Transforming Latin America's refineries: profit, performance, and decarbonisation

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A 75-year-old Brazilian refinery is rewriting the rules of modern energy by pairing digitalisation with a Profit Improvement Programme (PIP) to boost profitability, process reliability, energy, and supply chain performance, alongside a bold $2.4 billion investment in clean fuels.

Across Latin America, refiners face mounting pressure to improve margins, slash spending, shrink emissions, and stay competitive in a shifting landscape. In response, refiners are launching digital profitability improvement programmes focused on process optimisation, energy reduction, and margin improvement. These programmes also target key operational levers for cost reduction – especially energy, which accounts for nearly 50% of refinery operating costs – to deliver measurable cost savings and greenhouse gas (GHG) mitigation while Bringing Decarbonization to Life®.

These dual benefits – higher margins and lower emissions – are defining the region's most forward-looking refiners. Among them is Brazil's Mataripe Refinery (owned by Acelen), where a full-scale transformation is turning ambitious goals into achievable results. Since its launch, the programme has delivered more than $100 million in cumulative improvements. The 2024 total shattered planned performance targets by 26%. These consistent monthly gains span operations across process, energy, reliability, and supply chain performance, as shown in **Figure 1**.

Notable outcomes include a ~6.5 vol% increase in middle distillates from 2023 to 2024 and a 10% leap in energy efficiency, with low Capex, in just five months.

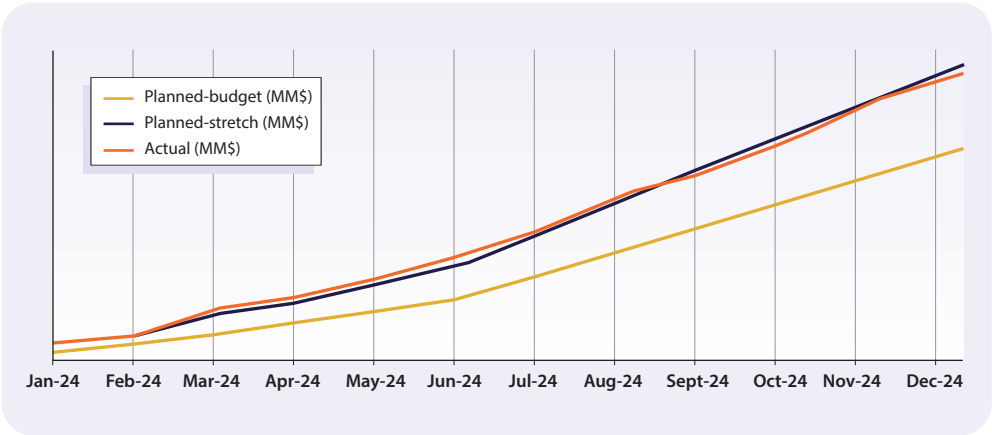

Figure 1 Validated cumulative benefit trending close to planned stretch targets

DID YOU KNOW? WHEN PAIRED WITH THE RIGHT STRATEGY AND PARTNERS, LEGACY REFINERIES CAN CONTINUE TO BREATHE NEW LIFE INTO OPERATIONS

BUILDING A MODEL FOR MODERN REFINING

In 2022, the refinery launched a full-scale transformation. More than a patchwork of upgrades, this effort rewove the refinery's DNA, threading digital tools, operational excellence, and sustainability into the site's operational fabric. A virtual refinery-wide model and first-principle process digital twins with linear programming (LP) vector generation capability were critical components of the digital transformation. These changes laid the foundation for a new era of operational intelligence to boost profitability while reducing emissions across the long-standing, but strategically vital, site.

MOVING TOWARD AUTONOMOUS OPERATIONS

With the digital backbone in place, the leadership began its progression toward autonomous decision-making. The refinery combined first-principles process simulation models, upgraded advanced process control systems, and real-time optimisation dashboards to move from reactive responses to predictive operations. These tools provided a digital window into operations to make quicker and informed decisions in real-time. One example is the installation of an Energy Real-Time Optimizer (ERTO) and online Visual MESA Greenhouse Gas Emissions Management (VM-GEM) software to reduce energy consumption and increase profits. This is now being enhanced with a multi-period utility plant optimiser to optimise further over several months, as shown in **Figure 2**. Another example was automating a compressor's control strategy to resolve chronic hydrogen flaring, plugging a leak in both emissions and margin.

Operational planning was also modernised. The site team overhauled its process industry modelling system (PIMS)-based LP models and integrated backcasting to bridge gaps between planned and actual performance. This allowed teams to continuously refine crude selection and align economic targets with operations. The LP overhaul increased profits by more than $30 million per year with better crude selection based on a more accurate LP model. Additional benefits are being captured with an enhanced crude selection methodology.

EXECUTING OPERATIONAL OPTIMISATION FOR MARGIN GAINS

As part of the PIP, the refinery team executed more than 25 targeted process improvements to improve yields and overall process performance while reducing energy. Focused upgrades in crude separation, catalyst use, and stream routing increased middle distillate yields by 6.5 vol%. Improved process unit capability, with better catalyst and constraint management, significantly reduced lower-value fuel oil production in favour of higher-value distillates. Furthermore, tighter quality control reduced giveaway and maximised distillate yields.

A systematic crude selection programme identified and processed additional lube crudes. Near-zero hydrogen flaring was achieved through improved hydrocarbon accounting, mass balance tracking, and equipment optimisation. In addition, gas flaring, which was once constant, costly, and carbon-intensive, was reduced by 30%. In total, these yield-related initiatives generated more than $100 million in profit.

TURNING ENERGY EFFICIENCY INTO PROFITS

Energy efficiency was one of the major drivers behind Mataripe's transformation. In October 2022, KBC's Best Technology (BT) benchmarking revealed significant room for improvement. By March 2023, a follow-up BT benchmarking showed a 10% improvement, driven by low- or no-Capex opportunities identified during the project.

After March 2023, the site launched a series of additional targeted initiatives, including pinch analysis, Energy Real-Time Optimization (ERTO), heat exchanger monitoring, and the ongoing Multi-Period Optimization (MPO). The site also developed its own initiatives to improve energy efficiency. These resulted in further improvements beyond the initial 10% improvement during the first five months.

INVESTING IN A CLEAN FUEL FUTURE

Building on this momentum, Acelen announced in 2023 a R$12 billion ($2.44 billion) investment to build a new biorefinery in Mataripe. The facility aims to produce one billion litres annually of renewable diesel (RD) and sustainable aviation fuel (SAF). This bold move positions Brazil as a global leader in clean fuel production, turning speciality crop oils into jet fuel for tomorrow's skies and renewable diesel for the roads.

BOOSTING AVAILABILITY AND CUTTING COSTS VIA SMARTER MAINTENANCE

Structured turnaround reviews (strategy, scope, planning/scheduling, and execu-

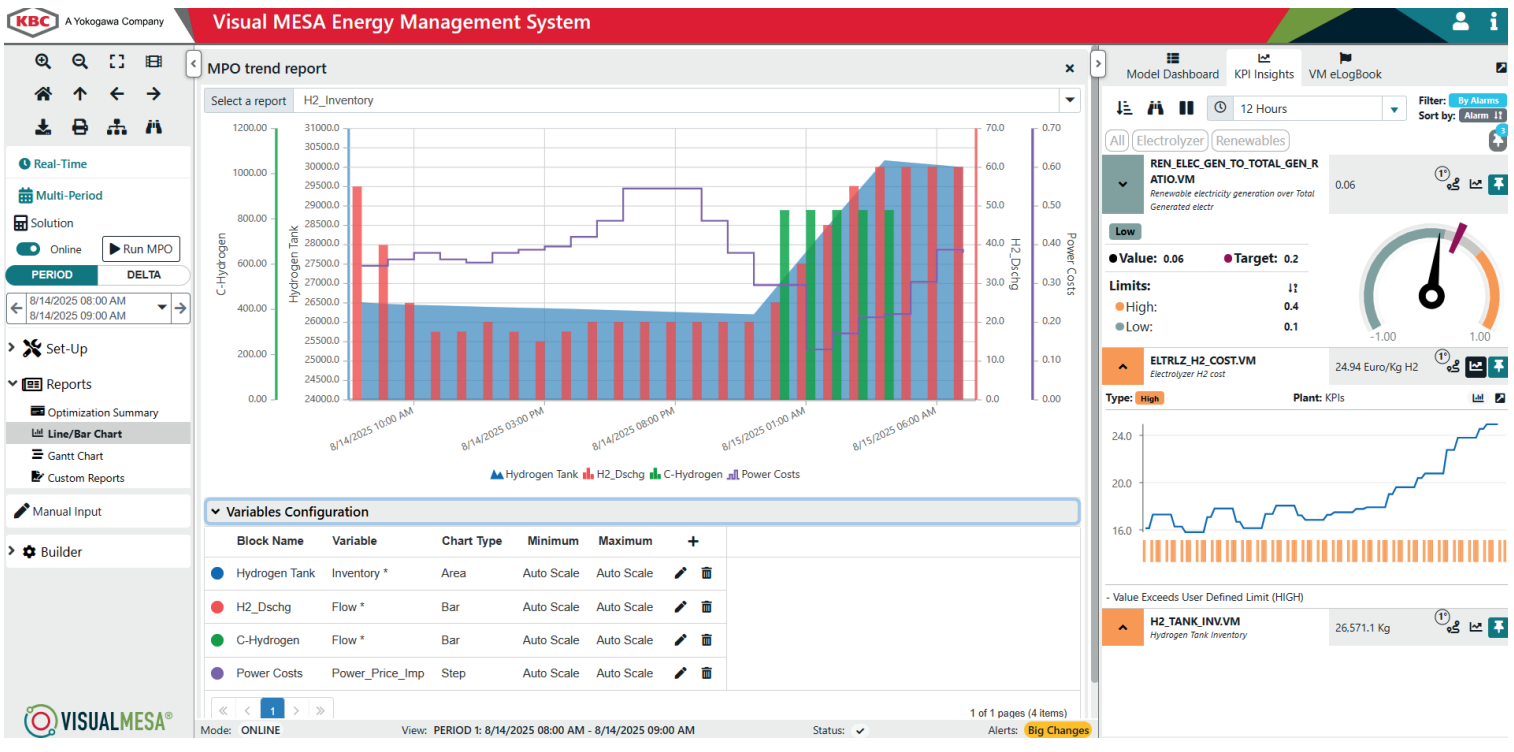

Figure 2 Real-time optimisation dashboard supports predictive operations and KPI tracking

tion) resulted in shorter turnaround and reduced costs. A dedicated gatekeeper role and a tightened maintenance work process ensured the scope and priorities were well-defined. These changes avoided more than $3 million in unnecessary work and an estimated $5 million in labour cost reduction. Root Cause Analysis (RCA) and Reliability-Centered Maintenance (RCM) techniques targeted underperforming assets to help reduce some of the estimated $30-45 million in production losses during 2023. As a result, mechanical availability, process safety, and sustainability all improved. Notably, these gains were achieved in addition to the reported numbers.

CONCLUSION

Mataripe Refinery's transformation is not just a corporate win – it is a compelling regional case study proving that ageing giants can learn to run lean and green when data, discipline, and engineering converge. These refineries are being reshaped into leaner, cleaner, and more capable centres of energy innovation.

Mataripe's numbers speak for themselves:

- More than $100 million in validated annualised benefits across process, energy, reliability, and supply chain performance.
- 6.5 vol% increase in middle distillate yields through crude separation, streamlined catalyst use, and stream routing optimisation.
- More than 10% energy efficiency improvement driven by no/low Capex solutions, such as MPO, ERTO, pinch analysis, and heat exchanger monitoring.
- More than $30M/yr in potential profits via PIMS LP upgrades.
- $10M/yr in margin improvements from the use of alternative lubricant crudes.
- Reliability gains via RCA and RCM reduced downtime linked to high-impact assets.
- Turnaround optimisation increased mechanical availability, and gatekeeper implementation reduced routine maintenance costs.
- Digital twins with calibrated simulations and dashboards deployed across key refinery units.
- Advanced planning and backcasting tools improved crude selection and operational alignment with the LP.

For refiners across Latin America, the message is clear: performance and decarbonisation are not competing, they are complementary forces. When paired with the right strategy and partners, legacy refineries can continue to breathe new life into operations and deliver enduring value – now and into the future – while Bringing Decarbonisation to Life.

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