



Decarbonizing the Future for One Refinery

A data-driven roadmap for emissions reduction while preserving operational excellence

Key Benefits

- 26% reduction in energy consumption potential identified through digital twin analysis
- Prioritized over 100 energy efficiency and CO₂ reduction opportunities
- Identified pathway to achieve 30% CO₂ reduction by 2030
- Optimized €1bn+ CAPEX investment with scenario-based planning
- Balanced emissions goals with economic viability and operational excellence

Background

- Target: Reduce Scope 1 and 2 CO₂ emissions by at least 30% by 2030
- Faced uncertainty on regulatory impacts, subsidies, and project prioritization
- Over €1bn in CAPEX investment, a shortage of qualified personnel, and the complexity of balancing day-to-day operations with a long-term decarbonization strategy

Client Challenge

European refiners are under increasing pressure to decarbonize while remaining competitive and profitable. For one refinery, this meant reducing Scope 1 and 2 CO₂ emissions by at least 30% by 2030 while ensuring that billion-euro decarbonization projects remained economically viable. At the same time, the refinery needed to manage day-to-day operational demands in a market environment shaped by regulatory uncertainty, unclear timelines for European Union subsidies, and a shortage of highly qualified personnel. Balancing short-term operational needs with long-term strategic goals required a data-driven approach. The refinery's original roadmap, designed in 2017, no longer provided the clarity or optimization needed, making validation, refinement, and economic reassessment essential.

The Solution

In 2022, the refinery partnered with KBC to validate and enhance its decarbonization roadmap. The engagement began with an intensive two-week assessment that identified over 100 potential energy efficiency and CO₂ reduction opportunities.

Using Petro-SIM® process simulator, various operational and investment scenarios were modeled to evaluate capital requirements, emissions impact, technology readiness, and overall implementation feasibility. This analysis revealed a pathway to cut energy consumption by 26% and provided a data-backed, realistic approach to achieving the 30% CO₂ reduction target.

To enable long-term success, KBC developed an Integrated Process, Energy, Emissions, and Economics Model, creating a refinery-wide digital twin for scenario planning and predictive analysis. Over the course of 12 months, this systematic approach allowed the refinery to prioritize decarbonization opportunities, assess economic and operational impacts, and build a roadmap that balanced environmental goals with financial viability.

The strategy incorporated advanced technologies such as carbon capture, electrification, and the integration of green and blue hydrogen. By co-developing this comprehensive roadmap, the refinery ensured regulatory compliance, operational resilience, and alignment with its 2030 sustainability commitments.

Results

The analysis confirmed that achieving 2030 emissions reduction targets would require more than €1 billion in capital investment, underscoring the importance of sequencing projects to maximize return on investment. Scenario testing within the digital twin gave the refinery confidence in its roadmap by validating strategies before implementation, reducing operational risks and avoiding costly disruptions. Based on this success, the refinery renewed KBC's involvement in 2023 for the implementation phase, a collaboration that remains active today.

The project has also earned external recognition, winning the Energy Transition Solution of the Year Award by the European Refining Technology Conference (ERTC).

Through this collaboration, KBC demonstrated its broader mission of Bringing Decarbonization to Life® to deliver measurable emissions reductions without compromising economic viability or operational performance.

