Lippis Report

A **Lippis Consulting** Industry Paper

Controlling Corporate Energy Consumption via the Enterprise Network

A New Approach to Achieving Energy Efficiency by Leveraging Network Infrastructure

by

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Abstract

Business leaders are defining sustainability initiatives that reduce their electrical power consumption and CO_2 emissions in an effort to not only reduce energy costs, but to also be respectful of global environmental concerns. To assist business leaders, IT suppliers are delivering products that consume less energy while offering new IT delivery approaches such as data center virtualization to reduce cooling and power demands. Cisco Systems has taken a broader approach to energy management by delivering a power command and control architecture called Cisco EnergyWise which seeks to provide business and IT leaders with the tools to measure, manage and control the power consumption of all devices connected to the corporate network. Further, EnergyWise seeks to connect facility heating, air conditioning, lighting and other non-IT systems—systems that consume the largest proportion of corporate energy—in an effort to provide IT leaders with the tools and means to manage their overall energy consumption. In this white paper we describe the current environmental challenges which confront business and IT leaders and offer EnergyWise as an important innovative technology to consider as part of their overall sustainability initiative.

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1. The Green Business: Challenges and Opportunities

There are multiple motivations driving business leaders to develop and implement green business initiatives. These motivations are part environmental sustainability, part economic and part regulatory compliance. All together a green business equates to greater profitability, thanks to a gain in business reputation and lower cost of operations. A new innovation in Green IT called Cisco EnergyWise leverages a corporate network to manage power consumption of both IT and non-IT systems delivering monitoring and control over corporate energy use.

The stock market crash of 2008 and subsequent global economic downturn has diverted attention away from major IT industry themes. But as business and IT leaders come to grips with new economic realities one theme, Green IT, has not lost its luster. In fact, Green is increasingly being viewed as "lean" as it complements corporate efficiency initiatives, which have been prioritized during this current business cycle. In short, the economic slowdown is offering business and IT leaders an opportunity to accelerate their Green IT plans as these programs improve operational and energy efficiency.

For IT executives most of their Green IT efforts have focused on data center power and thermal efficiency by leveraging tools and programs such as data center consolidation, server and storage virtualization and procurement of IT devices with improved power supply conservation technology. While data center power efficiency projects are worthy of their investments and results, the fact is that data center power consumption represents less than 2% of total electrical power consumed on average.

The Environmental Protection Agency (EPA) calculated that the energy consumed by the nation's servers and data centers was estimated at 61 billion kilowatt-hours (kWh) in 2006, which accounted for 1.5 % of total U.S. electricity consumption at a cost of about $4.5 billion. This consumption is two times larger than what was consumed in 2000 and is projected to double again by 2011 unless efficiencies are implemented, according to the EPA.

To limit climate changes, many believe that greenhouse gas emissions must be reduced by 25 gigatonnes (Gt) to 30 Gt of CO_2 equivalents (CO_2e) annually by 2030; a tonne is a metric ton. Gartner estimates Green IT's total CO_2 emission reduction is approximately 0.6 Gt. Clearly there has to be better ways to leverage IT to not only reduce its own power consumption but the power consumption of non-IT devices. For example, in a typical commercial building, lighting plus heating and cooling represents some 66% of total electrical energy consumption while IT represent between 25 and 30%. Within IT desktop computers, printers, etc., consume 50%, data centers draw 30% while networks represent 10% of electrical energy consumption.

In the IT vendor community much attention has been placed upon individual devices and data center power consumption in an effort to reduce carbon footprints and energy cost. And while these are all welcome activities which deliver real results in both power consumption reduction and savings on spend, there is a broader networked-based approach to address the remaining 98% power consumed which can deliver far greater gains in power efficiency and cost reduction. That approach is called Cisco EnergyWise and is offered by Cisco Systems, the global leader in network equipment.

2. The Networked Approach to Power Management

2a. What is Cisco EnergyWise?

The networked approach to power management is based upon the simple fact that all devices are connected into a network. In short the network touches every device. Today these devices are IT-based, including computers, storage, printers, access points, cameras, phones, special network appliances such as firewalls, mobile devices, and increasingly, TVs and other non-IT electronics. The network has a unique position to monitor, distribute commands and most importantly control the power consumption of the devices it connects. This concept is straightforward for devices that obtain their power from network switches via Power over Ethernet (PoE) such as wireless LAN access points (AP), IP phones, ethernet/IP-based video surveillance cameras, etc., as the network is their source of power. But the networked approach to power management concept can be extended to non-PoE IT devices such as computers, digital signage, printers, storage, fax machines, etc. The concept can be extended further still to non-IT systems such as building controls, lighting, elevators, 24/7 monitoring systems, HVAC-sensors, fire/smoke sensors, et al.

To achieve this level of power management Cisco EnergyWise needs to be an open architecture rich enough to foster a new ecosystem. The Cisco EnergyWise architecture offers business and IT leaders the command and control tools to manage and measure overall corporate vs IT power consumption with the potential to demonstrably reduce energy cost and CO_2 emissions, comply with government regulations, industry directives, and gain real business rewards through improved environmental practices and posture. Cisco EnergyWise offers the potential to extend Green IT initiatives from the data center to every power consuming device or system in the enterprise.

Conserving Energy Consumption via the Corporate Network
A Lippis Report Podcast with Ms. **Berna Devrim**, Senior Manager
Access Switching Marketing at Cisco Systems
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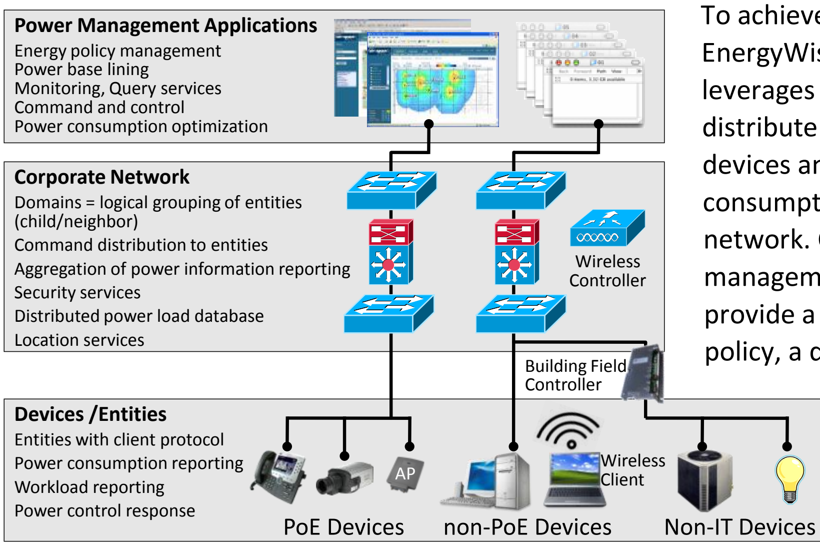
2b. Cisco EnergyWise Architecture

To achieve the scale promised by Cisco EnergyWise, an open architecture needed to be developed which included IP and non-IP devices offering a set of services capable of measuring power consumption throughout the enterprise or government agency. In addition to power measurement, the ability to understand device efficiency, that is a device's current workload or how hard it's working provides an organization with both an energy footprint baseline plus an understanding of a device's efficiency. For example, a network switch may be drawing little power but also processing few packets. However, if the same network switch was drawing a large amount of power while processing few packets then there is an opportunity to reduce its energy consumption. The combination of device power consumption and workload measurement allows for energy footprint optimization. Therefore, Cisco EnergyWise provides a means to baseline and identify energy reduction opportunities corporate wide.

Figure 1. 3-Tier EnergyWise Architecture



To achieve this, the Cisco EnergyWise architecture leverages the network to distribute commands, discover devices and aggregate power consumption of all devices on the network. Centralized power management applications provide a means to define energy policy, a dashboard, controls and graphic representation of power consumption across the enterprise by category. There is no centralized database but rather the network offers a virtual database whereby a query from power management triggers the network to pull power consumption information throughout the enterprise much like an SQL query into an Open Database Connectivity (ODBC) server. Location services are exploited to identify the whereabouts of devices to ease troubleshooting, fault isolation or simply to understand where power is being consumed in a geographically distributed enterprise. What's not needed to utilize Cisco EnergyWise is additional hardware or appliances; EnergyWise is built into existing Cisco Catalyst switches. And with a nod to Cisco for demonstrating its commitment to the environment and responsiveness to the energy concerns of its customers, EnergyWise is offered at no cost. Through the Catalyst switch, Cisco EnergyWise offers centralization of power management with highly distributed control and power consumption data gathering.

The Cisco EnergyWise architecture is defined by the following six attributes or services:

1. **Categories and Power Levels**. Various devices need a common lexicon that describes standard power levels so that a common understanding of perhaps sleep mode or standby is understood along with their corresponding power level. Cisco EnergyWise defines three categories including operational, standby and non-operations. These categories are color-coded and range between level 0 and 10 which correspond to power off to full power.

Mode	Color	Code	Level	Label
Operational (1)		FF0000	10	Full
			9	High
		FFFF00	8	Reduced
			7	Medium
		00FF00	6	Frugal
			5	Low
Standby (0)		0000FF	4	Ready
			3	Standby
		A52A2A	2	Sleep
			1	Hibernate
Non-Operational (-1)		000000	0	Shut

Table 1. Category and Power Level Table

2. **Entities**. An entity is any power consuming device or system that is connected to the network. Entities may be PoE, IP-based but non-PoE, non-IP and non-IT. Every entity has a unique ID. Entities can be a network switch or port as a switch may be drawing power if it's a PoE port. Entities have a parent-child relationship where the switch is the parent of all the children or devices it connects. A switch's children could be all PoE ports. Switch-attached devices such as IP phones and Cisco EnergyWise-compatible PCs would also be children of the switch. If a lighting controller was connected into the switch it would be a child of the switch too, and on and on. Between entities are neighbors. Two switches in a network could be neighbors. The neighbor relationship is designed for clearing the sending command and control messages while the parent and child entities are designed to control power.

3. **Domains.** To scale Cisco EnergyWise to large implementations, entities all join a domain which is a logical grouping of EnergyWise-enabled entities. All entities in the domain can be visualized as one unit of power consumption. In the Cisco EnergyWise architecture switches are peers linked together by their neighbors. As the domain structure provides scale and ease of power management as the same process to manage the aggregated power on one switch, so too can IT manage the power of a domain or a network of switches. To ease in the establishment of domains, EnergyWise provides an entity discovery feature which automates the discovery of EnergyWise compatible devices. Entities can also be added manually.

4. **Management Communications**. Once domains are established Cisco EnergyWise defines a communications network where control and command messages flow between entities and power management. There are two approaches: the first is to use SNMP on switches to leverage existing network management applications. Being backward compatible with SNMP enables network management vendors to participate in power management. Cisco EnergyWise defines a set of MIBs for EnergyWise data and EnergyWise command and control. SNMP allows one switch's entities to be managed but not a domain, thanks to the "get and set" limitations of SNMP.

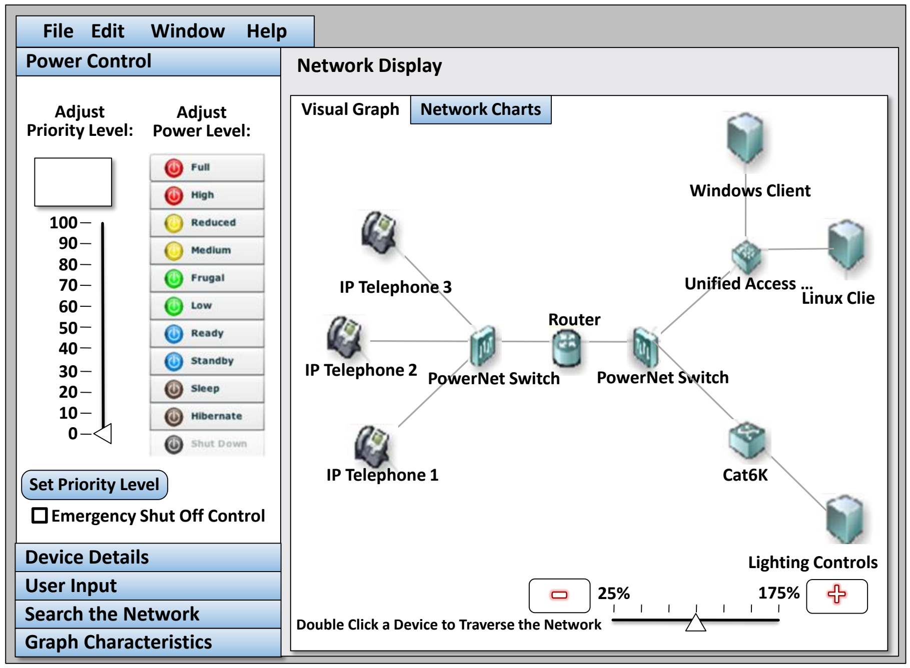
   The second approach is to manage an entire domain by activating a new well-defined Cisco EnergyWise "***management port***" on a switch in the domain. From this management port, IT can issue commands and queries into the switch that will retrieve information from the entire domain. Therefore, from a single power management console, a single query or command can be sent to thousands or tens of thousands of entities and their power level communicated back or reset.

5. **Management Applications and API**. Thanks to SNMP and the Cisco EnergyWise MIB, existing network management applications will be able to add power management to their collection of managed devices. New third-party partners and applications will use a management API designed for the Cisco EnergyWise management port to gain scope and scale. The management API offers access to entire domains to pull power consumption and device efficiency information as well as location. The management API operates in a similar manner to an SQL query into an ODBC server, except that the network is the ODBC database. Therefore, queries are performed across the entire domain or domains; thus the management application sees the whole domain as one

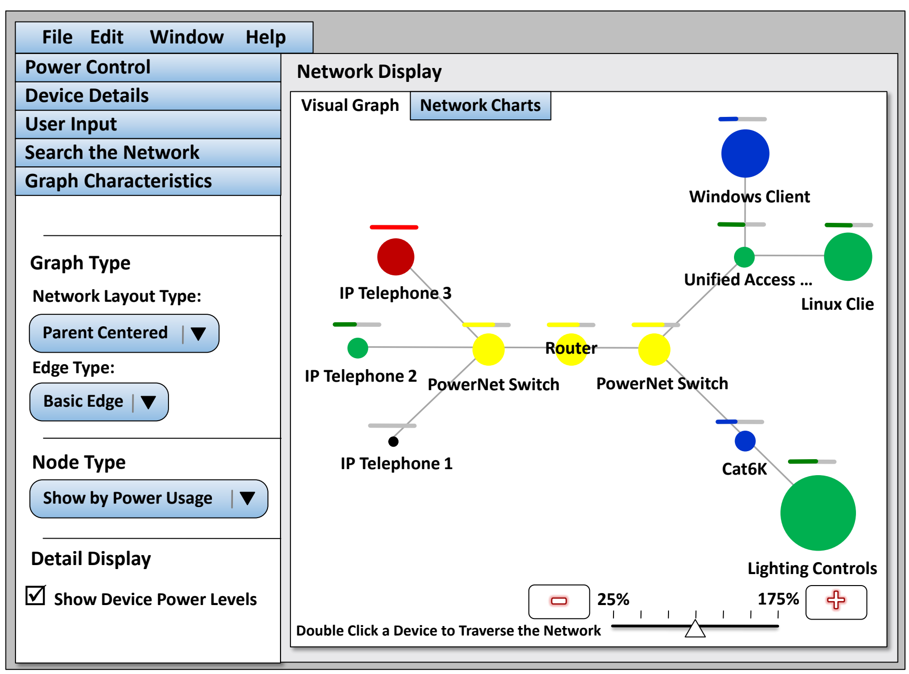
database as opposed to a set of discrete and different entities. This is as distributed a database as the world has seen. Turning this data into information, management applications utilize color-coded graphical representation of entities and domains based upon their power usage, so that efficiency and location are presented to ease power consumption and optimization identification.

Figure 2. Dashboard Example

Physical View



Logical View



6. **Queries and Data**. With the above architecture deployed IT operations has a rich set of queries they can send to entities distributed over large geographic distances, all from a central location. As mentioned above, entities are classified into categories, parent-child relationships and neighbors plus assigned a role, name and level of importance to operations. A light bulb would have a lower power priority while the CEO's IP phone and computer a higher priority. IP phones may be classified by role such as teller, lobby, desk, vault, emergency, etc., allowing policy to be distributed to commonly classified entities. Queries such as power usage, removing child entities, setting power attributes or power levels, setting time of day controls, etc., are examples of the types of commands and controls available under Cisco EnergyWise. These queries can be sent to specific categories with wattage use and time of day data sent back to the management application. Total power usage and "what if" scenarios are supported so that power level change commands can be assessed before issued.

   Clearly it will take time for the Cisco EnergyWise ecosystem to develop as its intended scope is wide and encompassing. But the entire ecosystem does not need to be developed before corporations can gain the value of power management. PoE devices that are Cisco EnergyWise compliant—meaning that they are able to process Cisco EnergyWise commands and the eleven control messages—can be power managed via a client protocol. Therefore, PoE devices will be the first to be managed under Cisco EnergyWise allowing IT to control energy consumption of IP phones, WLAN APs and IP-based video surveillance cameras, etc.

   Devices do not need to gain power from the network for Cisco EnergyWise to manage their power consumption. When non-PoE devices such as personal computers, laptops, printers, fax machines, storage devices, etc., are Cisco EnergyWise compliant—meaning again the ability to process Cisco EnergyWise commands and map the eleven power control messages into their own energy management behavior—they too will be power managed. For example, PCs have many energy modes such as hibernation, sleep, standby, etc., while fire alarms are either on or off. As these devices become EnergyWise compliant IT then will have the tools to manage their power usage.

   This is the same process for non-IT devices such as building control systems for lighting, heating/AC, etc. The control boxes for these systems will, over time, be able to process Cisco EnergyWise command messages providing IT with control over the majority of power consuming devices in their enterprise or government agency. Cisco EnergyWise is providing a lexicon of how devices communicate power status, efficiency and change power state upon request. This lexicon is the basis for a broad EnergyWise Cisco-funded ecosystem.

3. Power Management in the Network Era

3a. Network Sprawl and Power per Port Managed

Conventional wisdom is that data centers are the epicenter of Green IT initiatives as they are large centralized energy consumption footprints. Their centralization affords ease of access to control energy consumption. But there is far more energy consumed, over 90%, throughout a corporation than in its data center. The network sprawls the entire organization from headquarters to regional sites to manufacturing floors to branch offices, affording it access to control this larger energy consumption footprint and put power management under the control of IT. Cisco EnergyWise adds power management value by tackling the sprawl issue.

For example consider a 48-port switch that on average may connect 10 PoE phones, 10 WLAN APs and perhaps 20 PCs. Adding up the power consumed by all of these devices, a 48-port switch has the opportunity to manage and control some 6-7,000 watts of power or between 125-to-145 watts per port. For an organization with 10,000 IP devices connected into their network, a Cisco EnergyWise-empowered network has the opportunity to manage 1.45 million watts of power. This number increases significantly as non-IP building control systems are Cisco EnergyWise-enabled. In effect, a network switch is not only managing IP traffic, but also energy consumed by connected devices.

3b. Time of Day Control

In addition to power consumption information gathering and reporting, Cisco EnergyWise provides the means to control energy consumption by time of day. With a simple energy policy of shutting down devices for an average of four or five hours a day, a company will gain significant power usage savings. In essence, Cisco EnergyWise can utilize the network to act as a distributed programmable thermostat changing the power consumption of devices and business control systems based on time of day. The network keeps time and thus can be the timer for connected devices. The first use for Cisco EnergyWise will most likely be time of day policy management and monitoring energy usage on a query basis. Consider a 5,000-employee business all equipped with IP phones and 500 WLAN APs. By simply powering down IP phones and WLAN AP for ten hours per evening plus holidays and weekends, this firm would save some $51,000 per year by reducing their electrical energy consumption by 423,500kW, assuming 12 cents per kWh. That is the CO_2 equivalent of planting 200,000 trees or preventing some 12,000 mid-size automobiles from emitting annual emissions into the atmosphere. The cost and CO_2 savings increases significantly as non-PoE and non-IT devices become Cisco EnergyWise compliant, since IP Phones and WLAN AP represent less than 2% of total corporate energy consumption.

3c. Importance

The ability to baseline power consumption in an enterprise will provide insight not previously available. Most if not all companies don't fully understand where power is being consumed. Optimization strategies will follow once managers can measure and monitor consumption. Managers will realize in short order that once they view Cisco EnergyWise data it will be easy to identify hot spots that are consuming too much power. With location identification of devices automated and graphically depicted in power management, Cisco EnergyWise computes the relative importance between devices to assist in power conservation optimization efforts.

Knowing the relative importance between devices affords priority in power consumption. For example, a switch may connect 40 IP phones making it an important switch. However, another switch may connect one phone, but it's the phone of a top producer or trader, a person generating millions of dollars a minute for the business. When issuing energy reducing commands managers need to know which devices have priority or importance to the business. Further, the Cisco EnergyWise client protocol supports the notion that the client knows best. An entity has the ability to comply with or deny a Cisco EnergyWise request. For example, an IP phone could deny a request to power down because the user may be actively on the phone.

3d. What To Shut Down and When

Powering devices up and down needs to be conducted in a way which makes sense and does not disrupt business process. For example, in a WLAN environment, managers could turn off an AP, but that approach could cause challenges such as creating coverage holes forcing WLAN management to report a fault. Therefore, integrating Cisco EnergyWise into WLAN controllers maintains service levels while managing power. For unified communications (UC) the same applies; the IP phone should never be powered down when in use. Therefore it's important that Cisco EnergyWise be integrated or interfaced into other management systems and services so that corporations gain the value of common power measurement, common reporting and common business rules that are pushed down to entities without service distribution.

4. How to Get Started

As Cisco EnergyWise matures and is adopted by IT and non-IT suppliers the question of how to get started arises. There is a Cisco EnergyWise business value calculator available here www.cisco.com/go/energywise that quantifies energy cost and GhG (Green house Gas) potential savings. In addition to the calculator, EnergyWise deployment will be gated by the type of devices supporting its client protocol. Cisco EnergyWise-compliant PoE devices will be the first to be power managed. As more devices become Cisco EnergyWise compliant the larger its power management diameter will be and the greater value gained.

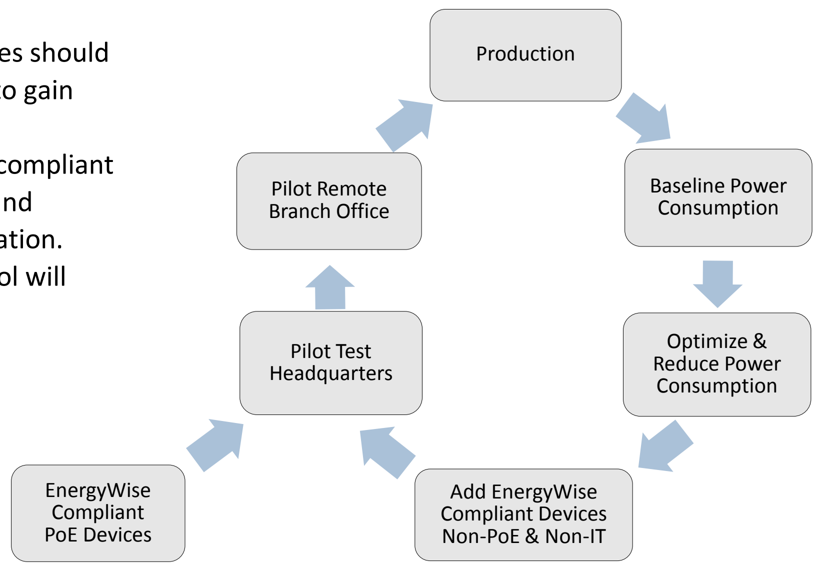
4a. Start with a Pilot

As with all new technologies, pilots are the appropriate starting point in the process to gain insights, understanding, skill set development and usefulness assessment. As there is no additional network cost to Cisco EnergyWise deployments, pilots should be relatively straightforward. During the pilot be sure to gain proficiency with all its query commands, management applications, device responses and how power management may impact other network and system management. As comfort is gained, a rollout can be planned, preferably in a location staffed with IT professionals such as a headquarters or regional facility. After a sufficient period of time where network administrators have gained trust with Cisco EnergyWise, a remote pilot and subsequent rollout can occur.

4b. Baseline and Optimization

One of the first post-rollout activities should be a power consumption baseline to gain insight into the corporate power consumption of Cisco EnergyWise-compliant devices, followed by optimization and power reduction policy implementation. For many, time of day power control will be the first optimization process as many seek to capture low-hanging fruit or energy reduction opportunities. Most IT leaders know that many devices can be powered off at a certain time of day but simply have no means of doing so. Branch facilities will be prime targets for time of day control.

Figure 3. Rollout Scenario



4c. Develop Energy Policy

Much thought needs to be given to energy policy so that energy conservation is maximized and business process disruption minimized or avoided. For example, computers should not be powered down during scheduled network back-up. Employees working at night should have full access to corporate resources in order to be productive. There will be trial and error as managers seek to balance green initiatives through Cisco EnergyWise and business productivity. Thoughtful energy policy and associated practices should minimize this trade-off.

5. Recommendations

We offer the following recommendations to business and IT leaders who seek to develop demonstrable impact on corporate energy cost reduction, power conservation, reduced GhG, emissions energy regulation compliance and the benefits associated with an improved corporate "Green" brand.

1) Consider Cisco EnergyWise as a component of your corporate green initiatives to, over time, manage not only power consumed by IT devices but all electronic systems. Clearly, Cisco EnergyWise will evolve over a long period of time as its ecosystem develops and value is added to its architecture. Cisco EnergyWise could be thought of as an eco-friendly -- and business beneficial -- technology that provides increased power conservation opportunities as it evolves and matures.

2) Consider pilot-based Cisco EnergyWise deployment first to understand the technology and its limitations, develop skill sets and perhaps most importantly develop an energy efficiency policy which can be managed, monitored, enforced and optimized under Cisco EnergyWise.

3) Consider developing success metrics such as power managed per port, energy reduction and spend goals, power consumed per worker productivity, power spend as a percentage of revenue, power spend as percentage of EBDIT (earnings before depreciation, interest and tax) plus other relevant success factors to track your progress and success.

Cisco EnergyWise is the most innovative approach to corporate energy management. The intellectual and engineering sophistication of the IT industry has stepped up to solve a difficult problem with sufficient scope and scale to deliver meaningful results. Cisco EnergyWise is both simple and elegant in its approach and we look forward to a healthy and growing ecosystem. Cisco EnergyWise represents a journey where the end game is not known, but the barrier of entry is low enough and the potential gain high enough to warrant the investment in personnel to pilot and explore Cisco EnergyWise.

About Nick Lippis

Nicholas J. Lippis III is a world-renowned authority on advanced IP networks, communications and their benefits to business objectives. He is the publisher of The Lippis Report, a resource for network and IT business decision leaders to which over 40,000 business and IT executive leaders subscribe. Its Lippis Report podcasts have been downloaded over 50,000 times; iTunes reports that listeners also download the Wall Street Journal's Money Matters, Business Week's Climbing the Ladder, The Economist and The Harvard Business Review's IdeaCast. Mr. Lippis is currently working with clients to transform their converged networks into a business platform.

He has advised numerous Global 2000 firms on network architecture, design, implementation, vendor selection and budgeting, with clients including Barclays Bank, Microsoft, Kaiser Permanente, Sprint, Worldcom, Cigitel, Cisco Systems, Nortel Networks, Lucent Technologies, 3Com, Avaya, Eastman Kodak Company, Federal Deposit Insurance Corporation (FDIC), Hughes Aerospace, Liberty Mutual, Schering-Plough, Camp Dresser McKee and many others. He works exclusively with CIOs and their direct reports. Mr. Lippis possesses a unique perspective of market forces and trends occurring within the computer networking industry derived from his experience with both supply and demand side clients.