LabOps and sustainable energy: The win-win paradigm

Former chairman and CEO of DuPont, Charles "Chad" O. Holliday, insists that sustainability is about more than climate. As an early advocate of sustainable business, Holliday understands that to excel at managing resources and working across departmental and institutional siloes, creating a new standard for competitiveness is necessary.

"Technology can help us deal with the resource challenges we face," Holliday said in conversation with McKinsey. "The [companies] that start looking for opportunities will find that using resources differently is the opportunity. Organizations that determine how to manage resources differently will have an advantage."

The health sector has been affected by changes and increasing demands from policy makers and the public to rationalize ecological resources, increase productivity, and improve the quality of the service provided to customers and patients. Presenting insights and approaches that organizations can use to seize the opportunity can transform how they manage resources and drive sustainable growth.

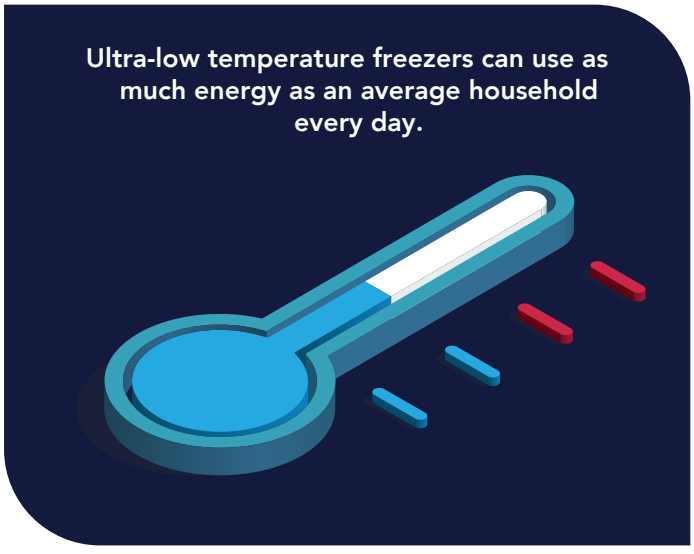
For the pharmaceutical and biotech industries, laboratory operations (LabOps) may become the biggest competitive advantage. With emerging technology, health sector leaders may want to consider LabOps as a way to maximize revenue cycle and operational success rather than simply as a bottom-line cost. LabOps serves as the interface to a laboratory's data, instruments, analyses, and reports.

What's The Opportunity for Sustainability in LabOps?

The global biotechnology and pharma industry has a carbon footprint larger than the semiconductor industry, the forestry and paper industry, and equal to nearly half the annual emissions of the U.K. The 2019 climate footprint of healthcare was two gigatons of carbon dioxide equivalent, representing 4.4% of total global emissions, with the majority (71%) derived from the healthcare supply chain, which includes biotech and pharma.

The global research enterprise includes millions of laboratories, consuming five to ten times the energy per square foot of a typical office space. Further, the biotechnology market is predicted to grow by 15% per year, and pharma market by 11%, reaching $2.44 trillion and $970 billion, respectively by 2028. Given the carbon intensity and rapid growth of the biotechnology and pharma industry sector, it is both critical and timely to examine the entire value chain of research and production.

LabOps may be the "lowest hanging fruit" as biotech and pharma companies assess and re-vamp their operations for sustainable action. Laboratories are one of the largest energy-consuming sectors after data centers. Industry leaders who are looking to increase savings while lessening their environmental footprint should note that laboratories are widely recognized as consuming more energy per square foot than any other sector. The energy-intensive



equipment, around-the-clock operations, 100% outside air requirements, and high airflow rates demand considerable energy.

One example where efficiencies can be improved are the 12 billion medical laboratory tests that are analyzed in the US annually. These tests are the highest-volume health care service nationwide. It's estimated that 70% of medical decisions are based on the results of laboratory tests, and the costs of these tests represent 3.5% of total health costs. As a result, cost management in the health sector has become a tool to support decision making in organizations that benefit sustainable management.

Demands for laboratory tests have become the highest volume medical act after years of steady increase. In the U.S. and Europe, the annual increase in the use of laboratory tests has been around 5% in the last decade. Investments in laboratory management not only decreases laboratory costs, but also creates further cost-savings further down the manufacturing and distribution line. Therefore, LabOps may be the biggest lever in transforming an organization's sustainable impact.

Fortunately, technology is rapidly transforming LabOps into more sustainable practices whilst reducing costs. Technological innovations provide far-reaching benefits despite seemingly-marginal changes. For example, chilling ultra-low freezers from at -70° C instead of the traditional -80°C reduces energy consumption by as much as 30-40%. This not only decreases general cooling costs, it also extends the life of equipment, creates less down time, decreases the chance of samples being compromised, and saves further production costs.

For fast-moving life science organizations, improving LabOps falls under the umbrella of manufacturing resource productivity. This framework empowers laboratory managers to contribute in efficiently spreading more value within an organization's value chain and providing increased value to its customers. And as such, pharma and biotech companies that launch sustainable laboratory initiatives align with greater efforts to innovate.

Changing Energy Innovations

History shows that innovations in technology can increase productivity, transform industries, and orient culture towards better futures. The rise of wireless technology has fundamentally altered telecommunications – transforming how organizations communicate and problem-solve. More recently, faster microchips have revolutionized the consumer-electronics industry with more dynamic smartphones and personal computers.

Most of the technologies that were once disruptive are now familiar – unconventional gas, electric vehicles, solar, and lighting from light-emitting diodes (LEDs). Importantly, these ground-breaking technologies also address the challenges of climate change.

Energy markets are on the verge of a similarly dramatic transformation. With prices for oil, steel, copper, aluminum, and other commodities soaring to historic highs, biotechnology and pharmaceutical companies are taking advantage of developments in areas such as software and consumer electronics, and semiconductors to greatly improve how the world produces and consumes energy.

Progressive pharmaceutical companies are shifting their focus from how much to produce to how to produce, simply by monitoring the efficiency of their energy-drawing equipment and operations. By monitoring HVACs, motors, and drives, vacuum pumps, fans, spray systems, pressure regulators, drain taps, cooling towers, compressors, temperature and pressure gauges, dryers, blowers, separators, etc, pharmaceutical companies can dramatically not only reduce energy costs (up to 30%), but become energy innovators.

Net Zero Initiatives

Countries, cities, organizations, and other institutions are pledging to get to net-zero emissions. Net zero means "cutting greenhouse gas emissions to as

close to zero as possible, with any remaining emissions reabsorbed from the atmosphere". As of now, more than 70 countries – including China, the U.S., and the E.U. – have set a net-zero targets, covering about 76% of global emissions. Furthermore, over 1,200 companies are now implementing science-based targets in line with net zero. More than 1,000 cities around the world, over 1,000 educational institutions, and over 400 financial institutions have joined the United Nations' Race to Zero, pledging to do their part in decreasing global emissions by 50% by 2030.

While many of the largest revenue-generating companies have been working to reduce their carbon emissions since 2015, the majority of companies within the biotechnology and pharma industry do not yet have climate commitments aligned with the net zero initiative. Companies must establish more ambitious targets if they wish to join the growing coalition of countries, cities, and organizations working towards cutting carbon emissions.

LabOps Innovations

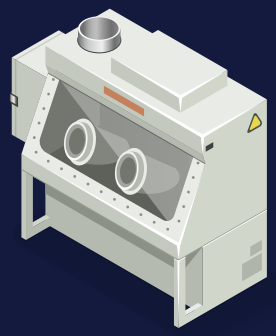
Fortunately some of the biggest technology and energy innovations are happening within the biotech and pharma value chain. Assuming that half of all American laboratories can reduce their energy use by 30%, the U.S. Environmental Protection Agency (EPA) estimates that the U.S. could reduce its annual energy consumption by 84 trillion British thermal units (Btu). This is equivalent to the energy consumed by 840,000 households. An improvement of this magnitude would save $1.25 billion annually and decrease carbon dioxide emissions by 19 million tons – equal to the environmental effects of removing 1.3 million cars from U.S. highways or preventing 56 million trees from being harvested.

It's important to note that energy efficiency serves as an umbrella for other aspects within the larger ecosystem of sustainable LabOps. It goes beyond electricity, like heating and cooling. Other aspects include site optimization, water conservation, and decreased energy demands of using environmentally preferable materials. These are also opportunities to increase savings while decreasing carbon footprint within the LabOps space. This kind of energy consumption shift translates into significant market breakthroughs for biotech, pharma, and the greater healthcare industry.

Other evolving technologies within LabOps include solar, and LED lighting grid-scale storage, digital power conversion, compressor-less air-conditioning and electrochromic windows, and automated diagnostic and monitoring electronics. Many organizations have already realized significant decreases in costs resulting from widespread adoption of these innovations, in particular LED lighting and laboratory monitoring electronics. These cost-effective technologies have the potential to save organizations hundreds of billions of dollars, annually. Organizations that are content to keep an eye on technological developments within LabOps, betting on averages rather than positioning themselves to benefit from the cutting edge, may fail to survive in the new world these innovations create.

Some main challenges for LabOps sustainability are the increasingly complex nature of research and the growing demand for services. As pharmaceutical research increases, so must the size and environmental impact of laboratories. Laboratory buildings with

Bio safety cabinets can consume 15 kWh/day, equivalent to also what a household produces



specialized equipment and ventilation systems pose challenges in terms of efficient energy use and initial construction costs. Additionally, lab spaces should have flexible and efficient layouts and provide a comfortable indoor research environment.

Considerations such as space zoning for grouping areas with similar energy requirements is performed to concentrate similar heating and cooling demands to simplify energy loads. By starting to build efficient LabOps now, organizations can create resilient physical and digital systems for the fast-approaching future.

COVID-19: The Canary in The Laboratory Coal Mine

The COVID-19 pandemic induced investment in life science industry innovation with R&D spending surged 22% from 2018 to 2019 – a trend that is likely to continue even after the pandemic.

Most pharma or biotech labs that have budgets greater than $1 million spend in the following categories:

Cell-based analysis kits and reagents
Cell-based assays and analysis are vital experimental tools in life science research and bio-manufacturing. Cell culture assays provide a means of quantitatively analyzing the presence, amount, or functional activity of a cell or tissue of interest.

Genome analysis kits and reagents
As the field of genomics advances, genetic and genomic tests are becoming more common in, and out of, the clinic.

Protein purification and separation kits and reagents
Protein purification isolates one or more proteins from biological samples. These products include various reagents, columns, kits, and related products designed for high performance protein purification.

Live animals
The use of animals in some forms of biomedical research remains essential to the discovery of the causes, diagnoses, and treatment of disease and suffering in humans and in animals.

General laboratory equipment and chemicals (plastic-ware, glassware, and disposables)
The majority of spending (over 60%) is on consumables: chemicals, life science reagents and kits, glassware, plastic-ware, and general laboratory supplies. Instruments and equipment make up as much as 40% of the remaining spending, with up to 27% of budgets allocated to the purchase of instruments and 13% to the purchase of equipment. As such, instruments are the single largest expense of laboratories.

The pandemic has taught leading pharma and biotech companies the wisdom in planning for the unexpected, such as research errors and delays, poor planning or miscommunication with vendors, and lab supply delays and back orders. Unlike other crises (i.e., natural disasters, acts of war, or terrorism) which often result in a sudden and sustained cessation of scientific research, the pandemic affected every LabOps system worldwide albeit to a varying degree.

Operational impacts caused by the COVID-19 pandemic are generally divided into three categories: complete shutdown, partial shutdown, and uninterrupted operations. Although many laboratories had contingency plans in place, the pandemic highlighted the importance of having such plans for continuity of service. Immediate changes occurred in the way labs operate due to potential virus transmission and in line with this new "best practices" have been established.

As pharma and biotech companies are facilitators of research, it is incumbent upon them to create laboratories that engage in strategic planning in volatile, uncertain, complex, and ambiguous environments such as the one generated by a global pandemic.

Centralized Facility Communications

Face-to-face communication is essential in LabOps, both in interactions with users (i.e., sort consultation, training, and operational feedback) and between staff (i.e., appointment and instrumentation management). COVID-19 forced staff to minimize face-to-face communication via a plethora of various digital platforms, predominantly involving email and video conferencing, to monitor equipment.

A more practical and centralized approach is needed for rapid dissemination of information. Importantly the tool(s) should be easily accessible by laboratory staff, maintenance, and security. Current tools like WhatsApp, Slack, Facebook Messenger, and Zoom are all valid ways to communicate, but do not integrate into monitoring laboratory equipment. To continue valid research and standarize outputs, automated maintenance and maintenance should be carried out to ensure cost-effective monitoring and communication.

Many organizations turn to building management systems that not only monitor the lab but the rest of the facility. Dedicated monitoring system such as the Elemental Machines Lab Monitoring Platform can provide lab managers, scientists, and engineers with the flexibility and features that are useful for their work.

There are three main advantages of using a dedicated lab monitoring system:

Tailor user management
LabOps, the heart of the biotech and pharma value chain, is often an inefficient one-size-fits-all solution. Elemental Machines' dedicated lab monitoring system can be easily configured and designed specifically to meet the needs of laboratory staff. This monitoring system, supervised by the lab manager, offers easy access to lab staff. The online dashboard offers secured data and information exchange amongst the teams who support laboratory operations—from research assistants to building security. This increases response times for on-site happenings, like an unintentional drop in refrigerator temperature, or network permission changes. Tailor-made LabOps monitoring for each organization's unique team, equipment, and site infrastructure means optimized decision-making.

Centralize and gain data insights
Various teams from the scientific, operating, and technical spheres make up LabOps. Successful lab teams depend on discovery, testing, analytics, compliance, and learning to be accessible.

A single chemical fume hood, powered by a building's ventilation system, can use as much energy as 3.5 households every day

Knowledge and project management is key for collaboration. Elemental Machines' LabOps system automatically collects data 24/7 from lab equipment, making it available for remote review. This gives teams the ability to remotely monitor and in real-time. If an issue occurs and staff is not on-site to resolve, select team members immediately receive a notification detailing the conditions of the alert. With the Elemental Machines dashboard, staff members may also review the history of the alert's circumstances. The monitoring system even annotates the data to provide information on the resolution or context behind the alert (i.e. accidentally unplugged freezer). Elemental Machines keeps information centralized to allow work to get done in ways that cannot efficiently happen in siloes.

Create resilient monitoring

In the past, researchers may have shown up on a Monday morning to find their work from the last year erased by a malfunctioning freezer. With the advent of monitoring and alerting tools, these occurrences never have to happen. Rather than monitoring separate pieces of equipment, the more resilient approach is comprehensive monitoring. This strategy gives teams visibility into the health of all equipment in the lab or elsewhere in the facilities. With Elemental Machines' dashboard presenting highly granular data, lab managers no longer need to rely on single daily data points from each piece of equipment as insufficient indicators of equipment health. Teams see in real-time equipment utilization trends and patterns, enabling them to optimize equipment usage and load balance.

Additionally, operations teams can analyze environmental factors on their equipment and laboratory buildings. By building a stable context for their laboratories, biotech and pharma companies create a more resilient value chain.

The Net Zero initiative gives companies a clear blueprint on bringing their net zero plans in line with science-a non-negotiable in this decisive decade for climate action. Sustainability is the long-term goal. For biotechnology, pharmaceutical, and other research-based organizations, creating resilient LabOps may be one of the biggest levers to not only decrease their environmental footprint, but also in becoming industry leaders in sustainable action.

About Elemental Machines

Elemental Machines is the trusted data collection and reporting technology supplier to researchers and clinicians around the world. The Cambridge-based company equips labs with universal cloud-based dashboards and turnkey sensors that unite data from every asset, every metric, and every location, enabling universal collection, seamless sharing, and turnkey reporting.

ELEMENTAL MACHINES

(617) 871-9692
185 Alewife Brook Parkway
Suite 401
Cambridge, MA 02138
sales@elementalmachines.com
www.elementalmachines.com