QDI STRATEGIES
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# Enterprise PC Power Management Tools:
## Greening IT from the Top Down

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**Abstract**
There are approximately 108 million desktop and laptop computers in use in commercial buildings in the US, with most PCs powered ñOnò at nearly equal levels day and night. This research was conducted to profile PC power usage 24/7 for selected businesses and institutions with distributed IT environments.

Prior work in this area is now several years old, and was based on in-person, after-hours power state audits. While this pioneering work in energy use measurement for office equipment demonstrated that significant energy savings could be achieved by putting inactive PCs to sleep at night, the majority of organizations today are not optimizing power savings tools.

This study provides the first large scale audit conducted by automated software agents running on desktop and laptop PCs, tracking usage second by second. The results of this study showed that PCs are ñOnò more than 90% of the time; in most cases well beyond actual client user demand for PC ñOnò time over the course of a day or week.

The study also demonstrates that organizations deploying a centralized, automated method of turning on PC operating systems power management features not only saved energy during evenings and weekends, but also saved energy during the workday.

**Acknowledgements**
This study was made possible in large part by data provided by Verdiem, Inc., as well as substantive insights provided by diverse subject matter experts in PC power management. Considerable project time was required to provide richness of data not previously available.

We also wish to thank current PC power management end-users for their participation, including City of Seattle and Stanford University, and experts at Lawrence Berkeley National Laboratory, pioneers in energy measurement for office equipment, for providing multiple views of energy savings programs and technology development opportunities.

***In This Article:***

*Learn how automated methods of turning on a PC can save energy during the workday*

**Introduction**

Environmental goals are emerging as an important mission for government, businesses, and institutions. Most sustainability initiatives focus on eliminating waste and emissions in manufacturing processes, transportation, and consumables, yet information of technologyôs overall energy impact is substantial. According to Gartner, PCs and monitors represent 31% of all energy consumed by IT equipment. Limited data is available, but frequently cited data from the U.S. EPA estimated that electricity consumed by IT equipment and site infrastructure systems in data centers alone cost $4.5 billion in 2006.

This study illustrates the magnitude of the opportunity to reduce PC power demand in business settings. While the potential for energy savings is largest on evenings and weekends, workdays were shown to represent savings opportunities as well. With an estimated 108 million desktop and laptop PCs used in U.S. commercial buildings today, powering down computers when they are not being used during the business day reduces operational costs, as well as local demands on the power grid during peak load periods.

Lawrence Berkeley National Laboratory (LBNL) has been broadly recognized as pioneers in energy measurement for office equipment, examining after-hours power status of office equipment. Published in 2004, an LBNL study was based on in-person, on-site data collected by observation of devices in commercial buildings and institutions, reflecting a snapshot in time for after-hours power status of devices. Data was captured on approximately 1,500 desktop and laptop computers, as well as other office equipment.

According to the LBNL study cited above, fewer than 10% of computers were configured to take advantage of energy savings features. Disabling of power management settings can occur for many reasons, both intentional and unintentional, by users and IT departments. Client PCs are reportedly left ñOnò overnight and on weekends for myriad reasons, including concerns about availability for important patches and updates, as well as misinformation or lack of awareness about enterprise IT policies. This, coupled with the findings from a 1E/Harris Interactive survey, reported that more than half of respondents said they were ñnot at all concernedò about their companyôs carbon footprint, concluding that effecting change in PC shut down practices at the behavioral level might yield disappointing results.

> *ñI've learned that the behavior is very hard to change; when you can, change machines, not people.ò*
>
> Bruce Nordman, LBNL

Centralized automated methods of managing PC power use are gaining traction. This study by QDI Strategies provides the first large scale audit conducted by automated software agents running on desktop and laptop PCs, tracking PC usage second by second on 110,000 PCs, with the goal to give the full 24 hour picture of device usage across days, weeks, and months in multiple industries.

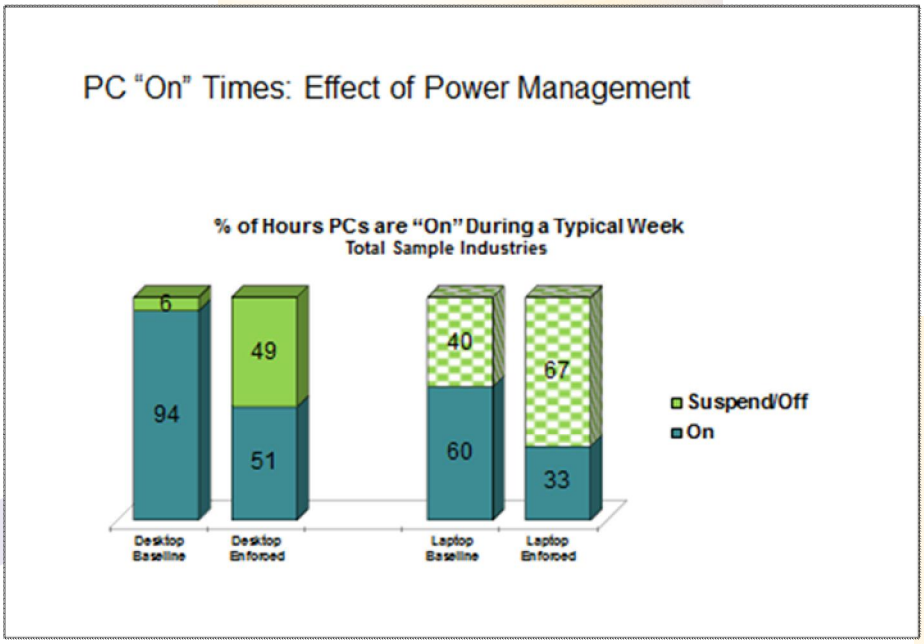
The primary focus of this report is on PCs where BOTH baseline tracking (without corporate PC power policies applied) and enforced power management tracking data was available to estimate savings potential when corporate power policies are applied and enforced. Data for environments without enforced power management profiles are discussed separately.

**Key Findings**

Computer energy use is a rich target for energy conservation strategies. IT managers and PC users in business and institutional settings continue to leave desktops and even laptops powered ñOnò day and night, apparently disabling factory-enabled power management settings. Much of this time the PCôs CPU is idle, yet consuming energy in a high power state.

This study demonstrated that energy savings can be compelling for organizations deploying a centralized, automated method of activating PC operating systems power management features to force computers into a low power state when the PC is inactive or idle for specified periods of time. While energy use depends upon the specific device, a desktop computer in idle may consume upwards of 65 watts of power (excluding monitor), compared to 3 to 5 watts in Suspend or Off modes. This is a significant energy reduction.

Baseline data showed that desktop PCs are ñOnò more than 90% of the time, well beyond actual client user demand for PC ñOnò time over the course of a day or week, and that when corporate power policies were defined and power management tools deployed, a high percentage of both desktop and laptops entered a Suspend or Off mode, resulting in considerable energy savings even during business hours.




PC power management initiatives reduce operating costs and support ñGreen ITò agendas, with little or no impact on PC user productivity.

**Methodology**

This study provides the first large scale audit conducted by automated software agents running on desktop and laptop PCs, tracking usage second by second. The data collected and analyzed by QDI Strategies is based on a blinded sample of over 110,000 PCs across a broad sample of industries and company sizes, headquartered in the US, with devices in North America. The focus of the study was to capture PC usage states in office and professional environments outside of data centers.

Usage of each machine was recorded electronically for approximately two weeks, with specific machine data collected over periods ranging from two days to nine months, from July 2008, to January, 2010.

One of two subsets of these 110,000 PCs have been highlighted in this report, with the main focus on PCs where BOTH baseline tracking (without corporate PC power policies applied) and enforced power management tracking data was available, accounting for 78% of desktop PC baseline CPU hours collected in this study.

PC power usage in organizations providing both baseline and enforced data provided a ñbefore and afterò picture of opportunities to save energy with power policy applied. This study looks at all the data provided by each organization, thus:

- Not every unique device in this baseline had companion enforcement data since organizations may have purchased new PCs and cycled out old devices between audits;
- Some PCs tracked in the baseline audit were not selected as candidates for deployment of centralized PC power management; desktop PCs were more likely to be selected for enforced power management than laptops;

Baseline data was generally tracked for longer periods of time than tracking periods for enforced data. However, the distribution of tracked CPU hours by day/ weekpart was similar between baseline and enforced environments.

Due to smaller sample sizes, some industry-specific data for laptops are not shown.

**PC Power Usage States**

Reducing power consumption of personal computers is a growing concern for many organizations. New capabilities in operating systems and computer hardware can assist in lowering power use, but may require actions on the part of IT managers to implement PC power policies across the organization. In addition, new software tools exist that are capable of collecting significant amounts of information about network and PC device usage states by observing network traffic, to determine inefficiencies and wastage of power, and simplifying centralized control of PC power policy.

In this study, 64.5 million ñOnò and ñSuspend/Offò CPU hours were tracked by agents on PCs in organizations that provided both baseline and enforced data, providing a ñbefore and afterò picture of opportunities to save energy with power policy applied. As such, three industries qualified for analysis: Education, Healthcare, and Finance. Eighty percent (80%) of total baseline CPU hours tracked were sourced from desktop PCs; 20% of hours tracked were reported by agents tracking laptops.

While the aggregate of these three industries provides a directional picture, the unique characteristics of these client environments are not known due to blinded data sources, and the data may not reflect the actual savings opportunities across other organizations. Data for client environments providing ñBaseline Onlyò data is shown separately for comparison purposes across industries. Industries profiled

in the baseline-only section show high ñOnò times and high idle times, suggesting that these industries would see similar savings from deployment of power management systems.

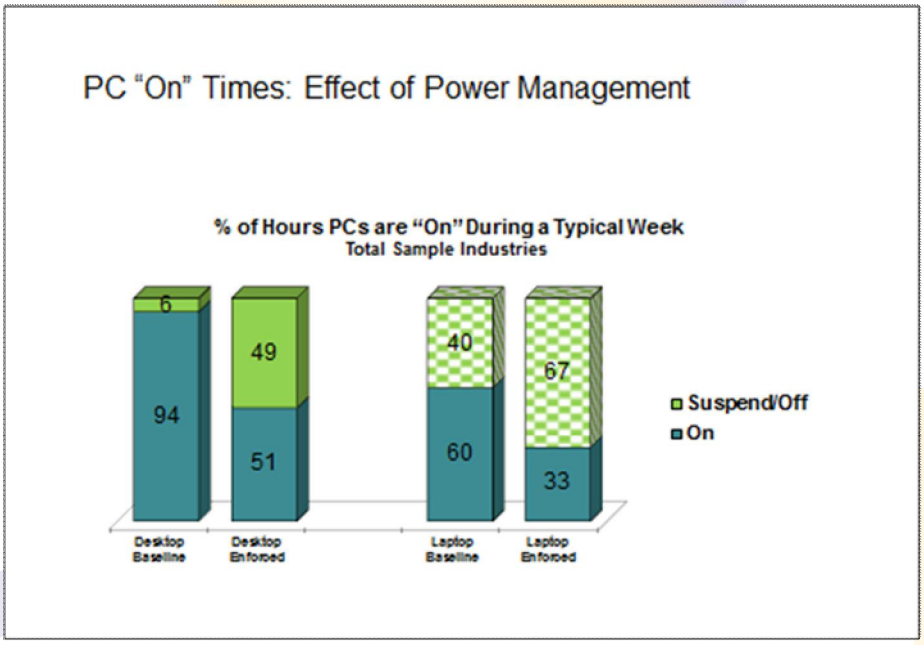
***Baseline Audits of PC Power States***

Baseline audits of PC power states revealed that desktop PCs are ñOnò 94% of the time overall, peaking at 96.8% of time during a typical workday (8 AM to 5 PM). PC ñOnò times for after-hours on work days (5 PM to 8 AM) and weekends/holidays were a startling 93.5% and 93.1% of time respectively.

Laptops are inherently more efficient than desktop PCs, yet still powered on 60% of the time overall. ñOnò times peaked at 74.1% during an average work day, compared to 56.4% of time after-hours, and 51.1% of time during weekends/ holidays.

***The Effect of Enforced PC Power Policy***

The application of corporate PC power policy showed a dramatic positive impact in reducing CPU ñOnò time:



Energy savings from powering down PCs at night and on weekends and holidays are substantial for both desktop and laptop PCs, on top of a 10 to 20 point drop during workdays, when high availability is required to sustain worker productivity. Reducing PC ñOnò times during workdays is of special interest to public utilities developing incentive programs to reduce energy use during peak load hours.

## Desktop PC "On" Times
Effect of Power Management by Day & Time

| Total Sample Industries: Desktop PCs<br>% of Hours PCs are "On" | | | | |
|---|---|---|---|---|
| | Baseline | Enforced | Point Chg | % Chg |
| Typical Week | 94.3 | 50.6 | -43.7 | -46% |
| Workdays 8 AM – 5 PM | 96.8 | 83.5 | -13.3 | -14% |
| Workdays 5 PM – 8 AM | 93.5 | 41.1 | -52.4 | -56% |
| Weekends & Holidays | 93.1 | 35.1 | -58.0 | -62% |

## Laptop PC "On" Times
Effect of Power Management by Day & Time

| Total Sample Industries: Laptops<br>% of Hours PCs are "On" | | | | |
|---|---|---|---|---|
| | Baseline | Enforced | Point Chg | % Chg |
| Typical Week | 59.7 | 33.1 | -26.6 | -45% |
| Workdays 8 AM – 5 PM | 74.6 | 55.9 | -18.7 | -25% |
| Workdays 5 PM – 8 AM | 56.4 | 27.2 | -29.2 | -52% |
| Weekends & Holidays | 51.1 | 22.8 | -28.3 | -55% |

***Variation By Industry Segment***

Regardless of day, weekpart, or industry segment, most desktop PCs in this study were ñOnò over 90% of the time:

Desktop PC "On" Times by Industry Segment

| % of Hours Desktop PCs are "On" | | | | |
|---|---|---|---|---|
| | *Total Industries* | Healthcare | Financial | Education |
| Typical Week | *94.3* | 93.4 | 94.3 | 96.9 |
| Weekdays 8 AM – 5 PM | *96.8* | 96.2 | 97.0 | 98.1 |
| Weekdays 5 PM – 8 AM | *93.5* | 93.0 | 93.2 | 97.0 |
| Weekends & Holidays | *93.1* | 91.7 | 93.6 | 95.9 |

Enforced, centralized PC power management on desktops reduced CPU ñOnò times significantly in all industries:

Desktop PC "On" Times
Effect of Power Management by Industry Segment

| Desktop PCs<br>% of Hours PCs are "On" | | | | |
|---|---|---|---|---|
| | Baseline | Enforced | Point Chg | % Chg |
| Total Industries | 94.3 | 50.6 | -43.7 | -46% |
| Healthcare | 93.4 | 46.0 | -47.4 | -51% |
| Financial | 94.3 | 56.0 | -38.3 | -41% |
| Education | 96.9 | 15.2 | -81.7 | -84% |

Power managed laptop computers show reductions in hours ñOnò, despite baseline profiles that were lower than desktops to begin with:

Laptop PC "On" Times
Effect of Power Management by Industry Segment

| Laptops % of Hours PCs are "On" | | | | |
|---|---|---|---|---|
| | Baseline | Enforced | Point Chg | % Chg |
| Total Industries | 59.7 | 33.1 | -26.6 | -45% |
| Healthcare | 60.4 | 31.0 | -29.4 | -49% |
| Education | 49.4 | 20.5 | -28.9 | -59% |
| Note: Financial not shown due to small sample size | | | | |

***"Baseline Only" Industries***

Industries tracked for baseline hours (but without data for enforced power policy) exhibited high levels of PC ñOnò time similar to data shown for client industries where enforced data was captured.

Desktop PC "On" Times
"Baseline Only" Industry Segments

| Desktop PCs % of Hours PCs are "On" | | | | |
|---|---|---|---|---|
| | Typical Week | Workdays 8 AM – 5 PM | Workdays 5 PM – 8 AM | Weekends & Holidays |
| *Total "Baseline Only" Industries* | *90.0* | *94.2* | *89.8* | *86.2* |
| Financial | 96.2 | 98.2 | 95.8 | 95.0 |
| Government | 88.1 | 91.7 | 87.7 | 85.1 |
| Higher Education | 76.5 | 89.5 | 74.2 | 67.9 |
| Manufacturing | 86.6 | 94.7 | 88.8 | 77.7 |
| Transaction-Based* | 71.0 | 87.2 | 68.6 | 60.8 |

*Transportation/Retail

**Analysis of Savings Opportunities**

The enterprise PC power management discipline is in an early growth stage. According to estimates, only 20% of firms surveyed have IT systems management suites that include power management or stand-alone power management solutions, suggesting substantial opportunities for expansion in distributed IT environments.

Energy efficiency will improve as old computers and operating systems are replaced with newer technology and enhanced built-in power management features. In combination with increased adoption of enterprise PC power management solutions, there can be a powerful impact to IT energy costs utilizing these tools outside the data center, and the argument to do it is easily made.

The most effective tool for reducing the power use of PCs is to ensure that they are not running when they are not in use. In addition, forcing groups of machines into lower power modes when idle for specified periods of time reduces energy use, and some lower power modes are highly energy efficient, modes that are not highlighted separately in this study.

For this analysis, a savings of 60 watts (.060kW) per desktop PC (excluding monitor) is assumed, based on 65 watts in Idle time reduced to 5 watts in Suspend/Off modes:

| | Increase in % of Desktop PCs (CPUs) in Suspend/Off | kW Savings per Desktop PC by Day/Weekpart | Annual kWh Savings per 1000 Desktop PCs (CPUs) |
|---|---|---|---|
| Workdays 8AM – 5PM | 13.3% | .060kW x 13.3% = .008kW per hour | 45 hours/week x .008kWh x 50 workweeks x 1000 PCs = 18,000kWh |
| Workdays 5PM – 8AM | 52.4% | .060kW x 52.4% = .031kW per hour | 75 hours/week x .031kWh x 50 workweeks x 1000 PCs = 116,250kWh |
| Weekends & Holidays | 58.0% | .060kW x 58.0% = .035kW per hour | 115 days weekends/holidays x 24 hours/day x .035kWh x 1000 PCs = 96,600kWh |
| Total Savings | | | 239,850kWh |

At 10.36 cents per kilowatt-hour (retail cost in 2008 for commercial customers), automated, centralized PC power management tools can save an organization with 1000 desktop PCs nearly **$24,000** annually, not including additional savings from powering down monitors.

## Conclusion

Future study of industry-specific IT environments should be conducted to expand upon this research, as well as exploring the extensibility of enterprise PC power management solutions to other form-factors such as imaging and printing devices, which are potential targets for energy saving initiatives.

A challenge to the adoption of centralized PC power management is that ownership of energy costs lie with facilities, thus energy savings accrue to facilities, not IT. Given these pervasive cultural issues, leadership from the top or from the CFO office is likely a critical success factor to improving most organizationsô bottom line via reduced energy bills. A culture favoring conservation and sustainability should aid IT managers in enlisting leadershipôs help in reducing energy waste and greening the IT function from the top down.

The principal consequence of inaction is continued ñleakageò at the bottom line, as dollars are wasted on energy for PCs that are not in use. Collectively, in a large enterprise this can amount to many thousands of dollars annually. These are dollars which could be put towards more productive uses within the enterprise.

We hope that organizations responsible for energy efficiency will use the data in this study to create, support, and fund projects and programs that encourage adoption of PC power management solutions.

## Endnotes

1 ñForecast: IT Hardware Energy Consumption, Worldwide, 2005-2012ò, Gartner 2006

2 Report to Congress on Server and Data Center Energy Efficiency, Public Law 109-431, U.S. Environmental Protection Agency ENERGY STAR Program, August 2, 2007

3 ñEnergy Savings Potential and RD&D Opportunities for Commercial Building Appliances -Final Reportò, Navigant Consulting, Inc., December 21, 2009; submitted to U.S. Department of Energy, Energy Efficiency and Renewable Energy Building Technologies Program; (estimate of computer stock in commercial buildings from 1E, 2009)

4 Roberson, Judy A., Carrie A. Webber, Marla C. McWhinney, Richard E. Brown, Margaret J. Pinckard, and John F. Busch, ñAfter-hours Power Status of Office Equipment and Inventory of Miscellaneous Plug-Load Equipmentò, Lawrence Berkeley National Laboratory, Study LBNL-53729, January 2004

5 Conservative estimate, based on information collected from multiple PC power management solution vendors.

6 ñAnnual Electric Power Industry Reportò, Average Retail Price of Electricity to Ultimate End-Use Sector, 2008; Commercial Sector, cents per kilowatthour; U.S. Energy Information Administration, Form EIA-861 (Note: 10.36 cents per kWh)

## About QDI Strategies, Inc.

QDI Strategies, Inc. is a marketing consulting firm that specializes in helping companies make breakthroughs in product, brand and channel strategies. Our consultants have helped clients to develop and implement breakthrough decisions across numerous industries over the last twenty years. This experience provides you with the expertise to develop market-driven answers to your business issues.

## For More Information

If you would like to receive additional information on identifying and harvesting new technologies, or would like to arrange an informative presentation, contact Michael Barr at 847-566-2020.

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