

Key Findings

Powering Down: Green IT in Higher Education

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Green IT has always been a good idea. Conspicuous consumption of resources and profligate production of waste might make sense if energy, raw materials, and landfill space were unlimited, but those conditions have never really existed on this planet, however much the behavior of our species implied they did. Yet despite its importance, widespread environmental awareness—"green" thinking—is a relatively recent phenomenon, and its application to information technology (IT) has so far fallen short of its potential. Even in higher education, the IT organization is seen as a junior partner, at best, in the institution's overall sustainability efforts.

Environmental sustainability (ES) imperatives have become stronger in the past several years. *Climate Change 2007*, the report of the Intergovernmental Panel on Climate Change,¹ made it clear that global warming is a real phenomenon caused in large part by greenhouse gas emissions. It became a matter of conscience for individuals and institutions to change their practices to minimize those emissions. At about the same time, an unprecedented spike in fuel prices stimulated a similar set of changes, motivated more by economics than by conscience. Although prices have dropped since then, \$4-per-gallon gasoline was a wake-up call that still rings in many ears and continues to influence institutional budgets and policies. Finally, the global recession beginning in late 2008 has eroded endowments, strained governmental budgets, and jeopardized many social services, including higher education—with mixed results for green IT initiatives.

IT is a major consumer of energy and, to the extent that the energy it uses is derived from nonrenewable resources, is a net contributor of greenhouse gas emissions and other forms of waste. Gartner Inc. estimates that the IT industry overall is responsible for 2% of global CO₂ emissions, which is equivalent to the impact of the airline industry.² Gartner also estimates that "potential power cost and CO₂ emission reductions of 50% are available...by better managing the power usage of PCs, monitors, and printers—for instance, by encouraging employees to turn them off."³ Clearly, each college or university IT organization has a role to play in the institution's efforts to combat global warming, reduce expenditures on energy, and become more efficient in its use of natural resources and manufactured goods.

Until now, very little has been published to summarize green IT practices in higher education. While the literature provides anecdotal information from individual institutions, little compilation of current practices has been done, and advice based on objective evidence is rare. This ECAR study fills the void with information about the positions that institutions and IT organizations have taken on green IT and ES in general, the initiatives they have taken on, and the influence of both of those factors on environmental outcomes.

The most fundamental finding of our study is that campus IT units are being good citizens in the quest for environmental sustainability in higher education, but they are not taking the lead. Enthusiasm about sustainability runs high, and most institutions have green initiatives under way. Hundreds of college and university presidents have signed a formal commitment to reduce greenhouse gas emissions, and nearly all institutions are serious about recycling. But CIOs and other executives very often lack the basic information about baseline and ongoing energy use that they need to inform the ES initiatives they take on. They point to a lack of funding for their organizations and for their ES initiatives as the biggest barriers they face in greening their own operations, and they often report that the strategic guidance the institution provides in this area is insufficient. Not surprisingly, ES outcomes are disappointing: While business activities appear to be greening a little, instructional and research activities are lagging.

Defining Environmental Sustainability

Two generally interchangeable terms refer to environmentally sound practices. Sustainable practices are those that can be carried out repeatedly and over long time spans without lasting negative consequences. Increasingly, the term is applied to practices that impact the natural environment, but historically it has also been used to describe purely financial practices. Green practices or initiatives are typically those that are in harmony with the ideals of the environmental movement, are good for the planet, and are environmentally sustainable. In this study, we apply both terms to IT practices specifically, but also to more general activities taking place in business, instructional, and research contexts.

Methodology

To study green IT in higher education, we took a multipart approach that consisted of

- a literature review to define issues, examine ES practices, and establish research questions;
- consultation with higher education IT administrators and ES experts to identify and validate survey questions;
- a quantitative web-based survey of EDUCAUSE member institutions that received 261 responses, 77.8% of which were from the institutional CIO or equivalent;
- qualitative interviews with 26 higher education IT leaders and staff; and
- two case studies, one examining the integration of ES into institutional strategies at Adelphi University and one detailing the process a consortium of British Columbia institutions has undertaken to optimize their use of environmentally sustainable power sources for a green data center.

Key Findings

Our study was primarily concerned with the steps institutions and, in particular, IT organizations are taking to reduce their carbon footprint and their contribution to the e-waste stream. We also sought evidence that IT is no longer just a collection of expensive devices that consume electrical power, but is becoming a source of clean, energy-efficient alternatives to traditional practices whose costs are becoming unsustainable. Areas of survey coverage, which map roughly to the organization of this study report, include:

- *The institution*—the way ES efforts are organized at the institutional level, and the status of a selection of broad ES initiatives.
- *The central IT organization*—the way ES efforts are organized within the central IT organization and the central IT data center, and the status of IT-related initiatives.
- *Distributed IT*—ES initiatives applied to IT facilities and desktop computers that central IT does not control.
- *Grassroots support*—how well informed about ES issues campus constituents are and how their participation in IT-related ES initiatives has changed recently.
- *ES outcomes*—an assessment of progress toward the goals of institutional ES and green IT.

In the following sections, we summarize and synthesize our main findings.

A Green Bandwagon?

Whether one's politics are red or blue, the dominant color of the next few years is likely to be green. Good public relations these days require that colleges and universities project responsiveness to environmental concerns, and many of them find they are looked to as sustainability leaders in their communities. Our respondents signaled broad acceptance of this role; three-quarters agreed that their executive leaders, students, and CIOs placed high priority on ES initiatives. Further, most characterized their institutions and central IT organizations as being "actively engaged" in ES initiatives.

Despite this strong show of interest, however, only 4 in 10 respondent institutions' chief executives had signed the American College & University Presidents' Climate Commitment. The commitment makes institutions accountable, in a highly visible way, for achieving well-planned, measured carbon-emission goals. We suspect most non-signatories realize that such goals are out of their institution's reach at present.

When it comes to strategic planning for ES, however, it appears that comparatively little progress has been made. A completed plan was in place at only a quarter of institutions and in a tenth of central IT organizations. At both levels, just under half reported plans in progress. (As a predictor of findings we will discuss below, approximately 1 in 10 respondents did not know the status of their own institution's ES strategic plan.) A lack of planning doesn't imply a lack of activity, but it does suggest that many of the ES efforts being made at institutions without plans lack the executive imprimatur that often tips the balance between interest and commitment.

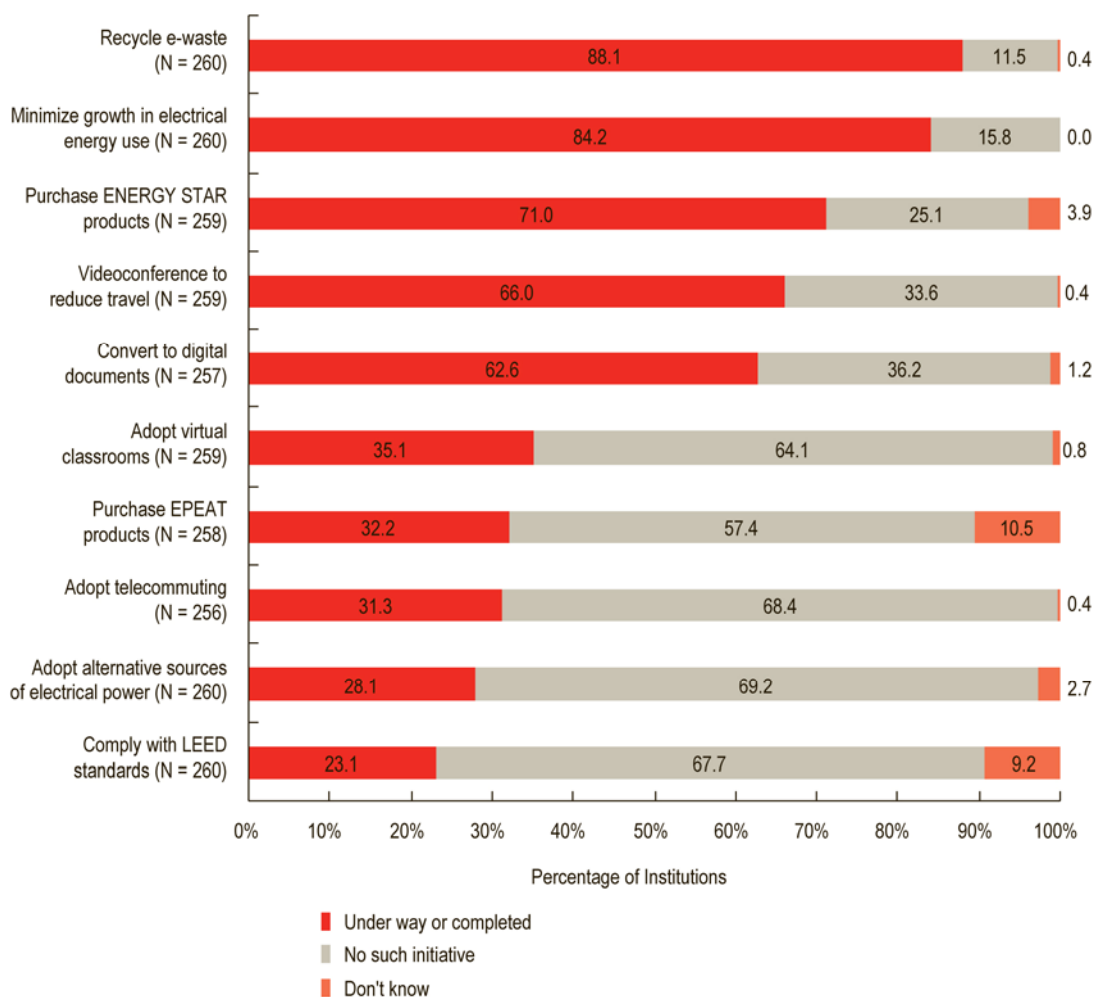
Green is a dominant color in another sense, as well. In the United States, at least, green is the color of money, and in these recessionary times financial issues have taken very high priority indeed. For both the institution and central IT, ES has the earmarks of an unfunded mandate. Only about half of our respondents reported the establishment of an institutional sustainability office to provide guidance and stability to those efforts; about two-thirds reported the less expensive approach of establishing an environmental sustainability committee. At the central IT level, guidance of ES initiatives is even less structured. Fewer than 1 in 10 IT organizations had assigned a full FTE or more to oversee ES initiatives, and fewer than a quarter had an internal committee whose charge included ES.

Clearly, most institutions are feeling economic pain. Three-quarters of respondents told us their institution's financial position had worsened, at least somewhat, in the 12 months prior to our survey. When asked to choose the top-three barriers to their central IT organization's ES efforts, respondents most frequently identified lack of adequate funding for central IT overall and for central IT's ES initiatives in particular. One-third of respondents indicated that economic pressures had affected their institutional and central IT ES initiatives, despite the fact that what is good for the environment is often good for the pocketbook as well.

Where the Action Is

Naturally, our respondents—mostly CIOs—were most knowledgeable about the initiatives under way in their own organizations (see Figure 1), and in the central IT data center “don't know” responses approach or exceed 10% for only two central IT initiatives but were more common for our questions about institutional initiatives and were very common (between 20% and 40%) for our questions about distributed IT initiatives. This, along with our finding that a tenth of CIOs don't know the status of ES strategic planning at the institutional level and other findings discussed below, builds a convincing case that when it comes to ES initiatives, many CIOs either choose to “tend their own gardens” or are simply not included in initiatives occurring outside their own units.

Figure 1. Status of the Central IT Organization's Environmental Sustainability Initiatives



Perhaps because concerns about it predate recent concerns about energy and climate, recycling of decommissioned IT equipment (e-waste) was the most active initiative, with most institutions' central IT organizations involved in it. Concerns about the climatic consequences of electrical energy production and about erratic changes in energy costs are obvious drivers of many other initiatives. While it may be unrealistic to imagine a future in which less energy is used, efforts to *minimize growth* in total electrical energy consumption are practicable, and strong majorities reported that both their institutions and their central IT organizations had initiatives under way to do so. One practical action is to purchase devices (not just IT devices) that have ENERGY STAR certification, indicating low energy consumption as compared with similar devices. Initiatives to purchase ENERGY STAR devices were in place at most institutions and in most central IT organizations. Videoconferencing to reduce staff travel and conversion from paper to digitally imaged document storage were also commonly reported.

The more common initiatives are inexpensive to implement or are worth some up-front costs because in the long run they save money in various ways. Far fewer respondents reported undertaking

initiatives in which change is more expensive or is harder to achieve because the issues the initiatives raise are complex and embedded in institutional culture. Among the 10 institutional and central IT initiatives we asked about, three that were seldom under way were adopting virtual classrooms, purchasing EPEAT-certified computers and monitors, and adopting telecommuting as an energy-saving way for employees to work. The first involves changing entrenched instructional paradigms; the second involves changing established purchasing paradigms for IT devices, where the trade-offs between capability and energy consumption may be more difficult to reconcile than for, say, ENERGY STAR refrigerators; and the third involves changing traditional human resource paradigms.

Where change is expensive, fewer undertake it. Included among the least pursued institutional and central IT initiatives was the adoption of alternative (clean/renewable) sources of electrical power. For most institutions, decisions about electrical power sourcing involve very few decision makers who often have very few viable options. At present, the financial costs (and sometimes the logistical costs) of switching the institution to a green energy supplier are usually prohibitive. However, with the advent of regulations involving a carbon tax or a carbon emissions cap-and-trade scheme, we could see the scales tip rapidly in favor of green energy sources.

At a very practical level, the central IT data center is fertile ground for a variety of low-cost ES initiatives, but in contrast to other domains, we found that the more popular data center initiatives were ones that required up-front capital investments. Most respondents said local storage for servers was being centralized onto storage area networks and the like, and a similar proportion said the number of data center servers was being optimized through consolidation and virtualization. A small majority was also upgrading air temperature management gear. While these four initiatives are likely to result in long-term cost savings, start-up for them is capital intensive, and we were surprised that in difficult financial times they were so pervasive.

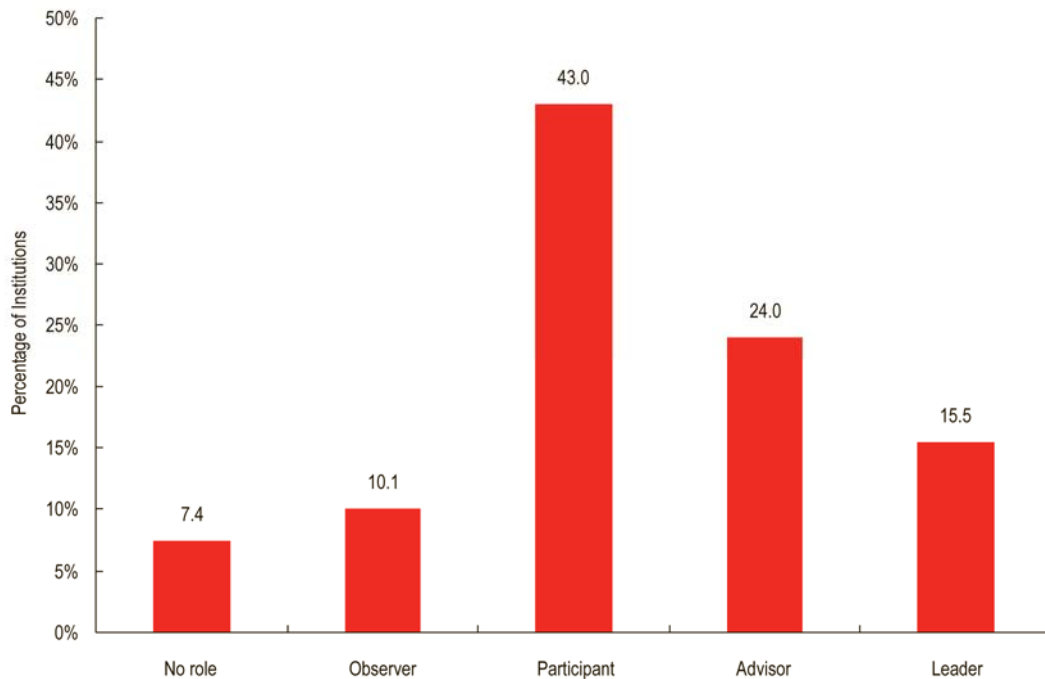
Initiatives that cost less but involve logistical or behavioral changes in the data center were much less popular. We had imagined the “low-hanging fruit” of data center ES initiatives to be softer initiatives that are mentioned frequently in the green data center literature, such as raising machine room thermostat settings, reducing machine room illumination, making greater use of outside air for cooling, and reengineering floor vents. Among the softer initiatives, the only one undertaken by a majority was repositioning of servers into alternating hot and cold rows to make cooling more efficient.

About half of our respondents said their institutions had departmental IT facilities not managed by the central IT organization. As mentioned above, many respondents were unaware of ES initiatives under way in these distributed facilities, but among the 100 who were able to speak to them, majorities reported initiatives under way to recycle e-waste, optimize numbers of servers through virtualization and consolidation, and aggressively manage PC power consumption. Departmental efforts to replace CRT monitors with LCDs were well under way for most units at a majority of respondent institutions, with efforts to replace desktop computers with energy-efficient laptops trailing somewhat. Initiatives to replace full-function PCs with thin-client workstations were under way only in selected units, and then at only a third of institutions.

Outreach from Central IT

Given CIOs' role in managing innovation and directing large and energy-hungry organizations, one might expect to find them in the forefront of ES initiatives. But our findings tended to confirm the pattern of IT marginality that we mentioned at the start of this chapter. We have seen that the CIO is not always knowledgeable about ES initiatives occurring at the institutional or distributed levels, and so it comes as little surprise that our respondents seldom characterized the CIO as a leader in the institution's ES initiatives (see Figure 2). In fact, a majority characterized the CIO's role as no more active than a "participant." Consistent with this finding, when asked what the three primary drivers of their central IT organization's ES initiatives were, a majority selected "participation in institutional initiatives." (Large percentages also selected "cost reduction/increased efficiency" and "doing what's right for the planet.")

Figure 2. Role of the Senior-Most IT Leader in Institutional Environmental Sustainability Efforts



As the relatively modest roles taken by CIOs suggest, central IT is acting more as a good citizen in institutional ES initiatives than as a change agent. We investigated IT's influence through three survey questions: Did central IT support the initiative by participating in it, by providing technology solutions/services in support of it to departments/individuals outside central IT, or by educating departments/individuals outside central IT about it?

For most initiatives, 9 respondents out of 10 said central IT supported it by participating in it. Exceptions were the adoption of alternative sources of electrical power and adoption of LEED green building standards, where central IT would naturally have little influence; for each of these, only a small majority of respondents said central IT participated. Central IT's provision of technology

solutions/services in support of ES initiatives was substantially less pervasive, though still common. Most frequently supported in this way were initiatives to convert to digital documents, videoconference to reduce travel, and adopt virtual classrooms. All are initiatives in which central IT would have particular expertise and to which centrally provided and/or supported technologies might bring the greatest advantage. For these three initiatives as well—and for the same reasons—central IT was most likely to provide support in the third way, by educating other campus entities about it.

Where the CIO played a more active role in institutional ES initiatives and where the central IT organization's ES strategic plan was more complete, central IT's support for institutional ES initiatives was significantly richer. These institutions, while rare at present, may be showing the way for central IT to emerge from its junior-partner status in the institution's pursuit of sustainability.

An added dimension of central IT's support for ES is its coordination of ES initiatives that are under way in distributed IT facilities. While CIOs knew relatively little about the ES initiatives distributed IT organizations had under way, where they were aware they were also often helping out. This is a wise investment for all concerned because coordination of distributed initiatives puts central IT in a position to influence behaviors that decrease the institution's carbon footprint, by helping stem the proliferation of departmental server rooms and computing laboratories, for example. These are often located in sub-optimal facilities and may not be managed with ES concerns in mind.

Getting It Together

It is axiomatic that you can't manage what you don't measure. We heard often in our discussions with higher education CIOs that the primary difficulty in benchmarking and tracking energy consumption was the institutions' inability to sub-meter electrical energy consumption at a useful level of granularity. Managing energy use is key to reducing an institution's carbon footprint and controlling energy expenditures in a shaky economy, yet most institutions lack the basic infrastructure for setting measurable energy-related goals. For most institutions, then, improving the granularity and availability of energy consumption information will be an important step in addressing the ES demands of the coming decade.

As past ECAR studies have documented, measurement of progress toward goals is often a challenge for higher education IT organizations, and the ES context is no exception. Some initiatives, like adoption of LEED green building standards, come with sets of predefined goals that most implementers can measure, and where that initiative was under way at the institutional level, a majority of respondents reported measured goals in place. Where initiatives were under way for adoption of alternative sources of electrical power and for minimizing growth in electrical energy use, more than a third of institutions reported having measured goals in place. But for the remaining seven initiatives, fewer than 25% of respondents reported measured goals at the institutional level. At the central IT level the situation is even worse: Fewer than 15% of respondents reported measured goals in place for any of the 10 initiatives.

Measurement of goals is one indicator of mature practices, but there are others. And where more mature sets of practices are applied to ES initiatives, clear benefits result. For the institution and for the central IT organization, our survey asked parallel sets of questions based upon the Carnegie

Mellon Capability Maturity Model Integration literature.⁴ Specifically, we asked respondents for their level of agreement with statements that their ES practices were

- well organized,
- applied consistently,
- well documented,
- assessed regularly, and
- closely aligned with strategic objectives.

From the responses, we calculated an ES practice maturity score for each institution and its central IT organization. Not surprisingly, we found that the two scores tracked well with each other. Where the institution had invested in a mature set of practices, the central IT organization had usually done so as well.

ES practice maturity at both levels is tied to many other aspects of institutional and central IT ES efforts, such as ES strategic plan status, existence of an ES office and committee, and the role of the CIO in institutional ES initiatives. And predictably, where measured goals were in place for more initiatives, the ES practice maturity score was higher at both the institutional and the central IT levels. These associations suggest that ES practice maturity runs deep, drawing from such attributes of institutional culture as planning, inclusiveness, and accountability. It is one element of a proactive approach to dealing with environmental concerns and, not surprisingly, is one of the most powerful explainers of ES outcomes.

Environmental Sustainability Outcomes

As we have seen, the approaches the central IT organization takes toward greening its practices spring from many sources, ranging from embedded cultural values, through economic expedients, to the enthusiasms of influential individuals. Much of our study focused on initiatives, which are, by definition, beginnings. To get a sense of where all the ES activity we measured has led, we explored respondents' sense of the progress their IT organizations and their institutions had made toward meeting several high-level goals.

About half of respondents reported that, in their judgment, the institution had increased or greatly increased the amount of material it recycled in the past 12 months. About 4 in 10 reported the same for the central IT organization. This difference is small and probably reflects recycling opportunities related to the presence of food service items and the like in the institution's waste stream. Only a small handful of respondents reported that the amount of material recycled had declined at either level. Results about the amount of material the institution recycled were unrelated to other factors from our survey, but change in the amount of material the central IT organization recycled was significantly and substantially greater where both the institution and the central IT organization had initiatives in place to recycle e-waste. This suggests that one way for central IT to improve its performance in this high-visibility ES activity is to put the framework of a formal initiative around it.

For change in energy efficiency, results were less uniformly positive. Half of respondents said that in their judgment the energy efficiency of the central IT data center had increased in the past 12 months, while 4 in 10 said the energy efficiency of the institution as a whole had increased. Again, the difference is small; in this case it probably reflects the rapid turnover in energy-consuming IT infrastructure, which speeds the influx of efficient devices. To our surprise, however, about 1 in 6 respondents said the energy efficiency of both entities had decreased in the past 12 months. With pressures—and opportunities—to improve energy efficiency looming so large in the year preceding our survey, any movement in the opposite direction is disturbing. Money seems not to have been a factor: Change in energy efficiency varied independently of all the financial indicators we asked about. Instead, we may be seeing evidence that at some institutions entrenched energy use practices are difficult to change, even when they result in losses rather than gains in energy efficiency.

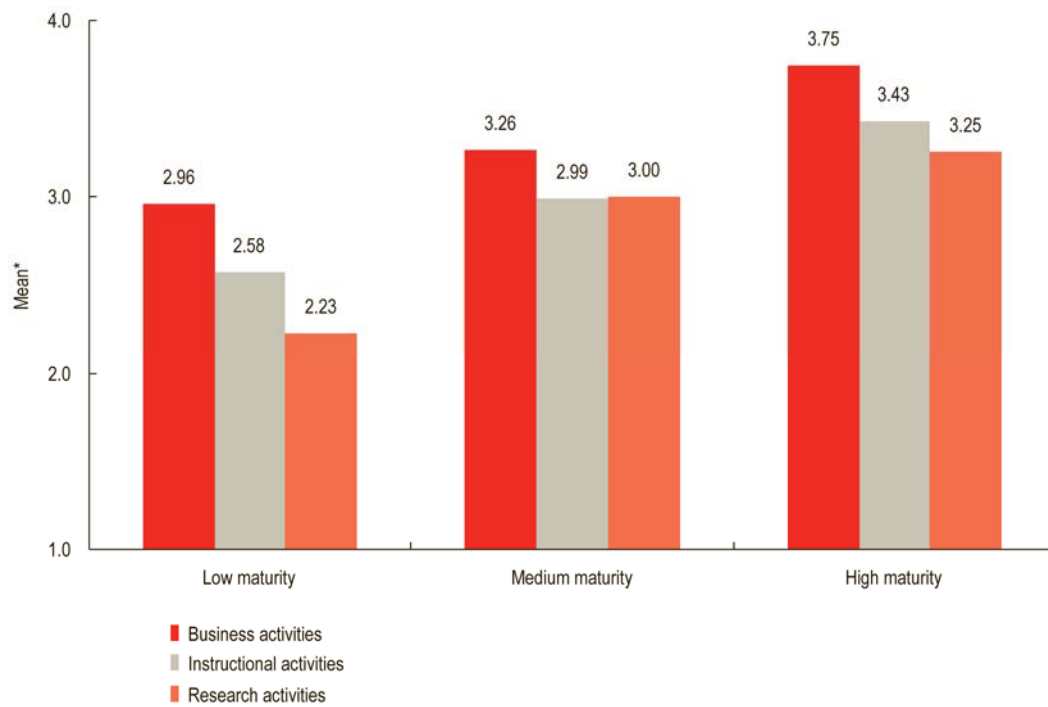
Respondents were much more variable in their agreement that, in the past 12 months, their institution had significantly changed its business, instructional, and research activities to become more environmentally responsible. Just under half of respondents agreed that business practices had improved in this way, which is not an impressive showing, considering the high level of engagement in ES activity respondents claimed.

Agreement was even weaker that the institution had significantly changed its instructional and research activities to become more environmentally responsible. Excluding “don’t know” responses, fewer than a third of respondents agreed that significant change toward environmental responsibility had occurred in both types of activities, while nearly equal numbers disagreed. We understand that business practices are more susceptible to central management than instructional or research practices, and so we are not surprised that ES initiatives were less likely to have led to perceived change in the latter areas.

“Don’t know” responses about research activities exceeded 30% of the total, after excluding institutions where a lack of research activity generated “does not apply” responses. No doubt the highly distributed—and highly independent—nature of research activities helps explain why so many of our respondents were unfamiliar with ES practices in that area.

Perceived recent change in energy efficiency and the amount of material recycled appeared to vary independently of nearly all other institutional and central IT characteristics we measured. Not so for the perceived greening of business, instructional, and research activities. As Figure 3 shows, progress in all three areas was greater where institutional ES practice maturity score was higher. The same was true for central IT ES practice maturity. Both types of maturity were felt most strongly in the research area, suggesting that where the institution really values the components of ES practice maturity, even the somewhat refractory research enterprise will participate more fully.

Figure 3. In Past 12 Months, Institution Has Significantly Changed Activities to Become More Environmentally Responsible, by Institutional Environmental Sustainability Practice Maturity Score



* Scale: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree

Other characteristics tied to positive change in these three activities suggest that the broader the commitments the institution and central IT make to ES, the more likely the three activities are to change in the direction of environmental responsibility. Among the most influential characteristics were

- the completion of institutional and central IT ES strategic plans,
- involvement in greater numbers of ES initiatives (from our list of 10) at each level, and
- stronger agreement that individuals at the institution are well informed about both general and IT-related ES issues.

The way faculty, staff, and students feel about the ES efforts under way at their institution is an important measure, not only of the appropriateness, integrity, and success of those efforts, but also of the institution's ability to adapt and evolve its strategies in response to changing conditions. Just under half of respondents agreed that faculty, staff, and students were proud of the institution's stance on ES, and most of the rest took a neutral position. Overall, this was a strong showing for green pride, and it's somewhat surprising in the face of the other, relatively lackluster, outcomes discussed above. The same ES-related characteristics of the institution that are positively associated

with change in business, instructional, and research activities—and most of those characteristics at the central IT level—are also strongly associated with green pride, reinforcing the message that where ES efforts throughout the institution are better planned, better informed, and more actively pursued, outcomes are likely to benefit.

Conclusion

Higher education clearly has taken a seat on the environmental bandwagon of the 21st century, but our findings suggest that most institutions' engagement in sustainability efforts is more opportunistic than systemic. Central IT has the potential to be a leader in ES initiatives. Its leaders often characterize their organizations as playing a “transformative” role in achieving the institution's goals. But in the context of green IT, our findings suggest that most are more reactive than transformative.

Our respondents—most of them CIOs—readily agreed that their institutions are participants in institutional initiatives but less frequently claimed a role in providing the campus with technical solutions and services to assist with them or in educating campus constituents about them. Fewer than a sixth of respondents characterized the CIO as a leader in the institution's ES initiatives; a majority chose more passive descriptions: participant, observer, or no role at all.

Many institutions and central IT organizations are clearly struggling to gain traction with their ES initiatives. While most central IT organizations have about as many ES initiatives under way as their parent institutions, IT was much less likely to have measured goals in place for them, making accountability for their accomplishments difficult. Fewer than half of respondents said their institutions had made significant progress in the greening of their business activities in the past year, and substantially fewer reported progress in instruction and research.

At most institutions, ES is an unfunded mandate, and financial obstacles may be partly to blame for lackluster performance. Many respondents pointed to a lack of funding for the central IT organization and for its ES initiatives as barriers to carrying out those initiatives. But institutional leadership is a problem as well, with many respondents telling us that the strategic guidance the institution provides in this area is insufficient.

To play a more active and effective role in their institutions' ES initiatives, CIOs—and other department heads—will require more information. At a strong majority of the institutions we studied, individual units were neither informed of nor billed for their energy use, nor had comprehensive energy audits been conducted in the past 12 months. Because reduction in energy use is the bottom line for so many ES initiatives, the lack of sufficiently granular usage information is a barrier to the management of ES initiatives—and poorly managed initiatives are often doomed to irrelevance.

Perhaps because of barriers to communication within the institution, but perhaps simply because of a lack of interest, respondents were commonly uninformed about ES initiatives and outcomes outside their own organizations, either at the institutional level or the level of distributed IT facilities. We are left with the impression that most CIOs are tending their own gardens but are not interested in—or are not included in—the ES activities of other IT-intensive units or of the institution as a whole.

Our findings throw some water on the fiery enthusiasm our respondents expressed in claiming their institutions and central IT organizations were “actively engaged” in ES initiatives and on their strong agreement that their leaders placed high priority on ES. Though enthusiasm is important to any worthwhile enterprise, without hard work it is seldom sufficient. But there is much good work to be done in the ES area, and central IT still has an important role to play in it. Even without additional financial resources and strategic guidance from outside central IT, there is low-hanging fruit to be harvested in data center energy management. And with a little outreach from central IT, server and workstation power management strategies can be promulgated across the campus, yielding substantial energy savings.

But more important than these incremental improvements is the potential for IT to fulfill its promise to transform the enterprise through the application of the technologies it knows best. For example, CIOs have the expertise and the resources to get out in front of energy-saving initiatives such as virtual classrooms and telecommuting, initiatives in which few central IT organizations now take the lead. And as regulatory pressures and the emergence of the smart grid turn energy management into a data processing and analysis function, CIOs will be called upon to engage. Those who are environmentally knowledgeable and whose organizations are mature, agile, and collaborative will find an opportunity to step up to a new level of leadership.

Endnotes

1. *Climate Change 2007—The Physical Science Basis*, Susan Solomon et al., eds. (Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, February 5, 2007), <http://www.ipcc-wg1.unibe.ch/publications/wg1-ar4/wg1-ar4.html>.
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A copy of the full study referenced above is available via subscription or purchase through the EDUCAUSE Center for Applied Research (www.educause.edu/ecar/).
