Exhibit 4: The CLEP Dashboard

About the CLEP Dashboard

From its inception, CLEP was articulated as a set of **mathematical formulas.**

When that approach proved to be a challenging for conveying these several interrelated and sophisticated ideas, an **Excel spreadsheet** format was developed to handle the various scenarios in which CLEP would be deployed. While a significant improvement, this, too, proved too challenging.

Data-driven modeling is the approach used in the CLEP Dashboard. It was developed by a computer and earth scientist from U.C. Berkeley (now at Science Tools Corporation) whose experience in real-world, data-driven modeling resulted in the integration of: i) an entire year's dataset of MISO pricing, ii) data that would allow more accurate estimates of New Orleans cooling loads, and much more, including iii) data that would interest regulators. His focus has been on modeling the entire CLEP universe from the point of view of regulators and consumers, but also with an eye toward improving utility profits.

Since MISO's pricing is based on 5-minute intervals, expressing it all on the screen works against simplification. So, an hourly average was employed instead. This provided the advantage that demand and consumption could be expressed simultaneously. However, MISO's originally published "hourly data" proved to be faulty and merely showed the value from first 5 minutes of each hour. Thus, a new dataset was created by averaging 5-minute data for every hour for the entire year of 2018 at the New Orleans' MISO node, "EES.NOPLD".

Other unavoidable deviations from a real-world implementation include the fact that CLEP calls for weighted-averages to ascertain the "cost-of-energy" — which requires information that is unavailable to us. To be truly accurate, the CLEP Dashboard would require a substantial amount of information that only ENO has today. The good news is that this weighting error is most likely underestimating real CLEP5 values: because the correctly weighted average wholesale price will cause peak demand times, which have both more consumption and higher prices, to disproportionally raise the cost-of-energy. Higher cost-of-energy will more encourage CLEP consumers to make more purchases outside of peak times — get more CLEP5 income — therefore everyone wins: consumers and the utility.

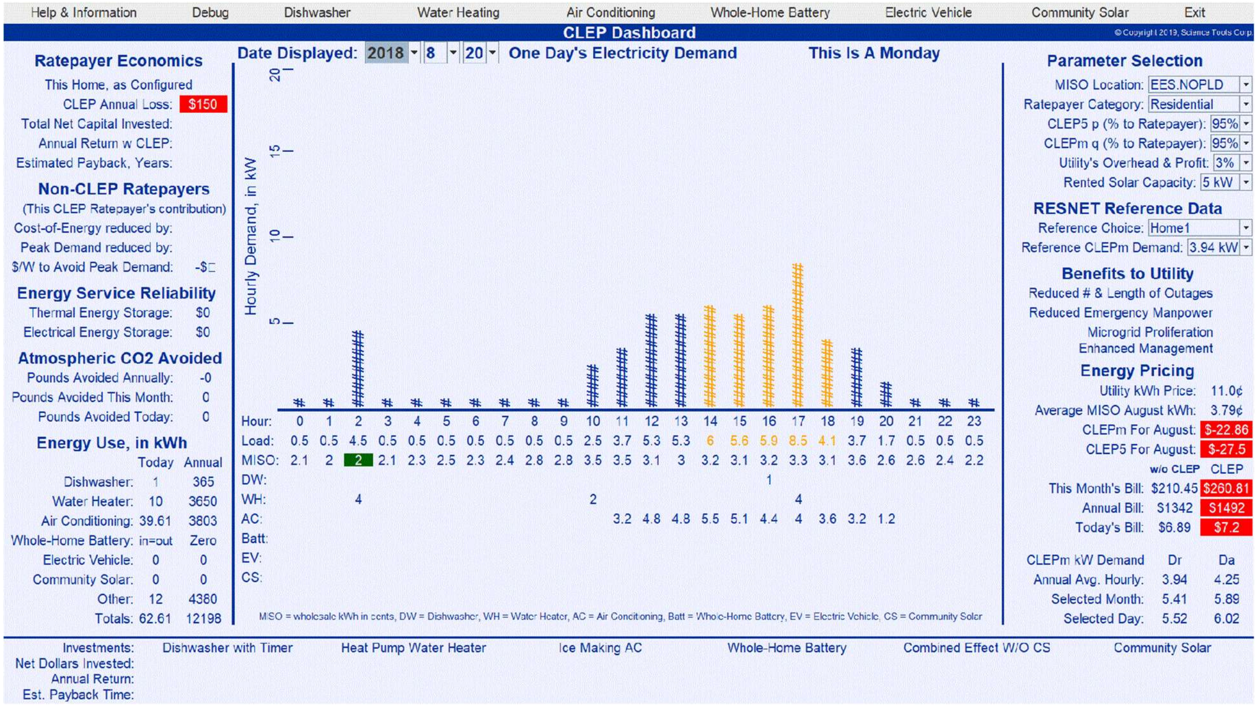
We would like to point out for anyone following along our screenshots with a calculator: The values displayed are always rounded, so while the CLEP Dashboard is calculating correctly and is only rounding the displayed value, using the displayed values as input to a calculator will have small apparent errors.

Below, we show several "screenshots" that show CLEP in action. We welcome all interested parties to coordinate with us for an in-person demonstration. We would like to remind readers that in a CLEP implementation as we envision it, the utility's bill is always paid in full; all their existing cost-payment mechanisms continue, and those costs are already covered. What CLEP does is provide a utility-friendly, with overhead and profit paid-for, incentive for energy consumers to use electricity more wisely and in ways that benefit everyone. And here, with the CLEP Dashboard, we illustrate exactly that with real data, as well as that can be done.

Just like understanding a computer game could never be explained with only equations and schematics, the CLEP Dashboard is intended to give its user a sophisticated simulation of the real world with CLEP.

Richard Troy, computer scientist, and Myron Katz, CLEP designer.

The Start Screen



Below, we will step through each of the various regions of the screen and describe their contents and function in some detail. But first, we begin with a less methodical description of what the program is aimed to do, and what the user sees when first starting the program.

This tool is designed to model the most common, prominent, and potential impacts of one individual ratepayer's electricity experience using many opportunities presented by CLEP.

Most fundamentally, the CLEP Dashboard user — who may be a consumer, regulator, or, indeed a representative of a utility — may select the location of where their wholesale electricity is coming from (such as MISO's EES.NOPLD node), the type of customer modeled (residential or not), what the utility's overhead plus profit is modeled to be, the functional formula values CLEP's **p** and **q** — which assign the percentages allocated to the customer — that regulators may choose to modify in order to alter consumer and utility outcomes — a "Reference Home" which describes the standard electrical load patterns expected of that facility (such as daily load not otherwise modeled) — all as background to the dynamic choices a ratepayer might make that affect changes in the load which can then be instantaneously modeled in real-time and represented in terms of time-of-day and overall loading, daily, monthly, and annually, with an eye toward providing feedback that can help drive good choices that benefit everyone.

Temporally, an entire year is modeled, and whenever any of the fundamental choices are changed the entire year is recalculated. Following this, any given month and day within the year may be chosen but these are display-only choices; no calculations are repeated.

Following the fundamental choices, a user may then choose from among at least 6 different types of "retrofits" to their modeled facility. The idea is to show their effects on electricity bills both directly from ENO and from CLEP, from their equipment and purchase choices displayed for each day, month, and, indeed the entire year, including the benefits to all involved.

While presently not all inputs are a part of the user-interface, the CLEP Dashboard permits whoever is running the program to alter virtually every aspect of the loads (possibly negative) used in the calculations so that the characteristics of different components can be compared. This is done by providing alternative data files that contain the needed data, and, when provided, these new data will be visible in the CLEP Dashboard's displayed choices in the appropriate locations. (A deeper discussion into this is beyond the scope of this document but is cited here to give the reader some insight into how this is done. Future versions may allow an easy user-interface to creating alternative data files, but this is yet to be accomplished.)

The CLEP Dashboard does not intend to represent full fidelity with a ratepayer's bill for many reasons, including differences in residential construction and efficiency, appliance efficiency, and resident lifestyles and generally only tries to get accuracy of around 90%. One example of this is the purposely ignored energy loss when an electric battery is charged and discharged; in reality, at least 5% is lost, but this software ignores errors of that magnitude. However, using the additional behind-the-scenes ability to modify what the CLEP Dashboard has available to it, virtually any scenario can be modeled fairly accurately.

Temporally, a very large set of data is at the user's fingertips in the form of electricity pricing (averaged by the hour) for an entire year and will lead to revelations that will likely surprise the user; these are highlighted via four colors as described below. Users can make various choices and see how these affect their energy bill daily, monthly and annually. CLEP economics are shown for preplanned variations from normal use of standard appliances, such as dishwashers and water-heaters, as well as with more novel energy upgrades (a.k.a., retrofits), such as installation of heat-pump water heaters, and ice-making air conditioners, etc., again with color highlighting here and there.

The dashboard layout is designed as follows:

Top — Across the top are pulldown menu tabs for help, debugging and the selection of key household appliances with options that significantly affect the electricity bills. "Debug" should be better named "Dump" because it lets the user "dump" the entire year's energy profile of the current selections into a file and then convert the format of that file enroute to external data analysis. The last two tabs, **Electric Vehicle** and **Community Solar** are key illustrations of CLEP-financed opportunities that complement an overarching goal of CLEP: ***financing sustainability with microgrids***.

Date Field — Selecting a date only changes the display and not any of the calculations that went into creating the present display-set. Different days associate to data and thus the Dashboard displays different MISO data and potentially different cooling loads accordingly; it is informative to see how each of these contribute to CLEP's ability to lower this customer's annual electricity bill and all non-CLEP ratepayers' electricity price.

It is important for the user to know that only by slowly stepping through many days in a year can a user somewhat gain full appreciation of the variability in wholesale electricity pricing. (Although the Dashboard displays the variability hourly, real MISO data varies 12 times as often.) For example, on August 20, 2018, a kWh's price averages less than two cents from 2 to 3 AM, while the next day, on August 21, it averages 29.7 cents between 3 and 4 PM.

Please note, that throughout the example screenshots provided below, we have kept the date set to a single day in August, i.e., August 20, 2018, because it is a representative day with heavy air conditioning load and, in addition, that day is one of the weekdays in August and thus has Peak Utility Demand Hours (PUDH). By keeping the date displayed the same, the screenshots represent an apples-to-apples comparison that permit the focus to remain on the changes/choices that the ratepayer has selected in the CLEP Dashboard.

THE GRAPH IN THE MIDDLE — graphically expresses **one day's data** and uses color to visually alert users to exceptional values. Presented is a relatively standard, **Consumption or Load** *vs* **hour of the day** graph. It has two complementary areas that provide data on an hourly basis, from left-to-right. The upper area provides vertical bars in order to graphically express the magnitude of both energy consumption [in kWh] and demand during that hour [in kW] (with each "#" representing ½ kWh or kW, respectively) while below: corresponding numerical values are displayed as the LOAD. Individually listed loads that make up that total are provided with their own row. Other data below the graph provide the abscissa values of the graph as "hour of the day" as well as the corresponding MISO price in ¢/kWh.

The vertical bars above the horizontal line simultaneously display both consumption and demand because the "per hour" units match numerically. The first row below the bar gives the hour of the day, from 0 to 23, the next row (down) displays the load profile based on equipment selections (from the pull-down menus at the top), and the default assumed load.

There are at least six choices an electricity consumer might make and each of these has its own horizontal row which denotes the current configuration chosen by the user for the current day.

While all the vertical bars and numerals are normally DARK BLUE, Peak Utility Demand Hours (PUDH) are **IN GOLD** to highlight them, however they may be highlighted in GREEN in "reverse video" if the demand goes below zero because this indicates a negative bill for the consumer and thus profit.

The next row below the hours are the hourly load totals, normally DARK BLUE, but again with **GOLD** used to highlight PUDH.

Below this date are the hourly MISO wholesale prices in cents per kWh. Also, normally DARK BLUE, GREEN highlighting in "reverse video" is used when the price is below two cents, **GOLD** (as a warning) when the price is ten cents and less than 20 cents, and RED when the price rises to twenty cents or more (per kWh) — to encourage / discourage consumption, respectively.

Following this are six rows that represent each of the fundamental loads or retrofit options among which the user can choose. They are generally arranged in order from left to right in increasing order of investment costs. When an option is chosen, a predefined "*set of hourly loads*" file defines the typical or optimal configuration for each day for that retrofit option.

We have conveniently totaled these "load" values individually, daily and annually, in **Energy Use, in kWh**, found at the bottom of the left-hand column**.**

Left Bar — Ratepayer Economics — This is the summary of the net effect on the overall annual electric bill for this individual ratepayer and non-CLEP ratepayers.

The Home, as Configured displays

- **CLEP Annual Loss**, e.g., $150 , can change to
  CLEP Annual Savings, e.g., $95**,** and can change to
  CLEP Annual Profit, e.g., $543, as the model progresses from its starting condition through the retrofits.

- **Total Net Capital Invested**
- **Annual Return w CLEP**
- **Estimated Payback Time in years** are displayed for the current ensemble of retrofits.

Non-CLEP Ratepayers — shows the net effect of this individual ratepayer's current set of choices on lowering the **Cost-of-Energy** and **Utility Peak Demand** and how these benefit non-ratepayers sharing the same electrical grid. It also displays the ratio of these values for comparison with utility investments that provide power.

- **Cost-of-Energy reduced by —** accumulates the $ savings from both

  1) ***avoided*** energy cost-shifts (normally accumulated from 2% of CLEP5 income) and
  2) ***avoided*** demand cost-shifts (normally accumulated from 2% of CLEPm income)

  onto Non-CLEP Ratepayers by using these parts of all CLEP income to buydown the Cost-of-Energy for the current month. However, if the CLEP customer opts-in, or otherwise has with a net cost shift onto other customers during any one month, 97% of all CLEP income goes to repay that subsidy before the CLEP customer receives any benefit from CLEP income. Only after that subsidy debt is repaid, does the contribution to Cost-of-Energy go to the normal accumulation rate of 2% of all CLEP income. This second condition guarantees that CLEP customers never cost-shift onto others.

- **Peak Demand reduced by —** is expressed in kW. Almost any act by a CLEP customer to generally reduce electricity consumption, i.e., measured by ENO bill, will decrease this home's demand during the utility's peak demand times, i.e., PUDH. The value presented here accumulates this effect.

- **$/W to Avoid Peak Demand** is the quotient of the last two values. Since the numerator is not borne by ANY customer, the best way to think about this ratio is that reducing peak demand happens without any cost burden to anyone and, thus, is expressed as a negative value. **<u>This is an important value to display</u>** because it illustrates a "cost free" alternative to building new power. For example, compare this negative value, reducing costs, to the economics of building a new peaking plant at more than $1.3/W for hundreds of millions of watts, dramatically increasing costs, which will burden all customers; <u>CLEP reduces the need for peaking-plants — at the very least: their scale can be substantially reduced if not eliminating their need entirely</u>. And this accumulating value helps to prove the point.

Energy Service Reliability — An "Energy Service" is what you do with electricity: e.g., cook, heat water, cool or light your home. These are the services that people want. There is no question that energy service reliability is paramount for most people, especially in the U.S. CLEP offers an approach to recognize key components of reliability that works on both sides of the meter.

One way to assure reliability is to install a whole-home battery, but to do that most cost-effectively, one must first invest in Thermal Energy Storage, and it is best to do these together. The CLEP Dashboard illustrates not only the financial benefits of these additions, but also *provides some quantification of the value of these assets to consumers. That's why the following breaks up electricity reliability into its most cost-effective component parts: first thermal and then electrical.*

- **Thermal Energy Storage**. Although currently not common, the savings from its use is displayed here via currently accessible technology. It is our estimation, and CLEP Dashboard assumes, that one-eighth of this potential can come from a programmed water heater which maxes out at $125/y while three-eighths is available via AC thermal storage device, a.k.a., ice-making AC, and maxes out to $375/y.

  Both depend upon whether all thermal energy is stored for the whole day, and the storage is "charged" before 6 AM each day. These are *ad hoc* descriptions of the progress a homeowner is making to decrease susceptibility to a power loss that occurs after 6 AM (when these and the next storage device have already been charged).

- **Electrical Energy Storage.** This displays savings from use of a whole-home battery (HWB). It is our estimation, and the CLEP Dashboard assumes, that $500 is the annual reliability value provided if the equipment can power the home for 20 hours after charging for 4 hours and charging is completed by 6 AM.

Atmospheric CO2 Avoided.

- **Pounds Avoided Annually / This Month / Today** — This area displays the annual net reduction in lbs of CO_2 from fossil-fuel powered generation caused by the effective use of off-peak, largely renewable power. This parameter display takes into account the observation that there is a high correlation between the wholesale electricity price and its carbon footprint. CLEP Dashboard makes a highly conservative but linear approximation to underestimate this effect. (We hope to improve this estimate and provide strong empirical evidence to support the assertions in CLEP in future versions of the Dashboard.)

Energy Use in kWh. As noted above, this box displays the ratepayer's energy profile based on all the present selections made. Each device is listed for that day as well as for annual consumption.

Across the Bottom – Investments. This area lists various potential electrical appliance choices available to the ratepayer and changes as electricity-bill-saving selections are made. It displays computed values for investment costs, return, and payback periods.

- Depicting pure ENO bills only, i.e., "non-CLEP" with no label but followed by "including CLEP" with the label: "w CLEP". For example: in the case of the heat pump water heater, one finds at the bottom of that column: "$240.9, w CLEP: $378.12". This means that the annual discount from reduced kWh consumption (a.k.a., *energy efficiency* savings) as found in the ENO bill is $240.90, but in addition, there is also a CLEP savings which adds to the $240.90 to get $378.12. Thus the "net" CLEP income for this retrofit is $378.12 - $240.90 = $137.22.

Future versions of the software may take into account the cost of funds and maintenance costs during the payback period. Notably, this information is summarized both in a column below the right vertical bar, and also in the upper left under **Ratepayer Economics.**

Right Bar

Parameter Selection. These are recommended parameters that affect the utility's participation and direct cost-recovery. It also identifies the database of pricing used. It is not anticipated that the ratepayer will need to adjust any of these factors. These choices are provided for the benefit of the utility commission (regulator) and the electricity provider utility. The software allows the user to change the recommended value of CLEP5's p or CLEPm's q from 95%, as well as the utility's default overhead and profit value from 3% (which together, at default values, gives 2% of all CLEP transactions to lower all ratepayer's bills as described earlier).

Some of the list-boxes are populated by the datasets available to the program when it starts and for some of these there is at present only one dataset, so while it may appear the program is not providing a choice, it is only because the datasets to back them up are not presently available. For example, the size of the Solar Array only has a "5 kW" dataset available.

RESNET Reference Data. This is provided for the utility commission and the CLEP team to communicate clearly the reference energy performance profile used in the software. This is is very important information to the calculation of CLEPm for a residence. As with the list boxes in the **Parameter Selection** section, available choices are populated by the software at startup.

Benefits to Utility

Utility Benefits are not yet fully calculated / determined but the potential is great. Consider that Hurricane Sandy taught New York and its Public Utility Commission, that standard metrics for electricity reliability (like SAIDA and CAIDA) were insufficient in such a major weather event. What saved lives went beyond the conventional grid and national standards imposed by NERC, (National Electricity Reliability Council). Hundreds of microgrids in New York saved lives even though few utility incentives stimulated their construction, nor did metrics of reliability predict their importance. This section is here to illustrate their importance and we hope to populate this section with useful data in a future version of the CLEP Dashboard.

Notably, consistent with the September 2015, Rocky Mountain Institute's report on *The Economics of Battery Energy Storage*[1], as well as the growing industry appreciation that one cannot attain the same level of reliability through investments on the utility side of the meter,[2] **the local CLEP team proposes to turn the utility into a partner with users and a direct beneficiary of CLEP.** Benefits currently proposed to be measured include *Reduced Number and Length of Outages*, *Reduced Emergency Management*, *Microgrid proliferation*, and *Enhanced Management*. These are the kinds of things we intend to model here.

Energy Pricing.

- **Utility kWh Price:** $0.11/kWh. This is the current, default value.
- **Average MISO August kWh** — is the average MISO price for the chosen month.

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[1] Fitzgerald, Garrett, James Mandel, Jesse Morris, and Hervé Touati. *The Economics of Battery Energy Storage: How multi-use, customer-sited batteries deliver the most services and value to customers and the grid*. Rocky Mountain Institute, September 2015. http://www.rmi.org/electricity_battery_value

[2] The concept of a *microgrid* is quickly becoming one of the most popular trends in energy distribution, offering resilience and independence that can't be achieved relying on the traditional power grid. Installations such as military bases, hospitals, universities and rural communities are already experiencing its many benefits. With the added benefits of infrastructure resilience and renewable energy emphases, microgrids seem like a perfect fit for the future of energy distribution. March 13, 2019 announcement of National Microgrids Conference on 17 - 18 April, 2019 - Boston, MA, United States

- **CLEPm** shows in RED reverse video the cost, and in GREEN reverse video the cost and savings, respectively, to the electricity bills from just CLEPm. CLEPm produces a demand charge for requesting power from the utility during peak demand times, and rewards customers with a negative demand charge for avoiding such demand. The magnitude of CLEPm's charges or credits is set to approximately match the current, annual cost of power (i.e., in actual demand charges) commonly charged non-residential customers. This is explained in detail in the answer to Question 10, in BSI's response to ENO's 1st interrogatory, submitted on June 1, 2019.

- **CLEP5** shows costs or savings from CLEP5. CLEP5 is the part of CLEP that penalizes *buying* electricity when its wholesale price is relatively high and rewards it when the price is low and also provides rewards and penalties for timely and untimely *sales*, respectively. The default assumption is the CLEP customer is paid or receives roughly 95% of the difference between the current price and the monthly weighted average wholesale price, i.e., Cost-of-Energy, so it is either a win or loss. This is similar to CLEPm, but instead, CLEP5 bases the reward or penalty on the difference between current wholesale price and the Cost-of-Energy. The CLEP customer is rewarded or penalized at the same absolute value of this difference. And, the four color choices for the display match those for CLEPm.

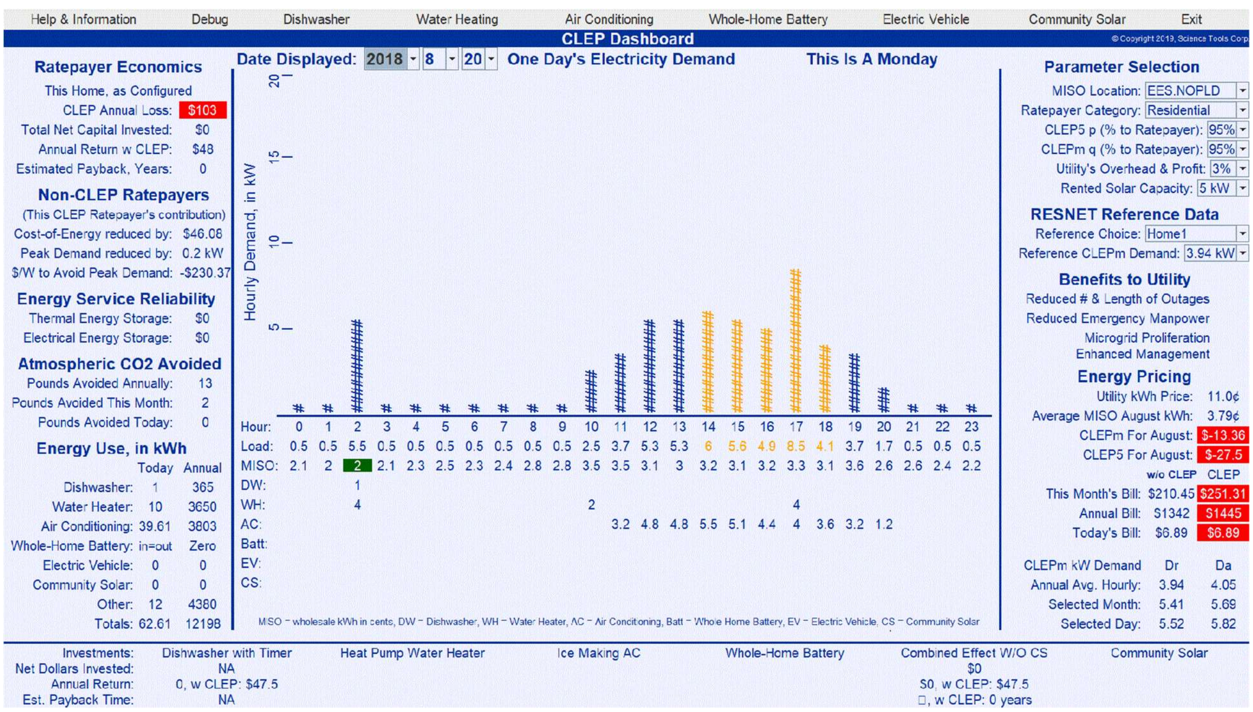
- **non-CLEP vs CLEP billing Monthly, Annually and for "Today"** — The values below this line show the impact on the electricity bill of not using CLEP versus using CLEP for a selected day, month, and entire year: depicting pure ENO bills only with "w/o CLEP" and aggregated ENO bills with CLEP depicted as "CLEP". For example: in the case of the isolated heat pump water heater retrofit, one finds on the "Annual Bill:" row under the "w/o CLEP" column the value $1101: and under the "CLEP" column the value $959. Thus the "net" CLEP income for this retrofit is $1101 - $959 = $142.

- **CLEPm kW Demand** table — For residential customers, CLEPm's contribution to a ratepayer's bill is calculated, in part, from the difference between actual kWs of demand and the expected (or Reference) demand. The pertinent values to evaluate this are displayed in the bottom right area of The Dashboard screen as a table: with one header row of three columns: "CLEPm kW Demand", "Dr" and "Da". The names of the rows are: "Annual Avg. Hourly", "Selected Month" and "Selected Day". The two value columns are labeled **Dr**, for Demand Reference (what's expected), and **Da**, for Demand Actual (what we computed [in the real world, this would be metered data]), and the values display are the averaged demand values during PUDH for their respective time periods. Recall that **Demand Reference** is *derived from the RESNET reference home* and **Demand Actual** for the hourly, monthly and daily time-periods are the calculated values for those periods for the presently configured customer. Good energy management should result when the **Da** values are less than the **Dr** values.

Ratepayer Economics

Please note that, prior to implementing any energy retrofits, the starting CLEP value is an Annual Loss of $150, see upper left side), with red representing a deficit. This starting value of a $150 loss represents, approximately (see below) the unintended cost-shifting onto other customers, this model customer was previously imposing costs on others before his/her OPT-IN to CLEP which (s)he will now be paying after OPTting-IN to CLEP, should she/he make no further changes to her/his energy profile. This customer's loss will decrease and convert to a savings as this customer increases CLEP income, at which time up to 97% of this $150 will be assigned to **Non-CLEP Ratepayers** benefits. For this customer, once the $150 is paid back, future CLEP retrofits contribute to the *Cost-of-Energy reduced by* field at 2% of the CLEP-generated income. This is displayed within the Non-CLEP Ratepayers area on the top left.

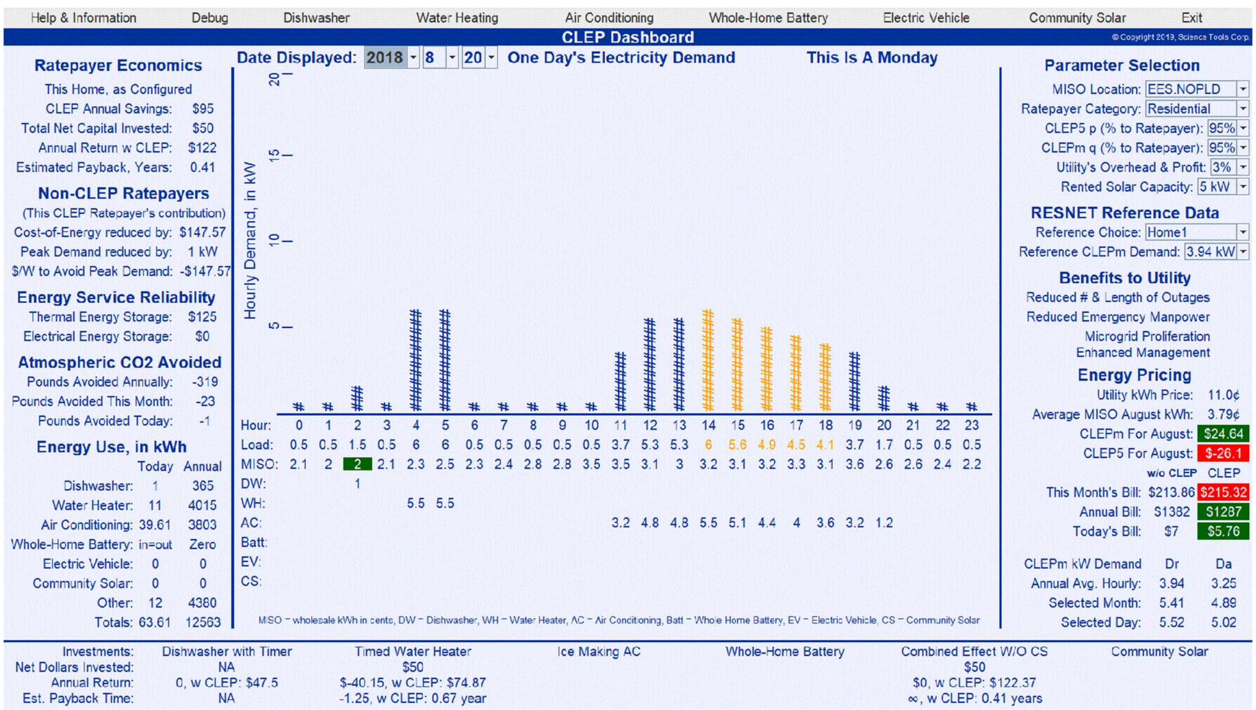
Timed Dishwasher



This screenshot shows an energy improvement that is very feasible and may cost nothing because many customers already have dishwashers and most new dishwashers now come with a built-in timer.

Choosing a time for programming the Dishwasher operation is completely flexible and can occur at any hour of the day. Enroute to making this selection, a pop-up window appears permitting choice of any hour of the day, (which the software assumes will be applied annually) we recommend an early morning setting, say 2AM, because the price at that time of the day is usually low. As the hour is changed, the ***annual return*** goes up or down by a few dollars — here, with 2AM chosen it changes to $47.59 currently displayed in the lower left of the screenshot, next to Annual Return: 0, w CLEP, but values could be slightly higher or lower depending on the hour selected. <u>Note that this retrofit does not decrease kWh consumption but does save money because it shifts consumption and demand: away from expensive electricity and peak demand times respectively.</u> This is an example of a non-Energy Efficiency retrofit that benefits the utility — and other users — but it one which is not economically financed without a "time-of-use" rate design like CLEP.

Timed Water Heater



This example shows a simple retrofit: a conventional electric water heater is fitted with a timer. Before the retrofit (as can be observed in the previous screenshot), the water heater consumption is assumed to be 10 kWh / day based upon the assumption that average bathing involves 15 to 20 gallons per person and the average home encounters around 3 to 4 showers a day. This is a conservative estimate; real bath-takers will see a larger economic benefit than represented in the model.

In this example, the water heater is timed to heat water during two 5.5 kWh events, occurring at 4 AM and 5 AM, chosen to reflect common bathing hours of 6-8 AM and 6-8 PM, while doing our best to avoid peak utility demand hours that start at 2 PM. Because we want to have enough hot water available at 6 PM, this requires over-heating the water temperature from

120 to 130°F, which uses an extra, one kWh/day. We also chose this time to “charge” the water heater because then, the price of electricity is low, and these times avoid PUDH.

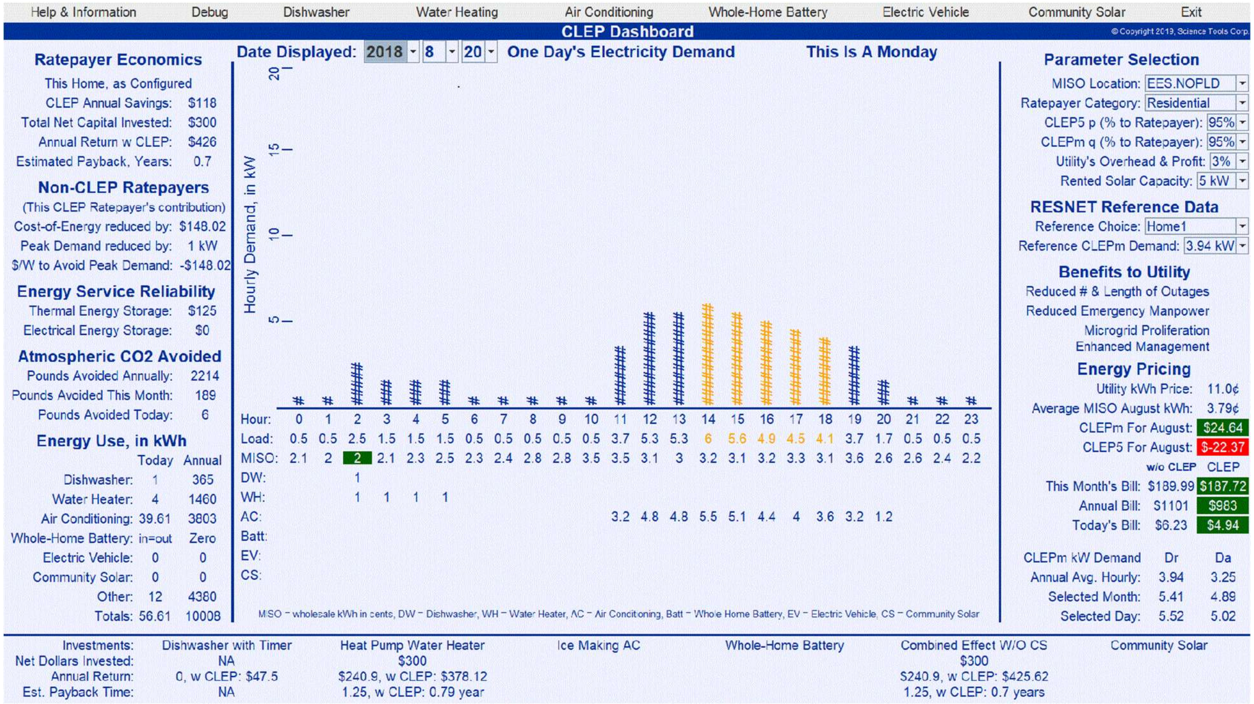
The retrofit’s cost is estimated at $50: $25 for the timer and $25 for installation.

Like the previous example, this is not an energy-efficiency retrofit. In the Annual Return field, under “Timed Water Heater”, the value, $-40.15, w CLEP, $74.87 means that no kWh savings occurred; in fact, 365 more kWh’s were used per year. Nevertheless, there was an annual CLEP income of 40.15 + $74.87 = $115.02 with a net value of $74.87.[3] More kWh were used, but because time-of-purchase was wisely chosen, this created both a time-of-purchase benefit (measured by CLEP5) and a demand reduction benefit (measured by CLEPm); i.e., the gross CLEP income is almost three times the $40/y extra cost arising from one more kWh consumed daily. Thus, the net decrease = ENO change + CLEP change works out to be almost twice as large as the increased costs from the 365 extra kWh purchases.

NOTE that the original CLEP Annual Loss, $150, seen on the Start screen, has been replaced by a CLEP Annual Savings of $95. This net change of $245 comes after only two simple, low cost retrofits, and this customer gets a lower bill than the starting ENO bill, by $95, and this customer has paid back the previous cost-shifting “subsidy” received from other customers where this customer had formerly shifted $150/y onto them.

[3] [There is a small SOFTWARE BUG in this version of The CLEP Dashboard: I know that there is a $35 understatement in the “$74.87” displayed value because the value at the “**Cost-of-Energy reduced by”** field is $147.57 which is a little more than 97% of $150 plus 2% of $47.5 (from the Dishwasher retrofit case). This indicates that the CLEP income without ENO bill change was about $150. Since the ENO bill increased by $40 (because of the extra 1 kWh of daily consumption), the net bill change after both effects should have been roughly $110 instead of $75.]

Heat Pump Water Heater



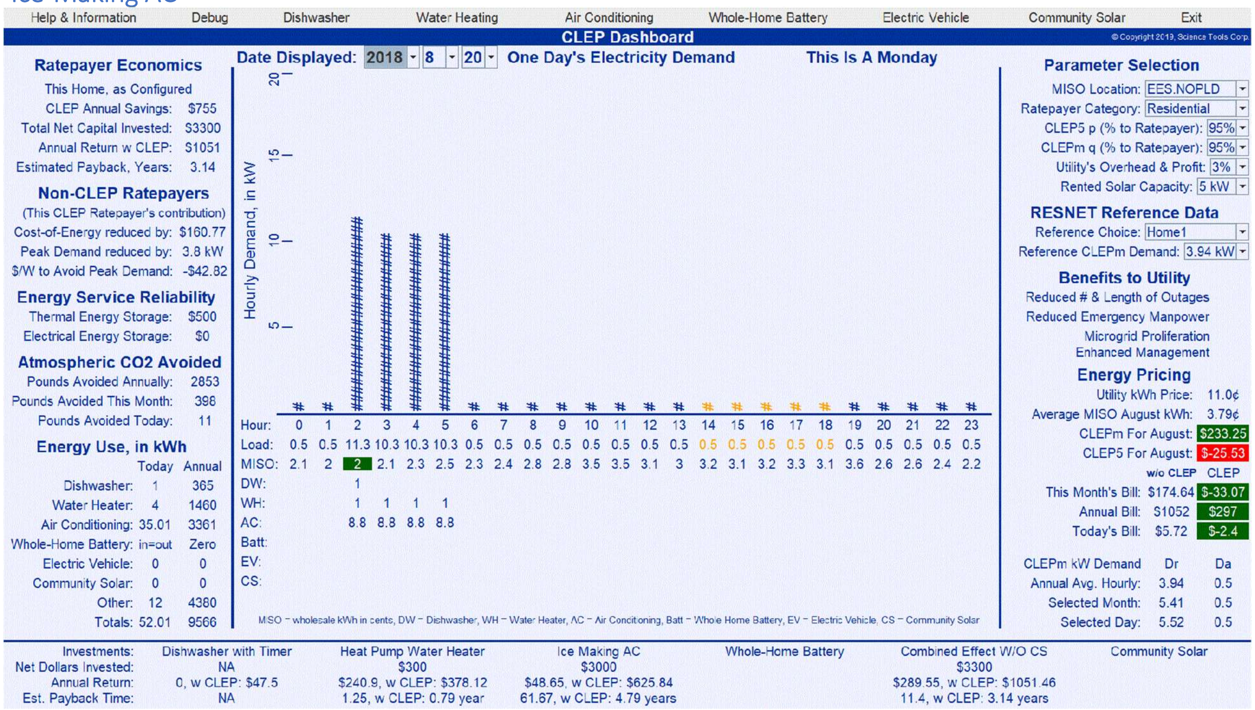
A Heat Pump Water Heater is a self-contained mini air-conditioner that provides air, cooled within the thermal envelope of the residence, and dumps this waste heat into the water tank. This appliance will not provide this cooling benefit if placed in the attic or other unconditioned space such as a garage. (The CLEP Dashboard does not estimate the value of this cooling effect.)

This is the first and least expensive of the retrofits that actually reduces kWh consumption; thus, it can be appropriately called an "energy-efficiency" (EE) retrofit. Indeed, the EE savings of $240.9 in the ENO part of the bill is bigger than the pure CLEP income, since "w CLEP" (income with CLEP) = $378.12, and "pure CLEP" = $378.12 - $240.9 = $137.22. Without CLEP, payback is just over a year; with CLEP, it's about 2/3 of that time.

The cost of this retrofit purchase is $300 at Lowes. https://www.lowes.com/pd/GE-GeoSpring-50-Gallon-Regular-10-year-Limited-Warranty-4500-Watt-Double-Element-Electric-Water-Heater-with-Hybrid-Heat-Pump/50335967. In January 2018, it listed at $550 with a $400 rebate from ENO's Energy Smart program. The residual $150 is for the labor to install the equipment, which otherwise connects exactly like the standard electric water heater it replaces.

Notably, CLEP can potentially replace ENO's $400 rebate program, which including the roughly $300 materials costs totals about $700 – about doubles the payback time – which would still be paid back by CLEP in under 2 years. No other billing strategy can match CLEP for incentivizing all parties in doing the right thing.

Ice-Making AC



An Ice-Making air conditioner is a newer technology, developed in 2003, that is being installed in California with major subsidies by the utilities to reduce peak demand, this kind of investment has been valued there for more than ½ a decade because it reduces the need for peaking power plants, and reduces the need to increase transmission line size and because it more cost-effectively handles demand increases by using onsite investments.

This cooling machine produces thermal storage by creating ice at night with a more efficient refrigeration process because of lower outside temperatures. Economics are also enhanced because electricity can be purchased at night at a substantial discount compared to what electricity costs in the afternoon, but of more value is this equipment's ability to shift demand to be well outside PUDH periods. In the morning, the condensing component provides refrigerant to the Fan Coil inside the residence. This continues until PUDH start. The Ice-Making unit then recirculates cold water through the ice coils onto a specially placed "radiator" coil, located between the fan and the evaporator coil, thereby providing cooling inside the building until the ice in the unit is fully melted. Once melted, the standard AC compressor switches back to conventional cooling until the unit can again make ice at night.

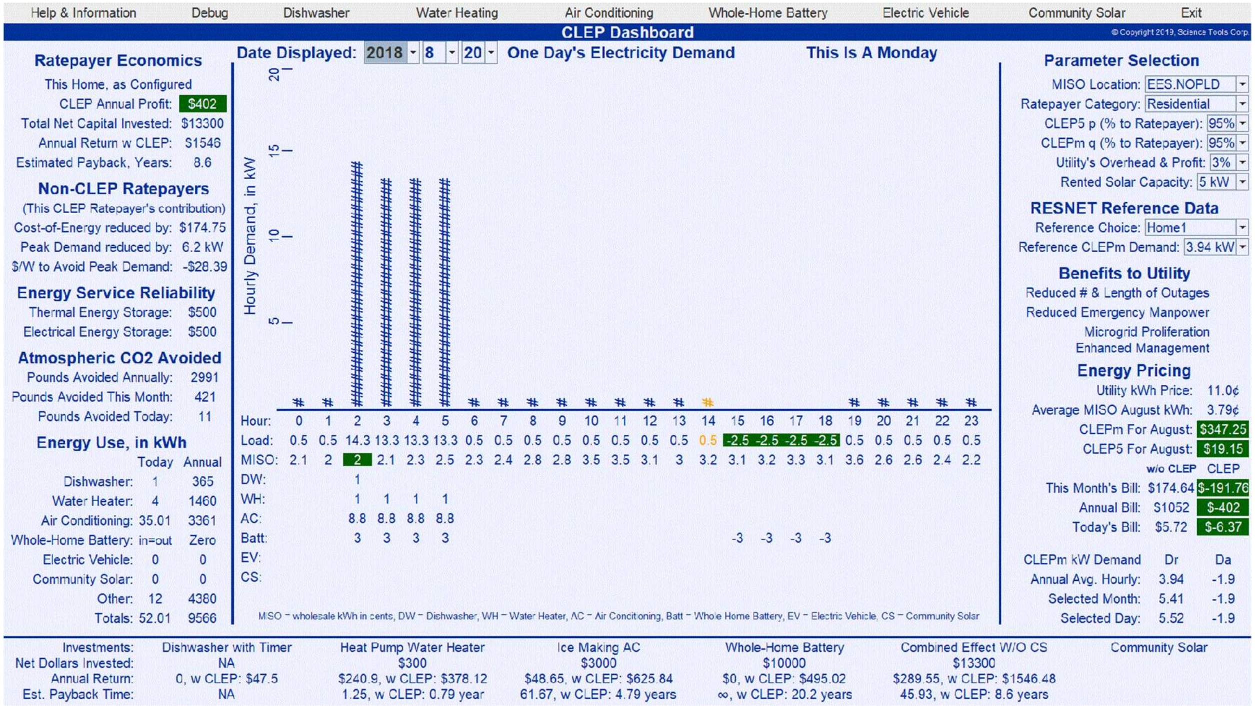
This equipment also provides an Energy Efficiency retrofit.

The $3000 price is one of the California utility's discounted price. If mass-produced on a scale like those made by Trane or Carrier, this equipment should have a more competitive price. Unlike the heat-pump water heater, the payback period without CLEP of 62 years is not helpful, but with CLEP, utility rebates, and energy storage tax credits, it can be financed with a 4 year or less payback. As production increases, and CLEP is implemented, there should be little-to-no need for rebates or tax credits.

The above can be observed on the screenshot.

Note the column on the lower right labeled **Combined Effect W/O CS** where the value of all prior retrofits is shown. This field accumulates the combination of all selected retrofits. Not included are electric vehicles, whose first costs are prohibitive, nor Community Solar, which does not represent a capital investment. The retrofits accommodated in this total-column at this time are the dishwasher (DW), water heater (WH), and ice-making AC (a whole-home battery has not yet been selected but its effects will be displayed here too when selected). This appliance group (sans battery) has a combined investment cost of $3300 and a combined payback of just under 3.15 years.

Whole-Home Battery



A Whole Home Battery (WHB) can provide all the electricity necessary to run the home for 20 hours after 4 hours of charging. The prior addition of the water heater and air conditioner retrofits programmed to charge simultaneously with the battery decrease the size and first cost of the battery needed for this home. <u>Without these retrofits, this battery would likely need have to have been at least twice the capacity to qualify as a whole-home battery.</u>

Without CLEP, payback is far from possible because a WHB does not even reduce kWh consumption (and, in fact, loses 3% to 10% of the energy that passes through the inverter/converter cycle). However, CLEP can provide over $600/year income by i) preventing load during peak periods CLEPm saving, ii) buying energy from the grid when the current energy price is low with CLEP5, or iii) by selling energy to the grid when the current energy price is high: this activity pays back in a reward from CLEPm as well as from CLEP5. These effects create a payback period of approximately 15 years, longer than the approximately 10-year warranty of the WHB. (This analysis uses prices from 3 years ago, but with current prices and better technology emerging today, the economics is looking rosier.)

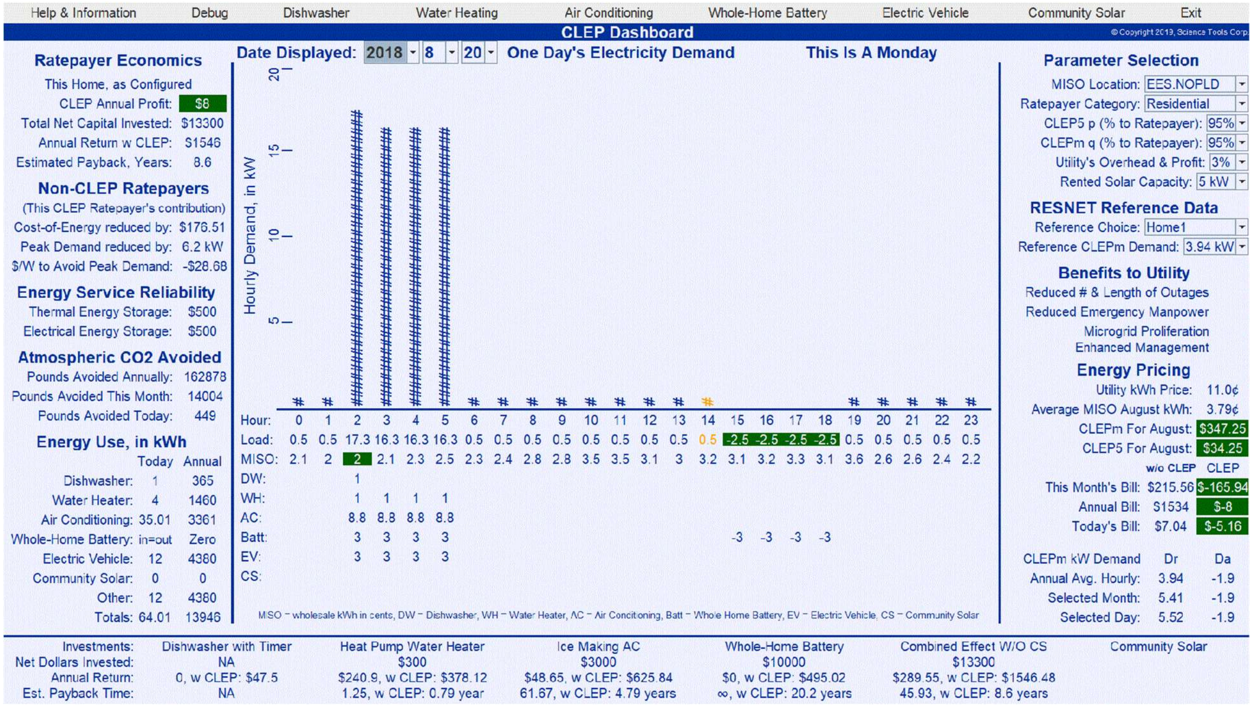
Bottom-row column 5 (below the right vertical line), **Combined Effect W/O CS,** notes that the full package of retrofits (DW, WH, AC, and Batt) has a combined payback of under 9 years and allows the WHB to be downsized from 24 kWh to 12 kWh. This also increases CLEP's income, which help to fully finance the ensemble faster than the useful life of the equipment purchased.

Energy reliability is valued by many customers. A 2011 study by PEPCO, placed a value on residential reliability in excess of $500 /year. This includes potential savings from things like avoided spoiled food and interrupted productivity. This value of reliability is reflected in the left column of the CLEP Dashboard under **Energy Service Reliability** (described above).

The Whole Home Battery adds a unique benefit that benefits all: it reduces peak demand needs, reduces CO_2 production, and increases overall grid reliability — especially valuable during power outages by helping maintain critical food sources, cooling, and communication.

Imagine a convenience store with a battery, serving citizens during a major outage, providing cell-phone charging, food and many other services, all “for free” if only they have batteries — and they already want them to preserve their refrigerated assets; all they need is a way to pay for them.

Electric Vehicle



This screenshot shows the benefits of owning Electric Vehicles (EV) under CLEP and its benefits to the grid, but ONLY if these vehicles are charged during nighttime peak hours, which CLEP strongly encourages as otherwise widespread ownership, which is needed for reducing our collective carbon-footprint, will burden the grid.

The Li-ion battery we consider in our example (commonly found in a Nissan Leaf, and typical of other electric vehicles) holds 24 kWh's and is designed to last over 20 years, or "longer than the car's lifetime", when restricting discharge down to not lower than 20% charged and always recharged up to 80% but seldom exceeding this value. This example assumes an average 50% discharge/recharge daily which takes 12 kWh and is statistically reasonable.

General EV economics are very favorable, using 25% of the cost of energy and 10% the cost of maintenance as compared with Internal Combustion Engines[4]. (CLEP improves this though we haven't yet quantified just how much.) One special benefit is that the car's battery can be hooked up to the home to function like a WHB at a much smaller cost. (Some EVs have optional equipment designed to do exactly this.)

The screenshot shows EV charging at night. Although, this increases CLEP5 income the additional 4380 kWh consumed to charge the vehicle increase the pure ENO bill, with the result

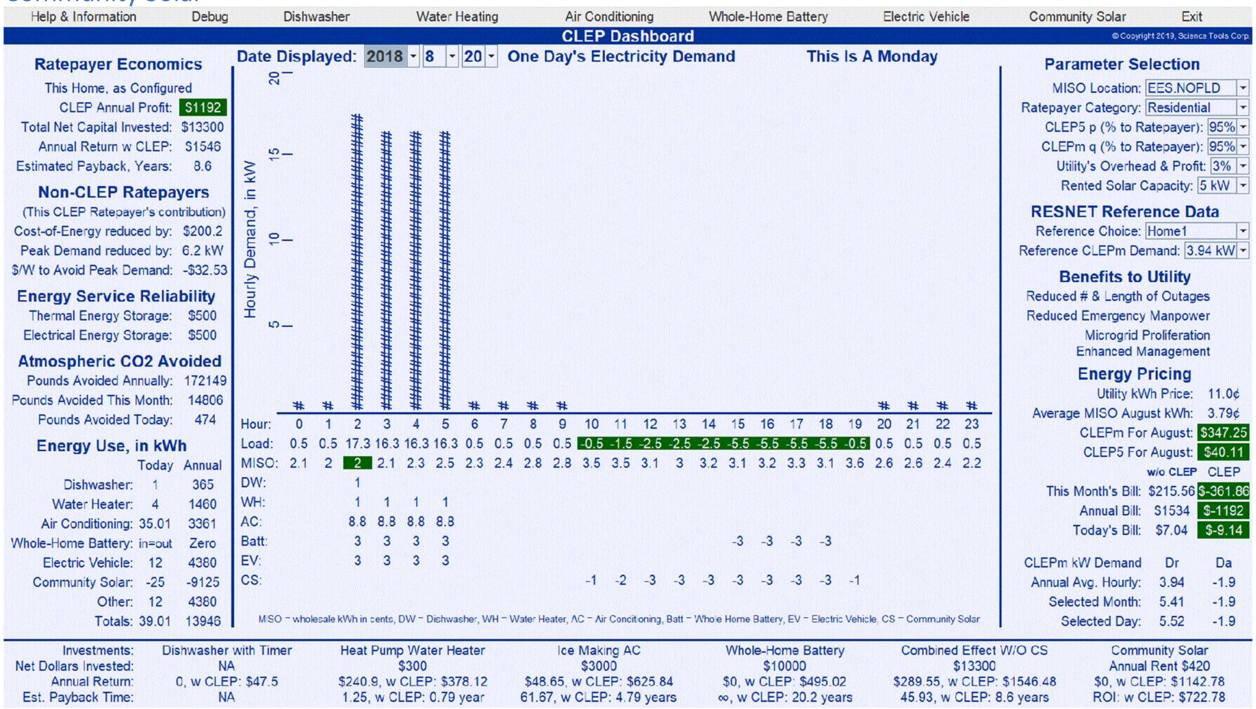
[4] https://afdc.energy.gov/fuels/electricity_benefits.html

that this process ate up almost all the $402 of “net income” displayed in the screenshot for the whole home battery.

Note that 4380 kWh will incur a 4380 times $0.11/kWh annual charge on the ENO rate = $481.80. The fact that the $402 net income only decreased to $6 means that there had to be annual CLEP5 income of $481.80 -402 + 6 = $85.60.

If, on the other hand, this same customer had chosen to charge the same vehicle during peak demand hours, there would have been an additional CLEPm charge of 12/5 * $50 * 5 = $600.

Community Solar



This Community Solar (CS) example assumes a community solar farm financed by renting out equal sections at 5% over 20 years, costing the renter, according to the National Renewable Energy Laboratory, $84/KW or $420/y for “5 kW”, which generates approximately 25 kWh’s/d, as shown on the CS row below the graph (lower right corner).

CLEP5 income is redefined for CS to be the actual MISO price * # of kWh generated.

CLEPm is redefined as CLEPm = $50 * (0 – **Da**). (Since **Da** is a negative demand, CLEPm >0)

Total CS income per kWh of $1142.78 is found on the lower right of the bottom section.

Total CS kWh per year “consumed”, -9125 is found to the left and is based on an annual average which approximates the users experience in New Orleans. (Note that an improved understanding of this calculation is already underway, based on the orbital mechanics of the Earth’s orbit, and will provide more correct daily value. We hope to have this better calculation in an up-coming version of the CLEP Dashboard.)

Taking a quick look at the economics, $1142.78 / 9125 kWh = $0.125/kWh. Given current ENO pricing for residential customers is roughly $0.11/kWh, <u>this payback is almost 14% higher than without CLEP and a key reason is because peak solar production always occurs during PUDH.</u>

Using CLEP with CS will improve solar’s affordability, as well as offer an option to Net Energy Metering (NEM) which is flawed and out of favor because it shifts costs to non-NEM customers.