Power Supply Workshop
PEC, San Francisco, CA
January 14, 2002

Workshop Notes

The following is a summary of some of the discussions that took place during the Power Supply Workshop hosted by Pacific Gas & Electric (PG&E), the Environmental Protection Agency (EPA), Lawrence Berkeley National Laboratory (LBNL), and the Natural Resources Defense Council (NRDC).

Introduction and Initial Remarks

Noah Hororwitz (NRDC) and Gary Fernstrom (PG&E) opened up the workshop with remarks on why both NRDC and PG&E were initially interested in a workshop on power supplies. Mr. Fernstrom stated that the reason PG&E sponsored this workshop was because it created a forum under which people could look for and talk about new opportunities for energy efficiency.

Mr. Horowitz indicated that NRDC's interest in the workshop originated from the people of California looking for new energy-saving opportunities due to the recent energy crisis. The interest in power supplies is moving from just addressing standby to also include active mode power efficiency. Mr. Horowitz pointed out that 400 million new power supplies are sold each year in the U.S. **If power supplies were made more energy-efficient there is a potential to eliminate 10 large power plants!**

The following is a list of stakeholders and their interests in energy-efficient power supplies:

EPA	ENERGY STAR® Labeled Products
DOE	Federal Executive Order
FEMP	Federal Purchasing
NRDC	Reduce Emissions; less power plants
PG&E	Local leader in energy efficiency for CA
LBL	Research Institution

California Energy Commission, Art Rosenfeld

The threat of power outages in California caused people to incorrectly assume that California uses more power per capita than other states. Actually, California has increased their efficiency by 2% per year since 1960.

There are many opportunities for energy efficiency. Example about the standby temperature of backup diesel generators, they don't have to be heated to 130

deg. F, 90 deg. F will work fine. The only difference is the generators give off a bit more smoke when starting.

Mr. Rosenfeld expressed California's and CEC's interest in seeing more efficient power supplies being used in the products discussed during the workshop.

Presentation: Background on Active Power, Chris Calwell

Roughly 2.4 billion products containing power supplies in use in the U.S. and more than 6 billion globally. About 5 to 6% of U.S. electricity consumption flows through power supplies. The energy efficiency opportunity is enormous – **about 1 to 2% of total U.S. electricity use could be saved by improving the active efficiency levels of power supplies.**

There is a need to market the superior designs on value instead of just price and perhaps utilize standardized efficiency "curves" for making meaningful efficiency comparisons across widely varying loads among different products.

Questions presented by the group:

- Are garage door openers on the list of power supply products?
- What are the assumptions of the hours of use of devices in the various operating modes?
- What percent of total products have power supplies?

Presentation: Standby Energy Use and Energy Savings Opportunities, Alan Meier

Alan Meier briefly described how the Bush administration became interested in standby power use and the origins of the Executive Order dealing with standby power. He then presented an international "house tour," showing pictures of the range of products drawing standby power in American, Japanese, French, and New Zealand homes. Each of these homes had around twenty appliances drawing standby power, leading to cumulative standby draws of 70 – 125 watts. In the United States, standby power is responsible for at least 5% of residential electricity use and an unknown amount in commercial buildings.

Standby power use is responsible for about 1% of global CO2 emissions. Mr. Meier then described three general strategies to reduce standby power consumption: switch to lower power components; avoid energizing unneeded components; and improve the efficiency of the power supply. When targeting the power supply, three more strategies are possible: reduce no-load losses, improve efficiency at low loads, and move the "power" switch to the high voltage side of the power supply. Mr. Meier presented several examples of successful and unsuccessful reductions in standby power use.

Panel Discussion #1: What are the needs and constraints of buyers?

Panelists
Tom Radley, Hewlett-Packard
Kelli Wise, Intel
David Traver, Sony

Questions Posed to the Panel
1. What is your level of involvement in the process of buying power supplies?

Mr. Radley from HP talked about the difference between internal and external supplies and stated that HP is increasing the percentage of external power supplies because it leverages more products. HP's goal is to find something for the customer that is low cost with high efficiency— but this is nearly impossible.

Sony uses power packs some of the time in merchandise because it is smaller, low cost, and the quickest way to get a product into the market.

Intel is a huge manufacturer of servers and workstations while selling most of its desktop products to other manufacturers. Ms. Wise, from Intel, stated that they have no external products because the power is too high so everything is internal.

2. Is energy efficiency on the list when buying power supplies?

All three panelists stated that energy efficiency is not on the top of the list when purchasing power supplies. Cost is the number one priority when purchasing power supplies for their product. Other factors that are considered are safety, size, reliability, and schedule of part availability. Intel mentioned that temperature is a big priority. For both customer satisfaction and safety, Intel does not allow the power supply to reach a temperature of more then 85 degrees on the surface.

Mr. Traver, from Sony, mentioned the above as factors considered when purchasing power supplies but they also look at the time to market issue. They want a reliable supplier who will get them their power supplies in an efficient manner allowing them to get the product to the market. It often takes 3 months and $300,000 to get UL to approve an internal power supplies design. Sony not only looks at the supply efficiency but they also look at the performance.

Mr. Radley mentioned a concern for efficiency of the power supply in standby as well as max loading. He stated that efficiency could be influenced by two things, ENERGY STAR and the temperature the power supply reaches. He also mentioned a strong focus on total cost of ownership (TCO) in terms of the manufacturer (not the end user). When it comes to laptops, size instead of cost is most important.

3. Who do you buy power supplies from?

Sony uses one or two suppliers for their power packs.

Intel has one supplier for their AC/DC silver box but two suppliers for the higher quantity stuff. Intel also designs some of their power supplies for their desktop products.

HP has between 1-4 vendors for both internal and external power supplies. They are shipped approximately 10,000-20,000 power supplies a month.

4. Have energy efficient power supplies been available?

Energy efficient power supplies have not been as readily available as these three panelists would like. There are some efficient supplies available at 80% but those are only available in limited quantities. Also, the market for energy efficient power supplies is driven by the laptop world. As they try to make laptops smaller and smaller they are also trying to decrease the size of the power supply and make it more efficient. Sony primarily looks at high voltage regulation rather then energy efficiency. They want to know how fast a TV moves from black to white for picture quality and this is a difficult test to perform on power supplies.

All three panelists stated that the challenge with finding and buying energy efficient power supplies is cost and they need to be able to order by the thousands.

Ms. Wise, added that incremental cost is largely a product of quantity. If one requested more efficient power supplies by the tens of thousands and not just as special orders, the price differential incurred in order to get more efficient power supplies would come down significantly.

Mr. Radley stated that they need to stay in the ENERGY STAR market because it is good and desired by the customer.

Ms. Wise indicated that Intel's goals are to have efficiency of up to 80%, optimize active power use, not standby, and find higher efficiencies to cool the servers.

Other Discussions

A couple of the manufacturers flagged the need for power supplies to tolerate wide voltage swings in developing countries (e.g., up to 400 volts in China and India).

Mr. Radley noted that the mainstream PC market (not just early adopters) wants small, unobtrusive PCs that make no noise and just get the job done. This creates an opportunity for highly efficient, compact power supplies to succeed in desktops, such as Intel's Concept PCs. He also added that design and

packaging are significant divers and he believed that when power supply manufacturers reduce the size, efficiency would also be improved.

Regarding efficiency curves, Ms. Wise indicated that Intel gathers such data across a wide range of loads. Mr. Traver said that Sony might look at performance under standard and extreme conditions, but not efficiency, per se.

While highly efficient power supplies could cost 2 to 3 times as much as the basic commodities in small-scale production, the price disparity might drop to 20% or less in full production mode.

The highest temperature that the exterior plastic can reach is 95 degrees C. The maximum HP will allow for “comfort touch” is 85 degrees C.

Low standby power supplies might involve around $2 worth of partner today, compared to about $.80 for a typical power supply.

PCs have power supplies that tend to be larger than needed due to the need for the ability to expand its capabilities; so that consumer may add to it.

The general consensus is that until higher efficient power supplies are required a lot of smaller companies will not bother to use and purchase them.

Ms. Wise mentioned that their newest processors are drawing 60 amps of current and headed toward 100 amps soon – need for new cooling and power supply solutions to keeps this heat from becoming unmanageable.

Panel Discussion #2: What technologies exist to make better power supplies?

The group noted that while 65% efficiency levels were typical for most PC power supplies, efficiencies of 78 to 85% were readily achievable in server power supplies, where chassis and fan size limit cooling options.

Dave Baton, N2Power, Inc.
N2Power sells high efficient (up to 90% efficiency) small size power supplies. They do not do AC adapters. Mr. Barton indicated the need to mandate better power supplies – voluntary and educational programs are not as effective.

Milan Jovanovic, Delta Products Corporation
Delta ships approximately 7 million AC/DC power supplies a year that range from 5 watts to 60 watts. Delta is trying to sell a more efficient, smaller, lower cost power supply. Mr. Jovanovic pointed out that efficiency numbers are meaningless unless you also give voltage and the application of power supply.

Cliff Walker, Power Integrations, Inc.
Power Integration's success is high efficiency on standby power with European cell phones. They produce 500,000 units a day, 7 days a week.

Dave Tam, International Rectifier
International Rectifier produces high efficient power supplies. Their innovation was a high-speed metro processor. Mr. Tam pointed out that efficiency is only an issue if the power supply is providing the consumer with what they want.

Dr. Ken Kayser, BIAS Power Technologies, Inc.
Dr. Kayser expressed his thoughts that standby power is easier to attack and can be reduced by 2%. He stated that the high cost of efficiency is related to volume so if demand goes up the price of these supplies will go down. He also added that high efficiency standby can go down to $1.00.

Dr. Kayser explained that switch mode power supplies are more efficient because they only send power to the transformer as needed. A high efficiency switch mode power supply is more efficient than other switch mode power supplies because of better components and manufacturing.

This panel discussion eventually turned into talking about making power supplies either ENERGY STAR qualified or mandated. It was also discussed that the efficiency of power supplies is very difficult to market because the consumer does not care and it is not the primary concern of the consumer.

Other Discussions/Questions

- Cost is the number one priority when purchasing power supplies
- Products are getting smaller increasing demands for more efficient power supplies
- Trend toward common standards
- Increased demand will reduce cost but how do we get there?
- Efficiency percentages need to be quoted in the context of output voltage and output wattage
- How do we stimulate the consumer? We don't – we need to stimulate the OEMS. No mandates
- No "One size fits all" solution
- Is ENERGY STAR providing enough product model differentiation?

Panel Discussion #3: Companies who have already made the switch to energy-efficient power supplies.

Panelists
Kelli Wise, Intel
Gus Pabon, Apple

Intel is the 800-pound gorilla and influences power supplies in the PC world. ENERGY STAR has become more of a standard in past years influencing the new specifications that will be written this year. Intel has made strides in the server world, but the power supply issue is less sensitive. Intel's power supply efficiencies range from 78-82%.

Apple's power supplies are driven by the designers who decide what the product will look like first—then engineering will build the product based on design. The new I-Mac has an internal power supply that was designed to fit the I-Mac specifically. In this case, engineers would have to use highly efficient power supplies to fit into the space available. The smaller power supply gives off less heat and thus, increases the life and reliability of the product. Apple does not use power supplies from vendors because they do conventional designs. The I-Mac is 85-88% efficient.

Break-Out Session: PCs and Laptops

This discussion quickly focused on ENERGY STAR specifications for these products. A few of the manufacturers want the specification to stay where it is, let companies recoup a little on costs and build customer awareness (label is not enough). A suggestion was made to start providing return on investment (ROI) stickers that let the consumer know how much money they are saving, etc. It is hard to market this to consumers because we are not sure what the consumer will add to the system. Target larger audiences (e.g., institutional purchasers [IP]).

ENERGY STAR is voluntary BUT when it is required for purchases in the Federal government, it may as well be mandatory across the board: IP is the largest customer.

When looking at a new ENERGY STAR specification for monitors, we need to consider different technologies (i.e., CRTs vs. LCDs). Minimize variables in the new specification – high number of sku numbers makes it difficult to manage within the U.S. and other countries. Also, you can't just take the top 25% of the market; you may be eliminating some high performance equipment even though they are not in the top 25%. Include "hard-off" in ENERGY STAR specification – maybe just for monitors.

We should leverage off existing ENERGY STAR specifications then look into bringing in new products as technology brings them to the market.

Laptops use less energy than PCs – 100 V into monitors vs. ¼ of this for laptops. These are designed to extend battery life by turning off different "sections" to conserve energy: good power management.

Can we make power supply a selling item? Ideas included offering a software suite to drive use to a certain operating mode; operate all modes at the same % efficiency; operational mode should not be tied to the ENERGY STAR program, this could affect performance.

Overall, the attendees in this group were open to adding active and standby mode requirements to an ENERGY STAR monitor specification but were very concerned about doing the same for computers. However, some manufactures expressed concern over implementing an active mode specification for monitors because this may kill off a certain technology that may not be as efficient as other technologies but is still viable in the marketplace.

Break-Out Session: Printers, Copiers, Other Office/Networking Equipment

The trade-off between external and internal power supplies got shifted once external bricks became smaller. At that point, it was more acceptable to consumers to have them be external (not obtrusive). HP is now doing external supplies as high as 200 watts peak/100 watts average.

Power supplies frequently have to be sized for peak motor loads (e.g., like a hard drive spinning up or a motor advancing a piece of paper in a printer) rather than for the average loads of moving a print head, etc. This can lead to inefficiencies, since peak load efficiency is normally a fair bit lower than full load efficiency.

Other themes that arose during this session:

Power Density raised the prospect of planar transformers, which are very thin, can move high amounts of power, and have excellent efficiency prospects. Currently an expensive technology, but becoming more desirable for very space-constrained applications, like laptops. It's been developed by an Israeli company, primarily for military applications.

Group noted that there are a number of advantages of "brick" style power supplies over "wall warts": they provide a longer cord, don't block adjacent outlets, and are less likely to fall out of the wall due to weight. They do increase cost slightly, however.

Federal procurement is more important for manufacturers deciding if a product should be ENERGY STAR than the consumer market is. Some of the peripheral manufacturers have already let certain loss cost items fall off the ENERGY STAR list, because they are primarily targeted at the price-sensitive consumer market.

Break-Out Session: Audio, Telecommunication, and Other Products

Battery Chargers on Cordless Appliances
Dust busters, cordless drill/screwdrivers, etc.

Two main types of batteries
- Continuous Rate or trickle chargers, low efficiency
- Quick Chargers, high efficiency: shuts down to a low current when charge is complete, must monitor batteries condition.

What can ENERGY STAR do?
- Report life cycle or annual cost
- Yellow "Energy Guide" efficiency labels – could the kind of disclosure currently done on appliances also be done on consumer electronics?

How long do these products last?
90% of consumers replace the item when the battery wears out.

Technical fixes for power supplies
Reduce the regulation

Potential Next Steps Following Workshop

- Create new/revise active power vs. standby power methods
- Revise ENERGY STAR specifications for external power supplies
- Offer incentives
    - target per power supply
    - target end product
    - find research and development
- Continued correspondence among attendees
    - Power Supply page to be added to ENERGY STAR Web site: posted materials include list of attendees, pictures, presentations, news, events, and updates in the industry
    - Future meetings/workshops/conference calls

Some Final Thoughts

- Art Rosenfeld from CEC made a suggestion to explore an external power supply incentive to OEMs. The rebate of up to a dollar would be provided via an upstream rebate.
- Tapping into the Intel offer for revising the voluntary PC spec
- Attending the APEC conference put on by the Power Supply Manufacturers Association in Dallas
- Highlight the ENERGY STAR procurement opportunities (bigger driver for the office equipment markets than consumer sales)

- ENERGY STAR could address the issue of power supplies, however, coming up with a separate set of specs could prove to be difficult and is not a top priority
- Recognize that even though standby consumption is smaller in total than active, a big percentage of it can be saved easily through improved technology
- Group wants to stay in touch and receive notes from the sessions in order to continue working on efficiency issues.
- Industry expressed interest in ENERGY STAR developing a TCO calculator and posting it on their Web site.
- There was interest in uninterruptible power supplies as well.