Bringing it all together

A Realist's Guide to Green Data Centres

"The pessimist complains about the wind; the optimist expects it to change; the realist adjusts the sails"
– **William Arthur Ward**

The benefits of centuries of progress in developed countries are obvious: people are living longer, earning more money and enjoying extra leisure time. It's no surprise the rest of the world wants a piece of the action.

Yet there's always a danger that we will fall victim of the relentless drive for progress for two related reasons. First, we enjoy the benefits first and think about downsides later. Second, when we do finally acknowledge a problem we expect future breakthroughs to provide the answer. It's an optimistic world.

A number of surveys have shown that most people apply this attitude to climate change. Only a minority deny it's a problem, but a problem that will, somehow, be sorted out without any need for a change in daily behaviour.

It's this attitude that inspired heavyweight environment champion Al Gore's message of collective responsibility. He asks everyone to take the initiative.

"I encourage people to make environmentally conscious choices because we all have to solve this climate crisis." (1)

Yet some critics, such as influential journalist Robert J. Samuelson, have openly opposed Gore's view. In a recent Newsweek article he argued that only major new engineering can save the day and he questions the drive for current energy efficiency solutions as "intuitively" tough.

"The practical conclusion is that if global warming is a potential calamity, the only solution is new technology." (2)

Samuelson, unlike Gore, but in line with the wider population, is pessimistic in the world's ability to change but optimistic that new inventions can provide the answer.

But can we simply wait on a new generation of breakthroughs to solve our problems? There are major environmental and economic consequences to consider.

Business Power – Data Explosion

Enterprises, like the rest of society, have been guilty of building up benefits while failing to identity, measure and tackle the downsides.

For example, very latest information technology (IT) is helping organisations of all sizes to become more economically and environmentally sustainable. There is a very compelling story focused on how unified communications and video conferencing will help with geographic regeneration and tackle pollution. Such advances are crucial to a flexible world where, amongst other benefits, virtual meetings eliminate millions of miles of travel.

Yet beneath the surface such benefits come with a cost as they stretch supporting infrastructures to their limit. Analyst firm IDC estimates 2006 revenue for the worldwide storage services market to grow from $28.8 billion last year to $35.3 billion by 2011 (3) as more files are created and kept. Email boxes, creaking with audio, video and enormous PowerPoints, are often at their limit. CFOs and their teams make financial statements available via live audiocasts and downloadable podcasts.

The downside can no longer be ignored. The fact is that enterprises have no choice but to improve energy efficiency as increased usage puts a strain on corporate data centres and their finite and expensive power supplies. Failure to manage the impact of the data explosion could, before long, even stem the ability of organisations to compete and innovate effectively.

Slowly the negative impact of the data explosion has been understood and moves to reduce carbon emissions - without sacrificing availability for users, optimum operational continuity of services or cost control - are well underway. The fact is that it's unrealistic for enterprises to rip out their existing IT infrastructure and start over, both in terms of cost and practicality. The only realistic option is creating a more energy efficient infrastructure.

Business Responsibility – Data Management

Nobody doubts that data centres' thirst for power has not peaked. Unchecked, the problem promises to produce arguably the biggest single sustainable energy challenge facing the business world. A recent survey found that just one UK data centre, from a total of over 1500, uses more power in one year than a city with a population of over 280,000 people. (4)

Another US survey found that even a 30,000 square foot data centre, by no means a monster, will now support 1,000 server racks. Depending on their power density, typically 150 to 200 watts per square foot, this translates into a site with a 12 mega watt power demand when cooling power is factored.

In the US, with maintenance and amortisation charges added, such a data centre would generate an operational bill of as much as $4.2 million. Europe's higher electricity prices could add a further 30 per cent to the total. (5)

Yet the initial response to the data explosion focused exclusively on the emergence of faster equipment at lower prices. The honest truth is that the environmental impact of the investment was not, perceived to be, a huge issue.

Things have changed dramatically in a relatively short space of time. Twenty years ago chips consumed no more than eight watts of power but today 110 watts is far from unusual. This phenomenon, christened the "underbelly of Moore's Law", along with new developments like blade servers which can increase the concentration of processing power, and therefore power demand, eight times per square foot, are conspiring to accelerate the problems.

The latest high density servers, working with inefficient infrastructures, are literally threatening to go into meltdown. A report by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) has revealed that between 43 and 65 per cent of data centre energy is used to power hardware equipment, between 20 and 25 per cent is used to power cooling systems and between one and three per cent devoted to lighting. (6)

Another IDC report found that US companies spent approximately $5.8 billion powering servers in 2005 and another $3.5 billion keeping them cool. The authors estimated the total cost of the equipment at $20.5 billion. (7)

The spiralling costs are compounded by a reliance on old fashioned and inefficient infrastructure. The Lawrence Berkley National Laboratory believes that for every watt consumed by a server is matched by supporting infrastructure that includes, but is not restricted to, cooling (8). The combination amounts to a dizzying level of energy consumption that, given the current state of the energy market, has the potential to bring businesses to their knees.

It's no exaggeration. Power suppliers are now refusing to sanction data expansion and are ready, with full government and regulatory support, to create a two tier price offering with rebates for enterprises with effective efficiency programmes.

The problems are not restricted to supply. The escalating cost of electricity, estimated at 30 per cent a year, combined with analyst warnings that energy budgets will rise from 10 per cent to 50 per cent of the typical IT budget in five years, are genuine board room concerns. The economic argument for efficiency is becoming just as compelling as its environmental equivalent. In a recent announcement, leading analyst house Gartner captured the extent of the problem.

"Power and cooling is a pandemic in the world of the data center," said Michael Bell, research vice president at Gartner Inc. "By next year, about half the world's data centers will be functionally obsolete due to insufficient power and cooling capacity to meet the demands of high-density equipment." (9)

Business Pressure – External Forces

The EU energy commissioner announced in October last year the goal of a 20 per cent energy saving by 2020. The plans are backed by a raft of new regulations, including measures aimed at cutting carbon dioxide emissions that would help Europe meet its obligations under the Kyoto treaty. A further series of directives are coming downstream and setting down minimum energy performance requirements for 14 priority products, which unsurprisingly include computing power.

Shortly afterwards the US Senate approved a bill and accepted that it is "in the best interest of the US for purchasers of computer servers to give high priority to energy efficiency as a factor in determining best value and performance for purchases of computer servers". (10)

The law instructs the Environmental Protection Agency to investigate the use of energy-efficient products and recommend new ways to attract interest in energy-efficient products, which has been the goal for years of the government's Energy Star initiative.

Under the weight of such internal and external demands the concept of waiting until something comes along is hollow. It's neither realistic nor sustainable from an environmental or economic perspective to rely on an alternative. So what can be done? Even in the absence of a ready made substitute for data centres there are simple changes that can ensure the boiling frog syndrome, where nothing happens until it's too late, does not become a truism.

There are a number of options available to enterprises who want to sustain their business.

Excerpt from International Energy Agency's "World Energy Outlook 2006" Report (11)

"Policies that encourage the most efficient production and use of energy contribute almost 80% of the avoided CO2 emissions. The remainder comes from switching to low and zero carbon fuels.

More efficient use of fuels, mainly through more efficient cars and trucks, accounts for almost 36% of emissions saved. More efficient use of electricity in a wide range of applications, including lighting, air-conditioning, appliances and industrial motors accounts for another 30%.

More efficient energy production contributes 13%. Renewables and biofuels together yield another 12% and nuclear the remaining 10%."

Seven Realistic Steps To Greener Data Centres

A whole wave of actions can deliver genuine efficiencies – some already making a difference, others soon to gain a foothold in the market – and re-assert data control. In line with the International Energy Agency's recommendations (boxed) such actions make an impact in stemming rising power demands.

1) Audit and learn

Know your infrastructure. A data centre audit is the right place to begin. A full audit should look into a number of different business issues, such as server status and power sourcing, to drive data centre efficiencies. While the main focus must be on major infrastructure projects tied in with future business plans and goals, effective asset management demands real attention to detail.

A simple, yet often overlooked, objective involves checking all electric assets to ensure that redundant items are switched off. Equipment must always be available but not always on.

With an understanding of systems, demands and external drives, the drive for improvements becomes more tangible. As part of its investigations, firms can conduct a full audit of all backups across the company and now ensures only the right data is stored for the right length of time.

The discovery contributed to BT's consolidation of 3000 services and reduce electricity consumption by 23GWh a year while reducing CO2 emissions by 3,300 tonnes. The knowledge helped BT reduce the energy bill of its data centres by £3.8 million over six months.

2) Power your data centre with renewable energy

Consider alternative energy sources. Just as it is in the domestic market, so-called 'green' energy contracts are available in the business world. Today costs of renewable energy are becoming far more competitive as suppliers emerge with government endorsed rebates on offer.

Renewable energy is an integral part of government policies across the world. The UK government has a longer-term aim of reducing CO2 emissions by 60 per cent by 2050 with a shorter term target of achieving 10 per cent of electricity supply from renewable energy by 2010.

BT has signed one of the largest of these deals in the world and will be saving the equivalent amount of carbon that is generated by 300,000 households in the UK. The move has the added bonus of reducing a company's overall carbon footprint.

3) Switch to fresh air cooling

Evolve your technology. Data centres have enormous cooling requirements, which can amount to an enormous energy drain. However, new data centres are now able to channel the air that circulates outside the building into the data centre to help keep temperatures at an optimal level.

Using fresh air instead of air conditioning to cool hardware is becoming a real option, even for high end data centres. It's highly energy efficient, but it does mean that data centre equipment has to tolerate a wider range of operating temperatures - 5 to 50 degrees Celsius, rather than 20 to 24 degree standard of today.

An increase in equipment that can work at high temperatures has become a key goal. The fact is that refrigeration costs are higher than heat losses. BT is now engaging suppliers, as part of the 21st Century Network programme, to deliver products that operate effectively up to 50 degrees.

4) Move from AC to DC

Think efficiently. Computers operate over a range of DC voltages, yet power is delivered from utilities in the form of AC voltages, and at higher voltage levels than required within the computer. Avoiding the power switch results in a 30 per cent power saving.

And the problem is not just the processors themselves. The rectifiers and power supplies that change the AC power from the wall to the DC that computers need also generate a lot of heat.

Often, these are mounted directly on the system boards, concentrating the heat generation further. This also increases operating costs for the data centre. If the data centre spends £1 million a year on power but the power supplies are only 70 percent efficient on average, then the company is wasting £300,000 a year.

5) Turn to multi-core processors

Consolidate systems. One of the new-wave of solutions to the green data centre issue. Multicore processors combine two or more processors into a single package. This means companies can consolidate many small servers on to fewer, more powerful systems and thus cut power consumption and energy spend.

6) Begin virtualisation

Perhaps the most exciting of all the emerging technologies is virtualisation, a technique that uses idle network power to use resources more effectively and efficiently. Take the example of ten servers being used at just 10 per cent of their individual capacities. Virtualisation can focus usage onto a single server, so that one server is being used to its full potential, while the others are not used, saving power and money.

BT has made some headway in this field. Its main project in this area to date reduced a 1500-server data centre down to just over 100, saving £600,000 per year.

IDC estimated that nearly 500,000 server boxes equipped with virtualisation software were due to be shipped in 2006, up from just above zero in 2003. By 2009, the number of units shipped is expected to reach 1.2 billion (12).

As the technology develops in years to come, it is anticipated that rather than just being used in limited clusters, these techniques will be applied across entire data centres, multiplying the economic and environmental benefits. Ultimately data centre managers will have an at-a-glance understanding of all of the processing power available to them across an entire data centre.

Similarly, in the future, virtualisation will be automated. The automation that is happening in many other IT-led processes in the business world will be mirrored in the data centre. Much of today's scheduling is done by administrators. But by removing the need for high levels of hands-on human management and monitoring, data centres could be relocated offshore where power is cheaper.

7) Reduce infrastructure

Another key area of development for data centres is in their ability to interact with the technology they house. By building resilience and disaster recovery functions into the applications that manage server hardware, the need for separate hardware to take care of these functions is removed.

In turn, this removes the need for power and cooling for those systems. It is also possible to replace systems that handle physical protection of server hardware, such as cleaning systems, with more environmentally friendly options. For example, rather than have dedicated cleaning systems to reduce contamination from dust and diesel particles, cooling air can be blown over a 'dead zone' to achieve the same effect.

The only approach

In making his arguments Samuelson stops short of saying energy efficiency or a shift in energy sources will fail. He is simply pessimistic that governments, businesses and society will ever be prepared to focus beyond immediate economic progress.

In many ways he is challenging his audience and looking to be proved wrong. Yet, as the issues surrounding data centres prove, the only option for enterprises, from an environmental and economic perspective, is to seek and deliver efficiencies.

A pessimist thinks nothing can be done. An optimist will wait on something to come along and solve the problem. But the only real option for businesses is to act now and do everything, within their ever so precious power, to create the most sustainable response possible. Let's not wait and see what happens to data centres – let's get to work instead.

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