Redefining industrial sustainability

openaccessgovernment.org/article/redefining-industrial-sustainability/188788

20 February 2025

Leilac-1 pilot plant in Lixhe, Belgium

Committed to providing decarbonisation solutions for the global cement and lime industries, Leilac's CEO, Daniel Rennie, discusses the principles for an environmentally and economically sustainable industrial transformation

Carbon-intensive industries face a dual challenge: reducing greenhouse gas emissions while simultaneously strengthening the resilience and competitiveness of local industry.

The cement and lime industries perhaps encapsulate this dual challenge better than any other. Cement and lime quite literally provide the foundations of modern society. Cement is the key ingredient in concrete, the most consumed substance on Earth, after water. Lime is a critical input to a variety of essential industries, including water treatment, agriculture, and steelmaking. At the same time, their inherently carbon-intensive production accounts for approximately 9% of global carbon dioxide emissions – a number that is set to increase as other industries decarbonise and the global population continues to grow and urbanise.

So, how do we decarbonise our hard-to-abate industries while also delivering economic growth, supply chain security and a future-proof industrial base? At Leilac, we believe the answer lies in enabling flexible pathways to industrial sustainability. These pathways follow a hierarchy of principles: avoiding emissions where possible, capturing them when not, and removing residual or legacy emissions from the atmosphere. The economic and socially just application of these principles provides a framework for a transition to a truly sustainable industry.

Avoid: Preventing emissions

As with most things, prevention is better than a cure. Switching industrial processes to use low-carbon fuels, feedstocks, and energy sources can avoid the generation of significant greenhouse gas emissions. For example, transitioning the energy required for cement's high-temperature processes from fossil fuels to low-carbon or renewable inputs could reduce the industry's emissions by 30-40%. At the same time, providing industrial facilities with optionality and flexibility on what energy inputs they can use and when can help create more economical and resilient operations and improve national security.

Perhaps the ultimate expression of such flexible industrial processes is the ability to use a hybrid electric-fuel solution. Such a system could dynamically respond to daily and seasonal volatility in the supply and demand of electricity and the availability of low-cost local alternative fuels, such as those derived from society's waste. Producers may reduce operating costs and improve energy security by rapidly switching to the lowest-cost energy input locally available. Importantly, the electrification and hybrid-fuel operation of energy-intensive industrial facilities could help integrate them into electricity grids, where they could then provide demand-side energy balancing services. In this way, sector coupling between heavy industry and electricity grids can help create more stable, resilient and economical energy systems.

Another route to emissions avoidance is substituting carbon-based feedstocks for low-carbon alternatives. The key raw material used in cement making, limestone, loses about half its weight as carbon dioxide when heated. These 'process' emissions are what earn cement its 'hard-to-abate' label and contribute around 60% of the industry's CO2 output. Supplementary cementitious materials (SCMs), such as calcined clay, can partially replace carbon-intensive raw materials to reduce emissions, particularly if they are processed using low-carbon heat sources.

Capture: Abating unavoidable emissions

Despite the best efforts to avoid emissions, a significant portion remains unavoidable for cement and lime. For these process emissions, carbon capture followed by safe and permanent storage is the only viable option. The Global Cement and Concrete Association estimates that, even if all other decarbonisation measures are implemented, some 1.4 gigatonnes of carbon dioxide will need to be captured and stored each year if the industry is to meet its climate commitments.

To address cement's unavoidable emissions economically, we must deploy low-cost capture solutions alongside accessible carbon management infrastructure at scale and speed. Innovative solutions to reduce the cost of carbon capture, coupled with coordinated policy support to develop the enabling infrastructure and regulatory environment, are needed, with a clear focus on unavoidable process emissions.

Remove: Mitigating residual and legacy emissions

Net zero implies balancing remaining carbon dioxide emissions with carbon dioxide removal (CDR). The need for carbon removal is further enhanced as emissions reduction targets are missed, meaning more legacy emissions must be removed later. In this context, Direct Air Capture (DAC) and Bioenergy with Carbon Capture and Storage (BECCS) are emerging as valuable technology options for safe and verifiable carbon dioxide removal. The IPCC projects that hundreds of gigatonnes of DAC and BECCS will be needed to return global temperature rise to 1.5°C, following a significant overshoot. As such, carbon removal is a means of addressing historic emissions. It can further enhance – rather than compete with – industrial decarbonisation efforts by sharing technology developments, infrastructure costs, and workforce skills.

Justly: Balancing emissions reduction with socioeconomic prosperity

Sustainability encompasses more than environmental goals. For industry, it must mean economic and competitive operations, now and into the future. For society, it means secure and well-paying jobs and improving living standards, particularly in lower-middle-income countries. Therefore, transitioning to a sustainable industry must balance cutting greenhouse gas emissions with socioeconomic considerations.

By enabling flexible pathways to future-proof production, industries can economically decarbonise while securing the jobs, essential supply chains, and economic activity they underpin. By delivering industrial transformation projects to benefit local communities, the industry can go a step further and help secure the public acceptance and support that is critical for projects to succeed.

Leilac's pathways to industrial sustainability

Leilac aims to accelerate the transition to a sustainable industry by following the abovementioned four principles. Our technology is purpose-built to provide flexible and economic pathways to avoid and capture emissions from cement and lime and help remove legacy emissions from the atmosphere.

Leilac's technology is being developed to efficiently capture unavoidable carbon emissions from cement and lime that are ready for use or storage without additional chemicals or processes. It's designed to be scalable, retrofittable, and operate flexibly using a hybrid energy system with low-carbon and/or low-cost fuels and electricity. It provides viable and economical pathways to low-carbon cement and lime. The same technology can also produce calcined clays.

By producing zero-emission lime, Leilac aims to support the decarbonisation of other hard-to-abate sectors and remove carbon dioxide from the atmosphere through Direct Air Capture (DAC).

With a large-scale pilot operating in Europe and full-scale developments being undertaken with our partners globally, Leilac has imagined the future of sustainable industry.

To learn more, visit: www.leilac.com

Contributor Details

- Article Categories
- Energy

- Article Tags
- Clean Energy
- CO2 Emissions
- Sustainable Development

- Publication Tags
- OAG 046 – April 2025

- Stakeholder Tags
- SH - LEILAC SARL