Manufacturing sustainability, particularly in the processing industries, can be greatly improved with Industry 4.0 technologies.

Use Industry 4.0 to Elevate Sustainability

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The data generated by today's digital-transformation technologies can help you cut energy costs and reduce your environmental impact.

ALL EYES ARE on the industrial world these days, with heightened expectations that it must play its part to reduce greenhouse-gas emissions and keep global temperatures down. Industrial companies must recognize this and work to ensure they meet these expectations, operating with a sustainable and energy-efficient focus. The shift in approach will not only help enterprise public images but also keep them more competitive. Additionally, as organizations face consistently volatile markets, solutions that lead to more sustainability often have the added benefit of improving company profitability.

Industry 4.0 technologies will help drive sustainable movements forward and make reaching sustainability goals a reality for many industrial organizations. Application of more-recent technology developments, such as machine learning, IIoT, and artificial intelligence, to industrial operations will help companies make strides toward a greener future.

Industry 4.0 is not hype anymore. It's real, and the technology advancements it has produced are pivotal to the industrial world, particularly in the area of operational efficiency. Digital process-control technologies help to boost production output while reducing energy consumption and cutting energy costs. They also reduce the overall carbon footprint of production processes.

Most industrial processes demand high-energy input. According to the U.S. Energy Information Administration, Washington (eia.gov), the bulk-chemical industry accounts for the largest portion of U.S. industrial energy use, at 28%, followed by the refining industry at 18%.

Operational instability also contributes to energy waste. When an asset malfunctions and leads to unexpected production downtime, organizations can experience millions of dollars in profit losses, as well as excessive energy waste. Artificial intelligence and machine-learning tech-

nology have, combined, enabled companies to predict equipment or asset breakdown weeks, if not months, in advance. The technology can detect anomalies in equipment behavior, and, upon detection, use historical and contextual data to determine the patterns that lead to failure.

Artificial intelligence provides organizations with visibility into the health of their operations by predicting malfunctions in advance and prescribing solutions to address looming issues. This predictive lens is not something the human eye can see alone, so relying on artificial intelligence to achieve this level of visibility is essential.

Unexpected cycles of production shutdown and startup also require more energy output than consistent, regular operations. Such incidents can also lead to safety hazards and unintended emissions from plant operations.

Another way technology helps improve energy savings, as well as reporting, is through simulation and process modeling. This type of technology provides organizations with the ability to take a closer look at the greenhouse gases generated by processes.

Historically, industrial organizations measured sustainability by the dollars saved in reduced energy consumption. However, that approach is changing as new digital technologies allow companies to dig deeper and expand emission-reporting metrics, all while continually improving processes to decrease additional emissions.

Simulation technology also provides organizations with the ability to model digital representations of actual processes early in process development. This approach uncovers alternate process routes and steps within those processes to best determine which routes lead to fewer CO_2 emissions and better optimize overall energy usage.

Simulating different process models ultimately presents opportunities to closely examine the pathways that can curb emissions and reduce energy output. This results in better insight into the environmental impact of plant operations.

Through simulation technology, companies not only do better reporting on emissions, such as NOx and SOx, but also get continuously better at optimizing energy usage and improving resource use. For example, Kuwait National Petroleum company (KNPC) examined a simulation of its processes, and made changes that reduced its carbon footprint and cut energy usage, resulting in an annual savings of $15 million.

Korean chemicals producer YNCC used energy and process-optimization models to cut energy consumption by 5% to 10% across it various production units and move toward its corporate target of 10% reduction in GHG emissions.

EFFECTIVELY MANAGE WASTE

When we think about sustainability and the environment, energy output is not the only area of concern. Material waste also has negative consequences, especially when viewed in the context of raw materials, wasted energy, and disposal issues. Interestingly, one technology that can help reduce material waste is supply-chain scheduling technology.

This technology makes possible data-backed decisions that streamline the order in which certain processes happen and helps organizations in two areas. First, it reduces the amount of transitional material waste produced between preferred product batches.

Second, it helps cut the amount of energy output by more effectively transitioning between different processes. This is best described in polymer processes where scheduling technologies can help order individual production processes for each polymer batch according to which processes require similar conditions, *e.g.,* temperature, to help curb dramatic changes between transitions, which tend to require more energy.

Outside of precise production planning, intelligent technology also makes it possible to analyze controlled and uncontrolled process variables in real time. Analysis of production process data can identify errors as they happen and provide guidance for teams on how to best mitigate or correct the process to recover the product. Multivariate analysis helps identify issues, such as drifting, temperatures, or feedstock quality, early on in processes, allowing corrections that improve product quality and reduce off-spec product waste.

Managing waste effectively requires a holistic view of the entire plant and its end-to-end operations. There are several scenarios within the plant environment, no matter how closely monitored by plant operators, that can lead to production waste.

However, the imperceptible events that sometimes lead to material waste, such as excessive energy usage, cannot rely on the human eye to catch. The events are often deep within the production layers, and a reliance on intelligent technology can help organizations uncover them.

Advanced technologies provide operators with the ability to observe sustainability metrics to cover a range of performance factors. In the coming years, we will see incremental improvements in digital technologies, where elements such as efficiency and data visualization will become even more effective and offer more value to organizations. The digital world is in a constant state of growth, and technologies that are making strides in sustainability efforts today will continue to offer more innovative solutions in the future. **EP**

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