Assessment of Energy Savings Potential of Products and Technologies

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ABSTRACT

Utilities and energy program planners across the country are investing millions of dollars in energy efficiency and market transformation programs based on products and technologies believed to offer long-term energy savings. One challenge in developing programs and answering customer inquiries is a lack of reliable, comprehensive information about the efficiency of new products and technologies. Due to increasing product complexity, the task of evaluating energy efficiency claims for new products and technologies is becoming more challenging. The cost efficiencies to be gained by implementing a regional service led to development of the "Product and Technology Review" service in the Pacific Northwest.

Through this service, electric utilities can more quickly learn about promising new products to consider supporting in their incentive programs, and are warned about products and technologies less likely to deliver reliable energy savings. This information can help electric utilities and their customers avoid unwise investments that could tarnish the reputation of conservation programs. Products that do save energy, and that are documented by independent testing, are likely to gain market share more quickly and attract investors (Stearns 2004). This service is not the only source of product energy savings assessment, but has a broader scope, a larger potential audience, and more public outreach than most others.

The Need for Product and Technology Assessments

Utilities across the country are investing millions of dollars in energy efficiency and market transformation programs that support products and technologies believed to offer long-term energy savings. One challenge in developing programs and answering customer inquiries is a lack of unbiased information about the efficiency of new products and technologies. Several factors, including those described in this paper, are pushing the need for assessments by impartial third parties. While this paper describes many challenges to identifying products with strong (as well as questionable) energy savings, it should be noted that the majority of manufacturers and vendors operate in a professional manner and represent worthy products. Without their efforts, energy efficiency technologies would not be developed and applied.

Increasing Product Complexity

Some products and technologies are well understood and have proven performance records, such as rigid insulation, compact fluorescent lamps, and LED exit signs[1]. These can be tested in a lab and relatively easily field-tested in a variety of applications. However, in the past ten years, there seems to be an ever-increasing number of products and technologies with

[1] However, even the latter two of these may have power quality concerns that are still too often underappreciated and misunderstood.

energy-savings claims that are not so easily assessed. New "smart devices" use integrated circuit logic to monitor and control lighting, motors, or HVAC.

Likewise, some conventional devices that improve power quality are now sold as saving energy in addition to their other functions. One category of products for which it is particularly difficult to calculate "deemed savings"[2] is that associated with "power conditioning." This category includes power factor mitigation, harmonic filtering, and transient voltage surge suppression. While these devices can be invaluable for maintaining an effective power distribution system, they are also marketed as having the additional benefit of saving energy, and this can be a hotly debated topic.

While some products can indeed provide significant energy savings, other products have exaggerated energy savings claims, or are marketed as universally effective when in reality they are only effective in certain applications. One example of an application-specific product is a motor controller marketed for broad application that has been shown to provide some energy savings with older, under-loaded motors—but provides little benefit in many other applications.

One positive example is Legend Power Systems' Electrical Harmonizer™, a device designed to conserve energy and improve power quality for an entire facility—when used in the right application. Legend is adamant about not permitting a customer to purchase the device until very specific pre-screening criteria are met for each potential facility. Legend assesses electrical service entrance voltage, load profile composition, kWh consumption, and KW peak demand to ensure that their product will provide a good return on investment in each application. (Plummer 2004)

Escalating Pressure on Utilities

With a plethora of new products and technologies coming to market, sharply rising energy prices in some areas, and the aggressive marketing efforts of some companies, many utilities are being deluged with requests from vendors seeking utility support and incentives for their products (generally this would be for a new product category; utilities rarely endorse or promote specific products). These same factors have led to an increase in requests from utility customers for guidance in assessing vendor claims.

Some utilities perform their own investigations of product performance by partnering with some combination of customers, vendors, consultants, state agencies, and other organizations to measure, monitor, and verify field installations. However, many utilities—facing declining funds and reduced staffing for conservation or efficiency programs—lack the time for this due diligence process, lack research and engineering skills, and/or are uncomfortable with the potential liability involved in performing such assessments.

Regional Cost-Effectiveness

Taken from a regional perspective, it is not cost-effective to have scores of utilities (out of roughly 150 in the Pacific Northwest) individually attempting to assess a product—taking staff time and resources away from other important tasks. Conversely, it is not cost-effective for product vendors to travel around a region to introduce each utility to their product.

[2] The potential energy-saving value to a region-wide or utility incentive program.

Market Transformation Objectives

For a product or technology to make significant inroads into energy conservation programs involves not only convincing utilities of its merits, but generating enough support from a variety of market players—distributors, retailers, vendors, and in some cases code officials. If these players are provided with unbiased information about products with outstanding energy savings potential, the products can more quickly achieve market penetration—a great benefit from a market transformation perspective. Conversely, it can be quite destructive to market transformation efforts to have program support for products that turn out to be incapable of performing as promised. Such negative experiences can reflect poorly on all energy-savings products and programs, increasing customer resistance to future efforts.

PTR Vision

The factors described above became the impetus for development of a centralized service to provide assessments in the Northwest. It is called Product and Technology Review (PTR). The vision for the service is:

- Northwest electric utilities quickly learn about the most promising new technologies to consider incorporating into their incentive programs, while spending less time dealing with vendors' and customers' questions about products.
- Manufacturers with promising products gain market share more quickly, while spending less time making presentations to individual utilities.
- "Snake oil" manufacturers are exposed quickly so that limited conservation resources are not wasted on measures that may be unable to deliver the energy savings expected.
- Manufacturers have more incentive to improve the energy-saving features of their products and to better document the energy savings performance through reliable third-party evaluation.
- Manufacturers are likely to enjoy more support from investors once they receive a favorable assessment and the assessment is promoted to Northwest utilities (Stearns 2004).
- Regional energy efficiency within commercial and industrial sectors improves.

PTR Technical Resources and Funding

The Lighting Design Lab in Seattle performs the PTR assessments of lighting products, while all other assessments are performed by the EnergyIdeas Clearinghouse program at the Washington State University Extension Energy Program (WSU Energy Program) in Olympia, Washington. The WSU Energy Program has provided product reviews for individual Northwest energy professionals for the past 14 years through their EnergyIdeas Clearinghouse services. The Lighting Design Lab is a regional center for lighting product and technology information, demonstration, and training.

Funding for Lighting Design Lab staff comes from the Northwest Energy Efficiency Alliance (the Alliance) in Portland and Seattle City Light, as well as from other major utilities

between Tacoma and British Columbia[3]. The Alliance also funds the WSU Energy Program's PTR services through the EnergyIdeas Clearinghouse.

The PTR Process

Thus far the PTR service has assessed six products. The long-term success of the project will depend upon a process that ensures cost-effective development of useful assessment fact sheets, clear communications, and limited liability for those involved. The process for assessing products, while still being refined, is described below.

Selection of Products to Review

Products and technologies can only be nominated for a PTR assessment by staff from a Northwest utility, the Bonneville Power Administration, Northwest state energy offices, and the Oregon Energy Trust.

Criteria for selecting which products and technologies are assessed and the order in which they will be assessed includes:

- The product or technology is new and not currently in common use within the Pacific Northwest, or it is an older technologies now marketed as having significant energy savings, including some traditional power conditioning devices.
- There is little published information available to educate utility staff and customers.
- Large electricity savings are claimed to be possible in the region through adoption of the product or technology.

Assessment

Once a liability waiver is signed by a manufacturer, the technical assessment phase begins by contacting the manufacturer for all available independent test data, engineering studies, case studies, and other literature. Some manufacturers are more forthcoming than others. One manufacturer never answered their phone, while another supplied a one-inch stack of technical literature. Manufacturers may supply marketing literature, including unsubstantiated testimonials and anecdotal case studies; however, that information is less relevant in the assessment process.[4] One challenge in this process is interacting with manufacturers and vendors such that all their input is fairly considered and they are aware of the general content of the assessment, yet they are not provided with the opportunity to modify the wording of the entire assessment to better meet their needs.

Assessing the validity of test data and case studies is the crux of the process. While some products can be tested in a laboratory using simulated applications, other products may not lend themselves to such testing. Likewise, if testing is not performed by staff well trained in measurement, monitoring and verification, the potential exists for erroneous correlations between

[3] These utilities include Seattle City Light, Puget Sound Energy, Snohomish County PUD, BC Hydro, and Tacoma Power.

[4] One utility engineer commented on the PTR listserv that a manufacturer's entire website seemed to be a "black box", indicating how vague and unhelpful the information was.

energy savings and factors unrelated to the product (such as a large rebate or purchase discount). It can help to have direct contact with the participants of the case study.

A thorough literature search is conducted to search for any references to the product or technology.[5] The WSU Energy Program has an extensive library dedicated to energy efficiency and renewable energy, with a full-time staff of professional research librarians. They can access thousands of periodicals, books, conference proceedings, Ph.D. theses, and, of course, the Internet. This library maintains Endex[6], an index service for useful energy publications not indexed elsewhere. It includes titles such as *Appliances*, *Energy Design Update*, *Environmental Building News*, *Energy Conservation News*, and *NWPPA Bulletin*. The library also reviews dozens of energy journals and annotates the best articles weekly through their *Energy Newsbriefs* service[7]. If conflicting data were to be discovered, further investigation would be necessary. With new and under-commercialized products, however, there is generally a lack of any good test data, and such conflicts have not been experienced.

Another source of valuable information is a closed PTR listserv (see description below under "Communication") through which electric utilities can share their experiences with installations of products being studied—ideally case studies involving measurement, monitoring, and verification. In some cases, we are also able to access and consider information gathered by organizations in other parts of the country.

While the assessment process involves trying to understand the engineering principles behind a product, in some cases if the product has valid independent test data and the manufacturer stands behind their energy savings claims, this full understanding may be less essential. As one program manager recently commented, "If there's some documentation and a guarantee that the product will save energy, it may not matter how black the 'black box' is." Additionally, while non-energy benefits and application concerns are noted in the PTR fact sheets, the PTR service does not focus on these aspects of product performance as much as some other assessment programs.

A critical part of the assessment process is to determine the credibility of the various information sources. To date, this has not been difficult, and there have not been situations of contradictory test data to resolve. Primary research is not currently part of the assessment process. Sometimes useful information can be obtained by talking to a manufacturer's competitors. If the manufacturer offers a guarantee of energy savings, it's also important to note the details of this; their requirements for pre- and post-monitoring may be too onerous or technically complex for most installations to comply with.

If little information is available on the product and the manufacturer signed a waiver but is not forthcoming with useful information, the assessment will simply be brief and state what could and could not be found. It is not the goal of the PTR service to generate useful information if little or none exists. If there is no independent test data, no case studies, and only sketchy marketing literature, this is probably not a product ready for regional utility support—and addressing the question of a product's worthiness for electric utility support is a fundamental goal of the PTR service. Additional information on product performance is always welcomed, even after assessments are completed, because the PTR fact sheets can be updated periodically.

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5 A good collection of questions to research about any new product or technology can be found in an *Energy User News* article by Lindsay Audin (Audin 2003).

6 The website for this service is http://www.energy.wsu.edu/library/endex.cfm

7 Reviews are available by email or on this website: http://www.energy.wsu.edu/library/newsbriefs.cfm

PTR Fact Sheets

Each assessment results in a PTR fact sheet that is developed using a common template. The fact sheets are typically two to four pages each and contain the following:

- Manufacturer contact information
- When product debuted in the U.S.
- Product function and application
- Energy savings claims
- Non-energy benefits
- Independent testing results (testing is not part of the PTR process)
- Cost
- Case studies
- Suggestions for further research and testing
- Additional comments by reviewer
- Disclaimer

Communication

A private listserv is provided by the WSU Energy Program to facilitate sharing of experiences, concerns and questions by the approved organizations listed in "Selection of Products to Review" above. This listserv is used by electric utilities to nominate products and to add their experiences and understanding of a product being reviewed. The listserv has generated some useful and occasionally colorful dialogue—for example, sharing of specific experiences of interested parties, engineering analysis, and some venting of frustration with over-zealous vendors of certain products. It is hoped that future listserv discussions will include specific examples of utility incentive programs that were modified partly due to the impact of the PTR service.

Once PTR fact sheets are complete, the fact sheets will be posted on the Northwest Energy Efficiency Alliance website. It is hoped that non-utility organizations also use this information in their programs. The City of Portland is a good example of a municipality that reviewed and field-tested the energy saving potential of a device, VendingMiser. After sharing the data with their local utility, the utility provided funding to retrofit 30 city vending machines, and the Bonneville Power Administration initiated a program to install the devices throughout the Northwest region.

Limiting Liability

Throughout development of the PTR service, the specter of liability has been an issue. The potential for litigation is a concern of any organization reviewing product performance.

Some manufacturers and vendors take a fairly aggressive stance, through threatened or actual litigation, to discourage organizations from producing any negative reports about their products. Some vendors have invested a substantial amount of their personal savings in a franchise and are understandably unhappy to hear a regional information provider questions their energy savings claims.

Regardless of whether or not litigation (threatened or actual) is valid, this is an expensive and inconvenient process for all involved. Consumers Union has been reviewing product performance since 1936 and has been sued 15 times, usually by disgruntled manufacturers and retailers. So far Consumer's Union has never lost or paid money to settle a case (Guest 2004).

There is quite a range of perspectives on potential liability; some utilities seem fairly unconcerned, while others express some amazement that an organization would publish product assessments. Several steps have been taken to try to limit the liability. These include:

- Perform secondary research—review and summarize findings of independent test labs and other reliable organizations, as well as information from the manufacturer. The assessments do not involve primary research and the authors are careful in stating opinions or making recommendations.
- Get manufacturers to sign liability waivers with the Alliance, providing liability protection to the Alliance and their contractors.
- Carefully document and record every step of the assessment process.
- Include a disclaimer at the end of each PTR fact sheet (see below).

Disclaimer

A disclaimer at the end of each PTR fact sheet outlines the intent and limited scope of the assessment. Specifically, it clarifies that the assessment:

- Is not to be construed (by the manufacturer, vendors, or others) as an endorsement, regardless of how favorable it may be.
- Should not be taken as a guarantee of product performance.
- Includes information directly from the manufacturer whenever possible.

PTR Topics

To date, six assessments have been completed. Fact sheets on these topics will be posted on a public website once the manufacturers sign waivers. It is still too early to observe impacts on utility incentive programs, but this is certainly a goal. In the coming year, the EnergyIdeas Clearinghouse plans to select and produce another 8-10 assessments. Products that have been nominated for assessment thus far include a motor voltage controller, ceramic coatings, a polarized refrigerant additive, a fan controller for walk-in coolers, a radiant heater, and power conditioning devices. Some products may be best addressed as a technology or product category rather than as individual products, especially when there are several similar products nominated.

Possible Future Directions

The PTR service could expand with formal or informal collaboration with other organizations performing primary research, secondary research, and/or information outreach related to product energy savings review. Most of the products nominated for PTRs are being marketed nationally if not internationally, so it would be cost-efficient to collaborate and coordinate for mutual benefit.

Additional funding would allow more products to be reviewed and possibly primary research to be performed, as is currently performed by the OSU MSRF and the Lighting Research Center. Roughly a third of the LRC's data is from primary research while rest is supplied by manufacturers. (O'Rourke 2004)

If funding allowed, WSU Energy Program and Lighting Design Lab personnel could proactively identify products for review rather than only responding to nominations. The Energy Center of Wisconsin found that when they were able to seek out new products to review rather than reviewing only those nominated by someone with concerns, they ended up with a better collection of promising products that were of great interest to their members. (Grabner 2004)

Expanded support could also generate an expanded focus that included more details on non-energy benefits and concerns. While energy savings are attractive, if non-energy issues result in added costs or operational disruption, the energy cost savings may not be worth the investment. These could include performance quality (lighting glare and color temperature, dehumidification capability), reliability, warranty, interaction with other systems, power quality issues, and special training requirements of staff. (Audin 2004) While non-energy benefits and applications concerns are mentioned in PTR fact sheets, some other programs, such as those of the Lighting Research Center and Consumers Union, provide extensive information about product performance in addition to energy savings.

It is expected that, as more products are reviewed and the results more widely distributed, the incentive for manufacturers to cooperate with the review process will grow. This change is what the WSU Energy Program experienced with their development of MotorMaster+ (motor system management) software. Once a database of 27,000 motor models was incorporated into the MotorMaster+ software tool, and the motor selection tool began being used by thousands of companies across the country, manufacturers had more incentive to provide their product performance and cost data as requested.

As the service grows and matures, it would be useful to explore specific impacts of the service on utility incentive programs, as well as impacts on manufacturers, to provide more and better documentation of their products' performance.

Other Organizations on Similar Paths

The need to assess energy savings of new products and technologies is not unique to the Northwest. Utilities and other organizations around the world are faced with similar challenges and take a variety of approaches to assessing the claims and sharing the results of their research. The following are brief examples:

- Puget Sound Energy recently launched their Commercial and Industrial Technology Evaluation Program, through which they plan to field test the energy savings of about half a dozen products annually (Jackman 2004).
- The Regional Technical Forum, with 24 voting and 18 corresponding members, is a standing advisory committee of the Northwest Power and Conservation Council, which is responsible for establishing the value of various energy efficiency and renewable energy measures to the Bonneville Power Administration's regional multi-million per year incentive program. (Eckman 2004).

- The Energy Center of Wisconsin using engineering and library staff to assess energy savings of new products on behalf of a member. They use only secondary research and share the results with only that member. (Grabner 2004)
- The Northwest Energy Technology Collaborative is nonprofit organization that would like to coordinate the product field testing efforts of utilities and municipalities through their Test Bed program, achieving combined data sets with more statistical significance than any one organization can likely generate (Stearns 2004).
- The New York State Energy Research and Development Authority co-funds the development and demonstration of new energy-saving products through a competitive solicitation process, utilizing a panel of experts to review applications. However, NYSERDA doesn't publish the results of these projects (Love 2004).
- Consumer's Union Consumers Union tests consumer products in 50 state-of-the-art labs and informs their subscribers through Consumer Reports magazine. They test mainstream products useful to consumers, and their focus is on performance, durability, and cost, so if energy efficiency is addressed it not usually in detail. (Guest 2004)
- The Electric Power Research Institute Power Electronics Application Center has tested the energy savings of some devices, but rarely shares the results with anyone other than the funder (usually a utility or manufacturer).
- The New England Efficiency Council (NEEC) hires engineering firms to assess product energy savings assessments to help NEEC make better recommendations for incentive program planning to local governments.
- Pacific Gas and Electric Company (PG&E) assesses the energy savings of numerous new products as part of their energy efficiency programs and services to provide reliable guidance to their customers, but they don't publicize their results findings for any products that they are unable to recommend. For some products the statewide utility Standard Performance Contracting program administered by PG&E and the other California investor-owned utilities includes an optional requirement for pre/post measurement to qualify for incentives. (Livingston 2004)
- E Source's Emerging Technology Service investigates product energy savings claims, sometimes collaborating with utilities and businesses to field test energy saving products. They make this information available to their 350 members. (Stein 2004)
- The Standing Technical Committee for the New Jersey SmartStart Buildings program has seven utilities members who review new products only if a customer has a potential project and the product meets the utilities' objective of market transformation. For questionable products they may require pre/post metering to verify savings. (Shaikh 2004)

Conclusion

To assist Northwest utilities and energy program planners in making wise investments in energy efficiency programs, the PTR service, conducts secondary research to assess the validity of energy savings claims of various products and technologies used in commercial and industrial buildings.

The goals of this service are to help accelerate the promotion and adoption of products with more predictable and reliable savings potential and to help utilities and customers avoid

unwise investment in products less likely to provide savings. As a result, manufacturers with promising products may be able to gain market share and more investors.

This service is more regionally cost-effective than individual utility efforts and can assess complex products and technologies more readily than most utilities. While there are other programs and organizations that assess new and emerging technologies, most have a narrower scope and more limited audience that the PTR program.

To limit potential liability, waivers are currently being sought from manufacturers before new assessments are performed of existing PTR fact sheets are posted on a public website. Dealing with potential liability has slowed the process somewhat but is a key issue to address.

The PTR service has thus far assessed six products, is working on two more, and plans to review up to ten additional products in the coming year. Thus far, Northwest electric utilities have been uniformly supportive of the development of the PTR service and look forward to increased activity. Because the assessments are recent and have only been distributed among a limited set of utilities, it is too early to observe and document the impact they may have on the region's utility incentive programs or the impact on the quality of manufacturers' performance testing and documentation. However, these observations would be useful to make in the future as funding allows. Other possible future directions for the PTR program include increased collaboration with other programs and organizations, primary research, and more focus on non-energy aspects of product performance. Replication of this service in other regions of the country is certainly possible.

References

Audin, Lindsay. May 27, 2003. "Does That GizmoWORK?" *Energy User News*, May 27, 2003.

Audin, Lindsay (President, Energywiz). 2004. Personal phone conversation.

Eckman, Tom (Manager of Conservation Resources, Northwest Power and Conservation Council). 2004. Personal phone conversations.

Grabner, Kevin (Senior Project Manager, Energy Center of Wisconsin). 2004. Personal phone conversation.

Guest, Jim. March 2004. "Monthly Letter to Readers." From Consumer's Union website (http://www.consumerreports.org).

Jackman, Joel. (Senior Energy Management Engineer, Puget Sound Energy). 2004. Personal conversations.

Livingston, Jon (Senior Program Manager, Emerging Technologies Pacific Gas and Electric Company). 2004. Personal conversations.

O'Rourke, Conan (Technical Director and Director of NLPIP, Lighting Research Center). 2004. Personal conversations.

Plummer, Scott (Director of Sales and Marketing, Legend Power Systems, Inc.) 2004. Personal phone conversations and e-mail

Shaikh, Siraj (Jersey Central Power and Light) 2004. Personal phone conversation.

Stearns, Tim. (Senior Energy Policy Specialist, Washington State Department of Community, Trade, and Economic Development's Energy Policy Division). 2004. Personal e-mail and phone conversations.

Western Area Power Administration Energy Services, Energy Solutions Resource. 2004. Available online: http://198.147.238.24/energy_solutions/res_details.cfm?resourceID=1262&category=Appliances&subcategory=Kitchen