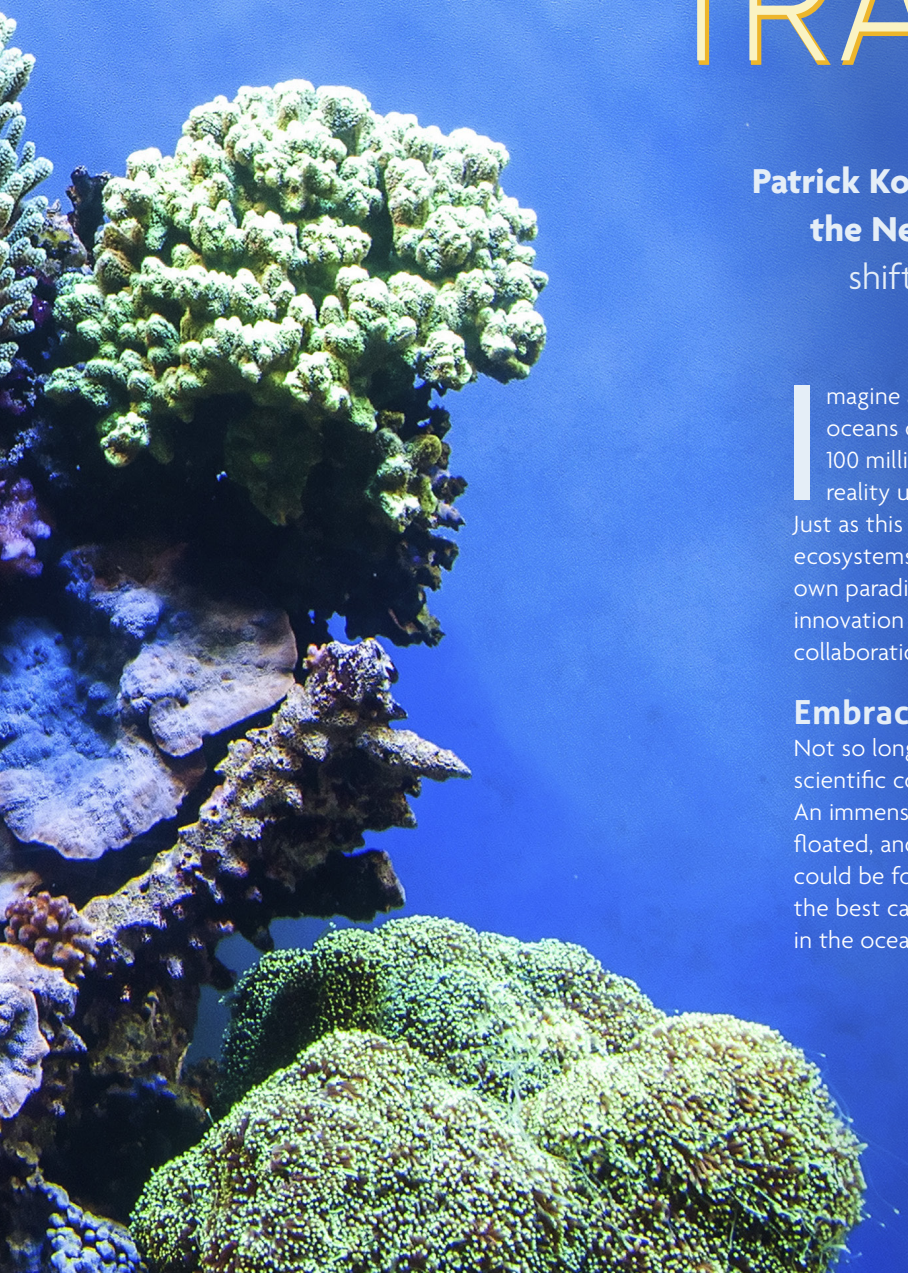
EMBRACING INNOVATION AND PRAGMATISM IN THE ENERGY TRANSITION



Patrick Kools, KBC (A Yokogawa Company), the Netherlands, explains how paradigm shifts in marine science can inspire the refining sector's future.

Imagine a world where the number of microbes in the oceans dwarfs the stars in the universe by a factor of 100 million. This is not science fiction – it is the astonishing reality uncovered by genomics pioneer, Craig Venter, PhD. Just as this discovery revolutionised understanding of marine ecosystems, the refining industry stands on the brink of its own paradigm shift, one that will be driven not only by innovation and adaptation, but also by new levels of collaboration and regulatory compliance.

Embracing bold pragmatism in refining

Not so long ago, there was a general consensus in the scientific community that the ocean was a sort of desert. An immense body of water where only a few fish swam, algae floated, and here and there bacteria and other microbes could be found. Scientists believed that maybe a dozen or, in the best case, a few hundred different microorganisms lived in the ocean.

Venter, the first to map the human genome, challenged this conventional wisdom. Between 2003 and 2018, he undertook a global expedition on a 30 m sailboat, during which his team collected seawater samples and analysed them using the same techniques previously applied to the human genome. The scientific community considered such basic field research to be an outdated way of working, but they soon changed their minds.

The results were astonishing. To put it into perspective there may be 10^{12} galaxies in the universe and 10^{22} stars. Based on Venter's work, science concluded that this small planet, in an insignificant corner of the universe, harbours 10^{30} bacteria. This means there are 100 million times more bacteria than stars in the universe. This discovery not only transformed understanding of microbial diversity, but also underscored the complexity and richness of life that exists in the oceans, waiting to be explored. They represent a myriad of new mechanisms to create energy, materials, chemicals and medicines which, in 100 years' time, may well make today's current technology look like child's play. Consequently, the role of refineries may well look very different in the not so distant future, offering many new opportunities – which are much needed.

As the International Energy Agency's (IEA) 'World Energy Outlook 2021' highlights, the energy sector faces significant challenges that require technology innovation, collective action, and a keen understanding of the regulatory framework to remain competitive.[1]

The stakes are high: industry research predicts that by the early 2030s, half of the European refineries could generate negative net cash margins. To counter this sobering forecast, industry leaders must unite, share knowledge, and resources to adapt effectively.

Despite these challenges, continued investment in oil and gas remains necessary. According to the IEA, the oil and gas industry currently invests approximately US$800 billion annually. This figure significantly exceeds the projected room for 2030 in a scenario aimed at limiting global warming to 1.5°C, or even 2°C. This highlights the delicate but bold balance that refineries must strike between maintaining current operations and investing in future-oriented technologies. Encouragingly, research indicates that refineries could reduce global cumulative emissions by 10% by adopting processing technologies and improving efficiency.

Collaboration between stakeholders – including refiners, technology providers, regulators, and governments – will be crucial to navigate these challenges, especially given the complexity of the European regulatory landscape. Understanding and complying with regional regulations can open doors for innovation and investment, while non-compliance may limit market access.

This article explores how applying an innovative mindset propels the industry beyond mere survival to prosperity. By drawing parallels between revolutionary findings in marine microbiology and the untapped potential for innovation within energy production, a transformative course for the refining industry can be charted.

Breaking the norms

As recently as the start of Venter's journey, the refining sector operated under well-established norms. But as Venter's groundbreaking research revealed the vast microbial diversity in the seas, the downstream industry too, is on the cusp of a transformation in how it views and operates refineries. The European Refining Technology Conference (ERTC) 2024 emphasises the necessity for pragmatism and for bold decisions as the industry navigates the energy transition amid regulatory uncertainty.

To support a first step in this shift, emissions management software enables businesses to continuously monitor and reduce carbon emissions while ensuring compliance with key initiatives such as the European Green Deal and Fit for 55 legislative package, which set ambitious climate targets for 2030 and beyond. Similarly, the US Inflation Reduction Act creates new opportunities for clean energy investments. These tools provide real-time data and process validation, allowing companies to optimise their operations and develop effective decarbonisation plans as they progress toward net zero targets, as shown in Figure 1.

In this landscape continuing to do the same, but a little bit better, will not be enough. The refining industry needs to rethink and reshape its role and position in the energy landscape.

To achieve this, collaboration across borders is essential. Joint ventures and partnerships between refiners and clean-tech firms can accelerate the development of sustainable solutions, ensuring both compliance and growth.

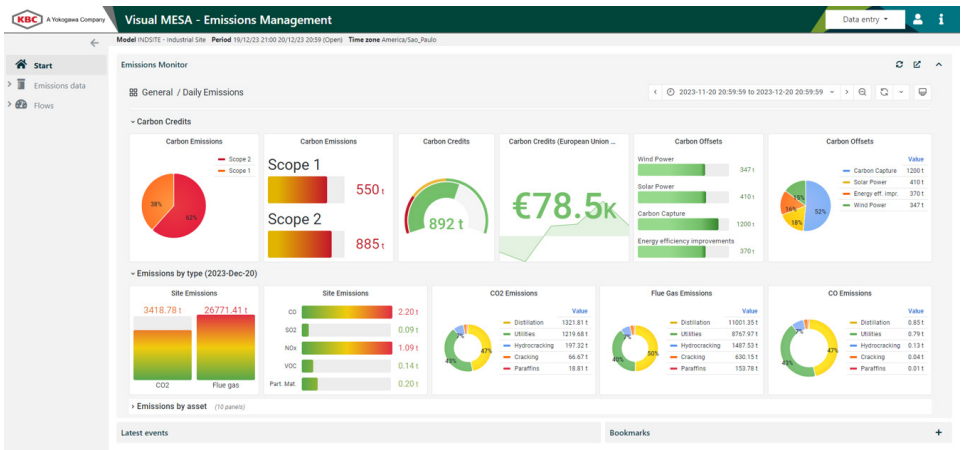


Figure 1. Visual MESA Greenhouse Gas Emissions Management dashboard.

This worldwide push for sustainable practices emphasises the need for bold, pragmatic approaches in the refining industry. In fact, Statista projects that global investments in renewable energy will exceed US$2 trillion by 2025, highlighting the widespread commitment to sustainable solutions.[2]

This moment in time invites the industry to rethink its strategies: could boldness be the most pragmatic approach? By applying solid first-principle thinking, robust yet flexible plans can be created that position the industry not just for survival, but for leadership in the evolving energy landscape. Perhaps going back to solid field research could also be beneficial in finding a new way to the future.

Leading the clean-tech race: an urgent call for action

The European Commission has sounded the alarm about the escalating clean-tech race. Economies across the globe – be it the US, India, China, or Japan – are investing heavily in green innovation. For the European refining sector to remain competitive, innovation must be coupled with strict adherence to evolving regulations that prioritise sustainability. While this creates significant pressure for the EU to maintain its competitive edge, it is crucial to view this not as a burden, but as a pivotal opportunity.

Take, for instance, the rapid influx of Chinese electric vehicles into European markets. This is not just competition; it is a clarion call for action. If this is viewed as mere pressure to conform, the industry risks stagnation and decline. Instead, it must be recognised as a vital opportunity to innovate and transform the sector.

Navigating the dilemma: prosperity, resilience and sustainability

Mario Draghi OMRI, Italian economist, paints a dire picture for the EU, framing its choices as a triad: prosperity, resilience, or sustainability. While this perspective might seem paralysing, it must be asked: is this a massive dilemma driving the industry into inaction, or does it point to a future where these elements can coexist and be achieved through active engagement?

As the discovery of microbial diversity opens new possibilities for biotechnological innovations, so too can an understanding of integrated approaches in refining unlock new avenues for success. By embracing a holistic view, synergies can be created that promote economic growth, resilience, and sustainability in harmony.

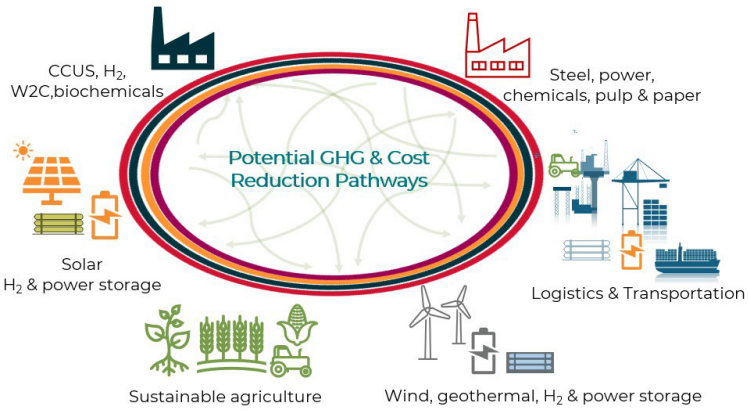


Figure 2. Refiners operate beyond traditional industry boundaries.

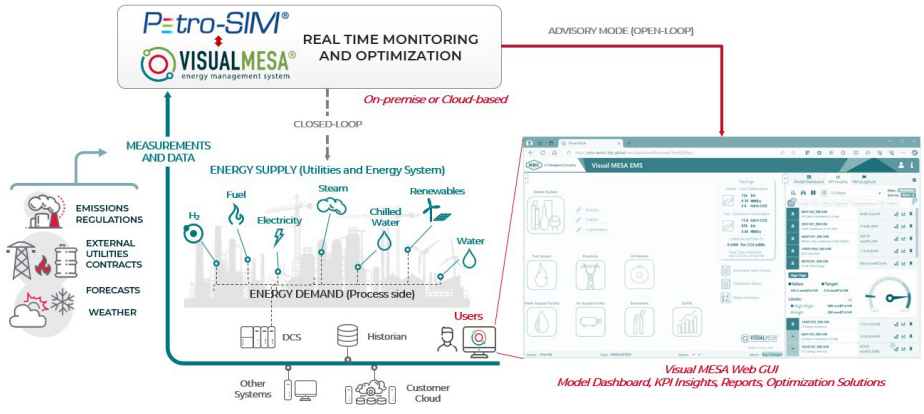


Figure 3. Advanced technologies provide real-time insights to tackle the transition challenge.

Redefining the role of refineries

To chart a successful course through these turbulent waters, the downstream industry must critically reassess what a refinery truly represents, shaped by regulatory requirements. Traditionally seen as facilities that convert crude oil into gasoline, this narrow definition limits the industry's potential. Instead, refineries should be envisioned as transformative hubs – energy bridges that integrate diverse energy sources and applications. Working together, while navigating regulatory frameworks, will allow the industry to leverage a wider range of expertise, leading to greater adaptability and sustainability, as depicted in Figure 2.

This broader perspective allows refineries to be seen not merely as producers, but as vital players in the energy transition, capable of adapting to and driving changes in the energy landscape. Such a vision invites creativity and innovation, enabling the exploration of new business models and pathways.

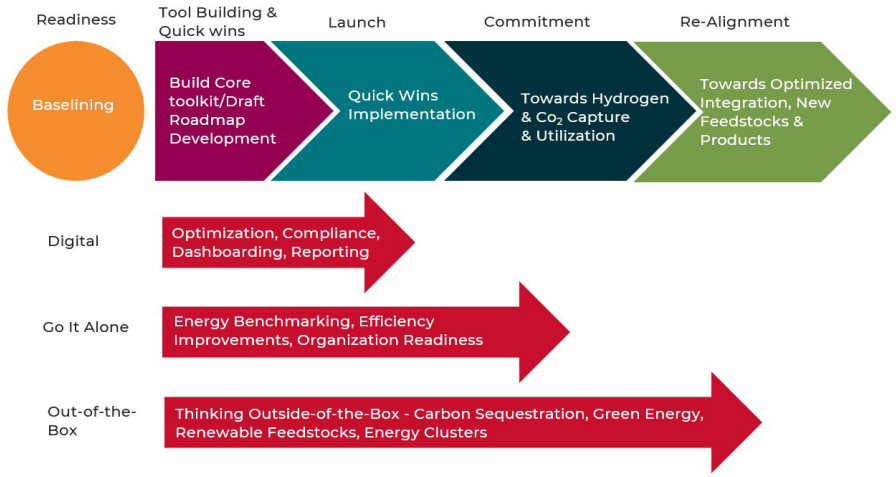


Figure 4. Out-of-the-box thinking yields innovation.

Tackling the transition challenge: three key elements

Transitioning refining operations successfully requires a multi-faceted approach, encompassing three core elements:

Optimising current operations

The first step is enhancing the efficiency of existing operations by integrating real-time data monitoring and optimisation, as shown in Figure 3. There must be a focus on reducing costs and emissions while maintaining essential business fundamentals. This is about energy efficiency, yield optimisation and asset management. All of these are not new, and certainly not the trendiest, but they are important fundamentals that are often still lacking in current facilities. This calls for a commitment to leveraging data analytics, advanced technologies, and process optimisation techniques. These refinements can yield immediate improvements, ensuring operations are not only effective but also environmentally responsible.

Integrating new technologies

Next, new technologies must be seamlessly blended into operations. This is not merely about incremental enhancements; it is about reshaping the entire business paradigm. For instance, Figure 3 also illustrates that energy managements systems can optimise energy supply and demand while providing real-time insights through dashboards and KPI reports. Beyond optimisation, investing in advanced solutions such as waste-to-energy, electrification, biochemicals and carbon capture technologies, the industry can redefine the role of refining step by step and prepare its organisations for a long-term future instead of a slow decline.

Innovating with new products

In the previous two elements, the focus has been on the pragmatic side. It is on the innovation side that perhaps an unusual boldness is required. As an interesting parallel, bacteria can directly exchange genetic material, enabling them to transform very rapidly and quickly acquire characteristics of neighbouring cells. The refining industry must embrace a fundamental shift in its offerings by exploring new product lines. Looking beyond traditional boundaries can lead it to innovative solutions that address emerging market demands, as shown in Figure 4. For example, research shows that refineries can leverage biochemistry to produce sustainable materials and chemicals instead of merely relying on fossil fuels.[3] Strategic foresight can unlock new revenue streams and ensure long-term viability, much like the groundbreaking work being done in microbial biotechnology.

Embracing first-principle thinking

As the downstream industry embarks on this journey, it is imperative to ground efforts in detail and scientific rigour. First-principle thinking is crucial in dissecting complex challenges and formulating plans that are both innovative and realistic. By fostering a culture of inquiry, adaptability, and collaboration, uncertainties can be navigated and a resilient refining sector ready to face the future can be built.

Forging a path forward

The refining industry stands at a transformative juncture. By embracing collaborations and bold pragmatism – where audacious decisions are rooted in comprehensive analysis – it can navigate the complexities of the energy transition. The path to a sustainable future is not just a distant aspiration; it is an imperative that must be actively pursued.

Redefining its role in the energy landscape and committing to innovative, resilient, and sustainable practices will secure the refining industry's future. Just as the vast potential of microbial diversity offers new pathways for innovation, so too can a willingness to adapt and embrace change propel the sector toward a successful, sustainable future in refining. In this journey, regulatory compliance must be viewed not as a constraint, but as a catalyst for innovation. By meeting and exceeding regulatory standards, refiners can position themselves as industry leaders and gain a competitive edge.

References

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