# ProRate: A MODERN ELECTRICITY RATE DESIGN

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## INTRODUCTION TO ProRate

A century-old problem of electricity rate design is cost-shifting between ratepayers (Wellinghoff & Tong, 2015). A much newer cost-shifting example of great and increasing importance happens whenever ratepayer-generated "renewable energy" is sold to the grid—all too often, this is accused of being unfairly rewarded (Ritchie, 2016). ProRate resolves both these concerns and ProRate can actually be derived simply from the premise of avoiding "all" cost shifts between ratepayers (Katz, CLEPm Rewards to Arrest Demand Cost-Shifting, 2019; Katz, CLEP5 Rewards to Arrest Energy Cost-Shifting, 2019). Another major problem with the *Old Utility Model*[1] is the lack of price signals[2] (Electric Choice, 2012; Duncan, 2017; Faruqui, Hledik, & Palmer, 2012; Milliner, 2019). ProRate utilizes time-varying rates for both energy and demand to eliminate cost-shifting onto others[3] and provides fair compensation to locally generated and/or locally stored electricity—both improve grid reliability, reduce instantaneous demand needs, and, importantly, reduce the carbon footprint of all ratepayers (Price Electric, 2015).

ProRate is a novel[4] (Katz, Direct Testimony of Myron Katz within DOCKET NO. UD-18-07—Entergy New Orleans Rate Case, 2019, p. 5) rate design that provides customers with both direct access to the wholesale electricity market and accurately priced and time-based demand charges and payments for actual and avoided demand. ProRate incentivizes choices that benefit the customer, other ratepayers, the utility itself, and the environment via a free-market solution without the use of subsidies by government or from any other source, and thus provides all of its benefits at negative economic cost (Katz, CLEP5 Rewards to Arrest Energy Cost-Shifting, 2019).

In short, ProRate is a subsidy-free, free-market solution that eliminates cross-ratepayer shifts of costs, provides financial incentives for "doing the right thing," incentivizes reduction in grid demand (and, therefore, load), while improving grid reliability, and addresses environmental issues such as climate change. It is a political winner because it addresses the concerns of the political right—free-market and lack of subsidies—while also addressing the concerns of the political left—climate change, providing an opportunity for ratepayers to lower their existing bills, and helping to fund meaningful progress (Katz, Direct Testimony of Myron Katz within DOCKET NO. UD-18-07—Entergy New Orleans Rate Case, 2019).

ProRate's implementation has a few requirements, such as the ability to measure electricity consumption as often as every five minutes, as is provided by "smart meters", and a regulatory structure that includes Prorate. Beyond this, it is up to the electricity customers to make good choices.

ProRate provides two fundamentally different electricity pricing components which are associated with ProRate's original name: "Customer Lowered Electricity Price," or CLEP (Katz, Direct Testimony of Myron Katz within DOCKET NO. UD-18-07 — Entergy New Orleans Rate Case, 2019, p. 22).

a. CLEP5 is calculated every 5 minutes and is based on the 5-minute wholesale prices provided by the regional wholesale electricity marketplace (MISO Energy, 2020; Wikipedia.org, 2020).
b. CLEPm is calculated monthly, but only applies during specifically identified, high utility-wide demand periods of that month and rewards customers for lowering their average electricity demand during such critical times. CLEPm either charges for demand or pays for

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***avoided*** demand during those months, times-of-day, and daysoftheweek chosen to minimally cover the probable ***peak demand*** times of the utility (Electric Choice, 2012).

Both CLEP5 and CLEPm provide a small profit to the utility — which is adjustable by the utility regulator, but we propose that to start, it should be set at somewhat lower than 5%[5]. Our proposed 5% is enough to recover the costs of the pass-through services the utility provides; thus, the residual is shared with the utility and all ratepayers; this lowers the electricity prices for all (Katz, Direct Testimony of Myron Katz within DOCKET NO. UD-18-07 — Entergy New Orleans Rate Case, 2019, p. 22).

By offering a dramatically improved price, ProRate incentivizes electricity consumers to apply cost-effective[6] and money-saving strategies that benefit everyone and "pays" consumers to ***purchase***[7] electricity at less expensive times, use energy efficiency to lower their bills, and even install batteries and/or electricity-generating equipment to be able to provide for their own needs and, in some cases, even provide electricity back to the grid when appropriate, thus turning customers into "prosumers" (Business Wire, 2019; Jacobs, 2016). Among the choices that ProRate encourages are: changing time-of-use, energy-efficient devices, photovoltaic solar power (PV) (especially Community Solar (Farrell, 2020)), and—a critical option for New Orleans where this started—batteries. Electric batteries—especially when combined with solar—can benefit everyone involved by increasing grid stability and may be indispensable for a 100% renewable energy future (Katz, Inverted Demand Compliant Construction May Be a Key to a Renewable Energy Future, 2014). Similarly, ice-making air conditioning is a form of battery, because, just like an electric battery, it can shift demand to non-peak demand times of the day (Kuo, 2015). Together, these provide resilience during power outages, reduce consumption and/or provide energy at vital times to decrease the need for stand-by power ("spinning reserve"), and can even provide some customers a profit (Business Wire, 2019; Jacobs, 2016).

## STARTING ASSUMPTIONS

Assuming a flat rate for electricity, a residential electricity (energy) bill is calculated by multiplying the kilowatt-hours (kWh) purchased at the current rate, which includes the cost-of-energy and cost-of-service (Katz, Direct Testimony of Myron Katz within DOCKET NO. UD-18-07—Entergy New Orleans Rate Case, 2019, p. 7). That is,

Residential energy bill =
#kWh purchased ∗ (cost-of-energy + cost-of-service)

Because utility-owned electricity storage is still rare, customer purchases always affect cost-of-service and cost-of-energy. Upon customer demand, utilities must either increase production or increase wholesale purchases. The weighted, monthly, average wholesale price is called the cost-of-energy. If that demand can stress the utility's distribution system, then it can increase the cost-of-service.

### a. Energy-Cost Burden

The way and amount a customer shifts energy costs onto others substantially depends on the time the electricity is purchased.

If that wholesale kWh purchase is overpriced,[8] the weighted average wholesale price of electricity increases. The key concept is that buying too high or selling too low will always increase the cost-of-energy and cause all customer bills to go up. That is,

SINCE: *cost-of-energy = weighted average wholesale electricity price,*

whenever a wholesale purchase is overpriced, the cost-of-energy increases.

### b. Demand-Cost Burden

Measuring the demand-cost burden, or how the average demand (in kW) of a particular building coincident with the peak utility's demand times raises the cost-of-service for all customers, is also part of ProRate and is simply explained here. That is,

SINCE: *cost-of-service = the sum of all utility costs and profits unrelated to electricity purchases or marginal generation costs divided by the number of kWhs sold,*

whenever a customer's average demand during the peak utility's demand times is extraordinarily high, this can aggregate among customers and cause the utility to eventually be required to invest more money to build peaking plants and/or more robust distribution equipment to provide power at such times. This can and has caused the cost-of-service to increase (Burke, 2018).

### c. ProRate is Opt-In like Net Energy Metering

Much like the Net Energy Metering (NEM) tariff used by rooftop solar owners, ProRate is an optional electricity rate that will either pay ProRate customers or cost them if used incorrectly (Solar Energy Industries Association, 2019). Opting-in to the ProRate rate design does not change which rate primarily governs the utility bill;

ProRate provides an additional cashflow like NEM, but, unlike NEM, ProRate can either raise the bill or, conversely, can change the bill into a monthly income.

## ProRate's FORMULAE

ProRate's simple monthly formula is CLEPm $+\sum$CLEP5.

a. CLEP5 is the energy-cost shift, explained above and below, and is calculated every 5 minutes.

b. CLEPm is the monthly cashflow that provides a utility bill ***credit*** for delivering power or a ***charge*** for demanding power, but it is only paid or charged during the peak utility demand times (PUDT), defined below. The target magnitude of CLEPm is to generate a cashflow equal to the same annual demand charge as that levied on commercial customers, using \$/KW-year as the unit. \$/KW-year means 12 times the average demand charge. For example, if the average demand charge is \$10/KW-month, this is equivalent to \$120/KW-year. By predicating all demand rewards and charges on actions only done during the peak utility demand times, these cashflows pay customers to avoid the utility's peak demand times, which are the most expensive periods (Katz, CLEPm Rewards to Arrest Demand Cost-Shifting, 2019).

**ProRate's formal definitions** (Katz, Direct Testimony of Myron Katz within DOCKET NO. UD-18-07—Entergy New Orleans Rate Case, 2019, pp. 19–20):

For each 5-minute period used by the wholesale market; that is, the smallest time period associated to a wholesale price change:

$$\text{CLEP5} = \mathbf{p} * \mathbf{n} * (\mathbf{e} - \mathbf{w})$$

$\mathbf{p}$ = utility regulator-determined "percent," $0 < \mathbf{p} < 2$; for this paper, assume $\mathbf{p} = 95\%$.

$\mathbf{n}$ = number of kWh purchased; therefore, if a net purchase, then $\mathbf{n} > 0$; and if a net sale from the customer to the utility, then $\mathbf{n} < 0$.

$\mathbf{w}$ = instantaneous wholesale price of electricity.

$\mathbf{e}$ = monthly, weighted average, wholesale-electricity price = this month's utility's cost-of-energy.

$$\text{CLEPm} = \mathbf{q} * \$50 * \mathbf{d}$$

$\mathbf{d}$ = Average demand during peak utility demand times (PUDT) *avoided*, where $\mathbf{d}$ is the calculated reference building demand during PUDT minus observed average demand during PUDT.

$\mathbf{q}$ = Utility regulator determined "percent"; $0 < \mathbf{q} < 2$; for this paper, assume $\mathbf{q} = 95\%$.

## Peak Utility Demand Times (PUDT)

Peak Utility Demand Times (PUDT) contain the hours where the utility's annual peak demand time(s) is expected to occur. This is reset annually by the utility regulator so that they are reasonably contiguous, and the regulator is 99% certain that they will contain the peak hours next year. The time slice is chosen to include

- all hours that are within 80% of last year's annual peak.
- at least 500 hours a year.

In 2019, New Orleans PUDT was chosen to be: 2:00 p.m. to 7:00 p.m., weekdays, May through September; however, PUDT will be different for different utilities and will even change for New Orleans from year to year because of changing climate and decreases in the peak demand over time.

## Reference Demand

For all utility customers, **besides for residential** customers, this team of researchers has found no good or reasonable approach for calculating a greater than zero reference demand.

However, the mere existence of https://RESNET.US, the industry that rates homes in the US and created HERS (Home Energy Rating System), and that RESNET has counterparts or allies in many parts of the world including most of Europe—effectively asserts that each home has a well-defined reference home and according to how much better the actual home is to that particular home's reference home, that is the basis of the home's energy rating[9] (Bailes, 2012).

ProRate's Reference Demand is merely the predictable demand of this same reference home during PUDT.

Note that all homes have greater than zero reference demand and the older the home is, the larger the reference demand. Every energy-performance enhancing investment made by the original builder beyond merely code compliant or made by any current or previous owner of the home has no effect and does not lower ProRate's reference demand for that home. And thus, ProRate pays a homeowner for such improvements on a performance basis based upon this ***a priori*** and proscriptive measurement.

*Reference Demand* = $\mathbf{d_R}$ = can be thought of as the demand the naïve customer should/would have, that is, if no energy- or demand-saving investments were made on/in the home from the moment it was new and the home was originally built to the minimal energy-performance standards of that date and location.

If we also define $\mathbf{d_A}$ as the average demand recorded on the smart meter during PUDT of that month, then

$$\mathbf{d} = \mathbf{d_R} - \mathbf{d_A} \text{ and}$$

CLEPm is more precisely described as

$$\text{CLEPm} = \mathbf{q} * \$50 * (\mathbf{d_R} - \mathbf{d_A}).$$

## CLEPm Example Calculation

Let us walk through an example of calculating CLEPm. CLEPm rewards the ProRate customer with lower bills if **d** is low enough and raises energy bills if **d** is too high.

If the ProRate (defined) reference demand for a particular residence were 5 KW, and that home experiences 4 KW of demand when "$\mathbf{d_A}$" is measured, those values inserted into the definition of CLEPm will cause ProRate to lower that customer's bill by $5 * \$50 * (5 - 4) = \$250$/year. If, instead, the same building served a business, $\mathbf{d_R} = 0$ and the annual demand charge would be \$1000.

The "100 – **q**" is the customer's "percent" of the income from these CLEPm transactions; thereby, each CLEPm transaction that helps to lower a ProRate customer's energy bill also pays the utility 5%: this cashflow will pay the utility's administrative costs and what is left over is used to share savings with all customers.

Calculations might look different depending on the industry. Concerning community solar,[10]

$$\text{ProRate} = \text{CLEPm} + \sum \text{CLEP5}$$

where

$$\text{CLEPm} = \mathbf{q} * 50 * (0 - \mathbf{d_A})$$

However, because Community Solar always produces negative demand, $\mathbf{d_A}$ is always negative and $\text{CLEPm} = \mathbf{q} * 50 * (0 - \mathbf{d_A}) > 0$ (Katz, Direct Testimony of Myron Katz within DOCKET NO. UD-18-07—Entergy New Orleans Rate Case, 2019, p. 27).

## CLEP5 EXAMPLE CALCULATION

Remember that CLEP5 measures energy-cost shifts. Also recall that

$$\text{Residential energy bill} = \\ \text{\#kWh purchased} * (\text{cost-of-service} + \text{cost-of-energy}).$$

Furthermore, because utilities must make or purchase kWh on customers' demand and the cost-of-energy = weighted-average wholesale price, if a wholesale purchase is overpriced, then cost-of-energy increases.

Without incentives or time-dependent metering, customers will "dump energy consumption onto the electricity grid" at any time[11] (Hardin, 1968). More energy-efficient homes will dump onto others less, but improved energy efficiency alone will not guarantee against either pushing energy or demand costs onto others. The fastest and cheapest way to lower cost-of-energy for a utility is by fully exploiting the wholesale market: that is, by day-trading: by pushing all/most purchases to times of lowest wholesale prices.

$$\text{CLEP5} = \mathbf{p} * \mathbf{n} * (\mathbf{e} - \mathbf{w})$$

Because there are roughly $12 \times 24 \times 30 = \sim 8600$ 5-minute periods/month, "$\Sigma$CLEP5" is the sum of these many CLEP5 calculations for any month. As a ProRate customer, increasing $\Sigma$CLEP5 lowers your electric bill and if that sum is high enough, can cause the utility to pay the customer.

"With a \$50 investment in labor and materials for installing a timer, a standard, electric water heater with a tank can be set to always heat water very early in the morning, a CLEP customer can save a \$150 a year. The CLEP incomes are approximately a) \$100 from lower priced wholesale electricity (via CLEP5) and b) \$50 savings on demand (via CLEPm). The payback period is about 4 months, i.e., 1/3 year" (Katz, Direct Testimony of Myron Katz within DOCKET NO. UD-18-07—Entergy New Orleans Rate Case, 2019, p. 25).

## THE OLD UTILITY MODEL

Creating electricity with twentieth century technology required very high capital costs to afford a central power plant and non-overlapping distribution lines which, together, led to monopoly utilities. These were either government owned or privately owned and regulated by the government. Such utilities were charged with the responsibility of providing both low-priced and reliable electricity. Significantly, and quite relevantly, the old utility model assumes that individual buildings cannot economically provide or store electricity. Another limitation of the old utility model prevailed because old electric meters and their meter readers were not economically able to provide electricity purchase data more often than monthly; for this reason alone, rates did not reflect the actual price of electricity delivered at the time that the electricity was purchased by the consumer.

Recall that the old utility model uses a "one size fits all", standard electric bill.

$$\text{Residential energy bill} = \\ \text{\#kWh purchased} * [\text{cost-of-energy} + \text{cost-of-service}]$$

In that situation, consumers get a cost-of-energy increase or "surcharge" on their bill for electricity purchased by the utility during the month, but this is an after-the-fact surcharge; the customer does not know or feel the monetary effect of his or his neighbor's purchases at the specific times when overpriced wholesale electricity is bought. This happens because there are no price or other signals used to help determine if any ratepayer's electricity purchasing choices are economical (as measured in \$/kWh) or efficient (as measured in kWh/[lb of $CO_2$ emitted]). Furthermore, because the consumer does not know or perceive the monetary effect of purchases made at the time the electricity is bought during the previous month, there is no reliable, much less functional, way to reduce purchases during peak periods or change purchase times to those with low wholesale electricity prices (for example, during the night).

This lack of price signals causes ratepayers to inadvertently dump energy costs onto one another. Even at peak periods, Mr. Customer is constantly charged at the flat, 10¢/kWh rate. This ignores the fact that the actual costs borne by the utility at that time may be many multiples of that price. In effect, his purchases are being subsidized by other ratepayers.

At the same peak time, his neighbor, Ms. Customer, is also being charged at the flat rate, 10¢/kWh, when the actual cost may be many multiples of that price. Her consumption is also being subsidized by other customers.

Because residential customers pay no demand charges, they dump large virtual demand charges onto each other.

But old utility model demand charges are poor price signals. Commercial electricity rate designs include demand charges, but to little avail. A business's peak demand may not coincide with the utility peak demand. (Example: churches' peak demands are generally on Sunday mornings). No price signal is given at the time electricity is demanded (in kW). Thus, there is little incentive to reduce demand at peak utility demand times.

Changes in the electricity industry are leading to a new paradigm which can be called the ***Utility of the Future***.

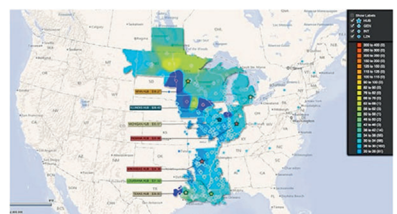
## THE UTILITY OF THE FUTURE

Recent developments that will allow customers to lower the price of electricity:

- Distributed energy resources (DERS) (Deora, Mandel, & Frantzis, 2017)
- Batteries and thermal storage
- Smart meters
- Wholesale marketplaces
- Aggregation services
- Prosumers

All DERS encounter problems, and often are undercompensated, under the Old Utility Model—"one size fits all"—approach to rate design. Here are examples:

- A heat pump water heater is three times as efficient as a standard electric model, and energy efficiency is a major resource, but payback is always within a zero-sum, self-limiting situation because the payback for any energy-saving investment is limited by previous investments and cannot exceed the initial energy bill.
- Photovoltaic solar comes in both rooftop solar and community solar varieties. Both have precarious cash flows because they are most often financed with NEM which never pays back in dollars . Under attack in many jurisdictions, NEM's perceived subsidy is often accused of unfair cost shifting (Ritchie, 2016).
- Because wind often produces electricity when there is little demand, wind power is often sold near minus 1¢/kWh in the U.S. A snapshot of the MISO Realtime Electricity Price (in \$/MWH) Contour Map is shown below; the purple areas on this map show where and when such electricity prices happened.



(MISO Energy, 2020)

## The Solution

Roughly half of U.S. customers have smart meters. Smart meters are slated for full deployment in New Orleans, Louisiana (NOLA) by the end of this year (2020). This development, coupled with ProRate, allows for NOLA ratepayers to robustly profit from bi-directional electricity flows. This allows selling to as well as purchasing from the utility, and (unlike mechanical meters which were only read monthly) smart meters record and report the amount and actual time of purchase and/or sale.

Prosumers are people who produce as well as consume a product: here, the product is electricity.

Prosumers can be an individual household or business. Under ProRate, which provides price signals at the time that electricity is either purchased or sold, customers will be incentivized to produce when wholesale prices are high, as well as purchase electricity when prices are low.

Customers will find new ways (think software, hardware, and aggregation service providers) to provide accomplish this at increasingly lower costs to themselves, and, thereby, make a profit for themselves and the companies who innovate or provide these technologies, while, at the same time, lower the wholesale electricity price for everyone. Were it possible to pay customers for providing this service—at almost precisely the same value of the cost-shift avoided—and do this in a steady enough fashion to provide reliable annual cashflows, this should be expected to create a mass-market sufficient to encourage businesses to jump-in and finance the deepest investments in DERS—all of which can be expected to happen at the normal speed of innovation, namely, quite rapidly and at no cost to ratepayers. ProRate can make this happen.

## PROVIDING A SIMULATION OF ProRate BY IMPLEMENTING A DATA-DRIVEN MODEL

From its inception, ProRate was articulated as a set of mathematical formulae. Data-driven modeling was the approach used in the development of the CLEP_Dashboard (Troy & Katz, 2019).

Features of this dashboard include an entire year's dataset of MISO prices for the New Orleans node, data that would allow more accurate estimates of New Orleans' cooling loads and, beyond that additional data that would interest regulators.

There are, however, unavoidable deviations between the simulated results and those created within a real-world implementation of a utility pilot, including the fact that ProRate calls for weighted averages to ascertain the "cost-of-energy," which requires information that is unavailable to the simulation software development team. To be truly accurate, the CLEP_Dashboard would require a substantial amount of information that only utilities, such as Entergy New Orleans, (ENO) have. The good news is that this weighting error will likely underestimate real CLEP5 values because the correctly weighted average wholesale price will probably cause the transactions at peak utility demand times, which have both more consumption and higher prices, and disproportionally raise the cost-of-energy. Higher cost-of-energy will encourage ProRate consumers to make more purchases outside of peak times, and earn more CLEP5 income, allowing everyone to win, both customers and the utility.

The simulation development team would like to point out, for anyone following along and very carefully studying our screenshots with a calculator, that the values displayed are always rounded, so while the CLEP_Dashboard is calculating correctly, rounding only occurs at the displayed value.[12]

## CLEP_DASHBOARD SIMULATION RESULTS

Excerpts from *Experiencing the CLEP_Dashboard* shows three screenshots that exhibit ProRate's estimated cost-shifting onto other ratepayers and the ProRate customer's savings — given the set of decisions he may make about energy-efficiency investments — as well as three other kinds of possible energy bill-reducing upgrades (Troy & Katz, 2019). See Figures 1–3 and their explanations.

Customer's Demand Profile Before Opting for ProRate, Figure 1, graphically depicts "normal (kWh) consumption and (kW) demand" for each of the 24 hours of a day, for a typical residence in New Orleans on August 8, 2018. The labels DW, WH, AC, Batt, EV, and CS refer to dishwasher, water heater, air conditioner, "whole home" electric battery, electric vehicle, and community solar, respectively.

As stated above, **p** = **q** = 95% is assumed, and, therefore, 5% of each ΣCLEP5 or CLEPm monthly transaction is allocated to be received by the utility. This cashflow pays all administrative costs for ProRate and then pays down the cost-of-energy with any leftover money. However, the formulae for ProRate do not specify how much of the 5% is beyond what is needed to fully reimburse the utility so that the rest is sent to all ratepayers each month—indirectly by lowering the cost-of-energy. To fully simulate ProRate, the software developers assumed that 2/5 of the 5%, or, equivalently, 2% of the pure ProRate income lowers the co0,st of energy each month. And, in fact, that 2% value shows up indirectly in all three screenshots, labeled Figures 1–3 (it is indicated in the "Parameter Section" on the top right as "Utility Overhead and Profit = 3%").

Figure 1 presents the presumed default situation wherein the resident has not purchased anything unusual nor chosen to use the appliances he has in any but the most common way; that is, according to the old utility model. This customer's electric bill, before becoming a ProRate customer, is can be calculated by *multiplying* the **Utility kWh Price** on the right, under **Energy Pricing** {**11.0¢),** *by* the number of kWh purchased (found near the bottom left under "**Energy Use, in kWh"** or **12198**. The product of these values is $1344/year. The home, as originally configured (in Figure 1) also displays, under "**Ratepayer Economics",** as "CLEP Annual Loss: $150". This demonstrates that, before this customer became a ProRate Customer, his cost-shifting burden onto other customers was $150 per year, which all ratepayers were required to pay to support this customer's inadvertent but poorly timed electricity purchases.

However, below, in the Demand Profile after Dishwasher, Heat Pump Water Heater, Ice-making AC and Whole Home Battery, Figure 2, this same field shows

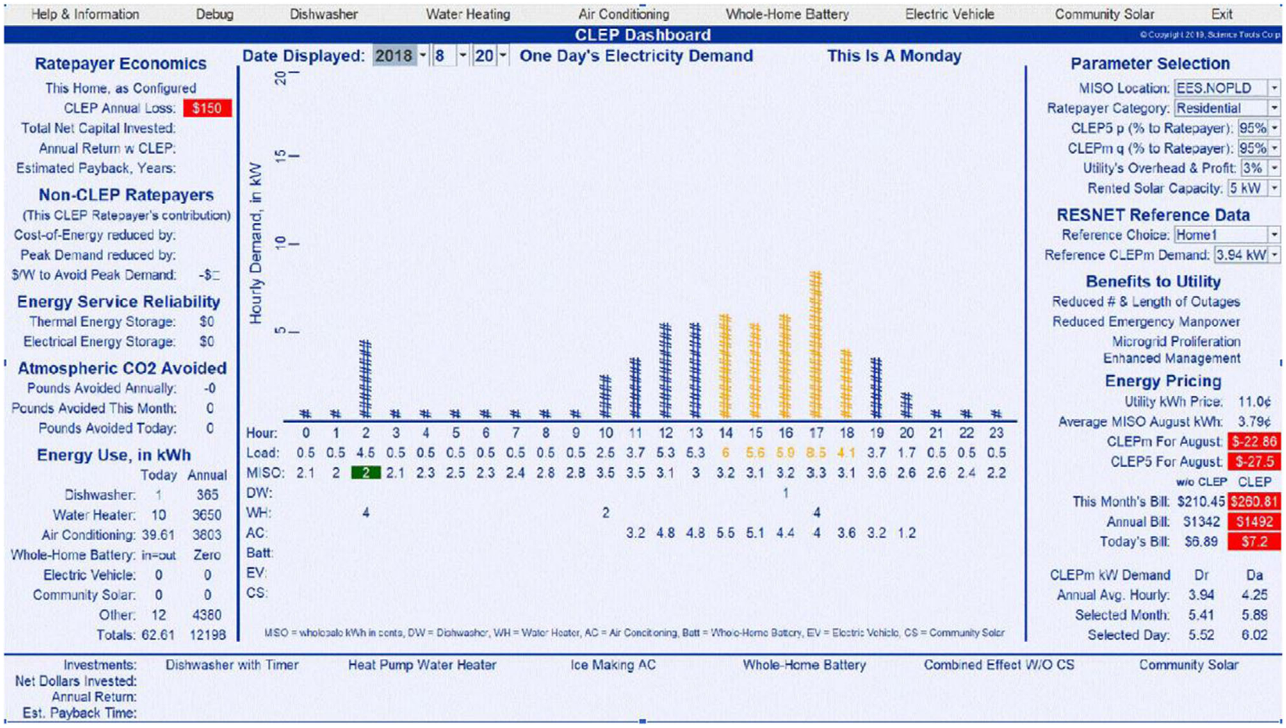


FIGURE 1. CUSTOMER'S DEMAND PROFILE BEFORE OPTING FOR ProRate

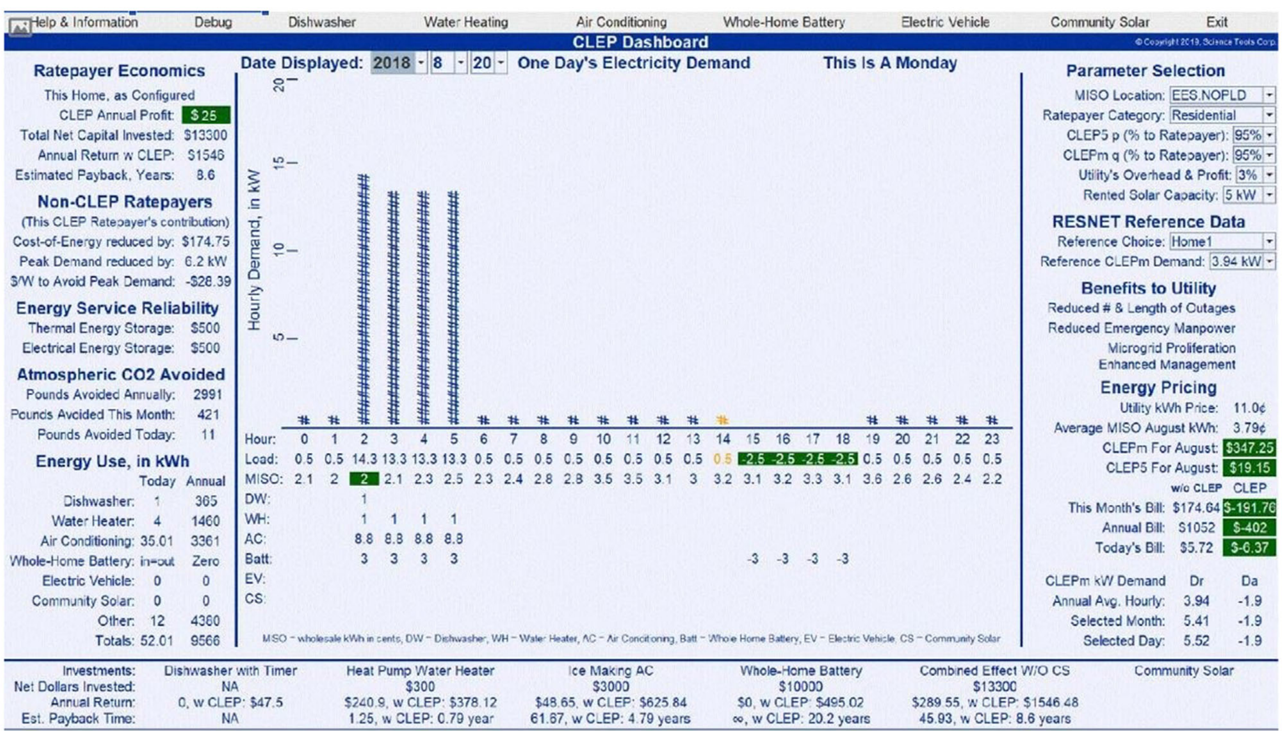


FIGURE 2. DEMAND PROFILE AFTER DW, HPWH, ICE AC and WHB

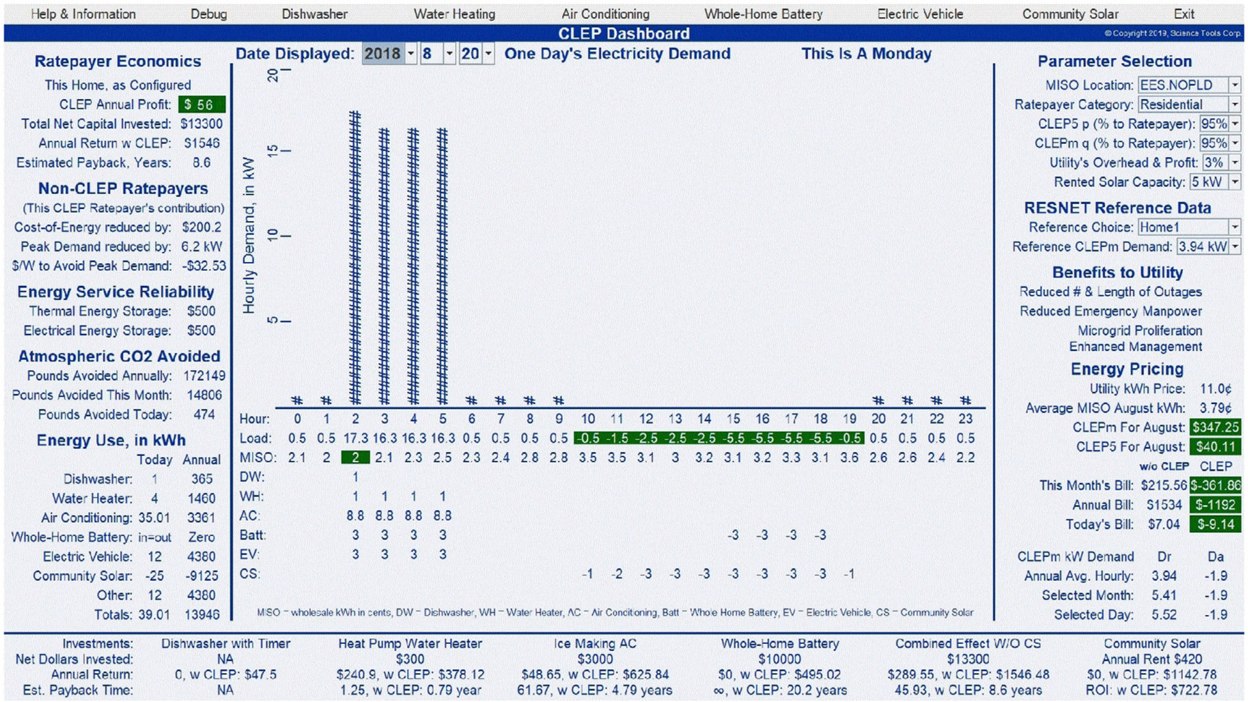



FIGURE 3. DEMAND PROFILE AFTER ALSO ADDING EV AND CS

"CLEP Annual Profit: $25" and reflects the fact that after this same customer exploits the opportunities of the ProRate system, his cost-shifting effect changes to $25 in ***support of*** other customers,[13] which helps lower their electricity bills. This customer accomplished this throughinstalling a heat-pump water heater, an ice-making AC, a whole-home battery, and programming each to exploit ProRate's cashflows. The total net 2018 income to this ratepayer, aggregated from ProRate income together with reduced kWh purchases, is found on the right, on the second to last row of the image: **$1546.48**($289.55 in a lower ENO bill plus $1256 in pure ProRate income). Although most of this $1546 per year was needed to pay for these investments, they will be completely paid off years before their useful life expires.

A whole home battery (WHB) can provide all the electricity needed to run the home for 20 hours after 4 hours of charging (Katz, Inverted Demand Compliant Construction May Be a Key to a Renewable Energy Future, 2014). However, without ProRate, payback is far from possible because a WHB does not reduce kWh consumption, and, in fact, any such a system loses 3–10% of the energy that passes through the inverter/converter cycle. Nevertheless, ProRate provides over $600 per year of income by the sum of these two effects:

a. buying electricity from the grid when the wholesale price is low and selling electricity to the grid when the wholesale price is high (via CLEP5), and
b. preventing demand or providing power during PUDT to generate CLEPm savings.

These two (often interdependent) activities pay back in rewards from CLEP5 and CLEPm, but this cashflow does not payback the first cost of the WHB before the end of its warrantied life.

To fully meet this payback problem, the last entry on the bottom right of the dashboard shows that when other, more cost-effective investments are made with the purchase and installation of the WHB, namely, the heat pump water heater and the ice-making AC, the ensemble of retrofits pays for itself faster than the rated life of the battery, namely, in less than 10 years.

Figure 3 shows what happens if the same customer later purchases an electric vehicle and subscribes to a community solar farm.

The full economics of the electric vehicle investment is a. A ProRate customer who owns an EV is paid over $75 simply for charging at night.[14] b. The number of kWh consumed by EV ownership is the difference in total kWh purchases from ENO between Figure 3 and Figure 2 (13948 – 9565 = 4383) which, at 11¢/kWh, costs about $483. Together, these assert that a ProRate customer's EV ownership is rewarded with a 20% discount in the cost of electricity. Because EV maintenance costs are roughly 2/3 that of standard vehicles,[15] (American Automobile Association, 2019), EV pared with ProRate is a win–win.

In Demand Profile after also Adding an Electric Vehicle and 5 kW of Community Solar, Figure 3, "CLEP Annual Profit: $56" reflects the fact that after this same customer even more robustly exploits the opportunities within the ProRate rate design, his cost-shifting effect onto other customers decreases to $56 per year in support of other customers, which helps to further lower their electricity bills, because he lowered the cost-of-energy for all customers by an additional $31 in 2018.[16] He accomplishes this by going beyond the installations depicted in Figure 2, to also purchasing an electric vehicle and renting 5 kW in a community solar farm. The total 2018 gross income from ProRate for just the community solar subscription is found on the second to last line and shown as **$1142.78.** However, this is not the net income because of the **$420** per year in rent; thus, this the real net income is **$722.78** per year.

These three excerpts and explanations from the *Exploring the CLEP_Dashboard* is the "*front story*," but there is also a "*major backstory*." Successful use of ProRate clearly causes the cost-of-energy to substantially decline. As it does, ProRate's affect on customers' purchases undermines the economic value of the most expensive sources of electricity. The fossil fuel (FF) industry cannot be expected to continue to economically compete with electricity generators that have no fuel costs. The only advantage FF generators currently enjoy is the ability to dispatch electricity on demand, but ProRate actively undermines this advantage and, thereby, hastens the demise of the FF industry, but does this in a way that should be more than palatable to those who espouse a free market economy, and want to see *performance improvement **only*** driven by non-subsidized economic forces.

## THE CONTRACTOR'S PERSPECTIVE

A typical interaction between a building contractor and the developer or designer results in the following question: "You want, what?" This question is often the contractor resisting the desire or interest expressed by the client, particularly for novel or green technology.

### Desire

The contractor wants to build what he or she understands and to make a profit. Also, if he is a negotiating contractor, he wants a repeat client. What he does not desire is to be unable to deliver what the client wants because of lack of training, knowledge, or experience.

### Education

Most contractors employ estimators and project managers who come out of schools or up through the tradesman ranks. Because of shortages in labor, many are hiring workers with non-technical backgrounds to fill positions. This reality does not help contractors keep up with advances in building technology.

### Green Community

Most contractors see green building advocates as idealists who promise unrealistic performance and underestimate the cost to the project of implementing green technology.

### Challenges

Educating the contractor and the client, and being able to back it up with an objective, cost/benefit financial analysis and successful results should be able to build a positive perception of green building industry.

### Engagement

If the contractor has not bought in, he may advise the client at every opportunity to remove what may be seen as costly "Green" components that neither add square feet nor rental/sales revenue.

This is where ProRate can make a difference. It demonstrates that even common-place appliances can be configured to generate an income and opens the door to much richer exploitation of energy efficiency, load shifting, and resiliency and how they relate to the full economics of our utility model.

## RATIONALE FOR ProRate

Why is a new rate design needed?

For over a century, electricity ratepayers have wanted low and fairly-priced electricity as well as safe and reliable access to the energy services electricity provides; but during most of that time a ratepayer had few levers they could pull to improve his lot.

For most of that time, three factors suppressed both opportunities and competition: low prices, poor technology and many barriers to competition simply arising from the traditional way we chose to regulate a monopoly utility. Two of those three are very different now: electric bills are no longer low and technology is no longer poor. Therefore, it is high time for an upgrade in how we regulate the utility.

In the last few decades, the opportunities, stakes, aspirations, and expectations of ratepayers have changed and are continuing to change more and more rapidly.

Examples abound: Some electricity ratepayers make much of their own and sell some to the grid. Some store energy for later use. Some are jealous or concerned that this is not fair. Some have lowered their consumption so low that others fear that this is unfair. While others take just the opposite attitude and make extraordinary demands on the grid. Smart meters are increasingly common and make it easy and cheap to associate purchase time to the highly time-varying price of wholesale electricity.

Now, and increasingly for some, the fear of global warming makes low carbon footprints the paramount goal.

The following list presents many of these problems in more detail.

1. The difference between the wholesale and retail prices of electricity has very little to do with utility profits.
2. The utility only profits at a rate near 10% annually on the undepreciated value of its capital assets; that rate, called the rate of return, is not guaranteed by any law or agreement and is reset as often as the last rate case. The most recent resolution on that issue in New Orleans was resolved in December 2019 and the Rate of Return was set just above 9%. Rate Cases are usually every 3 years or more often, however, in New Orleans, rate cases are a decade apart.
3. The retail price of electricity per kWh is, by and large, just the cost-of-energy plus the cost of service. cost-of-energy is the weighted average wholesale price of buying or making electricity during the last month. The cost of service is reset at the last Rate Case and is at least 90% for: paying the utility's residual costs of operation.
4. The utility does not make or lose money, respectively, when it buys or sells electricity—as long as, these price changes are only driven by variations in the cost-of-energy. These costs are merely passed through to customers in electricity bills. The utility has no direct economic incentive to lower its cost-of-energy (unless the utility regulator provides a special incentive for that purpose) but ProRate can remedy this.
5. The following shows how this works, using estimates of Entergy New Orleans (ENO) values as an example. ENO sells 10 billion kWh/year to its customers (Entergy, 2018). The cost-of-energy stays very near \$0.03/kWh and the Cost of Service stays very near \$0.07–0.08/kWh. This means that ENO spends roughly \$300 million per year buying or making electricity, with the other roughly \$700+ million largely used for distributing power and a host of other administrative, legal, payroll, maintenance, etc. costs.
6. Like many to most utilities, ENO is an active member of a regional wholesale market. ENO's wholesale market is MISO, for Mid-continental Independent System Operator. MISO's prices vary by both time and location because of varying costs and prices of generation, demand, and transmission, etc. Their website, www.MISOenergy.org, describes their prices using the term LMP, for Localized Marginal Price, in units of \$/MWH. MISO is a non-profit marketplace, servicing thousands of nodes, for buying or selling electricity, from New Orleans and points generally due north, into Canada, mostly limited to the same or nearby longitudes (MISO Energy, 2020).
7. MISO's prices usually at least double every day; but it is not uncommon, that they increase by much more daily. During the summer, the lowest prices usually occur around 2 AM, and the highest in the afternoon or early evening. This can basically flip in the winter.
8. With the growing amount of renewable energy supplying the world's electricity grids, there are often places and times when and where, the wholesale price is negative. This is common in Iowa at night, because of the many wind farms there, and the low demand for electricity at night. However, in southern California, there are often times in the year, namely around 10 AM, when the wholesale price is near zero, because of the deep investments in rooftop solar there.
9. This means that there is a potential for a correlation between low wholesale price and low carbon footprint electricity. In fact, such a strong correlation does exist, but it is not very predictable nor linearly proportional.
10. Most customers and utility regulators want more Energy Efficiency and Renewable Energy for many good reasons, but there are a host of problems within the nuances of these desires.

    A. Although improved Energy Efficiency means using less energy to get the same energy service (e.g., lighting, cooling, water heating), by and large, energy efficiency is not measured in the amount of primary energy consumed at the power plant (e.g. fossil fuel), but in avoided kWh use.

    B. As explained above, a growing percentage of electricity on the grid has little to no carbon footprint, that is, no fuel cost, and therefore there could be ways to lower fossil fuel consumption while increasing kWh consumption. In fact, a good example is electrically heating water at night in New Orleans, with relatively low carbon electricity (from Iowa); this can both reduce ENO's *cost-of-energy* and lower its environmental burden. To get the needed 120°F water at 6 PM for the evening shower, may require heating the water 10 degrees higher at 2 AM, to accommodate the heat loss during the day; in this case, this "retrofit" does not save kWh's but it does stand a good chance of saving fossil fuel consumption and money. Therefore, in the strictest sense and as is commonly used, this retrofit is not an energy efficiency retrofit, but is, nevertheless, better than that.

C. As good and cheap wind energy is, some scientists believe that the only renewable energy source large enough to meet the world's energy needs by 2050, is produced by the direct conversion of sunlight to electricity—like via solar cells on your roof.

D. Just like rooftop solar, wind farm investments are supported by federal subsidies. The former is supported by the Investment Tax Credit (ITC): 30% of the cost of installation, and the latter by the Production Tax Credit (PTC): $0.022 for each kWh, a wind farm sells to the grid. However, both the ITC and PTC are being phased out—starting this year and declining to zero over the next 5 years. These declining subsidies could be the death knell for current and future wind field operations and development, even though wind farms cost much less to develop in $/W than solar. ProRate can fix this.

E. Rooftop solar has been financed by net energy metering (NEM), which pays such customers for electricity sent back to the grid at the retail price. However, many consultants assert that NEM forces a cost or subsidy onto non-NEM customers to support NEM payments (Ritchie, 2016). Based upon this rationale, NEM is being phased-out or otherwise charged, in order to suppress these investments and/or overcome the perceived cross-subsidy. This has happened in Louisiana but not in New Orleans. ProRate can fix this, not just in Louisiana, but throughout the United States.

F. The federal government requires that electric utilities that own solar installations charge an effective 16% return on equity (much like Rate of Return) namely over 50% more than most utilities get rewarded in profit for their capital investments. This same surcharge is not forced onto privately owned solar installations. This means that we, as NOLA (New Orleans, Louisiana) residents, do not want any solar power built or owned on our behalf by ENO even if they had a track record of building anything at common market prices (which is not the case).

G. Building a solar farm at utility scale, namely at least 1 MW at a time, is roughly 1/3 as expensive as rooftop solar in $/W.

H. Most customers do not have the right conditions and thus cannot own rooftop solar; roughly about 30% nationally and only about 10% locally can benefit from rooftop solar. However, a technology invented in New Orleans in 2007,[17] but never implemented here, now commonly known as Community Solar (CS), defeats the barriers of both, small sized (and thus more expensive to install) solar installations, and limited access to ownership (Kabacoff, Midura, & Katz, 2007, p. 17). However, CS has in the past, most often been financed with NEM. But with NEM currently under attack, a new way to finance both CS and rooftop solar is needed. ProRate does that.

I. Because of the economic opportunity provided by much cheaper electricity, often only available when there is little demand, and the environmental imperative of reducing the causes of Climate Change, more and more energy advocates want a 100% renewable energy future. However, because, (with the exception of hydroelectric power) renewable energy cannot be throttled, a renewable energy future must be accompanied by a large and well-dispersed, investment in energy storage: both thermal and electric.

J. The timed water heater example (sketched above) cannot be financed with a time-independent electricity rate design. This is a pity, because in that case, it would lower both the cost-of-energy and a city's environmental footprint: a win win. ProRate can fix this.

K. An electric battery cannot generate ANY payback with time-independent electricity pricing, much less what may need to be as much as $1000 per year, to finance a battery in your home, big enough to run your home for 20 hours after charging for 4 hours. ProRate can fix this.

L. The City of New Orleans just agreed to spend roughly $58 million on Demand Side Management in their Energy Smart Program. Energy Smart (ES) is a good thing but ES is far from the most economical way to get the same result. ProRate can fix this. ProRate lowers the cost to get the same effect, can do more to grow the economy, and ProRate's results are not limited by preprogrammed estimates of "success." ProRate enables technologies that have not yet been considered by the team that found that the investment in ES will lower the cost of electricity by more than it costs to implement. Moreover, the process leading to this result (Integrated Resource Planning) itself cost the ratepayers many millions to run and pay consulting fees. And it took 3 years to implement. ProRate is faster, cheaper, much less limited and more market-transforming.

11. The City Council of New Orleans approved ENO spending $80 million to roll out Smart Meters, which by no coincidence are very useful to improve ENO's poor, and well-documented reliability record. However, Smart Meters (or some similar technology) are needed for Time-of-Use (TOU) rates. And the Council wants to make good on its promise to reward ENO's customers with lower cost electricity by use of this $80 million investment that would more than recoup that investment. This is a primary reason for the TOU docket. The ProRate team believes that ProRate will win the competition for the best way to meet this goal, and the host of goals mentioned in Item #10 and its component parts.
12. Cross-subsidies between customers in the same rate class and between customers in different rate classes are common and pervasive in the world, even when not trying to reduce the size of bills or lower environmental footprints. ProRate goes a long way toward fixing this. ProRate is not a subsidy but, in fact, it is designed to extinguish subsidies.

## A SUMMARY OF THE ProRate OPPORTUNITY

### What Do You Want a ProRate Customer to Do?

(a) Learn about being a ProRate customer. Watch a video, attend a webinar or visit a website to virtually use and exploit ProRate to substantially lower your electric bill, primarily by merely changing, when, you buy or sell— with no degradation in lifestyle. Create ever increasing, largely unlimited cashflows, well beyond reducing your electricity bill to zero. Other attractive potential benefits include improved reliability, comfort, health, safety, mobility, and lower energy use, and even a negative environmental footprint (if that works for you). ProRate customers are paid to be better stewards for themselves and the Earth's biosphere.

(b) Sign-up and OPT-IN for a 1-year, risk-free trial. As a ProRate customer you can earn $05/year to run a dishwasher at night, $183/year to run a water heater at night, or $700/year to rent 5 kW in a community solar farm.

(c) In following years, you might want to invest deeply with fast return-on-investment installations: for example, a heat pump water heater, ice-making AC, whole home battery, and/or electric vehicle. Together with those in (b), these investments can lower an initial $1400/year residential bill to a $1400/year net income.

(d) Increase your income even more, by contracting with an aggregator to fine-tune these transactions to when they save the most money, to increase the gross ProRate income by an additional 25%, and then pay the aggregator 10% of that.

### What Do You want the Electric Company to Do?

(a) Keep charging all customers their current, time-independent, flat rates, likely to be near $0.12/kWh.

(b) To help customers avoid cost shifting onto each other, track changes in the utility's <u>real cost</u> of operation and charge or pay CLEP customers accordingly. Do this when they cause

I. wholesale price changes in $/kWh (called "CLEP5") and / or
II. long-term cost of power changes in $/kW, (called "CLEPm").

Charge at 100% of the change when the cost increases and pay at 95% when it drops.

(c) Pay itself 5% whenever customers are paid, which should be more than enough to pay the administrative cost of the ProRate system and leave a residual that will lower the price of electricity for all ratepayers.

### What Would be the Advantages if Both Parties Did as Suggested?

(a) The utility will receive an income that can add to its profit by lowering a cash flow, the cost to buy or make electricity—called the *cost-of-energy*—usually near 30% of all costs the utility spends to operate. And ratepayers will help lower the *cost of service* often used to pay for future expensive equipment upgrades.

(b) ProRate customers will enjoy roughly double the net cashflow for existing, and common, energy efficiency, for example, Heat Pump Water Heaters, and renewable energy investments, for example, Rooftop Solar, help buy equipment otherwise difficult to impossible to finance, for example, 10 kWh whole-home batteries,

(c) Spur investments in market-transforming technologies like: Ice-Making AC's, Ground-coupling swimming pools, and others this author has yet to dream of, and

(d) Engage the Marketplace to greatly slowdown the causes of Global Warming.

Find the whole story at www.BuildingScience Innovators.com; there one can also find the complete evidentiary record of CLEP's inclusion in the 2018 ENO Rate Case.

## CONCLUSION

The fundamental problems with the Old Utility Model are cost shifting and the lack of price signals. Lack of price signals means that there is no incentive to purchase wind power at night and store it for sale to the grid at peak times.

- The Old Utility Model has no adequate means of financing rooftop solar or community solar, ice-making AC, whole home batteries or even putting a timer on a previously installed standard electric water heater.
- The Old Utility Model has no means of adequately financing batteries—batteries provide an important public service during grid outages.

Although ProRate resolves most cost-shifting problems within the Old Utility Model by providing maximally sized, price signals to customers which, in turn, will enable them to monetize and thereby minimize shifting energy and demand costs onto others, that is not ProRate's primary benefit.

a. CLEP5-financed price arbitrage of the variations in wholesale electricity prices, and

b. negative demand charges from CLEPm,

work together to provide adequately predictable annual cashflows to finance the deepest investments in DERS. These in turn provide means to turn a profit for the customer, net income, and even finance batteries in all buildings, which itself is a key requirement for a 100% renewable energy future.

## Notes

1. The Old Utility Model is more thoroughly discussed in a later section of this article, but a simple understanding is a system where electricity is sold at one, time-independent price. Since the model has been replaced in roughly one-third of the US's electric utilities, it can be referred to in both the present and past tense. Since it has not been mostly supplanted in the United States, this article uses the present tense when referring to the old utility model.
2. "Understanding these peak demand charges begins with understanding energy deregulation. Before deregulation was implemented in the late 1990s, electric utilities in the United States charged customers the same flat rate for standard energy use, no matter what time of day they were using the energy. When deregulation changed the market [in many states], the state-appointed utilities [often] launched Time-of-Use Pricing (TOU)."
3. Although "energy" and "demand" are parts of the jargon of utility economics, they are not any harder to understand than the notions of "distance" and "speed." Namely, distance is to speed just as kWh is to kW. However, unlike distance and speed, one can measure distance without motion; but because electricity is fundamentally dynamic, power expressed in watts (W) or kilowatts (kW) is the primary concept of electricity and electricity's energy—calculated as ***power times time***—is the derived idea and has the units of the kilowatt-hour (kWh). Also using standard utility jargon, this document calls an ***energy bill***, one derived from kWh sales. In the United States, until the advent of smart meters, nearly all residential customers pay for electricity from meters that only measured kWh purchased measured monthly. However, for nearly all other classes of US electricity customers, a.k.a., ratepayers, their meters also measured demand, or power, in kW. Until the advent of smart meters, utility meters were only read once a month, so the kW reading was only a snapshot of demand sampling the largest average demand in any 15 minutes. Note that this approach to measuring and charging for demand ignores whether demand peaked at that building during that month at a time coincident with peak demand times of the utility. ProRate, using smart meters, ameliorates this problem.
4. CLEP was invented in 2015. The first description of CLEP was published in 2016, within the 2015 Entergy New Orleans Integrated Resource Planning docket see https://www.buildingscienceinnovators.com/uploads/1/0/6/2/106256229/bsi_direct_testimony_of_myron_katz_19_02.01-v2-.pdf. However, CLEP has never been allowed to define rates for a utility pilot—neither in New Orleans or in any other utility worldwide.
5. The 5% value was chosen because simple arguments strongly suggested that 5% is probably more than enough to compensate the utility for its costs to set up a new rate design, collect the data, and send bills and payments accordingly. In fact, the authors do not really know whether 5% is adequate, too big or small.

Only a reasonable pilot application of ProRate can "prove" this 5% value. However, in the case, that 5% is too big or too small, it can easily be adjusted down or up accordingly.

6. In fact, the ProRate customer is presumed to be self-focused, that is, only upon his own utility bill; ProRate provides benefits to all customers and the environment, but the ProRate customer is presumed to be oblivious to those consequences. Moreover, the notion of "cost-effective" in this sentence simply means, the retrofit pays for itself soon enough. Although the customer MAY choose to change his lifestyle to enhance the ProRate cash flow, success of ProRate is purposely focused, instead, upon encouraging the customer to not sacrifice comfort, mobility, health, or safety at all. This is more than feasible because ProRate provides faster paybacks for standard energy-efficiency retrofits (where energy efficiency (EE) = Energy Service delivered / kWh consumed), than is possible with flat (i.e., not time-varying) electricity pricing. ProRate also more rapidly finances investments in renewable energy (RE), and thermal energy and/or electricity storage; note that none of these investments referred to in this sentence can or should be called EE retrofits.
7. The word "purchase" purposely replaces the word "use" in this sentence to help both the reader of this journal article and the ProRate customer to recognize that consumption of a kWh is not necessarily coincident with the time it is purchased. Two examples make the point: when the kWh is (a) used to make hot water in a water heater with a tank, the real consumption does not happen until the shower; (b) stored in a battery to run a lamp or air conditioner later or even for resale to the utility.
8. "Overpriced" here means more than the cost-of-energy the utility experiences this month.
9. "The HERS Reference Home. One aspect of the HERS Index that bears further scrutiny is the HERS Reference Home. Here is what the HERS Standards say about it: "The reference home is the geometric twin of the rated home, configured to a standard set of thermal performance characteristics, from which the energy budget, that is the basis for comparison, is derived."
10. In the software simulation of a ProRate customer presented near the end of this article, the customer elects to participate in Community Solar. The information in this section helps to explain the modelling results later.
11. Just like in England in the 19th century when the notion of the *commons* was first appreciated, the grid is like a commons where the actions of any participant can create shared costs for others. Just like a homeowner may be inclined to use a gas-powered lawnmower at any time convenient for him, he should not because the noise it will make at night should be expected to disturb a sleeping neighbor. When any customer buys electricity when it is overpriced, the grid-enabled, electricity commons causes that unfortunate purchase to increase the cost-of-energy that month and thereby increases the price of electricity for all those who share that local distribution grid.
12. If a particularly astute dashboard user were to input the displayed values into a calculator, this effort will expose small apparent errors that are in fact a necessary consequence of rounding up or down needed to have displayed data, that is, data with fewer digits past the decimal point than what is found in the background computations.
13. From Figure 1 to Figure 2, the CLEP Annual Loss: field has changed from a $150 burden onto other ratepayers to a CLEP Annual Profit: $25 support of other ratepayers. $25 is the money available from CLEP for that purpose as simulated was set to 2% of the annual pure CLEP income earned by that ratepayer which in this case is just over $1546 - $290 = $1256. Because 2% * $1256 = $25.12.
14. As one can easily see, charging of the battery in the electric vehicle is exactly three times as much and at the same times as employed to run the heat pump water heater. Since the Heat Pump Water Heater's pure ProRate income is $378 − $241 = $137 of which, only $25 is from CLEP5, and the electric vehicle's ProRate income all come from CLEP5 and are 3× as high but otherwise coincident with time the water heater heats its tank, the ProRate total income for the electric vehicle is 3 * $25 = $75.
15. "Fuel costs vary widely by vehicle type, ranging from a low of 3.65 cents per mile for electric vehicles, to 15.67 cents per mile for pickup trucks. Electric vehicles had the lowest maintenance and repair costs—6.6 cents per mile—while medium-sized SUVs had the highest at 9.6 cents per mile." However, Myron Katz owns a 2012 Nissan Leaf and has only paid for tire rotations as maintenance costs in the 7 years he has owned that car; this is far–far lower than the 6.6 cents per mile asserted in the quoted source.
16. CLEP Annual Profit: $56 is explained by (a) the $25/year drop in the cost-of-energy was explained in

that endnote and that value is derived from fully attributed ProRate income for the DW, WH, AC, and Batt depicted in Figure 2. With the new investments of an Electric Vehicle and Community solar each generate additional pure ProRate income. (b) As explained in the endnote two previous, the pure ProRate income for EV is $75. The Community Solar ProRate income (ignoring the rent) is $1143. Thus, the sum of the ProRate income for the EV and CS = $75 + $1143 = $1218. 2% of that is $24. So, adding that to the value found for Figure 2 gives $49.

17. Energy Hawk, 2007. See recommendation entitled "Remote Displaced Generation" in Page 17. https://www.buildingscienceinnovators.com/uploads/1/0/6/2/106256229/energyhawk.doc

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The doctoral thesis in mathematics at the University of California, Berkeley by MYRON BERNARD KATZ facilitated the first world patent in computerized tomography for medical diagnostic imaging. Soon thereafter, his career shifted to building science, primary energy conservation, renewable energy, and energy storage technologies as solutions to the environmental and economic problems facing our planet. With professional publications and presentations to engineering and other technical societies; this hands-on person later worked his way up the ranks from energy rater, to energy rater trainer, etc.; amassing a formidable list of building science certifications. For more than a decade as director of research at Building Science Innovators, LLC, a small consulting company, he specialized in building science, energy efficiency and moisture control, renewable energy, analyzing energy production and utilization, utility regulation and energy conservation. He may be reached at myron.bernard.katz@gmail.com

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- Electro-Optics- Polarization Optics, Lasers
- Engineering Management, Service Operations Management, MIS
- Sustainability, TQM, Decision Sciences, Technology Entrepreneurship & Statistical Process Control/ Quantitative Methods

He also serves in the following professional and civic roles: Examiner for the Louisiana Quality Foundation; Management Consultant for the City of New Orleans; member of the online advisory board at Xavier University; and member of the board of the Islamic School of Greater New Orleans. As an Editorial Board Member of the Universal Journal of Electric and Electronic Engineering, Dr. Ahmed is an investigator on multiple interdisciplinary grants and global collaborative research projects through multi-university research initiatives. He serves on Climate Reality, Interfaith and CLEP research boards. He may be reached at sahmed1@xula.edu

Starting in his teens, RICHARD TROY has over 40 years of experience in computer science, and began his career at TANO Corporation in New Orleans in the late 1970s where he both designed and wrote (solo) the entire operating system for the TANO Outpost in 6809 assembler—a system which has been in service since then controlling ships, pipelines, and for other industrial control purposes. Since then he has designed and built computer hardware and software for many applications, including a navigation aid for light aircraft and in 2018 he wrote half the control system for a locomotive-sized dynamometer used to measure the abilities of very large vehicles. Through the 1980s, he served Digital Equipment Corp. (DEC), the world's then #2 computer corporation, as top technical talent, becoming very well versed in customer support and consulting services, and used these skills to develop two substantial businesses for them which in 1989 brought in fully 25% of Digital's entire revenue. He then joined Ingres Corp, then the #2 database corporation, reporting to the VP level and serving every technical department in the company. There, he became famous for his ability to educate others on highly technical subjects and literally "wrote the book" on performance tuning the company's products. And he invented "client-side replication" and a new service business modeled on one he had created for DEC.

While there, Mr. Troy met Ingres' founder, Turing Award Winner Professor Michael Stonebraker and in 1995 Prof. Stonebraker invited him to lead a new project to computationally merge the Earth Sciences in an effort to better understand global climate change driven by global warming. Happy to help save the biosphere from stupid humans, he led the 43-person team in five discrete sciences spread across the continent. The work was successful and resulted in the world's first successful computing grid—a less-capable, homogenous version is now widely known as "the cloud" and offered by outlets like Amazon. In 1997, he was approached by NASA to commercialize his research and, with their initial funding, he did so and thus found Science Tools Corporation where he serves today as Chief Scientist.

In 2019, Dr. Katz invited Mr. Troy to use his experience in real-world, data-driven modeling to collect the MISO data and create a visualization tool for ProRate, and the result is now known as the CLEP Dashboard. (Customer Lowered Electricity Price, CLEP, was the initial name for ProRate.) His focus with ProRate has been on modeling the entire CLEP universe from the point of view of regulators and consumers, with an eye toward improving utility profits as a motivating factor for them to adopt the rate. He may be reached at Richard@clepenergy.org