nbi new buildings institute

FirstView®

Understanding FirstView® Results

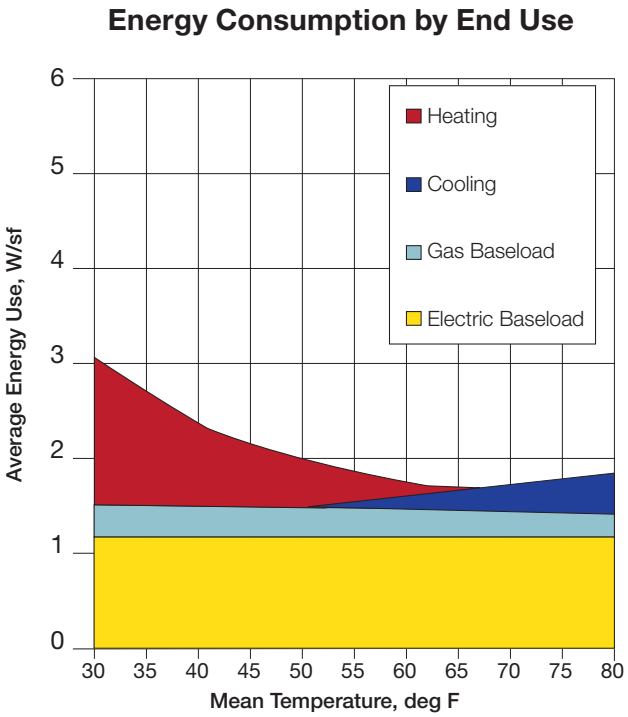
FirstView software and services from NBI allow for a quick diagnostic review of energy performance in commercial buildings. The FirstView tool's calculation engine creates a self-calibrated inverse model of a building that is able to disaggregate building energy end-use into heating, cooling, electric and gas baseloads. This allows building owners, operators and designers to better understand how the building is using energy in various systems and components. The FirstView tool also allows for an initial diagnostic analysis of building energy-use patterns and potential performance improvement opportunities.

With few data inputs, the FirstView tool plots an Energy Signature for the building. An Energy Signature is a display of average energy (vertical axis) in relation to outside temperature at the building location (horizontal axis) over the same time frame. High energy use is expected during hot and cold periods, with lower energy use expected during mild temperature periods.

The FirstView software tool quickly generates information about a building's energy performance and provides diagnostic information on potential areas for improvement.

FirstView Investigates Four Key Areas:

- **Heating:** The energy used for heating in relation to the change in outdoor temperature. The steepness of the slope, amount of energy and overlap with cooling provides indications of envelope, system and controls efficiency.
- **Cooling:** The energy use for cooling in relation to the change in outdoor temperature. The steepness of the slope, amount of energy and overlap with heating provides indications of system and controls efficiency, and solar gain characteristics.
- **Gas Baseload:** The base amount of energy used to heat domestic hot water (can only be disaggregated with gas-fueled hot water used across the year.)
- **Electric Baseload:** Electric baseload is generally not affected by outside temperature and represents energy use for lighting, equipment and other loads that are primarily driven by occupancy. The magnitude of this load can indicate occupant behavior patterns.



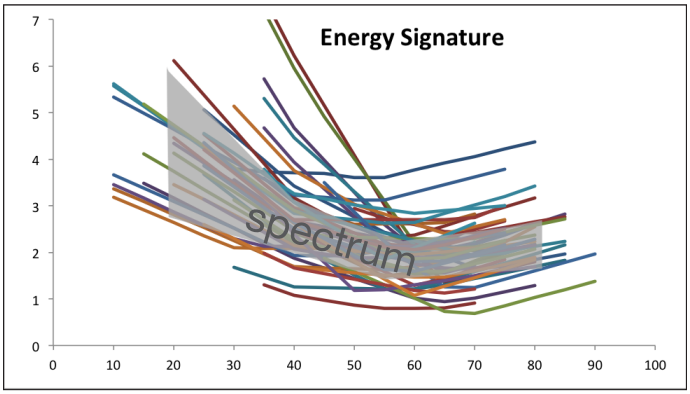
Additional explanation of how these end-use breakdowns are developed by the FirstView software is provided in the table below.

Energy End Use	Method
Electric Baseload	If there is a period during the year where no heating or cooling is utilized, the only energy use in a building is electric baseload. In the FirstView tool, Electric Baseload is calculated as the sum of lighting, plug loads, year-round fans and pumps, consistent process loads and electric water heating. The FirstView tool recognizes that these elements of a building's electricity consumption are relatively constant throughout the year and are independent of outside temperature.
Heating	Heating energy is derived in the FirstView tool by analyzing the estimated internal gains, overall heat transfer coefficient, and modeled equipment efficiencies of a building. Using this information, the FirstView tool calculates the energy used for heating (including estimated electricity consumption for fan and pump operation).
Cooling	Cooling energy is derived in the FirstView tool by analyzing the estimated internal gains, overall heat transfer coefficient and modeled equipment efficiencies of a building. Using this information the FirstView tool calculates the electrical energy used for cooling (including estimated fan and pump energy use).
Gas Baseload	Gas Baseload is derived in the FirstView tool by analyzing a building's summer gas use. Typically this is gas that is used for service water heating. However, some buildings may have additional year-round gas demand in the form of gas process loads (such as kitchen equipment). Electric-fueled water heating cannot be disaggregated with this tool.

Diagnostic Observations

NBI uses the Energy Signature plot to analyze performance patterns of the building. Using algebraic equations commonly used in energy modeling, the FirstView tool acts like a prism, revealing the component parts of end use in the areas of heating, cooling, electric baseload and gas baseload end uses.

The FirstView software tool then automates a diagnostic analysis. It does this by comparing mathematic parameters revealed in the Energy Signature to pre-determined thresholds in six areas: occupant load, heating and ventilation, cooling efficiency, controls, reheat, and gas baseload. For example, heating and cooling performance is revealed in the respective heating and slopes while electric lights and plug load energy use is represented in the height of the baseloads. Staff at New Buildings Institute with decades of experience set these diagnostic thresholds for particular building types.



In addition to a diagnostic comparison, FirstView software and services allow for an advanced benchmarking comparison that graphically illustrates how a reference building compares to peers. For this, NBI staff defines a comparison 'spectrum' of performance based on results from hundreds or thousands of previous FirstView runs. Currently, NBI has a high performance office spectrum, an average performance spectrum and a spectrum for K-12 schools. NBI can create a custom spectrum once a sufficient amount of data is aggregated.

NBI's diagnostic predictions and peer-building benchmarking comparisons are derived from whole building data, and do not require the collection of more extensive and expensive system sub-metering. Therefore, the FirstView tool can provide direction as to potential areas for further investigation at a fraction of the cost and effort of building sub-metering.

The FirstView Tool's Automated Diagnostic Observations

The interpretive comments on the FirstView tool's reports align with elements of the Energy Signature, while also drawing on more detailed analytical information from the underlying calculations. The following are some examples of automated observations that FirstView makes possible using only monthly utility data.

FirstView End Use	Method	Potential Areas to Investigate
Electric Baseload/ Occupant Load *The FirstView tool's observations for occupant load include: Low (good), Typical, High*	If there is a period during the year where no heating or cooling is utilized, the only energy use in a building is electric baseload. In the FirstView tool, Electric Baseload is calculated as the sum of lighting, plug loads, year-round fans and pumps, consistent process loads and electric water heating. The tool recognizes that these elements of a building's electricity consumption are relatively constant throughout the year and are independent of outside temperature.	Savings opportunities may exist in light levels, lighting controls, managing plug load and computer use (including data centers or 24 hour computer schedules), adjusting fan schedules and addressing parking garages and exterior lighting.
Heating Impact of Shell and Ventilation *The FirstView tool's observations for impact of shell and ventilation include: Poor, Good, Typical*	Heating energy is derived by the FirstView tool by analyzing the estimated internal gains, overall heat transfer coefficient, and modeled equipment efficiencies of a building. Using this information, The tool calculates the energy used for heating (including estimated electricity consumption for fan and pump operation).	Symptoms of envelope/ventilation issues can include: • Conspicuous morning heating followed by afternoon cooling or • Excessive pressure differences between inside and outside of building (doors pushed open) Causes can include: • Leaky, poorly insulated or over-glazed shells • Poorly synchronized supply and exhaust fans • Improperly adjusted outside air dampers • Unnecessary 24-hour ventilation or misadjusted outside air dampers
Cooling Efficiency *The FirstView tool's observations for cooling efficiency include: Poor, Good, Typical*	Cooling energy is derived by the tool by analyzing the estimated internal gains, overall heat transfer coefficient and modeled equipment efficiencies of a building. Using this information FirstView calculates the electrical energy used for cooling (including estimated fan and pump energy use).	Excessive solar gain may be driven by significant window area exposed to sun (especially in the afternoon), poor window performance and limited use or availability of shading devices. Other cooling performance problems may include system capacity, coil maintenance or control issues. Ventilation rates that are too high in hot periods or too low in temperate periods (poor economizer performance) can also contribute to excess cooling loads.
Controls *The FirstView tool's observations for impact of controls include: Large inefficiencies from controls, Moderate, None.*	The controls indicator compares the amount of heating and cooling that is used in a building, to the amount that would be expected for a building with similar occupant loads, shell and ventilation characteristics, and equipment efficiencies. A large discrepancy between the used and expected values suggests that control errors are creating inefficiencies. Overlapping heating and cooling energy patterns at transition temperatures are especially indicative of control issues, as described in the Reheat section below.	Control problems are an extremely common cause of poor building performance. The FirstView tool is able to identify energy-use patterns that do not align with expected performance. These may be caused by control problems. Control issues can include wide-ranging issues such as, but not limited to: • poor off-hour light and plug management • over-ventilation • mis-calibrated temperature sensors • conflicting zone controls

FirstView End Use	Method	Potential Areas to Investigate
Reheat *The FirstView tool's observations for Reheat include: Probable, None*	Reheat is a particularly common type of control problem. At the monthly data level, most office buildings will show a slight level of overlapping heating and cooling use in the 50–65 degree average monthly temperature range. Excessive reheat is suggested by overlaps covering a wider temperature range, high levels of both heating and cooling, and high summer gas use.	Reheat may be indicated by: • Activity by the re-heat coils or elements during non-heating periods • Recurring hot/cold calls due to poor system design or components (most commonly improper zoning), which cannot be easily addressed by control remedies. Possibilities for addressing this situation include: • Careful set up of heating/cooling temperature set points and temperature resets. Broadening dead bands where practical • Verifying accuracy of temperature sensors • Ability to set VAV boxes to minimum air flow when cooling is no longer needed • System or component redesign/replacement, especially targeted re-zoning
Gas Baseload *The FirstView tool's observations for gas baseload include: High, Typical*	Gas Baseload is derived in the FirstView tool by analyzing a building's summer gas use. Typically this is gas that is used for service water heating. However, some buildings may have additional year-round gas demand in the form of gas process loads (such as kitchen equipment). Electric-fueled water heating cannot be disaggregated with this tool. In the absence of special process loads such as laundry, cooking or exercise (shower) facilities, office building summer gas use is generally minimal. High gas baseload may be caused by HVAC or domestic water circulation/standby losses or reheat.	If special process loads can be ruled out, possible savings opportunities may be from domestic hot water circulation pumps (especially 24-hour circulation) and hot water leaks. Boilers operating below 50% load will have disproportionate thermal losses, often found when a large boiler operates in summer to serve only service water heating (domestic type uses). See Controls for discussion of high gas baseload associated with excessive reheat.
Data Consistency *The FirstView tool's observations for data consistency include: Orderly (good), Irregular*	Energy signatures are smooth patterns that fit as well as possible to the actual monthly energy data. Irregular data results in a poor signature fit and decreases the accuracy of the end-use estimates. Irregular monthly data typically arises from erratic system controls, inaccurate reporting of monthly energy use or very irregular occupant loads/ schedules.	If incorrect meter measurements can be ruled out, possible problems may be with seasonally adjusted temperature resets. Failure to readjust heating and cooling settings for optimum performance in each season will be particularly evident in higher energy use at the start of winter and summer.

New Buildings Institute

New Buildings Institute (NBI) is a nonprofit organization working collaboratively with commercial building professionals and the energy industry to improve the energy performance of commercial buildings.

www.newbuildings.org