

Green IT Report 2008

The Computer Equipment Lifecycle Survey



Google™

EMC²
where information lives®

IBM®



 Sun
microsystems

intel®

Contents

Author: Brian Doherty
Outsourcing Global
Sustainability Advisor

Introduction	.....	3
Executive Summary	.....	7
Methodology	.....	17
Partner Assessment:	.....	21
EMC	.....	21
Google	.....	29
Hewlett Packard (HP)	.....	33
IBM	.....	43
Sun Microsystems	.....	51
Conclusions & Recommendations	.....	59
Processors and Datacenters in the Future	.....	65
10 Steps to Green IT	.....	69
Acknowledgements	.....	73
Industry Bodies & Regulators	.....	75
Questionnaire	.....	81
Endnotes	.....	93
References	.....	95



Introduction

Most businesses acknowledge the need to respond to the environmental and commercial uncertainty brought about by climate change and a changing global landscape. However, across the commercial world, this response has varied in speed, scope and intent.

As the costs of non-sustainable fuels rise, commercial pressure is driving both private and public sector organizations to define a sustainability or green policy. Simultaneously, industries and commerce face the additional pressure of needing to demonstrate a responsibility to employees, to the local community and to the natural environment.

However, the need to present a corporate strategy and identity that are both green and promote sustainability is not limited to the confines of a given organization. Increasingly, emphasis and attention is spreading beyond the facilities of the organization to incorporate what happens before production (the supply chain) and what happens post-production and at product end-of-life. Are components and materials sourced in an ethically sound and eco-friendly manner? Does the manufacturing process take into account environmental considerations? Can products be recycled and who is responsible for this? The days of organizations being responsible for simply what goes on “in house” are gone. Today, the emphasis is on accountability and proving green and sustainability credentials for both in-house activities and beyond.

While a myriad of internal and external evaluations and assessors of green credentials and sustainability indicators exist, a standard accepted scale by which various infrastructure manufacturers and technology leaders can be judged and compared is conspicuous by its absence. In light of the increased publicity and scrutiny, clients and industry watchers increasingly



request that Capgemini presents a view on the green credentials of its main technology partners. This report represents that view. In bringing together and presenting this data and information, Capgemini has undertaken to form a view not limited solely to the immediate datacenter impact of products, but to assess the product lifecycle from manufacture through to disposal and, in the absence of an accepted and recognized standard, to devise a scale to demonstrate the findings.

Though more advanced in some geographies than others, the increased focus on environmental awareness and sustainability is not limited to regions or specific countries. Globally, pan-national and governmental organizations are developing carbon-reduction measures and guidelines. The United Nations' Global Compact, for example, notes that it is not a "regulatory instrument – it does not 'police', enforce or measure the behavior or actions of companies. Rather, the Global Compact relies on public accountability, transparency and the enlightened self-interest of companies, labor and civil society to initiate and share substantive action in pursuing the principles upon which the Global Compact is based."¹

However, such advisory and guidance organizations are increasingly being underpinned by legislation. For example:

In Europe:

- Waste Electrical and Electronic Equipment (WEEE) directive
- Restriction of Hazardous Substances (RoHS) directive
- Registration, Evaluation, Authorization and Restriction of Chemical substances (REACH) regulation

In China:

- Management Methods for Controlling Pollution by Electronic Information Products regulation

In North America:

- Resource Conservation and Recovery Act (RCRA)

In South Korea:

- Act for Resource Recycling of Electrical and Electronic Equipment and Vehicles

At the time of writing, the “Climate Change Bill” was being passed through UK parliament. Its confirmation as legislation would make the UK government one of the first administrations to “support emissions reductions through ... a mandatory cap-and-trade program covering energy use emissions.”²

Some industry sectors have come under more intense public and media attention for their carbon footprints than others. For example, the public sector needs to be seen to be putting its own house in order before it provides advice and establishes legislation on carbon reduction in other sectors. Meanwhile, across the private sector, heavy manufacturing, petro-chemical and the airline industries have all had to respond to public pressure to address the issue of carbon emissions and the use of non-renewable resources.

More recently, however, the IT industry is being viewed as an “offender” in the line-up of carbon-emitting giants.

A recent Gartner publication revealed that the IT industry’s global carbon footprint – at 2% – was equivalent to that of the under-fire airline industry. The big challenge facing the IT industry is to continue to develop products that consume less electricity, emit less heat, and can be manufactured efficiently and ethically and also to meet the increasing demands of the rest of industry to help it resolve its own carbon-reduction challenges.

Gartner states: “Businesses need to focus less on how IT contributes to their environmental impact and more on how IT can help lessen the environmental impact of business operations and the supply chain or that of enterprise products and services”, adding that “although making IT more green must remain a concern, there are areas where deploying more IT can significantly contribute to making an organization more environmentally sustainable.”³

This report serves as an analysis of Capgemini’s technology partners’ green credentials and sustainability policies and provides Capgemini’s views and recommendations. In addition, Capgemini has highlighted those areas of infrastructure manufacture that Capgemini believes will experience particularly important development in the future.



Source: Gartner Survey on IT Industry Carbon Footprint (Gartner Symposium/ITxpo 2007 Emerging Trends (April 2007, Stamford, Conn))

Throughout this report, references are made to a number of organizations and representative bodies either by title or abbreviated title. Please refer to the Industry Bodies and Regulators section on page 75 for an explanation of the organization's function and origin.



Executive Summary

The aviation industry is in the midst of a green storm. Aircraft are reported to account for 2% of the earth's rising carbon footprint with little sign of abating.

As negative publicity directed at perceived offenders increases and becomes more focused, the IT industry – itself reportedly responsible for another 2% of global CO₂ output – faces a similar challenge. Mounting public pressure, increased industry analyst scrutiny and the potential threat of legislation (such as the UK's Climate Change Bill) will drive the industry to reduce, or at least justify, its footprint. From a business perspective, organizations across all sectors, confronted by rising energy costs and global economic downturn, increasingly seek IT solutions capable of reducing costs or providing greater output for the same cost.

Computer manufacturers have responded with marketing campaigns aimed at clients keen to view themselves as “environmentally responsible.” In some cases, this green marketing message happily coincides with developments that are happening anyway as the relentless march of Moore's Law continues (see the Endnotes section for further information on Moore's Law and Intel). In addition, environmental accountability across the industry is widening. Power efficiency – the power consumed and heat omitted by a server as it sits on the datacenter floor – is no longer the whole story. Increasingly, the focus is on the total environmental impact of that server – from manufacture to disposal.

The Computer Equipment Lifecycle Survey sets out to establish how Capgemini's partners are responding to today's economic and environmental challenges and also to determine how much of the market messaging is backed by genuine developments in power efficiency.

As might be expected from some of the largest corporations in the world, all Capgemini technology partners have, for many years, been hugely aware of their potential to negatively impact the environment and of the positive value of a well-articulated corporate social responsibility policy. For the most part, these partners have not just been seen to be doing the right thing, but have actually been doing the right thing. Indeed, on many fronts, IT is actually leading the green charge, as demonstrated by Intel's first-place ranking in the US Environmental Protection Agency's (EPA) Green Power purchase program and IBM's implementation of its Environmental Performance Database (EPD) to serve as an internal measurement and tracking system.

What does the Computer Equipment Lifecycle Survey tell us about what Capgemini's partners are doing well?

Manufacturing

The reuse of materials in the manufacturing process is well-established throughout the industry. All of the surveyed partners endeavor to use recycled material within their manufacturing processes and this is typically about 30% depending on the partner's definition of "recycled."

All partners procure at least some of the electricity used in the manufacturing process from renewable sources. HP's Irish manufacturing facility is 90% powered by wind-generated power – saving 40,000 metric tonnes of CO₂ this year. Google has the so-called "solar trees" – thousands of solar panels that partially power the offices at the company's Mountain View campus. IBM's worldwide use of renewable energy increased from 2.7% of its electrical usage in 2005 to 7.3% in 2006, a year-on-year increase of 180%. In addition, both IBM and HP claim that they would procure even more electricity from renewable sources if it were available.

Reducing the amount of water used in the manufacturing process is a key focus of all surveyed partners. IBM states that 12% of all of the water used in its manufacturing facilities is recycled. HP, IBM and Sun all have self-imposed targets on reducing water used in the manufacturing process and EMC, through its closed-loop water systems, is active in the reduction of water use at its Franklin, Massachusetts, manufacturing facility.

Transport & Logistics

Capgemini's partners demonstrated a commitment to improving their practices in the field of logistics. IBM and HP are members of the EPA's SmartWay program – a program to improve the energy efficiency of and reduce the greenhouse gases (GHG) associated with transport.

Universally, an ongoing drive to reduce the amount of product packaging was displayed with some, notably Sun, taking back packaging after product delivery.

Disposal

All of Capgemini's technology partners adhere to the Waste Electrical and Electronic Equipment (2002/96/EC) (WEEE) and the Restriction of Hazardous Substances (2002/95/EC) (RoHS) directives. In addition EMC, HP, IBM and Sun Microsystems all reported that in excess of 95% of disposed product is recycled – or, conversely, less than 5% ends up as land-fill.

In response to the concerns raised in 2002 by non-governmental organizations (NGOs) relating to electronic waste being exported to non-OECD countries, Capgemini's technology partners re-examined their disposal chains to confirm that their disposal processes were ethical. In addition, and as a means to ensure responsibility across the supply chain, both IBM and HP extended their policies to incorporate on-site auditing of their disposal agencies.

Corporate Social Responsibility

Long before the phrase “corporate social responsibility” was coined, all of Capgemini's corporate partners had comprehensive policies relating to staff welfare – in many cases to comply with predominantly European legislation – and were active in local communities. All pursued philanthropic initiatives both through their employees and as a corporate policy.

However, as HP notes, CSR need not be a net cost to the business. HP estimates that in 2007, more than \$10 billion in revenue came from customers requiring HP to demonstrate diversity in its supply chain.

Some of the more interesting and innovative CSR activities around sustainability undertaken by the surveyed partners include:

- HP (working with Sun Power Corporation) offers incentives to its US employees to install solar panels on their homes.
- Sun Microsystems' recent, award-winning Open Work Energy Measurement Project found that the average flexible worker saves 2.5 workweeks per year in commute time, more than \$1,700 in fuel and vehicle wear and tear, and 5,400 Kilowatt Hours/Year.
- In late 2006, Google launched Renewable Energy Cheaper than Coal (RE<C) initiative. Acknowledging clean and affordable energy as a key requirement for the company, RE<C is a strategic initiative aimed at developing electricity from renewable sources cheaper than electricity produced from coal.
- In 2004, EMC was one of only 50 companies in the US to voluntarily join the US EPA's Climate Leaders program, an industry-government partnership that works to develop long-term climate-change strategies.
- From 1990 through to 2006, IBM saved 4.5 billion kWh of electricity consumption, avoided nearly 3 million metric tonnes of CO₂ emissions (an amount equal to 44% of the company's 1990 global CO₂ emissions), and saved over US\$290 million through its annual energy conservation actions.

What are the key challenges facing the industry?

Manufacturing, Transport and Logistics

The complicated nature of the computer manufacturing process undoubtedly hinders the ability of partners to implement practices that are both cost effective and environmentally responsible. The supply chain is complex: shared sub-component suppliers, highly specialized manufacturing environments and sophisticated material requirement planning systems mean that product (finished, sub-assembled and component) often travels around the world en route to the final assembly plant or datacenter floor. While most Capgemini partners appreciate the environmental benefit of limiting product air travel, they cannot cost-justify amending manufacturing processes solely on environmental grounds. Indeed, building additional manufacturing facilities simply to

reduce distance travelled during manufacture would, in fact, likely have a worse environmental impact.

As the Capgemini/Global Commerce Initiative report “2016 – Future Supply Chain” highlights, supply chains will need to be designed “for additional parameters like CO₂ emissions reduction, reduced energy consumption, better traceability and reduced traffic congestion. The impact of these new parameters on the current bottom line may not yet be substantial but will grow in the coming years and efficiency improvements will almost certainly be realized.”⁴

All respondents conceded there is room for improvement in this area. Currently, metrics relating to the efficiency of logistics operations are sorely lacking and, as such, none of the partners are in possession of high-quality data relating to the environmental impact of the journey from factory floor to datacenter floor. This is partly due to the outsourcing of logistics which weakens the ability of partners to extend their own policies through the chain and to obtain high-quality data on distance travelled, durations stored and CO₂ impact. However, there is a clear need for a standardized metric, perhaps in combination with the EICC and/or the EPA’s SmartWay program, to measure the environmental impact of logistics operations.

HP represents a notable exception in terms of quality metrics as it has calculated that transporting HP products generates roughly 2 million metric tonnes of carbon dioxide equivalent (CO₂e)⁵ emissions a year, thus exceeding the emissions related to operating HP facilities. In response to this and based on the calculation that “each tonne of freight transported by ocean produces only about 1/50th of the CO₂e from air freight or the environment”, HP places great emphasis on shifting freight from air to sea, wherever possible.⁶

Disposal

Despite all participating partners having programs in place to minimize the amount of hazardous waste used in their products, all noted that lead, mercury and PVCs are still permitted (for some products and in some circumstances), thus acknowledging a weakness in the overall strategy

around toxic substance reduction. Brominated flame retardants (BFRs) and PVCs have proved difficult to substitute entirely due to the lack of suitable alternatives that, in addition to not compromising product performance, must not adversely impact health. The development and introduction of suitable alternatives will be pertinent to not only Capgemini's technology partners but to all hardware manufacturers.

What developments will be relevant to Green IT in the future?

Ownership & Operation

All of Capgemini's technology partners are active in the development of servers and storage devices that are less power hungry and run cooler than equivalent products some years ago. IBM, for example, through the 2006 edition of the annual report, "IBM and the Environment", claims that its System Z reduces energy consumption by 19%, with System P and I servers also showing substantial reductions.⁷ HP has promised to reduce the combined energy consumption and associated GHG emissions of its operations and products to 25% below 2005 levels. However, working on the level playing field established by Capgemini for the purposes of the Computer Equipment Lifecycle Survey, Sun Microsystems' Chip Multi-threading (CMT) technology proved to be the most power-efficient, least heat-emitting of all servers assessed (see Power and Heat Calculations in the Methodology section). As the demand for IT that is both cost-effective and green increases, the development of this technology will become increasingly important.

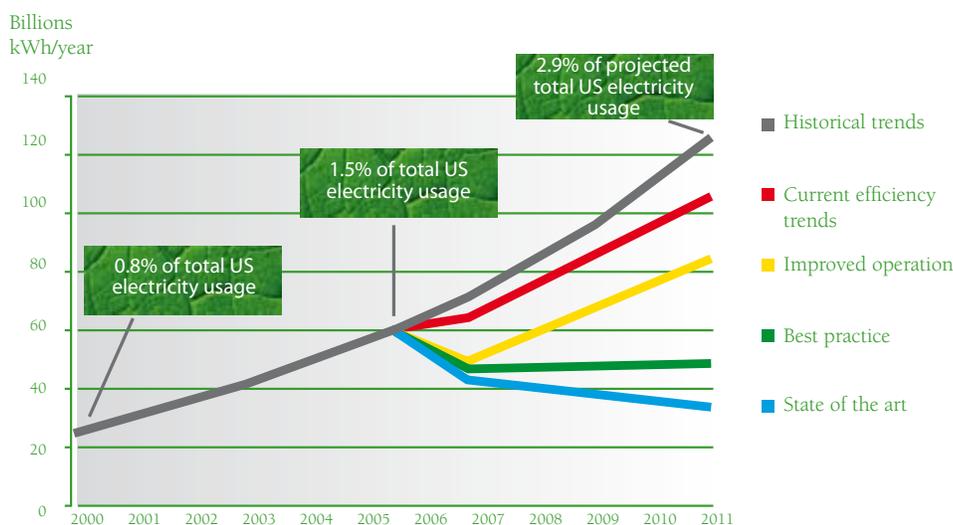
Processors and Datacenters

This survey, especially with regards to server manufacturers, has focused on the technology and innovation "wrapped around" the processor. However this component's development and its potential to increase the efficiency of CPU's will be central to energy-efficient IT practices in the future.

In the past, processors competed almost exclusively on the basis of "smaller", "faster", "cheaper" and, while these are still important, the onset of multi-core technology has seen "cooler", "cleverer", "cleaner" take on increasing importance. These buzzwords are more than just marketing – all of the relevant Capgemini technology partners back up product claims

with significant investment – amounting to billions of dollars – in the development of power-efficient, eco-friendly chips.

So while the processor is getting smaller and faster and cooler, the constant pursuit of Moore's Law will not result in fewer, smaller datacenters. On the contrary, the increased penetration and capability of information technology will actually drive a demand for more datacenters. Though datacenter design *per se* was not included in the survey, this topic will become increasingly relevant as part of the wider topic of improvements in infrastructure management.



Source: Intel/US Environmental Protection Agency Report to Congress on Server and datacenter Energy Efficiency; August 2, 2007

The increasing size and number of datacenters is forcing technology leaders to revise their approach to datacenter design. Sun and Intel (to cite just two) have completely redesigned their facilities in California and Oregon respectively with the focus on concentrating power and cooling energy on server “modules” or, in Sun’s terminology, “pods.” Combined with consolidation and virtualization programs, the rewards are lower energy costs in a very short return on investment (ROI) period and a more agile datacenter to adapt to changing business requirements.

As Sun Microsystems notes in its publication “Energy Efficient Datacenters – The Role of Modularity in Datacenter Design”, “The last thing that a datacenter design should do is get in the way of a company’s ability to conduct business ... Datacenter designs that facilitate – rather than limit –

growth, density, flexibility and rapid change can be a company’s competitive weapon.”⁸

Not all businesses have the luxury of designing their datacenters from the ground up. As such, they have to consider achieving datacenter efficiencies through third-party solutions. Cloud computing, Software as a Service (SaaS) and virtualization become potent carbon-reduction tools when offered through large-scale operations such as Google.

Business objectives cannot be sacrificed for the sake of “greener” datacenters. Rather, green IT strategies should be formulated within the context of overarching business needs. Once however, green IT needs are aligned with business objectives, IT and the datacenter can be thought about in terms of Kilovolt Ampere (KVA) and British Thermal Units (BTU) instead of, or at least in addition to, gigahertz and terabytes

Partner Assessment

The tables below are a summary of the partner assessment survey conducted by the Capgemini Outsourcing alliances team.

A total of 300 points were available for each category, with 1,500 points available overall. Further detail on individual partners can be found in the Partner Assessment section. The scoring system is explained fully in the Methodology section.

Category	Avg Score
Manufacturing	207
Transport & Logistics	244
Ownership & Operation	260
Disposal	254
Corporate Social Responsibility	282

EMC	
Manufacturing	204
Transport & Logistics	246
Ownership & Operation	237
Disposal	210
Corporate Social Responsibility	282
TOTAL	1179

Hewlett Packard (HP)	
Manufacturing	207
Transport & Logistics	270
Ownership & Operation	269
Disposal	297
Corporate Social Responsibility	294
TOTAL	1337

IBM	
Manufacturing	225
Transport & Logistics	192
Ownership & Operation	248
Disposal	267
Corporate Social Responsibility	279
TOTAL	1211

Sun Microsystems	
Manufacturing	192
Transport & Logistics	269
Ownership & Operation	284
Disposal	240
Corporate Social Responsibility	273
TOTAL	1258



Methodology

In order to build a consistent and independent view of its technology partners' green credentials, Capgemini undertook the Computer Equipment Lifecycle Survey. It is envisaged that this is the first of a periodic survey with this objective.

Note: Note: the full version of the survey received by partners can be found on page 81

Initially, seven Capgemini technology partners were invited to participate:

Cisco Systems

EMC

Dell

Google

HP

IBM

Sun Microsystems

Of these, Cisco declined to participate. EMC, HP, IBM and Sun Microsystems responded in full to the survey. Google was assessed on the basis of a service provider to Capgemini and not in the context of a manufacturer. At the time of going to press, Dell's response had not been received and so could not be included in this report.

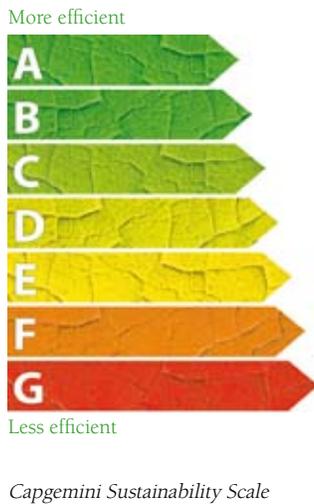
Intel provided substantial input to this report and AMD's point of view was considered via its website and white paper publication.

Capgemini Sustainability Scale

The survey has enabled Capgemini to develop a sustainability scale based on its partners' ability and willingness to conduct business in a manner that is fair, reasonable and considerate to the planet, its environment, its natural resources and its citizens.

This scale is represented in its simplest form by a graphic already familiar to





many people and used to demonstrate the energy efficiency of products and services.

The Capgemini Sustainability Scale shows the real commercial ethics of a Capgemini technology partner on the basis of the score achieved by the response to the Computer Equipment Lifecycle Survey.

The results of this survey will be used by Capgemini for three main purposes:

1. To establish a comprehensive point of view to present to the market.
2. To provide input to Capgemini bid responses.
3. To provide a meaningful metric to measure the green footprint of Capgemini datacenters.

The Computer Equipment Lifecycle Survey was conducted by the Capgemini Outsourcing alliances team.

The Questionnaire

The function of the survey is to analyze the lifetime of computers from leading IT datacenter equipment manufacturers. It considers a broad number of factors influential on the power performance, energy efficiency and carbon footprint of that equipment. This includes factors that are immediately outside of the control of the manufacturers but that can be influenced through marketing and direct contact. For example, this influence could be through targeted policy and market messaging aimed at suppliers, hosting companies, outsourcers, systems integrators and end-users.

This exercise also considers wider corporate policy around social responsibility. The survey was based around five categories:

1. Manufacturing
2. Transport & Logistics
3. Ownership & Operation
4. Disposal
5. Corporate Social Responsibility

Each of the five categories consisted of ten questions that covered a broad spectrum of topics within each category. Every question was scored separately for low-end, mid-range and enterprise-level servers (or equivalent storage product in the case of EMC).

In all, 1,500 points were available.

Scoring the Responses

The responses were scored co-operatively by Capgemini and the participating organization. Each respondent was sent a questionnaire containing fifty questions and a look-up table to provide an appropriate value (1 through 10) with which to respond to each question. The scores were agreed by reference to the look-up table and by mutual, iterative agreement.

So, in the example below, if the respondent sourced 54% of the electricity used in the manufacturing process from sustainable sources, then it would score a 6.

For example:

Question	Table	Explanation
M7: Does the manufacturing facility source electricity through Sustainable Energy schemes?	Table 3	A Sustainable Energy scheme is one where the electricity service provider or power generation company commits to sourcing electricity from sustainable sources that is equivalent to the full amount of electricity consumed by the manufacturing facility.

Reference Table:

	From	To	Value
	Percentage		
Table 3. M6, M7, D31, D32, D37. Recycled components OR Sustainable electricity source at the manufacturing facility(ies) OR Compliance with WEEE and RoHS Legislation (percentage of hardware) OR Percentage of disposed equipment is recycled.	91	100	10
	81	90	9
	71	80	8
	61	70	7
	51	60	6
	41	50	5
	31	40	4
	21	30	3
	11	20	2

Power and Heat Calculations

Within the Ownership & Operation section, several questions were posed with the aim of determining the most power-efficient (and cool) servers. In order to ensure a “level playing field”, the server partners were supplied with a system configuration for an Oracle HR system containing low, mid-range and enterprise-level servers and were requested to provide a system specification on that basis. Capgemini then undertook an exercise to determine the efficiency of the configuration based on published KVA and BTU information for the servers provided in the partners’ responses.



Partner Assessment: EMC

Overall Score: **1179**

Overall Rating: **C**

EMC's environmental priorities:

Product

- To establish a formalized Design for Environment (DfE) process for storage platform products
- By 2008, to adopt a metric or set of metrics that will be used to report and track improvements to the environmental efficiency of EMC products

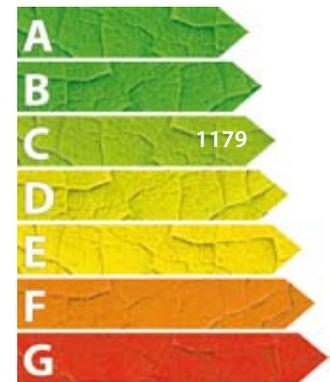
Operations

- By 2012, to reduce US greenhouse gas (GHG) emissions intensity by 8% below 2005 levels
- To continue participation in the Irish government's program to monitor and reduce direct GHG emissions
- To obtain Leadership in Energy & Environmental Design (LEED®) certification for EMC's US headquarters and new facility in Bangalore, India by 2009

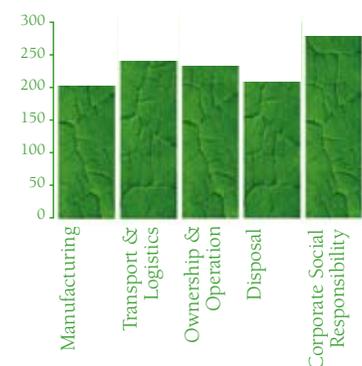
The Capgemini Green IT Report acknowledges the challenges of recording the attributes of storage devices within a survey focused predominately on servers. By definition, most storage devices will contain more moving parts than servers and, therefore, will consume more power. Nevertheless, an assessment of the data available reveals that EMC appears to have some of the most power-efficient devices of all of the major storage manufacturers.

In addition, as a company dedicated to designing, manufacturing and shipping data storage devices, EMC will naturally have different compliance drivers and priorities than a server manufacturer. An example of this can be found in the supply chain where, due to the

Best Corporate Sustainability
Credentials



Worst Corporate Sustainability
Credentials



Computer Equipment Lifecycle
Survey Score

presence of end-user data, EMC's supply chain is understandably required to place as much emphasis on meeting security standards as it does on transport standards.

EMC did not achieve a high score on its use of electricity sourced from sustainable sources or on the green governance of its supply chain – including disposal. However, this is not to say that EMC does not take its responsibility to the environment seriously – as demonstrated by participation in the US Environmental Protection Agency's (EPA) Climate Leader's Program and the Carbon Disclosure Project (CDP).

Manufacturing

Geographical Coverage

EMC has three manufacturing facilities worldwide. These are located in the US, Ireland and Brazil. In addition, the company has research and development centers in Belgium, Brazil, the Netherlands, Ireland, China, India, Israel, Russia, and the US

EMC's small number of manufacturing facilities globally means that it ships its product more widely than other survey respondents.

Supply Chain

EMC notes that responsible and ethical business practices are central to its efforts to ensure a socially and environmentally responsible supply chain. The EMC logistics organization is committed to the continued assessment of the supply base for environmental progress.

EMC has published supplier conduct guidelines with the aim of clearly establishing the minimum level of supplier behavior as a condition of selection and the continuing opportunity to do business with EMC. These guidelines include guidance on, among other areas, environmental management. Suppliers are also expected to comply with EMC's business conduct guidelines. Additionally, in 2008, EMC joined the Electronic Industry Citizen Coalition (EICC) and has since adopted significant portions of the Coalition's Electronic Industry Code of Conduct into its own Supplier Code of Conduct.

Energy Consumption and Resource Conservation

From a manufacturing perspective, EMC emits no industrial waste water. The Franklin, Massachusetts manufacturing facility uses closed-loop water systems in process-cleaning areas and materials laboratories, thus eliminating waste water discharges and conserving over 750,000 liters a year. EMC's other manufacturing sites do not use water in their manufacturing processes.

EMC has implemented the following technology initiatives in order to reduce energy use across its facilities:

- Installation of lighting sensors on all new EMC buildings to automatically turn off lighting in unoccupied spaces, and a phased upgrade to sensor systems in existing buildings.
- Implementation of a PC monitor energy-saver program which automatically shuts off employee computer monitors via the corporate network after 15-20 minutes of inactivity.
- Implementation of building automation systems and energy management systems to reduce energy use at EMC facilities.
- Installation of automatic temperature controls on chillers to link their operation to actual outside temperature and reduce operation.
- Completion of independent studies on electricity consumption at EMC datacenter and IT lab space to increase efficiency and reduce cooling energy requirements.⁹

Controlled Materials

EMC maintains strict controls on waste generation – with an emphasis on reducing or eliminating the use of hazardous materials. As a result, EMC's manufacturing operations generate only a small amount of hazardous waste.

Transport & Logistics

In-Transit

The EMC logistics organization is involved with multiple initiatives supporting environmental sustainability and global compliance to EU standards.

These include:

- Redesign of truck routes for greater efficiency (EMC reduced its fleet by two trucks in New England in 2007)
- Implementation of merge-in-transit (MIT) capabilities for fewer, fuller trucks and reduced fuel consumption. The increase in truck utilization decreases the number of trucks required. To date, EMC has implemented 14 MIT sites.

Packaging

EMC has instituted returnable packaging initiatives and packaging redesigns that significantly reduce waste and increase efficiency. For example, EMC recently redesigned one of its disk drive packages to use 100%-reusable materials, thereby reducing its material weight by 17%, decreasing space requirements and freight costs, and even reducing the labor time required for packing and unpacking. This redesign alone will save the company an estimated \$267,000 annually.

EMC, in its submission to the Carbon Disclosure Projects, stated that its “product packaging is designed specifically to reduce material content and weight, to increase the percentage of post-consumer recycled content, to maximize packaging reuse, and to ensure recycling of materials which are not reusable.”¹⁰

The EMC logistics organizations pay particular attention to ensuring that procedures with regards to the reuse and recycling of packaging are compliant with EU standards and support environmental sustainability.

The EMC “de-trashing” program encourages as much reuse and recycling of packaging as possible. This program was responsible for the diversion of 450 metric tonnes of material from the waste stream in 2007.

Ownership & Operation

Power and Heat

In a recent Aberdeen Report, end-users of EMC technology reported storage performance metrics that support an aggressive green strategy. The report notes “EMC’s efforts to deliver increased storage density while

achieving energy savings and maintaining required performance have resulted in measurable benefits.”¹¹

EMC's service offering Energy Efficiency Solutions addresses energy issues in the datacenter through efficient storage platforms, virtualization, data and file mobility, and backup/archiving/recovery.¹²

The Capgemini Equipment Lifecycle Survey – using published data as reference – assessed the power consumption and heat emission of EMC storage devices against peers such as IBM, HP, NetApp and HDS. The assessment revealed EMC to be notably more power efficient in the low-end product range than all of its competitors. Despite published numbers not being available for high-end products, EMC believes that this advantage is retained throughout its product line.

EMC continues to improve the power efficiency of all of its product ranges and, in reporting to the Carbon Disclosure Project (CDP), states that the company is “designing high-efficiency storage platforms and services to reduce electricity usage in our equipment.”¹³ Additionally, EMC design engineers are active in the design of energy-efficient systems using innovative power and cooling techniques, advanced storage technologies, and power-aware information management software to increase storage capacity while reducing energy footprint.

In the same CDP submission, EMC acknowledges the business opportunities arising from predicted power shortages, storm disruption and supply shortages (all of which are already having an impact on IT manufacturers). EMC states that there are substantial business opportunities to provide equipment and services to companies affected by, and seeking to protect themselves from, climate-related business risks. These opportunities come from businesses seeking to minimize their exposure to data loss caused by disaster and to protect critical business data on highly reliable and secure back-up servers.¹⁴

Disposal

Compliance

EMC complies with all applicable legislation including WEEE and RoHS.

Recycling

EMC recommends that customers redeploy their older-generation EMC products. Redeployment enables a customer to maximize the use of its equipment and reduces the total cost of ownership. When redeployment is not possible, EMC has processes in place to take back equipment from the customer.

EMC's Engineering and Manufacturing Design teams review the material content of EMC products and investigate ways to replace hazardous materials without jeopardizing the quality and reliability of products. EMC states that it is committed to continuous improvement in product end-of-life practices to optimize material reuse and reclamation.

Ethical Disposal

In the US, EMC has several processes to ensure electronic waste is properly managed and disposed of in accordance with federal and local laws and in an environmentally conscious manner. EMC works with Information Technology Asset Disposition (ITAD) providers and recyclers to ensure the maximum reclamation of raw materials, asset protection and data security throughout the recycle lifecycle while deriving maximum value and lowering demand for new materials whenever possible.

Corporate Social Responsibility

Corporate Citizenship

EMC's website notes that its goal is to be "socially responsible and responsive" and to work to be "an involved corporate citizen and thoughtful neighbor in our local and global communities."¹⁵

The company has established the “Green Business Initiative (GBI)” - a cross-functional internal committee that examines environmental sustainability across the company, coordinates activities, and develops strategy. Part of the GBI’s charter is the development of corporate programs to increase individual and business-unit engagement in addressing climate-change related opportunities.

As a company, EMC has demonstrated its commitment to environmental responsibility through its participation in the US Environmental Protection Agency (EPA)’s Climate Leader’s program. In 2004, EMC was one of only 50 companies to voluntarily join the program and has committed to reducing its GHG (green house gas) emissions to 8% below 2005 levels by 2012.

This dedication has also been manifested through EMC’s participation in the Carbon Disclosure Project (CDP). EMC’s annual submission, which includes greenhouse gas emissions, emissions reduction targets as well as both the risks and opportunities associated with climate change, was commended by the CDP in both 2007 and 2008. In addition, EMC was recognized by the CDP as 2008’s highest-scoring company in the category of technology, media and telecommunications.

EMC participates in IT industry organizations working to increase energy efficiency and to help control associated GHG emissions. EMC is a member of The Green Grid, a global consortium dedicated to advancing energy efficiency in datacenters and business computing ecosystems. EMC Chairman, President and CEO, Joe Tucci is an active member of the Technology CEO Council, which advocates the use of information and communication technologies to drive increased energy efficiency in the global economy. EMC is also a member of the Storage Networking Industry Association (SNIA) which works on energy-efficiency metrics for networked storage, the Uptime Institute, and chairs the Energy and Environmental committee at the Information Technology Industry Council.

Since 2000, EMC has maintained a robust in-house recycling program across its corporate campuses. In Massachusetts alone, this recycling

program has been responsible for saving the estimated equivalents of:

- 25,924 trees
- Over 40 million liters of water
- 484, 896 liters of oil
- 6,211,429 kilowatts of electricity
- 3,824 meters of landfill
- 41.5 metric tonnes of air pollution

In addition to the environment, education is central to EMC's global citizenship efforts. The company invests time, talent and financial resources to support all levels of education with a particular focus on the promotion of mathematics and science. EMC Chairman, President and CEO, Joe Tucci is active in public policy work to improve education and to close the achievement gaps that persist among children in the US.

EMC's Information Heritage program helps to preserve and protect unique collections through digital capture and safe storage, and to make them available to a global audience through the Internet. The goal is to expand access to these precious works for research, education, and enjoyment anywhere in the world, and to foster greater understanding of humankind's common information heritage.¹⁶



Partner Assessment: Google

Editor's Note: The Computer Equipment Lifecycle Survey considers Capgemini's hardware technology partners as service enablers for Infrastructure Management offerings. Although not a hardware manufacturer, Google delivers an optional component of Capgemini's managed desktop service and so a view on Google's green credentials has been included.

Green Credentials

Despite – or perhaps due to – its relative youth, Google has an established reputation as a green company and employer of choice. The company is the respondent that has a stated policy on carbon neutrality. Additionally, Google – both corporately and through its philanthropic organization google.org – funds many initiatives globally aimed at reducing greenhouse gas (GHG) emissions.

Google accepts that, at this time, its work to improve efficiency and generate renewable energy does not cover the company's entire carbon footprint. For this reason, Google also funds projects around the world aimed at reducing GHG emissions. According to the corporate website, Google actively welcomes projects where the environmental benefit can be accurately measured and that “provide a clear plan for monitoring and verification of results by third parties so we can be certain that the volume of offsets we purchase is sufficient to fully address our carbon footprint.”¹⁷

This environmentally conscious approach may be traced back to two of Google's founders: Larry Page and Sergey Brin, who were investing their IT dollars in emerging solar-power technology as far back as 2002.



Philanthropy and google.org

Google's charitable foundation, google.org, aspires to use the power of information and technology to address the most pressing global challenges: climate change, poverty and emerging disease. In collaboration with experienced partners working in each of these fields, the foundation aims to invest its resources and tap into the strengths of Google's employees and global operations to advance five major initiatives:

- Develop Renewable Energy Cheaper Than Coal (RE<C)¹⁸
- RechargeIT
- Predict and Prevent
- Inform and Empower to Improve Public Services
- Fuel the Growth of Small and Medium-Sized Enterprises.

Innovation

In 2007, Google launched the Renewable Energy Cheaper than Coal (RE<C) initiative. Acknowledging clean and affordable energy as a key requirement for the company, RE<C is a strategic initiative dedicated to developing electricity from renewable sources cheaper than electricity produced from coal. Initially, this project will focus on advanced solar thermal power, wind-power technologies and enhanced geothermal systems, although the program will also explore other potential breakthrough technologies. As part of this initiative, Google's Research and Development Group has established a team of engineers and energy experts tasked with building one gigawatt of renewable energy capacity that is cheaper than coal.

One of the more visible manifestations of Google's commitment to solar energy is the so-called "solar trees" initiative – which are, in fact, solar carports that constitute a component of Google's overall solar installation of more than 9000 panels generating 1.6MW of power.

Google also actively encourages innovation in the workplace through the "20% project", whereby all Google engineers have 20% of their time to pursue projects of interest. Well-known Google products spawned through this initiative include Gmail and Google News.

Corporate Social Responsibility

Staff Welfare and Representation

Google has been recognized by many relevant assessment bodies as an employer of choice. Various publications have voted Google as one of the best companies to work for and the company has featured on many “top employer” lists including Fortune Magazine’s “Best Places to Work”, the British Computer Society’s “Women in IT”, Ireland’s “Best Companies to Work For”, the UK’s “The Times Most Progressive Employer” and The Environmental Protection Agency’s (EPA) “Best Workplaces for Commuters” to name but a few. In addition, Google is consistently top ranked on the “Corporate Equality Index” of the Human Rights Campaign in the US.

Google’s corporate website states that it aims to be “a fun and flexible working environment with perks that are designed to make life easier and more convenient for employees to manage their life-work balance.”¹⁹

Corporate Citizenship

Google supports the work of external organizations by partnering with them in the common goal of diversifying the fields in which they both work, by bringing together thought leaders, conducting workshops, and providing networking and professional development opportunities. A notable – but not exhaustive – list of organizations supported by Google (in the US) includes:

- Anita Borg Institute for Women and Technology
- Grace Hopper Celebration of Women in Computing
- Celebration of Diversity in Computing
- National Society of Black Engineers
- The American Advertising Foundation’s (AAF) Mosaic Council



Partner Assessment: Hewlett Packard (HP)

Overall Score: **1337**

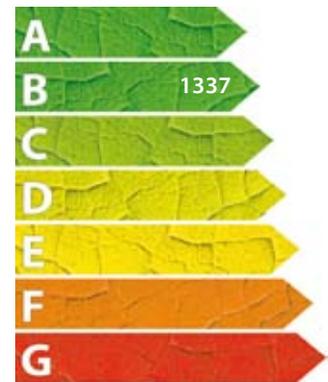
Overall Rating: **B**

HP's key green priorities are focused on:

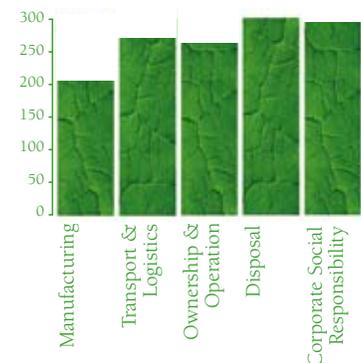
- Being transparent about product material content and working to eliminate materials shown to, or likely to, pose an environmental, health or safety risk
- Developing products that are smaller and lighter, resulting in a reduced transport burden
- Innovating to use new materials
- Using recycled materials
- Using materials that will be easier to recycle

HP achieved the highest overall score in the survey and led all other respondents in three of the five categories: Transport & Logistics (HP benefitted from its ability to provide data where other respondents could not), Disposal, and Corporate Social Responsibility. From the survey's perspective, HP sets itself apart through the green control that the company has on all aspects of its business. Much of this can be attributed to compliance requirements from the printer/cartridge division that feeds good practice across the corporation. HP has a metric in place for almost all of the areas surveyed and, in many of those cases, targets also exist.

Best Corporate Sustainability
Credentials



Worst Corporate Sustainability
Credentials



Computer Equipment Lifecycle
Survey Score

Manufacturing

Geographical Coverage

HP has a strong manufacturing presence in all key geographies. Production facilities are located in the US (Texas and California), Brazil, Germany, Ireland and Scotland. Most of HP's computer and imaging products are assembled in Asia, while a large proportion of sales are in Europe and the Americas.

Supply Chain

HP works closely with suppliers to quantify the energy consumed in manufacturing their products and associated greenhouse gas (GHG) emissions. The company estimates that these GHG emissions are of the same order of magnitude as the emissions associated with the energy used by HP products during customer use. By 2009, HP plans to report the energy use and associated GHG emissions of its first-tier suppliers representing more than 70% of materials, components and manufacturing supplier spending.

As the world's largest IT company, HP claims to have the industry's largest supply chain. The company acknowledges its responsibility to lead in this area and states that this responsibility is taken very seriously. Through its social and environmental responsibility (SER) program, HP is actively:²⁰

- Integrating social and environmental requirements into its sourcing operations
- Protecting workers' rights
- Improving suppliers' working conditions and health and safety
- Working to reduce suppliers' environmental footprint
- Collaborating with NGOs and other stakeholders to inform, improve and validate efforts

HP works to implement systems to achieve long-lasting improvements throughout the supply chain and requests that suppliers conform to the same rigorous ethical, social and environmental standards to which it adheres.

Energy Consumption and Resource Conservation

HP joined the Carbon Disclosure Project Supply Chain Leadership Collaboration in late 2007 to help develop a consistent and appropriate methodology for disclosing energy use and GHG emissions throughout the supply chain.

Notable HP Green Achievements include:

- In response to the Environmental Protection Agency's (EPA) challenge to Fortune 500 companies to double their purchases of renewable energy by the end of 2007, HP committed to increasing its renewable energy purchases by more than 350% during 2007. This was achieved by purchasing 50 million kWh of renewable energy credits in the US, representing approximately 2% of HP's worldwide energy consumption.
- In 2008, 80 million kWh, or nearly 90% of the electricity provided to HP operations in Ireland will be generated by Airtricity-provided wind turbines saving 40,000 metric tonnes of CO₂ per year.
- For 2008, Sun Power Corporation will install and operate 5,000 solar panels on the roofs of five buildings at HP's San Diego site, generating an estimated 1.7 million kWh of electricity.

Controlled Materials

Where applicable, HP-branded products fully meet the requirements of the European Union Restriction of Hazardous Substances (RoHS) directive, which restricts the use of lead, mercury, cadmium, hexavalent chromium, PBB and PBDE (polybrominated biphenyl and polybrominated diphenyl ethers) flame retardants. HP was one of the first companies to set and achieve a voluntary goal to comply with EU RoHS materials restrictions worldwide. Believing that it enables faster adoption to achieve the desired environmental benefits, HP promotes harmonization of material restrictions across different countries.

Over the last ten years, HP has proactively eliminated the majority of brominated flame retardants (BFRs) and polyvinyl chlorides (PVCs) from its products, with limited exceptions. For example, certain BFRs are still used in printed circuit boards due to the unavailability of suitable

alternatives and PVC is currently still used in cables. The survey notes that BFR and PVC have published phase-out dates of 2009.

Transport & Logistics

In-Transit

HP has estimated that the transport of its products creates roughly 2 million metric tonnes of carbon dioxide equivalent (CO₂e) emissions a year, which exceeds the emissions related to operating HP facilities. Most of these emissions are the result of international air freight, while roughly 25% is from road transport and parcel freight. Although ocean transport is used extensively, it is estimated that due to its energy efficiency, this accounts for less than 5% of the total emissions from logistics.

HP's strategy to reduce GHG emissions from logistics focuses on "modal shifts" away from air and road freight in favor of ocean and rail transport, and on improving loading efficiency. Other initiatives include:

- Optimizing the distribution network to decrease the distance from distribution centers to resellers.
- Converting to plastic pallets that are less than a quarter of the weight of wooden pallets, thereby lowering the energy required to transport them. This move resulted in saving 7,000 metric tonnes of CO₂e associated with notebook and camera shipments from Asia to Europe in 2007.

Although laptop and desktop devices were not considered for this survey, it is worth noting that HP has been shifting notebook PC transport from air to ocean freight. Each notebook PC shipped by ocean instead of air reduces GHG emissions by about 6kg of CO₂e.

Packaging

Material quantity and type, transport mode, and recyclability influence the environmental impact of HP packaging. HP packaging engineers address these factors by following these guidelines:

- Design to reduce packaging material use while protecting products.
- Eliminate the use of restricted materials such as lead, chromium, mercury and cadmium in packaging.
- Eliminate the use of ozone-depleting substances (ODS) in packaging materials.
- Design packaging components for ease of disassembly by the end-user.
- Maximize the use of post-consumer recycled content in packaging materials.
- Use readily recyclable packaging materials such as pulp, paper and corrugated materials.
- Reduce packaging size and weight to improve transportation fuel efficiency.

Logistics Provision

In May 2007, HP joined the SmartWay program. HP encourages all of its logistics service providers in the US to join SmartWay. As of February 2008, 77% had joined and HP's goal is to have 85% of its service providers signed up by the end of 2008.

Ownership & Operation

Power and Heat

HP has focused on improving product energy efficiency since 1992, when the Design for Environment program was launched. In 1996, HP established a Power and Cooling Team, and holds many patents in this area.

By 2010, HP aims to reduce the combined energy consumption and associated GHG emissions of operations and products to 25% below 2005 levels by achieving the following:

- Operations: HP will reduce energy consumption and the resulting GHG emissions from HP-owned and HP-leased facilities worldwide to 16% below 2005 levels.
- Products: HP will reduce the energy consumption of HP products and associated GHG emissions through specific goals for representative

product categories. In the case of high-volume server families, HP will improve energy efficiency by 50% relative to 2005.

HP offers over a thousand PCs, notebooks, monitors, and printing and imaging products that meet key eco-label programs. These include Electronic Products Environmental Assessment Tool (EPEAT™), ENERGY STAR®, Germany's Blue Angel, TCO (Sweden), China's Energy Conservation Program, Japan's Green Mark and Korea's Ecolabel.

Innovation

HP integrates energy-saving innovations across the spectrum of its products and services to help customers reduce their energy costs and GHG emissions. HP focuses on improving the efficiency of products that consume large amounts of energy and whose footprints are growing quickly due to the growth of the Internet and digital content, such as servers and datacenters. Particular focus is also placed on products that use relatively little energy – such as PCs and printers – because, in aggregate, these consume large amounts of energy worldwide each day.

Disposal

Compliance

HP complies with all applicable legislation including WEEE and RoHS.

HP-approved recycling vendors process obsolete IT equipment that customers have returned through HP take-back programs. The recyclers dismantle the recovered equipment and process components and materials to extract as much value as possible.

HP requires recycling vendors to meet HP-specific global recycling standards and policies as well as its general Supplier Code of Conduct. These standards and policies require vendors to store, handle and process equipment in ways that prevent the release of harmful substances and prohibit export of whole equipment or recovered materials without HP's approval. HP monitors compliance through site audits.

Recycling

The increase in the volume of recovered HP products accelerated in 2007, largely due to the implementation of the WEEE directive in Europe. Volumes also grew in the Americas and Asia Pacific and Japan. In 2007, HP collected approximately 3 million hardware units weighing 28,500 metric tonnes for reuse and remarketing.

HP offers recycling services in 52 countries or territories. Through collection services, HP has recycled more than 530,000 metric tonnes since 1987.

Including remarketed equipment, HP achieved a total reuse and recycling rate in 2007 of 15% of relevant hardware sales.²¹ While this metric seeks to account for the time difference between product sale and product return, HP recognizes the difficulty of matching returned product to the appropriate sales period, thereby affecting the accuracy of the calculation. Mixing recycling and reuse volumes also presents a challenge. Reused products and components have not yet reached the end of their useful lives, so including them can exaggerate the apparent impact of end-of-life programs.

HP will recycle any manufacturer's computer equipment as requested by the customer. In the US, HP uses three main recycling locations (Roseville, California; LaVergne, Tennessee; Meriden, Connecticut) and one main recycling facility in Canada (Brampton, Ontario).

With servers, HP achieves an average recycling rate of over 95% in Europe. This number is based on using best-in-class value recovery and processing equipment and an average mix of server products (some products are close to 100%).

Ethical Disposal

HP acknowledges that it cannot guarantee the ethical disposal of all HP hardware that enters the global domestic/home market. Where it can exert influence, in the enterprise space, HP ensures that all product disposal is compliant with local legislation (such as WEEE in Europe). The survey additionally notes that HP has a senior level Ethics and Compliance Committee that is externally audited.

Corporate Social Responsibility

HP publishes many policies to cover the whole scope of CSR. These include: Accessibility, Business ethics, Corporate governance. Customer engagement, Diversity, Environment, Global citizenship, Human rights, Labor practices, Privacy, Products and Supply chain.

HP has maintained a Corporate Supplier Diversity Program Office for more than 30 years in the US and belongs to more than 20 supplier diversity organizations in the US, Canada and Europe. Supplier diversity is mandatory for fulfilling contracts with the US government and with most US states and municipalities. In the US, the HP supplier diversity program supports minority-owned, woman-owned and veteran-owned businesses.

The HP supplier diversity program offers suppliers that would not typically approach HP the opportunity to join its global supply chain. HP is of the view that the promotion of diversity among suppliers brings fresh ideas, offers innovative products and processes, and contributes to the economic strength of their communities.

Corporate Citizenship

“Global citizenship” is one of HP’s seven corporate objectives reflecting the company’s long-standing commitment to making a positive contribution to the global community. Engagement with the communities and local leadership where HP employees live and work is core to HP’s philosophy and approach. HP employees are encouraged to apply their time and talent to help solve problems in their communities. HP also engages globally with various stakeholder communities to address issues related to the environment, economic development, digital divide, privacy and labor, and human rights.

HP’s environmental, health and safety, human rights and labor, data-privacy and supply chain policies are based on the following principles:

- Legal and Regulatory Compliance: Ensure products, operations and services comply with all applicable laws and regulations.

- **Continual Improvement:** Maintain an effective management system that is based on sound business and scientific principles. Integrate environmental, health and safety, human rights and labor, data-privacy and supply chain policies into the business and decision-making processes. Establish appropriate objectives and targets; regularly assess performance and practice continual improvement.
- **Information Access:** Provide employees, customers, shareholders, government agencies and the public with clear, accurate, and appropriate reporting about HP products, services and operations.

The survey also notes that HP and Sun Power Corporation offer incentives to US HP employees to install solar panels on their homes.

HP has a long history of working to improve the use of materials in its products and enhance its environmental and safety performance during production, manufacturing, distribution and, ultimately, disposal.

HP's overall commitment to environmental awareness is perhaps best represented by its ISO 14001 Global certification for manufacturing facilities and the company's status as a founder of the Electronic Industry Citizenship Coalition (EICC).

Editor's Note: Information on how HP calculates its recovery sales percentage can be found in the Endnotes section.



Partner Assessment: IBM

Overall Score: **1214**

Overall Rating: **B**

Green objectives, as outlined by the IBM Partner Stewardship Program:

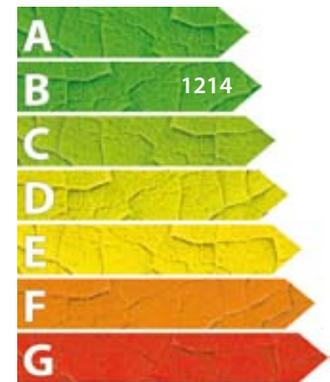
- Develop products that will provide improvements in energy efficiency and/or reduced consumption of energy.
- Develop products with consideration for their upgradeability to extend product life.
- Develop products with consideration for their reuse and recyclability at the end of product life.
- Develop products that can safely be disposed of at the end-of-life.
- Develop and manufacture products that use recycled materials where they are technically and economically justifiable.
- Develop products that minimize resource use and environmental impacts through selection of environmentally preferred materials and finishes.

As might be expected from an organization of IBM's stature, the company has a firm grasp of social and ecological policy as illustrated by the fact that elements of eco-policy have been present in the supply chain since the 1970's.

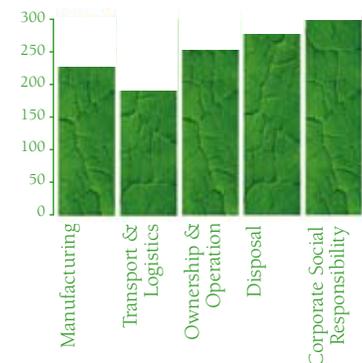
IBM's global presence resulted in a high score for questions related to manufacturing proximity to market and the company also recorded the highest percentage of recycled material within the manufacturing process. However, there is room for improvement in the supply chain – both in terms of improving the energy efficiency of the factory-to-datacenter journey and in implementing metrics to monitor such efficiencies. In other areas (such as renewable energy usage and recycling), IBM has very comprehensive – and publicly available – targets and metrics.

This report draws some information from the “IBM and the Environment

Best Corporate Sustainability
Credentials



Worst Corporate Sustainability
Credentials



Computer Equipment Lifecycle
Survey Score

Report” last published in 2006 and the “IBM Corporate Responsibility Report 2007”.

Manufacturing

Geographical Coverage

IBM has manufacturing/assembly sites in 8 countries (US, Mexico, Canada, Ireland, Hungary, France, China and Singapore). In addition, there are many fulfilment sites around the world at which testing may take place prior to delivery to clients.

IBM, along with many computer equipment manufacturers, considers the building of highly specialized facilities in many countries to be neither commercially nor environmentally effective. However, given its strong global presence with at least one manufacturing facility in each key geography (EMEA, the Americas, Asia-Pacific and Far East), IBM is able to ship relatively locally within a given region.

Supply Chain

IBM states that, when sourcing components, every endeavor is made to balance many factors including quality, reliability, cost, environmental attributes of the products/components, the environmental evaluation of suppliers, location, etc. However, due to the complexity of the supply chain and sophistication of Materials Requirement Planning (MRP) systems, it is not considered commercially practical for IBM to implement policies to always source components locally.

The survey examined each partners’ approach to measuring and monitoring the supply chain for its hardware product sets. IBM’s comprehensive baseline environmental requirements are detailed in the publicly available Engineering Specification ES 46G3772²² and the company’s overall environmental impact is measured by its Environmental Performance Database (EPD) which, at present, is published internally only.

The survey notes IBM’s long-standing commitment to ensuring environmentally conscious practices through the supply chain. In 1980, the company, as part of its global environmental management

system (EMS), expanded its environmental evaluation of suppliers to include production-related suppliers. On-site evaluations take place periodically to ensure compliance with environmental best practices and legislation.

Energy Consumption and Resource Conservation

IBM is a charter member of the World Resources Institute Green Power Market Development group, a voluntary partnership that promotes cost-effective renewable energy.

Notable IBM Green Energy Achievements include:

- IBM's worldwide use of renewable energy increased from 2.7% in 2005 to 7.3% of worldwide electrical usage in 2006, indicating a year-on-year increase of 180%.²³
- IBM featured among the top 20 renewable-energy purchasers on the 2006 Environmental Protection Agency (EPA) Green Power Partners List and received a Green Power Leadership Award.
- From 1990 through 2006, IBM saved 4.5 billion kWh of electricity consumption, avoided nearly 3 million metric tonnes of CO₂ emissions (an amount equal to 44% of the company's 1990 global CO₂ emissions), and saved over US\$290 million through its annual energy-conservation actions.

In 2000, IBM's semiconductor manufacturing operations established an annual water savings goal of 2% of total water usage. Over the past five years, IBM has exceeded this initial target by saving an average of 7%.

Controlled Materials

IBM prohibits the use of mercury, cadmium, chromium and brominated flame retardants (polybrominated biphenyls and polybrominated diphenyls ethers) in its manufacturing processes and products (with the exception of some allowable RoHS exemptions for critical applications). There is some PVC in the cables and cords procured.

Transport & Logistics

In-Transit

The distance travelled by hardware products by road, rail or air between the manufacturing facility and end-user floor is not routinely monitored by IBM and, as such, data is not currently available. However, participation in the US EPA's SmartWay Transport Partner program represents, at least in the US, a corporate intention to improve IBM's logistical operations and organization.

Packaging

IBM developed its Packaging Guidelines in 1990. These guidelines encourage keeping packaging to a minimum and, whenever feasible, to be composed of recyclable and/or reusable materials. Updated regularly and extended to suppliers and business partners, the guidelines prohibit the use of ozone-depleting chemicals, heavy metals, polybrominated biphenyls (PBBs) and polybrominated biphenyl oxides (PBDEs).

Logistics Provision

IBM operates globally and has multiple logistics providers. IBM encourages, but does not require, all of its suppliers to obtain ISO 14001 certification. In considering key environmental aspects of logistics, IBM's expectations regarding energy efficiency and climate protection for logistics suppliers are represented by the company's participation in the US EPA SmartWay Transport Partner program – the requirements of which are to be extended to logistics suppliers worldwide.

Ownership & Operation

Power and Heat

IBM has published data on power reduction across its server range. The "IBM and the Environment 2006 Annual Report" claims a 19% reduction in operating power consumption for System Z. Reductions for System P and System I platforms measured 10.4% and 15.8% respectively."²⁴

Support

IBM is moving towards an increased remote support model. The survey also acknowledges the research work that IBM is undertaking with the IEEE relating to autonomic computing.²⁵ This report and initiative represents IBM's belief that IT's continued growth in both size and complexity threatens to hamper the growth of IT due to the associated high costs required to support it. IBM's self-managed autonomic technology claims to enable a fluid response to change through computing systems that are capable of self-management and identification and resolution of problems prior to their discovery by IT personnel.²⁶

Power Management

IBM's recent development, the IBM POWER6™ microprocessor chip, supports advanced, dynamic power-management solutions that facilitate both management of the chip and of the entire server.²⁷ IBM claims that this enables a programmable power-management solution that can also be integrated into system- and datacenter-wide management solutions.

Innovation

As with the majority of Capgemini's technology partners, IBM invests significantly in the improvement of technology deployed around cooling and energy consumption (in IBM's case, this investment appears to be particularly focused on cooling). Notable developments include:²⁸

- Calibrated Vektored Cooling (CVC)²⁹
- Liquid cooling on blades and enterprise systems³⁰
- Water-cooled 3-D processors (with Fraunhofer Institute)³¹
- Rear-door heat exchangers
- Power6 processor power-management³²

Disposal

Compliance

IBM complies with all applicable legislation including WEEE and RoHS.

Recycling

IBM's Product Stewardship program spans the lifecycle of IBM products

– from design for environment through product end-of-life management (PELM). The company’s PELM operations date back to the mid-1980s when the company first began emphasizing environmental considerations in those operations related to the management of the product end-of-life of their own equipment and of IBM equipment returned on conclusion of lease agreements. As part of its PELM activities, IBM began offering product take-back programs in Europe in 1989 and, since then, has extended and enhanced these programs. IBM’s Global Asset Recovery Services organization offers Asset Recovery Solutions to commercial customers in 55 countries.

In 2006 IBM’s PELM operations worldwide processed 49,083 metric tonnes of end-of-life products and product waste. This represents 49% of the estimated 100,000 metric tonnes of new IBM IT equipment manufactured and sold in 2006.

Ethical Disposal

The survey notes IBM’s long-standing commitment to doing business with environmentally responsible suppliers and recognizes the company as an early leader in implementing requirements addressing this topic through the company’s global environmental management system. As long ago as 1972, a corporate directive requiring the environmental evaluation of suppliers of hazardous waste services was established. In 1991, this evaluation was extended to incorporate product recycling and product disposal suppliers.

In 2002, IBM expanded its environmental evaluations of product recycling and disposal suppliers to include a requirement to assess suppliers and certain subcontractors used to handle recycling and/or disposal operations in non-OECD countries.

Corporate Social Responsibility

Staff Welfare and Representation

IBM has a number of staff representative bodies across the globe – some of which apply only to specific geographies. These include the “Open Door”, “Panel Review” (US only), and “Confidentially Speaking” programs.

IBM policy encourages employees to communicate any questions and/or work-related issues to management and typically provides several options to initiate a thorough investigation of any grievances on those occasions when resolution between employee and manager cannot be reached.

Certain geographies have works councils while in others, staff bodies, composed of elected members, exist and are periodically scrutinized by independent professional bodies. The survey notes IBM's Innovation Jam initiative which is open to the families of employees.

IBM considers itself to be a leader in programs that facilitate employee work/personal life balance. In addition to the provision of child and elderly care programs, these include work-from-home, mobile-employee, job-sharing and flexible work-schedule initiatives. IBM has been recognized by Working Woman Magazine as one of the "100 Best Workplaces for Working Mothers" for 22 consecutive years.

Corporate Citizenship

Although not a signatory of the UN Global Compact, IBM expressed the view that the environmental, labor, anti-corruption and human rights principles addressed by the UNGC are met or exceeded by IBM policy.

The survey notes that IBM's "first environmental and energy conservation policies date back to 1971 and 1974 respectively, and programs supporting them have been embedded within IBM's global environmental management system (EMS) since that time. The policies have been a cornerstone of IBM's energy management and climate protection programs."³³

The survey also notes that IBM, through its "IBM and the Environment" report, measures a considerable amount of activity across manufacturing and business operations and reports publicly on an annual basis. All of these are measured against targets that are being met and/or exceeded. IBM has set itself a target of 12% CO₂ reduction by 2012.

The company's approach is to set specific goals and objectives and to implement programs that are:

- effective in achieving a measurable reduction in its greenhouse gas (GHG) emissions

- sustainable and capable of being deployed globally in a fashion consistent with the requirements of the IBM global environmental management system.

The survey notes the following from IBM's annual environmental report (2006): "In 1997, IBM became the world's first major multinational to earn a single global registration to the ISO 14001 Environmental Management System Standard. The registration covered IBM's manufacturing, product design and hardware development operations across its business units worldwide. IBM has since expanded its global ISO 14001 registration to include chemical-using research locations. Some IBM country organizations have also obtained ISO 14001 registration covering their non-manufacturing locations."³⁴

Editor's Note: IBM has issued a disclaimer which can be found in full in the Endnotes section.



Partner Assessment: Sun Microsystems

Overall Score: **1258**

Overall Rating: **B**

Sun Microsystems' key environmentally focused priorities are:

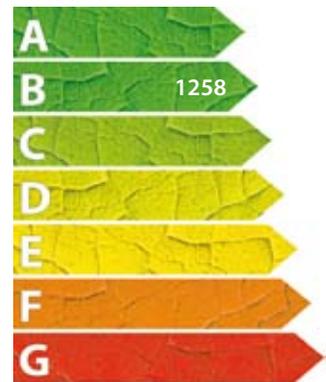
1. Continue to develop eco-friendly processors, systems, programs and services that help reduce power consumption, environmental impact and energy costs.
2. Deliver on Sun's commitment to the Environmental Protection Agency (EPA) to reduce its greenhouse gas (GHG) emissions in the US by 20% by 2012 (against a 2002 baseline).
3. Strengthen Sun's global product take-back program, including data collection and reporting.
4. Continue to develop working practices, technology and sponsorship to enable resource conservation across Sun's internal operations.
5. Determine the feasibility of measuring GHG emissions within the supply chain.

Sun Microsystems demonstrated contrasting approaches to sustainability. Though the company achieved the best score on Ownership & Operation, backing up Sun's own assertions around the efficiency of Chip Multithreading technology (CMT). However, its commitment to renewable energy consumption was, in some cases, poor – especially at outsourced manufacturing facilities.

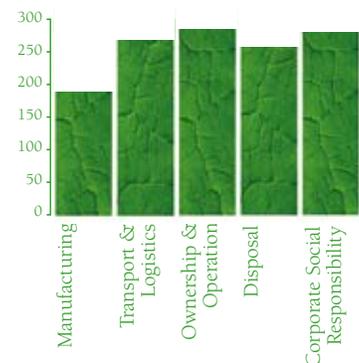
Sun has initiated a review of its transport and logistics processes and, as a result, has recently started to reduce its air and road shipping in favor of greater emphasis on optimizing shipments by sea and rail.

Sun's CSR policies (which encompass power usage, renewable energy, waste management, etc.) are based on three pillars: Innovate, Act and Share. Many of the policies which “hang” on these pillars reflect standard industry practice but there are notable – and innovative – exceptions. Sun's “greening the datacenter” initiative is demonstrated not just through

Best Corporate Sustainability
Credentials



Worst Corporate Sustainability
Credentials



Computer Equipment Lifecycle
Survey Score

energy-efficient product lines but also through the achievements of the redesign of the company's own datacenters. Additionally, Sun has initiated programs such as "Design for Environment" that incorporate eco-friendly principles into the design of all products and packaging. Sun has made some bets (and spent a good deal of its Research & Development budget) on the power efficiency of its products.³⁵

Manufacturing

Geographical Coverage

Sun has a global manufacturing presence. The production of low-end products for Europe, South America, Canada and the US takes place in South-East Asia and Mexico. Mid-range and enterprise-level servers are manufactured in the US (Oregon) for the domestic and South American markets and Europe is served by the company's Scotland-based manufacturing facility. Demand from the Asia-Pacific region for low-end products and mid-range and enterprise-level servers is satisfied by the South-East Asia manufacturing facilities.

In the manufacturing process, Sun generally uses recycled plastics and aluminum. However, the major components of a new system (CPUs, memory, disks, mother boards, etc) are all brand new. Sun states that this enables improved ability to guarantee that products are ROHS-compliant. Additionally, Sun serves large military and intelligence communities that place restrictions on the use of recycled hardware, thereby limiting the extent to which Sun can incorporate recycled materials into the manufacturing process.

Supply Chain

Due to the complexity of the IT supply chain, Sun does not have a policy on sourcing constituent components locally. However, Sun requires that all suppliers adhere to the Sun Code of Conduct, which was developed in accordance with the Electronic Industry Citizenship Coalition's (EICC) Electronic Industry Code of Conduct. In addition to requiring that suppliers abide by its Code of Conduct, Sun also mandates that contract suppliers meet the internationally recognized environmental standards of ISO 14001. To date, 100% of Sun's contract manufacturers have achieved ISO 14001 certification.

Energy Consumption and Resource Conservation

Sun is gradually increasing the use of green energy at all of its facilities. At present, the manufacturing of low-end servers is totally outsourced and, as such, green energy programs are not yet being driven there.

As part of the US EPA's Climate Leaders program, Sun has committed to a 20% reduction of its US GHG emissions over 2002 levels by 2012. In order to achieve this aggressive GHG reduction goal, Sun has formulated the following strategy:³⁶

- Continue to analyze its 2002 baseline GHG emissions data (estimated at 263,465 metric tonnes), on which the 20% reduction goal is based
- Establish tracking systems to capture and measure Sun GHG emissions, and report the findings publicly against a baseline
- Continue to reduce energy usage in Sun datacenters, converting them into eco-responsible facilities
- Develop an alternative energy strategy.

Sun's metrics and reporting standards are built around the definitions of the Global Reporting Initiative (GRI).

Sun has made significant water-use reductions at assembly facilities. As with green energy programs, water-reduction initiatives are not yet being driven at outsourcing partner's manufacturing sites.

Sun has year-on-year targets for water-use reduction within its ISO 14001 facilities and water-minimization strategies at all other sites. Sun is in conversation with tier-one suppliers under the EICC for water-conservation strategies.

Controlled Materials

At the beginning of 2007, Sun globally eliminated the use of mercury, cadmium, chromium, brominated flame retardants (BFRs) and polyvinyl chloride (PVC) from its products and no longer uses them within manufacturing and assembly processes. However, Sun notes that it cannot account for the chemical use in processes for component parts such as chip manufacturing.

Where possible, Sun has started replacing all of the plastics within the manufacturing process with metals or other recyclable materials. In addition, since 2006, Sun no longer paints the outer panels of servers, preferring to use exposed aluminium instead. These initiatives have both a direct impact on product manufacture and disposal (reducing effort and cost) and an indirect impact on product design (where a more efficient thermo-dynamic can be applied).

Transport & Logistics

In-Transit

Sun has recently started to reduce its air and road shipping in favor of greater emphasis on optimizing shipments by sea and rail. In common with other Capgemini partners, Sun does not have aggregate data for distance travelled and mode of travel for its whole product line.

However, with facilities located in each major geography and items shipped directly to the customer, Sun has assumed that products currently encounter one truck and one plane between factory and end-user.

Packaging

Sun has taken an active policy decision to evaluate its packaging strategy and has developed and implemented an action plan to address any potentially negative environmental impact of packaging and to incorporate eco-responsibility principles.

This evaluation considers everything from labeling and cardboard weight to recyclability. Sun already uses recyclable, unbleached cardboard and has worked with packaging engineers to test new materials such as biodegradable foam. The main difficulty faced by Sun is that its supply chain strategy is designed to deliver products to customers using the most direct route possible from the factory to the datacenter floor. This means that orders with parts produced in multiple locations are not shipped together and so may be received by Sun's customers in many boxes, each made from cardboard and containing foam inserts.

The survey notes that Sun is willing – as a part of a formal relationship – to take back all packaging from a customer and incorporate it into the recovery and recycling processes.

Sun is registered in the UK with the Scottish Environmental Protection Agency and reports on an annual basis on the recovery and disposal of all non-product waste (packaging, etc.) in Scotland. For Q1 and Q2 of 2008, the company's recycling was 24%-30%.

Ownership & Operation

Power and Heat

Along with performance, price and reliability, energy efficiency is one of Sun's core design targets for all products. Sun has an apparently unchallenged claim to have the most power and heat-efficient servers in the market. It is claimed that the UltraSPARC T1 processor with CoolThreads™ technology uses less than half the power of standard processors – just 72 watts, or about the same as a single incandescent light bulb.³⁷

Support

Sun provides extensive maintenance and monitoring services over the network and estimates that over 90% of preventative and maintenance functionality can be performed remotely. However, Sun notes that “We can't swap a bad component over the phone.”

Power Management

Sun has many power-saving features in its systems which “kick in” automatically (such as load-sensitive fans, the ability to turn off parts of processors). However, Sun would not recommend that a server be set to sleep or hibernate except under the control of a master management system. Sun technology is capable of putting servers to sleep based on its “lights out management” processor and external managers which function separately from the main system processor and is able to boot and power the main system on and off separately.

Sun claims that the next generation of Sun products will be capable of monitoring energy consumption at component level.

Innovation

Sun has made significant investment in research and development into power management, including component-level power management of microprocessors, memory devices, power supplies, and fans, as well as service processor firmware and operating system software. Sun is developing technologies that will make individual components and entire systems self-calibrate their energy consumption so that it is proportional to the demands of the workload.

In response to escalating power demands and costs, Sun has redesigned its California datacenter in order to more efficiently concentrate power and cooling energy on server modules or, in Sun terminology, “pods.” Combined with consolidation and virtualization programs, the rewards are lower energy costs in a very short ROI period and a more agile datacenter, capable of adapting to changing business requirements.

Disposal

Compliance

Since July 2006, all products shipped by Sun are RoHS compliant.

Recycling

Sun has a “take-back” program for the Americas in California, EU in the Netherlands, and for Asia-Pacific in South-East Asia. Sun will take any product back anywhere in the world for free. The only cost applicable to the customer may be shipping, which applies on a case-by-case basis (but will generally apply outside the EU). Sun is also expanding its network of take-back centers. At present, less than 5% is thrown away, with the remainder reused (either through refurbishment system or spares).

Ethical Disposal

Sun notes the challenges of ensuring an ethical process is maintained throughout a complex and multi-tiered disposal chain. As an organization, Sun is implementing increasingly strict disposal procedures.

Sun's entire disposal process is performed according to ISO 14001 standards. However, Sun notes that end-of-life product may travel some distance to an ISO 14001 site where it can be guaranteed that disposal takes place in line with the highest and most ethical standards.

Corporate Social Responsibility

Staff Welfare and Representation

Sun has employee representative councils in all major countries and in supranational communities such as the EU.

Corporate Citizenship

Sun works with customers on energy/carbon reduction projects, but does not monitor whether they have specific goals or plans. On request, Sun will provide customers with extensive data concerning energy use and carbon emissions of systems and can work with clients to evaluate the impact on their overall emissions.

Sun is a signatory to the EICC and has changed the terms and conditions applicable to all tier-one suppliers to include conformance to, and audit of, the EICC which encompasses labor rights, working conditions, environment, health and safety (EHS) and business ethics.

Sun is a large consumer of goods and services. As such, it recognises the positive impact it can have on the way its suppliers operate, thereby increasing the company's ability to create positive environmental and social change. Toward this end, Sun has begun to incorporate eco-responsibility principles into its sourcing decisions in four areas: office supplies, business travel, car rental/leasing and hotels. The objective is to reduce Sun's own environmental footprint while influencing and encouraging suppliers to adopt better environmental practices. The survey also notes Sun's Open Work Energy Measurement Project – a project devised to measure the full impact of flexible working.

With the aim of promoting employee participation and innovation, Sun has established its Sun Microsystems Foundations Ambassadors Program. There are more than 35 Sun Foundation Ambassadors around the world

residing in Australia, Canada, China, Germany, Hong Kong, India, Singapore, Spain, the UK, and the US.

Editor's Note: Sun Microsystems has issued a disclaimer which can be found in full in the Endnotes section.



Conclusions & Recommendations

The IT industry has, for some time, recognized the environmental impact it could potentially have – from manufacturing to disposal. The major manufacturers have been active in their attempts to limit this impact. This awareness was present years before terms such as green IT and CSR entered the business vocabulary. These steps span the product lifecycle and include:

- Regulation and recycling of electricity and water during manufacture.
- Ethical policies around the supply chain.
- An increasing, though as yet immature, awareness of a requirement to make transport and logistics policies greener.
- Investment in research and development aimed at reducing power consumption and heat emissions of server and storage products.
- Reuse and recycling of the vast majority of end-of-life product.
- The use of “alternative” power sources to meet demand at manufacturing and administrative centers.
- Participation in, and founding of, industry and regulatory bodies to drive improvement and policy transformation in many areas of environmental protection.

Despite their best intentions, most surveyed partners highlighted the difficulty in extending their own green or sustainability policies throughout the supply chain due to its complexity. In addition, with regards to reducing the distance from point of production to end-user, surveyed partners expressed their agreement with delivering as locally as possible, wherever feasible. However, the view was also expressed that it is neither commercially viable nor environmentally friendly to have in-country manufacturing sites in all major markets.

Across the Capgemini partner base, there are variations in how CSR and ecological challenges are being tackled. Additionally, there are

observations to make on partners' approaches to sustainability and on how the industry as a whole is reducing its carbon footprint. These are documented here:

1. All surveyed partners lack meaningful metrics on their logistics operations. It proved difficult to determine the carbon footprint of those transport operations that have been outsourced. HP has the strongest policies around transport and logistics (notably, its intention to move as much as possible from air to sea transport).
2. Across all industries (public and private), IT companies are among the leaders in carbon reduction and green power (power procured from renewable energy sources). For example, Intel is the largest consumer of green power in the US and Cisco is eighth (for year-end April 2008).³⁸
3. Despite the positive environmental impact that the many initiatives are having, the IT industry's carbon footprint is expected to grow. However, if this growth enables greater carbon footprint reduction across all other industries, this must be considered a good thing. Examples of the way in which IT helps to drive carbon footprint reduction across other industries include: teleconferencing to reduce corporate travel; supply chain systems to reduce truck journeys; building control systems to reduce air-conditioning usage, etc.
4. As power and cooling costs rise and servers become more power efficient, the business case for more frequent technology refreshes will be easier to make. In other words, the total-cost-of-ownership (TCO) consideration becomes a more compelling argument than the capital-expenditure argument (which will also drive the case for utility-based computing). However, conversely, increased technology refresh cycles will add to the amount of hardware subject to WEEE legislation.
5. In the US, there are many industry-convened organizations and voluntary codes of practice driving the IT industry to be greener. In Europe and Asia-Pacific countries, this activity is considerably

- more legislated (as well as self-policed). However, it is not clear if all manufacturers are manufacturing all product to the highest common standard (typically, European WEEE and RoHS directives).
6. There is still much discussion and little agreement within the industry regarding how best to measure the full lifecycle impact of its products on the environment. However, the sector is hungry for a comprehensive lifecycle metric and organizations, such as the EICC, are working towards this aim.
 7. All of Capgemini's partners are actively engaged in community projects, encourage employee participation in the local community, and have genuinely philanthropic aspirations from the top down. It is also worth mentioning that all of those individuals who participated in this survey (and are leaders in their company's CSR groups) are passionate about what they do.
 8. There is little consistency in the way hardware companies measure, report and target their resource usage. Most will have headline targets on CO₂ reduction but few have greater granularity on these targets (for example, on elimination of controlled substances or on water reduction). In some cases, websites where CSR policy is outlined and resource usage is reported are out of date by a year or more.
 9. Hardware manufacturers are marketing green IT on three key topics:
 - Cost savings through more efficient IT.
 - Direct impact on carbon footprint reduction. (Indirect impact is using IT to regulate and administer other carbon footprint initiatives).
 - Ability to expand capacity in datacenters where power supply is limited.
 10. Regardless of the decision taken by a corporate executive on IT hardware deployment, there will be an environmental impact.³⁹ A decision to remain on older hardware means continuing to consume more power/emit more heat/require more air conditioning,

than would be the case if a decision were made to upgrade to newer, more efficient technology. However, upgrading to newer technology results in more resources used during the manufacture of that hardware and the imposition of the legislative requirement to dispose of equipment. (In fact, as equipment becomes more efficient, it is probable that the manufacture and disposal processes will consume more electricity than the equipment will use in its lifetime).

Recommendations to Technology Partners and IT Manufacturers

There is clearly a requirement for hardware manufacturers to understand more about their transport and logistics operations. Some organizations and professional bodies are addressing some aspects of transport but there is no overall view of the journeys made/warehouses used by hardware products and their components. The industry needs to use and influence organizations such as the EICC and/or the Environmental Protection Agency's (EPA) SmartWay program to build an agreed comprehensive and standard metric to measure factory floor to datacenter floor environmental impact. Furthermore, output from this work needs to be globalized, not restricted to US-based activity.

Capgemini partners and hardware manufacturers need to be braver in publishing a comprehensive set of metrics on environmental impact, setting themselves targets on such metrics and reporting on the progress against such targets. Most partners publish some data on some areas (such as water usage in manufacturing or corporate recycling). IBM's annual CSR report, "IBM and the Environment" sets the benchmark for such reporting although even IBM itself has more data to report.

Most of Capgemini's technology partners market around datacenter efficiency, extolling the virtues of greener server and storage devices. However, there is little guidance on migrating from legacy datacenters full of various ages and types of servers to a Sun or Intel-style modular datacenter. The industry needs to provide solutions to aid migration to eco-efficient datacenters.



Processors and Datacenters in the Future

In conducting this research, Capgemini took the view that the value provided by a server manufacturer – certainly, from the perspective of this survey – is the innovation and intellectual property that are “wrapped around” the processor.

That said, the developments in processors in recent years and the development dollars that continue to be deployed on improving the power efficiency of CPUs should not be ignored.

As Gordon Moore foresaw, for many years the Research and Development objective of the main chip manufacturers has been to make chips denser, thinner and more agile. One of the key challenges in this task has been controlling the amount of heat generated and power consumed by these increasingly powerful products.

In the datacenter, the leading chip manufacturers (and those that use exclusively manufactured OEM product) have all marketed their latest processors primarily on their low power consumption and heat omission or, conversely, more throughputs for the same power consumption.

Intel has recently announced the world's first 45 nanometre (nm) transistor (Hi-k next-generation Intel® Core™ 2 and Intel® Xeon® processor families) and the development of the 32nm transistor. Both will be the basis of the next and future generations of Intel server and high-end PC processors. Energy efficiency was central to the 45nm chip launch message. The Intel white paper “Introducing the 45nm Next-Generation Intel® Core™

Moore's Law Demonstrated	
2004	2007
5.1M bops	5.1Mbops
6 Racks	1 Rack
126 Servers	17 Blades
240 sq ft (22.3 m ²)	40 sq ft (3.7 m ²)
48kW	6kW

Source: Intel “The Energy Efficiency Opportunity”⁴⁰ - Comparison of SPECjbb2005 bops (business operations per second)

Microarchitecture” introduces two processor-level energy-efficiency features, Deep Power Down Technology and Intel® Dynamic Acceleration Technology – aimed at improving power consumption/battery life and performance of the servers in which they are deployed.⁴¹ The launch of the 45nm transistor was very much led by a green message. Intel announced that the new product set would provide “breakthrough levels of energy efficiency” on a “100% lead free” platform.⁴²

Intel® Centrino®, the recently released long-awaited follow-up to the market-dominating Intel® Centrino® mobile technology notebook features significant reductions in power required as well as advanced active battery management. Intel has formally launched its new System-on-a-Chip (SoC), range of embedded processors combining what was previously several processors with different functions into a single chip boasting both reduced footprint and power consumption.

Sun Microsystems – a long-time champion of green computing, continues to develop its SPARC-based multi-core, multi-thread (CMT) processors. In marketing its range of servers around CMT, branded as CoolThreads™ servers, Sun has placed power efficiency at the center of the sales messaging. Sun’s executive vice president of the systems group, John Fowler, notes that performance of Sun’s CMT processors has “increased more than five times from generation to generation, maintaining the same footprint while improving on ... power efficiency and price performance.”⁴³

More recently, IBM announced that in the company’s development labs in Switzerland “tiny rivers of water are cooling computer chips that have circuits and components stacked on top of each other, a design that promises to advance Moore’s Law in the next decade and significantly reduce energy consumed by datacenters.”⁴⁴

Today, IBM’s POWER6 microprocessor provides real-time access to detailed power and thermal management information – marketed as EnergyScale™.⁴⁵

AMD, meanwhile, has associated power efficiency with all of its products and, in a recent white paper, has linked the decline of the mainframe and

the rise of industry-standard chipsets with the rise of power consumption and consequent increased energy costs.⁴⁶

So what does all of this mean?

Firstly, all of the major processor manufacturers are competing not on the basis of “smaller”, “faster”, and “cheaper” as they previously had. While these factors still apply, in today’s race, the challenge has widened to include building “cooler”, “cleverer”, and “cleaner” products.

Secondly, it is not just about marketing – all of the relevant Capgemini technology partners channel significant funds – amounting to billions of dollars – into the development of power-efficient, eco-friendly chips.

Thirdly, the constant pursuit of Moore’s Law will not result in fewer, smaller datacenters. On the contrary, the increased penetration and capability of information technology will actually drive a demand for more datacenters.

Digital Realty Trust – a global technology-related real-estate company – recently published a survey of US firms showing that:⁴⁷

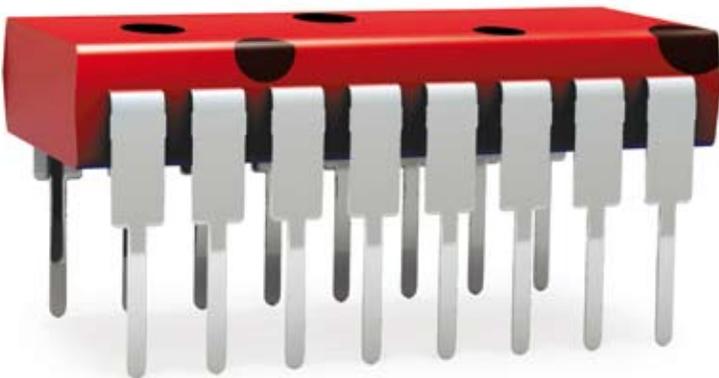
- 86% of respondents in the 2008 study will definitely/probably expand their number of datacenters in the next 12 months, indicating an active phase of datacenter development during the second half of 2008 and first half of 2009.
- 45% of respondents plan to expand in three or more locations. This is an increase of nearly 20% over 2007 indicating that the scope of datacenter projects has increased along with the number of projects.
- Planned square footage required for an average expansion site increased by 50% from 10,000 square feet (929 square meters) in 2007 to 15,000 square feet (1393.5 square meters) in 2008 – another indication that the scope of datacenter projects has increased significantly in the past year.

The same survey also indicated that:

Among companies that are planning datacenter expansions:

- 83% plan to expand physical space
- 77% plan to expand power capabilities
- 76% plan to expand cooling capabilities

So, while the number and size of datacenters is expected to rise, the emphasis will be on achieving greater energy efficiency through datacenter design. Sun and Intel have completely redesigned their facilities in California and Oregon respectively with the focus on concentrating power and cooling energy on server “modules” or, in Sun’s terminology, “pods”. IBM, meanwhile, has launched its “Big Green” initiative with the aim of achieving increased energy efficiency in the datacenter. A first central component of this initiative will be the opening of the company’s Research Triangle Park datacenter in late 2009.⁴⁸



10 Steps to Green IT

Many business executives recognize the need to act on carbon footprint reduction and green IT. However, a myriad of information exists – some of it contradictory – and it can be difficult to determine where to start.

Capgemini presents a 10-step guide to formulating a green IT strategy.

- 1. Implement an active Corporate Social Responsibility function.** Your company should have an active Corporate Social Responsibility (CSR) function with comprehensive policies that include ethical supply chain management to ensure that the IT procurement strategy is compliant with local legislation and is ecologically robust. This function should have executive sponsorship as, without this, any of the following steps will prove difficult, if not impossible, to achieve.
- 2. Benchmark your company's carbon footprint.** Consider aspects such as lighting, heating, air-conditioning, datacenters, car and truck fleets (mileage and carbon emission), business travel, vending and recycling. Determine a realistic benchmark and then set attainable but aggressive targets (perhaps over five or ten years).
- 3. Benchmark the PUE (Power Usage Effectiveness) of the datacenter.** This is the ratio of power entering the datacenter used to power the IT hardware, and is an established metric for datacenter efficiency. For more information on PUE, see the Green Grid white paper, The Green Grid Data Center Power Efficiency Metrics PUE and DCiE.⁴⁹

4. **Ensure IT and business work together.** The pursuit of green IT cannot come at the expense of business needs. Instead, a green IT strategy should fit within, and be aligned with, business needs. Business, however, should understand the potential benefits of pursuing green IT, such as cost-efficiency creation and improved workplace practices. A shared approach is necessary to ensure both green IT and business objectives can be pursued simultaneously and for mutual benefit.
5. **Make achieving targets everyone's responsibility.** Use the company intranet or notice boards to publish regular updates on progress against targets and advise on simple, achievable steps (e.g. recycling, turning off PCs before leaving in the evening).
6. **Consider the whole product lifecycle when contemplating technology upgrades.** While newer hardware will be more energy efficient, is this enough to outweigh the environmental impact of disposing of old hardware, manufacturing new hardware, and having it transported to your facilities? Any decision will have an environmental impact. Consider all of the factors to make a green decision.
7. **Work with suppliers to improve your IT carbon footprint.** Talk to your hardware suppliers and, if relevant, your datacenter services supplier. This should be more than a cost-based, procurement conversation. Determine what part they can play in improving your IT carbon footprint. Remember, there are benefits in it for them if they can cite your green credentials as a success story.
8. **Understand that more IT does not mean less green.** An increase in IT spending and the IT infrastructure does not necessarily mean a larger carbon footprint or a more negative environmental impact. For example, investing in video-conferencing technology and collaboration-enabling software, such as Google Apps, can help to reduce international travel. In the office, thin-client desktops or PCs enabled with Intel® vPro™ technology can reduce power consumption and noise while control systems can regulate heating, lighting and air-conditioning, thus reducing energy consumption and costs.

9. **Take a position on new technology.** Cloud and utility computing, virtualization, Software-as-a-Service (SaaS), Desktop-as-a Service and open source software represent technologies that serve business needs first, yet are also greener than existing technologies. Thin-client desktops and SaaS, for example, reduce the amount of power consumed, and volume of physical hardware and software produced and shipped. From a business point of view, user mobility is increased and data is centrally stored, better controlled and more secure.

10. **Consider enlisting help.** Investigate whether a body dedicated to sustainability already exists in your company's industry sector. It may be able to provide guidance in setting and realizing green goals. In the absence of (or in addition to) industry-specific bodies, there are many organizations that can help:
 - Specialist carbon-benchmarking organizations. In many regions, this may be a service available through national or local government. Otherwise, there is a growing number of companies able to offer specialist services.
 - Business consultants, technology consultants and outsourcers, such as Capgemini, who can provide guidance on appropriate business practice and technology deployment.
 - Governmental bodies such as the US Environmental Protection Agency (EPA) and quasi-governmental bodies like the Carbon Trust in the UK.
 - Utility companies often have energy-conservation advisors who can be engaged to advise on practices, green energy tariffs, etc.
 - Datacenter infrastructure specialists can advise on getting the best out of your datacenter. Sun Microsystems customers can request information on their own datacenter efficiency programs from account managers.
 - See the Industry Bodies & Regulators section for a list of many more organizations that can help.



Acknowledgements

Capgemini would like to thank all partners that elected to participate in the development of this paper. Completing such an extensive survey (among the many requests they receive for this type of data) is a time-consuming task and Capgemini expresses its gratitude for the time and effort invested by each participating company.

Capgemini also acknowledges that, while most of our partners were not entirely in agreement with the methodology used in all categories, most agreed to participate. Their reservations are pointed out in the Endnotes section of this report. In particular, Capgemini acknowledges the contributions of:

EMC

Kevin Biernacki
Rod Littlehailes
Ger Lyall

Intel

Tracy Nicholson
Robyn Shean
Mark Spargo

Google

David Chalmers

HP

Zoe Oates
Evelyn Sutherland
Bruno Zago

IBM

Steve Bushnell
Mick Walker

Sun Microsystems

Richard Barrington
Jim Craig
Dave Douglas
Marcy Lynn
Dean Nelson
Nick Robinson
Gilles Vernet



Industry Bodies & Regulators

There are many industry bodies, organizations, initiatives and programs around the world dedicated to regulating, reducing, monitoring and measuring carbon footprint in one way or another. Some of these are referenced in this document and so a brief explanation of what they are and what they do has been provided.

	AMD	Cisco	Dell	EMC	Google	HP	IBM	Intel	Sun Microsystems
Carbon Disclosure Project			✓	✓		✓		✓	
Climate Savers Computing Initiative			✓		✓	✓		✓	✓
Electronic Industry Citizenship Coalition (EICC)	✓	✓	✓	✓		✓	✓	✓	✓
ENERGY STAR Partner	✓	✓	✓			✓	✓	✓	✓
EPA - Climate Leaders	✓	✓	✓	✓			✓	✓	✓
EPA - Green Power Partnership		✓	✓			✓	✓	✓	
EPA - SmartWay			✓			✓	✓		
Green Grid	✓	✓	✓	✓		✓	✓	✓	✓
United Nations Global Compact		✓				✓			✓
World Resources Institute					✓		✓	✓	

California Public Utilities Commission's California Solar Initiative

www.cpuc.ca.gov/puc/Energy/solar

The California Solar Initiative is part of a state-wide effort to install 3,000 megawatts of new, grid-connected solar systems by 2016. The CPUC-directed program provides \$1.167 billion in rebates and cash incentives on solar systems to customers of the Pacific Gas and Electric Company, Southern California Edison, and San Diego Gas and Electric Company. These incentives, combined with federal tax incentives, significantly lower the total cost of a solar system.

Carbon Disclosure Project

www.cdproject.net

The Carbon Disclosure Project (CDP) is an independent not-for-profit organization aimed at creating a lasting relationship between shareholders and corporations regarding the implications for shareholder value and commercial operations presented by climate change. Its goal is to facilitate dialogue, supported by quality information, from which a rational response to climate change will emerge.

Climate Action Network Europe

www.climnet.org

Climate Action Network Europe (CAN-E) is recognised as Europe's leading network working on climate and energy issues. With over 100 members in 25 European countries, CAN-E unites to work to prevent dangerous climate change and promote sustainable energy and environment policy in Europe. CAN-E is part of The Climate Action Network (CAN), a worldwide network of over 365 Non-Governmental Organizations (NGOs) working to promote government, private sector and individual action to limit human-induced climate change to ecologically sustainable levels. CAN is based on trust, openness and democracy.

Climate Savers Computing Initiative

www.climatesaverscomputing.org

Started by Google and Intel in 2007, the Climate Savers Computing Initiative is a non-profit group of eco-conscious consumers, businesses and conservation organizations. The Initiative was started in the spirit of the WWF's Climate Savers program which has mobilized over a dozen companies since 1999 to cut carbon dioxide emissions, demonstrating that reducing emissions is good business. The group's goal is to promote development, deployment and adoption of smart technologies that can both improve the efficiency of a computer's power delivery and reduce the energy consumed when the computer is in an inactive state.

EICC

www.eicc.info

The Electronic Industry Citizenship Coalition (EICC) is a group of companies working together to create a comprehensive set of tools

and methods that support credible implementation of the EICC Code of Conduct throughout the Electronics and Information and Communications Technology (ICT) supply chain. Membership in the EICC is open to all electronic manufacturers, software firms, ICT firms, and manufacturing service providers, including contracted labor, that design, market, manufacture and/or provide electronic goods.

ENERGY STAR

www.energystar.gov

Focused on the domestic and commercial arenas, ENERGY STAR is a joint program of the US Environmental Protection Agency and the US Department of Energy that aims to save money and protect the environment through the use of energy-efficient products and practices. The EPA's ENERGY STAR partnership offers an energy management strategy that assists in the measurement of current energy performance, setting goals, tracking savings, and rewarding improvements. The EPA provides an energy performance rating system which businesses have already applied to more than 62,000 buildings across the US. The EPA also recognizes top-performing buildings with the ENERGY STAR.

Environmental Protection Agency (EPA) - Ireland

www.epa.ie

Ireland's Environmental Protection Agency is an independent public body established under the Environmental Protection Agency Act, 1992. The EPA has responsibility for licensing and control of large scale waste and industrial activities to ensure that they do not endanger human health or harm the environment; national environmental policing; monitoring, analysing and reporting on the environment; regulating Ireland's greenhouse gas emissions; environmental research and development; strategic environmental assessment; environmental planning, education and guidance and proactive waste management.

EPA – Climate Leaders

www.epa.gov/stateply

Climate Leaders is an EPA industry-government partnership that works with companies to develop comprehensive climate change strategies. Partner companies commit to reducing their impact on the

global environment by completing a corporate-wide inventory of their greenhouse gas (GHG) emissions based on a quality management system, setting aggressive reduction goals and annually reporting their progress to the EPA. Through program participation, companies create a credible record of their accomplishments and receive EPA recognition as corporate environmental leaders.

EPA - Green Power Partnership

www.epa.gov/grnpower

The EPA's Green Power Partnership is a voluntary program aimed at helping to increase the use of green power among leading US organizations. These organizations are encouraged to purchase green power as a way to reduce the environmental impact associated with conventional electricity use. The Green Power Partnership works with hundreds of leading US organizations, including Fortune 500 companies, local, state, and federal government agencies, manufacturers and retailers, trade associations, as well as a growing number of colleges and universities. Partners purchase billions of kilowatt-hours of green power annually, which has the equivalent impact of removing the emissions of hundreds of thousands of passenger cars from the road each year.

EPA – SmartWay Transport Partnership

www.epa.gov/smartway

The SmartWay Transport Partnership is a collaborative, voluntary program between the EPA and industry, including manufacturers who ship products, freight carriers and logistics companies, to improve the energy efficiency and reduce the GHG associated with transport. The EPA Green Power Partners List, a voluntary partnership between the US Environmental Protection Agency (EPA) and the US freight industry, targets reductions in fuel consumption, GHG emissions and other air emissions. By 2010, the EPA expects to remove at least 33 million tonnes of CO₂e emissions a year via this program.

EPEAT

www.epeat.net

The Electronic Products Environmental Assessment Tool (EPEAT) is a system dedicated to helping purchasers in the public and private

sectors evaluate, compare and select desktop computers, notebooks and monitors based on their environmental attributes. EPEAT also provides a clear and consistent set of performance criteria for the design of products, and provides an opportunity for manufacturers to secure market recognition for efforts to reduce the environmental impact of its products.

Global Reporting Initiative

www.globalreporting.org

The Global Reporting Initiative (GRI) has pioneered the development of the world's most widely used sustainability reporting framework and is committed to its continuous improvement and application worldwide. This framework sets out the principles and indicators that organizations can use to measure and report their economic, environmental and social performance.

Green Grid

www.greengrid.org

The Green Grid is a global consortium dedicated to advancing energy efficiency in datacenters and business computing ecosystems. In furtherance of its mission, the Green Grid is focused on the following: defining meaningful, user-centric models and metrics; developing standards, measurement methods, processes and new technologies to improve datacenter performance against the defined metrics; and promoting the adoption of energy-efficient standards, processes, measurements and technologies.

Scottish Environmental Protection Agency

www.sepa.org.uk

The Scottish Environmental Protection Agency (SEPA) is Scotland's environmental regulator and advisor, responsible to the Scottish Parliament through Ministers. As well as a role in controlling pollution, SEPA works with others to protect and improve the environment.

United Nations Global Compact

www.unglobalcompact.org

The UN Global Compact is a strategic policy initiative for businesses

that are committed to aligning their operations and strategies with ten universally accepted principles in the areas of human rights, labor, environment and anti-corruption. By doing so, business, as a primary agent driving globalization, can help ensure that markets, commerce, technology and finance advance in ways that benefit economies and societies everywhere.

US Green Building Council – LEED

www.usgbc.org

The Leadership in Energy and Environmental Design (LEED) Green Building Rating System™ encourages and accelerates global adoption of sustainable green building and development practices through the creation and implementation of universally understood and accepted tools and performance criteria.

World Resources Institute

www.wri.org

The World Resources Institute (WRI) is an environmental think tank that goes beyond research to find practical ways to protect the earth and improve people's lives. The WRI's mission is to move human society to live in ways that protect the Earth's environment and its capacity to provide for the needs and aspirations of current and future generations. Because people are inspired by ideas, empowered by knowledge, and moved to change by greater understanding, the WRI provides – and helps other institutions provide – objective information and practical proposals for policy and institutional change that will foster environmentally sound, socially equitable development.



Questionnaire

This section includes the original Computer Equipment Lifecycle Survey questionnaire that was sent to each technology partner

1. Manufacturing

M1. Where is the equipment manufactured for North America market?

M2. Where is the equipment manufactured for EMEA market?

M3. Where is the equipment manufactured for Asiapac market?

M4. Where is the equipment manufactured for South America market?

Explanation: Manufacturing in this case is the process that happens at the facility where the majority of the constituent components are assembled and tested to a point where the expected end-user functionality is proven. It does not include the manufacturing of sub-component parts (for example, power supplies, processors). This study differentiates between “partner” and “manufacturer” as these will not necessarily be the same organization in all cases. (For example, where OEM or other third-party organizations are used as a major element of the partner’s supply chain).

M5: Is there a stated policy to source constituent components locally, where possible?

Explanation: This should be a written and actively pursued policy aimed at minimizing the distance travelled by component parts to reach the assembly facility

M6: What percentage of constituent components is recycled?

Explanation: Recycled can mean the reuse of “healthy” components salvaged from other equipment or the use of components that are

primarily manufactured from recycled material.

M7: Does the manufacturing facility source electricity through Sustainable Energy schemes?

Explanation: A Sustainable Energy scheme is one where the electricity service provider or power generation company commits to sourcing electricity from sustainable sources that is equivalent to the full amount of electricity consumed by the manufacturing facility.

M8: Does the manufacturer seek to minimize the amount of water within the manufacturing process?

Explanation: As a natural resource, water is considered to be increasingly scarce. This seeks to determine if the manufacturer acknowledges this through a written and actively pursued policy to reduce the amount of water used within the manufacturing process.

M9: Does your manufacturing process use mercury, cadmium, chromium, brominated flame retardants (BFRs) or polyvinyl chloride (PVC)?

Explanation: These heavy metals and chemicals have been specifically identified as harmful to the environment by European and American environmental organizations (e.g. Silicon Valley Toxics Coalition). Many IT manufacturers have eliminated their use or have programs to phase out their use.

M10: Does the manufacturing facility have a stated policy to source sub-component parts from suppliers with energy efficiency policies?

Explanation: This should be a written and actively pursued policy that encourages the manufacturer's procurement function to source components from suppliers who themselves have written and actively pursued policies aimed at carbon footprint reduction at the facility where the sub-component is manufactured.

2. Transport & Logistics

T11: On average, how many road/rail journeys are involved between manufacturing facility and end-user floor?

Explanation: This is the average number of times an individual unit is transported by road or rail from the time of initial shipment from the manufacturing facility to the arrival at the end-user site (or host company, outsourcer, etc.). The average should be taken across geographies and comprise a reasonable sample in excess of 50 units in each category (L/M/E).

T12: On average, how many aircraft journeys are involved between manufacturing facility and end-user floor?

Explanation: This is the average number of times an individual unit is transported by air from the time of initial shipment from the manufacturing facility to the arrival on the end-user site (or host company, outsourcer, etc). The average should be taken across geographies and comprise of a reasonable sample in excess of 50 units in each category (L/M/E).

T13: On average, how many times is the end-user equipment stored at separate locations for more than 24 hours before final installation?

Explanation: This is the average number of times an individual unit is stored in a warehouse, cargo depot, reseller storage, etc, for more than 24 hours after the unit has been dispatched from the manufacturing facility and before it is installed at the end-user site (or host company, outsourcer, etc). This does not include overnight storage on road vehicles, ships, aircraft or rail transport where refrigeration is not required.

T14: Does the manufacturer have a stated policy of using transport suppliers with energy efficiency policies?

Explanation: This should be a written and actively pursued policy that encourages the manufacturer's procurement function to source

transport and logistics organizations that themselves actively pursue ways in which to reduce the carbon footprint of the vehicles/vessels that they use.

T15: Does the manufacturer have a stated policy on packaging reduction and sourcing?

Explanation: This should be a written and actively pursued policy that provides for the eco-efficient use of packaging materials under which the manufacturer can show a reduction of the amount of material used to package a unit and a policy of ethically sourcing packaging materials.

T16: Does the manufacturer have a stated policy on using packaging from recycled sources?

Explanation: This should be a written and actively pursued policy that provides for the eco-efficient use of packaging materials under which the manufacturer can show an increase in the amount of packaging material that is recycled and can show a policy of removing packaging from an end-user or host company after delivery for the specific intention of reuse.

T17: Does the primary logistics provider conform to ISO 14001?

Explanation: ISO 14001 specifies the requirements for an environmental management system. It applies to those environmental aspects which the organization has control and over which it can be expected to have an influence. ISO 14000 is the only standard against which it is currently possible to be certified by an external certification authority.

T18: Is the primary logistics provider a signatory of the the United Nations Global Compact?

Explanation: The Global Compact is a framework for businesses that are committed to aligning their operations and strategies with ten universally accepted principles in the areas of human rights, labor, the

environment and anti-corruption. It is a voluntary code.

T19: On average, how many road/rail journeys are involved between the end-user/host site and the disposal location for redundant and decommissioned equipment.

Explanation: This is the average number of times an individual unit is transported by rail or road from the time of collection from the end-user/host to the arrival at the disposal or deconstruction site. The average should be taken across geographies and comprise a reasonable sample in excess of 50 units in each category (L/M/E).

T20: On average, how many air journeys are involved between the end-user/host site and the disposal location for redundant and decommissioned equipment?

Explanation: This is the average number of times an individual unit is transported by air from the time of collection from the end-user/host to the arrival at the disposal or deconstruction site. The average should be taken across geographies and comprise a reasonable sample in excess of 50 units in each category (L/M/E).

3. Ownership & Operation

Questions O21 and O22 were superseded. In order to ensure a level “playing field” the server partners were supplied with a system configuration for an Oracle HR system containing low, mid-range and enterprise-level servers and requested to provide a system specification on that basis. Capgemini then undertook an exercise to determine the efficiency of the configuration based on published KVA and BTU information for the servers provided in the partners’ responses.

O21: What is the average power consumption of the unit in a lifetime (expressed in KVA)?

Explanation: This is the total electrical power consumption (expressed in KVA) consumed by the unit assuming a 24x7 operation from

installation until the unit formally reaches end-of-life.

O22: What is the average heat emission from the unit in a lifetime (expressed in BTU)?

Explanation: This is the total heat (expressed in BTU) emitted by the unit assuming a 24x7 operation from installation until the unit formally reaches end-of-life.

O23: Does the host company have a stated policy on carbon footprint reduction?

Explanation: This relates to the company hosting the unit on behalf of the end-user which, in some cases, may be the end-user themselves but in others will be an outsourcer or hosting organization. In any case, the hosting agency should have a written and actively pursued policy aimed at reducing the hosting organization's carbon footprint. This includes policies aimed at reducing the power consumption of the organization as well as other initiatives aimed at recycling, reduction in the use of other consumables such as printer cartridges, plastic cups, paper, etc.

O24: Does the end-user have a stated policy on carbon footprint reduction?

Explanation: This relates to the end-user of the unit. The end-user should have a written and actively pursued policy aimed at reducing its carbon footprint. This includes policies aimed at reducing the power consumption of the organization as well as other initiatives aimed at recycling, reduction in the use of other consumables such as printer cartridges, plastic cups, paper, etc.

O25: Is on-site routine preventative maintenance required?

Explanation: This assesses whether pro-active maintenance is required and necessitates a service engineer travelling to the site of the hardware. Also considered in the reply should be whether hardware, circuit boards, etc are replaced, introducing additional hardware into a

recycle, refurbish or disposal cycle.

O26: Are other functions possible by remote administration?

Explanation: This assesses whether most or all of the diagnostic and commissioning activities usually undertaken by a partner engineer can be conducted remotely.

O27: Does the manufacturer actively consider power efficiency as fundamental to product design?

Explanation: This relates to the amount of research and development consideration given by the manufacturer and/or partner into power efficiency and cooling including chassis design, processor selection and usage, and code design to operating system level.

O28: Does Mean Time Between Failure (MTBF) exceed 1m hours?

Explanation: This considers the Mean Time Between Failure in terms of the full implication of equipment breakdown from spare part manufacturing, engineer site visits and recycling or disposal.

O29: Does the equipment “sleep” or “hibernate” when not in use for a period of time?

Explanation: This addresses any power saving mode that the equipment might use when not in use for a period of time (e.g. overnight).

O30: Does the manufacturer commit to collecting decommissioned hardware regardless of age with the intention of recycling or ethically disposing of the equipment?

Explanation: This measures the manufacturer’s responsibility for the ethical disposal or recycling of hardware that has been decommissioned by the host or end-user. In some geographies, this is a legal requirement.

4. Disposal

D31: What percentage of equipment currently in the field conforms to WEEE regulations?

Explanation: The Waste Electrical and Electronic Equipment Directive (2002/96/EC) makes producers of electrical and electronic equipment (EEE) responsible for the environmental impact of their products. This questions aims to determine what percentage of equipment in the field is subject to the WEEE directive.

D32: What percentage of equipment currently in the field conforms to RoHS regulations?

Explanation: The Restriction of Hazardous Substances Directive (2002/95/EC) makes producers of electrical and electronic equipment (EEE) responsible for the environmental impact of their products. This question aims to determine what percentage of equipment in the field is subject to the RoHS directive.

D33: Where is the primary disposal facility for equipment manufactured for North America market?

D34: Where is the primary disposal facility for equipment manufactured for EMEA market?

D35: Where is the primary disposal facility for equipment manufactured for Asia-Pacific market?

D36: Where is the primary disposal facility for equipment manufactured for South America market?

Explanation: Disposal in this case is the process that happens at the facility where the majority of the constituent components are deconstructed or disassembled and are not suitable for recycling.

D37: What percentage of disposed equipment is recycled?

Explanation: This is a measure of the amount of component equipment that is put back into the manufacturing process after a device has been decommissioned. The percentage is expressed as a part of the overall number of components within the finished assembly.

D38: Does the partner ensure that the disposal of redundant equipment is carried out ethically?

Explanation: This establishes if the technology partner ensures that the disposal of all decommissioned equipment is carried out in a manner that is not detrimental to the environment (within European law) or to the health of those undertaking the decommissioning work.

D39: Is the organization engaged to carry out the disposal or decommissioning of the equipment a signatory of the United Nations Global Compact?

Explanation: The Global Compact is a framework for businesses that are committed to aligning their operations and strategies with ten universally accepted principles in the areas of human rights, labor, the environment and anti-corruption. It is a voluntary code.

D40: Does the manufacturer have a policy that seeks to dispose of equipment locally?

Explanation: This determines if the manufacturer/technology partner seeks to minimize the carbon footprint associated with long distance transportation of redundant equipment. The measurement is a written and active policy on sourcing local disposal agencies, not-for-profit organizations, etc.

5. Corporate Social Responsibility

C41: Does the manufacturer have a staff representative forum?

Explanation: This addresses the partner's corporate responsibility to its employees and establishes whether the manufacturer/technology

partner has a forum or forums through which it can communicate and negotiate with its staff and to which the staff appoint members through election.

C42: Does the manufacturer have stated HR policies on Diversity?

C43: Does the manufacturer have stated HR policies on Staff Welfare?

C44: Does the manufacturer have stated HR policies on Disability?

C45: Does the manufacturer have stated HR policies on Work/Life balance?

Explanation: This addresses the partner's corporate responsibility to its employees and establishes whether the manufacturer/technology partner has a range of policies generally accepted as best practices which in some geographies are a statutory requirement.

C46: Does the manufacturer participate in community or charity initiatives local to the place of manufacturer?

Explanation: This addresses the partner's corporate responsibility to the local community and determines whether the manufacturer/technology partner recognizes that it has a part to play within the community from which it draws its employees. This can be local sports clubs, charities or other bodies local to the office. The measurement is a written and actively pursued policy that supports such activity.

C47: Does the manufacturer actively promote corporate recycling and energy efficiency?

Explanation: This relates to the manufacturers' or technology partners' activities on recycling and energy efficiency. The measurement is written and actively pursued policies on recycling such as bins for paper, cans and batteries at every site, use of low-energy light bulbs and/or activity sensors in meeting rooms.

C48: Does the manufacturer have a stated policy on targets for achieving carbon neutrality?

Explanation: This relates to the manufacturer's or technology

partner's intentions on reducing their carbon footprint. In this case, the measurement is a written and actively pursued carbon footprint reduction target set against a reasonable benchmark.

C49: Is the manufacturer a signatory of the United Nations Global Compact agreement?

Explanation: The Global Compact is a framework for businesses that are committed to aligning their operations and strategies with ten universally accepted principles in the areas of human rights, labor, the environment and anti-corruption. It is a voluntary code.

C50: Does the manufacturer have procurement policies that require suppliers to behave in an ethical manner towards its employees, its suppliers and the environment?

Explanation: This seeks to determine whether the manufacturer has written and actively pursued procurement policies for all purchasing activity not just that which pertains to the IT procurement.





Endnotes

1. How HP calculates its recovery sales percentage

The recovery sales percentage is based on the following methodology:

- HP calculates a ratio of the weights of hardware products returned for recycling against the weights of HP product sales from seven years ago.
- HP calculates a ratio of the weights of hardware products returned for reuse against the weights of HP product sales from three years ago.
- The recycling and hardware refurbishment ratios are combined to provide an overall comparison with product sales.
- Beginning in 2008, HP has decided not to include recycled consumables in its recovery sales percentage, since stakeholders are primarily concerned with the rate for hardware. HP does not expect that this change will have a material impact on results. The calculation methodology has also been changed to be more consistent with other methodologies in the industry.

2. Sun Microsystems disclaimer

“Sun Microsystems pays high attention to CSR, and as such are willing to encourage efforts such as this Point of View by Capgemini. Nevertheless, Sun does not agree with nor takes responsibility for the scoring methodology of this survey. As part of Sun’s commitment to a strategic partner they have provided full and transparent answers to the survey as well as comments and opinions aimed at improving the process in its next and subsequent versions. Sun considers the Point of View by Capgemini as Capgemini’s own opinion in the absence of an agreed industry benchmarking standard.”

3. Intel

Gordon Moore is a founder and retired chairman and CEO of Intel Corporation. Moore is widely known for “Moore’s Law,” in which in 1965 he predicted that the number of components the industry would be able to place on a computer chip would double every year. In 1975, he updated his prediction to once every two years. It has become the guiding principle for the semiconductor industry to deliver ever-more-powerful chips while decreasing the cost of electronics.

Intel, Intel Core, Intel Xeon, and Intel Centrino are trademarks or registered trademarks of Intel Corporation or its subsidiaries in the United States and other countries.

4. IBM disclaimer

“Whilst IBM cooperated with this survey undertaken by Capgemini, IBM does not agree with nor endorse the scoring methodology of the survey, which was developed by Capgemini. Accordingly, IBM considers the conclusions reached and the opinions expressed in the survey to be solely those of Capgemini and do not reflect any agreed industry benchmarking standard or IBM’s own view.”

References:

All URLs are correct at the time of publication. However, Capgemini has no control over the permanency of links or the content therein (with the exception of References 4 and 39)

1. **The United Nations** – The United Nations Global Compact website: <http://www.unglobalcompact.org>
2. **DEFRA (UK)** – *Climate Change Bill – Explanatory Notes*, <http://www.defra.gov.uk>
3. **Gartner** – *Focus Less on IT as an Environmental Liability and More on How IT Can Improve Your Company's Carbon Footprint, Says Gartner*, Gartner Press Release, Egham UK, October 4th, 2007
4. **Capgemini/Global Commerce Initiative – 2016 – Future Supply Chain**, May 2008. http://www.capgemini.com/resources/thought_leadership/future_supply_chain_2016/
5. **Climate Action Network Europe** - <http://www.climnet.org/publicawareness/wasteCC.htm>
6. **HP** – *HP Global Citizenship : Eco Solutions – Product Design – Logistics*. <http://www.hp.com/hpinfo/globalcitizenship/environment/productdesign/logistics.html>
7. **IBM** – *IBM and the Environment 2006 Annual Report*. http://www.ibm.com/ibm/environment/annual/IBMEnvReport_2006.pdf
8. **Sun Microsystems** – *Energy Efficient Datacenters – The Role of Modularity in Datacenter Design*, *Sun Microsystems BluePrints™*, June 2008. <http://wikis.sun.com/display/BluePrints/Energy+Efficient+Datacenters+-+The+Role+of+Modularity+in+Datacenter+Design>
9. **EMC** – *Environmental Commitment: Energy Efficiency and Conservation*: <http://www.emc.com/about/global-citizenship/environmental-commitment/energy-efficiency-conservation.htm>
10. **EMC 2008 Submission to the Carbon Disclosure Project** <http://www.emc.com/collateral/about/sustainability/EMC-CDP6-Responses-Attach->

- Links-06-27-08.pdf
11. **Aberdeen Group** – EMC Storage: Increased Capacity with the Benefits of Green, March 2008. <http://www.emc.com/collateral/analyst-reports/aberdeen-group-emc-storage-benefits-green.pdf>
 12. **EMC** – Power Efficiency and Storage Arrays EMC White Paper, May 2008. <http://www.emc.com/collateral/hardware/white-papers/h2402-power-efficiency-storage-array-wp-ldv.pdf>
 13. **EMC** 2008 Submission to the Carbon Disclosure Project (as above)
 14. **EMC** 2008 Submission to the Carbon Disclosure Project (as above)
 15. **EMC** – Global Citizenship Pages: <http://uk.emc.com/about/global-citizenship/index.htm>
 16. **EMC** – EMC Information Heritage Trust. <http://www.emc.com/leadership/digital-universe/information-heritage-trust.htm>
 17. **Google** – Google's Green Energy pages: <http://www.google.com/intl/en/corporate/green/energy/index.html>
 18. **Google** – Google RE<C initiative: http://www.google.com/intl/en/press/presrel/20071127_green.html
 19. **Google** – Google's Green Energy: <http://www.google.com/intl/en/corporate/green/energy/index.html>
 20. **HP** – *FY07 Global Citizenship Report: Supply Chain: Responsibility*. <http://www.hp.com/hpinfo/globalcitizenship/gcreport/supplychain.html>
 21. **HP** – *FY07 Global Citizenship Report: Product Reuse and Recycling, - Performance*. <http://www.hp.com/hpinfo/globalcitizenship/gcreport/productreuse/performance.html>
 22. **IBM** – The Baseline Environmental Requirements for Supplier Deliverables to IBM. <http://www.ibm.com/ibm/environment/products/especs.shtml>
 23. **IBM** – *IBM and the Environment* 2006 Annual Report http://www.ibm.com/ibm/environment/annual/IBMEnvReport_2006.pdf
 24. **IBM** – *IBM and the Environment* 2006 Annual Report (as above)
 25. **IBM** – *IBM Autonomic technology*: <http://www.research.ibm.com/autonomic/business/benefits.html>
 26. **Chess, David. M & Kephart, Jeffrey. O (IBM Thomas J Watson Research Center)** – *The Vision of Autonomic Computing*, January 2003. http://www.research.ibm.com/autonomic/research/papers/AC_Vision_Computer_Jan_2003.pdf
 27. **IBM** – *IBM Journal of Research and Development – Power6 Microprocessor Technology*, Volume 51, Number 6, 2007. <http://www.research.ibm.com/>

- journal/rd51-6.html)
28. **IBM** – *IBM Journal of Research and Development – Power6 Microprocessor Technology*, Volume 51, Number 6, 2007 (as above)
 29. **IBM** – IBM Energy Efficiency webpage <http://www-304.ibm.com/jct03001c/systems/x/advantages/energy/save.html>
 30. **IBM** – *IBM Journal of Research and Development – Power6 Microprocessor Technology*, Volume 51, Number 6, 2007 (as above)
 31. **IBM** – Press Releases: <http://www-03.ibm.com/press/us/en/pressrelease/24385.wss>
 32. **IBM** – *IBM Journal of Research and Development – Power6 Microprocessor Technology*, Volume 51, Number 6, 2007 (as above)
 33. **IBM** – *IBM and the Environment 2006 Annual Report* (as above)
 34. **IBM** – *IBM and the Environment 2006 Annual Report* (as above)
 35. **Sun Microsystems** – eco responsibility pages: <http://www.sun.com/aboutsun/environment/index.jsp>
 36. **Sun Microsystems** – eco responsibility pages: (as above)
 37. **Sun Microsystems** – eco responsibility pages: (as above)
 38. **US Environmental Protection Agency** – *Green Power Partnership*. <http://www.epa.gov/grnpower/toplists/top25.htm>
 39. **Capgemini/Global Commerce Initiative** – 2016 – *Future Supply Chain*, May 2008 (as above)
 40. **Intel, Ted Reichelt** – “*Sand to Sand*” *Vision and Carbon Management*, June 2008
 41. **Intel** – White Paper, “*Introducing the 45nm Next-Generation Intel® Core™ Microarchitecture*”, 2007. http://www.intel.com/technology/architecture-silicon/intel64/45nm-core2_whitepaper.pdf
 42. **Intel** – 45nm transistor information at <http://www.intel.com/corporate/techtrends/emea/eng/45nm>
 43. **Sun Microsystems** – CMT information: <http://uk.sun.com/sunnews/feature/2008/080409/>
 44. **IBM** – Press Releases: <http://www-03.ibm.com/press/us/en/pressrelease/24385.wss>
 45. **IBM** – *Journal of Research and Development – Power6 Microprocessor Technology*, Volume 51, Number 6, 2007 (as above)
 46. **AMD** – *The Truth about Power Consumption Starts Here* AMD White Paper, May 2007. http://www.amd.com/us-en/assets/content_type/white_papers_and_tech_docs/43761C_ACP_WP.pdf

47. **Digital Realty** – Datacenter survey, Press Release, May 2008 at: <http://www.digitalrealtytrust.com>
48. **IBM** – Press Release, *IBM Unveils Plans for \$360 Million Data Center in North Carolina*, Research Triangle Park, NC, USA - 01 Aug 2008. <http://www-03.ibm.com/press/us/en/pressrelease/24786.wss>
49. **The Green Grid** – *The Green Grid Data Center Power Efficiency Metrics PUE and DCiE, July 2008*. http://www.thegreengrid.org/gg_content/TGG_Data_Center_Power_Efficiency_Metrics_PUE_and_DCiE.pdf





About Capgemini and the Collaborative Business Experience

Capgemini, one of the world's foremost providers of consulting, technology and outsourcing services, enables its clients to transform and perform through technologies. Capgemini provides its clients with insights and capabilities that boost their freedom to achieve superior results through a unique way of working – the Collaborative Business Experience™ – and through a global delivery model

called Rightshore®, which aims to offer the right resources in the right location at competitive cost. Present in 36 countries, Capgemini reported 2007 global revenues of EUR 8.7 billion and employs over 86,000 people worldwide.

More information is available at www.capgemini.com

Brian Doherty
Outsourcing Global Sustainability Advisor

+44 870 904 3545
brian.doherty@capgemini.com

