

## Methodology

Your buildings already have a sophisticated energy management system – their electric meters. They can tell you a lot about how your facilities use energy, and find opportunities for reducing energy costs:

- How big is your “24x7” load, from equipment which is never turned off (hint: it’s often much larger than you think)?
- What are your buildings’ most common usage profiles, when do they “wake up” and “go to sleep”. Are these what you expected?
- How often does the load spike at unexpected times, and what is this costing you. Is there a pattern to these spikes, like late nights or weekends?
- Are there long term or seasonal trends such as “load creep”?

Think of your meters as cameras which take a snapshot of your buildings’ energy consumption every 15 or 30 minutes. Then imagine looking at a year’s worth of these snapshots in sequence, like a movie. You would see regularly occurring patterns, such as winter vs. summer, weekday vs. weekend, or day vs. night. You would also see occasional deviations in these patterns, spikes or dips at unusual times.

This is what ENERGYai™ does. It systematically analyzes historic meter data to identify usage trends and deviations. It looks for “actionable” patterns, where operational changes may reduce energy costs. For example, an analysis for a commercial office building revealed a 12 hour bump in 90% of Saturday and Sunday electric profiles. Though the bump was small, it added over \$6,000 to the annual electric bill. A simple controls scheduling change eliminated the increase.

The ENERGYai™ analysis is not limited to electric utility meter data. Any system which measures and stores hourly or subhourly energy or demand data can provide the necessary input. This includes meters, submeters, data recorders, building control systems, etc. Almost any energy commodity can be analyzed, including electricity, natural gas, chilled water, steam, etc.

ENERGYai™ requires 6 to 13 months of interval readings (e.g. hourly, half hour, 15 minute, and shorter). Load data must be energy (e.g. kWh, therms, cubic meters, ton-hours) or demand (e.g. kW, therms/hour, tons). Loads can be large or small. A load might represent a single lighting panel in a building, or an entire university campus.

The way in which the ENERGYai™ findings are presented is as important as the analysis itself. Just as the front page of a newspaper highlights the big stories of the day, the “Load Analysis Report” highlights the biggest savings opportunities as concise “actionable information”. The report is delivered to you as a PDF document ([click here](#) to view a sample Load Analysis report).

The historic meter data for each load is processed through seven steps in the ENERGYai™ analysis:

- Data validation
- Long term trends
- Load profile patterns
- 24x7 load
- Deviations from the “expected”
- Shutdowns
- Energy prices and CO<sub>2</sub> emission factors

Each of these steps is described below.

## Data Validation

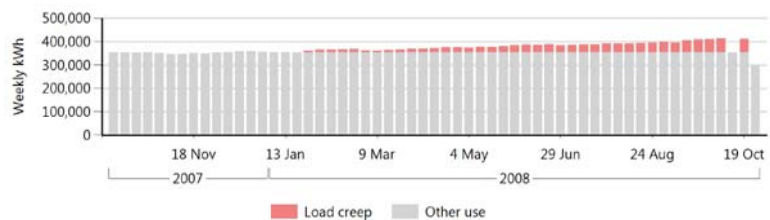
ENERGYai™ validates your meter data before running the analysis. So you don’t have to “clean” your files. Just download and send them to us. The validation process includes:

- Identifying gaps, or missing readings;
- Interpreting zero or negative value readings. While it is possible for a reading to have a zero or negative energy or demand value, it may also result from a meter error. So if there relatively few of these, they are interpreted as “bad” readings and excluded from the analysis;
- Flagging unrealistically high value readings caused by meter errors;
- Verifying that at least 6 months of data is available. ENERGYai™ requires 6-13 months of readings (more is better). If you send more than 13 months of data, ENERGYai™ will only use the most recent 13 months.

If a load has too much “bad” or missing data, the analysis will not be run, and you will not be charged for that load.

## Long Term Trends

ENERGYai™ identifies seasonal patterns and other long term trends over the 6-13 month analysis period. These include heating and/or cooling season increases, and steady load creep from added plug load or aging equipment. The Load Analysis report estimates the savings potential from improving heating/cooling system efficiency, or reducing the rate of load creep.

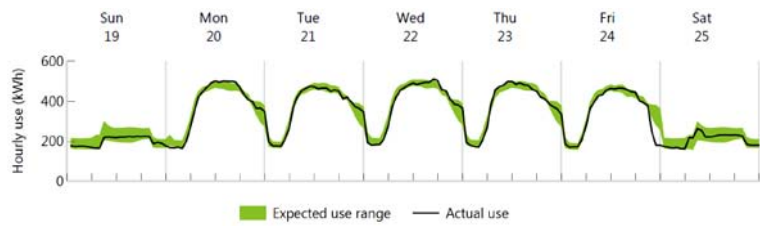


And sometimes no news may be good news. ENERGYai™ will tell you if your long term trend is flat over the analysis period.

## Load Profile Patterns

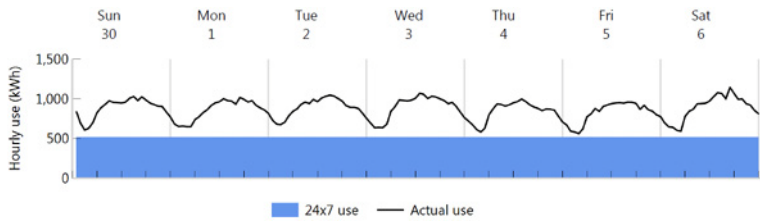
ENERGYai™ analyzes the hour-to-hour load change over the analysis period. Is weekend use significantly lower than weekday use, after adjusting for seasonal and other variations? Are there dominant times of day when the building “wakes up” and goes to “sleep”? At what hours does the load rise or fall most steeply? When does the load peak for the day, and when does it bottom out?

ENERGYai™ compares the dominant patterns for each day of the week. So you can see if Mondays behave differently than Tuesdays-Fridays, or if Saturdays are different than Sundays. In short, are your facilities behaving as expected?



## 24x7 Load

Just about every facility has “24x7 load” from equipment that is never turned off. Some of this load is unavoidable, like data centers, safety equipment, and security systems. But other continuous loads like circulating pumps can be reduced with controls. Standby, or “phantom” power from computers and appliances when they are supposedly off may also be a significant source of 24x7 load.



It is not unusual for 24x7 load to make up over 50% of a building’s annual electricity use. So even small reductions in this demand add up to big cost savings. ENERGYai™ estimates the potential savings from reducing this continuous load.

## Deviations from the “Expected”

By combining all of the prior analyses, ENERGYai™ creates an “expected” range of hourly use over the analysis period. It then zooms in on those periods when actual use is higher than this range, looking for patterns which might reveal savings opportunities.



For example, two factors can cause energy use to be higher than expected. The first of these might be called “who forgot to turn out the lights?” This is when the expected use drops (perhaps at the end of the work day), but the actual use remains flat, suggesting that equipment which is usually turned off is left on. The second factor might be called “who’s awake in the middle of the night?”, when actual use jumps during “off” hours.

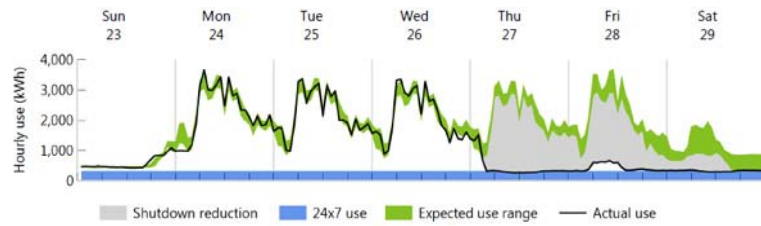
ENERGYai™ reveals when these patterns are most likely to occur, and how much they cost over the analysis period

## Shutdowns

ENERGYai™ looks at periods when actual use is less than expected, especially for one or more consecutive days. We call these “shutdown” days – when the use for almost all hours is significantly less than expected, usually near the 24x7 level.

The Load Analysis Report lists all of the shutdown days found in the analysis period. How is this “actionable”? Suppose your operations were closed for the week between Christmas and New Year’s.

ENERGYai™ will let you know if your equipment and systems were taking the holidays off, or if they were working as usual.



## Energy Prices and CO<sub>2</sub> Emission Factors

The Load Analysis Report not only presents potential energy savings found by the analysis, it also translates these into avoidable costs and greenhouse gas emissions. We maintain a database of energy prices for the U.S. and most countries, using recognized sources. For example, U.S. electricity and natural gas prices are updated monthly from the Energy Information Administration (EIA) national and state retail price database.

Similarly, we maintain current equivalent CO<sub>2</sub> emission factors from the Environmental Protection Agency’s “eGRID” database for the U.S., and from the International Energy Agency for international locations.