Proposal Details

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Proposal Title:	Reducing Electricity Consumption at USF by Using State-of-the-Art Methods to Power Manage Desktop Co
Organization:	student and staff from Department of Computer Science and Engineering
Description:	Information Technology (IT), including personal computers (PCs) and peripherals, telecommunications networks and devices, and data centers are a vital part of modern life. In 2007 the total CO2 equivalent emissions of IT (from electricity consumed) was about 830 MtCO2e, which is about 2% of the estimated total emissions from human activity released that year. It is estimated that this level of emissions will continue to grow at a rate of 6% per year through 2020 [1], [2]. This level of emission exceeds that of the aviation industry [2]. The electricity costs to power IT equipment are considerable. In the US it is estimated that servers and data centers cost $4.5 billion to power and desktop PCs about $6 billion [3]. GOALS AND OBJECTIVES Here at the USF Tampa campus we have about 10,000 desktop PCs in faculty and staff offices, dedicated labs, and open use areas (such as the library). With only a few exceptions, these PCs are under the control of USF Information Technology. Most of these PCs are fully powered-on 24/7 consuming about 70 to 100 Watts even when not in active use. If placed into a sleep mode these same PCs would consume less than 5 Watts. Such a sleep mode is natively supported by Microsoft, Apple, and Linux operating systems. The attached material shows power use measurements from a typical PC when active, inactive, and in sleep mode. Craig Woolley, Assistant VP for Administration and Support Services, estimates that the vast majority of the PCs on campus are not enabled to use sleep mode and remain fully powered-on 24/7 despite not being in active use at nights and (often also) on weekends, holidays, and breaks. There is a significant opportunity for energy savings and the associated reduction in CO2 emissions – and also direct cost savings to USF. This is in line with the USF Master Plan to reduce energy losses and with the American College & University President's Climate Commitment to achieve climate neutrality. The problem we are addressing is not as simple as just "enabling sleep mode" via the PC operating system. RESEARCH PLAN The key trade-off in reducing energy use of equipment – be it PCs or automobiles – is to understand the trade-offs between energy and performance. Simply putting PCs to sleep when no one has used them for a set period of time (say, 5 minutes) will make them unavailable for maintenance by USF IT and create an annoyance when a user has to wait for the PC to wake-up and become fully operational. Excessive user annoyance will cause power management methods to be disabled. As such, a means of determining usage patterns for PCs and using the determined patterns to set wake/sleep schedules is key to success of this project. A means also for allowing USF IT to have remote access for maintenance is essential. Beyond USF IT, faculty and staff who use Microsoft "remote desktop" to access their office PCs from home or travel also needs to be considered. For Phase 1 we will add software agents to existing PCs on campus to measure the actual time that the PCs are used. Data analysis will be conducted to determine wake/sleep schedules that achieve an acceptable level (and what is acceptable must be determined) of user annoyance in trade-off for energy savings. In Phase 1 we will determine which PCs can be power managed and which cannot. We expect that the "cannot" category will be small (perhaps on the order of 10% of critical use PCs). For Phase 2 we will use a commercial product specifically designed for energy management

	Phase 2 we will use a commercial product specifically designed for energy management of PCs. A leading candidate is Verdiem (http://www.verdiem.com) with 1e (http://www.1e.com) and JouleX (http://www.joulex.net) being other possible candidates. PCs on campus have Microsoft "SystemCenter" agent software installed. This product has limited capability for power management – this capability has not been enabled by USF IT and cannot be enabled until a successful Phase 1 study. We will determine which PCs can use the existing SystemCenter and which PCs will need a more capable product, such as noted above, to achieve energy savings. We are budgeting for 10% (or 1000) PCs requiring greater power management capability and the remainder being able to use SystemCenter for power management. For Phase 3 we will explicitly measure energy savings. Energy savings will be stored on a central server in USF IT and will be accessible to all via a web browser. ASSESSMENT METHODS We seek to assess two things, energy savings and user acceptance. We will do this as follows: 1) Energy savings will be assessed via the software tools described above. These tools directly report energy savings to a central server. The measured energy savings can be compared, at a high level, with actual overall building energy use statistics collected by USF Physical Plant. 2) User acceptance will be assessed via surveys. The surveys will serve the roles of a) determining the level of user acceptance for any possible annoyances from the system, b) collecting suggestions for improvements, and c) educating the USF community to the energy savings possibilities from power management of IT equipment. COMMUNICATING RESULTS TO USF COMMUNITY Our plans are to communicate results to the USF community via 1) the banner sign at the entrance to USF Tampa campus, 2) surveys to users of USF IT PCs, and 3) possibly a fun/competitive activity that will involve a prize (and is budgeted for). REFERENCES [1] SMART 2020: Enabling the Low Carbon Economy in the Information Age, A Report by The Climate Group on Behalf of the Global eSustainability Initiative (GeSI), 2008. [2] Gartner Estimates ICT Industry Accounts for 2 Percent of Global CO2 Emissions, Press Release, April 27, 2007. [3] ENERGY STAR Version 5.0 System Implementation Whitepaper, published by Intel and the U.S. Environmental Protection Agency, Feb. 2009 (citing that PCs account for about 2% of nation's 2010 net electricity generation – compare to estimated server usage of 1.5% at $4.5 billion)
Amount Requested:	$50,000.00
Budget Justification:	Funding is being requested to be used as follows (for a total of $50,000 to be expended over two years): * $20,000 for one half-time student employee for USF IT for one year (20 hrs per week, $20 per hour, 50 weeks per year). This student employee will be responsible for the evaluation and roll-out of the power management software to PCs on campus. This student employee will be instrumental in Phase 1 and the first part of Phase 2. The student employee may be continued by IT at the end of the first year – subsequent salary would be paid for by IT (and not this grant). * $13,440 for two half-time undergraduate students for REU (Research Experience for Undergraduates) for two years (20 hrs per week, $8 per hour, 42 weeks per year). The REU students will be part of the Information Systems Laboratory in the Department of Computer Science and Engineering. These two students will assist in all aspects of the project and will be primarily responsible for energy savings measurement and community education. *

	$15,000 for specialized power management software for 1000 PCs ($15 per PC for 1000 PCs). The software vendor is to be determined as part of the initial assessment during Phase 1 of the project. Likely candidates include Verdiem, 1e, and JouleX. For the remaining PCs we expect to be able to use existing software (notably, Microsoft SystemCenter 2012) which has already been paid for by IT budget. * $1,560 for miscellaneous expenses including possible conference travel for REU students, low-cost Watt meters, and/or small prizes for contest to be part of the final assessment. None of the above items are part of the USF IT budget. The exact budgeted amounts may vary slightly from that shown above, but the total will be $50,000.
Resource Matching:	Resource matching will be in terms of an in kind match from USF IT for time to train, offer guidance, and give basic supervision to the new employees hired as a result of this project. The estimate for this is 120 hours over the life of the project (per Craig Woolley, Assistant VP for Administration and Support Services for Information Technology).
Timeline & Milestones:	As described above, this project will require three phases. Phase 1 is to evaluate power management software products, Phase 2 to roll-out the necessary software, and Phase 3 to explicitly measure energy savings. Phase 1 will require 6 months from the start of the project. For Phase 1 monitoring software will be installed on PCs in open use lab PCs, library PCs, and selected faculty and staff PCs. This monitoring software will result in the necessary understanding for a successful Phase 2. A key part of Phase 1 is to select the appropriate specialized software to be used (e.g., Verdiem, 1e, or JouleX). Another part of Phase 1 is to determine the breakdown between using the specialized software and Microsoft System Center that is already owned by IT. The major milestones for Phase 1 are: a) hiring and education of employees and REU students, b) installation of monitoring software, c) set-up of the means for collecting usage data, e) installation and evaluation of software, and e) selection of appropriate software for Phase 2. Phase 2 will require 12 months from the end of the previous phase. Phase 2 will roll-out power management software and capabilities to more than 5000 PCs on campus. Initially, about 1350 open use lab and library PCs will be enabled for power management using the software selected in Phase 1. The initial roll-out will “make us smarter” and will lead to fine tuning of the software and to the roll-out of power management software to faculty and staff PCs. We are conservatively estimating that 50% of faculty and staff PCs could be successfully

	power managed with little, or no, annoyance to the users. The major milestones for Phase 2 are a) roll-out of power management software to open use and library PCs, b) an understanding of energy savings and user annoyance trade-offs, and c) roll-out of power management software to faculty and staff PCs. Phase 3 will require 6 months from the end of the previous phase. Phase 3 will explicitly measure energy savings and will make the project fully sustainable without additional funding. The $50,000 funding will be fully expended at the end of Phase 3. Large scale surveying of users will be conducted in Phase 3 (we expect to conduct smaller scale surveys in Phase 2 as may be needed). The major milestones for Phase 3 are: a) complete energy savings measurements, b) survey all users, and c) complete education of USF community.
Evaluation Metrics:	We will consider the project successful if the following objectives are achieved: 1) Measurable, significant, and sustainable energy savings are achieved 2) There is no annoyance to users ENERGY SAVINGS We estimate that the total annual energy savings of this project is approximately 1,640,310 kWh per year, or an annual $164,031 reduction in the university's annual electricity bill (assuming a cost of $0.10 per kWh). This corresponds to an annual reduction of about 1132 Metric Tons of CO2 emissions (equal to removing 222 cars from the road). The energy savings will continue after the completion of the project. We assume (see attached document for photographs of actual measurements): * Average power consumption of a desktop PC including monitor when on: 75 Watts * Power consumption of a desktop PC when sleeping: 5 Watts * Power management software, as described in this proposal, will enable a desktop PC to sleep on average 12 hours per day where today this same PC is fully powered-on at all times (or "24/7") We believe that these are conservative estimates where some PCs will consume greater that 75 W when on (for example, from the use of multiple monitors) and some PCs will be able to sleep more than 12 hours per day on average. Thus, the annual energy used by a single PC today (for $0.10 per kWh) is: 75 W * 24 hr/day * 365 day/yr = 657 kWh/yr = $65.70 With power management software the annual energy use would be: ((75 W * 12 hr/day) + (5 W * 12 hr/day)) * 365 day/yr = 350.4 kWh/yr = $35.04 And, the annual energy savings per PC would be: $65.70 – $35.04 = $30.66 savings per year per PC In Phase 1 of the project we expect 1350 PCs (corresponding to PCs in open use labs and in the library) to be power managed. Thus, the annual power savings for the first Phase will be $41,319 per year. In Phase 2 of the project we expect 50% (or 4000) of faculty and staff PCs to be power managed. Thus, the additional annual power savings for Phase 2 will be $122,640 per year. The estimated – and fully sustainable – total annual energy at

	completion of the project is thus $164,031 per year. This comes from an energy savings of 1,640,310 kWh per year. Using the EPA CO2 calculator, this corresponds to 1131 metric tons of CO2 (which is equal to 222 cars per year). The EPA CO2 calculator is here: http://www.epa.gov/cleanenergy/energy-resources/calculator.html. USER ANNOYANCE Energy savings are not always free – user annoyance from reduced performance can be a concern. In the case of this project, such annoyance could come from users having to wait for PCs to wake-up from sleep mode if the power management software usage schedules are "off". Another possible annoyance is to IT staff when doing remote maintenance (for example, anti-virus updates) of PCs. We will carefully measure user annoyance through surveys.
Plan for Sustainability:	Upon completion of this project, IT will continue to support the power saving features employed as a result of the initial implementation. The savings from this project will promote student success by making USF more economical. Possibly, the dollars saved could be used for a scholarship fund for needy students majoring in areas related to sustainability?
Annual Energy Savings:	1,640,310 kWh
Annual Cost Savings:	$180,434.10
Upload File:	Reducing Electricity Consumption at USF by Using State-of-the-Art Methods to Power Manage Desktop Co_ID3_SGEF.pdf View File

Added By	**Vote**
Stanley M. Kroh	Yes
Margaret Rush rush@epchc.org	Yes
Mark Stewart	Yes
Jim Gray	Yes
Susana Alvarado	No

Added By	**Comments**
Margaret Rush rush@epchc.org	IT technolgy power costs have been an issue for County government as well. We are all encouraged to power down our units at night, even though it may take a few extra minutes for PC's to warm up in the morning. The savings seem to be substantial, so the project seems very worthy. Tampa Internation Airport has installed software similar to the one you are describing to control thier desktop systems.
Mark Stewart	Good benefit/cost ratio, continuing savings. Proposal has clearly thought this problem through, and is logically phased. Some matching in-kind funds from USF IT benefit the project.
Nainan Desai	I support this project. Although our kWh cost is not that high, the total savings at the current cost of electricity would still be excellent. I wonder why 1/2 FTE student position should cost $20,000. Maybe it is an OPS position.
Susana Alvarado	I am sure if I understood the project entirely but it seems to me that this is pure research and only data and suggestions are being produced, not an actual change. If there is an application component, then I would say yes but for now I am going with no.

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