HOW YOU CAN USE BTU MEASUREMENTS TO DOCUMENT ENERGY EFFICIENCY

Performance Verification Proves Savings to Customers and Financiers

BTUs (British thermal units) are a widely-used metric for energy production and in solar HVAC system financing. From HVAC installers to schools seeking system performance verification for energy grants, technicians in every industry are monitoring this value in their facilities. BTU data can therefore represent significant savings and energy efficiency ratings.

What are BTUs?

A **BTU** is the amount of heat it takes to raise the temperature of one pound of water by one degree Fahrenheit (at a constant pressure of one atmosphere). More precisely, one BTU is equivalent to about **1055 joules.** As an easy-to-remember example, burning a four-inch wooden kitchen match generates approximately 1 BTU. However, keep in mind that BTU definitions based on different water temperatures can vary by up to 0.5%, owing to the non-linear temperature response of water to heat energy.

When used as a unit of power for heating and cooling systems, **BTU *per hour* (BTU/h)** is the correct unit to use, though it is often abbreviated to just "BTU". The BTU/h metric is most often used in the USA as a measure of power in the steam generation, heating, power, and air conditioning industries. It is still used in Canada and in some other metric English-speaking countries. In North America, the heat value (energy content) of fuels is also expressed in BTUs.

As a unit of power:

- 1 **watt** is approximately 3.41214 **BTU/h**
- 1000 **BTU/h** is approximately 293.071 **watts**
- 1 **horsepower** is approximately 2544 **BTU/h**

The notation **kBtu** or **KBTU** is often used for one thousand BTU, in the sizing of heating systems and in the Energy Use Index (EUI). Likewise the**MBTU** notation represents one million BTU. Other BTU measurements include a *ton of cooling* (12,000 BTU/h or 3.52 kW), a *therm* (100,000 BTUs), and a *quad* (10^{15} BTUs). BTUs and BTUs/hr can also be converted into watts, kilowatts etc. as needed, making them a useful and flexible indicator of energy efficiency.

How Can You Use BTUs as a Performance Metric?

Measurements: Temperature, Thermocouple, Flow, Pulse, 4-20mA

BTU measurements are especially important for users who need performance verification for solar water or air collectors:

Solar water collectors:

Solar systems are commonly used to heat facilities, residences and pools to provide cheaper hot water. For example a 1,000-gallon heating tank warming up the water to 150°F to provide residents with enough hot water all day. These green systems save facilities considerable energy costs since it's more efficient to store and heat water at 150°F instead of taking it from the ground at 50°F and then heating it when needed. Collector efficiency is therefore of great interest to installers, financiers and residents alike, all of whom want to ensure that their system is performing in the expected range.

In solar water heating applications, users can use a **data logger** to accurately measure and record the temperature of the water going into and then exiting the heating system. Meanwhile the datalogger also measures the water's flow rate, often expressed as gallons per minute. After collecting this multi-value data, users can then determine the system's actual BTU rating, expressing heat output in BTU/hr or in watts.

Additionally, HVAC installers can use an 'intelligent' monitoring system, i.e. with mathematical capabilities and analysis software, to record and document post-installation data. This shows verification of savings for later presentation to governmental and residential customers. For example, to monitor the efficiency of a solar collector water heating system, the logger can be installed in a utility closet and connected to a pair of thermocouple temperature sensors which are in turn connected to a storage tank's pipe fittings. A data recorder with universal analog inputs can also connect to a 4-20mA flow sensor attached to a heat exchanger loop running between the hot water tank and the storage tank.

Left unattended, the datalogger continually monitors both the water temperature from the thermocouples and the pulse signals from the flow sensor. This data enables users to view their solar system's water flow rate and the inlet/outlet water temperature in order to calculate heat gain and the BTUs the solar collector is getting. All this is accomplished using the datalogger software.

BTU data is also useful to advertise as a demonstration of cost savings. In this way HVAC providers can be confident that their installation will pay for itself after a few years, and the data is their way to prove it.

Solar air collectors:

For a **solar air collection** application, the process is similar: the logger measures air temperature entering and exiting the system as well as airflow, for example expressed as cubic feet per hour.

Solar Device Viability:

In the solar industry, device validation is a critical step to bringing new technology to market. Here a datalogger is useful to monitor photovoltaic (PV) panels and also PV cells in cases where the solar panels have microinverters monitoring them.

A datalogger with universal analog sensor channels can connect to different types of weather and environmental sensors to measure nearly every aspect of a solar energy process. The logger records the analog signals from all these sensors and automatically scales the data into engineering units.

Fin Doyle, Founder of **Sulas Industries,** describes his company's use of a universal monitoring system: "We're using an intelligent datalogger for multivalue data collection and process validation. We have three thermocouple temperature sensors measuring ambient air temperature around our patented HelioDrive system. Meanwhile our pyranometer measures solar radiation while our anemometer measures wind speed and direction. We've also connected tilt sensors to track solar panel angle to the sun. The logger collects information on our solar process and monitors every environmental parameter we're interested in."

Remote Data Transmission from the Field:

At Sulas Industries, users have also set their logger to automatically transmit its readings to selected emails via FTP (File Transfer Protocol). This was simply a matter of connecting the logger's Ethernet communication port to the network hub at the test field site and making a few configurations.

The logger now generates and sends out a nightly report containing the last 24 hours of recorded data. Every night at midnight, the logger sends the latest report to Fin Doyle and Sulas CEO Jeff Bloszies who later analyze the data in detail and compare it to the solar field electricity output.

Summary:

By monitoring key environmental/electrical parameters and calculating BTUs, facility technicians can accurately rate their facility's or system's energy efficiency. Whether users are qualifying for financing for HVAC systems, installing them for customers, or just looking to save on energy costs, BTUs are a key indicator of both system ROI and performance. As green and smart energy systems continue to proliferate, BTU measurement will become more integral to facility managers.