West Coast Climate & Materials Management Forum

INFORMATION & COMMUNITCATION TECHNOLOGIES (ICT)

Climate Friendly Purchasing Toolkit

Information and Communications Technologies (ICT):

This section provides specific strategies to reduce GHG emissions from the procurement, use, and disposal of information and communication technologies (ICT), including information services. Specifically, it addresses three subcategories of ICT procurement [links to individual sections]:

- Procuring and managing low-carbon desktop and enterprise ICT equipment
- Contracting for print management services and consolidated printing
- Reducing GHG emissions from purchased cloud-based or other ICT services

These areas were chosen because they are applicable to a wide range of institutions, there are relatively straightforward strategies that can be replicated across different organizations, and there are good existing models and approaches for measuring GHG emission reductions. Other areas of ICT procurement – such as telecommunications equipment, software licensing, - are not addressed here, but may be developed in future iterations of the toolkit.

Why ICT?

It's big, and growing…

- The electronics sector is an enormous market. In 2012, the United States imported $124.8 billion in Electronic Data Processing (EDP) and office equipment ($77.6 billion of which came from China).That same year, the United States imported $38.6 billion in integrated circuits and electronic components.[i]
- Governments spend a lot on ICT products and services. Federal and state spending alone equals nearly $100 billion annually.[ii]
- The SMARTer 2020 report estimated that the ICT Sector globally is responsible for 2% of the world's anthropogenic GHG emissions, and is expected to grow 6% per year through 2020.[iii]

It takes a lot of energy to make this equipment…

- Embedded emissions for ICT equipment make up a substantial share of the total lifecycle emissions. Carbon emissions from materials and manufacturing range from about 25-75% of the lifecycle total, depending on the product and the assumptions used.
    - For example, a 2010 Fujitsu study found that 40–50% of the total lifecycle GHG emissions of a desktop PC can be produced before it is first used.[iv]
    - Apple Computer estimates that production accounts for nearly 75% of the lifecycle carbon footprint for two of its popular laptops[v]

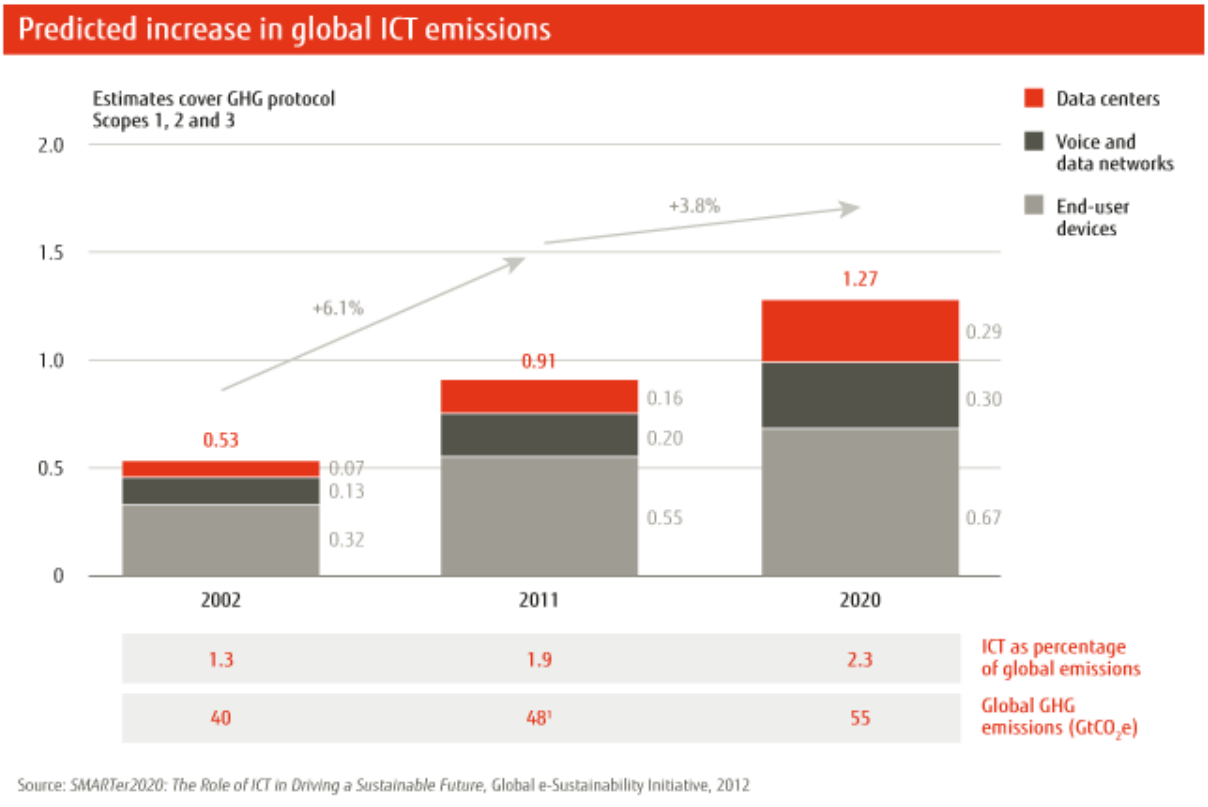
And it consumes a lot of electricity when in use….

- In commercial buildings, computers and monitors can make up more than 10 percent of overall electricity consumption of a building. In addition, the vast majority of small-scale

servers, workstations, and thin clients are found in businesses. Computers can frequently sit idle for large portions of the day, wasting much of the energy associated with them.[vi]

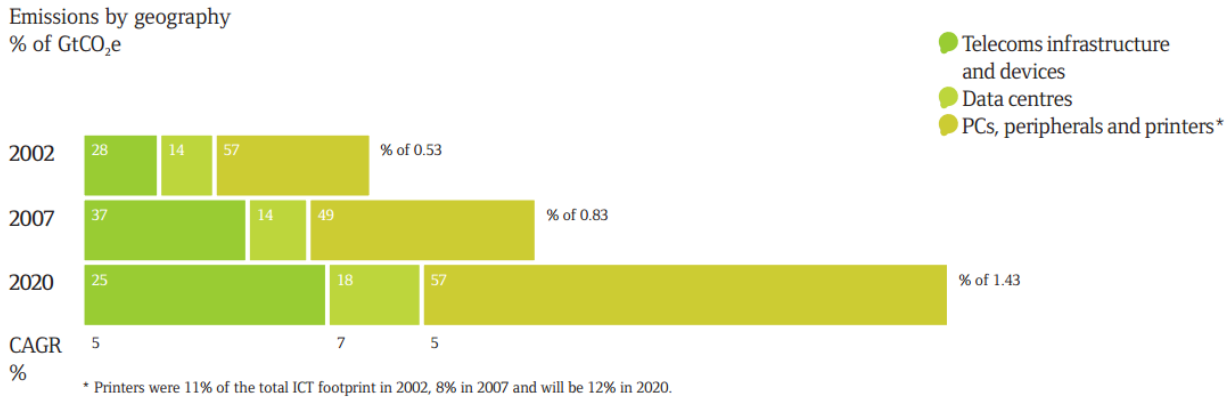
Emissions, like data, are shifting from office equipment to the cloud…

- The updated analysis of the SMARTer 2020 report shows the relative shift in the energy footprint of the ICT sector from devices to data center and networks, tracking the ongoing growth of internet-based computing and the shift to thin client devices like tablets.
- Based on the estimates contained in the SMARTer 2020 analysis, the aggregate electricity demand of the cloud (including data centers and networks, but not devices) in 2011 was 684 billion kWh. If compared with the electricity demand of countries in the same year, the cloud would rank 6th in the world.
- Data centers will be the fastest growing part of the global ICT sector energy footprint as our online world rapidly expands, with demand expected to increase 63% by 2020.[vii]



(source: http://www.sustainability-perspectives.com/article/the-four-key-environmental-factors-of-ict-energy-carbon-e-waste-and-water/#footnotes)

Fig. 2.3 The global footprint by subsector



Source: SMART 2020: Enabling the low carbon economy in the information age. A report by The Climate Group on behalf of the Global eSustainability Initiative (GeSI). 2008

But a big ICT footprint doesn't mean we should go back to paper… ICT, though it has a big and growing footprint, can reduce footprints in many other operations – document processing (vs. paper), virtual travel (vs. on road), improved logistics, and efficient delivery of services. So key is to keep its footprint as low as possible while still allowing its benefits.

PRINCIPLES FOR GREENHOUSE GAS REDUCTION IN ICT: DEMAND REDUCTION & EFFICIENCY

There are two main principles that apply to all the purchasing strategies covered in this section: Demand Reduction and Efficiency.

Demand Reduction is based on the idea of using only the right amount of equipment or service to meet your needs. That means taking the time to understand what is really needed for your organization – does every workstation need the super powerful machine, or a printer on the desk? Is your workforce going mobile, so may not need both laptops and desktops? It also can include increasing the life of existing equipment - the single best way to avoid production-related carbon emissions is to not buy a piece of equipment. In some cases, it may make sense to buy a slightly more powerful (and slightly more expensive) computer or printer so that it can maintain its function for 4-5 years.

Efficiency: This goes beyond simply reducing the amount of power used by a particular piece of equipment. You should also consider how much a product will be used. For instance, a desktop printer that sits idle for much of the day is far less efficient than a large multi-function device that services many people, even though it uses more power. The same is true for servers and data services – you want to ensure you are not paying for servers and server farm services that have not been optimized to run efficiently (e.g. through virtualization).

Strategy #1: Procuring and Managing Low-GHG Emissions Desktop and Enterprise ICT Equipment

The production, use and disposal phases of Information Technology (ICT) equipment by the government sector has significant impacts on the environment through overall energy consumption and emissions of greenhouse gas emissions. ICTC equipment includes desktops, laptops, displays, slates, tablets, imaging equipment, televisions, audio-visual equipment, in-house servers, and peripherals such as mice, cables and keyboards, and external power supplies.

The lifecycle of ICT hardware comprises several complex production stages, including acquisition of raw materials, manufacturing, transportation, distribution, use and maintenance, and end of life disposal.

Key climate impacts of purchases of ICT hardware result from both the use phase and upstream production phase:

- Energy consumed during the use phase:
    - If all computers sold in the U.S. were ENERGY STAR certified, over $1 billion in energy costs would be saved yearly. ENERGY STAR (www. Energystar.gov) is a U.S. Environmental Protection Agency voluntary program that helps governments, businesses and individuals save money and protect the climate through superior energy efficiency. The program certifies products that meet ENERGY STAR standards for energy efficiency.
- Greenhouse gases emitted:
    - If all computers sold in the U.S. were ENERGY STAR certified, approximately 15 billion fewer pounds of GHG emissions would be emitted, equivalent to more than 1.4 million vehicles being taken off the road.
- Upstream (or embodied) energy:
    - Energy consumed during the acquisition of raw materials and manufacturing components is also highly significant. This includes mining of metals such as copper, cobalt, gold, tin and aluminum which are highly energy intensive activities.
- Other significant impacts of the ICT lifecycle:
    - Chemical and water usage in mining processes, plastics production, component manufacturing and end-of-life management.
    - Use of flame-retardant chemicals, which have endocrine disrupting effects, in the product.
    - Use of conflict minerals sourced from regions where armed conflict and human rights abuses occur related to mining activities.

Estimates project that government will increase use of ICT hardware dramatically over the next decades. The expansion of technology use means that energy consumption and other impacts of the sector will continue to rise.

Key Strategies for Purchasing to Reduce GHG impacts of ICT Equipment:

1. Require products meet ENERGY STAR standards, and join Energy Star's Low Carbon ICT Campaign.

Energy Star is an international program for encouraging and recognizing the most energy efficient products in the marketplace. ENERGY STAR qualified computers and other ICT equipment use energy efficient power supplies, operate efficiently in multiple modes of operation, and come equipped with power management features. According to the EPA, in 2012, energy use in the U.S. associated with ENERGY STAR computers and monitors is 32 billion kWh per year less than it might have been without ENERGY STAR.

ENERGY STAR's Low Carbon IT Campaign is a comprehensive, nationwide effort to help organizations take advantage of all the programs resources to significantly lower energy consumed by ICT equipment. It promotes three key strategies to reduce energy consumption and GHG from enterprise ICT equipment:

- Choose Energy Efficient ICT Equipment: Organizations should require all products be certified to the current Energy Star standards. The program provides guidance on specifications and purchasing for computers, displays, small networking equipment, servers, VOIP phones, televisions, and uninterruptable power supplies (UPS). http://www.energystar.gov/index.cfm?c=power_mgt.pr_power_mgt_efficient_equipment. When developing bid language, reference the language in the ENERGY STAR Product Purchasing & Procurement template letter. (105KB)
- Enable power management systems that monitor and control activity levels of individual PC hardware components such as processors, batteries, AC adapters, fans, monitors and hard disk. The program provides a spreadsheet to estimate your PC power management savings. Check out how to Power Manage Computers, which covers how to activate sleep settings, the business case for power management, and how to calculate potential savings.
- Reduce peripheral energy consumption.

Encourage your ICT department to take the Low Carbon ICT Pledge. According to Energy Star, agencies have pledged over 7 million computers to power management, saving 2,786,806,470 lbs of GHGs avoided annually, and 1,815,509,101 kWh saved annually.

2. Go Beyond Energy STAR ™

Go beyond ENERGY STAR by requesting comparative Typical Energy Consumption (TEC) data and award higher points to vendors offering equipment with higher TEC numbers. Alternatively, require that equipment has a 20% higher TEC than current ENERGY STAR standards.[viii]

3. Purchase EPEAT registered computers, laptops, servers, printers, multifunction devices and other ICT equipment. http://www.epeat.net/

- EPEAT is an easy-to-use resource for identifying high-performance, environmentally preferable products. EPEAT is a voluntary registry covering desktops, notebooks, monitors, imaging equipment and televisions, which may be registered at the gold, silver or bronze level. EPEAT incorporates the current ENERGY STAR standards as they are updated and also addresses the full life cycle, including toxics. You can use the EPEAT registry to find products which meet key toxics reduction criteria.

Hundreds of businesses, schools, hotels, hospitals and governments around the world use EPEAT to help them make informed purchasing decisions.

- EPEAT is based on the IEEE 1680 family of Environmental Assessment Standards. This includes the "umbrella standard," which describes how products are registered by declaring their compliance to specific criteria, how they are rated based on the criteria they meet, how registration by country operates and how product declarations are verified. The related product standards 1680.1, 1680.2, and 1680.3 contain the specific criteria for "PCs and PC Displays," "Imaging Equipment," and "Televisions," respectively, upon which EPEAT registration and ratings are currently based.
- View Sample Contract Language from dozens of state governments, municipal jurisdictions, higher education and other organizations at http://www.epeat.net/resources/for-purchasers/#accordions-1=state-governments&tabs-1=modelpolicy%26contractlanguage.

3. Extend the life of ICT hardware:

A key procurement strategy to reduce the GHG emission footprint of your ICTC equipment is to extend the life of the equipment, which effectively reduces demand. By not purchasing as much new equipment, the embodied energy or upstream emissions embedded in ICT hardware purchases is lowered dramatically. There are a few strategies here:

- Implement longer replacement cycles, also known as product duty or refresh cycles, for ICT equipment. Many agencies refresh equipment every four to five years, compared to the former standard of three years. Also consider cycling older equipment to different agency uses when buying new equipment.

- Consider upgrading power-hungry components to more efficient versions. In particular, older graphics cards used in many workstations and high-end desktops can consume nearly as much power as the computer itself. Newer graphics cards can use half the electricity, and increase performance, while avoiding the embodied carbon emissions associated with replacing the entire computer.
- Purchase ICT equipment that is designed for longevity. Request comparable data from vendors on design for upgradeability, and reparability and durability. Award higher points to vendors offering better design options.
- Select a vendor that offers robust technical support to ensure that equipment is operated and maintained for highest energy efficiency.
- Train ICT staff on proper maintenance, which is a critical element in operating ICT equipment for energy efficiency. Temperature, dust, misuse and fluctuating electrical supplies can all have detrimental impacts on the functioning and energy efficiency of ICT equipment.

The European Commission Green Public Procurement (GPP) program has published helpful EU GPP criteria for maximizing energy efficiency through extending the life of equipment, including requirements that:

  - Memory is readily available and can be changed or upgraded.
  - Hard drive and CD/DVD drives can be changed.
  - Training and user support for green management of ICT equipment is available.
  - Energy management functions are present.
  - Parts for repair and upgradeability are available for at least three years from the time that production ceases?)
  - Additional points are awarded for easier disassembly and recycling

Other opportunities to consider:

- Require robust warranty terms
- Plan for turnover management
- Think about the function desired in relation to the purchase. See ENERGY STAR.
- Organizations also are interested in reducing toxics in ICT products:
  - ENERGY STAR ICT products must meet the standards of the ROHS regulations. The ROHS Directive aims to restrict the use of certain hazardous substances. It also bans placing new electrical and electronic equipment on the European Union market if it contains more than the agreed-upon levels of hazardous materials such as lead, cadmium, mercury, hexavalent chromium, and flame retardants.

    - Use the EPEAT registry to find products which meet several toxics reduction criteria.
- Including specifications or awarding points for packaging reduction (or use of reusable shipping containers) and smart delivery systems will reduce the amount of GHG in the upstream and transportation phases. One method for the latter is to reward participation in the EPA's SmartWay transportation and shipping program.
- Request detail and give points for post-consumer recycled content in plastics or shipping packages.

Cost considerations

Energy efficient ICT equipment is generally price neutral, i.e. there is little to no price impact from buying the more efficient products. Significant financial gains can be achieved due to reduced energy consumption over the lifecycle of energy efficient ICTC products. See the ENERGY STAR website for calculator.

Applying a total cost of ownership approach when awarding a contract will ensure that financial costs are minimized. According to the EU GPP report, total cost of ownership variables for ICTC equipment include: usage behavior, repair costs, on-site management, and shifting market trends affecting pricing. Note that organizations are often structured so that the department paying for the ICT equipment is not paying for the energy consumption of that equipment.

See additional ENERGY STAR purchasing and procurement case studies, including:

- Read the Commonwealth of Massachusetts best practices to ensure that state agencies purchase ENERGY STAR certified products.
- Learn which states have specified ENERGY STAR through executive order, law and policy.

How to measure success:

Purchasing results

- Track the number and percent of ICT products by product category that are ENERGY STAR certified or EPEAT registered. Put language in your contracts to require vendors to provide regular (semi-annual or annual) reports on the certification of the products your organization bought. See
- Track the number and percent of ICT products by product category that are EPEAT registered.

Environmental Results

- Use the EPEAT Electronics Environmental Benefits Calculator to quantify environmental and cost savings of buying EPEAT registered products, the emissions reductions from

extending the life of certain hardware, and end-of-life management strategies (reuse and recycling).

- Use ENERGY STAR tool to estimate the savings from implementing power management settings - Estimate your PC power management savings

Purchasing resources:

- Alameda County Green ICT Computer Guidelines – [LINK TO PDF which we will supply]
- California Department of Government Services Buying Green Buyers Guide , Office Equipment sections on Contracts, Specifications, Certifications and Standards, Buying Tips and other Resources.
- European Union (EU) Green Public Procurement Criteria for ICTC Equipment
    - Technical background report
    - EU GPP criteria
- Green Electronics Council Green ICT Resource Center
    - http://greenelectronicscouncil.org/programs/green-ict-resource-center/
- International Telecommunications Union (ICTU) Green ICTC Standards
    - http://www.itu.int/rec/T-REC-L.45-200010-I
    - The ICTU offers ICT hardware standards for "green" performance goals.
- TCO Development Practical Guide for Sustainable ICT Procurement:

Case Studies

- BSR Report on Improving the Lifecycle Energy Impacts of Notebook Computers in the Production Phase http://www.bsr.org/en/our-insights/case-studies/P10
- California Energy Commission Staff Report Analysis of Computers, Computer Monitors, and Signage Displays

STRATEGY #2: Managed Print Services and Consolidated Printing

Managed Print Services (MPS) is a blanket term for all aspects of providing printing for an organization. In the past this meant a combination of individual desktop printers, large copiers for duplication, and maybe shared resources like color printers, and fax machines. **The opportunities for GHG reductions comes primarily from cutting the number of printers in use, using that equipment efficiently (including minimizing unnecessary printing), and aligning incentives to promote repair and longevity.**

- Printers account for between 2-5% of energy use in the typical office building. While many have energy saving features, they still draw a significant plug load while on standby. **Typically, offices use an output device only about 15 minutes (2%) of every business day.** The goals of print management services and printer consolidation is **to optimize the number of printers devices to adequately meet your printing needs,** and **consolidating printing service so each device is used more efficiently.** In most organizations this involves transitioning from a model of owning (and maintaining) a large fleet of different equipment, to contracting for a service to provide the level of printing your organization needs. Doing so means you can have fewer machines, that operate more frequently, and you can set incentives for reducing total printing.

- While cutting carbon emissions is one outcome of a successful MPS program, most organizations realize significant cost savings, especially when considering the total cost of ownership (TCO, including equipment acquisition, maintenance, consumables, ICT support, etc.). Workplaces with significant distributed printing can save up to 20 – 50% on TCO by implanting MPS.

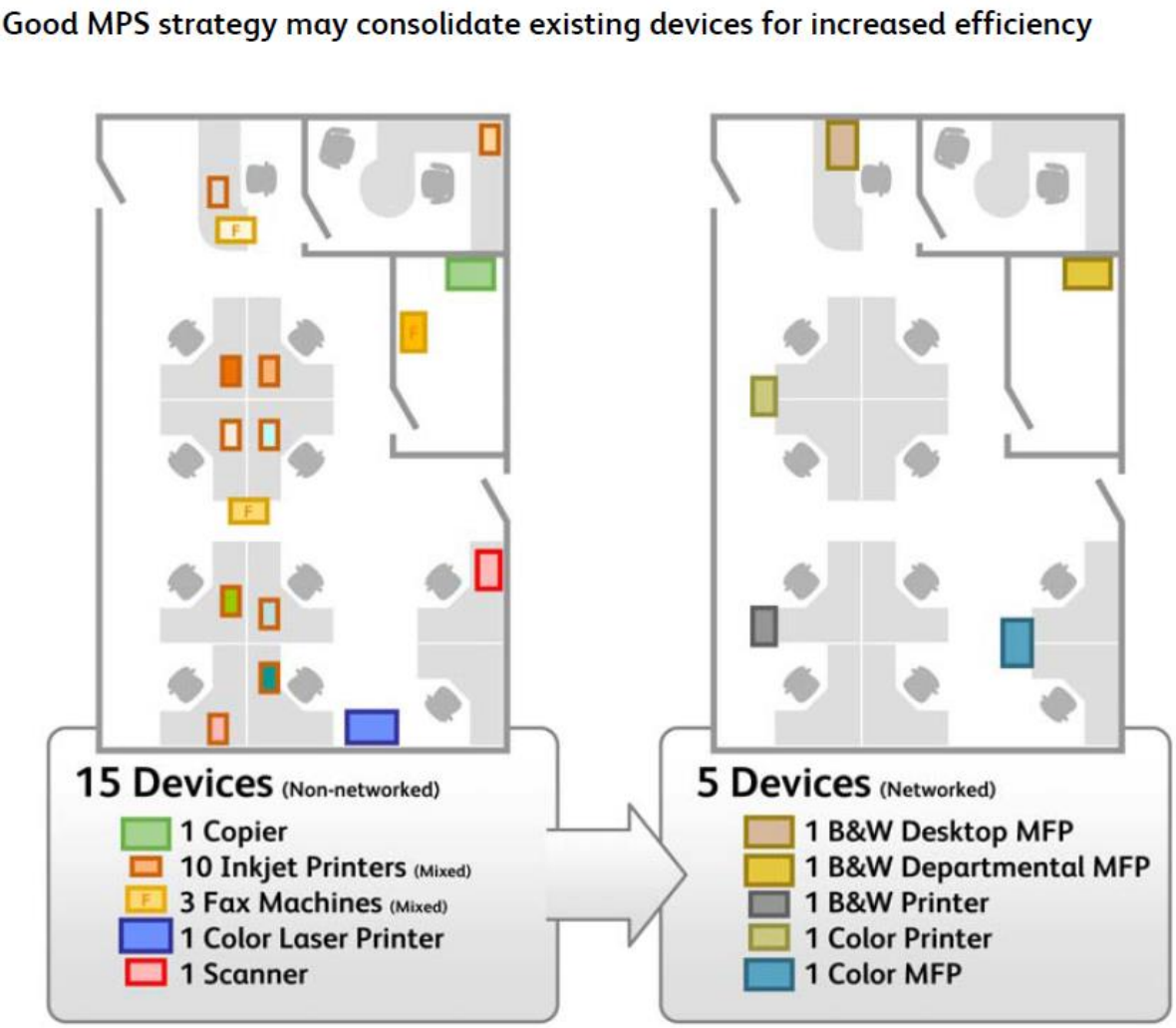


Figure 2: Typical consolidation based on MPS

Source: Managed Print Services for Mid-sized Organizations, Xerox Corp., 2009

How it is done:
Shifting from many individual printers to a managed and consolidated printing environment has three main steps:

Step 1: Analyze printing needs for a building, office or facility. Organizations need to take a deep look at the printing needs of their employees, often called a "print assessment." This involves understanding the current baseline, including:

- the number and types of different equipment that are in service, as well as a map of locations on each building floor

- the total number of “impressions” or pages that are copied on a monthly or annual basis, per machine if possible
- demands for specialized printing such as color, high resolution, large format plotting
- need for faxing or scanning
- needs for high volume duplicating
- needs for protecting private or sensitive information
- cost of maintaining existing equipment, including consumables such as toner, maintenance expenses, and estimates (if possible) of electricity use.
- Hidden costs of the current system, including demands on ICT departments, procurement, office management staff to service, and lost productivity from excessive down time.

This analysis can either be conducted by a stand-alone vendor, or as part of more comprehensive managed print services contract. In either case, the vendor should be asked to provide the following information:

- recommendations for consolidating or changing printer configurations to meet the identified needs, including leveraging existing print equipment (not all existing equipment needs to be replaced)
- estimates of cost implications, either savings or additional costs
- estimates of energy savings and GHG savings. For example, HP offers an online resource to estimate GHG and energy reductions from shifting equipment: HP Carbon Footprint Calculator

Step 2: **Develop a Plan for Consolidation**

Shifting from a mixed, desktop printing environment to a managed print environment can be a complex task. It involves significant workplace changes that need to be rolled out gently; a different procurement approach to secure a comprehensive service; and requires time for transition. Some of the key principles for a successful transition include:

- Leave adequate time for planning, engaging all the relevant stakeholders such as ICT, procurement, unions, frequent users, specialist staff, etc.
- Build in time and services for adequate training
- Make sure your contract language is complete and detailed enough to ensure you get the cost and efficiency savings you demand

Step 3: Implement slowly, and track results

The most successful examples of Managed Print Services are those where organizations seek a vendor to manage the entire printing enterprise. This changes the procurement approach from buying goods such as printers and copiers, to buying a **service** in which the vendor is responsible for installing and maintaining some or all of the printing equipment, and is paid based on the number of impressions or level of services that are provided. See the box “A different kind of procurement” for more information on contracting and procurement for MPS.

Some important features to consider in implementation include:

- Establish systems to allow for privacy, such as requiring a password to release a print job. This is important for any users who need to print Personal Identifiable Information or other confidential or sensitive information.
- Consider other features that help reduce GHG and other resources, such as requiring all employees enter a code to release a print job (cutting down on forgotten or duplicate printing); setting all equipment and software to default to double sided printing; and default to black and white printing to save on the often significant cost of color printing.
- Build service and maintenance into the contract to limit downtime, as this causes more problems when devices are widely shared. This should include both regular preventative maintenance and service standards for rapid response to breakdowns.
- Build in time and resources to train staff on new equipment and new procedures.
- Develop procedures and requirements for both your vendor and your organization to track progress and implementation, and to make shifts if needed. Some factors that should be tracked on a regular basis include total imprints, imprints per machine, user satisfaction, downtime, etc. You also need to make sure your contract allows for making changes to the configuration based on this information, as you may find some office or units need more or less service.
- Tracking and estimating savings in paper usage, electricity, and the GHGs associated with those efficiencies. The Paper Reduction section has links to those.

BOX: A change in the procurement process

In most cases, the best MPS solution emphasizes high-value service over the more traditional technology purchasing strategy based on lowest unit cost. These managed service contracts can deliver both cost savings and efficiencies.

The contract must establish a current cost and equipment baseline based on the assessment suggested in Step 1; define clear end-state savings targets; and establish milestones that chart progress between the two. The simplest and most visible way to measure savings is by using a consumption-based "utility" approach, i.e., cost-per-page, exactly as for a contract for electricity, gas, telephone or water. This allows savings measurement at the unit cost level, paying only for what is used, and makes costs absolutely transparent and predictable. Vendor selection should highlight key business drivers beyond cost and standard service-level agreement (SLA) goals. Also, make sure any contract includes the ability (internally and by your vendor) to continuously monitor the printing environment. The "Purchasing Resources" section includes several great guides for setting up the bid and contract language for managed print services

The MPS market is quite mature. Some vendors offer separate print assessment services, or MPS services. Some MFD and equipment vendors will also provide print assessment and PMS.

Purchasers will be on solid ground to request documentation of baseline print impacts and changes post-PMS efforts.

BOX 2: Paper reduction and Recycled Content Paper: Can't talk about printing services without including ways to reduce GHGS through the purchasing of paper and other peripherals. First order is to reduce paper use – see guidance here for strategies to reduce paper use (setting double sided)
Second is to buy recycled paper. See link to paper paper.

Case Studies -

Links to the following documents:
County of Madera - Ricoh case study
Cleveland State University Printer Case Study

EPA Region 6 Case Study

EPA Region 8 Case Study

Purchasing Resources

Purchasing Guides, FAQs

Reduce Costs through Printer Consolidation - Info Tech Powerpoint

Xerox Description – Managed Print Services

Top 10 Tips for Implementing Managed Print Services

MPS FAQ – University of Pennsylvania

RFPs, MultiState Contracts

Alameda County – Countywide Multifunction Devices RFP, 2012

US General Services Administration – Print Management RFQ (June 2011) – includes print assessment and delivery of MPS

WSCA/NASPO – placeholder, still out to bid

Strategy #3: Purchased ICT services (cloud-based, internet, e-mail, or telecommunications)

What do you need to know?

The days of governments owning all the equipment needed to satisfy their ICT needs are over. Governments now buy much of their ICT capacity as *services* not as *hardware*. E-mail is often a cloud-based service purchased from a vendor. Telephone service is now typically provided via the internet (voice over internet protocol or VOIP) or through cellular services. The recommendations in this section can also be applied to VOIP telephone services.

In this context, the procurement challenge becomes *how to compare ICT service providers and select those providing services with the lowest carbon footprint*.

In looking across the whole environmental life cycle of ICT services, the biggest GHG hotspot is **energy used in provision of the services**, so that's where governments should focus their attention.[ix] Energy use and GHG emissions of a server center are directly related to:

- Efficiency of the server center itself, mostly for temperature control
- Efficiency of the ICT hardware used in the center, and,
- Energy sources powering the data centers. So centers powered by coal will have a different GHG footprint than those using solar photovoltaic arrays.

The most effective approach to reduce the GHGs from these services is to use vendor questionnaires, standards, and certifications centered on energy use and electricity sources during the RFP process.

Procurement Goal:

The primary strategy for reducing GHG emissions from purchase of ICT services is to select services which are provided with the lowest GHG per unit of data.

How do you implement?

There are a variety of ICT standards and metrics that could be requested by government purchasers in RFPs to help lower the GHG emissions associated with procured ICT services. These range broadly in the scope of considerations, from full environmental life cycle standards that document "cradle to grave" impacts to pledges that companies will take energy-saving steps in ICT management.

Keep it simple.

Each of the approaches, standards and metrics below has the advantage of capturing overall energy use in some way. Many of them will capture relative GHG emissions as well. Government purchasers requesting any of these metrics shouldn't have to evaluate specific hardware at a vendor's data centers because the impact of the hardware selection will be incorporated in the larger metric.

Telecom services, while generally not the focus of this ICT procurement guidance, do fit into this discussion of ICT services. Telecom services that use data centers to transmit communications, such as webinar and video-conference services, and VOIP, are similar to other

ICT services. The energy and GHG metrics below will be relevant for both ICT and data telecom. Procurement of traditional copper wire "land line" systems wouldn't fit into this approach as well.

Here are brief descriptions, taken from a comprehensive study conducted by the Minnesota Pollution Control Agency in 2013[x] (where there is more detail). The call out box on page X has a simplified, prioritized list of purchasing recommendations drawn from these approaches.

1. Full LCA Standards - *Comprehensive approaches that incorporate multiple environmental impacts.*

A. Green Grid Data Centre Life Cycle Assessment Guidelines:
The Green Grid (an association of ICT professionals seeking to dramatically raise the energy efficiency of data centers) developed the Data Centre Life Cycle Assessment Guidelines , intended for use by data center owners, renters, and operators as a common basis so that impacts are comparable across different centers. The guidelines follow ISO 14040/14044 standards for the general steps in conducting a life cycle assessment of a good or service. The resulting LCA would encompass power generation or "grid mix", hardware, cooling systems, and building structure. They recommend 7 primary and 2 secondary impact areas that all data centers should assess.

Primary impacts (shall be considered for all data centers):

- Energy consumption during operation
- Raw material depletion for construction of the data center structure
- Raw material depletion for manufacturing of ICT and facility equipment
- Land use and environmental impacts of the facility
- Mix of energy-generating sources used to support operation − Water consumption during operation
- Reuse, recycling, and/or disposal of ICT and facility equipment and materials

Secondary impacts (should be considered if relevant to a given facility):

- Hazardous substance content of data center building and equipment
- Air pollution during operation

B. European Telecommunications Standards Institute:
ETSI, the European Telecommunications Standards Institute, produces globally-applicable standards for Information and Communications Technologies (ICT), 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).

2. Full LCA Standard - *Greenhouse gas impacts only*

A. GHG Protocol's "ICT Sector 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 services.

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.

3. GHG Metrics

A. Carbon Usage Effectiveness (CUE) (Green Grid and Energy Star)

The relatively new Carbon Usage Effectiveness (CUE) metric is very useful. It is a metric of the GHG emissions associated with a specific data center. This 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, see below) metric enables data center operators to quickly assess the relative efficiency and sustainability of their data centers.

$$Carbon\ Usage\ Effectiveness\ (CUE) = \frac{CO2e\ (kg)\ from\ data\ center\ energy\ consumption\ (electricity\ use)}{total\ IT\ energy\ consumption\ (kWh)}$$

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 ICT equipment. For now, CUE is specifically limited to GHG Scope 1 and Scope 2 emissions.

B. GHG intensity of information (e.g. CO2e/TB 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. It excludes emissions from manufacturing data center hardware. 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, suggesting that this would be a reasonable metric for state purchasers to request as well.

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.

4. Energy efficiency standards, certifications, and metrics

A. Power Usage Effectiveness (PUE)

The PUE metric was developed by Green Grid. It has been widely adopted by industry according to the Green Grid.[xi] ENERGY STAR has also adopted the PUE calculation. PUE measures the ratio of data center facility energy use to the energy in the ICT services delivered to end consumers, where facility energy includes everything that supports the ICT equipment, like lighting, heating, cooling, and the ICT equipment energy is the servers, computers, network equipment. A 100% efficient data center would have a PUE of 1.0, where every kWh of supporting energy serves a kWh of ICT equipment energy. According to a GreenGrid/EPA joint presentation, a 2.0 PUE is typical in the industry; 1.2 PUE is best in class.[xii]

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

B. Energy intensity 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.

5. Energy efficiency benchmarking

A. Energy Star Data Center Guidance/Certification w/ Portfolio Manager score >75

Energy Star's Portfolio Manager is an interactive energy management tool for facility managers. It now includes data center building types in the tool. Data centers can be Energy Star certified by achieving a Portfolio Manager score of 75 or more. Asking for Vendors' data center Portfolio Manager scores may be a useful metric for state purchasers

6. Company-wide GHG and energy inventories or pledges.

A. Energy Star Low Carbon ICT Campaign - Pledge
The ENERGY STAR Low Carbon ICT Campaign is a nationwide effort to assist and recognize organizations for reducing the energy consumed by their ICT 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 ICT energy usage.

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

How to implement

Applying any of these metrics to procurement of ICT services is a relatively new approach. While *hardware* has been a topic for sustainable procurement for some time, sustainable procurement of ICT *services* has not. It is suggested that you start early, well before the RFP needs to be issued. Become familiar with the approaches listed above. Then meet with potential vendors and any of your internal users, ICT or environmental staff who may be involved. Find out which sorts of assessments or metrics potential vendors may already be providing for clients.

Key players to involve - Besides the purchasers who specialize in ICT procurement, it is essential to form a team of ICT managers from your organization. If at all possible, have a vendor meeting prior to issuing the RFP to get input from potential vendors.

Important things to consider

1. Staff training: Basic understanding of environmental life cycle assessment will be helpful but not essential. Staff will not need to know the math, or detail, of conducting one. However, it will be helpful for them to understand how to compare LCA results. For example, the concepts of "functional units" and "system boundaries" are basic to knowing what's been included in the analysis and what has not, to ensure an "apples to apples" comparison. The American Center for Life Cycle Analysis can be a helpful source of training resources http://www.lcacenter.org/.

2. Pair your efforts to reduce GHG footprint of services with internal conservation efforts to reduce unnecessary use of services where possible. For example, encourage employees to clean-out e-mail periodically.

3. Address potential barriers / myths. For government, ICT can be one of an organization's biggest carbon footprint procurement categories because information and communication is such a large part of what government does. Some may erroneously conclude that ICT should then be reduced, in order to lower overall emissions, and more

paper should be used because paper doesn't use electricity in its use phase. This is faulty logic. In most cases, using digital resources is environmentally preferable to creation of paper documents and publications. Use of ICT to decrease use of paper, decrease travel or improve logistics will result in a net carbon footprint reduction.

Prioritized Procurement Specification Language For Purchasing Data Storage, Hosting and Telecom Services

There are a number of ICT vendor information requests government entities can make during new ICT request for proposals (RFPs). These options are grouped into three approaches -- i**n order of priority for reduction carbon footprint of procured services**: 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.

In reality, these are new metrics. Rather than making these *requirements*, we suggest giving points. Larger vendors may be able to provide one or more of the service-based approaches. In operations efficiency, PUE is proving to me more of an industry standard than CUE. So CUE, though preferable, may be harder to solicit. More points could be given for the higher priority approaches.

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, such as TB)
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 the following for the data center(s) that provide the services procured by the State:

1. Carbon Usage Effectiveness of data center operations
2. Power Usage Effectiveness of data center operations

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 ICT Campaign pledge.
3. LEEDv4 certification for newly constructed data centers or LEEDv4 O+M certification for already built, whole building data centers.

Adapted from Lahd, H., (2013, September). *Procured information communication and technology (ICT) climate impacts and procurement recommendations*. Minnesota Pollution Control Agency.

If Vendors cannot respond with any of the preferred metrics above, the next step would be to ask them to report on any of the EPA's recommended steps they may have implemented at their data center facilities.

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

ICT Opportunities

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

Airflow Management Strategies

1. **Hot Aisle/Cold Aisle Layout**
2. **Containment/Enclosures**
3. **Variable Speed Fan Drives**
4. **Properly Deployed Airflow Management Devices**

HVAC Adjustments

1. **Server Inlet Temperature and Humidity Adjustments**
2. **Air-Side Economizer**
3. **Water-Side Economizer**

Finally, in any ICT services RFP, purchasers can maximize the GHG reduction/environmental performance by allocating a greater proportion of scoring points to or requiring any of the above mentioned metrics.

Vendor Reports and Measuring Results

Once you have a contract in place where a service- or operations-based metric is provided, this can become the baseline. If possible, ensure that periodic usage reports are required in the contract. Reports should include service usage, dollars spent, and the carbon or GHG metric.

With these data points, the carbon intensity (carbon per dollar spent on ICT services), as well as the total estimated carbon footprint, can be calculated. See the hypothetical example in the next section below. If readers have additional approaches for assessing results, please share with the toolkit team to be added.

Examples and Case Studies

Hypothetical example of state ICT reduction using carbon per data unit: This is a hypothetical example of how a government could evaluate ICT services by using a basis of data purchased, the cost for the data, and the CO2e emissions per year. INSERT MINNESOTA'S ICT REDUCTION POTENTIAL SCENARIO here, best linked to as a PDF doc.

Insert other case studies that Patrick may have found.

Sources:

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[iii] GeSI SMARTer 2020: The Role of ICT in Driving a Sustainable Future, Global E-Sustainability Initiative, 2012

[iv] L*ife Cycle Assessment and Product Carbon Footprint: Fujitsu ESPRIMO E9900 Desktop PC*, Fujitsu, 2010.

[v] Apple Product Environmental Reports, available at http://www.apple.com/environment/reports/

[vi] California Energy Commission Staff Report, Analysis of Computers, Computer Monitors, and Signage Displays California Energy Commission 2014 Appliance Efficiency Pre-Rulemaking Docket Number 14-AAER-2.

[vii] GeSI SMARTer, ibid.

[viii] European Commission Green Public Procurement: A collection of good practices 2012 — 30 pp. — 21 x 29,7 cm Luxembourg: Publications Office of the European Union - http://ec.europa.eu/environment/gpp/pdf/GPP_Good_Practices_Brochure.pdf

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[x] Lahd, H., (2013, September). *Procured information communication and technology (ICT) climate impacts and procurement recommendations*. Minnesota Pollution Control Agency.

[xi] Avelar, V., Azevedo, D., French, A. (eds.) PUEtm: A Compresensive Examination of the Metric, 2012, The Green Grid. https://datacenters.lbl.gov/sites/all/files/WP49-PUE%20A%20Comprehensive%20Examination%20of%20the%20Metric_v6.pdf accessed 5/19/2015

[xii] Patterson, M (2010). The Green Grid EPA Data Center Assessment. The Green Grid. Accessed August 8, 2014 from http://www.thegreengrid.org/~/media/TechForumPresentations2010/EPA_Data_Center_Assessment_Report.pdf?lang=en