Planning a Green Data Centre

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Australia is in the midst of a Green Building boom. Property owners and developers are striving for better and better star ratings for their new office, retail, residential, healthcare and education projects, and are rapidly retrofitting existing facilities. But what are the key issues involved in carrying across the green building initiative to the data centre sector?

Each year data centre developers and their project teams are facing more and more challenges as the environmental requirements and stakeholder expectations increase, while costs are expected to remain competitive. Unfortunately, there is relatively little expertise and understanding of this field in Australia when compared to Europe and the United States. So, perhaps whilst we are all in the middle of the Global Financial Crisis and with private sector investment in new projects stopping, one may consider it a good time to pause and take stock of some of the key issues associated with planning green data centres.

Some of the key issues for consideration are:

- Are data centre carbon emissions significant?
- What is a green data centre and how is it measured?
- Does the location of a data centre make a difference?
- How to identify which energy efficiency technologies are worth pursuing?
- Does building green cost more?

Are data centre carbon emissions significant?

Data centre carbon emissions are significant on a national and global scale. It is now widely cited that the global ICT sector contributes 2% of global CO_2 emissions. Data centres are estimated to be responsible for up to one-quarter of this 2%, however this is expected to grow significantly with the adoption of consolidation of computing equipment, virtualisation and the onset of cloud computing.

There are two important aspects for discussion when considering the global CO_2 footprint of the ICT sector (i) how does the ICT sector go about reducing its own carbon footprint; and (ii) how can ICT be used as an enabling technology to reduce emissions in other sectors, e.g. transport, logistics, smart buildings, smart metering, automation, use of broadband, real-time energy monitoring, business process improvement, etc. This article focuses only on item (i), leaving item (ii) to experts in that field. Given the extent of the global CO_2 emissions attributable to the ICT sector, and the significant potential for the ICT sector to contribute towards reductions in other sectors, it is vital that new data centres are planned with energy efficiency and carbon reduction as key objectives.

What is a green data centre and how is it measured?

The term green data centre is highly subjective and in need of further definition. As a minimum, planning of a green data should include consideration of the following:

- Energy efficiency of the ICT equipment
- Energy efficiency of the building systems including power, cooling and ancillary systems
- Water efficiency
- Embodied energy in the construction
- Appropriate land use (e.g. re-using brownfield sites where possible)
- Impact on flora and fauna
- Emissions (including carbon, noise, watercourse)
- Sustainable transport
- Management/operational practices

The most widely accepted means of comparing data centre efficiency is the PUE (Power Usage Effectiveness) concept promoted by The Green Grid. The straight-forward PUE calculation is defined as the ratio of total facility power to the ICT equipment power. This calculation is useful for assessing the efficiency of the building systems such as cooling, power systems, lighting, etc. Existing purpose built data centres typically exhibit a PUE in the range of 1.6 to 2. Typical Office environments converted to house computer equipment can have a PUE as high as 3. New design concepts and technologies have seen the PUE reduce to the range of 1.2 to 1.4 in some exceptional data centre projects in Europe and the United States. Whilst the PUE concept is useful in drawing quick comparison between facilities, it only addresses one of the green data centre considerations described above. The PUE ratio is also notoriously mis-quoted as the result depends on the time of day (and time of year) the snapshot is taken. A realistic PUE should be measured over a long sampling period to take into account seasonal variation of efficiency.

Australia does not presently have a holistic building rating tool for data centres, however many projects seek to follow the guiding principles of the GreenStar rating tools developed by the Green Building Council of Australia. It is possible, and increasingly common, for data centres to obtain a LEED building rating from the US Green Building Council. The GreenStar and LEED building rating systems assess more than just energy efficiency and seek to cover a wide range of ecologically sustainable development topics.

We should resist temptation to think of the term green data centre as an oxymoron. Whilst it is true that data centres are energy-hungry buildings, it is important to look at the big picture and consider (i) the ICT equipment housed in data centres is necessary to support the function it is fulfilling and would still be running regardless of whether it was located in a data centre or not; (ii) placing ICT equipment together in a purpose built data centre is more efficient than operating the equipment in converted office areas, multiple smaller server rooms or converted warehouses; (iii) the ICT equipment is having an enabling effect in reducing carbon emissions from other activities; (iv) the goal should not be to reduce data centre energy use, rather to maximise the efficiency of the use of energy provided to the building.

Does the location of a data centre make a difference?

The location of a data centre alone can have a significant impact on the carbon footprint of the facility. Some locations, due to local climatic conditions, present significant opportunity for deployment energy efficient cooling technologies. Additionally, close proximity to low-carbon sources of energy such as co-generation or renewable technologies is becoming an increasing consideration. Data centres in inner-city areas may have less access to these alternative sources of energy due to planning restrictions and space requirements.

Even considering a grid powered solution, the carbon footprint of a data centre is affected by the vastly different emissions intensity of grid electricity in different states. The Australian average CO_2 emissions associated with grid electricity consumption are approximately 1 $kgCO_2$ / kWh. However the current Department of Climate Change NGA Factors indicate this varies widely between states, for example grid electricity consumption in Victoria emits 1.31 $kgCO_2$ / kWh, whereas Tasmania's grid electricity emits 0.13 $kgCO_2$ / kWh. All other states are within 6% of the national average. The difference between states is reflective of the different mix of electricity generation technology (coal, gas, hydro, renewable, etc) in each state. The implication of this is that the exact same data centre located in two different states can have dramatic and significantly different carbon footprints.

Another increasingly popular consideration is deploying co-generation systems (also known as tri-generation or combined heat and power) in data centres. This involves the generation of electricity on-site and then harvesting the waste heat from the power generation plant to drive equipment that produces chilled water used for cooling the data centre. The fuel source for on-site generation is usually natural gas, however other possibilities such as landfill gas and bio-fuels exist albeit on a very small scale. Co-generation in data centres has the potential to provide significant CO_2 reductions as the emissions from natural gas electricity generation are far superior to coal electricity generation which is the predominant source of grid electricity; additionally the waste heat captured reduces the burden on the data centre cooling systems. Co-generation systems can become particularly viable and beneficial when deployed in a campus situation, i.e. multiple data centres on one site supported by a highly efficient central energy centre.

How to identify which energy efficiency technologies are worth pursuing?

Bombarded with a seemingly endless list of potential energy efficient technologies and designs, it is increasing difficult to determine the best green strategy for a project. It is not within the scope of this article to assess the relative benefits of the available technologies, however the key considerations are as follows:

- Determine as early and as accurately as possible the real requirements for the facility (i.e. size, power and resilience)
- Correct sizing and modularity/scalability of a facility (not over/under sizing) is important in achieving optimal efficiency
- Consider the nature of the use of the facility (e.g. corporate data centre, co-location, telecommunications, etc)
- Consider the climatic conditions at the site and what efficiencies may be gained.
- Consider the big picture and achieving a balance between all green data centre considerations
- Consider the payback periods (both financial and carbon payback) of technologies under consideration

Does building green cost more?

When considering the costs of green buildings it is important to consider the total lifecycle costs – construction, operation and decommissioning. Whilst the initial construction costs may be higher, the ongoing operational cost savings of green buildings are significant. The operational savings are amplified in the context of data centres due to the typically large energy consumption. A well planned and designed green data centre not only reduces the carbon emissions but can easily repay any additional capital costs in the first few years of operation. The introduction of the Government's proposed Emissions Trading System within the next few years will further highlight the necessity for green data centres as there will be a significant cost incentive for reducing energy consumption.

Relevant links:

http://www.technicalrealestate.com – Technical Real Estate
http://www.gbca.org.au – Green Building Council of Australia
http://www.usgbc.org – LEED building rating tool – US Green Building Council
http://www.thegreengrid.org – The Green Grid
http://www.climatechange.gov.au/workbook/index.html - Department of Climate Change NGA Factors
http://www.theclimategroup.org – The Climate Group / GeSI Smart2020 Report

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About Technical Real Estate:

Technical Real Estate is a specialist Sydney based data centre developer and owner that supports long term tenure, tenant property control and lease terms which allow for capital upgrades to the data centre. Data Centre sites have been secured in Singapore, Canberra, Sydney and Tokyo.

Technical Real Estate is transforming the data centre landscape by bringing world leading environmental technology to our flagship project Canberra Technology City. This development will showcase Europe's most advanced technology to provide the data centre industry with CO_2 reductions in excess of 70%, power consumption reductions in excess of 40% and will place Canberra at the forefront of environmentally sustainable ICT.