FirstView®

nbi new buildings institute

Understanding FirstView® Results

FirstView software and services from NBI allow for a simple yet insightful diagnostic review of energy performance in commercial buildings. FirstView's calculation engine uses multivariable regression analysis to generate a weather-normalized simulation model of a building. The building's energy usage is disaggregated into heating, cooling, thermal baseload, and electric baseload. This allows building owners, operators and designers to better understand their building's energy use. FirstView can also provide diagnostics to help identify potential improvement opportunities.

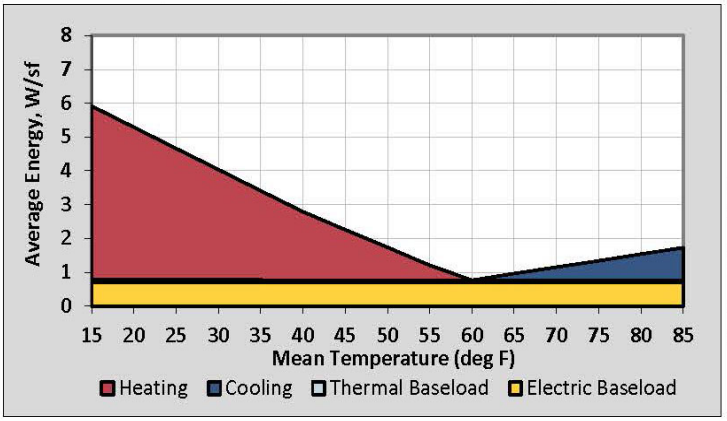
Using only a few data inputs are needed to model the building and plot an Energy Signature for the building. An Energy Signature is a display of normalized monthly energy use compared to monthly average outside temperature. High energy use is expected during summer and winter months, while the milder "shoulder" seasons typically show lower energy use.

FirstView provides easy-to-understand insights about a building's energy performance and provides diagnostics to identify potential improvement opportunities.

FirstView Investigates Four Key Areas:

- **Heating:** Energy used for space heating. The steepness of the heating slope, total amount of energy used, and overlap with cooling are indicators of envelope, system loads, and controls.
- **Cooling:** Energy used for space cooling. The steepness of the cooling slope, total amount of energy used, and overlap with heating are indicators of envelope, system loads, and controls.
- **Thermal Baseload:** Energy used year-round for thermally driven weather-independent loads such as water heating, cooking, or laundry. This energy may come from natural gas, liquid fuels, district hot water or steam, or other thermal sources.
- **Electric Baseload:** Energy used year-round for generally weather-independent loads such as lighting, plugs, consistent process loads, and electric water heating.

Consumption by End Use Energy Signature



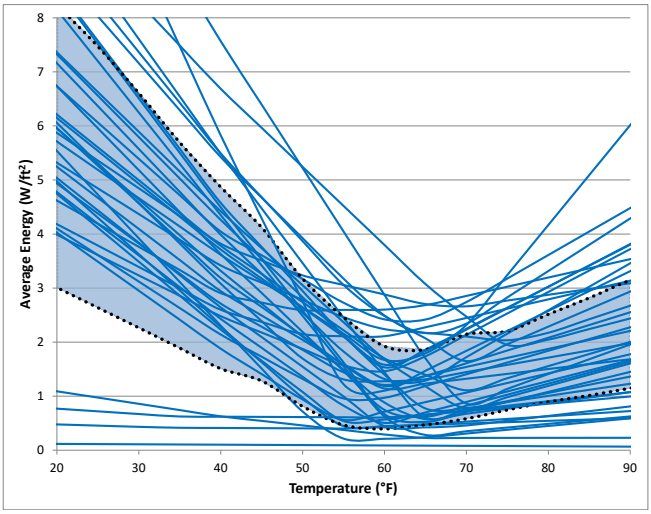
Additional explanation of how these end-use breakdowns are developed by FirstView is provided in the table below.

Energy End Use	Method
Heating	Heating energy is derived in FirstView by analyzing the estimated internal gains, overall heat transfer coefficient, and modeled equipment efficiencies of a building. Using this information, FirstView calculates the energy used for heating (including estimated electricity consumption for fan and pump operation).
Cooling	Cooling energy is derived in FirstView 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 heating-related electricity consumption for fans and pumps). Heating energy may be come from thermal sources (natural gas, oil, district hot water or steam, biomass, etc.) or electricity, or a combination of both. In buildings with both electric and thermal heating FirstView automatically calculates the portion of heating load met by each fuel.
Thermal Baseload	Thermal Baseload is derived in FirstView by analyzing a building's weather-independent (summer) thermal fuel usage (natural gas, oil, district hot water or steam, biomass, etc.). Typically this is natural gas used for service water heating. However, some buildings may have additional year-round thermal demand in the form of process loads (such as kitchen equipment). Electric-fueled water heating can be estimated but not derived with this tool, and is included in the Electric Baseload category.
Electric Baseload	If there is a period during the year where no heating or cooling is utilized, the only electricity use in a building is electric baseload. In FirstView, Electric Baseload is calculated as the sum of lighting, miscellaneous and plug loads year-round fans and pumps, consistent process loads and electric water heating. FirstView recognizes that these elements of a building's electricity consumption are relatively constant throughout the year and are independent of outside temperature.

Diagnostic Observations

FirstView uses a multivariable regression analysis method to generate a model of the building based on physical parameters. These parameters represent building characteristics like overall heat transfer coefficient through the building skin, heating and cooling setpoints, and system-level efficiencies.

FirstView 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. Unique diagnostic thresholds, calculated by staff at New Buildings Institute, are used for various 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 both high-performance and average-performance comparison spectra for offices, schools, multifamily buildings, fire stations, libraries, and community centers. NBI can also generate custom spectra for specific groups of buildings, such as a city or a building portfolio owned or managed by one group.

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, FirstView can provide direction as to potential areas for further investigation at a fraction of the cost and effort of building sub-metering.

FirstView's Automated Diagnostic Observations

The interpretive comments on FirstView'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, building type, and building size.

FirstView End Use	Method	Potential Areas to Investigate
Electric Baseload/ Occupant Load *Diagnostic Range: Low, 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 FirstView, 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 *Diagnostic Range: Good, Typical, Poor*	Heating energy is derived by modeling internal gains, overall heat transfer coefficient, and equipment efficiencies in the building. Using this information, FirstView calculates the energy used for heating (including estimated heating-related electricity consumption for fan and pump operation). Heating may be provided by electricity or thermal fuels, or a combination of both.	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 • Broken, failed, or poorly installed economizers
Cooling Efficiency *Diagnostic Range: Good, Typical, Poor*	Cooling energy is derived by modeling internal gains, overall heat transfer coefficient, and equipment efficiencies in the building. Using this information, FirstView calculates the energy used for cooling (including estimated cooling-related electricity consumption for fan and pump operation).	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 *Diagnostic Range: No Control Inefficiencies, Moderate Inefficiencies from Controls, Large Inefficiencies from Controls*	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. FirstView 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 • Simultaneous heating and cooling

FirstView End Use	Method	Potential Areas to Investigate
Reheat *Diagnostic Range: No Reheat, Probable Reheat*	Reheat is a particularly common type of control problem. At the monthly data level, most commercial buildings will show a slight level of overlapping heating and cooling use in the 50–65°F 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 and cooling, and high thermal baseload 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 often 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 *Diagnostic Range: Typical, High*	Thermal Baseload is derived in FirstView by analyzing a building's weather-independent (summer) thermal fuel usage (natural gas, oil, district hot water or steam, biomass, etc.). Note, electric water heating is included in the Electric Baseload category. 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 *Diagnostic Range: Orderly, 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.

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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.

For more information about FirstView, contact: firstview@newbuildings.org.