IBM Global Technology Services
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‘Green IT’ – the next burning issue for business

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Executive summary

It is becoming widely understood that the way in which we are behaving as a society is environmentally unsustainable, causing irreparable damage to our planet. Rising energy prices, together with government-imposed levies on carbon production, are increasingly impacting on the cost of doing business, making many current business practices economically unsustainable.

It is becoming progressively more important for all businesses to act (and to be seen to act) in an environmentally responsible manner, both to fulfil their legal and moral obligations, but also to enhance the brand and to improve corporate image. Companies are competing in an increasingly 'green' market, and must avoid the real and growing financial penalties that are increasingly being levied against carbon production.

IT has a large part to play in all this. With the increasing drive towards centralised mega data centres alongside the huge growth in power hungry blade technologies in some companies, and with a shift to an equally power-hungry distributed architecture in others, the IT function of business is driving an exponential increase in demand for energy, and, along with it, is having to bear the associated cost increases.

The problem

The IT industry is more vulnerable than most.

Rising energy costs will have an impact on all businesses, and all businesses will increasingly be judged according to their environmental credentials, by legislators, customers and shareholders. This won't just affect the obvious, traditionally power-hungry 'smoke-belching' manufacturing and heavy engineering industries, and the power generators. The IT industry is more vulnerable than most – it has sometimes been a reckless and profligate consumer of energy. Development and improvements in technology have largely been achieved without regard to energy consumption.

Highlights

The impact

Rising energy costs and increasing environmental damage can only become more important issues, politically and economically. They will continue to drive significant increases in the cost of living, and will continue to drive up the cost of doing business. This will make it imperative for businesses to operate as green entities, risking massive and expensive change.

Cost and environmental concern will continue to force us away from the 'dirtiest' forms of energy (coal/oil), though all of the alternatives are problematic. We may find ourselves facing a greater reliance on gas, which is economically unstable and whose supply is potentially insecure, or at least unreliable. It may force greater investment in nuclear power, which is unpopular and expensive, and it may lead to a massive growth of intrusive alternative energy infrastructure – including huge wind farms, or the equipment needed to exploit tidal energy.

Solving the related problems of rising energy costs and environmental damage will be extremely painful and costly.

Solving the related problems of rising energy costs and environmental damage will be extremely painful and costly, and those perceived as being responsible will be increasingly expected to shoulder the biggest burden of the cost and blame. It may even prove impossible to reduce the growth in carbon emissions sufficiently to avoid environmental catastrophe.

Some believe that the spotlight may increasingly point towards IT as an area to make major energy savings, and some even predict that IT may even become tomorrow's 4x4/SUV, or aviation – the next big target for the environmental lobby, and the next thing to lose public support/consent.

Highlights

A fresh approach is needed.

The solution

A fresh approach to IT and power is now needed, putting power consumption at the fore in all aspects of IT – from basic hardware design to architectural standards, from bolt-on point solutions to bottom-up infrastructure build.

IBM has a real appreciation of the issues, thanks to its size, experience and expertise, and can help its customers to avoid the dozens of 'wrong ways' of doing things, by helping to identify the most appropriate solutions.

There is a real, economic imperative to change arising now, and it is not just a matter of making gestures simply to improve a company's environmental credentials.

The cost of power

The whole topic of energy consumption is gaining increased prominence in Western Europe as a consequence of rising energy prices, and as a result of a growing focus on global warming and the environment.

The company bottom line

Energy prices rose during 2005 for a third consecutive year, driven by war in the Middle East, 'tight' capacity, extreme weather and a focus on energy among investors. The price of a barrel of Brent Crude reached US$50 for the first time (after a 40% increase since 2004), and UK and US natural gas prices also hit record highs. Global energy supplies were maintained even in the face of continuing conflict in the Middle East and despite the disruptive effects of the hurricanes that hit the US Gulf Coast, but concerns as to the security of energy supplies have increased, not least after Russia interrupted natural gas supplies to the Ukraine.

Highlights

Energy costs for UK businesses have increased by 57% during the last 12 months, and now form a really significant element of operational expenses, often greater than IT equipment depreciation, and sometimes greater than real-estate costs. Energy costs form a growing proportion of IT costs, which are increasing (despite the headline reductions in some hardware prices). "For every dollar spent on IT equipment, $3 to $4 is spent on operating it through life," according to Andrew Fanara, team leader for the US Environmental Protection Agency's Energy Star programme.[1]

Penalties associated with environmental impact (such as carbon taxes) will continue to increase.

With shrinking reserves and growing demand, there can be little doubt that energy prices will continue to grow, and inflation is likely to accelerate. The continued lack of sources of alternative, clean, green and renewable energy (which remains expensive and statistically insignificant) means that the penalties associated with environmental impact (such as carbon taxes) will continue to increase.

The environmental bottom line

According to BP's 2005 'Statistical Review of World Energy', the world still has some 40 years of oil reserves if demand remains static, though proven reserves are still growing, albeit slowly. The bulk of reserves are located in the Middle East (61.9%), with 22% in Saudi Arabia, but with significant reserves in Iran (11.5%) and Iraq (9.6%). Russia and Kazakhstan are together responsible for another 9.5%, leading to real concerns about the long-term security of supply. Oil consumption increased by just 1.3% in 2005.

The same source predicts 65 years of natural gas reserves, with 26.6% in Russia, 14.9% in Iran and 14.3% in Qatar. No other country has more than 4% of global reserves, making security of supply even more of a concern. Gas consumption increased by 2.3% during 2005.

[1] Quoted on ComputerWeekly.com by Cliff Saran, Tuesday 21 March 2006.

Highlights

The effect on the environment is potentially disastrous, with rising oil and gas prices now triggering a real switch to coal – the dirtiest and most polluting energy source. Though European and Eurasian coal consumption rose by just 0.4%, coal was again the world's fastest growing fuel, with the growth in consumption reaching 5% or double the 10-year average. Perhaps most worryingly, coal consumption rose fastest in Asia, especially in China (10.9%), and India (4.8%). The latter two economies now consume more than twice as much coal as the US (where the consumption of coal rose by 1.9%), accounting for almost half (47%) of the global total. Growth in Thailand (12%), Turkey (14%), Pakistan (14.8%) and the Philippines (17.7%) was even more rapid. Even in the UK, coal has enjoyed a minor renaissance, with the re-opening of the Hatfield Colliery in South Yorkshire, which had closed in 2004. Coal can thus be seen to be fuelling the growth of the world's most dynamic economies. Moreover, with some 155 years of reserves, at current rates of use, coal will continue to be important for decades to come.

Reducing energy consumption will become an environmental imperative, as well as an economic necessity.

The growing importance of coal will only focus attention on energy consumption among the public, customers and shareholders, all of whom are becoming increasingly environmentally aware. Reducing energy consumption will become an environmental imperative, as well as an economic necessity.

Energy consumption increasingly has a real effect on an organisation's reputation and corporate image. Though there are sources of clean, green and renewable energy, these remain expensive and statistically insignificant, and it is still impractical (if not actually impossible) for a major energy consumer to limit itself to using renewable energy.

Highlights

It is widely assumed that a typical computer uses about .65 kilowatts per hour (kWh) in use, or .35kWh (stand-by) and .03kWh in hibernate mode. Assuming that the computer spends 220 working days with 12 hours in operational mode (1716kW) and 12 hours in standby mode (924kW), and spends 24 hours in hibernate mode for the remaining 145 days (104kW), it will consume 2145kW of electricity.

According to UK government figures, 1kWh produces 0.51kg of carbon dioxide (CO_2), and 1,960kWh produces 1 tonne of CO_2. This makes allowance for the fact that with current nuclear capacity (which is reducing) some 15% of electricity is generated without producing any CO_2.

This means that a single PC in office mode costs an insignificant amount to run (£16.00 per annum), but generates 1.094 tonnes of CO_2 per annum equivalent to the CO_2 produced by a single passenger flying from London to Cairo – spread this across a distributed desktop environment of 2,000 PCs and you have an annual carbon footprint of 2,188 tonnes of CO_2.

A history – and the future – of increasing power consumption

Many of today's motor cars and car engines are increasingly poorly suited to today's demand for economy and fuel efficiency, having been designed when oil prices were low and when performance, space and comfort were the most important design drivers. Each new car model since the Model T was therefore designed to out-perform its predecessors. Only now is fuel economy and environmental 'friendliness' becoming more important than speed and horsepower.

The IT industry has seen a concentration on processing power and storage capacity, while power consumption has been ignored.

The situation is similar in the IT industry, which has seen a concentration on processing power and storage capacity, while power consumption has been ignored. As in the automotive industry, energy consumption was regarded as being much less important than performance.

Highlights

Modern IT systems are responsible for an overall increase in energy consumption and the cost of energy as a proportion of IT costs.

As manufacturers competed to create ever-faster processors, smaller and smaller transistors (running hotter and consuming more electricity) were used to form the basis of each new generation of processors. Increased operating temperatures added to the consumption of power, requiring more and more cooling fans.

Modern IT systems provide more computing power per unit of energy (kWh) and thus reduce energy consumption per unit of computing power. Despite this, they are actually responsible for an overall increase in energy consumption, and for an increase in the cost of energy as a proportion of IT costs. This is because users are not simply using the same amount of computing power as before, while using the new technology to reduce their power consumption (or operating temperatures), nor are they using technology to leverage savings in energy costs or in CO_2 production.

Instead, users are taking and using the increased computing power offered by modern systems. New software in particular is devouring more and more power every year. Some software requires almost constant access to the hard drive, draining power much more rapidly than previous packages did. Tests of the initial version of Microsoft** Windows** Vista indicated that it consumed 25% more power than today's Windows XP, for example.

The advent of faster, smaller chips has also allowed manufacturers to produce smaller, stackable and rackable servers allowing greater computing power to be brought to bear (and often shoe-horned into smaller spaces) but with no reduction in overall energy consumption, and often with a much greater requirement for cooling.

Despite the trend towards server virtualisation and consolidation in some companies, business demand for IT services is increasing, and many companies are still expanding their data centres, while the number of servers in such data centres is still increasing annually by about 18%.

Highlights

While the growth in demand for energy did slow down in 2005 (going from a 4.4% rise to just 2.7%, globally) and though the demand for energy actually fell in the USA, the International Energy Agency has predicted that the world will need 60% more energy by 2030 than it does today.

"A typical 10,000-square-foot data centre consumes more electricity than 8,000 60-watt lightbulbs. That represents six to 10 times the power needed to operate a typical office building at peak demand, according to scientists at Lawrence Berkeley National Laboratory. Given that most data centres run 24x7x365, the companies that own them could end up paying millions of dollars this year just to keep their computers turned on."[2]

Forrester Research estimates[3] that data centres require 0.5 to 1 watt of cooling power for each watt of server power used, and that a typical x86 server consumes between 30% and 40% of its maximum power when idle.

Energy consumption of distributed IT environments is difficult to audit, but some have already noted a progressive increase in power consumption.

Back to the data centre – the hot problem

In many companies, there has been a shift away from dedicated data centres, as part of an attempt to provide all IT requirements by using smaller boxes within the office environment. Many have found this solution too expensive, experiencing a higher net spend on staff as well as with higher support costs. Energy consumption of distributed IT environments is difficult to audit, but some have also noted a progressive increase in power consumption with the move from centralised to decentralised, then to distributed architecture, and finally to mobility-based computing.

Even where distributed computing remains dominant, the problems of escalating energy prices and environmental concerns are present, albeit at a lower order of magnitude than in the data centre environment, and even though the problems are rather more diffuse and more difficult to solve.

[2] '*DATA CENTERS Powering Down*', Susannah Patton – CIO.com, 15 April 2006.

[3] '*Power And Cooling Heat Up The Data Center*', Richard Fichera – Forrester Research, 8 March 2006.

Highlights

Technological improvement is driving requirements for greater energy into the building.

Some analysts believe that there is already a trend away from distributed computing back to the data centre, with consolidation and centralisation on the rise again. Within a data centre/server environment, technological improvement is driving requirements for greater energy into the building, for increased floor area and for increased cooling capacity.

This may be counter-intuitive, since the emergence of blade servers superficially promised to allow the more efficient use of data centre floor space, by packing more high-performance servers into a single rack.

However, this increase in computing power and server numbers for a given floor area multiplies cooling problems, since air is an inefficient media for cooling computers and empty space alone is insufficient to give adequate cooling. Air conditioning and other cooling techniques are required to keep temperatures in check. A typical 1980s server could be cooled quite easily, but though a modern server takes up much less floor space, it is more difficult to cool, and requires more space around it. Though it will require less power per unit of computing power, its overall energy requirement will be considerably higher, and the need for improved cooling will further increase energy requirements – and environmental impact, of course. Analysts at Gartner recently suggested that by the end of 2008, 50% of the data centres would not have enough power to meet the power and cooling requirements of the new equipment used in high-density server environments.

A blade server system set up in a single rack could call for 10 times more power than would have been required a few years ago.

The new systems are more compact and of higher density, and can call for more localised power and cooling than will typically be found in an existing data centre environment. A blade server system set up in a single rack, can easily weigh more than a tonne, and can in theory call for more than 30kW of power – more than 10 times what would have been required a few years ago.

Highlights

The energy consumed by cooling components already accounts for 60-70% of the total energy consumption in the data centre.

According to Sun Microsystems engineers, a typical rack of servers installed in data centres just two years ago might have consumed a modest 2kW of power while producing 40 watts of heat per square foot. Newer, high-density racks, expected to be in use by the end of the decade, could easily consume as much as 25kW and give off as much as 500 watts of heat per square foot. The energy consumed by fans, pumps and other cooling components already accounts for some 60-70% of the total energy consumption in the data centre, and Gartner predicts that energy costs will become the second highest cost in 70% of the world's data centres by 2009, trailing staff/personnel costs, but well ahead of the cost of the IT hardware.

It is now believed that in most data centres, particularly those located in single-story industrial-type buildings, electrical costs are already more than two to three times greater than real-estate costs, and many existing data centre buildings may be physically incapable of providing the higher levels of power and cooling that are now required.

Because IT equipment is usually depreciated every two to three years, investment in new hardware is relatively easy, whereas new data centre equipment (including air conditioning, universal power supplies and generators) are more usually depreciated over 20 years, making new investment more difficult. Investing in new buildings may be more even more problematic. It is thus difficult and costly to build your way out of power consumption and heat problems.

Data centre managers must focus on the electrical and cooling issue as never before.

The increasing drive toward server consolidation in an effort to improve operating costs and operational efficiency is further aggravating the problems of increasing energy consumption, and increased heat generation. Thus, data centre managers must focus on the electrical and cooling issue as never before.

Highlights

Cheap, quick-fix solutions are only a stop-gap answer.

Greater efficiencies and cost savings can be leveraged by addressing the underlying problem and by using longer-term solutions.

There are cheap, quick-fix, 'point' solutions that provide 'strap-on' cooling by retrofitting blowers and/or water-cooling systems. Installing water jackets on the server racks allows one to build a much smaller, denser and more efficient data centre.But although liquid cooling is more efficient than air-conditioning, it is still a short-term, stop-gap answer.

Much greater efficiencies and greater cost savings can be leveraged by addressing the underlying problem and by using longer-term solutions. This is likely to entail redesigning and reconfiguring the data centre, however, which obviously requires more long-term investment and a fresh approach to IT, with power consumption at front of mind.

An IBM pSeries* 575 weighs as much as a family car (1,367kg) and consumes 32kW per hour – enough to power a 2,500 square foot home!

Estimates suggest that data centres waste 875,000,000kWh of energy per year – this is equivalent to 436,000,000kg of CO_2 emissions annually.[4]

[4] Flometrics, March 2003.

Highlights

Businesses will have to learn to use less electricity in just the same way, using green computing to save money.

There is a real need for a power-based IT optimisation strategy.

Some will opt for modest steps; others for more energy-efficient components.

Strategies for change

The whole purpose of IT is to make businesses more productive and efficient, and to save money. Businesses are competitive bodies, used to having to 'do more with less' in order to remain competitive. They will have to learn to use less electricity in just the same way, using green (sustainable) computing to save money. This will demand major changes in IT user behaviours and policies.

As energy and infrastructure costs continue to increase exponentially, and as environmental considerations become more prevalent, there is a real need for a power-based IT optimisation strategy, bringing power right to the fore of IT policy, thereby impacting the end-to-end architecture, hardware and software, and on all of the processes undertaken day-to-day to support a company's workflow.

This could force the adoption of new infrastructure, and will increasingly inform decision making when new platforms are procured, or when decisions are made about IT strategies – whether to centralise or whether to adopt a more distributed architecture and so on. Other companies will have to take more modest steps, simply making sure that desktop PCs, monitors and printers are turned off at night, and/or using more effective power-saving modes on unused equipment. Others will opt to use more energy-efficient components, such as LCDs rather than CRT monitors when buying new hardware.

New dual-core processors are faster than traditional chips and yet use less energy, and the latest generation of dual-core processors (exemplified by Intel's** new 'Woodcrest') promise to consume about one third less power than their predecessors while offering up to 80% better performance.

Other IT users may need to investigate the use of DC power. Most energy suppliers provide AC power because it is easier to transport over long distances, although most PCs and servers run on DC, so that the AC current from the utility has to be converted to DC before it reaches the hardware, with inevitable losses of energy in conversion.

Highlights

Some companies may benefit from moving to a small, thin client server architecture.

Some companies may benefit from moving away from distributed computing based on individual desktop PCs to a small, thin client server architecture. It has been suggested that a 10-user system could save about 3,200kWh per year in direct electricity costs (while further energy savings, equivalent to about 11 tonnes of CO_2 per year, would be saved in manufacturing costs). The total production and operating cost savings over the three-year life span of a 10-user system would be more than 33 tonnes.

In an existing server environment, there are significant cost savings associated with any reductions in cooling requirements, and keeping server rooms and computer workspaces at the right temperature is critical.

Virtualisation and server consolidation can allow users to 'do more with less'.

Virtualisation and server consolidation can allow users to 'do more with less', allowing one large server to replace several smaller machines. This can reduce the power required and the overall heat produced. By reducing the number of servers in use, users can simplify their IT infrastructure, and reduce the power and cooling requirements. When Dayton, Ohio overhauled its IT infrastructure, replacing a network of 80 archaic terminals and numerous ad hoc PCs with thin clients for 60% of the staff and PCs for the rest, the city saw a corresponding drop in energy used. The switch saved the city US$700,000 annually from reduced data and software administration expenses, and especially from lower client maintenance costs, with a US$60,000-$90,000 reduction in electricity costs. There is also a corresponding reduction in carbon footprint.

Fortunately, business is getting outside support as it struggles towards greener computing. The US Environmental Protection Agency's Energy Star programme is already promoting more energy-efficient IT infrastructures and policies, while IBM, Hewlett-Packard, Sun Microsystems and AMD have joined forces to launch the Green Grid environmental lobby, aimed at reducing energy consumption at computer data centres by encouraging and improving power-saving measures.

Highlights

A more efficient and frugal approach could save significant amounts of money – both by reducing the consumption of energy, and by avoiding penalties for producing too much carbon.

When investing in new infrastructure, businesses must break the cycle of ever-increasing processor power, ensuring that their activity takes into account energy consumption and efficiency, while supporting their environmental aspirations.

IBM can help businesses identify the most appropriate solutions to the full spectrum of problems now being faced, and help them on their path into green computing.

IBM Global Technology Services

As society becomes more environmentally conscious, business has been forced to become more responsible for the impact of its operations, both legally and morally. It owes this duty of care to its shareholders and employees, who demand that it should invest wisely and generate income most efficiently but also to wider society. As energy prices continue to increase, businesses must start to think green for self-interested and pragmatic economic motives, and not just for environmental and ethical reasons. A more efficient and frugal approach holds out the promise of saving really significant amounts of money – both by reducing the consumption of energy, and by avoiding penalties for producing too much carbon. And rising energy prices are a problem that can only get worse.

IT companies and IT providers have a particular responsibility to raise awareness of the exponential increase in the energy and environmental costs of IT equipment and infrastructure. When investing in new infrastructure, they must break the cycle of ever-increasing processor power and of the linked dramatic growth in power consumption, and they must ensure that their activity takes into account energy consumption and efficiency, while supporting their companies' environmental aspirations. This is particularly vital now that a company's environmental credentials may have a real effect on the bottom line, and when 'greenness' can provide a useful differentiator against a company's rivals and competitors. IT costs have become a green issue.

As a major user and supplier of IT solutions small and large, IBM has an unequalled understanding and appreciation of the problems posed by increasing energy costs and the growing importance of environmental factors. IBM's size, expertise and experience means that it has the ability to help identify the most appropriate solutions to the full spectrum of problems now being faced, and help companies on their path into green computing.

For more information

If you would like to know more about how IBM can help you, please contact:

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