Using Data From Your Building Automation System to Achieve Energy Efficiency in Laboratories

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Laboratories typically use more energy than other types of spaces. The challenge is to implement energy efficiency strategies in a laboratory environment while keeping workers safe and protecting their research. One solution is to look at energy efficiency and indoor air quality as ongoing operational goals, rather than a topic to be discussed at the building design phase. By actively leveraging the data from your building automation system, you can achieve long-term energy efficiency in the laboratory environment.

Background

In the laboratory environment, effective HVAC function must:

- Exhaust air from primary containment devices (fume hoods, biological safety cabinets) at rates needed to control exposure
- Replace room air at rates needed to dilute and remove contaminants
- Balance supply and exhaust to avoid migration of contaminants
- Condition supply air to maintain required room ambient conditions

While energy efficiency is an important consideration during the design and construction of a laboratory facility, real performance takes place in the years of operation that follow.

Accomplishing that performance requires active management, and that depends on information. It is widely recognized that, "You can't manage what you don't measure." Laboratory systems are complex with many points of interaction with workers and related systems. Active management means measuring performance, identifying issues, and correcting them.

According to Laboratory Ventilation Standard Z9.5, a Laboratory Ventilation Management Plan includes documenting reliable operation, as well as periodic documentation that the ventilation system is used properly. This requires that you have a plan to measure performance and inspect the operation of your laboratory fume hoods on a regular basis. You must be ready to not only correct any faults with the hoods, but also be ready to improve systems and procedures.

Information is key to measure and monitor effective function

Your building automation system can provide valuable information, which can be used to measure and monitor effective function in terms of both safety and comfort. For example, the building automation system can document actual flow rates in relation to the specified values and continue to provide this and other data necessary for energy management strategies over the long-term. When measuring HVAC function in the lab, it is important to verify the following:

- Exhaust devices are operating correctly.
- Lab workers are using them properly.
- Sufficient air supply
- Directional air flow between spaces
- Environmental conditions (temperature, etc.)

Once your laboratory systems are operating effectively, then the next step is to improve energy efficiency. The process steps are:

1. Collect and analyze operating data.
2. Choose a strategy.
3. Implement.

First, collect operating data by individual room and analyze it. Building automation system vendors typically have analysis tools that can help you collect and analyze trend data. An example of a report showing room performance and identifying deficiencies is shown in Figure 1. This report is generated from a cloud-based performance analysis tool.

To create this report, a remote data analysis server regularly pulls standard operating data from the building automation system and stores it for on-demand use. Using a standard web browser, facility engineers, safety officers, or sustainability managers can log into the data server, which uses analysis algorithms and presentation formats to translate this data into a user-friendly report. This report can help you verify that the systems are working properly.

Figure 1 illustrates the utility of rolled-up data summaries when evaluating performance of building systems. Rather than tabulating or plotting hundreds of temperature trend values, the tool reports performance indices that evaluate and summarize performance. The report is designed to show, room-by-room, the percentage of time that the temperature was within a normal range. At a glance, the user can then identify a particular room that needs attention or confirm the spaces are functioning as intended. The same report summarizes ventilation rates and directional air flow for each laboratory room. This is the kind of data that supports active management of building performance.

Active management means measuring performance, identifying issues, and correcting them.

- If the data shows that the system is not functioning properly, then identify the system or equipment requiring repair or replacement and restore its function.
- If the data shows that the system is functioning properly, then look for ways to improve energy efficiency.

Repeat this three-step process in your laboratory rooms as part of an ongoing effort to reduce energy usage and improve operational efficiencies.

Strategies for improving energy efficiency

When discussing strategies for improving energy efficiency in the laboratory environment, the main concept is to use less air. Specific measures that could be taken include the following:

- Vary the dilution flow rate dynamically, based on demand
- Adapt fixed exhaust devices to VAV
- Manage the use of VAV hoods
- Set back room temperatures
- Optimize distribution temperatures
- Reduce hood flow minimums

In order to choose the correct strategy, you need to look at the air flow drivers or energy drivers for the room. These are:

- Dilution ventilation or "air change rate"
- Exhaust devices
- Thermal load and thermal comfort

At any moment, any one requirement drives air flow quantity. By attributing a percentage of the air flow to each driver and then tracking and analyzing the air flow data over time—again the data from your building automation system can supply the answer. As shown in Figure 2, this type of report can help you identify the driver and choose the correct strategy to implement.

To generate the Air Volume Driver report, the data analysis system processes trend data collected by your building automation system for one room over a defined time period. At each time sample, the system determines which driver set the air flow rate for the room. Then it calculates the total flow attributed to each driver as a percentage of all the air supplied to the room over that period. This percentage is a combination of the flow rate and the duration that it occurs. In this example, the report shows that dilution drives 90% of the airflow to this lab, which suggests that a re-evaluation of the minimum airflow is in order.

There are a number of renovation measures known to reduce air consumed by laboratory fume hoods. Each option requires discussion with lab workers, EHS professionals, and facilities staff. The Air Volume Driver report and other air flow details provided by your building automation system bring concrete data to these discussions and can help define direction and the best strategy to implement on a room-by-room basis.

Organization **Lab Report Demo**
Node **R&D Park [Other meters]**
Path **R&D Park**

Start date **4/1/11 12:00 AM**
End date **4/30/11 12:00 AM**

Room Performance Comparison | Performance Criteria | Create PDF

	Nodes	% of Satisfactory Temperature	% of Satisfactory Directional Airflow	% of Satisfactory Ventilation
		-	-	-
1	Lab N311	100.00	100.00	99.16
2	Lab N319	80.64	99.93	99.80
3	Lab N321	96.88	99.95	99.16
4	Lab S366	100.00	99.05	98.37
	-	94.38	99.73	99.12
	-	94.38	99.73	99.12

Figure 1. Room Environment Summary Report shows the percentage of time that the temperature was within a normal range for a given room.

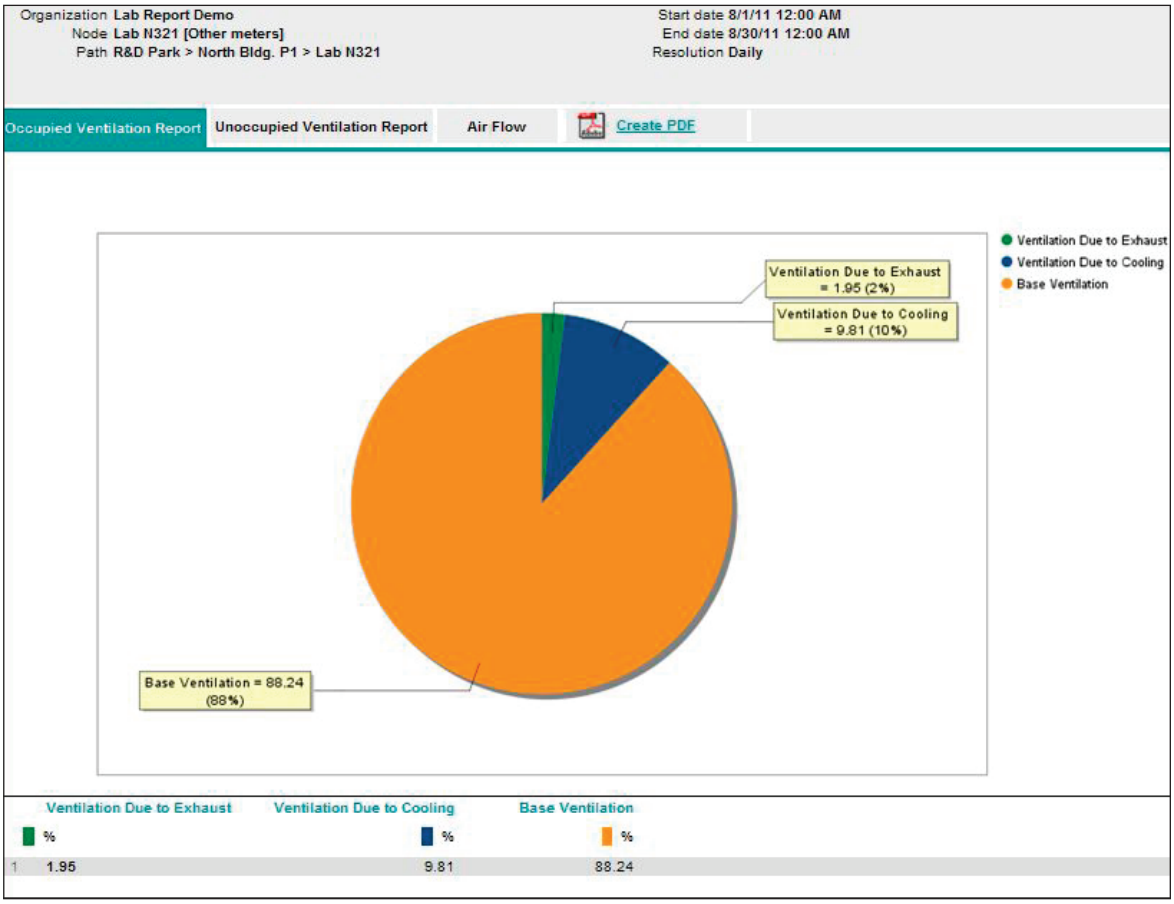

Figure 2. Lab Facility Air Volume Driver Report graphs the the total flow attributed to each driver as a percentage of all the air supplied to the room over a set time period.

Ask the following questions:

If the exhaust devices are the main driver, further review can identify the most effective measures to implement:

- Are the hoods used regularly? If not, consider decommissioning some exhaust devices.
- Are the hoods using air because they are left open? If so, sash management programs or automatic sash closers make sense.
- Are the hoods driving the air flow even when they are closed? This is the case that warrants re-evaluating the minimum flow rate in light of current guidelines.

If the base ventilation drives air flow, consider the following:

- Evaluate the dilution flow (ACH) in light of current industry trends. Lower rates may be justifiable.
- Implement unoccupied ventilation.
- Apply contaminant sensors to vary ventilation rate according to actual load.

If cooling drives the air flow rate, then look for ways to reduce the load:

- Re-locate heat sources.
- Reduce lighting.

Conclusion

Creating operational efficiencies in the laboratory environment is a long-term commitment. It requires on-going management which, in turn, requires information in a form that supports action. Analysis of data collected from your building automation system can help you identify strategies that will lead to the most efficient and safe system operation of your laboratory environments.

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