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HP Executive Viewpoint

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A vision for the refinery of 2030

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The refining business needs to change dramatically over the next decade. Refinery executives worldwide are tuned to the signals of change, but some are not sure of the best course of action. What are the challenges? How will technology disrupt the hydrocarbon processing business? What is the path forward for future success?

The signs of change. The uptake of hybrid, electric and high-efficiency vehicles, along with the pace of renewable power, are key variables in forecasting hydrocarbon fuels demand. The market for petrochemical feedstocks depends both on economic growth in Asia and, conversely, a strong push to avoid non-recyclable plastics.

Momentum towards efficiency is driving integration from oil production to finished goods, while a recognition of the need for a positive environmental image for the energy industry is driving innovation in carbon capture and new uses for performance chemicals to reach a carbon-neutral balance.

Sustainability initiatives are steering refiners to implement ambitious programs to reduce both energy and water use in refining and chemicals. Global cybersecurity concerns are driving innovation to enable digital transformation, while simultaneously protecting the safety and integrity of strategic assets.

Strategic choices. How do you position a refinery in the next 10 yr to make the right capital investments for change but be increasingly flexible? Will digital technologies be transformative in providing refiners a strategic cost and margin advantage? Can digital transformation make flattened refining organizations exciting destinations for the "best and the brightest" graduates—the future key people resources? How can organizations reduce cyber vulnerability and, simultaneously, increase agility and innovation?

The vision. The refinery of 2030 will be very different from the refinery of 2019. At its core, the multibillion-dollar physical asset—conversion, storage and separation units—will still be there. People will still drive refining, but in different jobs. However, it will become an intelligent, flexible and adaptive plant.

Demand-driven decision making. The refinery of 2030 thrives by being fully demand-driven, with decisions made quickly at the appropriate level. Across the management chain, knowledgeable workers in the 2030 refinery will take actions based on their impact on satisfying demand better than competitors. Integrated systems and visual interfaces show them how their individual and collective actions impact customer delivery and satisfaction, as well as how to optimize the asset to meet demand profitably.

Following the lead of Amazon's business model, the connected supply chain of the 2030 refinery ties together its supply chain with its operations, planning and trading, and sources solutions and applies powerful artificial intelligence (AI)-assisted analytics to understand the business opportunities presented by demand changes.

Business management, sales and trading use these analytics to find the business levers that give them market advantage.

Optimized production driven by trading and the economically optimum plan. The refinery of 2030 will operate with knowledge worker "pods" comprising planners, optimization experts, operators and reliability experts. Planning and scheduling will be fully integrated, with the planner supported by an AI expert dashboard displaying economic, sales, sustainability and operations trade-offs. Creation of the best schedule will be fully autonomous.

Prescriptive maintenance systems will flag to the planner and reliability expert situations that could interrupt achieving the production plan, along with alternatives for traders to purchase optimum crudes and operators to maintain operations at the best possible asset utilization, safety and profitability.

Using AI-assisted advanced process control (APC), the integrated plan and schedule will autonomously provide closed-loop optimization. By 2030, data sensors will be pervasive, but new real-time analytics deployed at the edge will provide process stream compositions, and catalyst nanosensors will drive better control over process performance. These

technologies will drive the APC and underlying control to operate through dynamically adjusted setpoints to achieve and exceed operations.

Smart units/equipment: Hardware embedded APC and models. Major process units and equipment in the refinery of 2030 will be smart plant building blocks. This built-in intelligence will greatly improve the ability of the refinery to operate at process operating limits. It will also be a critical element of asset flexibility. The asset owner will use this intelligence as an AI-based decision tool to model plant reconfiguration to shift product suites based on demand, to execute the reconfiguration rapidly, and to reconfigure the monitoring and control models for operating optimization.

The next-generation prescriptive maintenance system will not only flag future failure modes for equipment and units, but also will link to the planning and process models to propose operating changes that will delay or eliminate the future failure risk.

Taking people out of dangerous/remote areas. The further development of sensors, prescriptive maintenance AI solutions, unit analytics, etc., will provide the intelligence to understand physical asset conditions, trends, risks and emergencies, obviating most of the need to send people into the plant to inspect equipment and units for issues. AI-enabled virtual solutions will be able to not only plan but also manage startup and shutdown procedures largely remotely. Advances in plant robotics solutions will enable performance of many tasks without sending people into danger.

This concept is far beyond, and an alternative view to, the concept of "3D augmented reality." Conversely, it is the process and intelligent reliability, planning and execution systems that will drastically reduce the need for people to enter dangerous areas at dangerous times.

Sustainability oversight. The refinery of 2030 will only exist in an even more stringent "social license to operate" environment. Every decision-maker and worker in the refinery will have immediate visibility into the impacts of their tactical and strategic decisions on enterprise sustainability metrics and key performance indicators. Online optimization models will constantly optimize both energy and water use in the asset and throughout the value chain. Personnel will keep a running scoreboard of sustainability "points" the workers can earn recognition for when their actions help the enterprise improve its sustainability investment standing.

Executive risk-based visibility. Enterprise-wide, next-generation risk models provide a dashboard in the executive suite to assess an increase or reduction of risk being undertaken by different businesses, and capital and operational expenditures budgetary decisions. Cyber defensive capabilities and warnings will be built into every layer of the future digital refinery. These concepts will help the refinery of 2030 play a key role in the sustainable, highly-diversified and integrated energy enterprise of the future. HP