Removing Disincentives for Efficiency from Electric Rate Design

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INTRODUCTION

Current rate design employed by many electric utilities provides a disincentive for commercial customers to aggressively pursue efficiency improvements in their facilities. The more electricity these customers use, the less they typically pay per unit of electricity consumed. Conversely, the less they use, the more they pay per unit. This weakens price signals that otherwise would reward customers for investing in energy efficiency, reducing costs, and thereby improving their competitive position.[1]

This paper will address an innovative and groundbreaking effort to reform current electric utility rate design practice to better recognize, reward and promote efficiency among large commercial customers. Wal-Mart has teamed up with the Natural Resources Defense Council (NRDC) to promote this effort with selected large investor-owned utilities. The goal is to establish commercial rates based on a benchmarking system that rewards efficient buildings with lower rates than their less-efficient counterparts. The paper explores preliminary rate designs, and the policy and implementation issues of different options for moving to a system that recognizes and rewards efficiency. One option, further described below, would use a combination of existing and newly-developed benchmarking systems to set each facility's efficiency target based on location, type of business, size, and electric consumption and/or peak demand. Usage up to the level associated with a reasonably efficient facility would be charged at a lower rate, while usage above the benchmark would be billed at a higher rate.

First, we discuss the unique nature of the collaboration that led to this proposal. Next, we present new rate design options, consisting of both methods for establishing efficiency benchmarks and possible rate structures. Finally, we discuss the next steps in the development of the proposal and the status of implementation efforts.

We also note that eliminating pricing distortions with an efficiency-based tariff is useful but not sufficient to persuade businesses to increase cost-effective efficiency investments. An array of market barriers impede most customers from undertaking efficiency investments that an economically rational business would ordinarily make if they had the time, expertise, and wherewithal to pursue them. The efficiency rate design options we propose here would partly

[1] In most cases, the increased average rate per kWh incurred is small compared to overall bill savings from pursuing efficiency. However, in some cases higher rates have actually completely wiped out any financial benefit from efficiency. Consider for example a facility that drops below a target average monthly billing demand because of efficiency and therefore is forced onto a different tariff at higher rates.

but not completely address these well-recognized market barriers. To reinforce such improved price signals, we further recommend that utilities, where they have not already done so, develop and deploy energy-efficiency programs using proven strategies to overcome market barriers preventing businesses and institutions from saving electricity and consequently helping the economy and environment. Further, to encourage utilities to aggressively implement efficiency initiatives regulators should establish effective mechanisms to ensure that utilities benefit from considering efficiency resources on an equal footing with supply-side options. These topics have been written about extensively elsewhere; this paper does not discuss them.

A NEW MODEL OF COLLABORATION

The subject proposal is the result of an innovative collaboration of two parties that sometimes have very different agendas. While these parties each have significant leverage to effect change on a national level, at first glance they may not appear to have common goals. However, finding areas of common cause can allow for an effective coalition to advocate for change.

Wal-Mart has increasingly recognized the importance of environmental responsibility in its operations, as well as a desire to minimize its own operating costs. For example, in Texas, Wal-Mart has stated a goal of purchasing 100% renewable electricity.[2] As a business that has made numerous efficiency improvements in its facilities, only to experience higher electric rates as a result, it is highly motivated to pursue rate reform that might also benefit it directly. NRDC has a long history of promoting sound environmental practices, with lower energy use high on the list of priorities. By jointly sponsoring this proposal the two parties bring a strong coalition, combining the clout of NRDC's 1.2 million members and on-line activists with the large market clout of Wal-Mart and its proven ability to influence its supplier practices.[3]

INNOVATIVE RATE DESIGN

Currently, many electric utilities use declining block rates where the more electricity a customer uses the cheaper it becomes. In addition, many commercial rate classification boundaries are defined by the level of peak or monthly average demand of the facility. As a result, substantially improving the efficiency of a large commercial building can result in dropping a customer into a different rate classification with higher rates, or into a higher priced block within the same rate code. At best, this provides less incentive to pursue efficiency, and at worst can actually create a strong disincentive.[4]

Our proposed approach will overcome this disincentive and provide a price signal incentive for improved efficiency. In addition, by providing additional information to customers about how their usage compares to other similar buildings, it sets the stage for investment in efficiency improvements and recognition for companies that achieve efficiency. Tied with well designed efficiency programs, the rate can actually be a valuable marketing and education tool.

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[2] Hendrix, C., *Wal-Mart Masters Energy Markets,* Energy Biz Magazine, September/October 2006, p. 88

[3] Note that other instances of Wal-Mart's collaborative leadership in the energy efficiency arena include its recently announced compact fluorescent light bulb initiative.

[4] As an example, consider a customer who implements a marginal amount of efficiency and drops into a lower peak billing demand rate classification. The resulting increase in rates could more than offset the reduction in usage, resulting in higher bills.

The proposed rate structure relies on a relatively simple approach that focuses on overall energy and/or peak demand use and does not require any on-site or specific customer information beyond their building type, square footage, and the kWh and peak kW demand levels already metered. The rate can easily be adapted to traditional or dynamic pricing rates. As a result, it can be melded with whatever other goals are intended (e.g., realtime pricing) for a particular tariff. We believe simplicity is essential for any efficiency-based rate design to be effective and easily implemented. However, we recognize that even this relatively simple approach may face implementation barriers with many existing utility customer billing systems. In some cases, even the addition of a single field (building sq. ft.) to existing systems will create problems. We believe however, that this and other barriers can be overcome and allow for significant rate reform to occur.

Components of a Proposed Rate Design

A few possible rate design models have been considered, and as of this writing, are still being explored. The co-authors of this paper each have different primary concerns. For example, Wal-Mart is most interested in maximum accuracy, and has proposed a much more complex approach that requires documenting actual building equipment and system efficiency levels and setting rates based on modeled efficiency. Under this approach, all buildings achieving a level commensurate with an established standard such as ASHRAE 90.1 2001 could be considered "efficient," for example. Optimal Energy's experience however suggests this approach may be too complex for implementation, and has proposed a design that produces some biases and loss of precision, but is more likely to be successfully implemented by utilities.

The authors also have not fully resolved whether the best rate design should focus primarily on annual energy usage or peak demand as the most important efficiency metric. Possibly some combination of the two would be most effective. Below we describe the model, which could be applied to either annual energy usage, peak demand, or both. Focusing solely on annual energy usage has the advantage of providing incentives primarily for efficiency improvements. However, unless customer efficiency benchmarks were adjusted for hours of use, it has the drawback of penalizing those facilities with long hours of operation and unfairly rewarding those with very short operating hours. A focus on peak demand would eliminate hours of use as a major variable. However, it would shift much of the incentive to demand response strategies that may or may not improve efficiency, or could even result in increased overall energy consumption.[5] While we have not completely resolved this problem, we believe that good options exist to refine this design to provide the three primary objectives: 1) simplicity and ability to implement without major transaction costs or utility system barriers; 2) incentives to improve efficiency; and 3) avoidance of perverse incentives or unfair outcomes.

The basic approach for the rate design would be:

- Establish an "efficiency threshold" of either kWh/sq. ft. annual electric usage, peak hourly kW/sq. ft., or both for each major commercial building type.
- Collect building type and sq. ft. information from each customer on the rate.

[5] For example, load shifting strategies such as thermal storage could provide substantial bill savings while actually increasing overall energy usage.

- All kWh usage and/or peak kW billing demand up to each customer's efficiency threshold would be billed at the first, lower block rates (both kWh and peak monthly billing kW).[6]
- All kWh usage and/or peak kW billing demand above that customer's efficiency threshold would be billed at the second, higher block rates (both kWh and peak monthly billing kW).

A complete rate design therefore includes both a set of efficiency thresholds and a rate structure that is based on usage relative to those thresholds. We recommend that the rate structure accurately reflect the cost of providing electric service, both demand and energy.[7] Obviously, one could add additional blocks at even higher rates for the most inefficient buildings. The rate could be designed to be revenue neutral — in other words produce the same total revenue to the utility as the traditional tariff it replaces. The rate could be offered as an optional rate, with adjustments to either this rate or very small adjustments to other commercial rates, depending on who opts for the rate to maintain revenue neutrality.[8] We believe that the key features of this rate design are:

- removes disincentives for efficiency improvements (*i.e.,* increasing block rates)
- provides incentives for efficiency improvement (*i.e.,* decreasing block rates)
- provides customer "benchmarking" to educate customers on where their usage falls compared to other similar buildings, to encourage inefficient customers to pursue efficiency opportunities, with constant monthly feedback
- simplicity that requires minimal additional data collection by utilities, and allows it to work with virtually any likely commercial rate structure: traditional, time-of-use, real time (either day ahead or hour ahead), etc.

<u>Efficiency Thresholds</u>

Basis for Efficiency Thresholds

Below we discuss approaches explored and developed by Optimal Energy for a benchmarking system based on annual energy usage. As mentioned above, this approach introduces potential bias based on hours of operation, and is discussed more fully here for illustrative purposes. Wal-Mart is currently more interested in a focus on peak demand. A similar approach could be applied to peak demand. While peak demand data is not as readily available outside of utility billing data, if utility data were not sufficient to establish benchmarks

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[6] Under a rate where only kWh or peak kW thresholds were established, we propose use of a "proportional" peak kW monthly billing demand or monthly kWh usage. This "proportional kW/kWh would be established based on a rolling average ratio of kWh/peak kW-month for each building based on billing data.

[7] As is typical with most rates, a fixed customer charge would also exist.

[8] Under an optional scenario, it is possible that primarily efficient customers would choose it. Under this scenario, a very small increase to the alternative rate might be necessary to maintain neutrality. However, because the rate can be designed so that even an inefficient customer's average rate for all usage is similar to alternative rates, this may not be an issue.

another approach would be to rely on "proportional monthly peak demand" based on relationships of kWh to peak demand from utility billing data for each month and building type.

We propose establishing the efficiency thresholds at the 75th percentile of average annual kWh/sq. ft. (and/or peak kW) for each building type. In other words, those buildings within the most efficient quartile for their building type would have all their electric usage billed at the lower priced block. This correlates with the target for the U.S. EPA's *Energy Star*™ benchmarking and labeling program for existing commercial buildings. This offers several advantages, including the potential to leverage this effective branding effort and to tie into U.S. EPA's *Portfolio Manager*™ benchmarking tool.

Three options for developing an annual energy threshold exist for a given utility:

- **Option 1:** If the utility has customer building type and square footage data, it could use territory-specific distributions of efficiency for each building type to establish the thresholds. Most utilities track some SIC or NAIC data, however it is typically very incomplete. Rarely do utilities currently track sq. ft. data. Therefore, this option will not typically be available. If accurate data is available, this would be relatively low cost and provide the greatest accuracy.

- **Option 2:** If Option 1 is not feasible, similar data could be developed using a stratified random sample of commercial buildings in the utility territory. The survey would establish building types and sq. ft. data through site visits or phone surveys. This information would be merged with actual billing data to establish weather-normalized usage distributions by building type. This option offers a similar high level of accuracy to Option 1, but would be more costly.

- **Option 3:** This option can be readily performed with currently available data at a relatively low cost but will provide somewhat less accuracy. It would rely on a combination of U.S. EPA *Portfolio Manager*™ analyses and data from U.S. Energy Information Agency's Commercial Building Energy Consumption Survey (CBECS).[9] These data can be combined to establish the usage distribution by building type. Although *Portfolio Manager*™ currently supports only a limited number of commercial building types, CBECS supports a more comprehensive list. The table below shows the commercial building types supported by EPA and CBECS data. Because the CBECS data is only available by census region (typically a broader area than a single utility's service area), differences between the average weather across the region and the average weather in the utility service area may reduce the accuracy of this approach, but not below an acceptable level. CBECS does not support monthly peak demand data. However, we believe reasonable target demand levels could

[9] *Portfolio Manager*™ is a tool provided by EPA to benchmark commercial buildings energy usage, and allows buildings to be certified as *Energy Star*™ if they meet or exceed the 75th percentile of efficiency for their building type and location. CBECS provides commercial building energy use data based on detailed surveys of thousands of buildings nationally, and is updated every four years.

be established based on monthly kWh/kW relationships for either building types or individual customers from utility billing data.

EPA Portfolio Manager Building Types	CBECS Building Types
Offices (general offices, financial centers, bank branches and courthouses)	Education
K-12 Schools	Food Sales
Hospitals (acute care and children's)	Food Service
Hotels and Motels	Health Care (inpatient)
Medical Offices	Health Care (outpatient)
Supermarkets	Lodging
Residence Halls/Dormitories	Mercantile (retail other than mall)
Warehouses (refrig. and non-refrig.)	Mercantile (enclosed and strip malls)
	Office
	Public Assembly
	Public Order and Safety
	Religious Worship
	Service
	Warehouse and Storage
	Other
	Vacant

Accuracy Limitations

Within building types there are many parameters that can affect electrical usage that are not directly a function of end use efficiency. These include things such as operating hours, worker space density, and the extent of plug-load equipment. Wal-Mart's initial approach, which it has advocated in a number of jurisdictions including California, Georgia, Massachusetts and New Hampshire would most effectively address these differences. However, it also introduces substantial administrative costs and burdens, especially given current utility billing systems. Optimal Energy and NRDC believe accurately adjusting for all these features would require an overly complex approach, major levels of analysis for different buildings, and customer surveys (either on-site or mail/web-based) for every participant in the new rate. It is likely that some customers would meet the efficiency threshold only if their usage were adjusted for one or more factors, and these customers may feel that the new rate structure is biased against them. While their concerns are valid, it is important to note that current rate designs are also based on average customer usage characteristics, rather than particular circumstances. That is, there is also the potential for bias under current conditions.[10]

We believe this divergence does not eliminate or change the efficiency of the rate design in achieving the three main criteria articulated above. We also believe simplicity, ease of use, and transparency are essential for widespread adoption of this rate design. A more accurate but substantially more complicated approach would ultimately not satisfy these criteria as well. The

[10] For example, many customers are billed for peak monthly demand based on capacity cost of service regardless of whether their peak is coincident with the utility system critical peak period.

problem of bias can be addresses by making the efficiency-based rate optional for all consumers, or for specific segments that exhibit large variations in items that could influence energy use beyond equipment and building efficiency. It is also important to note that if customer usage is slightly higher than their threshold, the average rate per kWh paid is only slightly higher because the usage in the second block is very small. This means that customer costs are not highly influenced by small inaccuracies in setting the threshold.

Finally, developing the efficiency thresholds based on peak demand could neutralize the operating hours variable. Similarly, data on operating hours could be included along with sq. ft. to improve accuracy somewhat if an annual energy usage or combination kWh and peak kW approach were used.

Rate Structure

This section provides more detail on a specific rate proposal currently being discussed. As mentioned above, the conceptual approach can be applied with variations to different rate designs and still achieve its overarching goals.

The new pricing system would be developed and applied to all customers large enough to warrant the costs of interval metering. Any customer with interval metering currently would be moved to the new system, as would any customer over a fixed annual energy-consumption level. That threshold would be determined as the annual consumption for which the load shifting due to real-time pricing would be expected to approximate the additional costs of interval metering.

Initially, the new efficiency incentive would be applied only to commercial, multi-family residential, and educational facilities, for which efficiency can be defined on a kWh/sq. ft. basis. To avoid the problem of benchmarking industrial efficiency for a wide range of extremely heterogeneous products and processes, an industrial customer could be allowed to "opt in" to the efficiency incentive by establishing the industry average or standard efficiency in kWh and/or kW per unit of output and providing output data so that the utility can track the customer's performance. The basic rate design can be applied to all large customers; those without the efficiency incentive would be on a set of rates that average the efficient and inefficient block rates.

The rate design would consist of three basic components, listed below. The demand and energy charges would vary with the customer's efficiency level.

- Customer Charge ($/month), to cover the cost of metering, billing and customer service.
- Demand charge(s), in $/kW-month[11]
- Energy Charge ($/kWh).[12]

Demand Charges

The Demand Charges would be priced in two blocks:

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[11] Demand charges could be designed to mimic any existing or proposed rate design. Under a traditional approach, this would likely represent a single charge. \

[12] Energy charges could also be designed to mimic existing or proposed rate design. This model could follow typical utility rate approaches that have seasonal, time-of-use or real-time energy charges.

- $X/kW-month for usage up to the efficiency demand threshold,
- 1.5×$X/kW-month for usage above the efficiency demand threshold.

Under an annual energy benchmarking approach, the demand threshold for each customer is calculated as:

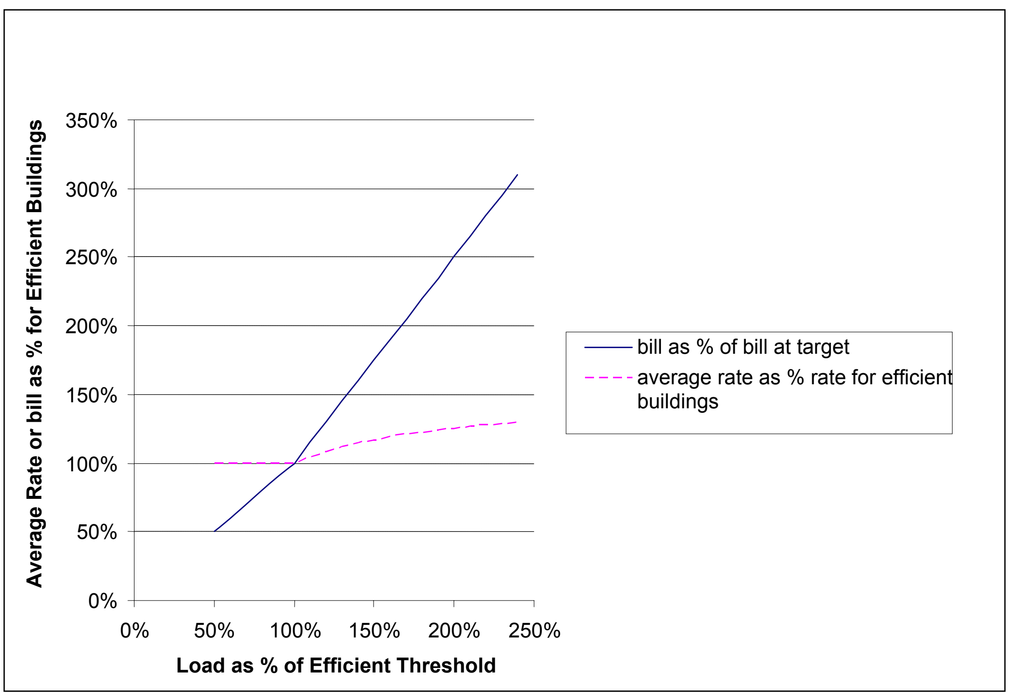
$$EI_t \times DER_i \times A$$

Where:

EI_t =	efficiency threshold energy intensity in kWh/sq. ft. for an efficient building of type *t*, based on the 25th percentile of consumption (75% percentile of efficiency)
DER_i =	demand-energy ratio (kW-months of billing demand per kWh sales)
A =	building size in sq. ft.

Under a monthly peak demand benchmarking approach, the demand threshold would be set directly for monthly peak demand and would eliminate the DER_i variable. In this case, EI_t would be in kW/sq. ft. rather than kWh/sq. ft.

For example, if a customer's efficiency threshold for its building type and size were 600 kW, and the building used 700 kW, the customer would pay the lower, "efficient rate" for the first 600 kW and the higher "inefficient rate" for the last 100 kW. This prevents bills from changing sharply at the efficiency threshold. A customer who used twice the efficient level would pay an average rate 25% higher than a customer using the efficient level or less (in addition to paying for twice as many kW). This relationship is illustrated in the figure below.



Energy Charges

The energy charges would be applied in a similar fashion as demand charges. In addition to the base energy price, a "Delivery Energy Charge" (DEC) would be applied to energy usage above the efficiency energy threshold. The DEC could be developed to result in revenue neutrality. The higher the DEC, the stronger the price signal to provide an incentive for efficiency. The above illustration assumes a DEC of 1.5. Under an efficiency threshold established based on energy only, the threshold is:

$$EI_t \times A$$

Where:

EI_t = efficiency threshold energy intensity in kWh/sq. ft. for an efficient building of type *t*, based on the 25^{th} percentile of consumption (75% percentile of efficiency)

A = building size in sq. ft.

If the efficiency threshold were set based on peak demand rather than annual energy, the above formula would look more like the equation shown for demand, and include an EDR_i term to represent the energy-demand ratio.

In each month, the customer's total energy usage for the past year (the current month and the eleven previous months) would be compared to the efficiency energy threshold. The Delivery Energy Charge would be multiplied to the minimum of:

- the customer's annual energy usage in excess of the efficiency or threshold, or
- the customer's current monthly energy use.

Transitional Ratemaking

Initially, the efficiency thresholds may be uncertain, unless the building type and square footage of each customer is clearly established before the rate design is completed. Other revenues (such as from the market energy prices) will also be uncertain. Also, if the rate is made optional, the actual distribution of customers who opt for the rate will be uncertain and will affect revenues. To avoid windfalls from any under-projection of the billing determinants, any excess of revenues from the new rates over the existing rates could be used to fund efficiency improvements, along with other funds that may become available from federal or state government programs or carbon-offset trading. In addition, utilities should consider additional internal funding of efficiency programs, using a traditional cost recovery mechanism, in consultation with regulators. Any revenue shortfalls should be deferred for later recovery from the entire group of customers eligible for the rate design, or from a standard rate if the "efficient" tariff is optional.

During the transition period, utilities should also assess the stability of revenues under the new rate design, and propose any additional measures that may be needed to maintain the utility's ability to earn its authorized rate of return.

As mentioned above, many current utility billing systems do not currently have the flexibility to include additional data fields. Our approach assumes some level of rate and system reform that will need to be achieved over an extended time period. In the mean time, utilities can consider other simpler methods to reward customers for efficiency, or at least not penalize them. For example, these could include at a minimum:

- Allowing customers that improve efficiency and as a result drop below a threshold peak demand or energy consumption level that would shift them to a more costly tariff a waiver to stay on the tariff they were on before efficiency improvements;
- Allowing customers that voluntarily engage in a efficiency adoption meeting or exceeding some threshold level (perhaps through utility-sponsored programs) to participate in a preferential rate;[13] or
- Allowing customers that meet some efficiency criteria based on current usage to participate in a preferential rate. For example, all buildings achieving an *Energy Star*™ building designation from EPA.

CONCLUSIONS

The rate design proposed above is still in the early stages of development. As of this writing, Wal-Mart has discussed its original proposal with two large investor-owned utilities, and submitted comments in regulatory proceedings in a number of jurisdictions. Wal-Mart, NRDC and Optimal Energy continue to collaborate on refining the approach, in consideration of various goals and feedback from utilities. The rate approach described is flexible to accommodate a variety of adjustments, the basic concept and structure is simple enough to meld closely with other rate design approaches, and could tie directly to EPA's *Energy Star*™ commercial building benchmarking initiative. Incorporating the rate along with a coordinated benchmarking effort and efficiency initiatives that provide technical and financial assistance to customers can result in a more compelling opportunity for commercial customers to adopt efficiency. We encourage utilities to continue to explore this and other mechanisms to reform rate design in ways that will create incentives for maximum efficiency and remove barriers to efficiency adoption.

[13] Precedent exists to offer select customers preferential rates such as economic development rates. These could be used to reward efficiency.