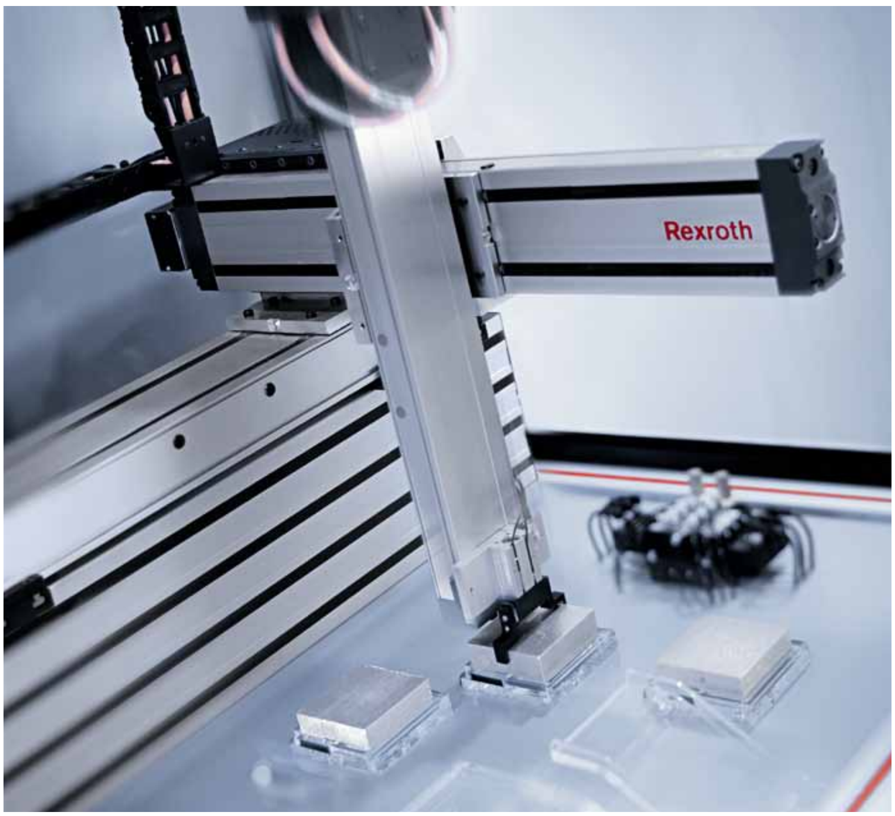
Drive & Control profile

Reduce your lab's environmental impact with smart equipment choices



With lab equipment that's properly designed and application-optimized from the beginning, it's possible to achieve substantial energy savings.

Most laboratory managers recognize that they can improve the energy efficiency of their lab by implementing common-sense tactics such as turning off equipment that's not in use, installing lighting sensors that dim lights automatically when natural ambient light increases, and making sure freezers and chillers are sized appropriately for the samples stored inside.

Collectively, these practices can make a noticeable impact on your laboratory's energy bill and environmental impact. This same

Opportunities for energy savings can be found everywhere in the lab:

- The equipment builder can optimize the machine as a whole for energy efficiency by properly sizing and selecting the electrical, mechanical and pneumatic components inside the machine.
- The size of the components inside the machine should be perfectly sized for the machine's application; oversized components require more energy than necessary.
- The machine should be compatible with the specific cleanroom requirements of the lab. Systems that have been over-engineered for cleanroom compatibility consume excess energy.
- Pneumatic components can be mounted close to the machine to reduce the energy needed to deliver the air. Pressure regulators can ensure that the exact amount of air is delivered.
- Pre-lubricated components improve energy efficiency.
- Aluminum structures in simple bolt-together designs allow for speedy reconfiguration of individual processes or even entire labs—and form the basis of a lean work environment.

concept, namely, evaluating the lab's needs and making several simple choices that can lead to a substantial collective impact, also holds true when choosing automated lab equipment.

There are several approaches that can be taken to ensure that the automated equipment in your lab is designed for and operating at its maximum efficiency. One approach is to consider the energy efficiency of individual components within the machine, such as the electromechanical actuators and pneumatic valves that control processes such as liquid dispensing and microplate handling. A more systematic approach, however, is to examine the overall machine design and look at how the components work together to achieve energy efficiency. With lab equipment that's properly designed from the beginning, in other words, optimized for a given application, it's possible to achieve substantial energy savings. We'll get started by looking at a few of the most beneficial guidelines for improving energy savings and reducing your lab's impact on the environment.

Machine design and selection: Small details can have a big impact

Liquid handling workstations, microplate handlers and automated storage and retrieval systems (AS/RS) are all examples of laboratory equipment that involve motion controlled by an electric motor (electromechanical) or by air (pneumatic). These motions are typically in one, two or three axes, such as a three-axis liquid-dispensing system that moves the pipettes up and down to the microplate, left and right from plate to plate, and front to back across each plate.

Since air losses can occur at distances as short as three feet, mounting pneumatic valves close to the actuators they control will reduce the energy needed to deliver the air. Pneumatic component manufacturers now offer smaller, lighter chemical-resistant valves that can be mounted directly on the machine instead of in a control cabinet, resulting in significant energy savings.

When choosing automated equipment, many lab managers focus primarily on throughput and ease of use. Although these are important factors that help maximize productivity and output, in order to determine the environmental impact of the equipment, lab managers should also ask the supplier *how the machine as a whole has been optimized for energy efficiency*. Significant energy savings can result if the equipment builder has properly sized and selected the electrical, mechanical and pneumatic components inside the machine. Conversely, if the components are sourced from multiple vendors and are not optimized to work together, or they are not designed with features that decrease energy consumption, then energy efficiency will inevitably be compromised.

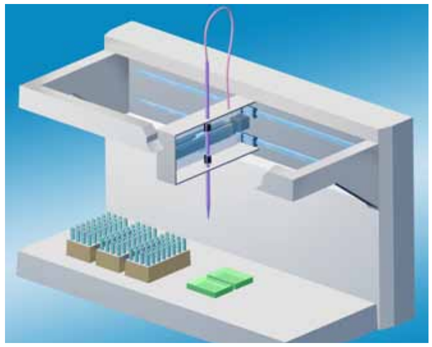
One of the most important factors contributing to energy efficiency is the size of components used inside automated lab equipment. When linear guides, ball screws or pneumatic cylinders are oversized for the application, they require more energy than should be necessary for the application. If the process includes multi-axis motion motion—for example, a pipetting application that includes both horizontal and vertical movements—the weight of the components themselves is another factor in energy consumption. Since each axis must carry the weight of the next axis that is mounted to it (in the pipetting example, the Z axis carries the pipette, and the X axis carries the Z axis with the pipettes), optimizing the size and weight of the Z axis subsequently allows the machine builder to use the smallest components possible for the X axis. The net results are lower mass and reduced inertia for the complete X-Z system, which translates into reduced forces needed to move the system and, ultimately, lower energy consumption.

Another factor that lab managers should examine in new automated equipment is whether electrical components such as motors, mechanical components such as linear guides and ball screws, and pneumatic components such as cylinders have all been optimized to work together, for example, in a liquid dispensing system. Many automation vendors now provide online tools for designing systems that incorporate these various types of components and have optimized their products to work together for ease of assembly and lowest energy consumption. If a machine builder has sourced multiple components from the same vendor, the system is more likely to have optimal performance and better energy efficiency than one that is built from components from different sources.

Energy-efficient electric motors—and the proper sizing of drives that control them— are also a factor in how much energy a laboratory machine consumes. Simply put, the fewer electrical components in the machine, the lower the energy consumption. Hardware such as integrated drives and controls that can command multiple axes and feedback inputs—servo, stepper, linear motor, etc.—can reduce complexity in the machine, as well as energy losses that are seen when multiple drives and controls are used.

Energy efficiency and air consumption

When considering how to increase energy efficiency, most people think of how to reduce electricity consumption directly, such as turning off electronics and equipment when not in use. Air-driven, or pneumatic, components also contribute to energy usage, since air pressure must be generated, regulated, and delivered from the source to the point of need. For pneumatic components, three factors contribute to lower



If a process includes both horizontal and vertical motion, for example in a pipetting application, the weight of the mechanical components becomes a factor in energy consumption.

energy consumption and reduced environmental impact: reducing pneumatic system volume, reducing air pressure, and minimizing leaks.

Since air losses can occur at distances as short as three feet, mounting pneumatic valves close to the actuators that they control will reduce the energy needed to deliver the air. Manufacturers of pneumatic components now offer smaller, lighter, chemical-resistant valves that can be mounted directly on the machine instead of in a control cabinet, resulting in an energy savings of up to 35 percent. Air volume and pressure can also be reduced by using pneumatic cylinders that are the appropriate size and diameter for the application. Moving microplates and pipettes, typical applications for pneumatic cylinders, involves relatively light loads, so lab managers should look for equipment with pneumatic components that are not oversized for the application.

With pneumatics, energy is frequently wasted when too much pressure is applied for tasks that do not need it. This can be overcome by using pressure regulators to control exactly when to exert energy and when to conserve it. By applying the exact amount of air pressure needed for each task, machines can realize energy savings of up to 40 percent in many cases. It is common for operators to increase air supply pressure on regulators in the hope of improving performance, but this can end up wasting energy if the components are not sized correctly. It is important to monitor machine system pressure to ensure that it is within both a minimum and a maximum value to avoid energy waste. And although one might think of it as just air, an energy audit might reveal the annual savings to be in the tens of thousands of dollars by simply eliminating leaks in the pneumatic system.

Cleanliness vs. energy efficiency

If cleanroom compatibility is required, lab managers should examine what the real needs of the lab are, especially considering the cleanliness that is required of laboratory automation systems. Although cleanroom class 1 and 10 specifications are common in the semiconductor and electronics industries, most laboratory environments require class 100 to class 1000 ratings at most. In some cases, the components inside automated laboratory equipment are classified for use in a more stringent cleanroom than what is required in most laboratory environments. Additionally, the equipment may include unnecessary fans or other devices to remove particles generated by the moving components, resulting in more complexity and increased energy consumption. By examining the true cleanliness requirements of the equipment, lab managers can avoid systems that have been over-engineered for cleanroom compatibility and consume more energy than is necessary.

For electrical and pneumatic components that provide linear motion, friction is one of the most significant factors that contribute to the force and energy required during movement, such as loading and unloading microplates in an AS/RS system. Friction also contributes to particle generation: the more contact between two surfaces, the higher the friction between those surfaces, and the more particles that will be generated during motion. Although some friction is inevitable in any moving system, low friction seals can eliminate the additional friction that is typically caused by the seal and reduce the force and energy required to move the actuator, while still protecting it from contamination.

Machine maintenance also affects efficiency

Machine maintenance is often associated with downtime and lost productivity, but it can also affect the efficiency and environmental impact of the equipment and the lab. For mechanical components, lubrication is the primary cause for maintenance. Some linear guides and ball screws are supplied with initial lubrication that can sustain the components for the lifetime of the machine. These pre-lubricated components reduce or eliminate downtime for lubrication, and ensure that the proper type and amount of lubrication is present: Too much or too little lubrication can reduce the efficiency of the components. Pre-lubricated components also eliminate the need for lab personnel to handle and dispose of lubrication, which has safety and environmental consequences for the lab. Maintenance time and effort can also be reduced by choosing a system with easy-to-access lube ports or the capability to use an automatic lube system. Lab managers should consider the maintenance requirements when evaluating new lab equipment and their efficiency and environmental impact.

If lab equipment frequently needs to be repositioned or reconfigured, it also makes sense to look for workstations, work benches and other structures within the lab that can allow for that. T-slotted, extruded aluminum structures are now widely available in simple bolt-together designs that allow for speedy reconfiguration of individual processes or even entire labs. Welded or stainless steel structures are often-used alternatives, but welded frames can’t be reconfigured and must be discarded—ending up in a landfill, along with the original investment. Aluminum extrusion-based workstations can also form the basis of a lean work environment, as the T-slots in the aluminum framing allow work instructions, parts bins, tools, shelves and fixtures to be positioned in optimum locations for efficient work.

If lab equipment frequently needs to be repositioned or reconfigured, look for T-slotted extruded aluminum structures with simple bolt-together designs that allow for speedy reconfiguration of individual processes or even entire labs.

Opportunities for energy and cost savings can be found everywhere in the lab, and a few smart choices in lab design can result not only in reduced environmental impact, but also in considerable cost savings. By implementing some of the suggestions noted above, you can ensure that your automated laboratory equipment is running efficiently—and generating significant energy savings at the same time.

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