

● **Shades of Green:** Which will your organization choose?

Maximizing the use of computing resources while reducing the “carbon footprint” of an organization’s IT infrastructure is the goal of green computing. Depending upon the goals and needs of your organization, some green computing solutions may fit, others may not.

This paper takes a look at some of the aspects of going green such as considerations regarding the infrastructure component, facilities, consumables options, developing a green strategy, and incenting behavioral changes.

About the Author

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Walk into any paint store and you will find a color palette of cards. If you scan the green ones, you will see a wide variety of hues and shades from which to choose. Only a few will meet your color coordination needs. Choosing a **Green IT strategy** is no different.



Environmental or “green” initiatives have been around for some time. Stewart Brand and his team published the first Whole Earth Catalog in 1968. It was a widely accepted compendium of earth-sustaining technology information and how-to advice. Well over a million copies were sold and in 1972 it won the National Book Award, a first for any catalog. In a recent commencement speech, Steve Jobs of Apple Inc. compared the Whole Earth Catalog to Google.¹

The researchers gathered information about existing (at that point in time) technologies that could be used to lessen our impact on the earth. Many of the devices they advertised had been around for years; used by ranchers to pump water to hydrate their cattle or methods of generating electricity to support off-the-grid living. Many of the technologies identified in those catalogs are still relevant and in use today.

Green computing, one of many environmental initiatives to reduce our impact on the Earth, is accomplished by taking actions that alleviate global warming and sustain Earth’s limited resources. Maximizing the use of computing resources while reducing the “carbon footprint” of an organization’s IT infrastructure is the goal of green computing. Depending upon the goals and needs of your organization, some green computing solutions may fit, others may not.

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Before we look at short-term and long-term strategies, let’s look at some of the different aspects of **going green**.

Infrastructure Component Considerations

Power conservation techniques and purchasing decisions result in devices that consume less power. Since cooling requirements can drive more power consumption than the unit’s electrical footprint, both electric and cooling requirements must be considered. Units

with wider operating temperature ranges can provide power savings as your building's indoor air temperatures can be adjusted to compensate for the wider ranges — warmer in summer and cooler in winter. Always look to use fewer but larger units as a greater number of small units needed to do a particular job generally use more energy than a single, large one. Server and disk array virtualization technologies can facilitate consolidations of many small units onto a single large unit.



When selecting equipment, look for Energy Star devices. Select processor speeds that are commensurate with business applications. Faster processors generate more heat so slower processors can be used with simple business applications, especially those not dealing with detailed graphics or heavy computational needs. Video cards also have different energy profiles. Email and word processing does not require the use of high-tech 3D video cards which use more energy and generate more heat. Where it makes sense, employ older technology cards which consume less power. Use LCD monitors, especially new ones that employ LEDs as they use substantially less energy and have improved hibernation capabilities.

There are a number of **power management** techniques that can be employed to reduce energy consumption. Probably the easiest is to turn PCs off at night. Newer technologies are not as susceptible to once-a-day power-on-power-off situations like older technologies were. Only turn on printers when you are ready to print. Ensure all eligible PCs have hibernation activated to minimize power usage after a reasonable period of idle time. One recent finding suggests reversing the monitor background where applications permit. Black backgrounds use 25% less energy than white.

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Some of the **sustainability** actions you can take include:

- Recycle electronics
- Purchase locally manufactured goods
- Buy only equipment that can be repaired

Recycling can take several forms. The most common is to dispose of old electronics through a recycler who will either refurbish the equipment and export it or harvest electronic components for reuse. Another recycling option is to reuse operation components, such as disk drives and video cards. We have become a throw-away society and are now paying for it in our landfills and in our groundwater. Buying repairable units elongates effective lifespan and reduces the amount of electronic debris that makes its way to landfills. No matter which method you choose, fewer electronic components will make their way to landfills, reducing chemical pollution that eventually makes its way into the groundwater.

Facilities Considerations

Utilities contribute to day-to-day operational costs of organizations, and reduction and conservation efforts can have a noticeable impact. Organizations can install solar, wind and/or hydroelectric generation facilities to reduce dependence on power from the grid. In fact, TeamQuest headquarters is located in an area that generates substantial amounts of electricity through wind generation. Solar water heaters can be used to replace conventional models, reducing power or gas costs. A number of large organizations employ heat exchangers to capture excess heat generated by computing and use it to warm work areas during cold weather.



Replacing incandescent light bulbs with compact fluorescents can also reduce energy usage. Some electric companies offer lower rates if you permit them to control air conditioning temperatures during peak periods. They also offer reduced rates if you operate emergency power facilities during those same peak periods, replenishing batteries during much lower utilization periods.

Rain water and grey water can be captured and used to water lawns and landscaping, reducing dependence (and costs) of domestic water supplies. Finally, in many states electricity generation and transmission are separated so you can purchase electricity generated from renewable sources.

As delivery vehicles age and become unreliable, they can be replaced with electric or renewable resource alternatives. Grants are available for acquisition, and some states have incentives, such as low-cost or no-cost financing, to make the changeover. In California, for example, Sacramento Municipal Utilities District (SMUD) has received a number of grants to convert its support vehicles to new ones that use electric power.

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As far as structures themselves, whether it's maintenance, renovation or new construction, there are a variety of options available for the "going green" organization. Using technologies such as Voice over IP (VoIP) reduces the amount of physical office space needed, while also saving commute costs and reducing emissions from gasoline used. Besides the facility cost savings, many companies have also seen retention numbers increase by as much as 30% when instituting a work-at-home program. One company we know went from a 60% retention rate to 95% when they instituted work-at-home for clerical staff.

Skylights and natural lighting techniques can substantially reduce the need for artificial lighting during daylight hours and as recent studies have shown, actually improve productivity. Building colors can be changed to reflect rather than absorb the sun's rays. Builders can use construction materials made from renewable sources such as bamboo and glass. Concrete walls and roofs hold in the heat and radiate it later, increasing the amount of power required to cool the facility. Using natural materials for the same purposes will reduce power consumption.

Other green options are to reuse diskettes or use memory sticks which are also reusable and hold more data.

Window films can reduce IR radiation, thus lowering cooling requirements. The use of fiber-optic cables reduces dependence on copper, a non-renewable resource. From an air quality perspective, using live plants and avoiding the use of carpeting and other synthetic furnishings can reduce the amount of toxins in the air. Using decorative interior treatments that contain some percentage of post-consumer materials is another conservation option.

As far as landscaping and grounds, additional savings can be obtained. Natural cover such as trees and shrubs can reduce cooling requirements. Some companies with flat roofs plant grass to reduce roof temperatures, thus lowering cooling expenses. Eco-friendly drought-resistant landscaping can also bring benefits, both from watering perspective as well as requiring less maintenance.

Consumables Options

Consumables are just what the name implies, consumed. The **less you use**, the fewer of Earth's resources are used. Data centers are known for "cutting down trees" by printing large volumes of reports. Storing reports electronically where they can be viewed and only specific pages printed can substantially reduce paper consumption, as well as equipment and shipping costs. In addition, installing print-on-demand systems can reduce the amount of printed materials held in inventory which eventually get destroyed because new procedures or instructions have made the older ones obsolete.



Other green options are to reuse diskettes or use memory sticks which are also reusable and hold more data. In many cases memory sticks can replace CDs and DVDs, reducing the amount of plastic (thus oil) needed for their manufacture. Organizations can promote the use of rechargeable batteries for company-owned portable electronics.

As far as shipping and mailing is concerned, organizations can look at electronic means to disseminate information. Where items must be packaged and shipped, packaging should be kept to a minimum and less invasive renewable materials used. Some shredders destroy data on reports sufficiently to where they can be used for packing materials instead of acquiring new.

Incenting Behavioral Changes

Green computing is a mindset; old behaviors have to change.

Sometimes the hardest part of implementing green initiatives is getting the employees on board. Green computing is a mindset; old behaviors have to change. Here are a few ways to incent green behavior.

Some large companies subsidize or finance the purchase of hybrid or high-efficiency vehicles. Companies — and some states — provide carpooling incentives, such as low-cost van financing and carpool lanes. Other companies incent the use of mass transit schedules. Companies can also encourage local sustainability by persuading truck farmers, local meat packers and other vendors to re-establish route deliveries. By providing shopping lists, local suppliers can make one stop delivery of fresh produce, meats and dairy, which saves transport costs and sustains local farmers.



Other environmentally-friendly actions include providing in-house recycling, selling or providing fair trade clothing and uniforms made from renewable materials, and delivering awareness education through such methods as brown bag seminars, group roadside clean-ups, etc. In-house recycling provides an easy way for employees to dispose of batteries plus aluminum can recycling payments can be applied to employee welfare funds, providing picnics and other functions for employee enjoyment. Promoting fair trade clothing and uniforms made from renewable materials may incent employees to purchase similar items for their leisure use, lowering the demand for synthetics and the non-renewable resources required to make them.

Community Opportunities

A number of large corporations have completed community-level projects. Large computer chip fabrication plants often use 1 million to 2 million gallons of water a day to clean and rinse silicon wafers. Intel Corporation in Chandler, Arizona, captures the excess water from



chip-making, cleans it to EPA standards, then pumps it back into the aquifer. As a result of their actions, ground water levels have actually risen in the area. Other companies have built wildlife refuges around their facilities, as well as green areas, picnic grounds, and buffer zones. Some progressive companies and government entities employ environmental methods for trash and sewer disposal. Eureka, California, uses natural marshland for sewage treatment. The process has improved the natural surroundings and reduced the city's processing expenses.

Developing a Green Strategy

The easiest way to do **green computing** is to go out and buy carbon credits, however that does not do much for building a credible corporate image. There are several reasons to adopt a more participative **green IT strategy**, the most common being marketing, financial and political. From a marketing perspective, we see and hear **green** messages every day in a variety of media. Companies are more frequently espousing their social responsibility as it pertains to their products. In some cases, companies with no green strategy are at a distinct competitive disadvantage, forcing them to take action. Care must be taken in proceeding with a strategy using little tangible content as those are soon uncovered, attracting public criticism followed by corresponding drops in revenues. In order to avoid these undesirable situations, any green strategy should include material actions that lead to tangible results.

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Many of the activities listed above can have a positive effect on the balance sheet. Using less power, for example, can lower electric bills and as time goes on and rates increase, even greater benefits are realized. For example, some places in the northeastern United States have seen electricity rates skyrocket from 8 or 9 cents per kilowatt-hour to more than 23 cents. Any savings realized at the lower rate have now tripled without any additional work.

Politically, there is now worldwide attention on global warming and sustainability. Unless effective actions are taken, it will only be a matter of time before governments put carbon footprint controls in place. In fact, some countries already have some level of control in place. As the results of global warming have greater impact on countries and their citizens, we can expect more stringent controls to be adopted. Therefore business needs to consider whether to wait for government mandates or take some action now to alleviate the issue and possibly reduce governments' urgency to react.

Many of the options listed above take time to implement. As in any long-term project, organizations should look to employ a staged approach, using short-term tasks that provide immediate benefits and reinforce the determination to proceed over the long term.

Short-term Activities

The most common activities to reduce carbon footprint are application tuning and server consolidation.

The most common activities to reduce carbon footprint are application tuning and server consolidation. With modest amounts of time and effort, these activities can reduce power consumption while improving performance and saving money as well — a real win-win situation.

Application tuning is accomplished by using analysis tools to scan collected performance information to identify inefficiencies in the computer programs and related computing infrastructure. Once improvement opportunities are identified, corrective actions can be commissioned and the work scheduled. The improvements result in business applications that perform better and consume fewer computing resources.

An example of tuning can be optimizing database read/write procedures to read and write fewer records. In addition, most equipment comes from the manufacturer with generic configuration parameters which are designed for the “average” shop. Analysis tools can be used to help you customize the configuration parameters to better serve your operations rather than the “average.” Many times making the configuration changes result in substantial performance improvements and lower usage levels — much like changing spark plugs and adjusting the engine’s timing to have the car perform better and get better gas mileage.



Consolidation activities include reviewing current devices, understanding predicted business usage needs and determining ways to eliminate devices by leveraging idle capacity. Capacity planning staff generally performs the work, which entails a cursory survey of the IT infrastructure to identify viable consolidation candidates. Once identified, additional research is needed to ensure there will be no conflicts if the candidates are put together. In addition, maintenance schedules need to be known to ensure business application availability is not adversely affected. For example Application A may have a Tuesday night maintenance window

Early in the project you can enhance acquisition processes by putting in place new environmentally-friendly requirements into a boilerplate used in Requests for Information and Request for Price.

but Application B and C have an early Sunday morning maintenance window and must be operational on Tuesday night. Once compatible units are identified, modeling tools must be employed to get a more detailed understanding of the implications of consolidation before the work is actually done. Without doing the work, incompatible application problems could result in operational chaos and have adverse impacts on the business. Virtualization technologies can minimize the risk of consolidating competing or incompatibilities, however modeling of some type should be performed to ensure expected levels of services can continue to be delivered.

Build on Successes

Benefits from short-term projects provide credibility and a foundation upon which to justify and sustain longer term green initiatives. Many of the opportunities listed above require substantial investments in time and money, so business must have some confidence that the money will be well spent and that expected returns will be realized.

Proven project management practices reveal that breaking projects into smaller steps promotes success, and green initiatives are no different. Simple changes can be made as forward progress is made. You can implement employee incentives; get them starting to think about green in their daily work. Early in the project you can enhance acquisition processes by putting in place new environmentally-friendly requirements into a boilerplate used in Requests for Information (RFI) and Requests for Price (RFP).



On a longer time scale, building renovations occur at regular intervals so appropriate changes can be made as part of those renovations. Delays in major undertakings may not be so bad. Some technologies are changing and improving. Worldwide, industry is rising to the challenge and striving to find, test and manufacture new and better green solutions. For example there are encouraging new air conditioning alternatives coming into the marketplace. One indirect cooling unit being tested dropped indoor temperatures to 74 degrees F (23 C) with an outside temperature of 95 degrees F (35 C) while using substantially less energy.

Tried and tested technologies like some photovoltaic and wind generation devices have been in use for several years. If one of these technologies is in your plan, you may wish to avoid delays and risks

attributed to implementing the new technology and proceed knowing others have successfully forged the path before you. Facilities and landscaping options are also proven and can be implemented with a high degree of confidence.

Summary

Green computing has many different aspects. Each organization needs to identify its green goals, determine the best options, build implementation plans and then accomplish them. If a large number of organizations get an early start using phased approaches, sufficient improvements may be realized that will forestall government regulation and restore the earth for future generations. Plus if you are wildly successful in your endeavors, your organization may be able to enjoy additional financial benefits by selling carbon credits to those who are forced to buy them because they didn't start early enough.

Which shade of green will your organization choose?

How TeamQuest Helps

TeamQuest performance management tools and techniques allow IT staff to identify potential performance improvement opportunities and address them. They also help spot adverse trends and anomalies in performance, and provide educated “rules of thumb” as a means to identify improvement opportunities, providing management and technical staff the time needed to effect the changes. The tools also help identify underutilized capacity for potential consolidation, redeployment or decommissioning.

TeamQuest IT Service Analyzer allows a capacity planner to quickly view workloads from multiple servers across the enterprise. Good candidates for consolidation are often servers with commonalities, such as servers that:

- are located in the same physical data center,
- are underutilized,
- host workloads of similar kind,
- run the same level and make of operating system,
- have appropriate service outage windows,
- share the same security policy, or
- have the same groups of users.

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Using TeamQuest Model, the capacity planner can quickly discover whether a proposed server consolidation project is feasible in terms of potential resource queuing that may occur.

TeamQuest Model is the capacity planner's absolute must-have tool for server consolidation projects. For a server consolidation project to be successful, it is paramount that performance remains within acceptable levels after the consolidation is completed. TeamQuest Model allows the capacity planner to verify a proposed server consolidation scenario to make sure that queues in the consolidated server remain low and that performance is not degraded for any of the co-hosted workloads.

Using TeamQuest Model, the capacity planner can quickly discover whether a proposed server consolidation project is feasible in terms of potential resource queuing that may occur. This important discovery is made without touching a single piece of hardware.

For more information on the TeamQuest suite of performance and capacity management software, please go to www.teamquest.com.

Research Credits

<http://en.wikipedia.org>

http://ecenter.colorado.edu/energy/projects/green_computing.html

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