Procured Information Communication and Technology (ICT) Climate Impacts and Procurement Recommendations

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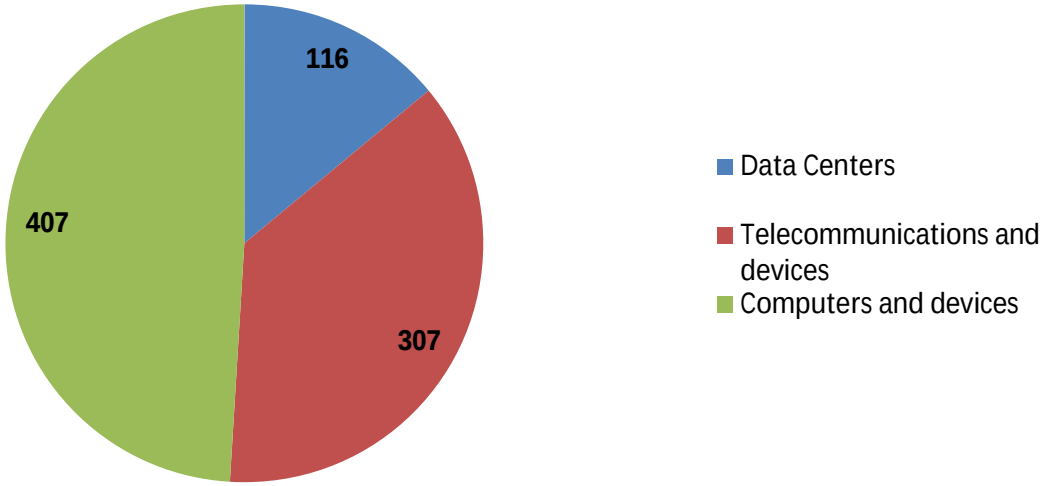
ICT Sector Introduction

Information, Communication, and Technology (ICT) services are large users of energy in the U.S and the world. The *Smart 2020* report estimated that the ICT Sector globally is responsible for 2% of the world's anthropogenic GHG emissions.[1] As such, they are increasingly a focus of governments and corporate sustainability efforts to reduce both the climate impacts and costs of these services. Procurers of ICT services have the potential to drive efficiency improvements through targeted procurement specifications.

Figure 1. Global ICT Sector Emissions (mmt CO_2e, year 2007) [1]



ICT is also capable of reducing the State of Minnesota's (State) GHG emissions by reducing the need for business travel, office paper products, mailings, and other State publications, as well as improve the efficiency of transportation and logistics networks used to supply State agencies and deliver State services. Therefore, in searching for GHG reductions in ICT, it is important to understand the efficiencies already embedded in these services. While ICT may improve energy efficiency in the economy as a whole, pursuit of energy efficiency opportunities in data centers remains important because of the potential for rapid growth in direct energy use in this sector.

ICT State Contracts

Minnesota Pollution Control Agency (PCA) staff collected a list of State contracts expiring in 2013. Each contract was assigned a corresponding sector North American Industry Classification System (NAICS) code to use in the Environmentally-Extended Input-Output (EEIO) analysis. ICT-related expiring contracts fit in either the NAICS categories "other computer related services, including facility management (54151A)" or "telecommunications (517000)". Combined, these ICT contracts account for over 56 million dollars of annual State expenditures and an estimated 7,236 metric tons of global warming emissions (see table 1 below).

[1] Global e-Sustainability Initiative (2008). *Smart 2020: Enabling the Low Carbon Economy in the Information Age.* http://www.smart2020.org/_assets/files/02_Smart2020Report.pdf

Table 1. Expiring ICT Contracts with Expenditure and Global Warming Emission Totals

CR #	NAICS Category Description	Contract Title	Annual Contract Amount	Vendor Name	Emission Factor (CO_2e/$)	Annual Impact (mt CO_2e)
E-103(5)	Other computer related services, including facilities mgmt (54141A)	ASAP-IT Master P/T Contract	$401,026	Trissential	0.16	49.8
			$ 308,279	MCCAA Webster &Associates	0.16	38.3
			$ 280,383	SDK Software Inc.	0.16	34.8
			$ 238,141	Tek Systems	0.16	29.6
			$ 222,079	Hollstadt & Associates Inc.	0.16	27.6
			$ 216,870	The Macro Group Inc.	0.16	26.9
			$ 211,828	Tech Pro Inc.	0.16	26.3
			$ 147,343	Systems Tech Group Inc.	0.16	18.3
			$ 142,280	Upnorth Vet Inc.	0.16	17.7
			$ 132,487	Ajilon Consulting	0.16	16.5
			$ 95,282	Int'l Projects Consultancy Srvc.	0.16	11.8
			$ 79,225	Xylo Technologies Inc.	0.16	9.8
			$ 72,292	On Demand Services Group	0.16	9.0
			$ 63,640	Aeritae Consulting Group	0.16	7.9
			$ 54,266	Ambient Consulting Solutions	0.16	6.7
			$ 42,678	CDI IT Solutions	0.16	5.3
			$ 15,280	Select Computing Inc.	0.16	1.9
C-753(5)		Mainframe & Midrange H/W, S/W & Maintenance	$50,000,000	IBM Corp Minneapolis	0.16	6,210
C-952(5)		Construction Document Distribution System	$ 25,620	Quest Construction Data Network LLC	0.16	3.2
D-217	Telecommun -ications (517000)	Teleconference Bridging, Recording & Storage for DEED	$ 310,460	Clear2there Inc.	0.23	55.9
T-737(5)		Telecom Services & Solutions	1,436,112	Qwest Corp.	0.23	258.4
			$ 138,137	Intercall Inc.	0.23	24.9
			$ 48,093	Onvoy Voice Services.	0.23	8.7
T-732		Telecom Application & Infrastructure	$ 433,498	Eloyalty Corp.	0.23	78.0
T-685		Telecom: Primary Rate Interface (PRI) Service	$ 900,000	Qwest Corp.	0.23	161.9
			$ 6,345	Zayo Managed Services	0.23	1.1
T-640		Telephone Based Interpretation - OET	$ 530,000	Language Line Services Inc.	0.23	95.4
Total			$56,551,644			7,236

Two ICT contract T-737(5) (Telecom Services and Solutions) State vendors participated in phone interviews with staff for this project: CenturyLink (formerly Qwest Corp) and Onvoy Voice Services. These interviews were beneficial in understanding the types of energy data ICT companies collect, and to identify potential improvement opportunities. Particularly helpful was the discovery that CenturyLink, in response to other customer requests, has begun calculating CO_2 emissions per terabyte (Tb), a common data unit.

The largest contributor to ICT services' GHG emissions is the energy used by vendors to store, host, and transmit information and data to the State.[2] Vendor questionnaires, standards, and certifications centered on energy use during the RFP process will be the most effective in reducing the State's GHG emissions from these services.

ICT Service Categories

Data Storage and Hosting Services

It is increasingly common for organizations to "outsource" the storage and delivery of their ICT services to virtual network delivery vendors. Common examples of some data storage, housing, and cloud services include, but are not limited to:

- Email systems
- Document management and other business applications
- Photo, video, music, and other data storage applications
- Search functions
- Database applications

The delivery of these services typically requires the use of a data center. Efforts aimed at increasing the efficiency of data centers are effective in reducing the GHG emissions of cloud-based services.

Data Centers

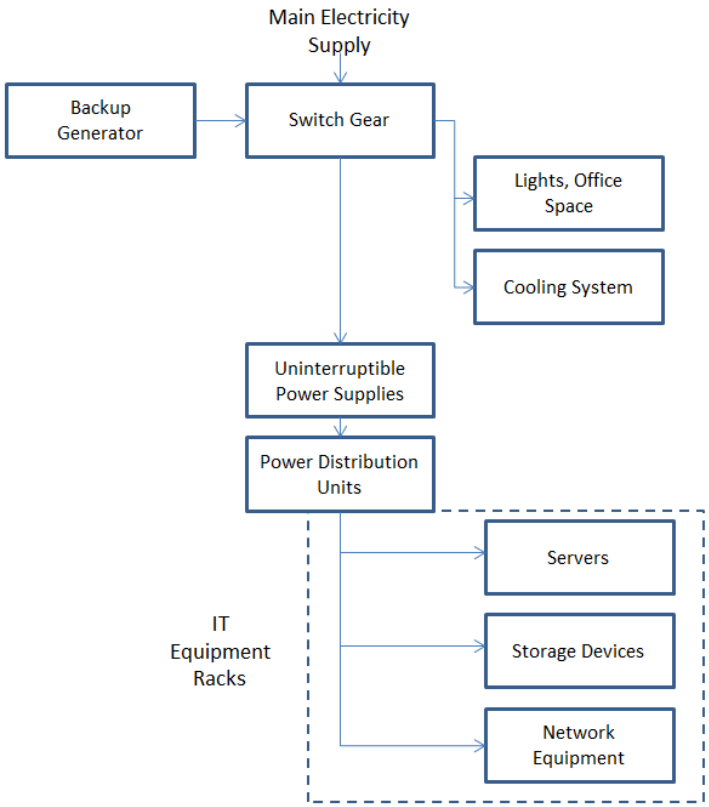
Data storage and hosting services require the use of data centers. The term Data Center applies to spaces specifically designed and equipped to meet the needs of high density computing equipment such as server racks, used for data storage and processing. Typically these facilities require dedicated uninterruptible power supplies and cooling systems. Data center functions may include traditional enterprise services, on-demand enterprise services, high performance computing, internet facilities, and/or hosting facilities.

Data centers range in size from small rooms (server closets) within a conventional building to large buildings (enterprise class data centers) dedicated to housing servers, storage devices, and network equipment. Data centers use a significant amount of energy to supply three key components: IT equipment, cooling, and power delivery.

Data center rooms are filled with rows of IT equipment racks that contain servers, storage devices, and network equipment. Data centers include power delivery systems that provide backup power, regulate voltage, and make necessary alternating current/direct current (AC/DC) conversions. Before reaching the IT equipment rack, electricity is first supplied to an uninterruptible power supply (UPS) unit. The UPS acts as a battery backup to prevent the IT equipment from experiencing power disruptions, which could cause serious business disruption or data loss. Power leaving the UPS enters a power distribution unit (PDU), which sends power directly to the IT equipment in the racks. Electricity consumed in this power delivery chain accounts for a substantial portion of overall building load. See figure 1 below for a diagram of the components.

[2] Vereecken, W., Van Heddeghem, W., Colle, D., Pickavet, M., & Demeester, P. (2010, March). Overall ICT footprint and green communication technologies. In *Communications, Control and Signal Processing (ISCCSP), 2010 4th International Symposium on* (pp. 1-6). IEEE.

Figure 1. Typical Electrical Components in a Data Center (reproduced from EPA Data Center Report 2007)



The continuous operation of ICT equipment and power delivery systems generates a significant amount of heat that must be removed from the data center for the equipment to operate properly. Cooling in data centers is often provided by computer room air conditioning (CRAC) units, where the entire air handling unit (AHU) is situated on the data center floor. Table 2 provides default peak power consumption for a typical server components.

Table 2. Component Peak Power Consumption for a Typical Server[3]

Component	Peak Power (Watts)
Central Processing Unit (CPU)	80
Memory (data storage)	36
Disks (encode data)	12
Peripheral Slots (part of interconnection system)	50
Motherboard (main circuit board)	25
Fan (for cooling)	10
Power Supply Unit (PSU) losses	38
Total	**251**

[3]Derived from: Fan, Xiaobo et. al. (2007). *Power Provisioning for a Warehouse-sized Computer*. Proceedings of the 34th International Symposium on Computer Architecture in San Diego, CA. Association for Computing Machinery, ISCA '07.

Telecom Services

Telecom services enable communication between two or more parties at different locations. Telecom services include:

- Network telephone service and voicemail
- Multi Protocol Label Switching (MPLS) Service
- Videoconferencing
- Webinars

For telecom services that use data centers in transmitting communications, energy metrics such as Power Usage Effectiveness and the GHG Protocol ICT Guidance also apply (see section below).

Life Cycle Assessment-based ICT Standards and Metrics

Multi-Impact LCA Standard

1. The Green Grid's Data Centre Life Cycle Assessment Guidelines

The Green Grid's Data Centre Life Cycle Assessment Guidelines is intended for use by data center owners, renters, and operators as a common basis in order to harmonize environmental impact studies.
The guidelines follow ISO 14040/14044 standards for the general steps in conducting a life cycle assessment of a good or service. They recommend up to 12 different environmental impact categories data centers can assess.

The guidelines were published as a white paper by the Green Grid in 2012. The guidelines represent the Green Grid's first step toward establishing a framework for studies and assessments on the environmental impacts of data centres. Case studies and future work on data center LCAs are planned by Green Grid.

2. European Telecommunications Standards Institute

ETSI, the European Telecommunications Standards Institute, produces globally-applicable standards for Information and Communications Technologies (ICT), including fixed, mobile, radio, converged, broadcast and internet technologies. One such standard is the "Life Cycle Assessment (LCA) of ICT equipment, networks and services; General methodology and common requirements (ETSI TS 103 199 V1.1.1 (2011-11)). The multi impact LCA standard is based on ISO 14040 and 14044 (the internationally-accepted LCA standard for any type of product and service).

GHG LCA Standard

3. GHG Protocol Product Standard ICT Guidance

The Greenhouse Gas (GHG) Protocol ICT Sector Guidance was set up to provide specific guidance on the GHG Protocol Product Life Cycle Accounting and Reporting Standard (the Product Standard). The objective is to provide a consistent approach for assessing the life cycle GHG impacts of ICT products. The ICT Sector Guidance is jointly convened through the World Resources Institute (WRI), the World Business Council for Sustainable Development (WBCSD), the Carbon Trust and the Global e-Sustainability Initiative (GeSI). The guidance covers ICT services of telecom networks, managed desktops, and cloud/data centers. Guidance on calculating life cycle greenhouse gas emissions from hardware and software products is also provided.

The second draft for public comment was released March 2013. The final version is expected to be released in late 2013. The GHG Protocol Product Standard and ICT Sector Guidance are free and publicly-available for download.

GHG Metrics

Unlike full ("cradle to grave") LCA standards listed above, the following metrics address the GHG or energy intensity of data center operations.

4. Carbon Usage Effectiveness

The relatively new Carbon Usage Effectiveness (CUE) metric addresses data center-specific carbon emissions, which is emerging as an extremely important factor in the design, location, and operation of these facilities today and in the future. CUE was developed by the Green Grid. CUE, combined with the Power Usage Effectiveness (PUE) metric enables data center operators to quickly assess the relative efficiency and sustainability of their data centers (see following section for a description of PUE).

$$Carbon\ Usage\ Effectiveness\ (CUE)$$

$$=$$

$$\frac{CO2e\ (kg)\ from\ data\ center\ energy\ consumption\ (electricity\ use)}{total\ IT\ energy\ consumption\ (kWh)}$$

Alternatively

$$CUE\ =\ Power\ Usage\ Effectiveness\ (PUE) x\ GHG\ Electricity\ Emission\ Factor$$

The GHG emissions from data energy consumption are calculated by multiplying the data center's electricity use total by the GHG emission factor of the electric utility provider or regional electricity grid system. The CUE's ideal value is zero (a zero carbon data center); CUE does not have a theoretical upper bound. Both CUE and PUE simply cover the operations of the data center. They do not cover the full environmental burden of the life-cycle of the data center and IT equipment. For now, CUE is specifically limited to GHG Scope 1 and Scope 2 emissions.

5. GHG Intensity of Information Metric (CO_2e/unit of information)

This metric is similar to a GHG LCA result for certain ICT services; the difference is that the metric only covers the GHG emissions from the data center operations, excluding GHG emission contributions from data center hardware manufacturing. It requires the vendor to know the total energy usage, emission factors of the energy sources, and the total amount of information processed and delivered to customers. In an informational phone call CenturyLink indicated that they are currently calculating CO_2/terabyte (TB) of information at the request of several customers. Other applicable denominators are length of service (e.g. 5 minute phone call between two parties, or 30 minute webinar with 10 participants, etc.) or per application run (e.g. one database search). The appropriateness of different calculation denominators will depend on the type of ICT service procured. There is currently no "gold standard" for calculating this metric.

Energy Only Standards, Certifications, and Metrics

The following standards, metrics, and programs evaluate a data center's energy efficiency and/or productivity, without considering the energy's source and GHG intensity.

6. Energy Usage: Power Usage Effectiveness (PUE)

The PUE metric was developed by Green Grid, association of IT professionals seeking to dramatically raise the energy efficiency of data centers. ENERGY STAR has also adopted the PUE calculation. PUE measures the ratio of data center facility power to the energy in the IT services delivered to end consumers.

$$Power\ Usage\ Effectiveness\ (PUE) = \frac{Total\ Facility\ Energy\ (kWh)}{IT\ Equipment\ Energy\ (kWh)}$$

Total Facility energy includes everything that supports the IT equipment load such as:

- Power delivery components such as UPS, switch gear, generators, PDUs, batteries, and distribution losses external to the IT equipment,
- Cooling system components such as chillers, computer room air conditioning units (CRACs), direct expansion air handler (DX) units, pumps, and cooling towers,
- Compute, network, and storage nodes, and
- Other miscellaneous component loads such as datacenter lighting.

IT equipment energy includes the load associated with all of the IT equipment, such as:

- Computers,
- Storage,
- network equipment, and
- supplemental equipment such as keyboard, video, and mouse (KVM) switches, monitors, and workstations/laptops used to monitor or otherwise control the datacenter.

A 100% efficient data center would have a PUE of 1.0.[4] According to a GreenGrid/EPA joint presentation, a 2.0 PUE is typical in the industry; 1.2 PUE is best in class.[5]

Table 3. Power Usage Effectiveness (PUE) Data Center Characterizations

General Data Center Efficiency Characterization	PUE
Standard	2.0
Good	1.4
Current Best in Class	1.2
Theoretical Goal: 100% efficiency	1.0

The PUE does not consider network utilization efficiency of data centers. For example, a data center could have a PUE of 1.4 while only utilizing 20% of its built capacity. In this case, the PUE does not show the potential for further efficiency by consolidating data center operations.

[5]Patterson, M (2010). The Green Grid EPA Data Center Assessment. The Green Grid. Accessed July 22, 2013 from http://www.thegreengrid.org/~/media/TechForumPresentations2010/EPA_Data_Center_Assessment_Report.pdf?lang=en

7. Energy Performance Metric (bits per kWh)

Another metric developed by the Green Grid is the bits per kWh consumed, a performance metric. This metric measures the output of a data center (in data unit 'bits') compared to the amount of energy used to deliver the bit to a customer. A bit is the basic unit of information in computing and digital communications.

8. ENERGY STAR Data Center Guidance

ENERGY STAR has a number of tools available to ICT customers and data center operators to measure and manage their electricity use. Two of these tools are portfolio manager and the low carbonIT campaign (see next section for information on low carbonIT campaign).

8.1 Portfolio Manager

ENERGY STAR's Portfolio Manager is an interactive energy management tool for facility managers. It now includes data center building types in the tool. By putting in annual facility energy data into the tool data center managers can:

- Compare their data center's energy efficiency to others.
- Earn ENERGY STAR Recognition. With a rating of 75 a data center earns the ENERGY STAR certified building designation.
- Estimate their data center's carbon footprint. Portfolio Manager calculates your building's greenhouse gas emissions – including carbon dioxide, methane, and nitrous oxide – consistent with the Greenhouse Gas Protocol.
- Track and report progress at their data center. Portfolio Manager allows you to examine data center energy use over time, evaluate savings from retrofit measures, and generates a Statement of Energy Performance (SEP) report.

Data Centers: Electricity Source Matters

The amount of GHG emissions from ICT services is determined by the amount of energy used and the GHG intensity of the energy source. An efficient data center supplied by fossil fuel intense electricity may result in more GHG emissions than a less efficient center with a low-GHG electricity supply.

$$\textbf{Electricity Use } (kWh) * \textbf{GHG Intensity of Electricity Grid } \left(\frac{CO2e}{kWh}\right) = \textbf{GHG Emissions}$$

The relationship between energy use and supply source shows that energy efficiency metrics alone are not sufficient proxies for GHG intensity of ICT services. Data centers located in deregulated electricity regions may be able to select a lower-GHG intensity electricity providing utility. Data centers in regulated markets do not have this option. These data centers, along with ones in deregulated markets, may decide to purchase Renewable Energy Credits (RECs) to reduce some or all of the GHG emissions attributable to their activities. Google uses power purchase agreements (PPA) with renewable energy projects to obtain the RECs from the renewable energy output of those projects as one way to reduce their carbon footprint.[1]

The issue of using RECs to reduce or "offset" an organization's GHG emissions can be a contentious policy issue in corporate sustainability circles; concerns about the additionality of RECs purchased by companies and the avoidance of double counting renewable energy with REC purchasers and the general electricity grid are two of the primary methodological issues. ICT companies that purchase RECs and report this information to the State in contract proposals should be asked how the RECs are purchased, and if the RECs hold any third-party verification on their authenticity.

If ICT vendors report energy metrics to the State, and they do not purchase RECs for 100% of their electricity usage, the State should request they report the location(s) of their data centers. At a minimum, they should report the state or e-grid region the centers are located in to assess the GHG intensity of the grid.

1. Google Data Centers | Renewable Energy. Accessed June 24, 2013. http://www.google.com/about/datacenters/renewable/

ICT Company-wide GHG and Energy Standards and Certifications

Another approach to ICT sustainability is corporate-wide GHG and Energy inventories. Unlike metrics based on services provided by ICT companies to customers, corporate GHG and energy inventories and standards look at the environmental impact of an ICT company across all of its operations. Since ICT companies offer different products and services, looking at a single GHG or energy number at a corporate level does not easily allow comparisons across competing vendors. Some organizations use corporate-wide sustainability results in the procurement process by identifying which vendors are showing improvements over time.

Two corporate/company-wide GHG and Energy Specifications and Programs specific to ICT companies are:

9. International Telecommunications Union

ITU (International Telecommunication Union) is the United Nations specialized agency for information and communication technologies – ICTs. ITU's Telecommunications Standardization Sector published its *Methodology for energy consumption and greenhouse gas emissions impact assessment of information and communication technologies in organizations (L.1420)* in February 2012. The methodology can be used to assess energy consumption and GHG emissions generated over a defined period of time for the following purposes: for assessment of related impact from ICT organizations or for assessment of impact from ICT related activities within non-ICT organizations.

10. ENERGY STAR low carbonIT Campaign

The ENERGY STAR Low Carbon IT Campaign is a nationwide effort to assist and recognize organizations for reducing the energy consumed by their IT equipment. Companies that take the pledge help ENERGY STAR evaluate its efforts and improve the campaign. In return for a company's pledge, the organization will have access to a number of free resources to help them lower their IT energy usage.

Organizations that have taken the low carbon IT campaign power management pledge:
http://www.energystar.gov/index.cfm?c=power_mgt.pr_power_mgt_low_carbon_participants

Table 4. ICT Standards, Metrics, and Certifications Scope Comparison

ICT Standards, Metrics, and Certifications	Full LCA, Multi-Impact	Full LCA, GHG Only Impact	GHG Intensity/ Effectiveness of Operations	Energy Efficiency/ Productivity of Operations	Energy Efficiency Benchmarking	Energy Efficiency Pledge
Green Grid Life Cycle Assessment Data Centre Guidelines	■					
Global e-Sustainability Initiative/GHG Protocol Product Standard ICT Guidance		■				
Green Grid/ENERGY STAR Carbon Usage Effectiveness			■			
GHG Intensity Metric (e.g. CO_2 per TB)			■			
Energy Intensity Metric (e.g. kWh per bit)				■		
Green Grid/ENERGY STAR Power Usage Effectiveness				■		
ENERGY STAR Certification with a facility Portfolio Manager Score >75					■	
ENERGY STAR Low Carbon IT Campaign — Power Management Pledge						■

Data Storage and Hosting Services, Telecom Services Procurement Specification Options

There are a number of ICT vendor information request options the State can ask during new ICT request for proposals (RFPs). These options are grouped into three approaches: service-based, operations efficiency-based, and facility/corporate certifications-based. Within each approach listed below different data request options are listed in order of preference. For each option the vendor should list the methodology, standard, and/or program they followed.

Service-based Approach:

Request Vendors provide:

1. Full GHG LCA of ICT service provided (CO_2e per service provided)
2. GHG Intensity of ICT Operations by service provided (CO_2e per unit of service)
3. Energy Intensity of ICT Operations by service provided (kWh per unit of service) and identify energy source and/or operations' electricity grid

Operations Efficiency-based Approach:

Request Vendors provide:

1. Carbon Usage Effectiveness of data center operations (ideally the data center that provides the service procured by the State)
2. Power Usage Effectiveness of data center operations (ideally the data center that provides the service procured by the State)

Certification-based Approach:

Request Vendors identify whether they have:

1. ENERGY STAR certification for the data center providing the ICT service procured by the State
2. Taken ENERGY STAR's Low Carbon IT Campaign pledge.

Table 5. ICT Programs and Standards, Certifications, and Metrics Comparison

Measure / Program	Multi-Impact LCA Guidelines	GHG LCA Guidelines	GHG Performance Metric (e.g. CO_2e per TB)	GHG Metric for Data Center (CUE)	Energy Performance Metric (e.g. bits per kWh)	Energy Efficiency Metric for Data Center (PUE)	Energy Efficiency Data Center Benchmarking	Data Center Benchmarking & Improvement Program
ENERGY STAR						■	■	■
Green Grid	■			■	■	■		
Global e-Sustainability Initiative/ GHG Protocol		■						

GHG and Energy Reduction Strategies for Vendors

The Department of Energy's Data Center Efficiency Guidance includes a number of energy efficiency opportunities data centers can employ to reduce GHG emissions. A list of 12 opportunities developed by ENERGY STAR is presented below. The PCA could supply vendors with a similar list in its procurement specifications, or request vendors provide information on whether their ICT services have already incorporated any of these measures.

Top 12 Ways to Decrease the Energy Consumption of Your Data Center

IT Opportunities

1. Server Virtualization
2. Decommissioning of Unused Servers
3. Consolidation of Lightly Utilized Servers
4. Better Management of Data Storage
5. Purchasing More Energy-Efficient Servers, UPSs, and PDUs

Airflow Management Strategies

6. Hot Aisle/Cold Aisle Layout
7. Containment/Enclosures
8. Variable Speed Fan Drives
9. Properly Deployed Airflow Management Devices

HVAC Adjustments

10. Server Inlet Temperature and Humidity Adjustments
11. Air-Side Economizer
12. Water-Side Economizer

ICT Hardware

ICT services require hardware devices to operate them. Hardware-related environmental impacts are included in LCAs of ICT services. While the majority of ICT product GHG emissions occur in the use/service delivery phase, selecting energy efficient hardware when the State makes direct purchases of hardware products will contribute to agencies' own electricity consumption reduction goals.

Types of Hardware Products include:

- Computers and peripheral equipment (e.g. monitors, desktops, laptops, external hard drives)
- Communication equipment (e.g. telephones, routers)
- Printers and Copiers
- Scanners and other imaging machines

Hardware Tools, Metrics, and Initiatives

EPEAT®

EPEAT® is a comprehensive environmental rating that helps identify greener computers and other electronic equipment. EPEAT criteria reflect several categories of environmental attributes that cover the full lifecycle of electronic products. The "PC and Displays," "Imaging Equipment," and "Televisions" standards address:

- Reduction/elimination of environmentally sensitive materials
- Material selection
- Design for end of life
- Product longevity/life extension
- Energy conservation
- End-of-life management
- Corporate performance
- Packaging
- Consumables (unique to Imaging Equipment standard)
- Indoor Air Quality (unique to Imaging Equipment standard)

Most EPEAT criteria apply to the characteristics of individual products. Other criteria apply to corporate programs. For example, a manufacturer must demonstrate the public availability of a written corporate environmental policy consistent with ISO 14001. Finally, EPEAT also includes a variety of service-related criteria. These focus on the takeback and responsible recycling of products, packaging and batteries, as well as the provision of extended warranties and other support services that can significantly reduce environmental impact. There are three levels of EPEAT certification: bronze, silver, and gold.

EPEAT is used by the U.S. GSA in federal procurement. Model contract specification language is available for different hardware product types on EPEAT's website: http://www.epeat.net/resources/for-purchasers/#contractlanguage.

ENERGY STAR Electronics and Computers

ENERGY STAR certified ICT products are listed on ENERGY STAR's website. At a minimum, all ICT hardware purchased by the State should be ENERGY STAR certified.

A few of ENERGY STAR's hardware specifications are:

- Computer Key Product Criteria: http://www.energystar.gov/index.cfm?c=computers.pr_crit_computers
- Audio Key Product Criteria: http://www.energystar.gov/index.cfm?c=audio_dvd.pr_crit_audio_dvd
- Uninteruptable Power Supplies Key Product Criteria: http://www.energystar.gov/index.cfm?c=uninterruptible_power_supplies.pr_crit_uninterruptible_power_supplies

International Telecommunications Union (ITU) Green ICT Standards

This ITU has developed a number of ICT hardware standards for "green" performance goals. The standards are developed through a consensus-approach; access to some of the standards is restricted to particular users.

ITU Standards: http://www.itu.int/en/ITU-T/climatechange/Pages/standards.aspx