BEFORE THE
COUNCIL OF THE CITY OF NEW ORLEANS

IN RE: RESOLUTION REGARDING PROPOSED RULEMAKING TO ESTABLISH INTEGRATED RESOURCE PLANNING COMPONENTS AND REPORTING REQUIREMENTS FOR ENTERGY NEW ORLEANS, INC.	**DOCKET NO. UD-08-02** **AUGUST 8, 2016**

MOTION BY BUILDING SCIENCE INNOVATORS, LLC FOR A PURE[1] CUSTOMER LOWERED ELECTRICITY PRICE (CLEP) PILOT WITHIN THE 2015 ENTERGY NEW ORLEANS (ENO) INTEGRATED RESOURCE PLAN

ON MOTION of Building Science Innovators, LLC (BSI), appearing herein through undersigned principal, and upon representing the following:

Because ENO is not originating this pilot request, BSI wrote this description as a motion to request the regulator to require ENO to revise the following and create a pilot program with the following as a starting point.

ENO will begin offering the CLEP tariff as an optional addition to a customer's energy bill on a pilot-basis on or after January 1, 2017.

To achieve bill reductions[2] from participating in CLEP, the customer must have a utility-approved way to measure energy consumption every five minutes. This can be accomplished with a smart electric meter, or one of a number of industry-standard battery-inverter systems or home-energy monitoring devices. The critical component needed for the CLEP tariff is measuring energy consumption in five-minute intervals timed to start exactly on the hour so as to be in complete synchronization with the MISO, 5-minute real-time wholesale energy marketplace.

ENO has repeatedly asserted over several years that the Advanced Metering Infrastructure (AMI), a.k.a., smart meters and their supporting equipment, needed to reliably measure, record and make data information for ENO's energy bill creation will happen and may be only six months away. The cost of that infrastructure is therefore assumed and not included in any cost calculations for this pilot.[3]

This pilot assumes that whether by AMI or other means, ENO will be able to reliably observe, remotely measure, record, and bill for consumption and sales at this temporal granularity for all customers who want to participate in this CLEP tariff pilot.

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[1] This CLEP pilot has the additional adjective "PURE" to distinguish it from two other pilot motions offered into this docket on the same day. This motion is also the first in that series. The other two pilot programs involve on-site battery installations and off-site, community solar investments, respectively. These last two pilots' descriptions depend upon this, the PURE CLEP pilot's full description of CLEP — only found in this document, in Appendix A.

[2] Or even net income as is explained in a subsequent footnote.

[3] There will be "back-office" charges for the software needed to collect and analyze the data, calculate CLEP cash flow and place credits onto bills. Even though the smart-meters go in and utilities are able to read them for monthly billing, there's no assurance that the capabilities will be present for the utility to calculate and bill using any other billing parameters. I'm not saying that is a just and reasonable outcome, but I've seen utilities make such arguments, repeatedly.

The What, Why, and How of CLEP and Worked Examples are found in Appendix A.[4]
A much more concise presentation is found in Appendix C.

The key idea is

CLEP is a market-based rate design that works in conjunction with traditional utility rates, to empower customers to lower their utility costs when they considerably reduce their consumption during the hours when utility service is more expensive.

CLEP tariff is composed of two cash flows:

CLEP5 pays for timely energy purchases and sales and allows customers to effectively buy electricity at wholesale prices while still paying their fair share of utility fixed charges, and

CLEPm pays for drops in demand during peak hours.[5]

The former is a simple way to help the customer appreciate the actual economic value of timely consumption, but CLEP5 doesn't pay very much.[6] The latter is harder to understand, but is worth ten times as much to the utility because it avoids real construction and maintenance costs for electricity generators, transmission and distribution equipment. However, both cash flows incentivize the same activity: buy electricity when it is cheap and refrain from purchasing or instead, actually selling back to the utility when wholesale electricity is expensive.

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[4] The reader is ***strongly urged*** to fully read and understand Appendix A which presents a detailed explanation of CLEP's rationale and function, along with and worked examples of how CLEP income changes based upon different scenarios. It is in an appendix because of its length, but Appendix A is not at all ancillary. It is important to note the CLEP's definition depends upon its application. Although CLEP was primarily conceived as a way to help engage residential customers as smarter consumers, CLEP can also be applied to a pure electricity generator like a PV (photovoltaic) system without batteries. In that case, CLEP sets CLEP5 directly proportional to wholesale price, not the difference between wholesale price current wholesale price and last month's average wholesale price as described in the next footnote. Moreover, the definition of CLEPm given in Appendix A works well for residential customers but cannot be applied to other customer classes; they need alternative, more customized approaches for measuring "avoided" demand.

[5] In utility industry jargon, CLEP (Customer Lowered Electricity Price) is similar to but different from CPP (Critical Peak Pricing); both reward the customer with paybacks that can exceed retail electricity price AND like CPP, payments to customers are always slightly lower than avoidable costs of the utility and thereby lower the cost of electricity to all customers. CPP has been traditionally offered only on an in-frequent and critical basis via day-ahead notice of a short-term spike in wholesale prices. Unlike CPP that is available only a few days each year, opportunities to save money using CLEP will be available to most customers every day. CLEP automatically pays customers two ways: 1) CLEP5 is similar to RTP (Real Time Pricing) in that customer reward, for decreasing consumption or increasing sales during utility peak demand hours, increases with wholesale price in a full-time, automated way. CLEP income can **only** be fully exploited if the consumer has implemented procedures to maximize response to wholesale prices in an automated way. CLEP5 rewards customers with payments that are directly proportional to the difference between the current, 5-minute, real-time wholesale price and last month's average wholesale price AND pays for both smart *purchases* **and** *sales* back to the utility, i.e., for smart consumption when wholesale electricity price is low and smart sales (production) back to the utility, when wholesale prices are high. 2) CLEPm is a kind of "negative" demand charge that pays customers for drops in their average demand during the peak demand hours of the utility; because CLEPm only pays during May through September, i.e., the months when annual utility peak demand may happen, and it is based upon "average customer demand during the utility's peak demand hours" instead of "peak customer demand" during any time of the last month, CLEPm pays at a rate roughly to or slightly greater than four times the highest, monthly demand charge already in the utility rate structure. While CLEP5 avoids very short-term, utility energy costs, CLEPm avoids long-term, future capital expenditures on transmission, distribution and/or generation.

[6] However, CLEP5 may be much lucrative. BSI learned less than 3 days before submitting this document that testimony in a regulatory environment for a utility operating in the northern part of MISO's territory asserted that "optimized" price-arbitrage (buying when energy is cheap and selling when energy is expensive) can pay for relatively expensive and relatively less efficient batteries than those specified in the CLEP battery pilot in four years: i.e., in about 40% of their warranted life.

Customers can make money on the CLEP tariff ***without any*** of the ***specialized*** equipment itemized in the next paragraph. For example, simply putting a timer on an electric water heater to keep it off during peak hours is a quick and very cheap way to improve CLEP income.

However, in order for customers to ***fully exploit*** CLEP's potential they must have equipment that is not normally found in residences. The most expensive is a battery, but they also must have an inverter, communication equipment capable of receiving information and/or control from outside of the home and software to make all of this work.

Similar opportunities exist for equipment that cools or dehumidifies a home or heats water.[7] For example, any heat-pump water-heater can be controlled as in the last paragraph but, in addition, such equipment cools and dries a residence while running. A heat-pump water-heater will operate at 1/3 to 1/10 as much power as a standard residential HVAC and can be made to operate in a mode that operates according to the dehumidification needs of the home instead of and/or in addition to the water-heating goals for which it was designed.

Residential-sized ice-making HVAC equipment is already on the market. https://www.ice-energy.com/residential/ is a very important example.

General Electric makes both heat-pump water-heaters and refrigerators with Ethernet ports that allow remote control of the most energy-intensive of their activities—thereby allowing demand to be shifted outside of peak demand hours. GE calls them Wifi-Connect™ appliances: http://www.geappliances.com/ge/connected-appliances/. They include refrigerators, water heaters, stoves, ovens, washers, dryers and dishwashers. For example, using this technology, a residents can set their refrigerators to avoid the defrost cycle during peak hours. [8]

Why aren't customers already buying and using such equipment? The answer is easy. Why should they? The do not get paid to do these things. CLEP fixes this problem and creates a cash flow strictly out of avoidable costs of the utility.

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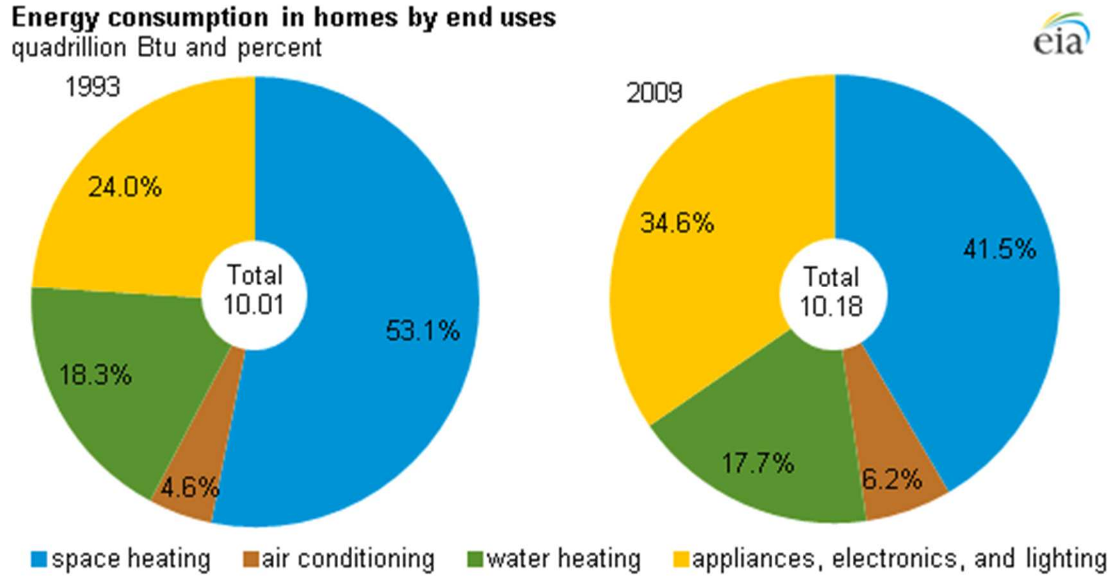
[7] GE's GEOSPRING heat-pump water heater has, for more than a few years, been a tried, tested and reliable part of Energy Smart, the demand-side management program—financed with ENO's cash flow and administered by a private contractor.

[8] One may think that CLEP would ***only*** be "an ideal pilot program for new construction". However, BSI, an industry expert in the economics of residential retrofits to reduce energy bills, points out that there is much, much greater resource to save energy within existing homes than new homes. At every appliance replacement or at the time of consideration of more comprehensive energy-efficiency retrofits, these appliances are ready to escort a resident into volunteering to be a CLEP customer.



http://www.eia.gov/consumption/residential/

Considering the fact that over 80% of a home's energy consumption falls within the consumption categories of GE's Wifi-Connect™ group and residential Ice-making HVAC, it is clear that a resident can easily reap great income with CLEP even if the home has no electric battery, inverter, sophisticated communications equipment or software.

Electric vehicle ownership is highly compatible with CLEP—particularly, because recharging is usually done at night.[9]

But how much money can a resident depend upon as utility bill savings or income from CLEP? Clearly, without a handle on this answer, a resident cannot justify the purchase of many of GE's Wifi-Connect™ product line.

"How much does CLEP pay?" depends upon many things, including what can only be calculated by a home-energy consultant. But the biggest unknown is whether CLEP's CLEPm coefficient should be $50 or something else.

Both Council's Advisers and Entergy personnel made objections about the size of the key coefficient in the CLEPm's formula—which this document asserts should be $57.60. The calculations used to establish this coefficient are explained in Appendix B.

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[9] Electric Vehicle (EV) compatibility with CLEP can be very simple or very enhanced; the "very enhanced" option has much higher capital costs but generates even greater CLEP cash flow. The simplest form of EV compatibility with CLEP occurs when a resident receives information from a car salesman regarding the enhanced cost of ownership if the car is used in the normal and simple way: charging the car at night. However, much greater CLEP income is available once the technology is installed that allows the car's battery to exchange AC electricity with the home in a two-directional and automated fashion. This can provide electricity to the grid at optimal times and reap great income when wholesale prices are very high and/or greatly lower the home's consumption during peak demand times of the utility. Many vendors are already offering such equipment, but without CLEP there is little to no economic incentive in the US. The same cannot be said for utilities in Japan or Australia.

It should be noted that BSI is also introducing a CLEP Battery Pilot. Therefore, the question arises: Why introduce a CLEP Battery pilot if a Pure CLEP pilot makes sense, given that a battery and inverter system will cost over $5000 and could easily run to almost $20,000 for the average residence?

There are substantial reasons for a battery pilot with remote-controlled batteries including:

a) the opportunity to buy **<u>and</u>** sell electricity at key times really opens up,
b) batteries as a complement to Photo-Voltaic Solar Energy collection systems (PV) substantially enhances the economics of PV and batteries,
c) batteries provide greatly enhanced reliability against short-term unexpected power interruptions,
d) batteries provide resilience against long term, expected power outages,
e) batteries are valuable in making renewable energy completely compatible with a modern electric grid; in fact, DOE scientists assert that more than half of the value of PV-produced electricity will be lost without batteries once the penetration of PV exceeds 20% of the power resold by electric utilities.
f) batteries allow for a rich set of services, called ancillary services, which can be very beneficial to the grid and potentially provide additional income,
g) batteries are more cost-effective if installed on-site rather than on the grid side of the meter, and
h) battery technology is already cost-effective today; because of the above avoidable costs from the services to a utility, batteries can be configured to pay for themselves and thus have a net zero cost if amortized over a decade; one of the CLEP Battery's goals is to prove this assertion.

For all of these reasons, BSI is submitting a CLEP battery pilot as a complement to this PURE CLEP pilot.

This PURE CLEP pilot does not necessitate any kind of major investment by ENO, unlike the roughly $6 million required for the battery pilot.[10]

This PURE CLEP pilot is not restricted to residential customers. However, because of the definition of CLEPm, a commercial or industrial customer will have to present a customized case to allow measuring observed drops in demand.[11]

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[10] Since the batteries will pay for themselves over time, ENO need not provide the funds. The funds can be obtained through any of a number of easy financing mechanisms at very low interest rates. PACE and PAYS® come to mind immediately. ENO might be smart enough to see that they are in a position to finance at very reasonable interest (on the order of 5% or less) plus earn ROI on a small portion of utility-enabling capital, but if the total installed cost runs to $6 million, my wild guess of the fraction that should be afforded a utility-style ROI might be as little as $600,000.

[11] Drops in peak demand that may be observed: 1) outside of cooling-season months or 2)outside of high utility demand hours that are restricted to afternoon and evenings on weekdays, are not relevant to CLEPm's cash flow. This distinguishes CLEP from traditional demand charges which depend upon 15 consecutive minutes of consumption at any time of the day, on any day of the month, all year long. CLEPm is predicated upon measurable drops in "average demand during peak hours" not "peak customer demand" any time in the month; CLEPm is predicated upon measurable drops during hours of utility peak demand. Without intense and concentrated rewards for drops in demand, like the over $2000/kW, one-time, up-front payment rewarded by Con Edison, commercial building owners cannot justify making substantial retrofits nor are they likely to perceive the benefit of investing in new technologies like ice-making HVAC. Residential customers benefit from the ability to measure drops in demand by reference to actual measurement at other, comparable homes in the same localized distribution system during the same months. No set of reference measurements have been proposed for commercial or industrial customers.

A very good way first step for a commercial building to accomplish this might be done by replacing whole building, conventional cooling equipment with ice-making HVAC equipment. There are many manufacturers that already make such equipment. The mechanical engineer who would specify and recommend this equipment can file an official engineering report with the city stating that the former equipment operated x number of hours during peak hours with a demand of y number of kW and assert that the replacement equipment has different specifications. Historic demand readings can help substantiate these claims.[12]

Other industries are invited to make a case for how to measure the actual drop in demand for equipment that they will newly install or change the schedule of use.

Basically, CLEP is a greatly enhanced and effective form of real-time pricing.

Residential Real Time Pricing Programs

"Residential real time pricing programs are an electric supply rate option offered by Ameren Illinois and ComEd in which customers pay electricity supply rates that vary by the hour. Like the utilities' fixed-priced electric supply rate reflected in the Price to Compare table, utilities also charge residential real-time pricing customers for the costs of purchasing the electric supply without any mark-up or profit. Unlike the utilities' fixed-priced electric supply rate, the utilities' charge residential real-time pricing customers for the electricity they consume each hour based on the corresponding wholesale hourly market price of electricity." https://www.pluginillinois.org/realtime.aspx

ENO has actually already endorsed ***real-timing pricing*** in its September, 2015 filing of its amended draft Integrated Resource Plan.[13] In that analysis the projected drop in demand from this new pricing scheme was more than 1 MW per year.

BSI asserts that if real-time pricing can do 1 MW/y in decreased demand, CLEP should do at least twice as well, proportionally, for the customers that elect this tariff and do it without ANY SUBSIDIES and at very little cost to the utility.

WHEREFORE, **BSI moves the City Council approve a pure Customer Lowered Electricity Price (CLEP) pilot within the 2015 Entergy New Orleans Integrated Resource Plan**.

RESPECTFULLY SUBMITTED,

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Myron Katz
Director of Research
Building Science Innovators

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[12] This suggestion is not intended to be exclusive or adequate, but merely, illustrative. The must be hundreds to thousands of such examples. CLEP opens the marketplace for many more kinds of retrofits and for all kinds of customers. Let the market work. BSI believes that the potential market for CLEP-enabled innovations dwarfs energy-efficiency opportunities.

[13] ENO's September, 2015 submission of its 2015 Draft Integrated Resource Plan asserted that over 1/MW predicts the expected drop in annual peak demand for the utility; ENO's current peak is near 1800 MW.

APPENDIX A. What is CLEP? Why is CLEP? How to do CLEP? Some CLEP worked examples.

CLEP Abstract within 300 words:

Customer Lowered Energy Price [CLEP]

1. is a *dynamic Time-of-Use pricing tariff* that also pays for sales of power, i.e., income from energy flows in the opposite direction.
2. provides a retail price which accurately exploits the highly fluctuating, wholesale price.
3. provides an optional, additional, economic relationship between a utility customer and his electricity utility; i.e., does not replace the retail RATE or customer class.
4. accumulates credits (or charges) every 5 minutes according to a simple formula.
5. reconciles with each monthly billing,
6. lowers the cost of electricity to all customers — both participants and non-participants.
7. avoids the need to impose time-of-use rates onto customers.
8. provides many or more of the benefits of time-of-use rates.
9. provides a no cost and superior kind of demand response.
10. creates a reliable cash flow sufficient to support battery installs within any building.
11. provides a market-based tool to harvest off-off peak power, from any source, for peak power use.
12. greatly forestalls grid defection.
13. forestalls the need to invest in expensive, less efficient and not well-utilized, peaking plants.
14. enhances opportunities for: Energy Performance Contracting and Demand Side Management.
15. makes battery backup far more cost-effective than locally installed, gas-fired generators.
16. provides an opportunity for a big payback for smart meters.
17. taps into the richest source of dollar paybacks as well as energy savings.
18. revolutionizes the whole concept of building energy design.

Experimental applications are being proposed for New Orleans. The head engineer, for the small public utility that is owned by and only serves the City of Lafayette (Louisiana), is interested but will not be the first to experiment with CLEP.

CLEP: What

Customer Lowered Electricity Price [CLEP] is an optional additional economic relationship between utility customers and their electricity utility. CLEP does not replace the retail RATE or customer class that determines the cost of each kWh or monthly kW (demand) charge (if a commercial customer). CLEP payments (or charges when $CELP_5$ is negative) are in addition to the monthly bill and accrue two ways: 1) every 5 minutes according to $CELP_5$'s formula: electricity purchases (i.e., in-coming electricity to the customer) or sales (i.e., out-going electricity from the customer) provide for an additional economic flow governed by the sum of energy flows for each 5-minute period and 2) every month according to $CLEP_m$'s formula which pays $50 per month for each peak kW avoided.

$$\text{A monthly CLEP payment} = CLEP_5 \text{ (summed over a month)} + CLEP_m$$

The cash flow for any (ISO preset) 5-minute period is: $CLEP_5 = p * n * (e - w)$, where:

p = utility regulator determined, but arbitrarily chosen, "percent" where $0 < p < 2$.[14]
n = during each ISO preset, 5-minute period, **n** is the number of kWh purchased by the customer; but, when the net electricity flow is outbound (i.e., production) during that period, **n** is negative,
w = the more advantageous, real-time, marginal, wholesale cost of power between that experienced by the utility from its sources and that available for purchase by the utility from external sources[15], and
e = utility bill published, monthly-average, cost of energy, a.k.a. fuel cost adjustment.[16]

<u>**Notes:**</u> 1) For Entergy, ISO means MISO. For a utility in Maryland, ISO means PJM, etc. All ISO's designate the 5-minute time periods as starting on the hour or after any multiple of 5-minutes thereafter. If **w** were defined to be the ISO, real time, 5-minute price of electricity, during most months of any year, the average value of **w** over a month should be only slightly higher than **e**. When the utility's marginal cost of electricity is different than the ISO price, a CLEP purchase uses the lower price; a CLEP sale uses the higher price.

2) Since $CLEP_5$ is calculated 12 times an hour, a monthly aggregation of $CLEP_5$ payment to a customer is the sum of roughly 12 x 24 x 30 such addends.

3) A "standard," monthly electric bill is well approximated by N * Price/kWh = N * (**s** + **e**), where **s** is (the remainder of the retail price of electricity or) the fixed part of the "cost of service" and **e** is the average marginal cost of electricity (whether generated by the utility or purchased from the

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[14] BSI recommends a value of 95% for **p** for real world implementation of CLEP. In the following discussion, **p** will be set to either 95% or 1 to explain various examples. The reason **p** is left to the regulator to adjust is so that the regulator will have the ability to adjust the CLEP5 cash flow to suit regulatory policy and assure all interested parties that CLEP will function as intended. This same explanation applies to **q**.

[15] In a preliminary definition of CLEP5, **i** was used in place of **w**; where **i** was defined to be the ISO, 5-minute real-time wholesale price of electricity. However, on subsequent consideration, **i** was replaced with **w** because sometimes the utility's cost is lower or higher than the ISO price and the utility cannot avoid using its own price for various reasons. For example, if a base-loaded plant is making more electricity that there is available load, that electricity may not find a customer. In that case, the utility's wholesale price could easily be less than 0 for the excess electricity that has no customer; even though the ISO price is still greater than 0.

[16] **e** is called the Fuel Cost Adjustment on Entergy bills. It is the average wholesale cost of electricity during last month.

wholesale marketplace) and N is the sum of the **n**'s for each of the 12x24x30, 5-minute time periods corresponding to a monthly bill.

4) When p = 1, CLEP measures the "benefit" of an off-peak electricity purchase (or an on-peak electricity sale). If $p < 1$, CLEP is shared with customers who are not a party to the kWh purchase by the CLEP customer: non CLEP customers receive their benefit the next time **e** is calculated because **e** is lowered by every positive CLEP transaction. HENCE the name: CLEP, i.e., "Customer Lowered Electricity Price"—such transactions lower the cost and thus the price of electricity for all customers during the next month. One can posit reasons why a regulator may want to set p = 2 at first and then let p slowly decline to around 90% over 5 years.[17]

5) CLEP is an optional, additional tariff that is open to all customers of a utility—much the same way Net Energy Metering (NEM) is an optional additional economic relationship a customer may choose to have with his utility.

$CLEP_m$ is defined = p * $50 * **d**

Where **d** = average number of peak kW avoided; **d** = observed reference building demand – observed demand. [18]

Notes:

1. $CLEP_m$ is available as an income stream to all customers whether or not that customer pays a demand charge.
2. A home connected to a well-configured and controlled battery and/or PV system can have a negative peak demand; thus, $CLEP_m$ can reward such a system with a substantial payment for the power in addition to the energy it provides.
3. **d** = ***observed reference building demand — observed target building's demand***, for any specific month when $CLEP_m$ is paid. The following explains this.
   (Just like HERS software has a reference home, every target building can have a reference building which can be used to "predict" how such a target building would perform according to some normalizing standard; one such standard is current building code; that can be a good standard against a new home's construction; HERS software uses this to calculate a *Home Energy Rating*. Performance according to current building code is not the best choice for CLEP because the home cannot be new—it may be anywhere from one month to over 150 years old. Moreover, because most homes probably have been retrofitted to exceed the building code (if any) or common construction practices at the

[17] The regulator may want to initially incentivize CLEP to encourage adoption of the tariff (which may have some upfront capital cost barriers) in order to more rapidly avoid building a new electricity generator.

[18] **d** is not average peak demand during a month, or traditional peak demand either. **d** is the average demand of customer during peak demand hours of the utility. For example, an average home may have a peak demand during May, 2016 of 10 kW, which may not even occur during peak hours of the utility. However, the only thing relevant to CLEPm, i.e., in the measurement of d, is the average demand of that home during the 5 hours every weekday for month. This is likely to be roughly half of peak demand. One might posit why CLEPm chose to define demand this way instead of in the more traditional way: peak demand during any 15 consecutive minutes of a month. The reason is that 1) the regulator should be ONLY concerned about demand that contributes to the utility's peak which for some customers may not be when their peak demand happens, AND because the regulator wants to reward something that can be added together. Since peaks are far less likely to add then average demand, CLEPm uses this definition of average demand. Moreover, d is a measured value of AVOIDED DEMAND… this can only be done by reference to homes in the same type as the target home. Demand is then normalized against variations in size by area of conditioned space.

time of construction of the target home but still poorer than current building code, it is neither fair to assume the current code for a substantially older home, nor to assume the comparisons should only be made to homes that have not been improved since new. The optimally fair reference for a building's average peak demand should be obtained by averaging real, observed data for real existing buildings in any utility district for that month from the set of buildings of the same type as the target building. Although most buildings in any type have probably been retrofitted with electrical, heating, cooling, water heating, and lighting equipment etc. or insulation since it was new; that information should **not** be cataloged and it is purposefully deemed to be irrelevant for the purposes of CLEP.)

Each target building's original structure is the only information needed; its condition when it was new determines its building type which includes other, readily-determined information like: age, location, building code or standard building-practices used at the time of construction, number of bedrooms, framing system, etc. For target buildings built after the advent of building codes, all target buildings will be compared to buildings originally built to be barely code-compliant under the building code of that time. The $CLEP_m$ benefit will be determined using the difference between real measurements made each month: for each home type, an average peak demand / square feet of conditioned area will be calculated; this will provide the information needed for the calculation of **d**, i.e., the demand of the reference building needed for the subtraction.

Homes or buildings wishing to gain access to the CLEP tariff have the home's reference home determined. This process should be as simple as reviewing published data in the city's assessor office to determine: 1) the type of home that should be used for reference, 2) the area of conditioned space and 2) the date the home was built.[19].

4. The **p** used for $CLEP_m$ need not be the same value as the **q** used for $CLEP_5$.
5. The coefficient of **d** in the definition of CLEPm, namely $50, is controversial.[20] In Appendix B below, BSI argues that $50 should be replaced with $57.60.

[19] nola**assessor**.com/ has this data on-line.

[20] To more fully appreciate this issue, please read Appendix B.

CLEP: Why

- CLEP provides a retail price that accurately reflects the highly fluctuating, wholesale price. Most utility customers pay for electricity at an averaged-out wholesale price—thus without CLEP or some other TIME-OF-USE Rate, they do not get a price signal to consume when electricity is cheap and curtail use when electricity is expensive. Without such a change, utility customers do not receive any benefit for buying electricity when it is cheaper and neither does the utility. In the current situation, customers never get the message that their actual energy consumption depends upon both the number of kWh used and when, where and how those kWh's were produced.
- CLEP does not require the regulator to impose TIME-OF-USE [TOU] RATES upon any customer but does provide a rich, economic resource for customers who choose to participate in CLEP. That is, just like for CLEP or TIME-OF-USE (TOU) rates, the customer benefit is contingent on customer usage, and in fact the AVERAGE total kWh consumption remains the same before and after participating in CLEP. If customers change their usage to avoid peaks, then there will be a reduction in operating and utility peak plant capital costs; the first effect lowers **e** while the second slows the rise of **s.** CLEP converts some to most of these avoided costs into customer benefit.
- TIME-OF-USE RATES have a variety of problems which make them less satisfactory than CLEP:
  a. Mandatory TOU rates are unpopular since they impose mental effort upon all customers about when to use electricity and TOU rates require everyone to get special electric meters; CLEP only adds costs or imposes awareness on customers who choose an obligation in return for a potential benefit.
  b. TOU rates are a regulatory challenge because some effort must be devoted to setting and resetting the appropriate times of day, which are dependent upon seasons of the year, as well as choosing the right "PRICE STEPS" for the various prices of electricity.
  c. Thus, TOU rates can be expected to be "WRONG" more than 10% of the time, and when they are, they provide incentives to buy when **w** is high and not to buy when **w** is low.
  d. TOU rates may only be feasible or make good economic sense for the few utilities that sit on the edge of the wholesale electricity producing map in an easterly or westerly sense, or utilities who are not part of any well-integrated or geographically-expansive ISO marketplace.[21]
- CLEP empowers customers who want to have a minimal environmental footprint because low electricity price is highly-correlated with lower heat rates, i.e., less CO2 production / kWh.[22]
- CLEP greatly forestalls grid defection.[23]

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[21] California may be a particular good place for TOU rates because there is no source of generation with load to its west and relatively little to the east. Therefore, the ability to shift resources to an earlier or later time of day is far more restrictive in Ca than for utilities like those in MISO which can tap into generation assets to the west and share excess capacity to the East.

[22] The correlation between wholesale price and carbon content can be inferred in the chart in appendix D, it appeared in a talk given to the La Engineering Society in January, 2016.

[23] Grid defection for customers who live in the midst of a functioning utility distribution system but without access to a CLEP tariff is encouraged by current economic factors. This is because such customers habitually receive no benefit from the utility for excess generation beyond their needs or find any significant cash flow to support batteries. These customers, who are considering whether to get off the utility grid, i.e., "defect", would have to buy excess generation equipment and batteries; that is, being off-grid necessitates more capital costs for both batteries and PV systems than if they were to stay on the grid. Very often, customers who consider grid defection actually think they are improving (i.e., lowering) their environmental footprint by getting off grid because they may think that they are relieving the plant's CO2 production. Although that ***might*** play out after decades, in the short term, the utility's sunk costs, i.e., large capital investments that were already incurred,

- CLEP provides an economic, *level playing field* for customers who:
  a. Want to lower their bills by heating water or making ice at night or at any time that wholesale electric prices are very low or similar such strategies.
  b. Generate electricity with solar power, or
  c. Utilize batteries to move electricity consumption and/or production to more advantageous times.
- CLEP revolutionizes, enhances and grossly improves the opportunities for all of: Energy Performance Contracting, Building Energy Design, and Demand Side Management, etc., because it allows energy conservation to be pursued beyond the goal of lowering kWh consumption (a.k.a., Energy Efficiency) to lowering CO2 production.
- CLEP allows a business to aggregate and automate CLEP transactions to provide a large cash flow to be shared with its client utility customers.[24] This deep-pocket opportunity can:
  a. Subsidize the purchase of the needed equipment;
  b. Provide the automating software and/or control to maximize CLEP transactions;
  c. Provide an amalgamating process where the same equipment can be used to sell Frequency Regulation and/or Spinning reserve to the utility and/or ISO; and
  d. Allow this business to become a formidable competitor to other kinds Energy Service companies.

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will still be utilized — just more inefficiently—because there will be less demand for the already-constructed base-loaded generating plants which cannot be turned off. On the other hand, suppose the same customers who have made the same investment or may consider making the same investment in PV and/or batteries, instead consider the CLEP opportunity. In that case, the PV energy will not be wasted when it habitually produces more on the roof than can be consumed at that home, and because of the myriad uses of the batteries (explained in this document) the utility can avoid paying more for expensive electricity and more easily avoid the next expensive generation construction expense. As CLEP participants, these customers are 1) paid to contribute to the common economic welfare of all customers, 2) lower the utility's, and via CLEP, the customer's operating costs, 3) share more, CLEANER energy with their neighbors and 4) help to support PV and Wind that may be located near or far from their homes. This can drastically lower environmental footprints for everyone. And largely to the extent that it does, CLEP customers are rewarded.

[24] This business niche already has quite a few players; the field is called "Demand-Response Aggregation".

CLEP: How

- Implementing CLEP for a single customer minimally requires a smart meter that at least collects energy purchases and sales data every 5 minutes and be set to synchronize with the ISO clock. The meter would also have to meet some security standard (like being able to be uniquely identified or be integrated into the utility's accounting process). Clearly, these problems have been resolved because there are already 50 million smart meters deployed in the US (in response to incentives within ARRA of 2009) and many more in Europe as well.
- Published data show smart meters cost less than $500 including installation. However, utilities that have yet to invest in smart meters are not very likely to do so because, even with TOU rates, it is often the case that net utility bills are not reliably lower for all customers on average.
- CLEP does not require smart use to be functional, but it does require smart use to be economical. Thus a savvy customer should not be expected to choose CLEP unless he has:
  a. Paid an energy design professional for advice and/or installed equipment that economically uses energy according to time-ofday and/or day-of-year.
  b. Has a battery backup system, or
  c. Has a relationship with a big business that provides an automated service to get maximal use from CLEP.
  d. Moreover, a customer who has done all of the above can expect to greatly benefit from CLEP; BSI strongly suspects that these steps will lead to recurrent, future bills that will be zero to negative 100% of their previous magnitudes.[25]
- CLEP can be incentivized by utility regulators by setting p > 1 for a few years. A regulator can probably be shown a convincing argument that DSM (demand side management) programs can be really effective at lowering peak demand if they have access to a CLEP tariff with a high value of **p**. In this circumstance, non-participants' utility bills will not be lowered in the short term because **e** is lowered (in fact it will tend to rise), however, **s** will be kept from rising because the high **p** will generate deep penetration of CLEP customers — this can be expected to significantly lower the need for new peaking plants. For that argument to prevail, the projected decrease in rise of **s** must have significantly more value than the projected increase in the rise of **e**.
- Energy Conservation by Timing has much more potential to save CO2 production than reducing kWh consumption (a.k.a. energy efficiency). With CLEP, reducing CO2 production quite directly: PAYS $$$. Once this connection is provided by CLEP as an easy to utilize economic tool, many will exploit this opportunity in ways that this author cannot predict. But here are a few:
  - Demand Response — This can be aggregated and use FERC order 745.
  - Supply Response — must be worth at least as much as DR.
  - Battery Backup — worth > $500 / year per average home
  - Frequency Regulation — pays $2 - 5/day per average-sized home
  - CLEP — Pays $25 - $2000 per year per home
- What to do first?
  - Get a business plan concept
  - Identify customers — perhaps do pilot programs to prove concept and create advocates for CLEP

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[25] This assertion is completely consistent with the whole idea that a CLEP together with batteries that are optimally controlled to exploit CLEP, will generate cash flows fast enough to repay the cost of $10,000 battery systems in ten years. This means cash flows at least on the order of $1000/y and $1000/y is pretty close to the average residential bill in New Orleans. 0% to 100% negative is consistent with paying back the cost of batteries in half that time; this comparts with the assertion made by the expert who claims price-arbitrage alone can generate such a cash flow.

- Plan the regulatory change
- Plan publications and/or talks at major conferences.
- The following pages will present worked examples.

CLEP: Worked Examples

Assumptions needed for calculating CLEP transactions:

The current unit price of electricity = the energy cost of electricity + the cost of service per kWh.

= **e** + **s**

This discussion presumes that we're in the current situation where **s** is constant between rate cases and **e** is recalculated monthly.[26]

NO TIME OF DAY RATES or other kinds of dynamic pricing.

The value of **e to be used in the formula** is the monthly-average marginal cost of electricity whether produced by ENO or purchased from others including via MISO = utility bill published, average, marginal, cost of energy, a.k.a. fuel cost adjustment. Recent statistics from ENO indicates that the Fuel Cost Adjustment is very nearly constantly $0.03/ kWh.[27]

Let i = ISO, real time, 5-minute price of electricity, and

Let's assume that the regulator sets p at 95%.

A quality goal for the use of batteries is **INVERTED DEMAND**, i.e., using a battery/inverter system to collect and store in your batteries all energy needed for a day when electricity is very cheap, during four to six hours, and then be effectively off-grid for the remainder of the day.[28] This allows the homeowner to provide almost perfect reliability to the home's outlets. This mechanism supports unabated growth of wind-powered electricity generation. It utilizes power generated at great distances because the transmission lines are hardly used at night.

A key idea needed to understand CLEP is to distinguish between an energy-efficiency retrofit and an investment that lowers utility costs in a way that is not measured in standard retail electricity bills.

By definition, and common usage, an energy-efficiency improvement is a retrofit of a customer's building that invests capital to lower future energy bills so that the avoided cost of future electricity consumption generates a cash flow that repays the investment in less than a decade. In a utility district

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[26] Tom Stanton asserted that "e is recalculated monthly" depends upon how it is reconciled annually.

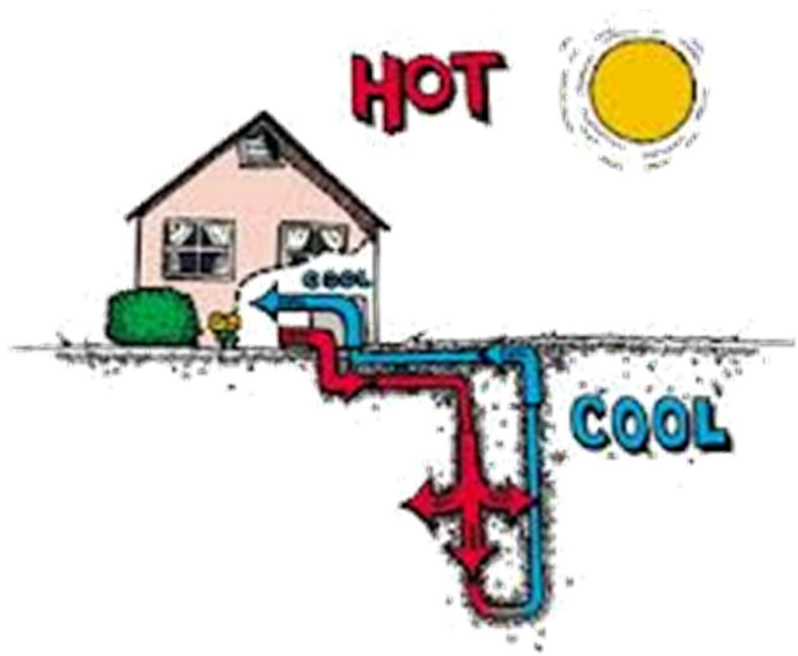
[27] The FCA is recalculated every month. In the last year, the FCA for ENO has been holding steady at very near $0.03/kWh. The variation from this value is less than 5% from month to month and it has been this way for about a year.

[28] IDCC & CLEP formed the subject of talks given to the Louisiana Engineering Society in Jan and RESNET in February, 2016. IDCC means "Inverted Demand Compliant Construction". Homes that invert demand and can respond to remote control of batteries to consume or produce electricity is the meaning of the specification.

like one found in most of the U.S., a residential energy efficiency retrofit avoids every kWh at the same price regardless of the time-of-day or day-of-year that kWh was consumed. However, CLEP changes the potential economics of such retrofits so profoundly that new jargon is needed.

BSI defines “Primary Energy Conservation” as any activity that reduces the amount of primary energy (think fossil fuels or uranium) consumed. In talks given at the Louisiana Engineering Society over three years ago and twice more recently, as well as, at EEBA in 2014 and the Electric Power Expo in 2016, BSI pointed out that this goal, unlike “Energy Efficiency”, has many more means. That is, there are many more ways to reduce primary energy consumption besides doing energy-efficiency retrofits of buildings. Moreover, even if we restrict all consideration to means within buildings, “energy-efficiency” comes up very short. The most important, poorly exploited, subset of means to lower primary energy consumption within buildings BSI calls “energy conservation by timing”.

An Energy Conservation by Timing or a “Timing” retrofit, is any technology that delays the end-use consumption of a kWh — milliseconds to months after the primary energy used to make that kWh was consumed, and does this with the effect that less primary energy is consumed in service to that end-use. Examples of this concept are already found in buildings by the use of run-capacitors of electric motors, thermal walls, time-controlled water heaters, electric batteries, and ground-coupled heat pumps.



CLEP is designed to exploit energy conservation by timing. Two major cash flows are directly perceived within the wholesale electricity marketplace, are very time-dependent and are critical to the costs of the utility: 1) the time-varying wholesale cost of electricity and 2) the great expense to own peaking power plants as well as the transmission and distribution expansions primarily done in service to peak demand. CLEP's cash flows are all about communicating to the end-user, the customer, the these two costs borne by the utility, in a timely basis, ***literally in a timely basis***.

If a home energy consultant designs a retrofit to reduce energy bills that have nothing like a CLEP tariff or even time-varying prices for electricity, such retrofits are called energy-efficiency retrofits. BSI suggests that a whole new jargon is needed for retrofits that exploit the CLEP tariff. Perhaps "Energy Conservation by Timing" retrofits should be used.

In the following examples, battery prices and performance are assumed to be that advertised by Tesla in the Spring of 2015: its 2015 PowerWall offering had a 10 kWh hour li-ion battery selling for $3000 and included a 10-year warranty. In retrospect, this price and performance is unreasonably inexpensive and unreasonably capable of providing adequate deep-cycle discharges and recharges for 10 years of use. However, even though such assumptions seriously undermine the PRECISE conclusions of these examples, the over-riding theme of these examples remain: batteries make economic sense and these examples help to highlight the how and why.

The following examples, listed 1 through 8, will be summarized in a table a few pages thereafter in this document.

Example 1) A. Buying during off off-peak hours only (and merely using stored energy during peak times);

The average energy bill of a New Orleans residential customer is around $100 / month or 1000 kWh month or $1200 / year. The average home will have a 5 kW average demand during peak hours: we'll assume that pre-retrofit the value is 5 kW, post aggressive energy-efficiency retrofit, the value is 3 kW. However, for this example, we will assume an extremely modest energy-efficiency improvement that consumption should decrease to 900 / month or 30 kWh / day with around a 1 KW drop in average demand peak during peak demand hours from those retrofits.

(In version 1B, a more aggressive, but cost-effective energy-efficiency retrofits against electricity costs of $0.10 / kWh are easily capable of lowering electricity consumption by over 57% [Florida Solar Energy Center citation: found in BSI's *You're Hot* talk]. This means that a home should be using around 400 kWh /m or 14 kWh / day and have at most a 2 KW of average demand during peak demand hours. A Li-ion battery system with inverter / charger of 20 kWh costs around $7500 and is guaranteed to run 10 years without need to replace the batteries.)

The average wholesale price of electricity at New Orleans in the MISO marketplace between midnight and 6 AM is near $0.03 / kWh in the summer and goes down to around $0.02 /kWh in the winter.

Because the energy-efficiency retrofits are modest, the size of the battery system needed to invert demand is large. In this and the following case, all demand during peak hours is zero by design because the battery is chosen to be big enough to be completely off-grid during those times.

Assuming that none but extremely modest energy efficiency improvements are used (and their benefits against their costs are zeroed out), 30 kWh of batteries would be needed at an installed cost of around $15000.

A monthly CLEP payment would be

$CLEP_5$ = p * n (e - i) = .95 * 900 ($0.02 - $0.03) = 0.95 * $9 = $8.55 for the average month outside of the summer. This works out to be about $72 annually. Added to

$CLEP_m$ = p * $50 * d = .95 * $50 * 5 = just under $237.5. This works out to be about $1187.5 annually because there should only be about 5 months a year with peak demand (high enough to cause the utility to consider buying new peaking plants).

Thus the annual effect of CLEP = $CLEP_5$ + $CLEP_m$ = $1259.5.

Why would a residential customer do CLEP and only pursue INVERTED DEMAND? Answer:

$520 in value from avoided losses from poor reliability [PEPSO citation found in BSI's IDCC talk].

$1259.5 from CLEP

$1779.5 discount in the $1200 yearly bill.

This would generate an effective cash flow against the $15,000 investment of $1779/yr with a simple payback (without interest) of 8.4 years.

Example 1) B

Assuming that extremely aggressive but cost-effective energy efficiency improvements are employed (and their benefits against their costs are zeroed out), 14 kWh of batteries would be needed at an installed cost of around $7500.

A monthly CLEP payment would be

$CLEP_5$ = p * n (e - i) = .95 * 400 ($0.02 - $0.03) = $3.64 for about 8 months a year. This works out to be about $29 annually.

The $CLEP_m$ remains the same as in Example 1.A:

$CLEP_m$ = p * $50 * d = .95 * $50 * 5 = just under $237.5. This works out to be about $1187.5 annually.

Thus the annual effect of CLEP = $CLEP_5$ + $CLEP_m$ = $1216.

In this case, why would a residential customer do CLEP and only pursue INVERTED DEMAND? Answer:

$520 in value from avoided losses from poor reliability [PEPSO citation found in BSI's IDCC talk].

$1216 from CLEP

$1736 discount on the $400 a year bill.

This would generate an effective cash flow against the $7500 investment of $1736 /yr with a simple payback (without interest) of 4.3 years. If the customer discounts the PEPCO reliability value to zero, the payback changes to 6.2 years.

Both of the previous calculations ignore the public benefit to the citizens of New Orleans associated with avoiding peak demand completely. (The following sentence was written in Oct., 2015; the projected gap is smaller now, but the point is the same.) The current IRP for ENO proposes to close a roughly 225 - 300 MW gap caused by projected peak demand to exceed existing supply. Building such a plant will cost over $1/2 Billion. Thus the COUNCIL (City Council of New Orleans) may want to set the **p for $CLEP_5$** at some value much higher than 95%, like 200% in order to jumpstart CLEP. If so, the payback for such a residential-sited battery investment could easily be around 3 years.

EXAMPLE 2) A With no retrofit, buying off off-peak and then selling into the grid on peak or doing smarter things than that; but the battery system is too small to completely invert demand.

As shown in the IDCC talk, MISO data shows that on some (perhaps commonly or many) days of the year, the ratio of MISO wholesale prices exceeds 6 to 1—by comparing peak hours to between midnight and 6 AM. [In fact, a deeper exploration, done months after the following was written, into the MISO data found that this six to one ratio in prices is very uncommon, but a 2 or 3 to 1 ratio is common.] Other data (with BSI's ENO IRP comments RE Missouri utility data) shows that around 5 AM many mornings, the base loaded plants of some (perhaps most) utilities make more power than they can sell (locally or otherwise). Thus the price of that electricity at that time is negative. That may be the price at the generator, but we should expect at least $0.02/kWh transmission fee from Missouri. Although the round trip efficiency of most batteries is around 80%, the margin of arbitrage may be often more than 6 to one.

In this case, the battery system's size needed does not have to have any relationship to the consumption needs of the home. However, if not sized big enough to handle a day's consumption needs and used to produce INVERTED DEMAND, the $520 / year value (earned for providing very good, residential, electricity reliability) described above is not received.

Wholesale sales to ENO from MISO during general peak times should be expected to occur when MISO prices range from $0.09 to as much as $100 /kWh with an average around $0.10 / kWh. [These prices are a little high on average, but that does not undermine the basic logic of this discussion.] Assume a 10 kWh battery system with an installed cost of $4500.

A daily 5 kWh CLEP5 transaction of **purchases from** the utility between midnight and 6 AM (assuming p = 95%) = **+** 95% * 5*($0.03 - $0.03) = 95% * 0 payment to the customer—during the high summer, but this may go up as high as a difference of $0.01/kWh on average for 8 to 9 months a year, i.e.

CLEP5 summed over any month but summer, on average = **+** 95% * 5*($0.03 - $0.02) = $0.045 / day => $1.35 / month. => $10.8 / year.

A daily 5 kWh CLEP5 transaction from **sales to** the utility during peak hours (assuming p = 95%) = **-** 95% * 5*($0.03 - $0.10) = 95% * $0.35 = $0.3325.

This generates a net cash flow of just under $0.3325 / day or $10/month or about $120 / year.

Together with the $520/ year from reliability, $11 from purchases, $520 + 11 + 120 = $641 would generate a 7-year simple payback against a $4500 initial investment. But the battery size is probably too small to get the $520/year from reliability. Payback is over 30 years — too long.

However, focusing upon CLEPm, the picture could greatly improve: This depends upon EXACTLY WHEN those 5 kWh’s are sent back to the grid. Let’s assume they can be used to primarily run the AC system in the afternoon and thereby reduce demand by 50%, in that case, the CLEPm payment grossly exceeds the CLEP5 payment.

$CLEP_m$ = p * $50 * d = .95 * $50 * 2.5 = just over $118.75. Assuming only 5 months have peak demand at all, this works out to be about $593.75 annually. Together with the CLEP5 purchases, this amounts to $604.55. This is smarter use of the energy in the batteries, and the payback is 7.4 years.

EXAMPLE 2)B With no retrofit, buying off-off-peak and then selling into the grid on peak or doing smarter things than that; but the battery system is big enough to completely invert demand.

Assuming that none but extremely modest energy efficiency improvements are used (and their benefits against their costs are zeroed out), 30 kWh of batteries would be needed at an installed cost of around $15000, but in addition to what was assumed for 1.A, an extra 10 kWh battery is purchased just to make money with price arbitrage; this increases the investment by $3000 to $18000.

A monthly CLEP payment would be

$CLEP_5$ = p * n (e - i) = .95 * 1200 ($0.02 - $0.03) = 0.95 * $12 = $11.4 for the average month outside of the summer. This works out to be about $91.2 annually.

$CLEP_5$ = p * n (e - i) = - .95 * 300 ($0.10 - $0.03) = 0.95 * $21 = $19.95 for the average month during the five months with peak demand. This works out to be about $100 annually.

$CLEP_m$ = p * $50 * d = .95 * $50 * 5 = just under $237.5. This works out to be about $1187.5 annually because there should only be about 5 months a year with peak demand (high enough to cause the utility to consider buying new peaking plants).

Thus the annual effect of CLEP = $CLEP_5$ + $CLEP_m$ = $191.2 + $1187.5 = $1378.7.

What is the payback for a residential customer with CLEP that pursues INVERTED DEMAND and price arbitrage? Answer:

$520 in value from avoided losses from poor reliability [PEPSO citation found in BSI's IDCC talk].

$1378.7 from CLEP

$1898.7 discount in the $1200 yearly bill.

This would generate an effective cash flow against the $18,000 investment of $1898.7 /yr with a simple payback (without interest) of 9.4 years. Note that compared to 1.A., this extra $3000 investment was not as cost-effective because the payback time increased from 8.4 to 9.4 years, but it is still more cost-effective than a new PV purchase which typically has more than a 20-year payback.

EXAMPLE 3.A Solar PV charging batteries during the off peak hours and then selling during peak hours.

To make a meaningful example, assume that the home installs a 5 KW PV system. It should then be expected to generate a bit more than 25 kWh/day during the cooling season, peak demand days. With adequate batteries, the energy produced by the PV system should be able to reduce average demand during peak-demand hours to nearly zero by concentrating all energy produced to that job. Then, the remaining economic value of the solar-produced energy left over is negligible. This is because, compared to avoiding peak demand, selling back to the grid is not significant. The payback for just this solar investment would be almost totally associated with the drop in demand, i.e., the result would be:

$CLEP_m$ = p * $50 * d = .95 * $50 * 5 = just under $237.5. This works out to be about $1187.5 annually because there should only be about 5 months a year with peak demand (high enough to cause the utility to consider buying new peaking plants).

But to do that will require batteries. Roughly 15 to 20 kWh may needed to be employed to assure that flows to the grid are coincident with the operation all electrical equipment in the home. One way to do it is to completely run the home off of the batteries during peak demand times. That requires a battery-bank at least 60% of the size of completely inverting demand, i.e., **Example: 1.A**; with that plan, three 10 kWh batteries should be enough; if that doesn't do it easily, a little bit of applied energy-efficiency retrofits would probably be more cost-effective than a fourth battery. (It may be possible to do this with one battery, but that requires understanding electronics and skills beyond this researcher's knowledge.)

Because the home's batteries are still doing the job of inverting demand all by themselves, they are still avoiding all of the demand of the home. Thus the original demand before any batteries or solar was installed was a positive 5 kW while the new demand is probably more like a negative 4 kW:

$CLEP_m$ = p * $50 * d = .95 * $50 * 9 = just under $427.5. This works out to be about $2137.5 annually.

In that case, there will be some excess generation on the order of 5 kWh/day. This can be placed onto the grid at optimal times to maximize payback at the wholesale rate which should average between 10 and 20 ¢/kWh on weekdays and around 8¢ on weekends.

CLEP5 = p * n (e –w) = .95 * 5(.03-.15) = $.57 daily (20 days a month) and

CLEP5 = p*n (e – w) = .95 *5(.03-.08) = $.23 daily (10 days a month)

CLEP5 for each month in the 5 month, cooling season: generates $13.7 / month => $68.

During other months there will be more excess capacity but lower wholesale prices during the day. Let's assume that income is about $10 / month. => $70. Total CLEP5 income is around $130/year

With the energy-efficiency retrofit getting the daily energy use below 20 kWh, this plan will earn the $520/month residential resiliency bonus with a net benefit of $2137 + 130 + 520 = a bit over $2787 / year, needed to pay back the cost of $7500 in batteries and a 2.7-year payback.

EXAMPLE 3.B Solar PV without batteries: Sell all energy whenever it is produced.

This really means that the value of the PV system is considered using the CLEP tariff but without regard to the consumption needs of the home. To fully appreciate what a pure energy producing device means with a CLEP tariff, consider that the energy producer has two features: It makes electricity which has value exactly equal to its wholesale price, but in addition, because the electricity is being produced within the distribution system of the utility, the power produced ALSO decreases demand of the utility. That means CLEPm is the same but CLEP5 for a pure producer is merely the wholesale price of electricity. That is, for a pure energy producer,

CLEP5 = **p** * n * w

Because the final result of this calculation will compare NEM to CLEP, we'll make the simplifying assumption **p = q =1 at the outset** and the effect of assigning value to **p** less than 1 will be revisited at the end of this example.

To make a meaningful example, assume that the home has a 5 KW PV system. [Assuming the array has a fixed latitude tilt with no tracking and sited in New Orleans, the relevant DOE site states that the array should generate 5 kWh per day during the year on average for each kW installed.] It should then be expected to generate around 30kWh/day during the cooling season, peak demand days. Without batteries, the energy produced by the PV system cannot be expected to reliably reduce peak demand by the full 5 kW by concentrating all energy produced to that job; but it will probably do about 60% of that during summer months. In that case,

$CLEP_m$ = **p** * $50 * 3 = $150. This works out to be about $750 annually because there should only be about 5 months a year with peak demand.

To calculate CLEP5 consider that there will be average generation near 6 kWh/day during the cooling season and 4.33 kWh/day during the rest of the year. This cannot be reliably placed onto the grid at optimal times to maximize payback at the wholesale rate which should average around 6 ¢/kWh on weekdays and around 4¢ on weekends during the cooling season and a penny lower respectively during the rest of the year

CLEP5 = p * n *w = .95 * 6 *.06 = $.36 daily (20 days a month) =>$7.20/m

CLEP5 = p*n * w = .95 * 6*.04 = $.24 daily (10 days a month) => $2.40/m

CLEP5 for each month in the 5 month, cooling season: generates $9.60 / month => $48.

During other months

CLEP5 = p * n * w = .95 * 4.33 * .05 = $.2165 daily (20 days a month) =>$4.33/m

CLEP5 = p*n * w = .95 *4.33 * .03 = $.1299 daily (10 days a month) => $1.30/m

CLEP5 for each month in the 7 month, non-cooling season: generates $5.63 / month => $39.41.

The total CLEP5 payment for a pure supply system is $87.41, but since the wholesale prices used for energy were approximate, this number is equivalent to $85. Thus, the total CLEP payment of CLEP5 and CLEPm for the year is $85 + $750 = $835.

However, if the new CLEPm coefficient were used, i.e., $57.60, the $750/y income increases by a factor of 1.15 to $862.50. Recalculating with this addend: CLEP income becomes $862.50 + $85 = $947.50.

Compare that to net-energy-metering: The home's solar plant should be expected to produce on average: 25 kWh /day @ $0.10 /kWh retail, the value is 365 * $2.50 = $912.50. Thus CLEP pays back just below Net Energy Metering with the $50 coefficient and just above net-metering with the $57.6 coefficient. Another way to look to compare CLEP to NEM is consider the ratio of their magnitudes. With the $50 CLEPm coefficient, CLEP pays around 8% lower than NEM. With the $57.6 CLEPm coefficient, CLEP pays around 4% better than NEM.

At this point, the value of **p** which was temporarily set 1 will be revisited. If **p** is set to 95% as is the default and recommended value, CLEP is now negligibly different from NEM.

Since this series of worked examples is all about the relative value of various ways to employ batteries, it is natural to ask if it would be smart to install batteries at the array in the case that the array is not at the residence or building served by the consumer that owns the solar array. At first glance the answer would seem to be obviously YES, because this gives the lucrative opportunity to move electricity generated before the onset of peak demand hours, namely 2 PM, to be stored to later in the day and thereby earn much more for avoiding peak demand. Batteries doing that job will be richly rewarded by CLEPm and very modestly rewarded by CLEP5. However, that answer ignores the fact that the batteries installed at the site of consumption (namely at customers' homes and offices) also "earn" value to the consumer via reliability and can perform exactly the same time-shifting function on-site and do it much more economically. Moreover, every time you pass energy through a battery you should expect to lose around 10 to 20% in the roundtrip.

However, as PV penetrations increase a new problem arises. That's where batteries become important, but they do not need to be within the same home as the PV system.

Solar power placed onto the grid around 10 am at PV penetrations greater than 10% may find no associated load. The probability that will happen increases with PV penetration but does not happen for almost all utilities below 10% PV penetration, but can be forestalled to 30% if the utility has a large number of small generators instead of a small number of large generators. (Also consider this footnote: if the buildings served by the utility have a large number of batteries that can absorb often unplanned for excess generations and/or provide often unplanned for supply, the utility can be expected to be even more flexible and PERHAPS be able to utilize PV power at even higher PV penetrations… PERHAPS that is the ONLY way high PV penetration can be economical.) When this happens, the utility has a real cost. So, not only does the utility "have to absorb and effectively pay for" electricity at 2 to 4 times the wholesale price but it can't even use that power. This can be a double whammy. When the electricity is placed onto the grid during peak hours, it is much less likely that there will be no available unmet load. Moreover, if by coincidence, the local demand for electricity exceeds (otherwise) local supply, the purchase of expensive wholesale electricity at more than $0.20 / kWh can be avoided.

However, **Supply Response** is described in the IDCC talk. This is a mechanism where supply of electricity happens on response to a request from the grid operator. In that case, COINCIDENCES ARE NOT NEEDED. This can only be accomplished with batteries. Solar alone cannot do this. When CLEP is considered, the call for power can either come from the grid operator or the BIG-Brother (STEM in the following link) company that "operates" the batteries remotely. Unlike the original intent of the IDCC talk, the call for operation does not need to be the utility, as long as strong enough economic signals are available for reasonably sized company to economically receive and process them the building owner and utility can get the benefit without actual intervention by the grid operator. This is exactly the fundamental value of CLEP.

Based upon BSI's understanding of FERC order 819, issued November 20, 2015, FERC defined Primary Frequency Regulation Service

"primary frequency response service as the "autonomous, automatic, and rapid action of a generator, or other resource, to change its output (within seconds) to rapidly dampen large changes in Docket No. frequency."2 pp 9 and 10.

And that the sale of this service was contingent upon passing two "screening" tests:

"The Commission analyzes horizontal market power for market-based sales of energy and capacity[29] using two indicative screens, the wholesale market share screen and the pivotal supplier screen, to identify sellers that raise no horizontal market power concerns and can otherwise be considered for market-based rate authority.[30] The wholesale market share screen measures whether a seller has a dominant position in the relevant geographic market in terms of the number of megawatts of uncommitted capacity owned or controlled by the seller, as compared to the uncommitted capacity of the entire market.[31] A seller whose share of the relevant market is less than 20 percent during all seasons passes the wholesale market share screen.[32] The pivotal supplier screen evaluates the seller's potential to exercise horizontal market power based on the seller's uncommitted capacity at the time of annual peak demand in the relevant market.[33] A seller satisfies the pivotal supplier screen if its uncommitted capacity is less than the net uncommitted supply in the relevant market.[34]" *pp 10 & 11. FERC ordered that this was optional and not a mandatory requirement of RTO/ISO.*

http://www.utilitydive.com/news/stem-pge-bid-aggregated-energy-storage-into-caiso-real-time-market/405218/

Wholesale sales to ENO from MISO during general peak times should be expected to occur when MISO prices range from $0.09 to as much as $100 /kWh with an average around $0.10 / kWh. [This needs a citation, but best matches my very limited review of MISO data.] [DK1] Assume a 10 kWh battery system with an installed cost of $4000.

However, if the timing of the flow is manipulated by a big-brother company that purposely provides the power when ENO or MISO has the greatest need, the average price could more than double the $0.10 average wholesale price to over $0.20 / kWh for selected sales.

"Regulation is a service that corrects for short-term changes in electricity use that might affect the stability of the power system. It helps match generation and demand and adjusts generation output to maintain the desired electrical frequency for the grid to function normally. Devices such as hot water heaters and plug-in hybrid electric vehicles can respond to the PJM frequency regulation signal and act as demand-side regulating resources. Learn more in the Energy Innovations section."
http://learn.pjm.com/three-priorities/buying-and-selling-energy/ancillary-services-market.aspx

EXAMPLE 4) No Batteries or PV… which retrofits are promoted by CLEP?

This mechanism supports unabated growth of wind-powered electricity generation. It utilizes power generated at great distances because the transmission lines are hardly used at night.

Easy retrofits that utilize Energy Conservation by Timing.

Not-Frost Free Refrigeration. Saves: 300 to 600 W for 15 minutes to an hour.

> The following link has an active link with a graphic that shows that a normal fridge can stand being kept off for 9 hours without having a temperature rise above 9°C.
>
> http://diy.stackexchange.com/questions/2621/can-i-save-energy-costs-by-turning-off-the-refrigerator-for-1-2-hours-every-day
>
> Average peak watt for a fridge is 0.1 kW

Make Hot Water while you're sleeping. 4.5 kW for 30 minute

> Average peak watt for water heater .51 KW.

Wash dishes while you're sleeping. 1.2 KW for 30 minutes

> Average peak watt for dishwasher is 0.15 kW.

Could do all of these. Effects: more than ¾ KW or $37/month in CLEPm payments. And about 3.5 kWh/day of time-of-day shifted consumption which pays about $0.04 wholesale price differential during the 5-month cooling season. CLEP5 = p * n (0.04) = p * 3.5 (0.04) = $0.14 / day or $4.20 month. For each of these months: CLEP5 + CLEPM = $4.2 + $21 = $26.2. There are 5 such months, so the annual payment is $133.

Table of worked examples:

All examples assume that the home has a 5 kW-sized, average peak demand reference home type. The sum of this home's energy bills is 10,000 kWh/year or $1000/yr and it has average efficiency for New Orleans.

Worked Examples		$CLEP_5$ Energy				$CLEP_m$		Batteries or other investment		Backup Power	Payback	Income annual
#	Descrip -tion	Purch -ases		Sales		Demand Savings		Size	Price	Benefit		
		MWh	$/yr	kWh	$/yr	KW	$/yr	kWh	$1000	$/yr	years	$/yr
1.A	IDCC	10.8	58			5	1250	60	21.0	520	11.5	1828
1.B	EE Ret	5.4	32	600	30	6	1500	30	10.5	520	5	2082
2.a	PA	12	70	1200	42			10	4.5		30	150
2.A	PA & DR	12	70	1200	42	3	750	10	4.5		5.2	862
2.B	1A&2A	12	70	1200	42	8	2000	70	24	520	9.1	2632
3.A	5KW PV	1.2	12	2000	220	5	1250	30	10.5	520	5.25	2000
3.B	3.B	1.2	12	800	150	3	750					912
4	Fridge	.7	7	700	7	0.10	25					39
5	Water Heater	3.5	35	3500	35	0.51	125					195
6	Dish washer	1	10	1000	10	0.15	32					52

APPENDIX B

Why CLEP should be remunerated with a cash flow exceeding net-metering by 5%? namely, CLEPm's coefficient should be set to $57.60.

a) This argument relies heavily upon a comment by Andrew Owens, chief economist of Entergy Services Inc., that $12/kW-m is already in the rate structure of Entergy; he made this assertion in a meeting within the renewable energy docket, (a.k.a., NEM discussion) in the last week of June, 2016. He made this comment to discredit the $50/kW-m coefficient within the definition of CLEPm; he claimed that it was too high. It turns out that $12/kW-m is the same as $144/kW-y and this fact plays out in the following argument.

b) CLEPm's original definition, i.e., with the coefficient set to $50, was justified by an assertion from Steven Fenrick, chief economist of Power Systems Engineering, an engineering, think-tank, consulting firm that serves 50 utilities worldwide. He asserts that the right demand charge for anywhere in this country should be $25/kW-m or $300/kw-y.

c) However, original CLEPm pays out at $125/kW-y. Here is why: Consider that normal demand charges are for peak demand during peak hours, but CLEPm pays for average demand during peak hours. Since residential peak demand is primarily a function of AC operation that, by design is only on 20 to 30 minutes an hour, average demand is less than half of peak demand. Therefore, CLEPm's $50 factor against average demand during peak hours generates the same cash flow as a $25 coefficient against peak demand during peak hours. Consider the case that a home has a 10 kW peak demand, if all of this were avoided during peak hours throughout a year, the number of kW of average demand during peak hours would be about 5kW. With CLEPm's original, $50 coefficient, such a home would be paid 5 * $50 each month for the months of May, June, July, Aug and Sep. That is 5*$50*5 = $1250 annually in CLEPm payments. However, in terms of peak demand during peak hours, the 5 kW number changes back to 10 kW. Therefore, using the same meaning for $/kW-y as referred to in a) and b) above, CLEPm pays at the rate of $125/kW-y.

d) Therefore, if CLEPm's original definition uses $50 and this generates $125/kW-y, then applying Andrew Owen's assertion that CLEPm should not exceed the cash flow of a $12/kW-m demand charge, the income of CLEP should be changed by the ratio of $144 to $125: when this factor is applied to $50, the result is $57.60.

e) Using p = q = 95% and this the new coefficient for CLEPm, CLEP generates a cash flow roughly identical to NEM (as is explained above in Example 3.B in the Worked Examples section of Appendix A.)

f) CLEP can be applied to a residence, commercial building or a solar farm; however, each instance requires a slight variation in the definition of CLEP to keep the rationale "kosher." The definition for a residence is given in Appendix A. The problem with CLEP applied to customers that are not residents is simply about how to measure kW of avoided demand. How to do a commercial building is somewhat explained in the main part of this document: hire a mechanical engineer and file a specific engineering report asserting what will happen and how to measure it; a similar process can be envisioned for industrial customers for other equipment besides for HVAC.

g) It is interesting to note that ENO's highest demand charge seems to be $8.5/kW-m found in the large commercial rate plan; this is equivalent to $100/kW-y.

h) Legend Consulting (the engineering advisers within the legal adviser team who have a recurring contract for utility regulatory advice in service to the City Council of New Orleans) asserts that roughly $90/kW-y is the projected Cost of New Energy (CONE), that "may" kick in by 2022; until then, the capacity markets of MISO only pay about $1/kW-y. ENO, just two weeks ago (in a response to an interrogatory submitted by the Council's legal advisers), asserted that their original estimate of the price of roughly $700/kW (published in the IRP documents) for their hoped for combustion turbine is too low and the real cost is over $900/kW; this is roughly a 30% increase in the CONE price for siting a combustion turbine in New Orleans (compared to siting it elsewhere) and predicts that a realistic CONE price should be at least $90/kW-y * ($900/$700) = $118/kW-y. Note that this value is this is only slightly lower than CLEP's original payment rate of $125/kW-y. Legend's assertion is also questionable about "WHEN" the CONE price will dominate (the cost of capacity) since in the last 2 years, the excess capacity within MISO decreased by more than 90% in one year: from 8000 MW to 700 MW. Moreover, buying capacity through MISO is not as cheap as the capacity auction may predict, because Luke Piontek's intervention documents point out that tens to hundreds of millions of dollars are needed to upgrade Amite South's transmission equipment and this may be the cheapest way to avoid building a new plant in the near future.

i) Even if the $12/kW-m figure is deemed too high from a certain perspective, by reference to what is going on in New York, a $0.02/kWh subsidy was just deemed a positive long-term economic decision by their Public Utilities Commission for the purposes of promoting a Clean Energy Future and the economic advantages to the state such industry provides.

j) By CLEP paying 5% higher than Virtual Net-Metering, CLEP makes an innovative contribution to the national community solar program design, becomes more likely to receive a $1.5 million prize from DOE and is able to more easily subsidize a larger number of low and moderate income residents.

Appendix C is the attached PDF file entitled:

CustomerLoweredElectricityPrice_EP-PPT-Slides-2016.pdf

is published at the Electric Power Expo site, but not available to anyone without a username and password. The talk was given at the Electric Power Expo in New Orleans on April 22, 2016. The PDF is an extraction from a Power Point Presentation which has Presenter's Notes and is available on request from its author/presenter, Myron Katz.

Appendix D. Wholesale Price of Electricity is Correlated with Carbon Content.