Energy Industry Guidebook

Achieving Energy Efficiency in PC Networks

A guide for utilities and energy industry service providers.

VERDIEM

Power Management for PC Networks

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Executive Summary

Energy efficiency initiatives, whether promoted through active demand side management programs, energy services projects, energy performance contracts, or through other more informal channels, have been an integral part of the energy marketplace for more than two decades. However, one source of energy consumption, networked personal computers (PCs), has been growing at alarming rates and has received little, if any, attention. In fact, this overlooked energy draw has quietly grown into a problem of epidemic proportions. As such, solving the problem of wasted energy in networked PCs presents huge opportunities for an organization and its utility and energy service provides.

According the Lawrence Berkeley National Laboratories, more than 71 million personal computers are operating in commercial settings in the United States. Despite the fact that most PCs have the capability to shift to a low power state when not in use, the vast majority of these devices do not do so. In fact, it is estimated that more than 40% of the monitors in the commercial marketplace never utilize low power states, and that a staggering 90% of CPUs are continually left in an 'always on' mode. Further, a disturbing number of machines are not shut down at night, often at the request or mandate of the IT department that is responsible for managing them. For a typical commercial energy consumer, these inefficiencies present an incredible opportunity to save tens, or even hundreds, of thousands of dollars each year, simply by properly managing these devices.

Solving this problem and harvesting the savings, while once a daunting task, is now possible due to the advent of new and innovative technologies, and more specifically due to Verdiem's development of SURVEYOR, a unique product that provides dynamic management of PC power states while simultaneously measuring and reporting energy consumption.

This guide more precisely defines the problem of energy waste in networked PCs, quantifies the savings opportunity for customers, utilities and ESCOs alike, and shows how this growing and elusive draw can be managed in a way that provides savings, ensures persistence and provides for ongoing measurement and verification (M&V). Indeed, what was once thought to be an immeasurable and unmanageable source of energy consumption is now a rapidly addressed and significant source of opportunity for energy savings.

The Problem, The Myths & The Opportunity

The Problem

Energy consumption attributable to desktop office equipment has grown exponentially in the last decade. The reasons for this growth are both intuitive and surprisingly counterintuitive. The intuitive reason is simply related to the rapid proliferation of desktop PCs in commercial and institutional settings, where there is at least a one to one ratio between workers and computers. In fact, many institutions now have more PCs than employees. The counterintuitive reason is that many believe that newer generation PCs are more efficient and are using less energy.

However, the reality, which is discussed in detail in the 'Myths' section below, is that PCs are consuming more energy than ever before. The equation is troubling indeed: more PCs consuming more energy add up to unprecedented energy consumption and cost….and most consumers, while noting that their energy costs are rising, are still unaware that the PC explosion could be at the heart of the problem.

Why power management functionality is largely unused has been the topic of much research in the past decade. To be sure, it is attributable to a number of factors, all of which point to a fundamental lack of historic balance between what have emerged as competing goals of energy efficiency and basic network management. Early versions of power management often resulted in impacts to both users and to productivity, conflicts that were primarily caused because computer hardware was often unable to 'wake up' from a low power state.

As a result, many organizations institutionalized policies against using power management, producing a generation of knowledge workers who thought that power management of PCs wasn't possible. Despite the fact that newer equipment has resolved these conflicts, the old negative views of power management persist. Studies have repeatedly shown that the vast majority of PCs in the commercial marketplace have their power management functionality disabled.

In addition, many modern IT departments have institutionalized bans against power management for another reason altogether: because they want PCs to be on and available at all times in the event that a virus update, system maintenance or other network activities are to be conducted. Due to the lack of a dynamic central management system, the result of all of these postures is an enormous waste of energy and operational dollars.

The Myths

Myth #1: New PCs already have ENERGY STAR functionality, and therefore are more efficient

False. While it is true that newer PCs have EnergyStar functionality, we now know that the functionality is disabled in the vast majority of commercial PCs. However, the presence of this functionality is what makes SURVEYOR such a powerful tool. In fact, the more power management capabilities that a PC has, the more powerful SURVEYOR becomes. ENERGY STAR functionality is what allows a PC and its monitor to use low power states, such as 'standby' and 'hibernate'. Unfortunately, this functionality is rigid in that it is useful only for a single machine and that it cannot accommodate multiple policies during a 24-hour period. Further, it cannot tell a PC to shut down as a scheduled event. The net result is that even modern ENERGY STAR functionality, by itself, is not effective at curbing energy consumption in networked PCs.

SURVEYOR, which elevates control of ENERGY STAR functionality to a central management interface, allows organizations to harness ENERGY STAR functionality for the entire network, striking a perfect balance between energy savings and networked productivity. More will be discussed about SURVEYOR's functionality in section IV (SURVEYOR: The Only Comprehensive Solution) of this guide.

Myth #2: New CPU's and monitors are more energy efficient and consume less energy

False. While the components of new CPUs and monitors are generally becoming more efficient, as a combined unit they are consuming as much or more energy than ever. CPUs, for example, are consuming significantly more energy today than they did in past years. The reason for this is simple; machines continue have more memory, more drives, faster processors and often more fans to keep them cool.

With monitors, many believed that the onset of LCD monitors would be the answer to bulky and inefficient CRTs. However, that is not proving to be the case. First, the transition to LCDs is extremely slow, mainly due to their high cost. Secondly, those customers that are making the transition are typically buying a larger flat panel display to replace their old CRT. For example, they might replace the 15" CRT with an 18" flat panel. And lastly, in many instances a single CRT is being replaced by two LCD monitors. This market trend shows that there are few savings that are being realized by this transition, and that a new CPU and monitor duo that is typical in the marketplace will consume as much or more than its predecessors.

The Opportunity

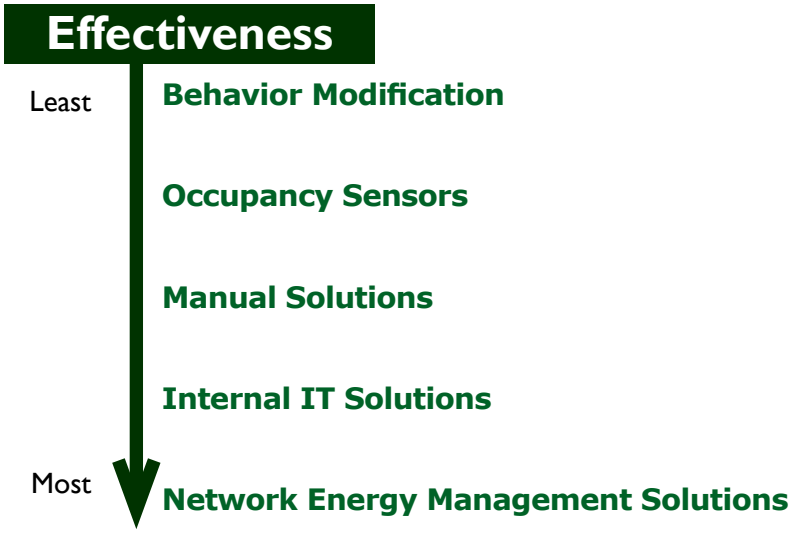
In 2002, Arthur D. Little published a study that indicated that computers and monitors consumed over 36 terawatt-hours (TWh) in 2000, or a whopping 3.3% of energy consumption in the entire commercial sector for that year. This consumption is expected to grow at a rate of more than 4% each year through 2025, clearly distinguishing it as one of the most rapidly increasing sources of energy consumption in the country. Over the past several years, market studies have repeatedly shown that only a small number of PC users enable the power management functions that are built into virtually every computer that is found in the commercial and institutional marketplace. A study published by ESource indicates that as few as 6% of PCs in nonresidential settings have power management enabled.

Further, most PCs are, whether intentionally or by design, left 'on' overnight and on weekends. The net effect, when factored across the 71-million-plus PCs currently operating in the commercial sector in the US, is unnecessary energy waste of 24 TWh per year….which equates to a staggering $1.92 billion of potential annual energy savings (at an energy rate of $.08 per kWh).

To put these numbers into perspective, a typical organization with 5,000 PCs is currently wasting an average of 2 million kWh of energy per year, or $200,000 at average energy rates. That is more than $1 million of needlessly wasted energy cost in a five year period, a staggering number indeed considering the budget crunches currently faced by most public and private organizations.

Solving the Problem

As with any energy efficiency project, there is a hierarchy of solutions that can have a positive impact on reducing PC-based energy consumption. Behavior modification programs, occupancy sensors, manual enabling of power management functionality, internal IT solutions and network energy management solutions, while varying in cost, effort and effectiveness, all can serve to reduce energy consumption from this equipment. However, an analysis of each shows that the only solution that can fully solve this problem is a network energy management solution.



Behavior Modification

Behavior modification, or awareness education, represents the most basic type of energy efficiency initiative. It requires no capital, no building retrofits, and little visible expense. That is not to say, however, that these programs aren't expensive. Studies have shown that these types of efforts are extremely costly in staff time, and that the efforts often produce mixed results with little or no persistence. For networked PCs, behavior modification is even more difficult than campaigns that target lighting or heating and cooling systems. This is because IT mandates and individual preferences are often incompatible with behavior modification efforts that would seek to have PCs turned off when not in use. Further, there is absolutely no measurement or tracking component available with this type of effort, making it all but impossible to understand if and to what degree that efficiencies are being achieved.

Occupancy Sensors

Occupancy sensors are a relatively simple way to get control of some electrical systems, particularly lighting or devices such as vending machines. And while they do have some application to PCs, that application is limited. Products exist in the marketplace that can be attached to computer monitors, turning them off when an individual leaves his or her office space. However, occupancy sensors are never used to control the CPU itself due to risks of data loss and system failure from experiencing repeated hard shutdowns. Because of this, occupancy sensors are only capable of achieving savings on about half of the total energy draw attributable to a PC system. Further complicating the use of occupancy sensors is cost. Most of these devices carry costs of $70 - $120 per unit, with one unit being required for each monitor. The return on investment from such a purchase is likely to stretch out to several years, making the project financially unviable.

Manual Solutions

Energy consumption in PCs can also be controlled by manual efforts. Individuals can be tasked with physically turning off PCs at nights, on weekends and after hours. This requires a significant amount of manpower and poses often unacceptable risks to data loss and impacts on user productivity.

Internal IT Solutions

A minimal form of PC power management can be achieved by leveraging existing IT desktop management tools such as Active Directory (AD) and Group Policy Objects (GPO). Startup/login scripts can be set for each group of PCs on a network, enabling AD and GPOs to achieve a one-way power setting policy push to networked PCs, moving them into a lower power setting. Unfortunately, the power management results are limited since:

- Scripting can only group users based on the object and attribute confines of the AD framework (users, computers, OUs, Sites, Domain controllers, DNS, etc.) verses based on PC usage behavior and energy consumption patterns
- Scripting cannot measure the amount of energy being used nor report on the amount of energy being saved
- Scripts may not affect all PCs on a network since they cannot change administrative-level settings unless the logged in user has administrative rights

Additionally, scripting is labor intensive, requiring IT resources to write, test, and debug scripts for each group of PCs and since most power settings are not scripted, a utility is required to kick them off.

Active Directory, Group Policy Objects, scripting, and tools like them are ideal for day-to-day desktop management, but not for maximizing PC power management. Truly effective PC power management requires:

- Dynamic "switching" power schemes that make PCs energy efficient without impacting user productivity by matching users' work schedules with the after-hours schedule of the IT department.
- Verifiable measurement and reporting on per-PC and network-wide energy consumption and savings.
- Power management "profile groups" that coordinate the power needs of similar clients, operating systems, or users to set power settings that harmonize with diverse user needs, schedules, and preferences.

Currently these critical features and functionality can only be found in network energy management solutions.

Network Energy Management Solutions

Network energy management solutions are the most comprehensive and cost-effective means of solving the problem of wasted energy in networked PCs. This type of solution elevates power management control to a central level and provides the IT department with the ability to achieve energy savings while maintaining their ability to insure network stability and to carry out all of their scheduled tasks. Network energy management solutions can vary greatly in their features. A comprehensive solution will have the following minimum capabilities:

- The ability to accurately measure PC-based energy consumption;
- The ability to generate cost and energy consumption reports;
- The ability to create distinct 'groups' of users that can each have unique and customized energy profiles;
- The ability to create multiple profile periods within a 24 hour period;
- The ability to execute automated 'shutdowns' of either individual PCs or groups of PCs either on a preset schedule or at the discretion of the system administrator;
- The ability to provide individual users the option of 'overriding' a shutdown command in the event that they are actively working at their PC;
- The ability to abandon a shutdown in the event that a program is open on a PC, thereby insuring that critical data will not be lost.

There are but a few of the critical components that should be present in a Network Energy Management Solution, and are the key management elements that allow organizations to strike balance between energy efficiency, user productivity and network stability.

SURVEYOR: The Only Comprehensive Solution

What Does SURVEYOR Do?

Simply put, SURVEYOR is the only network management tool that brings balance to the competing needs of energy efficiency and user productivity. It provides organizations with a simple but powerful way to establish network energy policies that insure that the maximum amount of energy will be saved without negatively impacting end users or placing a burden upon the network. Just as a lighting efficiency retrofit will fail if it does not provide enough light for a building occupant, so too will a PC energy efficiency measure fail if it is too rigid to accommodate the specific needs of a wide array of users. SURVEYOR's highly customizable administrative interface insures that balance can be struck, and that energy efficiencies can finally be garnered by wisely managing networked PCs.

How SURVEYOR Saves Energy

SURVEYOR provides centralized control over the power management features of each PC within a computer network. This centralized control feature allows organizations to set standards that insure that when PCs are not in use that they are either using low power states appropriately or that they are completely shut down. SURVEYOR is completely configurable and customizable, and allows every organization to set policies that will insure that the maximum amount of energy savings are achieved without negative impact to either the PC network itself or to the productivity of individual users. In order to insure that the maximum amount of energy is saved, SURVEYOR is engineered to allow different sets of policies to be established for different groups or types of users. This 'grouping' feature insures that each individual PC is being managed appropriately from an energy perspective. Further, SURVEYOR allows multiple policy periods to be established throughout the day, allowing an organization to be less aggressive about energy savings during the active work day, and much more aggressive after hours and on weekends. SURVEYOR also provides an automated shutdown feature that allows PCs to be powered off on a pre-established schedule.

On average, SURVEYOR saves about 200 kWh per PC per year, and does so in a way that is transparent to the end users. For an organization with 5,000 PCs at average energy rates, this equates to savings of around $100,000 per year. SURVEYOR's pricing assures that the product generates a simple payback within 12-18 months at average energy rates. For large volumes and in areas of high energy cost, SURVEYOR's payback often drops to six months or less.

How SURVEYOR Measures PC-Based Energy Consumption

SURVEYOR is a comprehensive measurement tool in addition to a management tool. SURVEYOR very specifically measures 'time in state' data for each and every PC in the network. In other words, it knows the exact duration of time that every PC in a network spends in their 'On', 'Standby', 'Hibernation' and 'Off' modes. In the beginning of each deployment of SURVEYOR, actual watt readings are taken for the typical PCs and monitors in each of the power states indicated above. These watt readings are then used as the multiplier for the 'time in state' data that is collected by SURVEYOR on an ongoing basis. The result is an incredibly accurate measure of PC-based energy consumption. The data from each PC is aggregated by SURVEYOR's built-in reporting tool, which allows up-to-the-minute energy consumption and cost reports to be generated on-the-fly.

How Savings are Tracked through Verdiem's M&V Protocol

Verdiem has integrated the M&V protocol that is the standard for the State of California statewide program as sanctioned by the California Public Utilities Commission (CPUC). Verdiem has adopted this standard since California is a recognized leader in energy efficient practices, setting some of the nation's most aggressive energy saving goals and this protocol incorporates the International Performance Measurement & Verification Protocol (IPMVP) - used throughout the United States and the world to help standardize concepts and options for M&V of energy. Almost all performance-contracting firms adhere to the IPMVP.

Using an established protocol ensures the establishment of an accurate baseline and makes certain that actual savings are derived by referencing savings data to the baseline at regular intervals. A full copy of Verdiem's M&V protocol can be found in the 'Supplements' section of this document.

SURVEYOR measures and quantifies the amount of energy consumed by a PC network via client-server application. The SURVEYOR server software includes a management console for an energy manager or network administrator to define and "push" power management settings to PCs on the network.

The SURVEYOR client software receives and enforces those power management settings, and continuously collects data such as the time and energy state of each PC. The resulting data is periodically saved in a server database to feed reports that can be generated to show energy consumption over any given period of time.

By determining the amount of time each PC spends in each of its energy states, SURVEYOR can precisely calculate the actual network energy consumption and enable organizations to establish optimum power management settings that minimize user impact and maximize energy savings.

SURVEYOR's Third Party Validations

SURVEYOR's measurement functionality and field performance has been validated by a number of independent, third party organizations, including the Northwest Energy Efficiency Alliance (NEEA). NEEA commissioned Quantec LLC, an independent contractor, to conduct a series of market evaluation reports aimed at discovering SURVEYOR's impact in the commercial marketplace. Two of these reports have been completed and posted on the NEEA website at www.nwalliance.org under Evaluation Reports off the Resource section of the site.

Among other critical evaluation factors, Quantec evaluated SURVEYOR's measurement capabilities head-to-head against more traditional measurement equipment such as data loggers. Loggers were connected to PCs at a number of Verdiem's customer sites in order to collect data simultaneous to SURVEYOR. The results confirmed that SURVEYOR's measurements were statistically equal to those collected by data loggers.

Since the completion of the Quantec reports, SURVEYOR's measurement functionality has been evaluated by other organizations as well. Southern California Edison, Advanced Energy (part NC State University) and Platts are among the other organizations who have conducted rigorous studies verifying the validity of SURVEYOR's measurements. Numerous less rigorous evaluations have been conducted as well by utilities and energy service companies throughout North America.

Product Persistence

Persistency of energy efficiency measures is a common concern for utilities and other organizations that support products with financial incentives. SURVEYOR is engineered to have an extremely high level of persistency, the primary factors of which are enumerated below:

A. SURVEYOR licenses are not 'machine specific'

This means that when an old piece of equipment is replaced, the license for SURVEYOR is simply allocated to the new piece of equipment. This means that SURVEYOR will always remain active as a management tool no matter how many times new equipment is brought into an organization.

B. Maintenance aids in persistency

Verdiem offers an ongoing maintenance program that keeps the company highly engaged with its customers. For a nominal cost, this maintenance program provides customers with ongoing customer support, free upgrades to new versions of SURVEYOR as they are released, and a comprehensive annual energy audit. Through all of these mechanisms, Verdiem is able to insure that the customer is using SURVEYOR to its maximum potential and that the product remains active over time.

C. The Assessment of the Bonneville Power Administration

In 2002, the BPA approved SURVEYOR in a sweeping decision that provided incentive money for the product to consumers throughout the Pacific Northwest. Persistency was a major component in the assessment of the BPA, and after review a persistency factor of four (4) years was officially established for the purposes of the incentive program. However, officials conceded that actual persistency could be indefinite due to non-machine specific licenses and ongoing maintenance as described above. The BPA/RTF worksheet is included in the attachments section.

D. Robust Management Console Provides PC Network Insight

Surveyor ensures persistence through its comprehensive management console that details which PC's are connected and provides detailed information on each and every PC (MAC address, IP address, Last logged-on, Computer name, OS level, etc.).

Who is Verdiem?

Verdiem is the leading developer of power management software for PC networks. Verdiem's SURVEYOR provides measurable energy and cost savings, simplified and automated management of PC power options, and painless implementation that comes with minimal maintenance and a rapid payback. The development of SURVEYOR was funded in part by the Northwest Energy Efficiency Alliance, and the software is approved as a conservation measure by utilities and power producers throughout North America. Verdiem is a recognized EPA ENERGY STAR ® Buildings Program partner and was recently awarded Premier Partner status in the U.S. Department of Energy's Rebuild America program. For more information on Verdiem, please visit www.verdiem.com.

SURVEYOR Incentive and Rebate Programs

Verdiem seeks to integrate itself with utilities and power providers in each of the markets in which it does business. Because of SURVEYOR's excellent value proposition and documented savings abilities, utilities and energy efficiency organizations across the United States and Canada have adopted it for inclusion in incentive and rebate programs. The following page provides a sampling of these programs and is subject to change.

Utility Name	Type of Program/Level of Support
Avista	Conservation program/$10 per PC
BCHydro	Product Incentive Program/$3 per workstation OR Purchase via e.Points Bonus program
Bonneville Power Administration	C&RD program/up to 200kWh per PC
Idaho Power	"Easy Upgrades" Program $10 Per License
New York Power Authority	Custom financial incentives
Northeast Utilities	Up to 50% of product's installed cost is rebated to customer
NSTAR	Custom incentive program
Oregon Energy Trust	Incentive covers 25% of the cost of Surveyor
PacifiCorp	Custom incentive program
PG&E	Express Efficiency program/$15 per license
Puget Sound Energy	Custom program/up to 50% of product cost
Sacramento Municipal Utility District	Internal review underway
San Diego Gas & Electric	Express Efficiency program/$15 per license
Seattle City Light	Custom program/$.04 per kWh saved
Snohomish PUD	Uses CR&D program/50% of product cost
Southern California Edison	Express Efficiency program/$15 per license
The United Illuminating Company	Up to 50% of product's installed cost is rebated to customer.
Wisconsin Focus on Energy	Custom program/$4 per PC
Xcel Energy	Custom incentive program

SURVEYOR and Energy Performance Contracting

SURVEYOR is naturally suited to provide benefit to the ESCO business model. Not only does SURVEYOR allow ESCOs to accurately measure the largest portion of plug load and significantly improve the accuracy of their energy audits, it also provides a simple-to-deploy project that carries an incredibly rapid payback. SURVEYOR requires no building retrofits, no construction, no permitting and no disruption to the staff or facilities of the customer. It can be deployed in a matter of hours and can be operational almost immediately, making it a very unique project by comparison to others that are typically part of ESCO packages. Its rapid payback can be hugely beneficial in improving the financial picture of a larger performance bid, and can help pay for projects that are more expensive or have longer return periods attached to them.

The average per-PC savings of all of our SURVEYOR projects is 200 kWh. Testing by the Bonneville Power Administration and other third parties also supports this forecasted savings level. SURVEYOR is priced on a per-seat basis in such a manner that 9-18 month project payback periods are normal. SURVEYOR's reporting tool allows customers to confirm that, on an ongoing basis, SURVEYOR is still saving the organization money and to make any necessary adjustments. Across North America, SURVEYOR has been included in Phase I EPC bids and added into existing contracts.

Verdiem's technical team works in concert with the ESCO's project team to test SURVEYOR's compatibility with the customer's technology infrastructure prior to the sale. Once there is customer agreement, Verdiem coordinates and facilitates the installation of SURVEYOR with the customer and the ESCO. Installation times vary depending on the nature of the customer's environment, but generally are completed in 1-2 days.

In summary, SURVEYOR is a natural addition to the ESCO business model, and represents a unique and as yet untapped source of energy savings. ESCOs that are embracing SURVEYOR are finding a project that not only makes their own packages look better, but that often distinguish and separate them from the competition.

SURVEYOR's Third Party Validations

SURVEYOR has a solid track record of delivering savings to public and private organizations Worldwide. Additionally, it has been tested, validated and supported by numerous third party organizations including utilities, energy groups and consultants.

Utilities & Energy Organizations

Verdiem's SURVEYOR software is recognized by power producers, utilities and energy groups throughout North America. Many of these organizations have supported SURVEYOR through development, marketing, incentive or outreach programs. The following list provides a sampling of these organizations and associated programs.

ENERGY STAR ® is a U.S. Department of Energy EPA program that helps businesses and individuals protect the environment through energy efficiency. As an ENERGY STAR Buildings Program partner, Verdiem is complementing EPA's effort to educate public and private organizations about energy waste and greenhouse gas emissions that result from PC energy consumption.

Rebuild America is a U.S. Department of Energy program that focuses on energy-saving solutions for U.S. communities. Verdiem is a Rebuild America Premier Business Partner, educating the organization's members on how to eliminate energy waste in PC networks.

Bonneville Power Administration studied SURVEYOR to determine its applicability for BPA's Conservation & Renewable Discount program. The study concluded that SURVEYOR would save an average of 200 kWh per PC per year and led to SURVEYOR's acceptance in BPA's utility incentive programs.

The Northwest Energy Efficiency Alliance (NEEA) is a regional consortium of utilities and energy efficiency groups that work to make affordable energy-efficient products and services available in the marketplace. NEEA provided funds for SURVEYOR's product development and hired an independent engineering firm to audit SURVEYOR's performance in customer environments, confirming its savings and reporting accuracy.

Northeast Utilities is a Fortune 500 diversified energy company with regulated and competitive subsidiaries, providing reliable, reasonably priced electricity, gas and energy services in the northeastern United States. Northeast Utilities conducted a rigorous evaluation of SURVEYOR's performance before offering a reimbursement program covering up to 50 percent of the installed cost of SURVEYOR.

Southern California Edison is one of the largest electric utilities in the U.S. and the largest subsidiary of Edison International. They conducted a meticulous internal review of SURVEYOR and Verdiem's measurement and evaluation protocols. As a result, Southern California Edison provides financial rebates to customers who purchase SURVEYOR through its Express Efficiency Program.

New York Power Authority (NYPA) is America's largest state-owned power organization. NYPA operates 18 generating facilities and more than 1,400 circuit-miles of transmission lines and is a national leader in promoting energy efficiency. NYPA provides custom financial incentives to customers using SURVEYOR.

Research Organizations

Quantec

As previously mentioned, Quantec LLC was commissioned by the Northwest Energy Efficiency Alliance (NEEA) to conduct a series of market evaluation reports to discern SURVEYOR's impact in the commercial marketplace.

Quantec is an advanced analytics consulting firm. They measure and predict consumer behavior and its impact on energy, financial and natural resources for the benefit of decision-makers in business and the public sector. Their clients rely on their expertise in strategic planning, market research, forecasting, risk management and program evaluation.

For more information on Quantec please visit http://www.quantecllc.com/?page=tools&action=about_quantec

Quantec, Market Progress Awareness Report 2: SURVEYOR, Software, May 2004

Advanced Energy

"The SURVEYOR software package by Verdiem, Inc., of Seattle, Washington, effectively enforces a low-energy profile on server-connected computers to regulate computer energy use. The demonstration project at Advanced Energy showed significant energy savings for all desktop computer configurations and some savings for laptop computers.

SURVEYOR accurately recorded energy use on all computers, even laptop computers, which can be hard to track with their mobile nature. Moreover, Advanced Energy verified results from a 2003 Northwest Energy Efficiency Alliance (NEEA) study of SURVEYOR that showed approximately 25 percent savings on desktop computers…"

"…The software was remarkably effective at reducing energy consumption, easy to use, resulted in no loss of data, and has the potential to greatly impact businesses in the state of North Carolina. There is the potential to reduce 371-GWh of energy consumption in the state, which could save NC businesses $998 per 100 computers per year. Therefore, SURVEYOR should be considered by all businesses with a networked computer system."

About Advanced Energy

Located in Raleigh, North Carolina, Advanced Energy is a national resource that focuses on industrial process technologies, motors and drives testing and applied building science. Their facility houses state-of-the art laboratories, where they perform testing and applied research in all three of these evolving disciplines.

For more information on Advanced Energy please visit http://www.advancedenergy.org/

Advanced Energy, Demonstration of SURVEYOR Software Implementation and Economic Feasibility, Final Report; August 2004

Platts

Platts Research and Consulting prepared a report in late 2004 examining network power management software. Platts deemed Verdiem's SURVEYOR software to be the universal winner, stating that it allowed "the greatest flexibility and broadest applicability with ease of deployment and minimal maintenance requirements."

About Platts Research & Consulting

Platts, a division of The McGraw-Hill Companies, is a leading global provider of energy and metals information. With nearly a century of business experience, Platts serves customers across more than 150 countries. From 14 offices worldwide, Platts serves the oil, natural gas, electricity, nuclear power, coal, petrochemical and metals markets.

Platts' real time news, pricing, analytical services and conferences help markets operate with transparency and efficiency. Traders, risk managers, analysts and industry leaders depend upon Platts to help them make better trading and investment decisions.

For more information on Platts please visit http://www.platts.com/

Institute of Electrical and Electronics Engineers (IEEE) Society

IT Professional Magazine, November/December 2004

"Several studies have shown that if every PC followed a best-practices approach to power management, an organization could easily lower its energy costs by $18 to $45 per year per PC."

About IEEE

The IEEE, a non-profit organization, is the world's leading professional association for the advancement of technology.

Through its global membership, the IEEE is a leading authority on areas ranging from aerospace systems, computers and telecommunications to biomedical engineering, electric power and consumer electronics among others.

Members rely on the IEEE as a source of technical and professional information, resources and services.

Recent News

Seattle Post-Intelligencer

July 13, 2007

Venture Capital: Startup cuts PC power use

"Some corporations are interested in being more green because it is good marketing, some want it for employee retention purposes... and some realize that being green actually represents a good cost savings," Schlein said. "You take all of that ... and it leads you to Verdiem."

"It is a no-brainer first step for corporate IT to begin contributing to an overall corporate sustainability objective," said Klustner, a former Sightward and WRQ executive who joined the startup as chief executive last year."

Wall Street Journal

March 27, 2007

IT Managers Make a Power Play

"Quad/Graphics Inc. in Sussex, Wis., has also outfitted its 4,000 PCs with SURVEYOR after a pilot study of the software last year showed it would shave 35% to 50% off the cost of the company's computer power bills, say officials of the commercial printer. This equates to as much as $70,000 annually in lower power costs. That's a real boon, the officials add, since their business has been squeezed by fierce pricing pressure. 'Every dollar saved has a direct impact to the bottom line,' says Mike Fegley, Quad/Graphics's manager of energy and corporate facilities."

AMR Research

February 26, 2007

Do PCs Dream of Electric Sleep?

"Verdiem has created a software utility called SURVEYOR, which allows companies to centrally measure and manage PC power settings. The SURVEYOR software allows network administrators to measure PC power usage and then centrally administer energy saving strategies. For example, companies can transition to low-consumption energy states based on time of day or user activity. Managers can also schedule PCs to wake up at night to administer software upgrades without interrupting users during the work day."

"In discussions with managers at several large educational institutions, each claimed paybacks within 18 months. A school district close to Microsoft's Redmond campus uses 11,000 PCs in 45 schools. As the district's Resource Conservation Manager noted, 'telling people to do the right thing doesn't work.' While the district had been struggling to get energy use down, automating PC energy savings 'was a touchdown."

Energy and Power Management

February 1, 2007

CUNY Manages Computer Energy

"Many facilities managers do not realize the hidden high cost of energy use by their organizations' PCs. During the past decade, PCs have grown in their power and size, translating into increased energy usage in the office. According to a 2002 study by Arthur Little (now known as TIAX), PCs and related equipment accounted for 9% of all energy used in offices, and were on their way to becoming the third largest source of power demand in the commercial sector."

The Seattle Times

THE WALL STREET JOURNAL.

Business 2.0 - Green Wombat

December 19, 2006

Verdiem: Energy-Savings Software Sales Boom as Corporate America Goes Green

"A running tally on Verdiem's site, for instance, trumpets that its clients have saved nearly $18 million and cut their greenhouse gas emissions by about 146,000 tons - the equivalent of taking 19,000 cars off the road. Such numbers give companies green bragging rights, of course, but also could potentially prove valuable as limits on greenhouse gases are imposed and carbon trading markets emerge in states like California."

Public CIO

December 2006

Energy Hogs on the Server Farm - Side Bar: Greening the IT Department

"In 2004, the Lake Washington School District in Washington state installed power management software on its 12,000 PCs and 85 servers. The Surveyor product, developed by Seattle-based Verdiem Software, lets IT groups monitor power usage and put PCs to sleep when not in use."

"We leave our computers on 24/7 because we often work on them at night,' explained Bob Siemers, a senior network engineer for the district. 'This software gives us the best of both worlds, because we can leave them on, but when we're not working on them they are using much less energy. The savings are significant."

CNET News

September 2006

Curbing the CO_2 that comes from PC use

"The savings from SURVEYOR can be fairly substantial, according to Verdiem. The company has found that the software can cut power bills by $20 per PC and reduce carbon dioxide emissions by 440 pounds a year. Fifteen PCs can generate as much carbon dioxide annually as a typical midsize car, according to the company, although the exact figure depends on where and how the electricity is generated and other factors."

AMR Research

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Proven Results

SURVEYOR delivers energy and cost reductions in a number of diverse and challenging environments, with an average savings of 200 kWh per computer per year. The following customer examples and testimonials illustrate a few of the many customer success stories and demonstrate SURVEYOR's performance. *(Figures depict average savings over 12 months of use as well as savings expected over 4 years of service.)*

SURVEYOR Results

City University of New York (CUNY); New York State

- With 19 colleges, and over 400,000 full and part-time students, CUNY is one of the largest educators in the U.S.
- The SURVEYOR project at CUNY is supported by the New York Power Authority.
- Annual Per-PC Energy Savings: 173 kWh / $15.92 @ $0.092 per kWh
- Projected 4-yr Total Savings:
- 21 Million kWh
- $2 Million
- 18 thousand metric tons CO_2 green house gases not emitted

City of Boston

- Boston is one of the largest cities in the U.S.
- City of Boston has been recognized as a national leader by the EPA's Green Power Partnership Program
- *Annual Per-PC Energy Savings: 180 kWh / $25.00 @ $0.14 per kWh*
- Projected 4-yr Total Savings:
  - 270,000 kWh
  - $150,200
  - 171 metric tons of CO_2 green house gases not emitted

Prince George's County Public School System (PGCPSS); Maryland

- 134,190 students in 202 schools, PGCPSS is one of the largest school districts in the U.S.
- *Annual Per-PC Energy Savings: 142* kWh / $18.46 @ $0.13 per kWh*
- Projected 4-yr Total Savings:
  - 21.6 million kWh
  - $2.8 million
  - 23 thousand metric tons of CO_2 green house gases not emitted

Customer Success

"In my opinion, this software package is the best that I have experimented with. Verdiem is the most professional and helpful sales company that I have worked with in the past thirteen years. I can't say enough about them."

— Edwin Hood, A.Sc.T., Energy Management Coordinator, School District 34 Abbotsford

"Many computers throughout the district were left on overnight or on weekends. Verdiem's software provides global control for the energy saving features already built into Windows. The software works well and hasn't caused any conflicts."

— Matt Evans, Director of Technology, Oceanside Unified School District
Director of Technology, Oceanside Unified School District

"Every dollar saved has a direct impact to the bottom line"

— Mike Fagley, Quad/Graphics manager of energy and corporate facilities

Measurement & Verification Protocol

Verdiem has integrated the Measurement and Verification M&V protocol that is the standard for the State of California statewide program into SURVEYOR, as sanctioned by the California Public Utilities Commission (CPUC). Verdiem has adopted this standard since California is a recognized leader in energy efficient practices, setting some of the nation's most aggressive energy saving goals and this protocol incorporates the International Performance Measurement & Verification Protocol (IPMVP). This standard is used globally to help standardize concepts and options for M&V of energy. Almost all performance-contracting firms adhere to the IPMVP.

Using an established protocol ensures the establishment of an accurate baseline and makes certain that actual savings are derived by referencing savings data to the baseline at regular intervals. A full copy of Verdiem's M&V protocol can be found below.

SURVEYOR measures and quantifies the amount of energy consumed by a PC network via a client-server application. The SURVEYOR server software includes a management console for an energy manager or network administrator to define and "push" power management settings to PCs on the network.

The SURVEYOR client software receives and enforces those power management settings, and continuously collects data such as the time and energy state of each PC. The resulting data is periodically saved in a server database to feed reports that can be generated to show energy consumption over any given period of time.

By determining the amount of time each PC spends in each of its energy states, SURVEYOR can precisely calculate the actual network energy consumption and enable organizations to establish optimum power management settings that minimize user impact and maximize energy savings.

Verdiem Measurement and Verification Plan

(formulated as described in the State of California SPC Procedures Manual)

Step 1: Process/Measure Description and Example

A. Verification of Existing Process/Equipment

First, determine the types of PCs that the organization currently utilizes throughout its facilities and whether or not there is any current means of centrally controlling the power states of those computers. On average, the amount of energy wasted in a typical PC network exceeds 400 kWh per year per PC, with approximately 200 kWh per year per PC available to be transparently saved by introducing appropriate power management controls.

B. Proposed New Equipment Retrofit or Enhancement

Verdiem and the organization will utilize Verdiem's SURVEYOR software solution to cast a comprehensive central management net around all of the organization's networked PCs. SURVEYOR is a unique software tool that enables comprehensive measurement and management of networked PCs. The product elevates control of power management features up from the individual PC to a central administrative console, allowing IT and energy personnel to define and control organization-wide energy policies in a consistent and comprehensive fashion. These policies insure that PCs are always available to users when they need them, while ensuring that when they are not in use they are either in a low power state or completely shut down, including at appropriate times in the evening or on weekends. SURVEYOR is engineered with a robust set of data collection and reporting features, and provides measurable and verifiable data that details energy consumption, energy savings and cost savings. The methodology utilized by SURVEYOR is described in detail below.

C. Resultant equipment and/or process

While the organization's PC equipment will not change, the process by which that equipment is managed will change significantly. By using SURVEYOR, the organization will have the ability to develop customized energy management policies that

are appropriate for the many groups of users within the network. These policies will enable the organization to approach energy management of PCs in a logical, metered fashion, guaranteeing that energy savings can be garnered in a way that has no negative impact on end users, user productivity or IT network management activities. The detailed data that SURVEYOR collects insures that the organization's IT staff and energy personnel have the information necessary to report on energy savings and to ensure that their energy policies are as effective as they can possibly be.

Step 2: Establish Baseline Annual Energy Use

As discussed in the section above, SURVEYOR is a comprehensive tool that both measures and manages energy consumption across PC networks. Once deployed across the network, SURVEYOR provides a unique opportunity to measure current energy consumption levels without imposing any new energy management policies on the system. This enables an extremely accurate 'baseline' consumption level to be established, while also gathering critical information on how various groups of users interact with their PCs. This usage information is important in identifying the appropriate energy policies that should be imposed on any given group of users.

The following are the steps that Verdiem utilizes to establish baseline energy consumption levels with SURVEYOR:

1. In cooperation with the organization, Verdiem will establish an inventory of PC equipment, including both CPUs and monitors;
2. Verdiem will use national average consumption values for the specific hardware noted (based upon data from over 300 SURVEYOR projects), or take actual energy consumption measurements of each of the typical PCs and monitors present on the network in each of their power states, including: on/active, standby, hibernate, and off.
3. Verdiem will create a table of the energy consumption levels of this equipment in each of its various power states. Based on inventory of each of these types of equipment, Verdiem will establish an average PC consumption figure that will serve as the standard in the SURVEYOR reporting tool. Below is an example of this process in a theoretical environment of 6,000 PCs with three primary CPU and monitor configurations:

Type of Equipment	# of units in system (6,000)	Watts Consumed On	Watts Consumed Standby	Watts Consumed Hibernate	Watts Consumed Off
CPU's					
CPU #1	2000	55	25	4	2
CPU #2	2000	45	20	2	2
CPU #3	2000	60	35	8	2
Average PC Energy Consumption		**53.3**	**26.6**	**4.6**	**2**
Monitors					
Monitor #1	2000	60	0	n/a	0
Monitor #2	2000	48	0	n/a	0
Monitor #3	2000	55	1	n/a	0
Average Monitor Energy Consumption		**54.3**	**0.3**		**0**

4. Once energy measurements for specific PCs are agreed upon, SURVEYOR will be deployed to each of the PCs within the organization's PC network.
5. For a period of 2 consecutive weeks, SURVEYOR will simply collect data that will enable an accurate 'baseline' energy consumption level to be established for the organization's PC network. SURVEYOR specifically collects precise information that determines the amount of time that PCs and monitors spend in their various power states. This 'time-in-state' data, when multiplied by the average energy consumption levels established above, provides the critical information necessary to calculate precise energy measurements. An example data set for one day of energy consumption for the 6,000 PC network described above is:

Baseline CPU Consumption

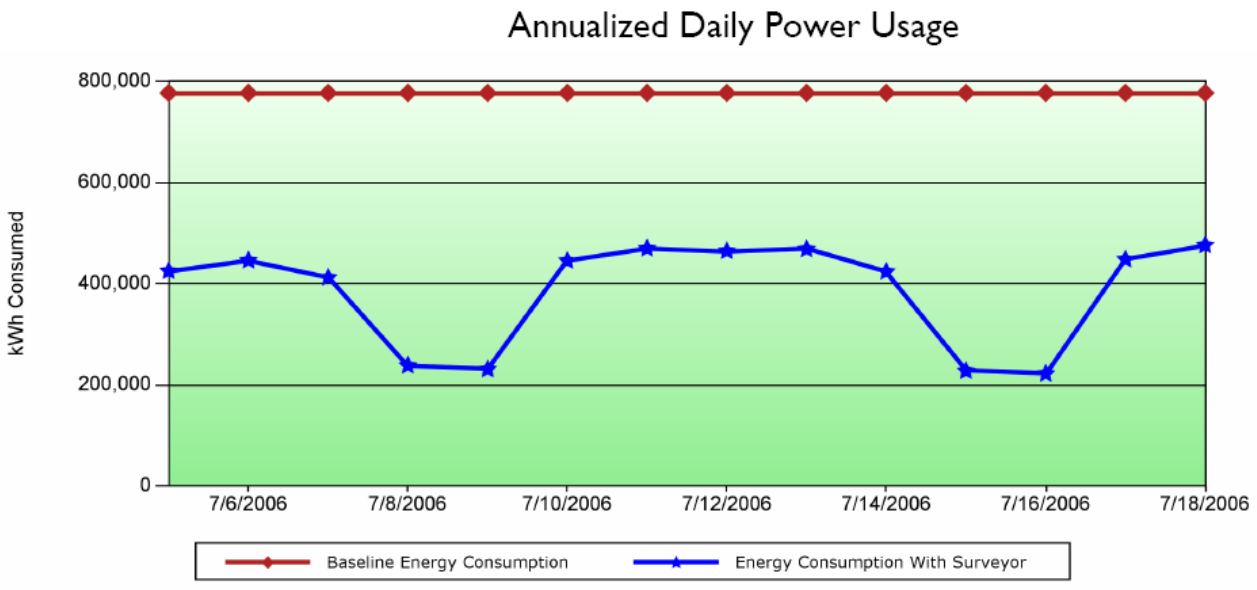
Equipment	Time in State (Hours for all 6,000 units)	Time in State (Hours Per Single Unit)	Watts Consumed Per Unit in Each Power State	kWh Consumed Per Unit	Annual kWh per PC
CPU's					
On	42000	10	53.3	0.533	194.54
Standby	12000	2	26.6	0.053	19.42
hibernate	18000	0	4.6	0	0
Off	72000	12	2	0.024	8.76
Total CPU Consumption	**144,000 Hours**	**24 Hours**		**0.610**	**222.72**

Baseline Monitor Consumption

Equipment	Time in State (Hours for all 6,000 units)	Time in State (Hours Per Single Unit)	Watts Consumed Per Unit in Each Power State	kWh Consumed Per Unit	Annual kWh per Unit
Monitors					
On	42000	10	54.3	0.543	198.16
Standby	12000	2	0.3	0.0006	0.22
Off	72000	12	0	0.0	0
Total Monitor Consumption	**144,000 Hours**	**24 Hours**		**0.544**	**198.38**

Baseline Combined PC/Monitor Consumption

Equipment	Daily kWh Consumed Per Unit	Annualized kWh Consumed per Unit	Annualized Consumption for all 6,000 Networked PCs
CPU's	0.61	222.65	1,335,900
Monitors	0.544	198.38	1,190,280
Total System Consumption	**1.154**	**421.21**	**2,526,180**



Energy consumption is extrapolated to a population of 2,000 PCs based on actual measurements.

SURVEYOR has a robust internal data collection and reporting system that makes all of these calculations automatically and provides diverse reporting capabilities for administrators of the product. The tables above depict annualized consumption data derived from baseline data typically collected over a period of 2-4 consecutive weeks. This is a period of sufficient length to capture user trends and anomalies that might impact data collection efforts of shorter duration.

Step 3: Establish Post-Installation Annual Energy Use

The process for establishing post-installation annual energy consumption levels for this project is almost identical to that of establishing the baseline consumption levels as described in the previous section. Below are the specific steps:

1. Once the baseline consumption information is gathered, Verdiem will review the information in detail with the organization in order to gain an understanding of how and when various groups of PC users within the network utilize their machines. This information will be used to create energy management user groups and profiles within SURVEYOR that will gain energy savings without impacting users or user productivity.
2. Verdiem will provide a detailed review of software and BIOS settings to help in the eventual configuration of systems and the network, to facilitate low power states in the computers.
3. The organization, with assistance from Verdiem, will configure systems, the network, and energy management policies that will ensure that PCs properly use low power states when users are away and appropriately powered down in the evenings, on weekends, and on holidays.
4. For a period of 2 consecutive weeks, an identical timeframe to that of the baseline collection period, SURVEYOR will both enforce energy policies and continue to collect data that will enable an accurate 'post-installation' energy consumption level to be established for the organization's PC network. The collection, calculation, and reporting of data occurs in an identical fashion to that of the baseline period. The only difference is that the consumption numbers will be significantly reduced since SURVEYOR is now actively controlling PC power states. For example, the energy consumption on a per unit basis for the 6,000 PC network described above AFTER energy policies are enabled is:

Enforcement CPU Consumption

Equipment	Time in State (Hours for all 6,000 units)	Time in State (Hours Per Single Unit)	Watts Consumed Per Unit in Each Power State	kWh Consumed Per Unit	Annualized kWh per PC
CPU's					
On	42000	5	53.3	0.267	97.46
Standby	12000	5	26.6	0.133	48.55
HIBERNATE	18000	3	4.6	0.014	5.11
Off	72000	11	2	0.022	8.03
Total CPU Consumption	**144,000 Hours**	**24 Hours**		**0.436**	**159.14**

Enforcement Monitor Consumption

Equipment	Time in State (Hours for all 6,000 units)	Time in State (Hours Per Single Unit)	Watts Consumed Per Unit in Each Power State	kWh Consumed Per Unit	Annualized kWh per Unit
Monitors					
On	42000	5	54.3	0.272	99.28
Standby	12000	8	0.3	0.0001	0.088
Off	72000	11	0	0	0
Total Monitor Consumption	**144,000 Hours**	**24 Hours**		**0.272**	**99.32**

Combined PC/Monitor Enforcement Consumption

Equipment	Daily kWh Consumed Per Unit	Annualized kWh Consumed per Unit	Annualized Consumption for all 6,000 Networked PCs
CPU's	0.436	159.14	954,840
Monitors	0.272	99.32	595,920
Total System Consumption	**0.708**	**258.46**	**1,550,760**

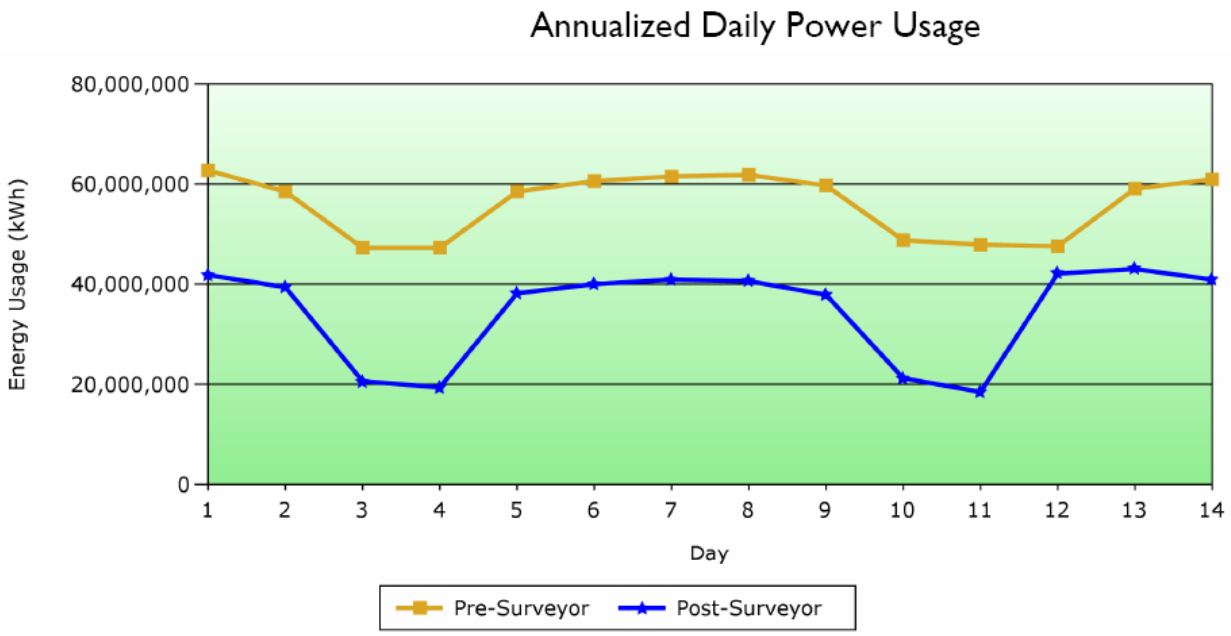
Step 4: Calculate Energy Savings

Once the baseline and post-installation (i.e., enforcement) energy use measurements are completed, savings levels are simply the difference between the baseline and the post-installation consumption levels

Savings (kWh/year) = Baseline Energy Use – Post Installation Energy Use

Applying this formula to the data sets used as examples above yields the following results:

Baseline Consumption per PC per Year	Enforced (post Installation) Consumption per PC per Year	Energy Saved per PC per Year	Amount Saved per PC per Year (Based on $.14 per kWh)	Amount Saved/Year for the Entire 6,000 PC Network
450	**250**	**200**	**$22.79**	**$136,710**



Energy usage is based on the average measured daily power usage, extrapolated to 100,000 PCs.

Step 5: Calculate Corresponding kW Reductions – Impacts on Demand

The data collected in the previous sections can be further analyzed to determine SURVEYOR's impact on demand and kW reductions. At the request of several utility partners, SURVEYOR was reengineered to collect data in a way that enables 'time of day' analysis, providing an opportunity to define the amount of kW reductions that can be attributed to SURVEYOR activities. As a result of the relative newness of this data collection capability, Verdiem believes that this analysis is valid and verifiable and has 3rd party validation in process, but doesn't yet have published results. It is clear, however, that SURVEYOR provides significant demand reduction benefits, and as an additional benefit of the product SURVEYOR will provide this data for the benefit of Verdiem customers.

Since it's founding, Verdiem has solely concentrated on developing comprehensive PC power management software that accurately measures and reports energy consumption and savings. No other solution on the market today has as much experience, expertise and backing from external experts and utilities as SURVEYOR.

New and existing customers alike continue to substantiate the findings of the previous evaluations of SURVEYOR. Currently, SURVEYOR monitors and controls the energy use of more than 400,000 PCs worldwide saving their owners more than $32 million, and saving the environment from 276,000 tons of carbon dioxide emissions—the equivalent of taking 34,000 cars off the road.