

Harnessing IT to Boost Sustainability — and Profit





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Global commerce has enabled a standard of living in developed nations that would exceed the imaginations of kings from centuries past. But such progress has come at a price. Today the global community finds itself on a precipice, balancing society's need for more energy with the urgency of protecting a life-sustaining environment.

Technology offers solutions while spawning problems its inventors never envisioned. When it comes to the energy that lights our homes, runs our businesses and fuels our vehicles, that problem is greenhouse gas emissions. But technology, combined with smart policy, can significantly reduce the emissions responsible for climate change. Information technology (IT) can, for example, optimize energy use in high-load electrical devices, power grids, transportation networks, communications and manufacturing.

In this article, experts from Wharton and Wipro Technologies examine areas where IT offers high-impact potential to reduce carbon emissions while boosting profitability. They also consider how organizations can use IT to “green” their practices for larger-scale future benefits. A key takeaway is that the efficiencies possible through leveraging IT translate to high-return economic and environmental benefits.

One example: A report from the U.S. Energy Department's Electricity Advisory Committee — a body of industry, consumer groups, regulators and policy-makers — noted the following benefits of rebuilding the aging power system into an IT-enabled “smart grid”:

- reduced consumption through energy efficiency and “demand-response” programs that actively manage energy loads (demand response lowers utility rates in exchange for curbing energy demand during peak times);

- reduced carbon emissions through maximized demand response, minimized use of peak generating plants and greater renewable power sources; and
- potential for enhanced reliability and security.

Areas of Opportunity

IT already plays a major role in helping enterprises squeeze efficiency from their operations. But opportunity remains for IT to wring inefficiencies from shipping, the electric power industry, manufacturing, and internal and external communications processes.

“Information technology — which some experts are beginning to call ‘knowledge technology’ — will play a significant role in reducing power use and greenhouse gas emissions by becoming more efficient,” says Michael Tomczyk, managing director of the Mack Center for Technological Innovation at Wharton. “More important, IT will provide the monitoring and control technologies needed to help other industries go green.” These opportunities could, by 2020, amount to an abatement equal to 15% of today's global annual emissions — or some 7.8 metric gigatons of greenhouse gases — according to a 2008 McKinsey & Company report.

Take logistics, for example. With its inherent network orientation, the field affords substantial opportunity for IT to enhance efficiency. Network optimization — selecting the best route — is critical for any company that moves people or goods over distances.



I. Vijaya Kumar, Wipro's chief technology officer, notes that in the fresh-food industry his company broke down production planning into as fine detail as "sub-daily planning." The methodology looks at tactics including process flow changes and route optimization for shipping. Improvements can mean less food spoils because less gets stored or shipped for too long — or under the wrong conditions. The planning to ensure that food stays fresh includes greater attention to processing last-minute customer orders, priority rankings and the like.

"It results in energy conservation, and the more prominent or tangible benefit is that you create less waste," Kumar says. "You can apply this to a lot of other industries as well."

Experts envision wider use of computerized vehicle routing, scheduling systems and telematics, an umbrella term that refers to telecommunications and informatics. It includes such things as GPS navigation, integrated hands-free wireless communication and vehicle tracking. Experts also predict wider-scale use of online freight exchange services, which work to fill up freight trucks and reduce trips with sparse loads.

Using such cooperative methods, shipping companies could raise the amounts shipped per mile while lowering carbon emissions. In Europe, for example, companies with six trucks or fewer control 60% of the truck fleet. Smart truck-logistics systems, which have yet to gain a foothold, could help smaller operators optimize their loads.

Paul R. Kleindorfer, professor emeritus of operations and information management at Wharton, says commercial shipping presents many challenges to enforcing a workable and effective system for regulating emissions. "When you get to road transport, there are many difficulties. Europe has a cap-and-trade system, but it's not efficient to regulate road and maritime transport, mainly because there are too many sources." Nonetheless, he says, many shipping-intensive companies are taking the initiative to account for and reduce carbon emissions before large-scale regulations are imposed.

In the United States, Walmart reported that by reducing the number of "empty miles" its trucks drove and optimizing how merchandise was stacked in its trailers, drivers logged

87 million fewer miles in 2008 while transporting 161,000 more cases of merchandise. This enabled the company to save 15 million gallons of diesel fuel. McKinsey & Company calculates that, if implemented worldwide, such optimization systems could cut emissions by 1.52 metric gigatons annually.

"You're seeing major retailers now increasingly confronted with the pressures to account for the carbon and energy content in their overall supply chains," says Kleindorfer, who is also distinguished research professor in technology and operations management at INSEAD. "They're actually pushing this way up the supply chain and accounting for it. The pressure for measuring that footprint is going to go higher for [shipping] operators like Maersk. Similarly, the manufacturers in China are going to face pressure to measure the carbon content of things they produce."

Ultimately, consumers will be able to make purchasing decisions by reading a carbon footprint label on individual products, much as they can read nutrition information labels now, Kleindorfer says. "In Scandinavia, they have the carbon content stamped on cartons of milk.... If you can imagine this starting to occur for blue jeans, electronics and so forth, you can get a picture of the product-specific auditing of those sources," Kleindorfer says.

Awakening the Smart Grid

Tomczyk notes that the electric power industry stands to emerge as a big winner from IT-enabled efficiencies. While renewable energy sources such as wind, solar and even tidal-generated electricity make headlines, their cost-effectiveness and transmission-adequacy issues are still to be resolved. Meanwhile, technologies that can streamline the patchwork power grid offer potentially lower capital outlays for public and private sectors. "One area where IT will contribute most meaningfully in the green space involves the implementation of smarter power grids and, in particular, smart meters in homes and commercial buildings," Tomczyk says. "Smart meters and a smart grid will enable more efficient monitoring, analysis and pricing of electrical use."



According to the Galvin Electricity Initiative, “Smart-grid technologies would reduce power disturbance costs to the U.S. economy by \$49 billion per year. Smart grids would also reduce the need for massive infrastructure investments by between \$46 billion and \$117 billion over the next 20 years.” (The Galvin Initiative is a privately funded group sponsored by the Galvin Project, Inc., which was created by Robert W. Galvin, former CEO of Motorola.)

In India, a power grid used IT to monitor its network and reduced power losses by 15%. McKinsey reports that power production creates 60% of all emissions in India and, therefore, cutting power losses from transmission lines by 30% could save \$13 billion a year while shrinking the carbon footprint.

In the U.S., the Obama administration announced a \$3.4 billion investment in smart-grid technology as part of its broad economic recovery plan. The taxpayer-funded initiative would leverage an additional \$4.7 billion in private investment to increase reliability of a nationwide grid that costs U.S. consumers \$150 billion annually in power outages — or about \$500 for each U.S. adult and child.

The administration’s smart-grid money will fund electronic metering systems that give the power company real-time data about outages and individual customers’ power use. The systems will feature on-premise displays that allow consumers and businesses to manage their usage and reduce energy bills, and will foster development of smart devices that can take advantage of the IT-enhanced relationship between customers and power providers. Such features have typically been available only to large industrial customers. The Electricity Advisory Committee says smart grids hold the potential not only for saving money and reducing emissions, but even for enhancing the security and reliability of the power grid.

From Smart Grid to Smart Gadget

As smart grids begin to flourish, look for makers of appliances and other electrically powered equipment to produce smart devices that capitalize on them. General Electric, for example, launched a smart water heater in

late 2009, believed to be the first of its kind commercially available in the U.S. The smart appliance is equipped with a communications port that could link to the data network of a local utility that used smart-grid technology. The two-way communication would allow, in theory, this and other such devices to deactivate during times of extremely high loads on the power grid, and to re-activate during nonpeak hours, when more plentiful power would cost less with certain pricing plans.

Similar demand-response systems without the smart communications technology exist today, for use with home water heaters, clothes dryers and other residential appliances. But they are more common in more energy-conscious Europe.

Google, best known for dominating the online search field, has put significant resources behind technology that reduces power use and, therefore, carbon emissions. One of the tools it unveiled this year, Google PowerMeter, lets residential electricity customers view online how much power their home has been using. The free online tool requires that the user either have a utility-installed smart meter or a consumer-owned electricity management device. Seen through the customer’s personalized Google page, the Google PowerMeter readout gives the amount of energy used for a selected period and lets customers compare current use with past use and with that of other households.

Tomczyk says that one of the biggest drivers of such technology may evolve from one of today’s biggest sources of carbon emissions — the automobile. The evolved version, the electric car, does not create emissions directly, and could mark an important step in solving the “chicken or egg” dilemma of which to create first: the infrastructure or the products that can use it.

“I believe that as the performance of electric cars improves, more people will be charging their vehicles overnight in their garages,” Tomczyk says. “And this single application could be a driving force that will pull smart meters into homes.... This will require sophisticated information technology applications to implement and will be an important area where IT will contribute to more efficient power consumption.”



What's more, a movement is afoot to make the IPSO (Internet Protocol for Smart Objects) Alliance the IT standard for smart devices designed to work with a smart grid. If the effort succeeds, it would be a win for consumers, who would not have to worry about compatibility issues that arise whenever a standards battle erupts over emerging technology. Supporters of the Internet Protocol for Smart Objects Alliance include such companies as Intel, Cisco, SAP, Fujitsu, Bosch, Johnson Controls and Sun Microsystems. Under such a program, every device that is compatible with a smart grid — every smart plug-in car, clothes dryer, dishwasher — would have its own IP address, just as each computer connected to the Internet does already. Proponents say this would make it easy for utility company computers to trade data with devices using the network, no matter what those devices were.

One application, for instance, would be for a driver to program his plug-in electric vehicle to charge only when electricity was least expensive. The smart car could, either wirelessly or using an Ethernet-type connection, detect when demand on the electric grid was high and wait until prices subsided to recharge its battery. Or it could be programmed to accept a charge only when power was being produced by renewable sources, which it would know because of information received through its IP connection. These processes would be completely automated, but if the driver chose, he could see real-time pricing and other data on an electronic display screen.

Communications — Keeping in Contact, Virtually

Staying in touch with clients and customers holds vast potential for realizing IT-derived economies, both financial and environmental. While communications holds promise as a way to control costs, no company can afford to compromise its messaging to employees, customers and other stakeholders. Enter IT, which allows companies to slash printing costs (using electronic communications instead) and to dramatically reduce business-related travel, using any number of voice, video and on-screen collaboration tools for connecting geographically dispersed workers.

Wipro's Kumar says such policies require time and patience for testing on an experimental scale before they are imposed across an organization. With the company's own policy of encouraging electronic communications as a replacement for travel in many cases, "you have to promote it as a process change and a behavioral change" to get useful adoption from staff and support from management.

Wipro is using IT to lower its carbon footprint and reduce costs associated with communicating through several means as follows:

- virtual meetings using e-collaboration tools such as online telephony, webinar, videoconferencing and related services;
- streamlined governance using Web workflows, automation of reporting and business intelligence dashboards; and
- newer information channels, including mash-ups that incorporate real-time data, RFID (radio frequency identification) data and GPS location information.

"One reason why things move fast here is because innovation is demanded when you're in a state of unfinishedness," Kumar says, referring to the pace and mind-set of a business in India's developing economy. "There's a natural tendency for recycling, for reducing waste, for cost-control."

Business travel remains a wide-open category for changing attitudes and behaviors. Most business travelers plan level or increased business travel in the near future, despite a down economy and increasing availability of IT-based virtual meeting tools, according to a 2009 survey by the National Business Travel Association and Vanson Bourne. The survey of European business travelers found that 52% planned to maintain their current level of business travel over the subsequent 12 months, while 22% expected to increase it and 26% anticipated decreasing it. Close to 20% had never used conference-call services, while 35% had never used videoconferencing. Of the individuals surveyed, just fewer than half said their company's environmental policy influenced their business travel, the biggest change being that they were using more public transportation.



Manufacturing

Manufacturing offers another compelling case for IT as a driver of carbon management and other conservation efforts. Once again, minimizing waste, and thus reducing costs, provides a clear impetus for adoption.

According to a 2009 report from Boston-based research company Aberdeen Group, the companies that ranked in the top 20% “best in class” of those surveyed were able to reduce energy consumption by 24% and emissions by 30% over the previous year, while exceeding their operating margin goal by 19%.

Undergirding these results was a strong framework of IT-enabled data management, according to the report, “Sustainable Production: Good for the Plant, Good for the Planet.” The best-in-class firms showed significantly higher adoption rates than lagging firms when it came to technologies such as dashboards, emissions monitoring and analytics.

The Aberdeen Group study of manufacturing firms found that 40% of respondents perceived competitive advantage as a top pressure driving sustainability efforts. Ensuring regulatory compliance was cited by 39%, while acknowledging customer demand for eco-friendly products was cited by only 29% of respondents.

The report concluded that automated data-gathering and visibility differentiated the top performers, who used the collected information as the basis for data-driven decision-making. In the course of business, a company will generate massive amounts of spreadsheet data about how it operates. “Visibility” refers to how easy or difficult it is to find specific pieces of such information — for instance, how much a particular business unit spends on heating and cooling. Automating the collection of such information lets companies see inside the nooks and crannies of their spending, therefore identifying potential savings.

Tying It All Together

With such an array of possible inputs, it can be difficult for a company to get an accurate read on where it falls on the sustainable practices landscape. Not surprisingly, a multitude of software tools exists to provide companies an IT solution for this need. They range from simple, downloadable Excel spreadsheets to complex, dynamic packages that integrate tightly with an organization’s business intelligence and enterprise resource planning systems.

“There have been more than 50 companies that have come up with similar solutions” for monitoring emissions at the enterprise level, says Hari Kishan Burle, practice head of Business Solutions & Architecture at Wipro. By and large, “companies are not spending money on the software yet” as they wait to see what the regulatory rules of the game will be.

One clear trend, though, is that the IT infrastructure itself is fast migrating away from users’ facilities and into the “cloud” of web-based service providers. In computing terms, “cloud” is an abstraction for the concept of using services for which someone else provides the applications and servers. Wipro and other companies provide cloud-administered software that lets companies calculate their emissions, observe how their emissions profiles change after mergers or acquisitions, and compare emissions-reduction goals to actual performance. Such a capability lends itself to the software-as-a-service, or SaaS, subscription model that has become standard for web-based reporting and analytics tools, as opposed to a one-time purchase of a software product. Such software can help companies monitor their direct emissions from activities such as work vehicles burning fuel; indirect emissions such as electricity used to power office buildings; and yet more indirect emissions such as business travel.

“When we started doing the research around this, we looked at cloud-as-a-service and ‘green,’” says Burle. “This is very highly standards-driven and so we figured it would be very good to be offered as an SaaS model.”



Rationale for Action

The last decade has witnessed a worldwide shift in business attitudes regarding sustainability — from a “nice to do” action item to a “must do.” Regulatory requirements (both current and forthcoming), public sentiment and increasingly dire warnings from the scientific community have repositioned “go green” pressures on the corporate agenda. And, of course, very tangible financial benefits can be captured in some cases.

One of the world’s largest retailers over the last few years has made sustainability a cornerstone of its business practices. Speaking at Walmart’s “2009 Sustainability Milestone Meeting,” incoming CEO Mike Duke told his charges “how very, very committed I am to this topic of sustainability. I am very serious about it. This is not optional.” Walmart’s green push began in 2005, when then-CEO Lee Scott set goals for the company to be supplied entirely by renewable energy, to create zero waste and to sell merchandise that supported sustainability. The company that prides itself on low prices has squeezed companies that make up its supply chain to adopt environmentally aware practices as well.

Many companies worry whether their investment in IT as a catalyst for greener operations will deliver financial returns. It was the top concern of IT professionals who responded to Forrester Research and Tech Touchstone Events’ 2009 UK Green IT Survey. Specifically, 49% said the main purpose of their green IT practices was to reduce power consumption, 40% said it was to extend the life of IT equipment, and just 9% said it was to stay ahead of forthcoming regulations.

Fair Isaac Corp., the credit scoring company, provides one example of what is achievable. The company (which now goes by its popular name, FICO) slashed power consumption by a third and paper output by a half in just six months after pursuing its aggressive Sustainable Enterprise Initiative. In a March 2009 case study reported by the data center journal *Enterprise Systems*, FICO said it focused on three areas to achieve the savings: making IT infrastructure more efficient, reducing travel through greater use of telecommuting, and greatly reducing printing.

Some other highlights from the FICO initiative include the following:

- The company consolidated 24 data centers into four, using virtualization, blade servers and the decommissioning of legacy heating and cooling systems, generators and uninterruptible power sources. That led to a 33% reduction in energy use.
- To support telecommuting, the firm built an infrastructure that included secure virtual private networks and higher bandwidth.
- To achieve the big printing reduction, the company instituted mandatory PIN code entry with all print jobs — a way to get employees to think twice before printing materials. The firm also enforced double-sided printing.
- To make it all work, the company launched an internal green education program, which has helped create the buy-in necessary to achieve results.

From this initiative alone, the company said it is realizing annual savings of \$740,000.

At Wharton, gaining buy-in from stakeholders has been crucial in greening IT operations and using IT to usher in greener practices. In 2008, for instance, Wharton Computing and Information Technology (WCIT) touted the merits of two-sided printing to faculty, staff and students. WCIT was able to make double-sided printing the default setting on all public printers. Furthermore, printers were adjusted to stop all abandoned print jobs. WCIT estimates the changes annually save Wharton 2.4 million sheets of paper, \$24,000 in paper costs, \$14,000 in toner costs, and that 267 trees a year are spared.

Regulation Ahead

With high hopes originally set for the United Nations climate conference in Copenhagen in December 2009, delegates failed to reach a legally binding agreement to replace the expiring Kyoto climate protocol. (Kyoto’s first commitment period expires at the end of 2012.)

Kleindorfer, who attended the conference, noted that there was a sense among international maritime associations and logistics groups that they must take carbon mitigation measures regardless of slow bureaucratic progress.



The consensus, he says, is: “If they don’t do this they’ll be considered irresponsible and have all kinds of [non-governmental organizations] on their backs.... So they might as well get ready for it.”

Before Copenhagen, legislative leaders worldwide agreed to promote proposals in their home countries that would set greenhouse gas target levels, enforcement methods and the support systems needed to implement them. The Global Legislators Organisation for a Balanced Environment meeting was seen as a prequel to the Copenhagen summit, providing a backup set of rules in the event that bureaucracy stalled the effectiveness of the Denmark conference.

Burle notes that individual countries and regions have moved ahead in promoting area climate laws, but it will be difficult to reap the full opportunities of IT — for instance, robust carbon exchange markets — without an international framework. “There has to be a concerted effort to make it an international solution.”

Changes to society brought about by IT in recent decades would have defied belief of non-technologists in the 1970s and 1980s. And yet it has been shown that the frontiers of technology will continue to expand under forces such as Moore’s Law — the continued increases of data density on integrated circuits — and the limitlessness of human imagination. Using the past as a guide, it does not seem unreasonable to project that information technology, along with innovation, could enable us to reach carbon emission reduction targets that seem aggressively optimistic by today’s standards.



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