Surveyor Network Energy Manager

Market Progress Evaluation Report, No. 2

prepared by

Quantec

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Market Progress Evaluation Report 2:

Surveyor Software

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Executive Summary

The Northwest Energy Efficiency Alliance (the Alliance) and Verdiem, Inc. (formerly EZConserve, Inc.) formed a public/private partnership in 2001 to help commercialize the Surveyor Network Energy Manager software. Through their collaborative effort, the Alliance and Verdiem have sought to:

- Enable network operators to remotely implement energy-saving strategies for commercial networked personal computers (PCs)
- Establish Verdiem as a viable energy efficiency business that develops, promotes, and supports energy-saving PC products and services

This MPER covers research and analysis conducted between November 2003 and April 2004 and includes a project characterization, market characterization, findings from customer interviews, verification of Surveyor functionality and savings, and cost effectiveness analysis.

Project Characterization and Market Transformation Theory

The Alliance provided funding to Verdiem to introduce a software project that reduced the energy consumption of personal computers (PCs) connected to a network. The product is a fully supported, private sector software product that enables the underlying EPA Energy Star software for managing energy consumption of computers and computer monitors. The software allows network operators to enable these features and to remotely turn-off the PCs, thus saving energy.

The Alliance funding, offered as matching funds, was designed to help Verdiem overcome key market barriers, including:

- Lack of product that is aggressively marketed to help reduce the unnecessary on-time of networked computers
- Lack of knowledge on the part of customers about the potential energy savings from controlling networked computers
- Reluctance of network administrators to adding software to their server
- Lack of brand recognition in the marketplace of both Verdiem and the Surveyor software

The project is viewed as an initial step in achieving the ultimate goal of market transformation in the networked computer market. The near term indicators of success include:

- Updated Business Plan including a market strategy, production/service strategy, research and development strategy, organization and management strategy and a financial strategy.
- Successful completion of the Beta software.
- Market awareness of the Contractor's products and services.
- Energy and non-energy benefits in customer installations via Surveyor features.
- Field verification of average electrical savings per unit.
- Sales in the Pacific Northwest.
- Minimum breakeven sales of approximately 114,000 units (2.6 aMW savings)

Project Updates

The company introduced Surveyor Version 2.1 in late 2003 with a number of additional features, including database enhancements, a new user interface, improved reporting, and streamlined installation.

Verdiem has focused its sales and marketing activities on states that rank highest in spending on energy efficiency as determined by the American Council for an Energy Efficient Economy, including several states in the Northeast, Midwestern states such as Wisconsin and Minnesota, and all of the Western region. School districts and other public institutions remain the primary target markets. Verdiem is leveraging its relationship with the Alliance to form individual utility partnerships, with such utilities and BPA and NYPA, that offer discounts or incentives for customers.

Market Characterization

Using a number of secondary research reports, Quantec conducted a "top down" approach to estimate both the total energy consumption of computers and monitors in the Northwest and the potential savings from Surveyor. First, we relied on secondary data sources, including IDC and census data, to calculate the number of desktop computers/monitors (approximately 2.6 million) in commercial applications in the Northwest at the end of 2003. Second, we estimated the total energy consumed by this equipment (approximately 1.7 MWh/year) by estimating the power levels and distribution of the different computer power states (active, low, and off modes). Finally, we estimated the reduction in consumption that could be attained by enabling power management (approximately 447,000 MWh/year).

The Surveyor software product could face competition from several sources. None of these potential competitors, however, provides the exact functionality of Surveyor, and in many cases, they offer far less.

In an effort to simplify Surveyor adoption across operating systems, the Alliance formed a partnership in May 2003 with the Distributed Management Task Force, Inc. (DMTF), the industry organization leading the development, adoption and interoperability of management standards and initiatives for desktop, enterprise and Internet environments.

Customer Interview Findings

Quantec conducted 14 detailed interviews with representatives from 10 organizations currently using Surveyor software. The interviews indicated that:

- The primary objective to be served through the purchase of Surveyor was to save energy and associated energy costs (9 of 10 respondents); non-energy benefits were not a motivating factor.
- Most of the respondents indicated that the reporting capabilities were critical to the decision to purchase Surveyor, yet few had actually used this feature.
- Advance purchases, incompatibilities, and user profiling led to delays in installation and implementation for over half of the respondents (7 of 10).
- The primary market barriers remain resistance from the IT department. This is based on three concerns: fear of incompatibilities with other software, that the software will not work with existing hardware configurations, and that network security issues could be compromised.
- Customers expressed a high level of satisfaction with the functionality of the Surveyor product and with Verdiem overall (all respondents indicated they were extremely satisfied or somewhat satisfied with Surveyor overall).

Verification of Surveyor Functionality and Energy Savings

Puget Sound Energy (PSE), as part of an internal evaluation of Surveyor, installed the power management software on the majority of their workstations (computer and LCD monitor combinations) at one of their new facilities in fall 2003. The results indicated that:

- Surveyor log files provide an accurate recording of the status of the computer and a good, although slightly less precise, approximation for the monitor status.

- The average CPU time "on" dropped from an average of 11.5 hours per day pre-enforcement to 6.6 hours per day post-enforcement. Monitor used decreased from 10.5 to 4.1 hours per day following power management.
- The expected annual savings per workstation was estimated at 176.2 kWh/year.

Savings at five other sites ranged from a low of 33.8 kWh/year per work station to 330 kWh/year per work station. Generally, however, savings were on average quite close to the Alliance's assumed 200 kWh annual savings.

Market Transformation Assessment

Verdiem offers an innovative product and continues a steady pattern of growth and acceptance by the marketplace, fulfilling an important "niche" in energy savings potential and functioning as an important market transformation project. The company has received a number of high profile endorsements, and offers distinguishing features in an increasingly competitive market place.

The company has also successfully met many of the short term indicators, including an updated business and development plan, completion of market ready (post-beta) product, market awareness of the product, energy savings in customer installations, field verification of savings, and sales in the Northwest.

I. Introduction

The Northwest Energy Efficiency Alliance (the Alliance) and Verdiem, Inc. (formerly EZConserve, Inc.) formed a public/private partnership in 2001 to help commercialize the Surveyor Network Energy Manager software. Through their collaborative effort, the Alliance and Verdiem have sought to:

- Enable network operators to remotely implement energy-saving strategies for commercial networked personal computers (PCs)
- Establish Verdiem as a viable, for profit energy efficiency business that develops, promotes, and supports energy-saving PC products and services

Quantec completed a previous Market Progress Evaluation Report (MPER) in March 2003 that was focused on:[1]

- An assessment of the market for technologies designed to reduce the energy consumption of networked computers
- Identification of and comparison to potential competitors
- Collection of customer opinions and preferences related to networked computer energy use
- The results of early site monitoring of systems with the Surveyor software. The site monitoring focused on verifying the logging capabilities of the software and developing methodologies for assessing savings potential.

Quantec also conducted a savings validation analysis for the Portland Public School district, analyzing data from two separate study periods.[2] The purpose of these validation studies was to:

- Confirm that the baseline profiles were being properly summarized from the "roll-up" files
- Verify that the algorithm used to generate the different simulations (profile phases) was working properly
- Verify that the annual savings estimates were being calculated correctly

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[1] Northwest Energy Efficiency Alliance, "Market Progress Evaluation Report 1: EZConserve," Report #E03-110, March 2003, prepared by Quantec, LLC.

[2] See the Quantec January 23, 2003, memo "Validation of Surveyor Data for Portland Public Schools" for an analysis of the data gathered during the holiday period (December 20, 2002 – January 13, 2003) and the March 3, 2003, memo "Post-Holiday Validation of Surveyor Data for Portland Public Schools" for data gathered during the post-holiday period (January 3, 2003 – February 2, 2003).

This MPER covers research and analysis conducted between November 2003 and April 2004 and includes:

- A review of the evolution of the Verdiem organizational structure, business/marketing strategies, product offerings and features, and sales (Chapter II)
- An assessment of the technical and market potential for energy savings related to networked computers in the Northwest commercial sector, including an assessment of potential competitors (Chapter III)
- Findings from interviews with 14 individuals from ten Surveyor customer organizations regarding their decision-making process, deployment strategies, and satisfaction with the software (Chapter IV)
- Verification of the functionality of Surveyor software, including an estimate of energy savings from both a metered site and other Surveyor customers (Chapter V)
- A review of the cost effectiveness of Surveyor and the Alliance's initiative to promote the software solution (Chapter VI)

II. Project Characterization

Market Transformation Theory

The Alliance provided funding to Verdiem to introduce a software project that reduced the energy consumption of personal computers (PCs) connected to a network. The product is a fully supported, private sector software product that enables the underlying EPA Energy Star software for managing energy consumption of computers and computer monitors. The software allows network operators to enable these features and to remotely turn-off the PCs, thus saving energy.

Market Barriers

The Alliance funding, offered as matching funds, was designed to help Verdiem overcome key market barriers, including:

- Lack of product that is aggressively marketed to help reduce the unnecessary on-time of networked computers
- Lack of knowledge on the part of customers about the potential energy savings from controlling networked computers
- Reluctance of network administrators to adding software to their server
- Lack of brand recognition in the marketplace of both Verdiem and the Surveyor software

Project Strategy

The explicit strategy of the partnership is to:

- Introduce the Surveyor product to the market
- Establish Verdiem as a financially sound and viable business selling the Surveyor products
- Sell approximately 18,000 units in the Pacific Northwest by December 2003

Project Progress Indicators

The project is viewed as an initial step in achieving the ultimate goal of market transformation in the networked computer market. The near term indicators of success include:

- Updated Business Plan including a market strategy, production/service strategy, research and development strategy, organization and management strategy and a financial strategy.
- Successful completion of the Beta software.
- Market awareness of the Contractor's products and services.
- Energy and non-energy benefits in customer installations via Surveyor features.
- Field verification of average electrical savings per unit.
- Sales in the Pacific Northwest.
- Minimum breakeven sales of approximately 114,000 units (2.6 aMW savings)

Company Changes

EZConserve underwent drastic management and structural changes during 2003 to accommodate recent and anticipated growth. The changes began in April 2003 with the hiring of an experienced software executive, Steve Sperry, to provide leadership as President and CEO.[3] The company also established headquarters in Seattle, Washington. Then, in June 2003, EZConserve changed its name to Verdiem Corporation[4] to reflect its expanded market focus, plus outlined two important goals:

- Attract venture capital to fund further product development, hire sales staff, and allow that staff to travel to various prospects and market events (trade shows, etc.)
- Expand the penetration of the software beyond early adopters, with a broad market presence

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[3] Prior to joining Verdiem, Mr. Sperry founded two software companies: Primus Knowledge Solutions, now a company with market cap >$1billion and Acadio.com, which specialized in web-based continuing education tools. Mr. Sperry has a B.S. and an M.S. from the University of Washington.

[4] Verdiem means "green day" in Latin. It was thought that this name was more professional and better conveyed the image that the company wanted to project.

The company has also adopted a relatively flat structure with senior staff reporting to Mr. Sperry in the following functional areas:

- Finance and Operations (Charles Mulberg)
- Product Development (James Tatham, the founder of EZConserve)
- Energy Partnerships (utility programs, etc.) (Kent Dunn)
- Sales (David Paul Harvey)
- Marketing (Michael Thelander)

In addition to keeping Surveyor up to date, the Product Development group provides engineering, quality assurance, and technical support services. The sales group has a distinct Northwest regional focus but has started to expand sales operations by adding a Baltimore, MD, office to complement its offices in Seattle and Portland. Any anticipated growth in staffing is likely to occur in the area of sales, with those staff being located near markets where potential is highest.

Product Changes

The original version of Surveyor, released in late 2001, provided basic functionality and worked with Windows 2000. Surveyor 1.2 was released in April 2002, adding compatibility with Windows 98 and NT operating systems. Version 1.3, which included expanded reporting and recording capabilities, was made available to Surveyor evaluation partners in May 2002.

Surveyor version 1.4 was released in November 2002 and is compatible with every Windows-based operating system in use today – NT, 95, 98, 2000, and XP. This version added an integrated reporting function that provided detailed cost and energy consumption information for an entire network. Network administrators are able to observe network energy consumption on a daily, monthly, or annual basis. With a free add-on utility, network administrators could also simulate power management schemes for their network to compare modeled to actual energy consumption.

In addition to these compatibility and energy conservation improvements, Surveyor 1.4 delivered non-energy, asset management features. It can be used to show the processor, operating system, BIOS, and memory details of each PC on the network.

While most of the current customers are using Version 1.4, the company introduced Version 2.1 in late 2003. Additional functionality added to Version 2.1 includes:

- ***Database enhancements***: The data store now supports the data needs of complex, large enterprises as well as more traditional network

environments: SQL server support, built-in Microsoft SQL Desktop Engine (MSDE), etc.

- ***Application protection for PC clients***: "Abandon shutdown" prompts
- ***Scalability and interface enhancements***: a new user interface, plus the ability to support up to 12,000 to 50,000 clients, depending on the hardware configuration
- ***Reporting enhancements***: remote reporting from other PCs, selection of specific clients, hourly roll-up files
- ***Administrative enhancements***: automate the cleanup of duplicate or replicated clients, pass critical client info to server
- ***Deployment enhancements***: supports additional motherboard installations, increased scripting knowledge base, and central deployment.

Sales and Marketing Activities

Target Markets

Verdiem has focused its sales and marketing activities on two primary regions: the Western region (encompassing the Pacific Northwest and California) and the rest of the United States (referred to as the Eastern region). Within these regions, Verdiem is paying attention to the states that rank highest in spending on energy efficiency as determined by the American Council for an Energy Efficient Economy, including several states in the Northeast, Midwestern states such as Wisconsin and Minnesota, and all of the Western region.

School districts and other public institutions remain the primary target markets. Verdiem has a three-phased sales strategy planned, with the following targets identified in order of priority:

- ***School districts with 15,000 or more students*** – a typical school system maintains a student-to-PC ratio of 5:1, yielding a sale of approximately 3,000 licenses if they purchase licenses for all machines
- ***Community colleges with 10,000 or more students*** – community colleges typically have more centralized decision making than universities and, with a 3:1 student-to-PC ratio, would have approximately 3,000 PCs
- ***Municipal, city or state governments with a minimum of 3,000 employees***

While many of its sales to date have been smaller, Verdiem sees a need to attract larger customers for two reasons:

- Larger sales are required to support the one-on-one sales effort they are currently engaged in[5]
- Larger communities have more name recognition and provide stronger reference value when working with other potential customers

Utility Partnerships

Verdiem is leveraging its relationship with the Alliance to form individual utility partnerships both in and outside the Northwest. Utility partnerships aid the company's marketing efforts by providing:

- An endorsement of the Surveyor product when utilities promote the software to their customers
- Substantial incentives that reduce the cost for customers considering adoption of the Surveyor software

The first significant event in this area was the recognition by Bonneville Power Administration (BPA) in 2002 that savings are real through a "deemed savings" estimate. This allows the distribution utilities served by BPA to offer incentives under the Conservation & Renewables Rate Discount and/or the Conservation Augmentation programs, without further impact evaluation requirements. Since BPA's acknowledgment, Verdiem has begun to work with the various distribution utilities to encourage the purchase and adoption by their customers.

Verdiem is also working with the New York Power Authority (NYPA) to establish arrangements for their institutional customers to streamline the purchase of Surveyor and to enable customers to pay for Surveyor over time. Current arrangements provide for as many 50,000 licenses to be distributed to NYPA customers. San Diego Gas and Electric also offers its commercial customers incentives for the purchase of Surveyor through the Energy Saver Program.

Although the company is not working directly with the Distributed Management Task Force, Inc. (DMTF), the organization that is standardizing the software and hardware compatibility for power management, the Alliance has funded an initiative with the DMTF (discussed in Chapter III). This could potentially provide additional exposure for Verdiem with the Original

[5] At this time Verdiem does not have any plans to augment their sales strategy to us by using distributors or focusing on back office service providers.

Equipment Manufacturers (OEMs), possibly making them a target for a potential buyer.

Surveyor Sales

The company continues progress toward achieving the proposed long-term sales goal of 410,000 units by 2010. As of end of April 2004, Verdiem has delivered approximately 66,500 units, or about 16%, of the long-term goal. Verdiem expects total sales to be about 200,000 units by the end of 2004.

Of the total units sold through the end of December 31, 2003, 41% of the licenses were for organizations in the Pacific Northwest (Table II.1)

Table II.1: Sales through April 2004

Location	Organizations	Licenses
Pacific Northwest	17 (61%)	27,263 (41%)
Other U.S.	11 (39%)	39,233 (59%)
Total	***28 (100%)***	***66,496 (100%)***

The list price of Surveyor is $20 per license, but many sales to date have been discounted significantly to gain a foothold in the marketplace. Verdiem is working to reduce or eliminate those discounts over time and had considerable success in the last quarter of 2003 in that effort by focusing on the product value.

III. Market Characterization

Market Potential

Computers and other electronic equipment continue to become more ubiquitous in the commercial workplace. The latest Commercial Building Energy Consumption Survey (CBECS), for example, reported a 35% increase in the number of computers in commercial buildings from 1995 to 1999.[6] Energy consumption from desktop computers and monitors in commercial applications in 2000 was estimated at 36.2 TWh/year, and personal computers and monitors currently account for approximately 40% of all energy consumed by office and telecommunications equipment in U.S. commercial buildings.[7] Lawrence Berkley National Laboratory (LBNL) estimates that only 25% of all computers and 60% of monitors have power management enabled; if these settings were activated and functioning in computers, monitors, and other electronic equipment, 17 TWh/year could be saved annually.[8]

Using a number of secondary research reports, Quantec conducted a three-step analysis to estimate both the total energy consumption of computers and monitors in the Northwest and the potential savings from Surveyor:

1. Calculate the number of desktop computers and monitors in commercial applications in the Northwest
2. Estimate the total energy consumed by this equipment
3. Estimate the reduction in consumption that could be attained by enabling power management

Number of Commercial Desktop Computers and Monitors in the Northwest

Quantec implemented a "top down" approach for estimating the total number of computers and monitors in commercial facilities the Northwest at the end of 2003. Based on a number of studies and the reduced cost for new computers, we assumed a three-year lifetime for computer systems. We collected International Data Corporation (IDC) data on the total number of

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6 http://www.eia.doe.gov/emeu/cbecs/pc_copier/table_4.html. Note that the 2003 CBECS was not available at the time of this study.

7 Roth, et al, "Energy Consumption by Office and Telecommunications Equipment in Commercial Buildings." January 2002, Arthur D. Little for Office of Building Equipment.

8 Kawamoto, K., Koomey, J., Nordman, B., Brown, R., Piette, M.A., Ting, M., and M. Meier. "Electricity Used by Office Equipment and Network Equipment in the U.S.: Detailed Report and Appendices," LBNL-45917. February 2001.

commercial computers sold from 2001 through 2003 in the United States. The analysis was limited to desktop computers (since laptop computers consume far less energy than desktops and are not part of Verdiem's core target market), assuming that desktop sales have dropped from 80% of sales in 2001 to 73% of sales in 2003, once again based partially on IDC data.

Next, we estimated that 4.1% of all computers in the U.S. are sold in the Alliance territory. This was based on a population ratio (using 2003 Census estimates) of Washington, Oregon, Idaho, and Montana compared to the rest of the United States.

As shown in Table III.1, we estimated a total installed base of 2,947,185 desktop computers in commercial applications in the Northwest at the end of 2003.

Table III.1: Installed Base of Commercial Desktop Computers in the Northwest

	Total Commercial Sales**	Desktop Commercial ***	NW Commercial ****
2001	30,500,000	24,538,613	1,010,453
2002	30,500,000	23,325,557	960,502
2003	32,700,000	23,707,500	976,230
Total	***93,700,000***	***71,571,670***	***2,947,185***

* Roth estimates a 3-year lifetime; Kawamoto estimates a 4-year life. We assumed a 3-year life because of the reduced cost for new computer systems.

** Based on the IDC Worldwide Quarterly PC Tracker, updated January 2004.

*** Percentage of desktop sales estimated from Arthur D. Little Study #72895-00 (Roth, Kurt, et. al, January 2002) and IDC study as reported on CNETNews.com, January 9, 2004.

**** Assumed 4.1% based on a ratio of the 2003 population of Washington, Oregon, Idaho, and Montana compared to the rest of the U.S.

Next, we conservatively limited the primary market for Surveyor to Windows 98 Second Edition (SE), Windows 2000, and the Windows XP operating systems.[9] Estimating percentage of operating systems sold by year, we assumed that 86% of the commercial desktop computers sold in 2001 were eligible for Surveyor, increasing to 91% by 2003 (Table III.2).

[9] Surveyor will work on Windows 95, NT, and 98 First Edition but can only shut these computers off (i.e., it cannot go into low power modes). There is currently no version available for Macintosh Operating systems.

Table III.2: Assumptions for Operating System by Year

Year	Windows 95, NT, or 98FE	Macintosh	Windows 98SE, 2000, or XP*
2001	5%	9%	86%
2002	0%	9%	91%
2003	0%	9%	91%

* Assumed that only Windows 98SE, 2000, or XP were eligible for Surveyor. All figures are Alliance/Quantec estimates. We do not account for differences in operating system by business type (e.g., the Macintosh operating system accounted for 37% of the school market in 1999-2000, according to Quality Educational Data, Inc.).

To estimate the installed base of monitors, we assumed one monitor per computer. We also distinguished between cathode ray tube (CRT) monitors and the newer liquid crystal display (LCD) technology, which consume less energy per monitor. As shown in Table III.3, we estimate that LCD sales continue to increase each year, from 16% in 2001 to 42% in 2003.

Table III.3: Market Share for LCD Monitors[10]

Year	CRT Monitors	LCD Monitors
2001	84%	16%
2002	73%	27%
2003	58%	42%

Finally, computers must be networked in order to be eligible for Surveyor. Based on CBECS, approximately 5.2% of all workers work in companies of five people or less. We assumed that one-third of these computers (or 1.7% of all computers) are not networked. Correcting for the desktop operating system and out-of-network computers, we estimate that 2,590,448 desktop computers in commercial applications in the Pacific Northwest are eligible for Surveyor.[11]

Assuming one monitor for each PC in use and the distribution of CRT and LCD monitors above, we estimate that there were 1,751,458 CRT monitors and 838,991 LCD monitors in northwest commercial applications at the end of 2003. Table III.4 summarizes the potential number of computers and monitors in the Pacific Northwest that could utilize Surveyor software.

[10] Based on estimates from Roth, et. al (using IDC data) and Displaysearch.com.

[11] Note that we do not attempt to account for computers that are operating out of a network.

Table III.4: Installed Base of Eligible Desktop Computers and Monitors in NW Commercial, Networked Applications

Equipment	Total Installed at End of 2003
Desktop computers	2,590,448
CRT Monitors	1,751,457
LCD Monitors	838,991

Total Energy Consumption from Computers and Monitors

Quantec calculated the energy consumption using the Alliance's approach, which relies on the following formula:

$$UEC = (PA*HA + PL*HL + PO*HO)$$

Where:

- UEC is the Unit Energy Consumption for equipment type (kWh/year)
- PA is the average active mode power for computer or monitor (Watts)
- PL is the average low-power mode power for computer or monitor (Watts)
- PO is the Average off mode power computer or monitor (Watts)
- HA is hours of operation in active (on) mode for computer or monitor (hours/year)
- HL is hours of operation in low-power mode for computer or monitor (hours/year)
- HO is the ours of operation in off mode for computer or monitor (hours/year)

Average power levels for computers were assumed from a recent study from LBNL and are shown in Table III.5.

Table III.5: Assumed Power Levels for Computers and Monitors (Watts)[12]

Mode	Computer (desktops)	CRT Monitor	LCD Monitor
Active (PA)	70	65	30
Low (PL)	9	5	2
Off (PO)	3	1	2

[12] Roberson, et al. "Power Levels in Office Equipment: Measurements of New Monitors and Personal Computers." ACEEE Summer Study, 2002.

Next, assuming that 25% of computers and 60% of monitors have power management enabled and working, we assume that computers are active for 59% of the time, in low-power mode for 4% of the time, and off 37% of the time. Monitors, on the other hand, are active for only 37% of the time, in low-power mode for 34% of the time, and off for 29% of the time (Table III.6).

Table III.6: Current Annual Hours of Operation by Mode[13]

Mode	Desktop Computers	CRT/LCD Monitors
Active (PA)	5,131 (59%)	3,281 (37%)
Low (PL)	375 (4%)	2,980 (34%)
Off (PO)	3,254 (37%)	2,499 (29%)
Total	***8,760 (100%)***	***8,760 (100%)***

Using these calculations, the UEC estimates for computers, CRT monitors, and LCD monitors are presented in Table III.7. Total energy consumption for this equipment – in networked northwest commercial applications eligible for Surveyor – is estimated at 1,659,296 MWh/year (189 aMW).

Table III.7: UEC Estimates and Current Energy Consumption Estimates for Applicable Surveyor Computers and Monitors in the Northwest

Equipment	NW Commercial Applications Eligible for Surveyor	UEC (kWh/Year)	Total (MWh/Year)
Desktop Computers	2,590,448	389.5	1,008,980
CRT Monitors	1,751,457	302.8	530,341
LCD Monitors	838,991	143.0	119,976
Total			***1,659,296***

Potential Savings from Power Management

As shown in Table III.8 and Appendix C, the Alliance estimates that Surveyor can improve the incidence of power management enabled and working from 25% to 85% for computers and from 60% to 85% for monitors. Furthermore, the Alliance estimates that activation of the Surveyor software will lead to a shift from hours active to hours in off-power modes (Tables III.9 and III.10).

[13] Roth, et al, "Energy Consumption by Office and Telecommunications Equipment in Commercial Buildings, Volume 1: Energy Consumption Baseline." Arthur D. Little, January 2002, Cambridge, MA.

Table III.8: Percentage of Computers and Monitors with Power Management Enabled and Working

Equipment	Current Values*	Post-Activation of Power Management **
Desktop Computer	25%	85%
CRT/LCD Monitor	60%	85%

* Kawamoto, 2001

** Alliance estimates

Table III.9: Hours/Year by Mode, Post-Activation of Surveyor Software

Mode	Desktop Computers	CRT/LCD Monitors
Active (PA)	3,827 (44%)	2,237 (26%)
Low (PL)	375 (4%)	2,983 (34%)
Off (PO)	4,557 (52%)	3,541 (40%)
Total	***8,760 (100%)***	***8,760 (100%)***

Table III.10: Comparison of Pre- and Post-Power Management Estimated Hours of Operation

Mode	Pre-Activation of Surveyor		Post-Activation of Surveyor	
	Desktop Computers	CRT/LCD Monitors	Desktop computers	CRT/LCD Monitors
Active (PA)	59%	37%	44%	26%
Low (PL)	4%	34%	4%	34%
Off (PO)	37%	29%	52%	40%
Total	***100%***	***100%***	***100%***	***100%***

As shown in Table III.11, the shift from "on" to "off" hours leads to a drop in the UEC estimates for computers and monitors. For example, the UEC for desktop computers would drop from 389.5 kWh/year to 288.5 kWh/year, while the UEC for CRT monitors would drop from 302.8 kWh/year to 190.8 kWh/year. Assuming an installed base of 2,590,448 computers and monitors that are eligible for Surveyor, we would expect a potential savings of 502,265 MWh/year.

Table III.11: UEC Estimates and Potential Energy Consumption Estimates for Applicable Surveyor Computers and Monitors in the Northwest

Equipment	No. NW Commercial Applications Eligible for Surveyor	Current UEC (kWh/Year)	UEC with Power Management (kWh/Year)	Total Savings with Power Management (MWh/Year)
Desktop Computers	2,590,448	389.5	288.5	261,635
CRT Monitors	1,751,457	302.8	190.8	196,163
LCD Monitors	838,991	143.0	90.0	44,467
Total				***502,265***

Competitive Assessment

The Surveyor software product could face competition from several sources, including:

- Competing software products that provide energy management control of monitors and/or PCs
- Advances in operating systems and hardware capabilities that make power management using these tools easier and more reliable
- Internal company practices that encourage and promote energy conservation behaviors
- Sophisticated network administration practices designed to achieve energy conservation

The following section focuses on competing software products, comparing a number of different power management programs to Surveyor in terms of functionality, compatibility, cost, and support.

Competing Software Products

The producers of competitive power management software products include the Environmental Protection Agency (EPA) and private firms based in the U.S. and abroad. The competitive products vary significantly in functionality, reporting tools, the control they allow an administrator, the hardware that they control (monitor, PC, both), and the manner in which they integrate with existing systems. Tables III.12 and III.13 list some of the competitive software products, detailing important aspects of the products and companies.

Table III.12: Competitive Products and Features for U.S.-Based Companies and Government Institutions

	EZSave	EZ GPO	Wattsavvy CE	Energy Saver Pro
Company and Location	EPA ENERGY STAR®, Oakland, CA, and Boston, MA	EPA ENERGY STAR, Oakland, CA, and Boston, MA	Blue Owl, Orange County, California	EDU Business Solutions, San Diego, California
Major Features	▪ Polls monitors on a network to determine each monitor's power management settings ▪ Generates reports on the result of the polling ▪ Sets appropriate power management settings on monitors on the network through login scripts ▪ Sets appropriate screen saver settings on monitors on the network so that users retain	▪ Provides centralized control of user power management settings to network administrators using GPO's ▪ Sets appropriate power management settings for both the computer monitor ***and*** PC box ▪ Intelligently selects only "capable" computers when activating "system standby" (generally those running Windows 2000 or higher with Pentium 4 chip sets capable of S3 standby mode)	▪ A visual scorecard of user behavior is displayed on the front panel as well as a pie chart illustrating power saving history ▪ Reports on PCs that are "wasting energy" ▪ Passive monitoring, does not actually change computer or monitor settings	▪ Easy implementation for centralized power management settings ▪ Diagnostic/Reporting tool to measure on-time of CPU's, disks and monitors across your network
OS and PCs Supported	▪ Uses the existing power management functionality in Windows (95/98/ME/2000)	▪ Uses the existing functionality on Windows 2000 and XP	▪ Will run on any PC that is supported by Microsoft Windows version 95 or later ▪ Not an absolute requirement to have Internet access from your PC, but it helps	▪ Microsoft Windows 2000/2003 Server
Management Tools/Capabilities	▪ Centrally managed ▪ Requires no special processes on the network, no special hardware, and no client installations	▪ Centrally-administered ▪ Requires no special hardware or network processes	▪ Server-based, centralized ▪ Web service giving facilities managers realtime power management status information	▪ Centrally managed ▪ Requires no special processes on the network, no special hardware, and no individual client installations
Cost and Licensing Requirements	▪ Free	▪ Free	▪ $15/seat	▪ Varies based on quantity, goal of four month ROI
Support	▪ Provided by the Cadmus Group in MA	▪ Provided by The Cadmus Group in MA	▪ Will also assist their customers with applying for energy-saving rebates ▪ Provided via email or web-based submission	▪ Toll free telephone and online support
Distribution Channels	▪ Downloadable off the web ▪ Advertised for on the EPA web site	▪ Downloadable off the web ▪ Advertised for on the EPA web site	▪ Enterprise version not readily available over the web, must submit request form	▪ Contact customer service
Third-Party Endorsement	▪ Natural Resources Canada ▪ ENERGY STAR and FEMP (US D.O.E.)	▪ Natural Resources Canada ▪ ENERGY STAR and FEMP (US D.O.E.)	▪ Not readily available	▪ Not readily available

Table III.13: Competitive Products and Features for Foreign Companies

	NightWatchman	Energy Management Option (EMO)	RSHUT Pro	Remote Anything Desktop Management
Company and Location	▪ 1E.com, United Kingdom	▪ Fujitsu, Australia	▪ Real-Time Security, Russia	▪ TWD Industries, France
Major Features	▪ Designed to ensure that systems are shutdown or logged off in a consistent manner each day ▪ Integrated Wake-on-LAN technology also ensures that PCs can be remotely switched on ▪ Can work with locked workstations	▪ Client monitors the utilization status of the desktop computer then decides whether the computer should be powered down ▪ Informs the user via logon screen of the level of savings that have been achieved (energy, $$, and CO2); generates reports of this information in 24 hour periods and since product installation ▪ Will save all open data files, close all apps and the operating system before shutting down a CPU	▪ Centralized RSHUT PRO Server can manipulate remote computers with any required actions to execute anytime ▪ Can turn monitors on and off based on the settings ▪ Cannot provide energy consumption reports for network clients	▪ Power saving options include time-out to power down the screen of distributed slave PCs ▪ Can centrally wake-up, reboot, or power down a group of PCs
OS and PCs Supported	▪ Windows NT, 2000 and XP	▪ Not available	▪ Will run on any PC that is supported by any version of Microsoft Windows	▪ Windows 95, 98, ME, NT4, 2000, XP, and 2003
Management Tools/Capabilities	▪ Configure NightWatchmanTM clients via the Administrator console ▪ Select single systems, groups, or multi-select systems - then adjust the settings using property pages ▪ Set user logoff and shutdown options ▪ Set the shutdown time and days of operation ▪ Integrates with SMS	▪ Uses TCP/IP protocol to transport information from client to server ▪ Client is distributed to CPUs via software distribution tool or logon script	▪ Can be administered centrally or on an individual computer	▪ Centralized administration requires “master” computer and “slave” clients ▪ Remote control of slave computers from master ▪ Network management and network security ▪ LAN/WAN browser to search to search slave PC’s

	NightWatchman	Energy Management Option (EMO)	RSHUT Pro	Remote Anything Desktop Management
Cost and Licensing Requirements	▪ $8-10 per license and $250-300 for 1 management console ▪ Optional maintenance contract includes priority support, patches and any version upgrades to the product for 1-3 years ▪ Maintenance costs is 25% per annum of the total product price	▪ Not available	▪ Depends on many factors, including number of PCs and type of license ▪ Can get a site license or worldwide license ▪	▪ Depends on quantity ▪ For 1,000 slaves and 10 masters - $14/slave and $86/master
Support	▪ Located in London ▪ UK phone number and address ▪ Support via email	▪ Located in Australia ▪ Support provided by Energy Management Solutions over the phone (in Australia)	▪ Located in Russia ▪ Support via email only, but can expect a prompt reply to inquiries	▪ Located in France ▪ International phone number and address ▪ Email requests returned in 24 hours or less
Distribution Channels	▪ Partner with a Value Added Reseller in the UK ▪ Purchases made on the web site	▪ Email or phone call required to obtain information on purchasing	▪ Can purchase online, by phone, fax, or purchase order	▪ Can purchase online with credit card, product is then sent via zip file
Third-Party Endorsements	▪ Microsoft ▪ SMS Alliance	▪ Not readily available	▪ Not readily available	▪ Not readily available

None of these potential competitors provides the exact functionality of Surveyor, and in many cases, they offer far less. The following features provide Verdiem a competitive advantage:

- Developed and supported in the United States with free support available from 8:00 a.m. to –5:00 p.m. PST Monday though Friday through a toll-free number or email. All support requests are addressed within 24 hours.
- Centralized control through the user's network, administered on site
- Reporting tools allow auditing and savings analysis
- Power management of both CPU and monitor
- Other non-energy benefits, including remote shutdown of PCs and monitors saving labor and enhancing security, and computer inventorying

An article by Michael Thelander of Verdiem, published in *Energy User News*, states that, if computer power management is to be accepted in the workplace, it must never interfere with worker productivity.[14] He goes on to define three parameters that are critical to the success of any power management solution:

1. ***Compatibility***: Power management must easily accommodate any differences in operating systems and PC/BIOS capabilities.
2. ***Customizable settings***: The power management scheme must be dynamic and flexible, allowing for a multiplicity of power schemes for different users, time of day, or day of week.
3. ***Reporting*****:** The power management tool must include the ability to report energy consumption and energy savings, plus conduct "what if" analysis of alternative power management settings.

To facilitate the comparison Quantec evaluated each software package to see how well some of the available software meets the criteria outlined above (Table III.14). For each criterion, the software is assessed using the following scale:[15]

● = Completely satisfies this criterion

◘ = Somewhat satisfies this criterion

◉ = Slightly satisfies this criterion

○ = Does not address or fulfill this criterion.

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[14] Thelander, Michael, "Desktop Energy Users Add to Energy Bills," *Energy User News*, February 26, 2004.

[15] Obtaining and testing evaluation copies of these software products was considered outside the scope of this project, so ratings are based on a review of product Web sites and limited e-mail and telephone correspondence with manufacturers.

Surveyor was the only product to completely address two of the three criteria, and "somewhat" satisfy the compatibility criterion.[16]

Table III.14: Assessment of Competitive Software in Meeting Criteria

	Compatibility	Customizable Settings	Reporting
Surveyor	◉	●	●
EZSave	◉	○	◉
EZ Group Policy Object (GPO)	◉	○	◉
Wattsavvy CE	◉	○	●
NightWatchman	◉	●	○
Energy Saver Pro	◉	◉	●
EMO (Energy Management Option)	N/A	◉	◉
RSHUT PRO	◉	◉	○
Remote Anything Desktop Management	◉	N/A	N/A

Additional Initiatives

In May 2003, the Alliance announced a partnership with the Distributed Management Task Force, Inc. (DMTF), the industry organization leading the development, adoption and interoperability of management standards and initiatives for desktop, enterprise and Internet environments. The Alliance believes that the availability of a common, standardized, power management interface, for all networked computer systems and devices, would allow software and hardware manufacturers to expand their product offerings related to power management across additional computer platforms and network devices.

To work toward its goal of expanding and normalizing the CIM's power management interface, the Alliance has undertaken the following tasks as part of its partnership with the DMTF:

- Review the overall CIM standard, particularly in regards to its support for power management, and identify any areas for improvement;
- Create draft proposals for any changes and additions the Alliance would like to see made to the CIM standard;
- Work within one of the DMTF's working groups to formalize any proposed changes and to have them adopted as part of future releases of the CIM standard.

[16] None of the programs was compatible with Apple Macintosh computers, so no program received the highest rating.

The effort focused on a number of specific goals, including:

- ***Addition of a means to query a system or device for its current power state***. The first step in power management is to include a PowerState property to indicate the current power state of a computer. The goal is to clearly define the power management interface for a system or device. In this way all the other goals of the DMTF initiative – standardized states, notification of changes in states, inventoried supported states, and job control – would be functional. In addition, by accepting these CIM power management profiles, power management would be more easily enabled among all computer platforms (including MAC and Linux), plus other networked devices, such as printers and scanners.
- ***Addition of a means to query a system or device for its supported power states***. Centralized power management, such as that performed by Surveyor, can normally override the individual power management settings on computers, monitors, or other equipment. However, some devices do not support specific settings, thus nullifying the power management settings. The work with the DMTF, therefore, sought to identify a way that each client could be queried for what states are supported.
- ***Use industry standard power management terminology when defining power management elements***. The initial goal of the project was to promote more consistency among the power management interface controls (i.e., the terms, symbols, labels, etc.). Although power management controls are currently present in hardware and software, they are often not used (or used incorrectly) because users find them confusing (e.g., sleep, suspend, hibernate, etc.). It is believed that more consistency among the power states would minimize confusion among users and promote a more widespread use of power management. The Alliance proposed the same power states that LBNL recently recommended to the California Energy Commission: on, off, and sleep (with sleep using the crescent moon symbol and hibernate being presented as a form of off).[17]
- ***Addition of a means to set scheduling criteria for when a system or device's power state should change***. The Alliance wanted the new CIM standard to allow for batch processing (job control) of power management jobs, to allow for more flexible, customizable settings for different groups of users.

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[17] Nordman, Bruce. "Draft Standard for User Interface Elements in Power Control of Electronic Devices Employed in Office/Consumer Environments." Institute of Electrical and Electronics Engineers (IEEE P1621). December 2002.

- ***Addition of a means to be notified of a change to a system or device's power state***. The DMTF initiative also sought to have a way of recording changes in states in computers. Although Surveyor uses an algorithm to log the states of the computers and monitors, these are not always 100% reliable (particularly for monitors). The initiative, therefore, worked to use event notification software to "listen" for changes in the state of the computer, and (if set up) e-mail notification to a central user. These changes in states could then be recorded in a log file.

Accomplishments and Impacts

The DMTF has approved the standardized power states, notification of changes in states, and ability to inventory supported states for the next major CIM release (version 2.9). However, at least three factors could delay any realized energy savings:

- CIM 2.9 is not expected to be released until 2006.
- There is a lag following the release until new product designs incorporate the recommended CIM (and existing inventory is sold).
- Compliance with the latest CIM is optional, not mandatory, so vendors may pick and choose individual pieces to implement.

In addition, the job control and CIM power management profiles were not fully approved by the DMTF to the satisfaction of the Alliance program implementer, thus the Alliance continues to pursue the incorporation of these additional features.

IV. Customer Interviews

Quantec conducted detailed interviews with organizations currently using Surveyor software. The interviews were designed to gain insights from early adopters, and addressed the following issues[18]:

- The purchase decision-making process for Surveyor
  - Other products considered
  - Types of testing performed
  - Any barriers or concerns
- The deployment of Surveyor
  - Number of machines with Surveyor installed
  - Number with power management schemes deployed
  - Plans for purchase of additional licenses
- Satisfaction with various aspects of Surveyor
- Importance and use of reporting capabilities
- Expected and actual savings
- Ideas for improved functionality or support

The study methodology, as well as findings for each of these areas of inquiry, are discussed below.

Methodology

Verdiem provided contact information for 12 organizations that had purchased Surveyor in the last year; Quantec interviewed 14 respondents at ten of these. The respondents included IT staff (5) and other decision-makers regarding the purchase of Surveyor, including energy/facility managers (5), fiscal control staff (2), and energy program managers (2). The respondent companies had purchased a total of about 17,000 licenses, representing approximately 25% of the total licenses sold to date. The seven organizations (11 individuals) interviewed within the Pacific Northwest represented approximately 14,500 licenses, or about 44% of regional sales. Overall, the ten responding companies included school districts (4), utilities (3), colleges (2), and a city government.

[18] The interview instrument is included in Appendix A.

Findings

Decision to Purchase Surveyor

The current customers of Verdiem learned of the Surveyor software through a variety of mechanisms. Most were contacted directly by Verdiem (6 of 10), but others learned of the product through trade journal articles (2 of 10), the Internet (2 of 10), from a utility representative (3 of 10), or an energy efficiency information provider (2 of 10).[19] The primary objective to be served through the purchase of Surveyor was to save energy and associated energy costs (9 of 10 indicated). Some users mentioned that it was an easy way to do something beneficial for the environment. Two of the users in the Pacific Northwest mention the need to save energy to reduce the likelihood of "brownouts" or an "energy crisis."

In almost all cases (9 of 10), multiple decision makers within the customer organization were involved in the process of procuring Surveyor. Included in the decision were: energy or facilities managers, fiscal management or contracting professionals, and IT staff. Typically, the energy or facilities manager made the final purchase decision, as the purchase would be funded through the facility budget. Although IT staff needed to "buy-in" as part of the decision making process, they rarely provided the final approval (2 of 10).

The IT staff were most concerned about potential compatibility issues with existing hardware and software systems, deployment requirements and network security in considering the purchase. The other decision makers were more concerned with the validity of the savings projections and the expected costs and benefits to their organization. These other decision makers recognized that Surveyor did not necessarily support the performance objectives of the IT staff, but thought that IT staff could be recognized for their contributions to saving energy and reducing costs.

Most of the Verdiem customers conducted some testing of the software in a laboratory or on a subset of machines (8 of 10). This testing assured that:

- No incompatibilities with other software existed
- The software worked with existing hardware configurations
- No network security issues were introduced

The testing was also used to develop organization-specific savings estimates based on operating schedules and hardware configurations.

Few of the customer respondents (3 of 10) considered other networked-computer energy-management software options. Those that did indicated that

[19] More than one response was accepted.

they considered Windows-based power management capabilities or freeware (respondents did not specify or identify any freeware packages). In general, Surveyor was preferred for its simplicity in deployment and function.

Factors that seemed to significantly impact or expedite the decision to purchase the software included:

- Alignment with organizational philosophy (e.g., environmental responsibility)
- Availability of incentives from the local utility
- Short payback period (one year or less)
- Endorsement from another user

Some of the respondents (4 of 10) indicated that case studies from similar types of customers would have been useful to them. Other than that, any questions or concerns were addressed quickly and thoroughly by Verdiem during the decision-making process.

Most of the survey respondents had a policy that monitors (9 or 10) and computers (7 of 10) should be shut off when not in use for extended periods of time. Little was done to enforce these policies, other than occasional email reminders. Despite these policies, respondents reported that an estimated 40% to 90% of machines were left on during nights and weekends.

One of the more interesting deployments was on a college campus in the Pacific Northwest. The college bought licenses for its computers and for the incoming freshman. Like many schools, the college provides freshman with several applications to:

- Ensure students are working with compatible systems
- Allow students to complete and submit assignments electronically
- Provide sufficient virus protection

Surveyor was provided with these other applications on a CD Rom distributed at freshman orientation sessions.

A couple of issues have arisen with this installation. First, it was difficult for the college to track the installation of Surveyor on the student systems. Secondly, many of the students use laptop systems that have significantly lower savings potential (due to far lower power requirements vs. desktops). Students also have less predictable schedules and may be off campus during a good part of the year.

The lower savings potential has been a contentious issue as the college was hoping to obtain incentives from its local utility. While incentives equal to 80% of the software cost have been paid for licenses installed on the college computers, payment of incentives for licenses to be installed on student computers is still pending.

Surveyor Deployment

Surveyor deployment seemed to take longer than expected in most cases. Several of the Verdiem customers reported being behind schedule in both installation of Surveyor on machines and the implementation of power management settings (7 of 10). Delays were attributed to the need to conduct comprehensive user profiling and internal communications. About half of the licenses had been installed at the time we conducted our survey. Of the licenses installed, power management had been enabled on about 80%.

Two of the school district users of Surveyor reported that they could not use Surveyor on machines with older operating systems or with particular software packages (e.g., Deep Freeze, a software designed to protect from changes in system configurations). Verdiem was able to assist the users with patches and other "work-arounds," but this process took time. Another factor affecting the speed of the deployment was the existence of multiple facilities.

While many of the respondents were still in the process of deploying the software (7 of 10), those that indicated they had "completed" deployment had successfully installed Surveyor and enacted power management on approximately 90% of the workstations within their organization. Four of ten of the responding organizations indicated that they had obtained enough licenses for their anticipated growth over the next two to three years. Based on expected organizational growth and increased saturation of technology, as many as 10% of the licenses obtained to date may be reserved for future use.

Once deployed, little feedback from company employees was received, which was considered a "good thing" by the IT staff and other decision makers alike. If feedback was received, it was in support of the effort to save energy and reduce costs. In a few instances (three of ten), respondents reported requests for changes in the energy management schedule from employees that worked non-standard schedules or on critical processes. Respondents indicated a variety of approaches toward power management – some doing detailed user profiling to maximize energy savings while others utilized a more conservative, "one size fits all" approach.

Satisfaction

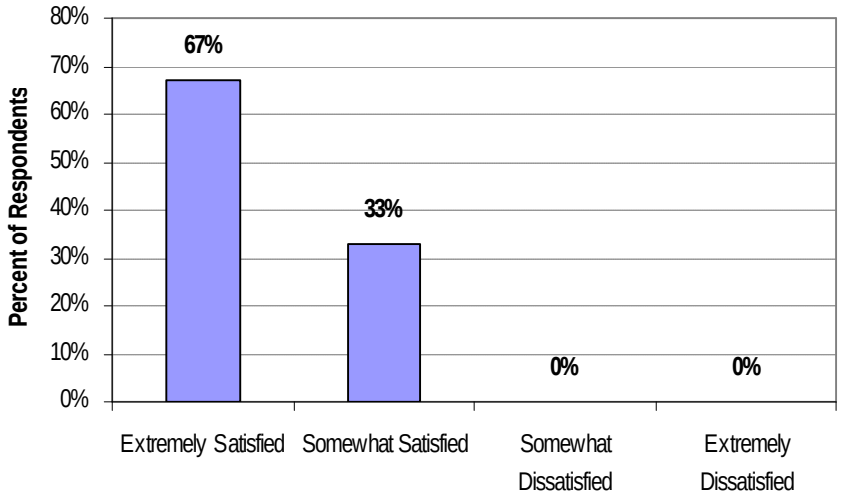
We considered each individual response in assessing satisfaction with the Surveyor software. Quantec asked survey respondents about their satisfaction regarding several aspects of the software, including:

- Installation
- Functionality
- Reporting capabilities
- Product support
- Manuals and other documentation

Among Verdiem's early customers are utilities that are not only evaluating the software for their own use, but considering it to recommend to their customers. The utilities report being highly satisfied with the performance of Surveyor in their own facilities. These are important relationships for Verdiem to cultivate as they can increase the use of the software

In general, energy managers and other decision makers were more enthusiastic about the Surveyor product and Verdiem than were IT professionals, but all respondents indicated they were extremely satisfied or somewhat satisfied with Surveyor overall (See Figure IV.1). Those that indicated they were somewhat satisfied felt that it was too early to claim the very highest level of satisfaction overall, but anticipated being very satisfied when deployment was further along.

Figure IV.1: Overall Satisfaction



The energy managers and other decision makers expressed a high level of satisfaction with the functionality of the Surveyor product and with Verdiem overall. The simplicity of the Surveyor software was seen as a strength. As one respondent said, "It doesn't do much, but what it does, it does very well." Respondents felt that Verdiem was very responsive to requests for information and proactively provided support. They often deferred questions regarding the installation process or product documentation to the IT staff.

Some difficulties with the installation process were reported (at half of the respondent organizations), which were resolved with responsive assistance from Verdiem. Respondents were generally not familiar with product documentation and manuals, as there were few instances in which they would have been referenced. Respondents indicated general satisfaction with the reporting function, with recognition that they had not fully utilized all the reporting capabilities.

Reporting

Only two of the Surveyor customers have used the reporting features of the software on a regular basis. However, most of the respondents indicated that the reporting capabilities were critical to the decision to purchase Surveyor. Many (6 of 10) claimed to have used the reports during the testing stage of the decision making process. Some respondents (4 of 10) reported that they hadn't reached a stage in deployment that the reporting would be useful, but they planned to run reports in the future. Actual or intended uses of the reports included:

- Verification of savings
- Optimization of power management settings

- Equipment inventorying/asset management
- Review patterns of use of computer systems
- Provision of annual or semi-annual updates to management on savings achieved

The few respondents who indicated they did not intend to use the reporting functions felt that they had established a substantial level of confidence in the savings that would be achieved and that there was not a need to verify the savings post enforcement.

More sophisticated users of Surveyor have developed other mechanisms for assessing energy savings (e.g., utilities doing short-term continuous monitoring in both pre and post energy management enactment). Those more sophisticated users saw value in increasing the precision of the reporting by allowing more detailed site-specific information to be considered. For example, the current reports only allow one entry for assumed power consumption at each state (on, off, standby, hibernate); instead, Surveyor should allow the user to enter in power levels based on the multiple configurations (desktop or laptop, CRT or LCD monitor, etc.) of computer systems.

While other decision makers were more likely to utilize the information available in the various reports, IT or network administrators actually ran the reports. Some of the other decision makers expressed some hesitancy to asking IT staff to run reports, recognizing that they had spent considerable time installing and enacting the software.

Savings

Savings expectations were consistent with the savings estimates calculated by Verdiem. Depending on the utility rates in place in a particular location, annual savings could be from $12 to $20 per computer (about 160 kWh to 200 kWh).

Many of the respondents indicated that their savings estimates were developed and presented by Verdiem, based on test results, inventory of equipment and some assessment of usage patterns (e.g., number of computers left on overnight). Half of the survey respondents indicated that they calculated their own pre-installation savings estimates that were comparable to Verdiem's.

While most of the respondents (8 of 10) had not used the reporting function, they generally felt that actual savings were at least equal to the expected savings. This comfort level with the savings estimates was attributed to several factors, including:

- On-site verification of usage patterns (i.e., recognition that a large percentage of systems are being left on overnight)

- General conservatism with the initial savings estimates
- Relatively low-cost of the software – especially when utility incentives are provided

Some respondents (3 of 10) indicated that the payback or return on investment threshold requirements could be met even if the savings realization rate was less then 100 percent. One respondent indicated that while they anticipate that their actual savings will align with the savings estimated, the installation of Surveyor would meet their investment threshold at half the expected savings.

Opportunities for Improvement/Enhancement

While the respondents were overwhelmingly satisfied with the Surveyor software, they did offer some feedback for Survey and Verdiem. The recommendations for additional features include:

- Power state control that would allow network administrators to turn on computers for after-hours software updates
- Expand capability to work with Apple/Macintosh systems
- Allow power management of other networked devices such as printers, copiers, and servers

In addition, the respondents (4 of 10) recommended that Verdiem involve the information technology team early in the purchase decision-making process because of the critical nature of their participation. There were some cases in which the "other decision makers" were well in the process to procure Surveyor, only to have to halt the process to allow the IT staff to get comfortable with the software.

V. Verification of Surveyor Functionality and Energy Savings

A number of previous studies have been conducted to verify that the Surveyor software was functioning properly.[20] These studies, some of which included use of data loggers, provided an in depth examination of Surveyor features, including:

- Confirming that the client computers were going into the Surveyor-assigned power management settings
- Verifying that the Surveyor logs accurately represent the power management status of the client PCs
- Validating that the simulations and savings projections were being calculated correctly

Although these analyses confirmed that Surveyor was generally working as expected, determining energy savings was difficult because the studies were based on a small number of work stations, monitoring periods were either short or included major holidays, or sites included mandatory evening/week-end computer shut offs.

The goals of this research, therefore, are threefold:

- Validate the functionality of the software using a greater number of data loggers over a longer period of time
- Estimate energy savings from the metering site
- Estimate energy savings from other Surveyor client sites

PSE Metering Study

Puget Sound Energy (PSE), as part of an internal evaluation of Surveyor, installed the power management software on the majority of their workstations (computer and monitor combinations) in fall 2003.[21] As part of their evaluation PSE allowed Quantec to install 20 HOBO data loggers on a sample of workstations, plus analyze all Surveyor log files.

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[20] See "Validation of Surveyor Software: Northwest Energy Efficiency Alliance Experiment," Memo prepared by Quantec, August 7, 2002; Northwest Energy Efficiency Alliance, "Market Progress Evaluation Report: EZConserve," Prepared by Quantec, LLC, November 8, 2002; "Validation of Surveyor Data for Portland Public Schools," Memo prepared by Quantec, January 23, 2003.

[21] PSE installed Surveyor version 1.4.

Data Collection

Quantec was provided a list of approximately 380 workstations that included department, computer type (laptop vs. desktop), and monitor type (all were flat panel). Because there were more than twenty departments, and some departments were excluded from the sample (e.g., the trading floor), Quantec selected a stratified, random sample of computers from the departments with the largest numbers of workstations. A total of 19 (95%) of the 20 data loggers were installed on desktop computers (vs. laptop computers), reflecting the fact that the majority (90%) of the computers in the building were desktops.

At the time of installation Quantec also used a true-RMS instantaneous power meter to measure the demand of the CPUs and monitors in each state.[22] As shown in Table V.1, the operating ("on") flat panel monitors drew approximately 31.7 Watts, desktops drew approximately 50.8 Watts, and laptops drew 15.8 Watts. In sleep/suspend, flat panel monitors drew approximately 0.6 Watts, desktops drew approximately 1.8 Watts, and laptops drew 2.8 Watts. In addition, all equipment had a low-level "parasitic" power demand, even when turned off.

Table V.1: Average Power Demand for PSE Workstations

Mode	Flat Panel Monitors	Desktop Computers	Laptop Computers
On	31.7 Watts	50.8 Watts	15.8 Watts
Suspend/Sleep	0.6 Watts	1.8 Watts	2.8 Watts
Off	0.6 Watts	1.2 Watts	2.5 Watts

On January 23, 2004, Quantec began collecting baseline data on the 20 HOBO data loggers. Approximately five weeks later, on February 26, 2004, PSE set a power enforcement scheme for the metered workstations: [23]

- Monitors shut off after 10 minutes of no activity, day or night
- Computers, from 6:00 p.m. to 6:00 a.m., shut off after 10 minutes of no activity (although users had the option to delay the shutdown for four hours).

The data loggers continued to record for approximately two and half weeks following enforcement and were removed on March 15, 2004.

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[22] The true-RMS meters provided higher resolution estimates of demand compared to the HOBO data loggers, which did not use true-RMS sensors, plus only recorded current (and thus could not record fluctuations in voltage).

[23] PSE, at the time of this report, had still not implemented power management for any additional computers. The savings analysis, therefore, is based only on the 17 desktop workstations for which PSE set power enforcement (the laptop was excluded).

Validation of Survey Log Files

The data from the Surveyor log files are "rolled up" into daily files that record the number of hours that each workstation is in each mode (on, off, suspend, hibernate, or sleep). The HOBO data loggers, recording the values for current (amps) every eight minutes, were then converted into daily files with a similar format to the Surveyor data. The two files were then merged together, so that the resulting file had an observation for each "client day" of the study (i.e., a workstation with 45 days of data would count as 45 observations).[24]

Discrepancies between the Surveyor log files and the HOBO data loggers were then explored. As shown in Table V.2, 96% of the observations had estimates for the number of CPU hours "on" per day that were within 15 minutes of each other from the two data sources. In addition, there was little difference between the pre- and post-enforcement periods. Only seven of the 721 daily readings (1%) had discrepancies that were greater than one hour.

Table V.2: Daily Difference for Number of Hours "On" Between Surveyor Log Files and Data Loggers: CPU

Difference	Total	Pre-Enforcement	Post-Enforcement
0 – 15 minutes	689 (96%)	474 (96%)	215 (95%)
16 – 60 minutes	25 (3%)	19 (4%)	6 (3%)
Greater than 1 hour	7 (1%)	2 (<1%)	5 (2%)
Total	***721 (100%)***	***495 (100%)***	***226 (100%)***

For monitors, however, the difference between the Surveyor Log files and HOBO data loggers was more notable: 85% of the daily readings were within 15 minutes, 9% were between 16 minutes and one hour, and 6% were over one hour (Table V.3). The difference was even more pronounced in the post-enforcement period, where 11% of the daily readings had a difference in the estimated hours "on" per day of over one hour.

The most probable cause for the different estimated hours of monitor use is the fact that Surveyor does not have any precise way of recording whether or not the monitor is being used. Instead, the software relies on an algorithm – based on the power management settings, the power status of the CPU, and the idles/in-use status of the PC – to estimate the monitor power status. The algorithm appeared to be more accurate in the pre-enforcement period, where 20% of the metered monitors were left on for 24 hours a day, compared to the post-enforcement period, when they were powered down more frequently.

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[24] A total of 15 of the 20 metered computers had valid data for comparison: three workstations had corrupted HOBO data, and two workstations were erroneously not installed as Surveyor clients.

In addition, the Surveyor log files tended to underestimate monitor use. For example, during the post-enforcement period, Surveyor estimated the monitors were on for an average of 4.03 hours per day, compared to an estimate of 4.55 hours based on the data loggers (Table V.4).

These results indicate that the Surveyor log files provide an accurate recording of the status of the computer. For the monitors, however, the log files are less precise, although they generally provide a good approximation for the monitor status.

Table V.3: Daily Difference for Number of Hours "On" between Surveyor Log Files and Data Loggers: Monitors

Difference	Total	Pre-Enforcement	Post-Enforcement
0 – 15 minutes	614 (85%)	452 (91%)	162 (72%)
16 – 60 minutes	61 (9%)	22 (5%)	39 (17%)
Greater than 1 hour	46 (6%)	21 (4%)	25 (11%)
Total	***721 (100%)***	***495 (100%)***	***226 (100%)***

Table V.4: Average Number of Monitor Hours in Each State for Surveyor Log Files vs. Data Loggers

	Pre-Enforcement		Post-Enforcement	
	Surveyor	HOBO Data Logger	Surveyor	HOBO Data Logger
Average Number of Hours On	8.17	8.24	4.03	4.55
Average Number of Hours Sleep/Off*	15.71	15.76	19.83	19.45

* Surveyor included combined the sleep and off hours for the PSE data.

Estimation of Energy Savings

In addition to evaluating the validity of the Surveyor log files, Quantec estimated the resulting energy savings from the implementation of power management.[25] Energy savings were estimated by a four-step process:

1. Average power levels for each workstation, in each state, were estimated based on the watt meter readings (Table V-1)
2. Average hours, in each state, were calculated for the pre- and post-enforcement periods based on the Surveyor log files

[25] The analysis period for energy savings includes the entire period for which Surveyor log files were available: November 2, 2003 through February 25, 2004 as the baseline (99 days) and February 26 through March 18, 2004 as the post-enforcement period (22 days). December 19, 2003 through January 5, 2004 were deleted from the analysis because a high percentage of staff took vacation days around the holidays.

3. The delta between the average daily unit energy consumption for the pre- and post-enforcement periods was calculated by the equation:[26]

$$UEC = (PA*HA + PL*HL + PO*HO)$$

Where:

- UEC is the Unit Energy Consumption for equipment type (kWh/day)
- PA is the average active mode power for computer or monitor (Watts)
- PL is the average low-power mode power for computer or monitor (Watts)
- PO is the Average off mode power computer or monitor (Watts)
- HA is hours of operation in active (on) mode for computer or monitor (hours/day)
- HL is hours of operation in low-power mode for computer or monitor (hours/day)
- HO is the ours of operation in off mode for computer or monitor (hours/day)

4. Annual savings estimates are calculated by multiplying the UEC by the number of weekdays or weekend/holiday in a calendar year.

As shown in Table V.5, before power enforcement, the average CPU was on for 11.5 hours per day; following power enforcement, this dropped to an average of 6.6 hours per day. Monitors also exhibited a significant drop in hours of use per day, from 10.5 to 4.1 hours per day following power management (Table V.6).

Table V.5: Average Daily CPU Hours, by State, in Pre and Post Enforcement

	Pre-Enforcement	Post-Enforcement	Delta
CPU On	11.5	6.6	-4.9
CPU Off/Hibernate	12.3	17.1	4.8
CPU Suspend	0.2	0.3	0.1
Total	***24***	***24***	

[26] Because of the significant difference in hours of operation between weekdays and weekend/holidays this equation is actually computed separately for these two strata. This also corrects from differences in the proportion of weekends/holidays between the baseline and post-enforcement periods. Note that Surveyor reports compute a simple average daily difference of pre- vs. post-enforcement consumption, and then multiplies this by 365 to obtain annual savings estimates.

Table V.6: Average Daily Monitor Hours, by State, in Pre and Post Enforcement

	Pre-Enforcement	Post-Enforcement	Delta
Monitor On	10.5	4.1	-6.4
Monitor Off/Suspend*	13.5	19.9	6.4
Total	***24***	***24***	

* These categories were combined in the Surveyor log files.

Given that the daytime power management settings only included the monitors and employees would typically be working at their computers, the majority of energy savings would be expected to occur from night and weekend/holiday power management.[27] As shown in Table V.7, five of the 17 (29.4%) computers and monitors were normally left operating during weekends/holidays before power management; following power-management, only one computer (5.9%), and no monitors, were normally left operating on the weekends.[28]

Table V.7: Percent of Equipment Operating during Weekends/Holidays

Equipment	Pre-Enforcement	Post-Enforcement
Monitor	29.4%	0%
CPU	29.4%	5.9%

The expected annual savings for computers, based on the 17 desktop computers, was 97.8 kWh/year (Table V.8). The 17 flat panel monitors had expected savings of 78.4 kWh/year. Total annual savings per workstation, therefore, was estimated at 176.2 kWh/year.

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[27] Surveyor v1.4 does not collect hourly data for status, only daily roll up files, so Quantec was able to examine weekend use, but not evening use.

[28] Based on computers or monitors that were on for more than 50% of the weekend/holiday hours. Note also that the one computer that remained on during weekends/holidays in the post-enforcement period apparently did not respond to the power management settings (i.e., it did not shut off). Note also the baseline figures are slightly lower than a recent study by LBNL that found that 60% of computers were normally left on at night: Roberts, Judy, "After Hours Power Status of Office Equipment and Inventory of Miscellaneous Plug Load Equipment," Laurence Berkeley National Lab, January 2004. Because Surveyor only had daily roll-up files, not hourly, we could not look at evening hours, only weekend hours (and a higher percentage of computers may be off during weekends compared to evenings).

Table V.8: Energy Savings for PSE Surveyor Deployment

	Pre-Enforcement (kWh/yr)	Post-Enforcement (kWh/yr)	Savings
CPU			
CPU On	216.4	116.2	
CPU Suspend	0.1	0.2	
CPU Off/Hibernate	5.3	7.6	
CPU Total	*221.8*	*124.0*	*97.8*
Monitor			
Monitor On	121.8	41.7	
Monitor Off/Suspend	2.2	3.8	
Monitor Total	*123.9*	*45.5*	*78.4*
Total CPU and Monitor	***345.7***	***169.5***	***176.2***

Savings Estimates from Additional Surveyor Customers

In addition to the PSE metering study, Quantec attempted to collect Surveyor log files and usage reports from 11 additional Surveyor customers. Unfortunately, six of the 11 customers did not respond to our multiple requests to provide either data or Surveyor reports. Of the five customers that did provide data, only two provided usable files or reports. Table V.9 discusses reasons that data from three of the sites could not be used. Results for the two sites with usable data are then presented. Additional savings calculations, however, have also been included from a forthcoming E-Source Report.[29]

Table V.9: Reasons for Unreliable Savings Data

Site Number	Sector	Outcome of Data Analysis
1	School District	Hard copy report only showed seven-day baseline period, plus a gap in reporting between May 13, 2003, and February 6, 2004, that could not be explained.
2	Community College	Customer was unable to report exact date of implementation. Baseline monitoring period was done on only a few computers and would not be a good proxy for the entire population. Almost half of the client-dates had zero for the number of hours "on" for the computer.
3	School District	Data files and reports were provided for 1,000 clients, but showed only one month of data with no baseline monitoring period due to reported data corruption. The post-enforcement data also appeared to be corrupted, with many "client-days" hours adding up to more than 24 hours.

[29] Greenberg, Dan, "Network Power Management Software: Saving Energy by Remote Control," Forthcoming E-Source Report.

Issaquah School District

As shown in Table V.10, Quantec assumed different demand levels based on additional research. Issaquah School District reported that 99% of the 5,130 computers used CRT monitors, and that 90% were desktop computers.

Table V.10: Assumed Average Power Demand

Mode	Flat Panel Monitors*	CRT Monitors**	Desktop Computers***	Laptop Computers****
On	31.7 Watts	65 Watts	50.8 Watts	12.0 Watts
Suspend/Sleep	0.6 Watts	5 Watts	1.8 Watts	1.9 Watts
Off	0.6 Watts	1 Watt	1.2 Watts	1.2 Watts

* Based on PSE study
** Based on Roberson 2002
*** Based on PSE study
**** Based on PSE study

Unfortunately, Issaquah School District did not conduct baseline monitoring prior to using Surveyor for power enforcement, instead trusting the results of the audit performed by Verdiem to demonstrate the product. As a result, the evaluation team was forced to estimate a reasonable average number of hours that the computers and monitors were in each state prior to enforcement. Issaquah School District estimated that 1,500 (29%) of the computers in the district were left "on" 24 hours/day, 7 days/week in the pre-implementation period. The evaluation team used this information, as well as a weighted average of each state from two other sites, to calculate the number of hours the computer and monitor remained in each state prior to enforcement.[30]

As shown in Table V.11, before power enforcement, we estimate that the average CPU was on for 10.82 hours per day; following power enforcement, this dropped to an average of 4.66 hours per day. Monitors also exhibited a significant drop in hours of use per day, dropping from an estimated 9.89 to 3.35 hours per day following power management (Table V.12).

Table V.11: Average Daily CPU Hours, by State, in Pre and Post Enforcement

	Pre-Enforcement	Post-Enforcement	Delta
CPU On	10.82	4.66	-6.16
CPU Off/Hibernate	13.02	19.00	5.98
CPU Suspend	0.16	0.34	0.18
Total	***24***	***24***	

[30] The weighted average came from the results of monitoring done by PSE and Metro Government, both of which are included in the report.

Table V.12: Average Daily Monitor Hours, by State, in Pre and Post Enforcement

	Pre-Enforcement	Post-Enforcement	Delta
Monitor On	9.89	3.35	-6.54
Monitor Off/Suspend*	14.11	20.65	6.54
Total	***24***	***24***	

* These categories were combined in the Surveyor log files.

As shown in Table V.13, the Issaquah School District estimated that 29.2% of the computers and monitors were normally left operating during weekends/holidays before power management; following power management, 10.0% of the computers and 7.0% of the monitors were normally left operating on the weekends.[31,32]

Table V.13: Percent of Equipment Operating during Weekends/Holidays (n=5,130)

Equipment	Pre-Enforcement	Post-Enforcement
CPU	29.2%	10.0%
Monitor	29.2%	7.0%

The expected annual savings for computers, based on the 5,130 total computers in the district on which Surveyor was installed, was 102 kWh/year/unit (Table V.14). The monitors had expected savings of 151 kWh/year/unit. Total annual savings per workstation, therefore, was estimated at 253 kWh/year/unit.[33]

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31 Based on computers or monitors that were on for more than 50% of the weekend/holiday hours. Power management would normally have shut off all computers for at least 50% of the weekend hours. Follow-ups with Issaquah indicated that the enforcement scheme they set would not turn computers off that had applications running, thus accounting for the relatively high percentage in the post-implementation period.

32 A study released in May 2004 and conducted by researchers in the Environmental Energy Technologies Division of the Lawrence Berkeley National Laboratory concluded that 60% of desktop computers are left "on" after-hours. Since this is more than double the estimate provided by Issaquah, the savings results that we present here may be somewhat conservative.

33 This estimate of savings does not take into account all the vacation time common to schools. A more conservative assessment would be to assume that computers and monitors are off during the school summer vacation and thus no savings would be gleaned during that period. The conservative estimate would then be to multiply our calculated savings by 1/6 for a total savings per unit of 211 kWh/year.

Table V.14: Energy Savings for Issaquah Surveyor Deployment

	Pre-Enforcement (kWh/yr)	Post-Enforcement (kWh/yr)	Savings (kWh/Yr)
CPU			
CPU On	181.7	76.8	
CPU Suspend	0.1	0.2	
CPU Off/Hibernate	5.8	8.4	
CPU Total	*187.6*	*85.4*	*102.2*
Monitor			
Monitor On	229.3	76.2	
Monitor Off/Suspend	5.2	7.6	
Monitor Total	*234.5*	*83.7*	*150.8*
Total CPU and Monitor	***422.1***	***169.1***	***253.0***

Portland Metro Government

As shown in Table V.15, Quantec assumed different demand levels based on additional research. Metro Government reported that 90% of the 386 computers used CRT monitors, and 100% were desktop computers.

Table V.15: Assumed Average Power Demand

Mode	Flat Panel Monitors*	CRT Monitors**	Desktop Computers***
On	31.7 Watts	65 Watts	50.8 Watts
Suspend/Sleep	0.6 Watts	5 Watts	1.8 Watts
Off	0.6 Watts	1 Watt	1.2 Watts

* Based on PSE Study

** Based on Roberson 2002

*** Based on PSE Study

As shown in Table V.16, before power enforcement, the average CPU was on for 6.65 hours per day; following power enforcement, this dropped to an average of 6.10 hours per day. Monitors also exhibited only a slight drop in hours of use per day, dropping from 4.28 to 3.71 hours per day following power management (Table I.3).

Table V.16: Average Daily CPU Hours, by State, in Pre and Post Enforcement

	Pre-Enforcement	Post-Enforcement	Delta
CPU On	6.65	6.10	-0.55
CPU Off/Hibernate	17.13	17.65	0.52
CPU Suspend	0.22	0.25	0.03
Total	***24***	***24***	

Table V.17: Average Daily Monitor Hours, by State, in Pre and Post Enforcement

	Pre-Enforcement	Post-Enforcement	Delta
Monitor On	4.28	3.71	-0.57
Monitor Off/Suspend*	19.72	20.29	0.57
Total	***24***	***24***	

* These categories were combined in the Surveyor log files.

Given that the daytime power management settings only included the monitors and employees would typically be working at their computers, the majority of energy savings would be expected to occur from night and weekend/holiday power management.[34] As shown in Table V.18, 9.7% of the computers and 2.2% of the monitors were normally left operating during weekends/holidays before power management; following power-management 4.7% of the computers and 1.1% of the monitors were normally left operating on the weekends.[35]

Table V.18: Percent of Equipment Operating during Weekends/Holidays (n=386)

Equipment	Pre-Enforcement	Post-Enforcement
Monitor	2.2%	1.2%
CPU	9.7%	4.7%

The expected annual savings for computers, based on the 386 desktop computers, was 16.5 kWh/year (Table V.19). The monitors had expected savings of 17.3 kWh/year. Total annual savings per workstation, therefore, was estimated at 33.8 kWh/year.

[34] Surveyor v1.4 does not collect hourly data for status, only daily roll up files, so Quantec was able to examine weekend use, but not evening use.

[35] Based on computers or monitors that were on for more than 50% of the weekend/holiday hours. Power management should have shut off all computers for at least 50% of the weekend hours, indicating that either (1) the customer did properly set enforcement or (2) the software did not function properly.

Table V.19: Energy Savings for Portland Metro Surveyor Deployment

	Pre-Enforcement (kWh/yr)	Post-Enforcement (kWh/yr)	Savings (kWh/Yr)
CPU			
CPU On	122.9	105.9	
CPU Suspend	11.3	11.8	
CPU Off/Hibernate	0.1	0.1	
CPU Total	*134.4*	*117.8*	*16.5*
Monitor			
Monitor On	93.9	76.3	
Monitor Off/Suspend	7.0	7.2	
Monitor Total	*100.8*	*83.5*	*17.3*
Total CPU and Monitor	***235.1***	***201.4***	***33.8***

Additional Sites

The forthcoming report from E-Source presents savings estimates from a number of additional sites. These findings are summarized below.

Southern California Edison. Southern California Edison (SCE) conducted extensive testing with the Surveyor software to ensure that it was compatible with other software, didn't pose a security risk, and didn't require excessive computer memory. As part of their testing they installed Surveyor on 10 computers, and used dataloggers to measure energy consumption. Estimated savings from this study indicate that Surveyor will save 330 kWh/year per work station. SCE reported, however, that these estimates may not be typical of other applications, because the pilot study included a number of high-demand 21-inch CRT monitors.

Queensborough Community College. Queensborough Community College in Bayside, NY is one of two community colleges in the City University of New York (CUNY) that were selected to participate in an evaluation of Surveyor sponsored by the New York Power Authority (NYPA). Surveyor was installed on about 850 workstations: 700 administrative computers (used by instructors and administration) and 150 in the computer labs.

In January 2004, following three months of power enforcement, Verdiem examined the data logs in January 2004. The analysis revealed expected savings of 129 kWh/year for the administrative computers and 317 kWh/year for the computer labs. The higher expected savings for the labs results from longer idle times.

Robert Batemen Secondary School As part of the BC Hydro Power Smart Partner Demonstration program, Abbotsford School District, in British

Columbia, participated in a case study to test Surveyor in the Robert Batemen Secondary School.[36] The objectives of the demonstration project were to demonstrate and confirm the electricity savings achieved by installing energy conservation software in a network environment, and ensure the compatibility of the product with the district's computers in a network infrastructure. Surveyor was installed on 19 of the schools 250 computers, and energy use was then monitored for a one-week period in April 2003. Projected electricity savings were estimated to be 253 kWh/year per computer.

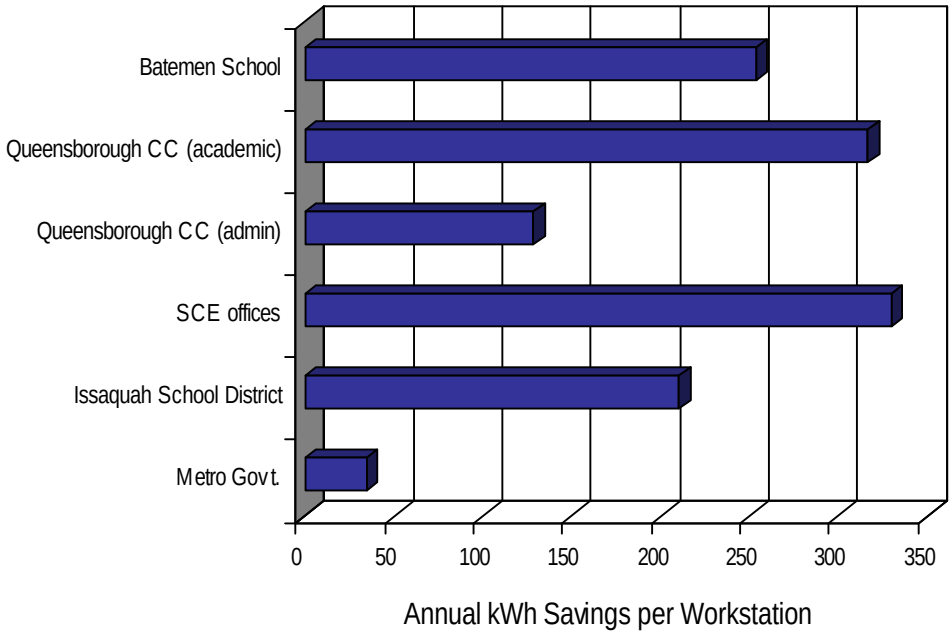
Summary of Savings Estimates

As summarized in Figure V.1, estimated annual savings can vary dramatically for different Surveyor installations. There are a number of "drivers" that can impact these savings estimates, including:

- ***The length of the study period***. Short study periods (some of these were only one week), can potentially bias the results (e.g., a short period that at a school district over a holiday weekend).
- ***The number of computers monitored***. Smaller sample sizes will obviously be more prone to picking up "noise" (e.g., one user spending two days offsite at a meeting and leaving their computer off).
- ***The type of computers monitored***. A sample that includes powerful desktops and large CRT monitors will obviously have higher potential savings vs. a sample that includes a mix of desktops, laptops, and flat-panel monitors.
- ***Baseline practices and compliance***. Some companies have policies to shut off computers in the evenings, often because of security concerns. Companies with high compliance with this practice will clearly have far lower potential savings estimates than companies where the majority of workers leave their computers on during the evening.

[36] This program was developed by Hydro to encourage the development and market adoption of new energy-efficient technologies. More information can be found at http://www.bchydro.com/business/success/story9583.html.

Figure V.1 Summary of Annual Energy Savings from Surveyor



VI. Cost Effectiveness Analysis

The key assumptions for calculating the cost effectiveness of the Verdiem project are listed in Table VI.1.

Table VI.1: Alliance Cost-Effectiveness Assumptions

	Assumption
Alliance Venture Costs and Other (Verdiem & Utility) Costs	Alliance - $985,000 Verdiem - $750,000 Utility - $98,500/year for 10 years
Surveyor Cost	$10/unit for large sites (6% of sales), $15/unit for medium sites (24%), $20/unit for small sites (70%). Average cost was $18/unit.
Installation Cost	$5/unit
Life of Measure	10 years
Annual O&M Costs	None assumed
Market Size	>3.2 million in 2010
Units Sold in Pacific Northwest	~452,000 by 2010 or ~14% market saturation
Annual Energy Savings	200 kWhs/unit

The paragraphs below describe these assumptions in more detail and, in some instances, provide revised estimates based on Quantec's evaluation to date.

Venture Costs & Other Administrative Costs. The Alliance estimates venture costs of $985,000 (Alliance funding is $750,000 Verdiem contract, $175,000 evaluation and $60,000 total administration costs). Verdiem provides co-funding of $750,000 over the first two years of the venture, and the local utility provides annual support of $98,500 through 2010.[37] These figures are based on primarily on Verdiem's contract with the Alliance and are considered reasonable.

Surveyor Cost. The Alliance estimates that the average cost for Surveyor will be approximately $18 per copy over the ten-year period. This is based on the assumption that small companies will be $20/unit, medium sized companies will pay $15/unit, and large companies will pay $10/unit. In addition, there was originally a discussion about a two-priced option, where the customer can pay a slightly higher cost and not be forced to renew the license when it is rolled over to a new computer. Based on discussions with Verdiem, however, it appeared that all customers had purchased the licenses with this assumption. We would recommend that the Alliance run the model with different cost

[37] The assumption is that the utilities will pay the same amount as the Alliance, but spread out over ten years.

levels, looking at average costs of $10/unit to $15/unit and evaluate cost-effectiveness at each of this levels

Installation Costs. The installation costs at each site will vary depending on the deployment strategy of the organization. These costs will consist primarily of the network administrators' efforts to install and configure the software to apply the appropriate energy management strategy based on the users' profiles. The customer survey revealed that companies are expending a considerable amount of effort into developing user profiles. However, the average Northwest sale is for approximately 2,000/units per customer. Assuming the cost of $5/unit, total installation costs would be $10,000/site (or 2,000 units multiplied by $5/unit). If a network administration staff is charged at $100/hour, this would be 100 hours of labor, which seems reasonable, possibly slightly low.

The newer version of Surveyor reportedly minimizes installation costs by allowing automated login scripts, which are dormant until the regular user logs into their PC and triggers installation of the Surveyor software. The software, therefore, no longer requires CD installation on each individual PC. The new product also has a closer integration with network infrastructures and software deployment tools like SMS. Verdiem reports that these new features have substantially reduced installation costs, sometimes well below $1 per PC.

Quantec recommends that the Alliance compare cost effectiveness with alternative estimates for installation costs (as the hours and cost per hour can vary widely by organization), possibly using values of $0.50 to $1.

Life of Measure. The Alliance is using an estimated measure life of ten years. Given that the license extends beyond the life of the computer, we would expect that it would be greater than three to four years (the average life of a computer, according to a literature review). However, given the rapid changes in the technology industry, there is quite a lot of uncertainty about the market for Surveyor in ten years. Quantec therefore recommends that the Alliance monitor the market (including the incidence of renewal licenses and the expected useful life of computers) and adjust the lifetime accordingly.

Annual Operating and Maintenance (O&M) Costs. Currently, the Alliance assumes no annual O&M costs. Some costs (network administrator time) may be incurred if there are any changes to the power management strategy for the company or if additional tracking and reporting are conducted. Assuming that the average site has 2,000 licenses and will require O&M of 40 hours/year at $100/hour, this would be $4,000/year (or $2 per unit). The O&M, however, would likely drop after the first year or two of having the product installed. Quantec recommends that the Alliance adopt an O&M cost of at least $1/unit.

Market Size. The market size in 2010 is based on the current estimated number of PCs in use and the expected growth rate. There were an estimated 2.3 million eligible desktop PCs in the Northwest market as of the end of

2003. At a 2.5% growth rate, this will grow to approximately 3.2 million PCs by 2010. The Alliance needs to examine population growth forecasts, and use these as a proxy for growth in market size, but also balance this growth by the likely increase in the percentage of laptops in the marketplace.

Units Sold. The Alliance needs to update this to reflect sales of 33,750 units in the Northwest at the end of 2003 (the model currently only shows 17,985 units). However, the interviews revealed that deployment was less than 100% of the purchased units for a number of reasons, including:

- *Delays in Deployment*. Customers took longer to find the required administrative time to install Surveyor and activate power management
- *Advance purchases*. Because procurement is a challenging process for some public entities, some customers have bought ahead (e.g., "I have enough licenses for my current computers and the computers I plan to add in the next few years.")
- *Incompatibility*. In a number of cases, customers learned that some of their older computers were still running older operating systems (e.g., Windows 98 FE)

Given these factors, Quantec recommends that the number of installed and operating units be discounted by 15% to 20% from the number of units sold.

In terms of growth rate, these sales would result in a market saturation of 14%. Quantec agrees that that this level of saturation may be achievable once full-scale marketing of the product commences and if the recommended changes in the functionality of Surveyor are adopted.

Annual Energy Savings. The Alliance currently assumes 200 kWh of savings for each PC (CPU and display combination) where Surveyor is installed. This savings is based on the assumed baseline energy management practices and the expected power management strategy deployed, and *may be updated at a later revision of this report when we have additional savings estimates*. In addition, given the increasing market share of flat panel monitors, savings per work station should be reduced after the next two to three years by at least 10%.

Monitoring and Tracking

The Alliance should contact Verdiem on an annual basis to obtain regional and national sales data (with the revenue sharing agreement in place, the Alliance will have access to sales data for the foreseeable future). In addition, average savings per unit should be calculated by looking the percent of units that are installed on desktops vs. laptops and flat panel monitors vs. CRTs, and updating the typical EUC per client. These calculations will allow for simple estimates of total energy savings from Surveyor.

VII. Findings, Conclusions and Recommendations

This report presents the findings from a number of data-collection and analysis activities, including an assessment of potential competitors, customer interviews, verification of the functionality of Surveyor, and an estimate of annual savings potential. The most significant findings, conclusions and recommendations are presented below.

Conclusion 1: The growing market awareness of acceptance of Surveyor indicate that the software is achieving its short term market transformation objectives. Surveyor continues to offer an innovative product that gains market acceptance, with features that

Verdiem offers an innovative product and continues a steady pattern of growth and acceptance by the marketplace, fulfilling an important "niche" in energy savings potential and functioning as an important market transformation project. The company has received a number of high profile endorsements, including BPA and NYPA, as well as positive press articles. In an increasingly competitive marketplace – another sign of market transformation – Surveyor offers distinguishing features that appeal to potential customers.

The company has also successfully met many of the short term indicators, completion of market ready (post-beta) product, market awareness of the product, energy savings in customer installations, field verification of savings, and sales in the Northwest. Completion of a new, updated business plan and the use and promotion of non-energy benefits, however, have not been pursued.

Recommendation: If possible, Verdiem should utilize the Alliance utility database to identify and contact the proper person at additional Northwest and west coast utilities. Leveraging the Alliance support in this way allows Verdiem to reach influential market actors that can help promote the product and lead to exponential sales growth. Continue to highlight these important features, such as the detailed reporting, to potential customers, and proactively explore non-energy benefits that appeal to IT staff.

Conclusion 2: The primary market barriers remain resistance from the IT department. This is based on three concerns: fear of incompatibilities with other software, that the software will not work with existing hardware configurations, and that network security issues could be compromised. In addition, although the final decision maker is normally the energy or facility manager, the IT staff has a major role in the decision, including "veto power."

Recommendation: Verdiem needs to allay these concerns by providing customer references, testimonials, and case studies. As in the case with any new technology, Surveyor continues to move along the adoption curve, and those following the innovators and early adopters require additional reassurance. In addition, including IT staff in early stages of the sales cycle should help reduce their concerns.

Conclusion 3: The only apparent market driver is saving energy; nonenergy benefits have not influenced sales. Current customers did not feel that the software offered any additional features that appealed to them.

Recommendation: Without adding additional non-energy benefits for IT staff, Verdiem could continue to find that IT resistance remains a significant barrier to sales and installation. Verdiem should proactively pursue non-energy benefits that appeal to IT staff. IT staff did request that Surveyor add additional power state control that would allow network administrators to turn on computers for after-hours software updates.

Conclusion 4: Although sales continue to exceed projects, deployment and enforcement are slower than expected. For example, of the 17,000 licenses purchased by the responding companies, only 8,400 had been deployed, and only 7,000 had been set to enforcement. Advance purchases, incompatibilities, and user profiling were among the reasons for the delays.

Recommendation: Customers should be encouraged to conduct simplified versions of the profiling task so as to minimize the delay in power management.

Conclusion 5: The reporting remains an important, but underutilized, feature of Surveyor. Numerous respondents reported that they were impressed by the exceptional reporting capabilities, including the sophisticated scenario analysis, and that this feature was an important factor in their decision to purchase Surveyor. However, many of these same respondents reported that they had not yet run any reports. This paradox is likely the result of respondents feeling that IT would need to run their reports, and they did not want to further burden IT with an additional request.

Recommendation: Verdiem needs to more effectively communicate to customers, including energy and facility managers, that non-IT staff can run reports. This may also require additional training, including more automated reporting features. A number of more sophisticated users requested that that reports allow for more configurations (i.e., more than one estimate of kW at each state).

Conclusion 6: Surveyor has few problems with functionality, and annual savings appear to be about 176 kWh/year for desktop PCs with LCD monitors. Based on the results of a metering study, Surveyor generally

appeared to properly shut down the computers and monitors, leading to energy savings. The majority of savings are in the evening and weekend hours, when users are normally not using their computers and when power management was most stringent. Savings can be expected to be higher with CRTs and savings still significant with LCDs.

Recommendation: Surveyor should continue to collect savings data from additional customer sites. Attempts should be made to maximize the number of workstations and the length of the monitoring periods in the studies. In addition, extrapolation to annual savings should be stratified based on weekdays vs. weekends/holidays. Finally, trends in the market, such as the increasing incidence of LCD monitors and laptop computers, need to be factored in to organizational savings potentials.

Summary and Response to Previous Recommendations

Verdiem should revise its business plan to reflect it current business strategy and to establish revised goals for product development, sales, and market penetration. This has not been completed.

Verdiem should define the desired functionality for future versions based on their product vision, the feedback from Premier Evaluation Partners, and the survey findings discussed in this report. As discussed in this report, Verdiem has added a multitude of new features in their latest version, V2.1.

Verdiem should be prepared to launch an aggressive marketing campaign once the next production of Surveyor is ready, clearly establishing the product's value proposition and highlighting both energy and non-energy benefits. EZConserve must differentiate Surveyor from its direct competitors and possible substitutes. As discussed earlier in this report, Verdiem marketed Surveyor through a number of avenues, including getting trade press to disseminate information about the product and features and expanding its sales force in geographic areas where energy efficiency spending is highest. The inclusion and value of non-energy benefits, however, continues to lag, and could potentially hinder future sales. Other features, however, such as advanced reporting, have been key to driving sales and distinguishing the software from the competition.

EZConserve should be confident that the next version has been thoroughly tested and is ready to market before initiating an intensive campaign. Customer appeared to be satisfied with the functionality of Surveyor, indicating that the testing was extensive and there were no major bugs.

Verdiem should consider the potential window of opportunity for the Surveyor product, particularly in light of rapidly advancing hardware and operating system power management capabilities. Verdiem has expanded

compatibility with additional operating systems and has established an important market niche.

Long-Term Monitoring and Tracking

In addition to tracking sales, the Alliance should also consider a more detailed examination of true customer use of the software. This evaluation raised a number of important questions about the timing and number of licenses that are actually being deployed, how many computers are being set for power management schemes, and what type of enforcement policy is being implemented (daytime, evening only, etc.). In addition, different companies have varying policies (and compliance) regarding evening/weekend turn-off. We therefore recommend that the Alliance conduct continued customer research to examine these issues and develop a more refined estimate of energy savings. The most informative approach would be to collect additional customer savings reports or raw data files, as we have done for this report.

If funding allows that Alliance should also examine other evidence of more widespread market transformation, such as the appearance of competitive software, changes in behavior regarding shut off, and changes in software/hardware power management configurations. This analysis, of course, would also require a careful attribution assessment to determine the impact the Alliance venture had on these “spillover” developments.

Appendix A. Interim Memos

[To be included electronically in final PDF version]

Appendix B. Customer Interview Instrument

[To be included electronically in final PDF version]

Appendix C. Energy Saving Calculations

[To be included electronically in final PDF version]