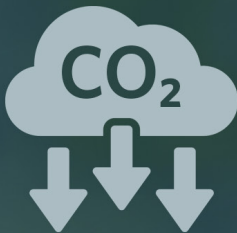




Digitalization Strategies to Gain Leadership in Sustainability

by Antonio Pietri, President and CEO, Aspen Technology, Inc.





Taking Up the Dual Challenge

These are demanding times for companies across all industries and around the world. As **Abu Dhabi National Oil Company** (ADNOC) Chief Executive Sultan Ahmed Al Jaber noted at ADIPEC 2022, “the world needs maximum energy and minimum emissions.”¹ This dual challenge—meeting the demand for resources from a growing population with increasing standards of living, while also addressing sustainability goals—is pushing industry leaders to develop new strategies and solutions that will transform the global economy for decades to come. While those efforts may follow different pathways and work on different timelines, one thing is certain: Technology in support of digitalization will play a central role in how industry responds.

The need for action will only grow more urgent in the decades to come. By 2050, global demand for energy is expected to increase by 50 percent according to U.S. Energy Information Administration (EIA) estimates.²

To enable growth in the deployment of renewable energy, spending on electrical grids is expected to increase from \$320B USD today to more than \$740B USD by 2030.³ As electrification increases, demand for metals such as lithium and cobalt is expected to grow by as much as 600 percent by 2035⁴ while the demand for chemicals is projected to rise 300 percent by the middle of this century.⁵

The COVID-19 pandemic, the intensification of calls for climate change action, the commitment by companies to hit net zero targets by 2050 and the Eastern Europe conflict all happened in quick succession over the past few years. The resulting financial impacts on global economic recovery have been enormous—roiling financial markets, disrupting trade, tightening energy supplies and driving already-high inflation. More recently, monetary policy threatens to slow global growth and perhaps trigger a recessionary period in some of the world’s major economies.

Maurice Berns, Managing Director & Senior Partner at the BCG Center for Energy Impact, noted that politicians are struggling with managing short-term crises against longer-term imperatives. For those businesses already feeling financial pressure, juggling today's needs and tomorrow's hopes at the same time can create additional challenges. In fact, many of the world's largest companies face a "major credibility gap" because of their incomplete plans for slashing carbon emissions, according to a study by Net Zero Tracker. "Of the 702 companies with a net zero target, two-thirds haven't made it clear how they plan to achieve that goal." ⁶

In the not-too-distant future, the energy transition could lead to a persistent VUCA (volatility, uncertainty, complexity and ambiguity) environment if not managed adequately as the world looks to integrate new energy sources into the mix. If firms hope to meet the dual challenge, agility, flexibility and insight must be critical components of any effort to not only achieve operational excellence, but to meet sustainability goals going forward. Automation and digitalization will play an increasingly important role in those efforts, enabling firms to increase efficiency by optimizing the use of key resources and minimizing carbon emissions.

A heightened focus on ESG (environmental, social and governance) reporting will also be important, both as a way to demonstrate companies' commitment to sustainability and as a factor for attracting and keeping new employees. Those benefits will be key to driving the early phase of the transition to put companies on track to hit the 2050 net zero carbon goals while scaling the technologies, such as carbon capture and sequestration, hydrogen, biofuels and others, that will decarbonize the environment around us. The drive to circularity for resources produced in some industries will certainly benefit the reduction in CO₂ emissions, and over time, those sustainability benefits will also help support the creation of a circular economy which will reduce waste in the environment and optimize the use of resources.



A Call to Action for Executives

Tackling the dual challenge becomes even more daunting for organizations and their leadership who must also consider a variety of equally pressing external factors, such as political and socioeconomic pressures, supply chain disruptions, geopolitics and the Great Resignation. Executives need to make long-term capital investment decisions to scale their operations to meet the expected demand growth in a VUCA environment. For example, new chemical plant capacity can cost billions and take years to get the regulatory approvals and permits for construction. Mining investments to produce the metals needed for electrical batteries are of a similar scale and timeframe. Meanwhile grid operators are rearchitecting distributed energy resource management systems (DERMS) to maintain a stable and flexible grid, while supporting a larger and more diverse set of renewable power sources.

As companies explore different business models and technology solutions in an effort to design assets with the flexibility for an uncertain future, “the next few years will be critical,” said Bob Maughon, **SABIC** CTO and CSO, Executive Vice President of Sustainability, Technology and Innovation, during a Chemical Week Executive Conversation on the Challenges and Opportunities of the Circular Economy.⁷

A key question is “what are going to be the right solutions?” Maughon noted. “How do we bring the most cost-effective processes forward? How do we bring the right products forward? When you have that kind of disruption and that kind of risk, there’s a strong logic toward looking at how we collaborate differently to manage that risk in this transition. I think you’ll see that there’s a willingness from companies, in our peer group—for example, in the chemical industry—to collaborate together more intimately on innovation, on setting of standards, on an approach to the market, different than in the past.”



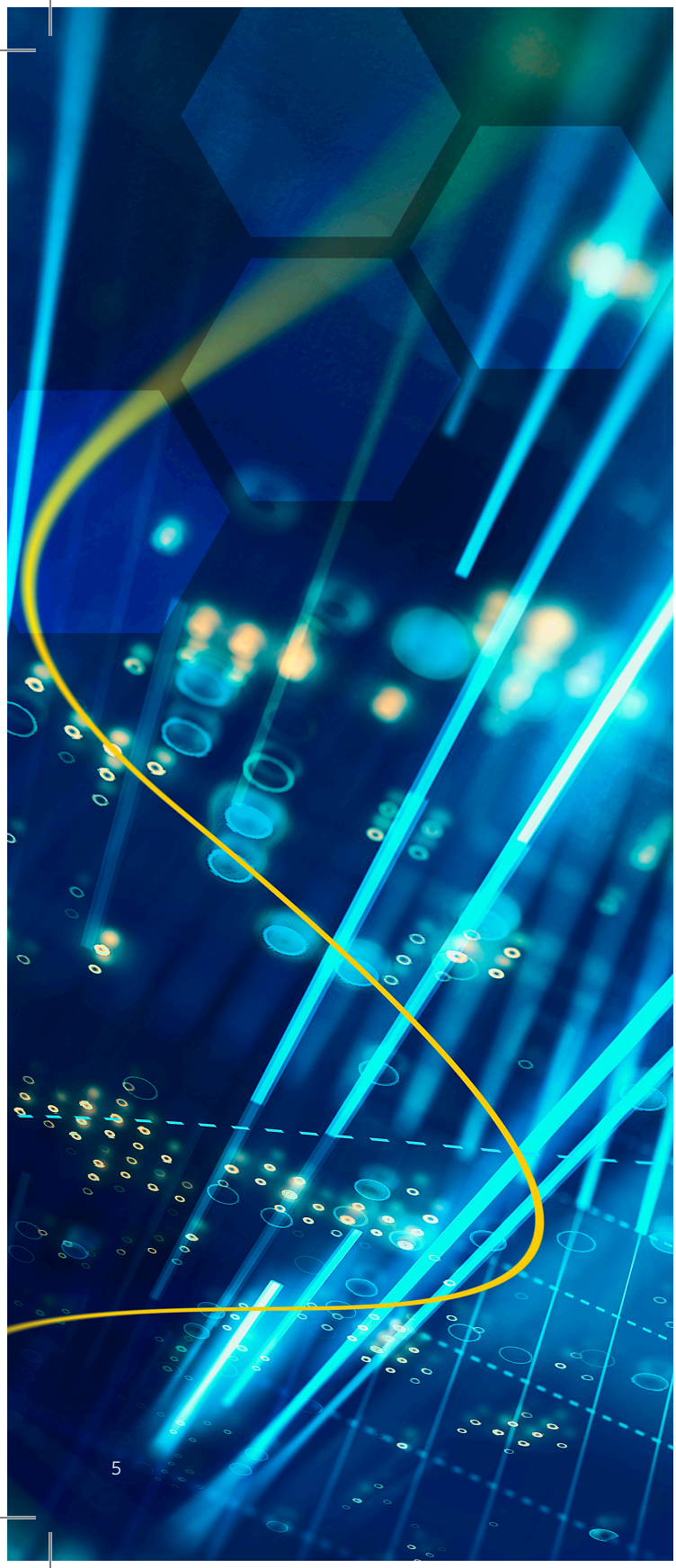
At the same time, executives must point their organizations toward achieving ever-higher levels of operational excellence that will now require meeting ambitious sustainability goals. Asset optimization, energy use and waste reduction, safe production and manufacturing are all key to ensuring companies stay financially competitive and address sustainability goals. Importantly though, leaders must also recognize that technology and innovation cannot work in isolation.

The workforce is experiencing dramatic change, and companies must respond by investing in the talent pool of the future, building new capabilities through training programs and establishing the future best practices. These organizational excellence strategies will all play a critical role in ensuring the evolving workforce has the skills necessary to meet the profitability and sustainability goals, adopt new technologies and transition to new business models in the decades to come.

The path forward is immensely complex, but the good news is that progress is being made. Studies conducted by Accenture and the UN Global Impact found that 81 percent of CEOs surveyed are already developing new sustainable products and services, and 74 percent are deploying new and circular business models.⁸ Among AspenTech customers, a similar trend has emerged—by leveraging our digital solutions, companies have prevented millions of metric tons of CO₂ from entering the atmosphere while still driving greater profitability.

Each company is unique and faces its own particular hurdles as it strives to meet the dual challenge. While partnering with customers in recent years, AspenTech has identified a number of instances where digitalization solutions can be leveraged to achieve sustainability and profitability, both now and for the future.





Key Strategies to Advance Sustainability and Maintain Growth

As you look to advance sustainability initiatives while maximizing profitability through operational excellence, there are several key strategies you should consider now as part of your digitalization journey:

Creating a Single, Trusted View of Your Operations from Disparate Sources of Data

One of the first challenges companies face when beginning an emissions reduction program is gathering the data necessary to establish a baseline and identify potential areas for targeted action. Collecting data, however, is only the start. Companies must also analyze that data to glean insights and make informed decisions that operationalize emissions reductions and show improvement with each reporting period as they work to reach targets. With the increase in ESG reporting requirements across regions, data aggregation, structuring and relationships will also play a key role in reliable external reporting.

Digital tools can help streamline the collection of this data from sensors and unit operations, simplify the process of combining data from isolated systems and make it available in a centralized location. Applications ranging from a digital twin of the asset to optimization capabilities, including for the supply chain, will identify the maximum potential reduction in CO₂ emissions.

Wesley Tucker, Head of Digital Transformation at [De Beers Group](#), said in a virtual Fireside Chat on Digitalization in Metals & Mining, “If we look at the way in which we’re deploying digital technologies in our business, there’s a huge amount of value to add in using data and using the insights to find the areas where we can make improvements in sustainability.”



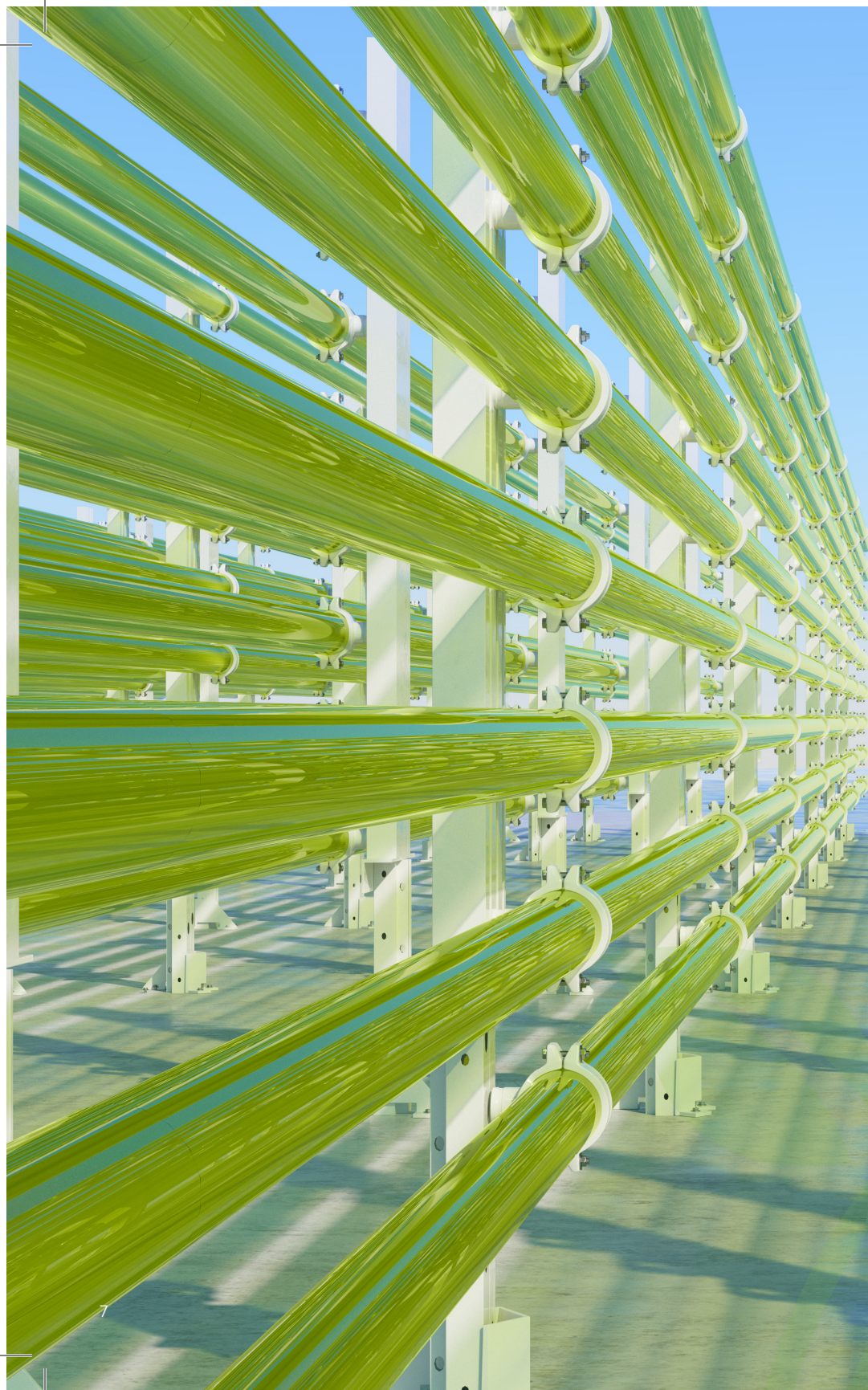
Data management systems not only help you capture the relevant detail, but also establish the relationships in the data to make it actionable and traceable, so that it can be a reliable reporting source of information for auditing as needed by authorities. In a world with exponentially increasing data sources, turning information into actionable insights is critical. Situational awareness solutions leverage advanced visualization capabilities to provide you with actionable intelligence on areas such as CO₂ tracking and forecasting that supports real-time decisions.

Extracting Efficiency and Reducing Emissions from Existing Systems

The demands for efficiency are dramatically increasing to achieve long-term net zero goals. “Energy efficiency measures can and must deliver huge emissions reductions. In fact, more than 40 percent of the required reduction in energy-related emissions over the next 20 years required

to meet the Paris Agreement goals must come from energy efficiency measures,” according to the International Energy Agency (IEA).⁹ Combined with renewable energy and other measures, energy efficiency is indispensable to achieving global climate targets. Improving resource efficiency is an important area too as customers are looking for opportunities to reduce water usage, reuse and recycle materials, and more. In addition, the volatile cost of energy and resources is one of the biggest challenge companies face as they navigate a global economic environment that is expected to remain uncertain for the foreseeable future. The pressure to extract efficiency and reduce emissions from existing assets remains a foremost challenge.

To deal with this ongoing volatility, many companies have turned to digitalization solutions to gain efficiency benefits that enable them to weather cost increases while maintaining operations at a high level and reducing emissions.



Emissions reduction is accelerated by digital solutions that provide you with visibility and insight, and can help reduce CO₂ and other greenhouse gas emissions. As a first step, operators can analyze emissions data to quickly identify both problems and opportunities for optimization and provide feedback on how local decisions impact both emissions and financial outcomes.

Companies are currently using modeling technologies to improve resource efficiency in process operations, to optimize energy, water and feedstock use. Digital twins, for example, are valuable tools that can connect to plant data for continuous asset monitoring. These models can also run offline, allowing you to perform what-if analyses to unlock deeper discovery of optimization opportunities that meet both sustainability and profitability objectives.

Advanced process control and optimization capabilities ensure reliable operations and keep processes from drifting outside of optimal ranges. As operational conditions change, adaptive control and optimization solutions can make appropriate real-time, online adjustments based on the process feedback to not just maximize profitability, but also minimize emissions and waste. In the case of **Cepsa**, multi-unit dynamic optimization tools helped reduce CO₂ emissions and hydrogen losses by optimizing its complex, refinery-wide hydrogen network.

Avoiding Costly Environmental, Health and Safety Risks

Unexpected breakdowns and emergency shutdowns can be very costly, both in terms of profitability and the impact on employees and surrounding communities—in some cases a single incident may release more carbon than a year of normal operation. The challenge companies face is how to avoid such incidents.

While nearly all companies rely on systematic maintenance programs to ensure equipment is running properly, such programs aren't designed to predict breakdowns before they happen. Digitalization solutions, by comparison, can help predict potential breakdowns in advance, and enable engineers to build process safety into their designs, reducing the risk for employees and ensuring companies comply with industry safety standards. In other cases, integrated system analysis is used to develop comprehensive plans for critical pressure relief and flare systems across the plant and the entire complex. As those same systems integrate current operations, dynamic modeling capabilities allow easy model upgrades, resulting in greater accuracy.

In addition to supporting better design, technologies like AI-powered monitoring and control technologies deliver insights on risk and asset lifecycles by allowing for detailed process hazard analysis, impact assessment, incident management and management of operational changes. These insights are essential to the implementation and maintenance of cost-effective regulatory compliance strategies. The same models that result in better design and operations can also help manage unexpected breakdowns, while operator training systems using digital twins of current and future operations are becoming standard practice across the industry.

Machine learning technologies are instrumental for examining historical and real-time operational and maintenance data that precede asset degradation and breakdowns to predict future failures, alert staff and prescribe actions to mitigate problems that impact operations and the environment. In the mining industry, for example, companies are now better able to plan and schedule service on heavy-haul trucks and ore processing equipment, improving operator's safety and productivity, increasing efficiency and reducing emissions.



Managing Through Market Volatility and Reduced Energy Security

In recent years, markets have experienced tremendous volatility resulting from many factors, forcing communities and companies to work through the uncertainties of the energy transition. Regional disparities in supply and energy options are creating unfamiliar and isolated conditions that can substantially impact profitability positively or negatively, driving the adoption of alternative operating strategies to sustain or reverse those effects. In addition to those challenges, the ongoing conflict in Europe has further upended energy market prices and availability in unexpected ways.

“The trouble with the whole topic around climate and energy is that the world of energy is a very complex one, with many connecting parts,” **TotalEnergies** CEO Patrick Pouyanné explained. “Just look at the way that some politicians have only just discovered that the price of electricity is linked to the price of gas in Europe.”¹⁰

Large price swings in feedstocks and products, as well as uncertainty in the availability of raw materials, demand flexibility in operations. Visibility on emissions and waste metrics, in addition to financial impact, give you the insight to respond to market shifts while staying within regulatory boundaries.

Supply chain solutions help you optimize scheduling as customer and raw material needs vary, leveraging alternative scenarios to define optimal outcomes to meet demand. Using value chain optimization solutions, **Repsol** reduces production waste and maximizes production margins while strategically supplying the southern European and Mediterranean markets.

Resilience in power supply is also critical for energy and chemical companies. Microgrids are an important digital solution to optimize energy production and consumption, as well as locally managed renewables and storage. As digitalization drives down the cost per kilowatt hour of renewable energy, companies are accelerating their use of electricity to achieve zero carbon manufacturing. Already, forward-



looking companies are pursuing efficiencies made possible through distributed generation, microgrids, wind farms, battery technology and hydrogen fuel cells. **The Salt River Project** in Arizona, for example, enables the seamless integration and distribution of 350 MW of renewable power to more than one million customers.

Taking on New Approaches to Meet Ambitious Net Zero and Circularity Goals

The path to net zero is narrow and will require deployment of all available clean energy options between now and 2030. The IEA projects that “to reach net zero emissions by 2050, annual clean energy investment worldwide will need to more than triple by 2030 to around \$4 trillion,”¹¹ with about seventy-five percent of the investment being allocated to innovative technologies in areas such as carbon capture and storage (CCS), low carbon power and battery storage.¹²

As companies focus on innovating and creating new technologies to meet ambitious net zero targets, they will require significant resources for initial research activities and subsequent capital investment in new and revamped assets.

The use of simulation helps you accelerate research efforts by reducing the time and expense associated with laboratory experiments and enabling the evaluation of alternative solutions. Accurate process modeling is crucial for not only selecting the right processes, but for designing the most energy efficient and sustainable solutions including providing economic analysis at each stage.

Once identified, new processes and products can be scaled and duplicated successfully using tools that integrate critical design and site location configuration decisions early on in planning. That integrated approach also reduces project risk for engineering and cost management, helping to speed your scale-up and expansion of new processes.





Systems-level risk modeling can be a valuable tool for companies as they consider CCS, carbon capture and utilization (CCU) and other technologies, to identify the most practical and economically feasible option for them based on their specific carbon reduction goals. More specifically, industry leaders are using subsurface geophysical and geological modeling software to quickly determine the best reservoir targets for reliable, long-term carbon storage. In another example, both **Carbon Engineering** and **Carbon Capture, Inc.** are using concurrent engineering modeling to evaluate thousands of carbon capture options, then simulating scale-up to understand tradeoffs between capital and operating costs.

Other innovation efforts are looking at reducing waste through improvements in the circularity of consumer products. Developing new plastics, for example, that can be more readily recycled, helps you reduce waste in the environment, lowers emissions and minimizes resource depletion from new production.

Plastics will continue to play a crucial role as the world transitions to a low carbon future. In fact, when looking at greenhouse gas (GHG) emissions, plastics may eventually become the preferred material over others that are typically viewed as more sustainable. Based on product life and impact of usage, commonly-used plastics, like grocery bags, packaging and soft drink containers, have between 50 and 90 percent lower climate change impact than alternatives such as glass, paper and aluminum, according to a 2022 McKinsey study.¹³ Based on its lower GHG footprint and potential recyclability, plastics will be a key component of decarbonization efforts in coming years.



Focusing Beyond Operational Excellence to Include the Organization

According to a study by The Manufacturing Institute, 78 percent of companies indicated they were “very or somewhat” concerned about the aging workforce; specifically the loss of knowledge that accompanies these retirements. By 2030, one in five Americans will be age 65 or older.¹⁴ The high volume of workplace departures has led to a huge gap in talent, expertise and skills at many companies, hindering their ability to increase the level of operational excellence across the organization or to fully embrace sustainability initiatives.

Historically, operational excellence has been focused on maintaining safe, reliable and efficient operations in support of the health, safety and profitability objectives of the organization. Other benefits, like lower carbon emissions, have been achieved through improved operational efficiencies but have not been the main driver in decision making.

Today, as organizations set emissions-reduction targets and declare net zero commitments, sustainability is a core component of operational excellence, and organizations are investing in digital technology with the specific purpose of driving sustainability benefits.

In tandem with those efforts to build operational excellence, many companies are also taking steps—like investing in talent, building training programs and establishing best practices and learning pathways—aimed at achieving organizational excellence including within sustainability focused teams.

Many companies are also finding that a focus on ESG principles can pay off in a number of ways, from attracting new customers who share environmental and social concerns to reducing costs and regulatory actions.



A combined focus on organizational excellence and ESG principles can also drive investments in human capital, help to build internal competencies, allow employees and organizations to adopt new technologies faster, and leverage machine learning capabilities to accelerate sustainability efforts.

“What will take us to the next level is continuous improvement and a transformative mindset, and that’s where innovation comes in,” according to Zhanna Golodryga, Executive Vice President, Emerging Energy and Sustainability at **Phillips 66**. “Data informs those decisions, and technology enables those transformative outcomes.”¹⁵

Identify the Right Partners for Your Digitalization Journey

Companies that take effective action to boost the efficiency of today’s assets and plan for future technologies will thrive as their assets run safer, greener, longer and faster. Implementing robust, integrated digitalization strategies will help organizations accelerate their transformation and ensure long-term business resilience during the volatile periods to come.

There is no one preset solution for sustainability. The journey for each company will be different. Choosing the right partner to guide your journey and the right solutions to drive successful outcomes are critical steps in the process. Partnerships will be critical to help companies tackle the magnitude of this challenge and the transformation required.

AspenTech understands the value of partnership and the deep and lasting bonds that come from continuous engagement, working side-by-side with customers to identify new applications as they adapt to changing market demands while also ensuring sustainability progress. AspenTech also works closely with industry groups, such as the Alliance to End Plastic Waste, in a collaborative effort to develop solutions to help global communities meet their sustainability goals.

As companies focus on evolving their business models and cultures to meet the dual challenge, there is a clear opportunity for purpose-driven organizations to leverage digital capabilities to attract a new generation of workers that are motivated by commitment and technology to build the organizational excellence that will scale and support the business. Meeting the demands of a rapidly growing global population without compromising the environmental expectations of tomorrow, requires a holistic approach to operational excellence that equally emphasizes a company's capacity and capabilities to successfully transform its operations and business. By fully implementing digital technologies, industrial companies will have greater success in navigating today's challenging and uncertain markets and innovating to keep tomorrow's hopes intact.

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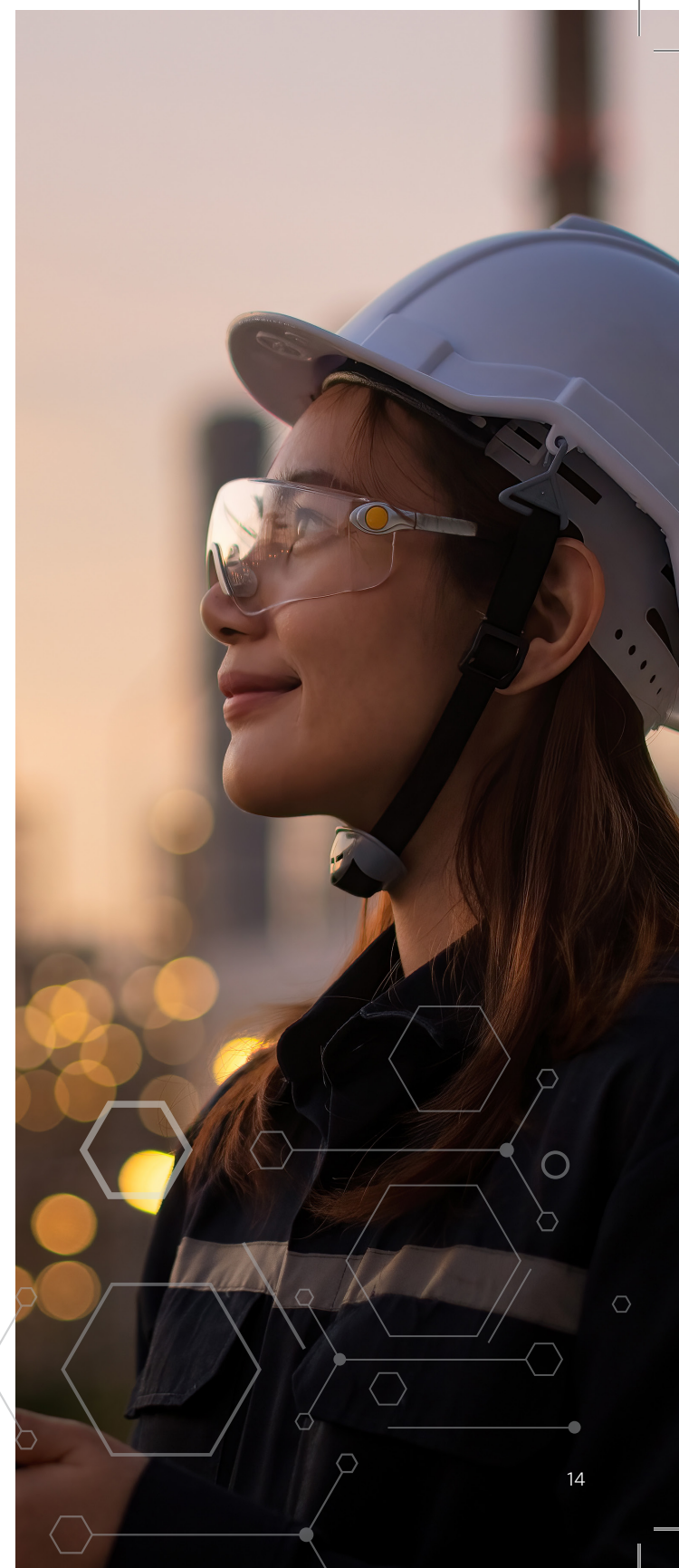
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About Aspen Technology

Aspen Technology, Inc. (NASDAQ: AZPN) is a global software leader helping industries at the forefront of the world's dual challenge meet the increasing demand for resources from a rapidly growing population in a profitable and sustainable manner. AspenTech solutions address complex environments where it is critical to optimize the asset design, operation and maintenance lifecycle. Through our unique combination of deep domain expertise and innovation, customers in capital-intensive industries can run their assets safer, greener, longer and faster to improve their operational excellence.

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