately planned design load.
- Document proposed future expansion plans for the data center including the planned IT and support power load for each addition or phase until the data center reaches the full design capacity.
- Document allowances for IT growth for the first year following completion of the facility with separate categories for existing application growth, new applications and acquisitions and consolidations. The objective is to identify compounding

safety factors that could result in future over capacity to eliminate inefficient operation at part load.

- Document that the basis of design for the data center environmental conditions: (temperature, relative humidity and air quality) are based upon ASHRAE TC 9.9. Document the rationale for requiring environmental conditions at the inlet to the equipment outside the recommended ranges in applicable standards or equipment specifications, if operation outside the recommended ranges decreases energy efficiency of the data center.
- Determine the necessary level of redundancy required in the data center electrical and mechanical building systems required for the planned business use of the data center over its intended life-cycle, based upon the Uptime Institute's Tier Classification system designation and current specifications provided by the IT manufacturers.

Technologies and Strategies

Design the building envelope, mechanical and electrical plant (including uninterruptible backup power systems, and critical load distribution, mechanical systems for the computer rooms, building HVAC, lighting, and other building systems to maximize energy performance. The ASHRAE 90.1-2007 User's Manual contains worksheets that can be used to document compliance with this prerequisite. For projects pursuing points under EA Credit 1, the computer simulation model may be used to confirm satisfaction of this prerequisite.

If a local code has demonstrated quantitative and textual equivalence following, at a minimum, the U.S. Department of Energy standard process for commercial energy code determination, then it may be used to satisfy this prerequisite in lieu of ASHRAE 90.1-2007. Details on the DOE process for commercial energy code determination can be found at www.energycodes.gov/implement/determinations_com.stm.

Rationale for modifying this prerequisite

Requirement 2: The utilization level of data center's mechanical and electrical systems is affected by the required level of redundancy in data center's cooling and IT power conditioning systems. Within the energy efficiency community, and less so within the user community, there is a wide range of and debate over required levels of redundancy and environmental conditions necessary for data centers. While the EPC cannot prescribe a particular level of equipment redundancy; utilization or environmental conditions that a data center should operate at, the intent of this prerequisite is to ensure that owner's IT, critical facilities infrastructure and design team do not use excessively conservative requirements without due analysis and consideration of alternatives.

Experience has shown that new projects often start out with assuming high levels of IT load that in practice take years to develop. Until this load develops, the data center operates at low utilization and is typically energy inefficient. The Team should demonstrate that they discussed initial and future load assumptions and investigated options for making mechanical and electrical capacity increases correspond with IT load increases to achieve a higher operating point by balancing load and capacity for optimal energy efficiency. Another option to be considered would be specifying a significantly higher level of part load efficiency, (i.e. 15 to 40 percent loads) for uninterruptible backup power systems and chillers than would be typical, so that if the IT load did not develop as planned, the planned energy efficiency of the data center would still be high. This plan should also require turning off other installed equipment, such as computer room cooling units to balance load with capacity.

Prerequisite 4: Minimum Energy Metering *(Added)*

Intent

By requiring that the data center DCiE from all energy sources be measured and trended over time; the building owner and/or operator will be able to verify that the building's energy related systems are performing according to the basis of design.

Requirements

The data center shall be equipped at a minimum with energy metering to provide total facility power and energy usage and total IT Equipment power and energy usage on a historical basis. The number and type of meters that are required to be installed shall be determined by the data center design, but at the minimum shall be one percent accuracy, full-scale and provided to meter all forms of energy to the data center, (electricity, natural gas, steam, chilled water, one-pass cooling, etc.) and at the output of the uninterruptible backup power systems or power distribution units (PDUs) that serve the IT equipment. If the data center uses on-site renewable energy or on-site energy generation, the data center shall be equipped at a minimum with power and energy metering to total power and energy input and output and net power and energy to the utility and the building.

Rationale for Addition

Data center energy use can be very significant depending upon size and design of the facility, the location and climate. Measuring power and energy use on a historical basis provides a data center owner with the information necessary to determine opportunities to improve their data center's operational efficiency and how their data center compares with similarly designed data centers.

Verify that the data center's energy related systems are installed, calibrated and perform according to the owner's project requirements, basis of design, construction documents and to enable the data center operator to understand how the data center performs as IT equipment is installed. The addition of these meters will also enable the data center operator to participate in the Energy Star program and to benchmark the data center's performance with similar data centers.

Credit 1: Enhanced Energy Sub-metering & Automated Reporting of Metrics of Performance *(Added)*

Intent

By permanently installing enhanced energy sub-metering and automating the ongoing reporting of its component constituents and performance metrics, the building owner and/or operator will be able to verify that the building's energy related systems are performing according to the basis of design and manufacturer's specifications for efficiency performance at both partial load and full-load conditions.

Requirements

The data center shall be equipped with energy metering to provide power and energy usage for the facility's power transformation and distribution systems, cooling systems and any on-site generation and trending of these metrics on a historical basis. The number and type of meters that are required to be installed shall be determined by the data center design, but at the minimum shall be one percent accuracy, full-scale and provided to sub-meter the electrical and mechanical systems as follows:

1. Lighting and lighting controls: power (kW) and consumption (kWh) by data center room.
2. Electrical power (kW) and consumption (kWh) or other energy sources for all mechanical cooling systems including (chillers, cooling towers, chilled water and condenser water pumps, cooling tower sump heaters or equivalent mechanical equipment for DX systems.)
3. Chilled water generation or equivalent for DX systems: tons, (based upon chilled water flow, supply and return temperature), and kW/ton or equivalent if other energy sources are used.
4. Heating water or steam generation: energy kBTU/per energy unit input.
5. Computer room cooling systems: power (kW) and consumption (kWH).
6. Uninterruptible backup power systems: power (kW) input and power output (kW) and consumption (kWH) input and output for each uninterruptible backup power systems.
7. Engine generator power equipment: power (kW) output and consumption (kWh) for each generator. Fuel consumption (diesel or natural gas) for all generators.
8. On-site renewable energy power generation: production power (kW) and production (kWH), and site specific weather characteristics (irradiance, wind, and temperature)
9. On-site power generation: production power (kW) and production (kWh).

The points shall be awarded on a sliding scale for sub-metering the electrical and mechanical systems as follows:

Data Center with no on-site renewable or power generation:

Requirement 1: 1 Point

Requirements 2-5: 3 Points

Requirement 6-7: 2 Points

Data Center with on-site renewable and/or power generation:

Requirement 1: 1 Point

Requirements 2-5: 2 Points

Requirements 6-7: 2 Point

Requirements 8-9: 1 Point

Rationale for Addition

Data center energy use can vary significantly depending upon size and design of the facility, the location and local weather conditions. Measuring energy use and reporting these metrics provides a data center owner with the baseline information necessary to determine opportunities to improve their data center's operational efficiency and how their data center compares with similarly designed data centers in their climate zone.

EA Credit 2: Optimize Energy Performance *(Modification of the existing credit)*

Intent

Achieve increasing levels of energy performance above the baseline in the prerequisite standard to reduce environmental and economic impacts associated with excessive energy use.

Requirements

Achieve increasing levels of energy performance above the baseline in the prerequisite standard to reduce environmental and economic impacts associated with excessive energy use.

The 90.1 baseline requirements for a new Data Center (Class 1 as defined in the ASHRAE Thermal Guidelines for Data Processing Environment) shall have a DCiE Equal to or less than the DCIE specified in Table 1 depending upon Climate Zone and Data Center Type (Tier I thru Tier IV as defined in the Uptime Institute Tier Classifications Define Site Infrastructure Performance). The DCiE shall be based upon full build out or design DCiE and not startup DCiE which will generally be higher and unable to the requirements of Table 1.

DCiE by Climate Zone & Data Center Type				
	Tier I	**Tier II**	**Tier III**	**Tier IV**
1A	0.56	0.53	0.52	0.50
2A	0.57	0.55	0.53	0.52
3A	0.59	0.57	0.55	0.53
4A	0.61	0.59	0.57	0.55
5A	0.64	0.61	0.59	0.56
6A	0.66	0.63	0.61	0.58
7A	0.68	0.66	0.63	0.60
8A	0.71	0.68	0.65	0.63
	Tier I	**Tier II**	**Tier III**	**Tier IV**
1B	0.59	0.56	0.55	0.53
2B	0.61	0.58	0.56	0.54
3B	0.63	0.61	0.58	0.56
4B	0.65	0.63	0.60	0.58
5B	0.68	0.65	0.63	0.60
6B	0.71	0.68	0.65	0.62
7B	0.74	0.70	0.67	0.64
8B	0.77	0.73	0.70	0.67
	Tier I	**Tier II**	**Tier III**	**Tier IV**
1C	0.57	0.55	0.53	0.51
2C	0.59	0.57	0.55	0.53
3C	0.61	0.59	0.56	0.54
4C	0.63	0.61	0.58	0.56
5C	0.66	0.63	0.61	0.58
6C	0.68	0.65	0.63	0.60
7C	0.71	0.68	0.65	0.62
8C	0.74	0.70	0.68	0.65

Table 1: DCIE by Climate Zone & Data Center Type, ASHRAE TC9.9 Committee, 4/28/08

Project teams documenting achievement using a whole building energy simulation are assumed to be in compliance with EA Prerequisite 2. The Project Team shall perform a whole building energy simulation including technology systems at both 100% design load and at the partial load conditions of the data center as determined in Prerequisite 2, Rule 2 at the end of the first year's operation.

If the demonstrated percentage improvement in the proposed building performance rating compared to the baseline building performance rating at partial data center design power load is less than 75% of the percentage improvement at full data center design power load, then the points achieved shall be reduced by a factor of 2.

NOTE: EPC for New Construction projects are required to achieve at least ten (10) points under EAc2.

WHOLE BUILDING ENERGY SIMULATION INCLUDING TECHNOLOGY SYSTEMS (10–34 Points)

Demonstrate a percentage improvement in the proposed building performance rating compared to the baseline building performance rating per ASHRAE/IESNA Standard 90.1-2007 (without amendments) by a whole building project simulation using the Building Performance Rating Method in Appendix G of the Standard (with changes as indicated below).

The minimum energy cost savings percentage for each point threshold is as follows:

New Buildings	Existing Building Renovations	Points
5.0%	2.0%	10
7.0%	3.5%	14
9.0%	5.0%	18
10.5%	7.0%	24
12.0%	8.0%	28
14%	10.5%	30
16.0%	12.0%	32
17.5%	14.0%	34

Appendix G of Standard 90.1-2007 requires that the energy analysis done for the Building Performance Rating Method include ALL of the energy costs within and associated with the building project, including the IT equipment load. To achieve points using this credit, the proposed design—

- must comply with the mandatory provisions (Sections 5.4, 6.4, 7.4, 8.4, 9.4 and 10.4) in Standard 90.1-2007 (without amendments);
- must include all the energy costs within and associated with the building project; and must be compared against a baseline building that complies with Appendix G to Standard 90.1-2007 (without amendments). The baseline building rating shall include the electrical requirements and corresponding cooling loads for the technology systems.

For EA Credit 2, technology system electrical loads shall be identical for both the baseline building performance rating and for the proposed building performance rating. However, project teams may follow the Exceptional Calculation Method (ASHRAE 90.1-2007 G2.5) to document measures that reduce technology system electrical requirements. Documentation of technology system electrical requirements energy savings shall include a list of the assumptions made for both the base and proposed design, and theoretical or empirical information supporting these assumptions.

Potential Technologies & Strategies

Design the building envelope and systems to maximize energy performance. Use a computer simulation model to assess the energy performance and identify the most cost-effective energy efficiency measures. Quantify energy performance as compared to a baseline building.

If a local code has demonstrated quantitative and textual equivalence following, at a minimum, the U.S. Department of Energy standard process for commercial energy code determination, then the results of that analysis may be used to correlate local code performance with ASHRAE 90.1-2007. Details on the DOE process for commercial energy code determination can be found at www.energycodes.gov/implement/determinations_com.stm.

Changes to Appendix G of Standard 90.1-2007 to be used for data center projects:

G1,4 c. – The input and output reports must include the energy breakdown of the following component (where applicable):

Component	Notes
IT Equipment	Include the full design kW/rack power for all compute and storage servers, networking equipment and any other technology equipment that will be located in the computer and data processing rooms.
Mechanical Systems	
Computer and Computer Hardware Process (formerly called mainframe water cooling)	Include all mechanical systems (heating, cooling, dehumidification, humidification, ventilation and exhaust systems that directly support computer equipment or indirectly support the computer equipment (like uninterruptible backup power systems and battery room make-up and exhaust and other mechanical and electrical support spaces)
CRAC – Air Cooled	Include both the computer room unit with internal refrigeration compressor and external condensing unit
CRAH – Water Cooled	Include indoor unit and heat rejection equipment but not pumping
CDPR – Water Cooled with Economizer Coil	Include indoor unit and heat rejection equipment but not pumping
CDPR – Glycol Cooled	Include indoor unit and dry cooler but not pumping

CDPR – Glycol Cooled with Economizer Coil	Include indoor unit and dry cooler but not pumping
CPPR – Chilled Water	Include only indoor unit
Heat Rejection	Only use for chilled water systems
Open Cooling Towers	Use for indoor packaged water cooled chillers
Fluid Coolers	Use for indoor packaged water cooled chillers
Evaporative-cooled Condensers	Use for indoor water chiller with remote condenser
Air-cooled Condensers	Use for indoor water chiller with remote condenser
Fans	
CDPR Air Conditioning Units	
Other indirect support equipment	e.g. chiller room, mechanical substation room, uninterruptible backup power systems room, battery rooms, load bank substation room
Pumping	
Chilled Water	
Condenser Water Glycol	
Heating Hot Water	
Spray Pumps	For evaporative cooled rejection equipment
Heating	
Humidification and Dehumidification	
Electrical Systems	
Lighting	For CDPR and support areas only
Primary MV to LV Transformer	$=kW_{in} – kW_{out}$
Uninterruptible backup power systems	$=kW_{in} – kW_{out}$
Power Distribution Units	$=kW_{in} – kW_{out}$

Rationale for Modification

Because data centers are from 10-100 times as energy intensive as an office building it is very difficult and expensive to attain the percentage thresholds for commercial buildings. Accordingly, we have decreased the thresholds while substantially increasing the energy points to reflect that the energy systems are the most significant environmental impact of data centers.

EA Credit 3: On-site Renewable Energy *(Modification of the existing LEED credit)*

Intent

Encourage and recognize increasing levels of on-site renewable energy self-supply in order to reduce environmental and economic impacts associated with fossil fuel energy use and transmission distribution losses.

Requirements

Use on-site renewable energy systems to offset building energy cost. Calculate project performance by expressing the energy produced by the renewable systems as a percentage of the average peak power (kW) of the data center using the table below to determine the number of points achieved.

Use the building annual energy cost calculated in EA Credit 2.

% Renewable	Energy Points
2.5%	2
5.0%	4
7.5%	6
12.5%	8
15.0%	10
20.0%	12

Technologies and Strategies

Assess the project for non-polluting and renewable energy potential including solar, wind, geothermal, low-impact hydro, bio-mass and bio-gas strategies. When applying these strategies, take advantage of net metering with the local utility.

Rationale for modification

Because Data Centers are from 10-100 times as energy intensive as an office building, the current availability and technology for on-site renewable energy makes it possible, although difficult and expensive to exceed the percentage thresholds for commercial buildings. Accordingly, we have increased the thresholds while substantially increasing the energy points.

EA Credit 4: On-site Generation *(New credit)*

Intent

Encourage and recognize increasing levels of on-site power generation in order to reduce environmental and economic impacts associated with fossil fuel energy use and transmission losses from utility power plants.

Requirements

Use on-site generation energy systems to offset building energy cost. Calculate project performance by expressing the energy produced by the on-site systems as a percentage of reduction in source energy use and using the table below to determine the number of points achieved.

Use the building annual source energy use calculated in EA Credit 2.

% On-Site Generation	Energy Points
7.5.0%	1
12.5%	2
15.0%	3

Technologies and Strategies

Assess the project for on-site energy generation potential including fuel cell strategies. When applying these strategies, take advantage of net metering with the local utility.

Rationale for addition

Because data Centers are anywhere from 10-100 times as energy intensive as an office building, the current availability and technology for on-site generation of energy makes it economically possible to reduce source energy use by on-site energy generation in a data center. Accordingly, we have added this strategy and energy points for achieving certain levels of source energy reduction.

EA 7: Enhanced Measurement and Verification *(Modification of the existing LEED credit)*

Intent

Provide for the ongoing environmental operating conditions and accountability of building energy consumption over time.

Requirements

Develop and implement an enhanced Measurement & Verification (M&V) Plan consistent with Option D: Calibrated Simulation (Savings Estimation Method 2), or Option B: Energy Conservation Measure Isolation, as specified in the *International Performance Measurement & Verification Protocol (IPMVP) Volume III: Concepts and Options for Determining Energy Savings in New Construction, April, 2003.*

The M&V period shall cover a period of no less than one year of post-construction occupancy and provide a report of the environmental operating conditions of the data center and the data center energy performance metrics, DCiE. Hourly average DCiE shall be provided to enable M&V of the data center energy efficiency performance over the first year of operation.

Technologies and Strategies

Develop an M&V Plan to evaluate data center environmental operating conditions and energy system performance. Characterize the building and/or data center energy systems through energy simulation or engineering analysis. Install the necessary measurement and metering equipment to validate the data center environmental conditions and measure energy use. Track performance by comparing performance at the closest predicted partial load point (25%, 50%, 75% and 100%) to actual performance at a specific load point, broken down by temperature differential across computer room cooling systems, average cold aisle and hot aisle temperature differential by room zone where each zone is pre-assigned a computer hardware load density, air flow or pressure differential across the computer room, and temperature differential across the central chilled water plant. Evaluate energy efficiency by comparing actual performance to baseline performance.

While the IPMVP describes specific actions for verifying savings associated with energy conservation measures (ECMs) and strategies, this LEED credit expands upon typical IPMVP M&V objectives. M&V activities should not necessarily be confined to energy systems where ECMs or energy conservation strategies have been implemented. The IPMVP provides guidance on M&V strategies and their appropriate applications for various situations. These strategies should be used in conjunction with monitoring and trend logging of significant energy systems to provide for the ongoing accountability of building energy performance and the establishment of seasonal profiles to assist operator predictability of the use of free and partial free-cooling opportunity.

Rationale for modification

The purpose of including measurement of the data center environmental conditions and the temperature differentials across the cooling systems, along with total power and electrical consumption for the data center and the IT equipment is to inform users of how utilization levels and climatic changes affect the data center efficiency. Continuous measurement of these data center environmental conditions and energy efficiency metrics keeps real time information in front of the user to show the effect of their actions. The measuring device can also serve as an additional indicator of proper mechanical and electrical support systems operation and maintenance.

EA Credit 8: Renewable Source Power *(Modification of the existing LEED credit)*

Intent

Encourage the development and use of grid-source, renewable energy technologies on a net zero pollution basis.

Requirements

Provide at least 7.5% of the building's electricity from renewable sources by engaging in at least a two year renewable energy contract with a Green-e certified REC provider. Renewable sources are as defined by the Center for Resource Solutions (CRS) Green-e products certification requirements.

Use the building annual energy use (kWh) calculated in EA Credit 2.

% Renewable	**Energy Points**
7.5%	1
12.5%	2
15.0%	3
17.5%	4

DETERMINE THE BASELINE ELECTRICITY USE

Use the annual electricity consumption from the results of EA Credit 2.

Technologies and Strategies

Determine the energy needs of the building and investigate opportunities to engage in a renewable source power contract. Green power is derived from solar, wind, geothermal, biomass or low-impact hydro sources. Visit www.green-e.org for details about the Green-e program. The power product purchased to comply with credit requirements need not be Green-e certified. Other sources of renewable power are eligible if they satisfy the Green-e program's technical requirements. Renewable energy certificates (RECs), tradable renewable certificates (TRCs), green tags and other forms of green power that comply with Green-e's technical requirements can be used to document compliance with EA Credit 6 requirements.

Rationale for modification

Data centers are from 10-100 times as energy intensive as an office building. Thus it is much more difficult and expensive to achieve the same percentage thresholds as commercial buildings. Accordingly, we conservatively reduce the thresholds by dividing current LEED thresholds by 2.

12-23-08

Materials & Resources

Default Project Materials Cost

Used in credit calculations for EPC MRc3 and MRc4

Proposed modification:

The LEED NC Default Project Materials Cost is currently 45% of the project's total Construction Cost. The proposed EPC default project materials cost is 21%, which is 24% less than the LEED NC Default Project Materials Cost.

Rationale:

LEED NC allows projects to use 45% of the project's total construction cost as a default value for the architectural trades' Material Cost –the denominator for credits MRc3, MRc4 and MRc5. This default is based on the construction cost of a commercial building, for which the EPC committee determined MEP and equipment costs make up about 24% of the total construction cost, (based upon an analysis done by the Labs 21 committee of 7 random projects.)

By comparison, MEP and equipment costs make up about 75% of a data center project's construction cost; based on the EPC committee's analysis of several data center projects. To account for the lower percentage of architectural trade costs in a data center project, the EPC committee multiplied 25% (the remainder of a data center's construction cost after 75% for MEP and equipment is deducted) by the LEED NC's assumption that 60% of the architectural trades construction cost is material cost. (This LEED NC assumption was figured backwards by the EPC committee based on the analysis that 76% of a commercial building's construction cost is architectural (i.e. not MEP and equipment): 45% * 76% = 60%.) The outcome of this multiplication was a revised architectural trades' material cost default of 15% for data center projects.

The LEED AGL architectural trades' Material Cost default is tied to the LEED NC default. If the LEED steering committee reduces the LEED NC default, the LEED AGL default shall be proportionally reduced.

MR Credit 3.1: Materials Reuse: 5% *(modification to existing credit)*

Intent

Reuse building materials and products in order to reduce demand for virgin materials and to reduce waste, thereby reducing impacts associated with the extraction and processing of virgin resources.

Requirements

Use salvaged, refurbished or reused materials such that the sum of these materials constitutes at least 5%, based on cost, of the total value of all materials including the MEP trades.

Mechanical and electrical equipment and materials such as computer room cooling conditioning units, chillers, pipe and fittings, IT equipment racks, floor tiles, transformers, paralleling switchgear, engine generators, uninterruptible backup power systems and PDU equipment, loadbanks, general electrical switchgear, electrical wire and cable may be included in this calculation. Only include materials permanently installed in the project.

Technologies and Strategies

Identify opportunities to incorporate salvaged materials into building design and research potential material suppliers. Consider salvaged materials such as raised floor supports and floor tiles, IT equipment racks, electrical and mechanical equipment and components, etc.

MR Credit 3.2: Materials Reuse: 10% *(modification to existing credit)*

Intent

Reuse building materials and products in order to reduce demand for virgin materials and to reduce waste, thereby reducing impacts associated with the extraction and processing of virgin resources.

Requirements

Use salvaged, refurbished or reused materials such that the sum of these materials constitutes at least 5%, based on cost, of the total value of all materials on the project, including the MEP trades.

Mechanical and electrical equipment and materials such as computer room cooling conditioning units, chillers, pipe and fittings, IT equipment racks, floor tiles, transformers, paralleling switchgear, engine generators, uninterruptible backup power systems and PDU equipment, loadbanks, general electrical switchgear, electrical wire and cable may be included in this calculation. Only include materials permanently installed in the project.

Technologies and Strategies

Identify opportunities to incorporate salvaged materials into building design and research potential material suppliers. Consider salvaged materials such as raised floor supports and floor tiles, IT equipment racks, electrical and mechanical equipment and components, etc.

12-23-08

Indoor Environmental Quality

EQ Credit 7: Data Center Acoustic Environment (*New credit)*

Intent

Demonstrate that the acoustic design targets are 10% lower than industry regulated levels.

Requirement

Establish acoustic design targets and implement acoustic design strategies as required to exceed industry regulated levels for the following specific interior sound control performance targets including:

- Noise Criterion (NC)
- Room Criterion (RC)
- Building assembly Sound Transmission Class (STC)
- Outdoor-Indoor Transmission Class (OITC)

Technologies and Strategies

Specify building assemblies including interior partitions, ceilings/floors, and exterior wall configurations to achieve specific acoustic design targets.

Rationale for Addition

Attention to the acoustic environment of a data center is essential to protect the health and safety of data center workers from sustained noise levels that exceed 90 dB. The comfort of the data center users remains important but must be secondary to their protection. Unlike offices and other general purpose workspace, where ventilation air is provided for occupant comfort, in data center's high air flow rates may be required to cool the IT equipment; which may lead to a significantly workplace noise levels.

The EPC cannot prescribe a particular acoustic environment, because operational needs vary widely. The intent of this credit is to encourage data center owners to ensure that noise levels

12-23-08

Innovation & Design Process

ID Credit 1 – 1.8: Innovation in Design *(Modification of the existing credits)*

Intent

To provide design teams and projects the opportunity to be awarded points for performance above the requirements set by the EPC for New Construction Green Data Center Rating System and/or innovative performance in Green Data Center categories not specifically addressed by the EPC.

Requirements

Credit 1.1 (1 point) In writing, identify the intent of the proposed innovation credit, the proposed requirement for compliance, and the design approach (strategies) that might be used to meet the requirements.

Credit 1.2 through 1.8 (1 point each) Same as Credit 1.1

Potential Technologies & Strategies

The following is a list of suggested areas for data center innovation credits. It is not meant to be an exhaustive or restrictive list, and innovations not on the list may also be candidates for innovation credits, provided that the strategies or measures demonstrate quantifiable energy efficiency or environmental benefits.

- Air Flow Management: Minimize the amount of recirculation of hot air and minimize by-pass air of cold air in the data center by designing physical separation or containment of either the hot or cold air streams. Successfully implemented, both measures result in energy savings and better thermal operating conditions.

  The recommended submittal to qualify for this measure is submission of the DOE DC Pro Air mixing metrics: Rack Cooling Index (RCI); Return Temperature Index (RTI) for the data center. RCI is a measure of how effectively the equipment is cooled and maintained within an intake temperature specification and should be ≥96%. RTI is a measure of the level of by-pass air or recirculation air in data centers and should be 100%, ±5%.

- Implement and utilize "free cooling" techniques, such as airside economizing, waterside economizing, indirect evaporative cooling, and heat wheel cooling – where applicable and to the maximum extent possible

- Passive cooling systems that eliminate the requirement for additional air distribution fan power

- Hot Water Heating using Heat Recovery from Data Center to serve adjacent spaces or facilities

- Reduction of Hazardous Materials on-site: Reduction of on-site hazardous materials, such as fuel storage, lead-acid batteries, etc.

- Energy Star IT Equipment: Greater than 75% of all servers, storage and networking equipment to be procured for the data center shall be ENERGY STAR qualified, under its Tier 1 specification and have power management enabled.
- Energy Use Sub-Metering by User: The data center is designed to enable sub-metering of IT electrical power (kW) and consumption (kWh) to specific internal business unit or external customers based upon utilization. In addition a mechanism to include either metered or allocated energy use for the additional data center cooling and electrical power losses is recommended.
- IT Asset Utilization Capability: The data center is designed to automatically track and report IT equipment utilization, power usage and IT productivity output metrics for IT server, storage and network equipment installed in the data center to enable full life cycle tracking, including end-of-life and decommissioning of obsolete or under utilized equipment.
- IT Asset e-Waste Recycling Program: Agreement by the data center owner to abide by the EPEAT™ and WEEE Directives and put in place a purchasing and e-waste recycling program for IT equipment used in the data center.
- Adaptive IT & Cooling Load Optimization: The data center cooling systems are capable of automatically increasing or decreasing their capacity to match the IT heat load to optimize the energy consumption of the support infrastructure at varying IT work loads.
- Enroll in the EPA ENERGY STAR program for buildings: Agreement by the data center owner to enroll the data center in the ENERGY STAR program for data centers.
- Perform a DOE assessment of the data center annually and report the resulting DCiE metrics and track the on-going continuous improvement in energy efficiency in the DOE on-line tool, DCPro.
- Enroll facility technicians in ongoing educational programs annually to enhance and demonstrate their growing competence in operating the complex and interacting mechanical and electrical systems in the data center at higher levels of energy efficiency performance than in the assumptions used in the original basis of design.
- Owner's Project Requirements Document: Assign a senior member of the design team the responsibility for development and justification of environmental and energy efficiency improvements are funded and justified for inclusion in the design. In addition this individual shall be responsible for assurance that life cycle costing, total cost of ownership and the environmental impact of the original design are considered if these design improvements are re-considered during the value engineering and construction phase of the data center.