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8 December 2023

Calix Newsletter – Issue 46 - Introducing the Leilac Newsletter - December 2023

Sydney, Australia | 8 December 2023 – Australian environmental technology company, Calix Limited (ASX: CXL) ("Calix" or "the Company") is pleased to provide a copy of its latest newsletter, providing a comprehensive update on activities across the Leilac business line. The newsletter is attached overleaf.

–ENDS–

This announcement has been authorised for release to the ASX by:

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About Calix

Calix Limited (ASX: CXL) is an environmental technology company solving global challenges in industrial decarbonisation and sustainability, including CO_2 mitigation, sustainable processing, advanced batteries, biotechnology and water treatment.

Calix's patented core technology platform delivers efficient indirect heating of raw materials to enable electrification of industries, efficient capture of unavoidable emissions, and green industrial processing solutions. Its flash heating approach can also produce unique nanoporous materials with enhanced chemical and/or bio-activity.

Leveraging its core technology platform and a global network of research and development collaborations, Calix is urgently developing multiple environmental businesses that deliver positive global impact. Because there's only one Earth, and it's already ours.

Mars is for quitters.

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Calix News

Special Edition:
Introducing the Leilac Newsletter

December 2023

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Phil Hodgson
Calix CEO and
Managing Director

Welcome to
Issue 46 of the Calix Newsletter

In this special edition, we take the opportunity to introduce the new Leilac newsletter. Leilac's newsletter will provide regular updates on its progress to develop and deploy decarbonisation solutions for the cement and lime industries, in addition to other applications of its technology, such as Direct Air Capture of atmospheric carbon dioxide.

Leilac is of course the first example of our capital light, licensing strategy in action. Carbon Direct Capital Management's investment of €15 million for a 7% stake in Leilac Limited demonstrated how impact investment at the subsidiary business level could provide look-through value for specific applications of the Calix technology and accelerate its development and commercialisation.

The subsequent spin-off of Leilac enabled investment in a single-focused team and the development of application specific technology beyond Calix's core platform. It has been satisfying to see the progress the Leilac team has made to date and the momentum that is building within the company.

Most recently, Leilac announced the signing of a global and perpetual licence agreement with Direct Air Capture company, Heirloom. Direct Air Capture is a method of removing carbon dioxide directly from the atmosphere, something the International Panel on Climate Change predicts will be needed at the scale of 1–10 billion tonnes of CO_2 per year if we are to limit global temperature rises to 1.5 °C.

Leilac's partnership with Heirloom will employ electric versions of Leilac's same core technology for CO_2 capture from limestone. It opens up a rapidly emerging new market for Leilac with significant public and private sector support, particularly in the US. It will also support and accelerate the electrification and scale-up of Calix's core platform technology for other mineral processing applications, including cement, iron and steel, and critical minerals.

You can read more about our partnership with Heirloom plus a report on a techno-economic analysis of Leilac's vision for cement decarbonisation at full commercial scale, updates on the Leilac-2 and Leilac-1 projects, and an opportunity to get to know some of the Leilac team in the first edition of the Leilac newsletter that follows.

In other Calix news, the 2024 financial year is off to a good start with all KPIs currently on track across the group. Following a successful Financial Investment Decision, work continues with our joint venture partners Pilbara Minerals on the construction of a demonstration plant to produce a mid-stream sustainable lithium salt product. Construction is expected to commence in April-June 2024, with the production of the first lithium salts targeted for Apr-Jun 2025.

Our expanded iron ore testing program continues following significant interest in our Zero Emissions Steel TechnologY (ZESTY). Early pilot-scale testing showed excellent metallisation across a range of ore types, including hematite ores from the Pilbara. A Front-end Engineering and Design study for a 30,000 tonne per annum zero CO2 emissions ZESTY iron plant is expected to be completed by the end of the calendar year.

We also recently published our Sustainability Report for 2023, which details our ambitions for sustainability across our own operations and the progress we are making. The full report is available on the Calix website.

I hope you enjoy this first edition of the Leilac newsletter, and you can subscribe here to ensure you stay up to date with future editions. Our regular programming will resume in the new year with the next Calix newsletter. In the meantime, I wish you all an excellent end to the year.

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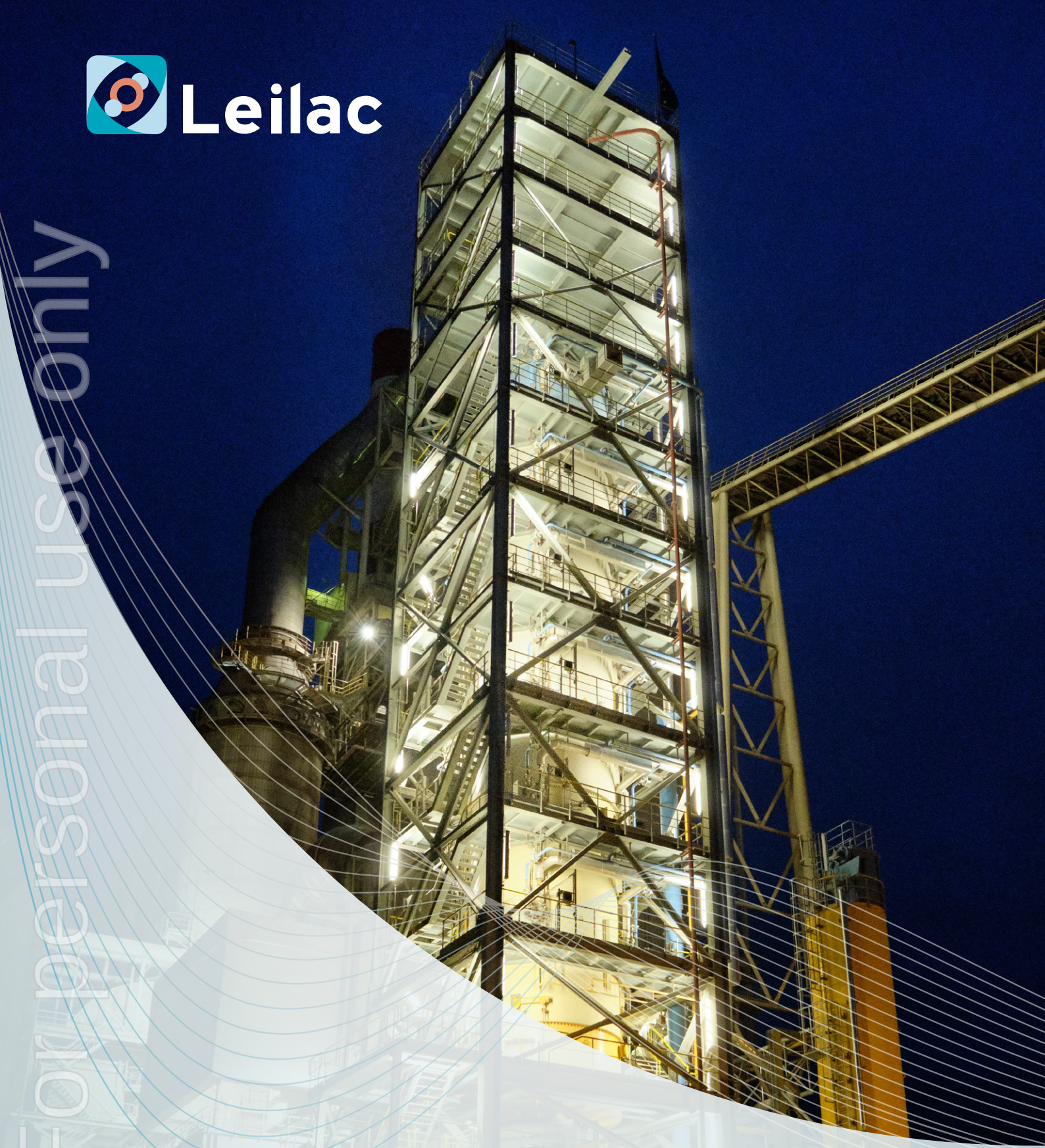

Leilac News

DECEMBER 2023

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Content

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Welcome **from the CEO**

Welcome to the new Leilac newsletter, where we share several recent milestones in Leilac's progress towards delivering low-cost decarbonisation solutions for our partners across the cement and lime industries, direct air capture, and other exciting applications of our technology to CO_2 mitigation.

Strong tailwinds are encouraging industrial decarbonisation and the abatement of atmospheric CO_2 across the globe, including public policy and industry commitments. The commitment to CO_2 transport and storage infrastructure development in the EU's Net Zero Industry Act is one example, while US initiatives like the Department of Energy's (DOE) Bipartisan Infrastructure Law's Regional Direct Air Capture (DAC) Hubs program have the potential to turbocharge the rapidly emerging DAC industry.

In this first edition of our newsletter, we feature a newly published report analysing the techno-economics of our full-scale vision. The report is published by the Leilac-2 consortium as part of our EU funded Leilac-2 project and provides a detailed illustrative example of the retrofit and integration options for a typical cement plant and possible costs to capture CO_2 based on central European prices. The fact-based report contains important findings, including Leilac's potential to provide the most flexible, scalable, and low-cost solution for capture of unavoidable process emissions. In addition, we explore economical pathways to net zero through the efficient combination of Leilac with a conventional capture solution for fuel emissions, or direct electrification.

We are also proud to share information on our new license and collaboration agreements with Heirloom, a direct air capture (DAC) company permanently removing carbon dioxide (CO_2) from the atmosphere, to deploy Leilac's renewably-powered electric kilns at future Heirloom DAC facilities. Together, we have the potential to deliver a significant impact on removing legacy emissions while also creating an accelerated pathway for the electrification of hard-to-abate industries, such as cement and lime.

The newsletter also covers developments with our first two EU funded projects. Leilac-2, our demonstration project in Hannover, Germany has an updated lighter, smaller and simplified design, while Leilac-1, our pilot project in Lixhe, Belgium has had some significant upgrades to continue to test and support our technology development.

Our partners also play an invaluable role in our business. Their commitment to lead change and develop and implement decarbonisation solutions is essential. In particular, I am grateful to the Leilac-1 and Leilac-2 consortium partners, who have been integral to the Leilac story from the start.

It is a privilege to lead such an inspiring and committed team that seeks to develop and implement our innovative technology, and you can watch four of our employees discuss their roles and the impact that they want to make on the world. Since Leilac Limited was formally spun-off from our parent company Calix in September 2021, our team has expanded from 8 to over 50 today. We continue to look for talented and purpose-driven new team members and encourage anyone interested to reach out to us. We are a diverse group, and we want our team to reflect the communities we serve. Our employees speak 21 languages, hold 19 nationalities, and live across 12 countries.

As CEO, I think the biggest challenge for us is not moving fast enough. I firmly believe we have the most promising technology to safely address some of our most enormous environmental challenges, but we need to move quickly in the race to decarbonise the world around us. It is in this spirit that we want to make a significant contribution to a just transition to net zero, urgently developing solutions that help enable an affordable and sustainable low-carbon future for our industries and our planet.

Thank you for your interest and support. We look forward to keeping you updated on our progress.

Daniel Rennie
CEO, Leilac Ltd.

Leilac's full-scale vision for low-cost cement decarbonisation: **a techno-economic study**

Decarbonising Cement: Leilac at Full Commercial Scale, a new study produced by the EU funded Leilac-2 consortium, provides a detailed analysis of the Leilac technology's potential to deliver flexible and low-cost decarbonisation solutions for a cement plant with a capacity of 1.2 million tonnes of clinker per year, with costs based on central European prices.

The study includes a techno-economic analysis of multiple, fully scalable retrofit and integration options that can deliver:

- Low-cost capture of unavoidable process emissions
- Strong synergies with post-combustion capture for near net-zero emissions and
- Electrification for future-proof cement production

Leilac CEO, Daniel Rennie, said the study supports a compelling vision for the decarbonisation of cement plants at full commercial scale.

"The CO_2 abatement costs presented in the report, with flexible, low impact and retrofittable integration options, provide economical solutions for cement decarbonisation, particularly in the context of the regulatory incentives being implemented by governments around the world," Rennie said.

"Leilac, in collaboration with its global partners, will continue to develop, scale and implement solutions that can enable the cement industry to meet its climate commitments and protect jobs and prosperity through a just transition to sustainable cement."

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Long version only

Targeting the lowest cost solution for unavoidable emissions

The study provides an analysis of the Leilac technology's application at the full-scale of a typical cement plant, with costs based on central European prices.

Through a simple replication of the module being developed for the Leilac-2 demonstration plant, the study finds that a typical full-scale Leilac plant could capture around 600,000 tonnes of CO_2 a year for a cost of around €33/tonne of CO_2 avoided, or ~€16/tonne clinker. These costs include CO_2 compression, maintenance, and capital repayment,[1] and results in avoidance of ~75% of the host plants fossil CO_2 emissions. With transport and storage costs in the range of €15-50+/tonne of CO_2, full CCS avoidance costs may be possible for around €48-81+/tonne of CO_2 avoided. Actual costs will be site-specific, and each plant will require a short scoping study.

Currently, the cost of emitting CO_2 within the EU is around €90 under the EU ETS, while the US Inflation Reduction Act increased the incentive to capture CO_2 from industry to US$85 per tonne. The study finds that full-scale implementation of the Leilac technology at a typical cement plant in central Europe may be able to capture CO_2 emissions worth €53 million per year for a potential annual cost of €20 million, excluding CO_2 transport and storage.

Low-cost and future-proof pathways to net zero

If a carbon-containing fuel is used, the Leilac technology can be combined with any other carbon capture process to address fuel emissions.

Post-combustion capture (PCC) technologies can increase CO_2 avoidance rates and deliver carbon neutral or even carbon negative cement. The combined use of the Leilac technology – to capture the unavoidable process emissions – and any viable 'flue gas capture' process can enable significant synergies.

With Leilac capturing the process emissions, the required PCC unit is only one-quarter of the size that would otherwise be required if it were the only technology used for carbon capture. Importantly, this dual capture scenario means that the energy requirements of the small PCC unit could be sourced predominantly from waste heat, all but eliminating its largest operating cost.

Using a formulated amine as an illustrative example PCC technology, the techno-economic analysis found that a combined Leilac + PCC system could reach net zero for ~€39/t CO_2 avoided (excluding transport and storage). A comparative scenario using the same post-combustion capture technology for all plant emissions resulted in a 90% cost increase compared with a dual Leilac and post-combustion capture approach.

Low impact retrofit

The study finds that the Leilac technology could be successfully retrofitted to a typical cement plant with minimal downtime. All costs presented in the study include the cost of taking the cement plant offline to complete the installation.

The Leilac technology has a similar footprint to the existing pre-heater tower, and its modular design can enable flexible layout, process and integration options tailored to a given host plant.

Leilac's capture of process CO_2 at >98% purity also removes the need for a CO_2 purification unit and reduces CO_2 compression unit size and costs.

Leilac Techno-Economic analysis 2023

[1] For a cement plant with a capacity of 1.2 million tonnes of clinker per year. That cost includes a Leilac CAPEX of around €123m (excluding compression) and Leilac OPEX would be approximately €9/tonne of CO_2 avoided (excluding compression). Compression CAPEX is approximately €19m, and OPEX €14/tonne of CO_2.

Towards full scale

Leilac's technology is purpose-built to efficiently capture unavoidable process emissions from cement and lime production. Leilac's process modification approach is proven at pilot scale and requires minimal additional energy input and no additional chemicals or processes.

The Leilac-2 project aims to develop a low-cost and retrofittable modular capture unit for process CO_2 emissions released unavoidably in the production of cement and lime. Once developed, this modular design will be replicable and can therefore be applied at any scale. Eventual delivery through a blueprint model for roll out by local companies using local resources is designed to urgently deliver scalable and accessible decarbonisation solutions for the global cement industry.

About the Leilac at Full Commercial Scale study

The study had two key objectives:

- Ensure that the Leilac technology could provide a low-cost option for full commercial-scale implementation, and
- Ensure that Leilac-2 is testing and developing a design that supports that full-scale vision.

The study assessed the capture rate and costs for full-scale Leilac plants based on duplicating the current Leilac-2 design (4-tube modules), representing the simplest approach to applying the design at full-scale. Future module designs, containing more tubes per module, may provide improved design solutions that further reduce capture costs.

Leilac is currently undertaking multiple detailed engineering studies for full-scale implementations of the Leilac technology at cement plants around the world, offering a near-term, commercially relevant solution.

The results presented in this study are illustrative, based on central European costs. Regional and plant specific analysis is provided through a scoping study. For further information, please:

- Download the study here
- Email contact@leilac.com

Leilac-1 | Pilot plant

Lixhe, Belgium 2019
25,000 tonnes / year CO_2
160 tpd clinker equivalent
~5% throughput

CAPTURE CO_2 | TUBE QTY 1

Leilac-2 | Demonstration plant

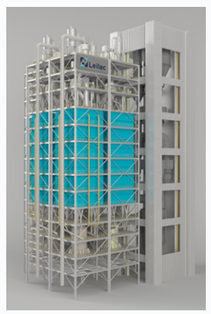
Hannover, Germany
100,000 tonnes / year CO_2
640 tpd clinker equivalent
~20% throughput

CAPTURE CO_2 | TUBE QTY 4

Leilac-3 | Full commercial scale

The Future
500,000+ tonnes / year CO_2
3000+ tpd clinker equivalent
100% throughput

CAPTURE CO_2 | TUBE QTY 20



Decarbonising cement | Leilac at Full Commercial scale[1]

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The Leilac technology

- **No additional chemicals or processes**
- **Scalable modular design**
- **Low-impact retrofit**
- **Future-proof fuel optionality**
- **Flexible layout and integration**
- **Targeting the lowest cost**

Techno-economics

~€33/tonne CO_2
Cost for process emissions avoidance.[2]

€39/tonne CO_2
Cost for near-zero emissions cement[4]

~€16/tonne clinker Cost increase for process emissions capture

€53m worth of CO_2 captured[3] for **€20m**

~€90-135m
Leilac CAPEX requirements[5]

~10€/tonne CO_2
Leilac operating cost[6]

>98% Expected captured CO_2 purity

92% Direct CO_2 emissions avoided with e-Leilac

Illustrative figures based on central European costs. Regional and plant specific analysis is provided through a scoping study. For more information please email contact@leilac.com.

[1] A technoeconomic analysis of a full-scale implementation of the Leilac technology at a typical 1.2 million tonne clinker per year cement plant with a capture capacity of 590 ktpa of CO_2.

[2] Typical CO_2 process emission capture cost on a per tonne of CO_2 avoided basis. Includes CO_2 compression, maintenance, and CAPEX repayment. Excludes CO_2 transport and storage.

[3] Annual value of CO_2 captured, and associated capture cost. Assumes an average EU ETS price of €90. Excludes CO_2 transport and storage.

[4] With the addition of a small post combustion capture unit for fuel emissions.

[5] For a typical, 1.2 million tonne clinker per year plant, excluding CPU CAPEX. Range includes optionality on fuel and preheater replacement / reuse.

[6] Excludes compression and CAPEX repayment. Assumes use of 95% alternative fuel at negative prices.

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Leilac and Heirloom sign agreement to use electric Leilac **technology for direct air capture**

Leilac and Heirloom have signed licence and collaboration agreements to deploy renewably-powered electric kilns at future Heirloom DAC facilities.

27 October 2023

Heirloom's© Direct Air Capture facility in Brisbane, California

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Heirloom, a direct air capture (DAC) company permanently removing carbon dioxide (CO_2) from the atmosphere, and Leilac, a decarbonisation technology partner, have signed licence and collaboration agreements to deploy renewably-powered electric kilns at future Heirloom DAC facilities.

Heirloom will employ Leiliac's electric kiln technology to heat limestone to produce high purity CO_2, which will go for permanent storage, and calcium oxide, which is looped through Heirloom's process to remove CO_2 from the atmosphere.

In welcoming the announcement, Leilac CEO, Daniel Rennie said, "These agreements establish the collaborative foundation for a partnership that combines two complementary technologies and a shared ambitious and purpose-driven culture."

"Our rapid progress is testament to the dedication and ingenuity of both the Leilac and Heirloom teams. Together, we have the potential to deliver a significant impact on removing legacy emissions while also creating an accelerated pathway for the electrification of hard-to-abate industries, such as cement and lime."

Heirloom CEO, Shashank Samala agreed, "Heirloom is committed to having our DAC facilities run on renewable energy and we're excited to further a partnership with Leilac to achieve low-cost carbon removal at future facilities on the way to achieving gigaton scale."

Following the signing of a memorandum of understanding earlier in 2023, Leilac and Heirloom have progressed the integration of Leilac's electric calcination and CO_2 capture technology into Heirloom's DAC plants through an extensive research and development campaign. This work is informing the design of new commercial DAC facilities.

Prevent, reduce, remove: a shared approach to CO_2 mitigation

Leilac and Heirloom's partnership is designed to support a range of CO_2 mitigation efforts. The electrification of mineral processing, including cement, lime, iron and steel and critical minerals, can enable a transition from carbon-intensive to renewable energy inputs, preventing future emissions and improving air quality for local communities.
Some hard-to-abate industries, such as cement and lime, produce CO_2 as an unavoidable by-product of raw material processing. For these industries, effective and low-cost carbon capture and storage is essential to reduce emissions.

But decarbonising alone will not be enough to achieve global climate goals. The Intergovernmental Panel on Climate Change projects that carbon dioxide removal in the order of 1–10 billion tonnes of CO_2 per year could mitigate residual emissions and, in most scenarios, achieve net negative emissions to return global warming to 1.5°C, following a peak.

Leilac and Heirloom's collaboration seeks to actively develop and support solutions across the three priorities to prevent, reduce and remove carbon dioxide emissions.

Heirloom and Leilac's combined DAC approach

Heirloom's DAC technology uses lime in a novel c arbonation process to directly capture CO_2 from the air and form limestone. This process accelerates the natural binding of CO_2 and lime from a period of years to just three days.

After binding and removing CO_2 from the air, the reformed limestone is fed back into the renewably powered Leilac kiln, where the CO_2 is separated and captured, and the cycle begins again.

The CO_2 removed from the air will be mineralised, where it is bound to rocks or other materials, or injected underground into existing natural geological structures, where it remains safely and permanently stored.

The integrated Heirloom and Leilac DAC solution will be 100% renewably powered to deliver the maximum net reduction of atmospheric CO_2.

Mutual benefits for decarbonization and DAC

Applying Leilac's technology to Heirloom's DAC process enables the DAC industry to leverage many years of technology investment and development from Leilac and its parent company Calix, the European Union and partners across the cement and lime industries.

With double the current combined capture capacity of all DAC facilities globally, Leilac's pilot plant is the largest operating carbon capture facility for cement in the world, outside China. A Leilac demonstration plant, with a designed capture capacity of 100,000 tonnes of CO_2 per year, is due for construction in 2024. Cement is]responsible for ~8% of global CO_2 emissions, with most of these emissions being directly and unavoidably released from the raw material.

Mr Rennie continued, "Leilac is excited to apply our core technology, developed for and with the cement and lime industries, to DAC. In turn, we expect our partnership with Heirloom will accelerate the development of electric calcination, as we work with all our partners in support of a just-transition towards an industrially sustainable low-carbon society. It's a win-win arrangement that aims to maximise the scale and speed at which we can reduce industrial and atmospheric CO_2."

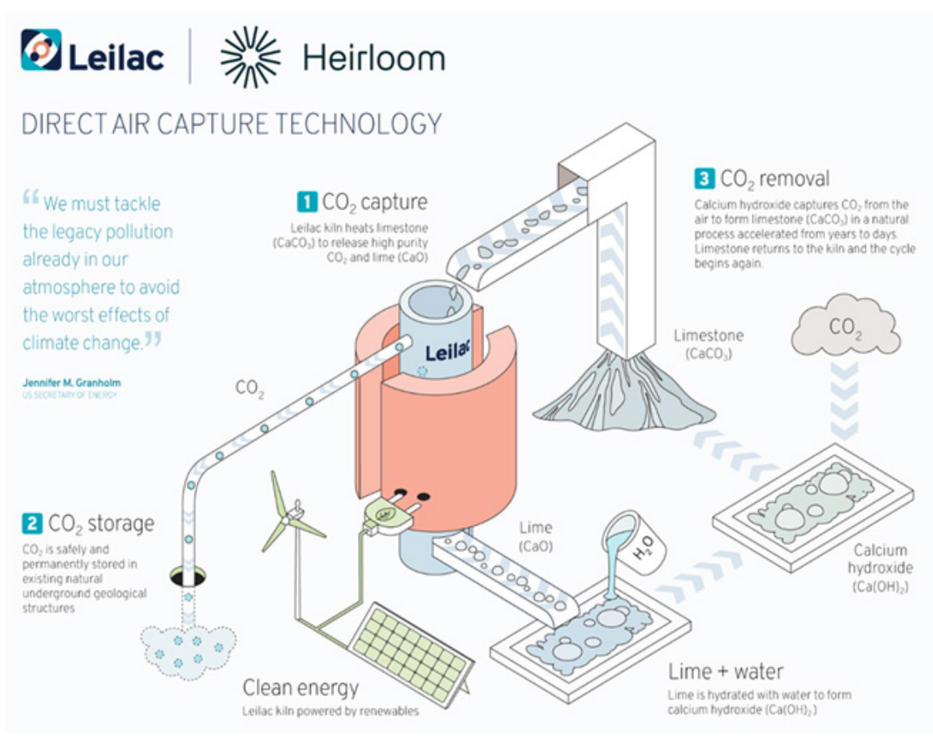
Supporting sustainable local industry

A just transition to net zero requires solutions that balance social, economic and environmental sustainability.

Low-cost and scalable CO_2 mitigation solutions can help maintain the competitiveness of industry in a low-carbon economy. Scaling decarbonisation solutions for essential industries like cement and lime will also help support and maintain sustainable local industrial manufacturing bases.

Heirloom is developing the fastest path to low-cost, permanent CO_2 removal by harnessing limestone. With a cost of approximately US$10-$50/tonne, limestone is inexpensive and easy to source. Combined with highly-modular, easy-to-manufacture facilities, Heirloom's solution is built to scale quickly to meet the urgency of climate action.

Ultimately, Leilac and Heirloom's projects are designed to be delivered through local firms using local resources, supporting local jobs in a just transition to sustainable industry.



Heirloom's Direct Air Capture process powered by Leilac's renewably-powered electric kiln.

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Listen to the Heirloom and Leilac CEOs **discuss DAC and their partnership**

In this Innovating for the Earth podcast, Heirloom CEO Shashank Samala and Leilac CEO Daniel Rennie explain how their partnership aims to accelerate the removal of legacy carbon dioxide (CO_2) emissions in the Earth's atmosphere and provide a pathway for the electrification of hard-to-abate industries, including cement, lime, iron, and steel.

GCCA India **visits Leilac-1**

Leilac was delighted to host GCCA India and 20 visitors from the Indian cement sector for a visit to the Leilac-1 pilot plant on 24 November 2023. The visiting group included many of India's largest and most innovative cement companies, in addition to representatives from the Indian Government's Ministry of Power and Department for Science and Technology.

India is the world's second largest cement producer, with an annual production of over 334 million tons. And with the demands of ongoing population growth, urbanisation and infrastructure development, this figure is set to increase.

India's cement industry also leads much of the world in the efficiency and emissions intensity of its cement and continues to set bold targets in support of sustainable development goals.
The visit provided an opportunity to share and learn from the various sustainability initiatives underway in the Indian cement industry, as well as the solutions that can help to enable a vision for sustainable cement and concrete.

Leilac was pleased to present its purpose-built solution for the efficient capture of carbon dioxide that is unavoidably released during the manufacture of cement and lime. In addition to a hands-on tour of the pilot-plant, we also shared plans for additional projects, such as Leilac-2, our demonstration plant in Hannover, Germany, and an analysis of our full-scale vision.

Leilac looks forward to partnering with cement producers in India and across the world in a just transition to net zero.

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An impression of the Leilac-2 demonstration plant, located at Heidelberg Materials' Hannover cement plant.

Leilac-2 gets a new improved design **and a revised timeline**

Leilac-2 gets a substantial update, including a lighter and simplified design that supports Leilac's vision for low-cost decarbonisation solutions for cement and lime.

The Leilac-2 demonstration plant's Front End Engineering Design Study (FEED) provides a substantial update to the project's original design. The FEED study, a critical phase in large industrial projects and an important milestone for the Leilac-2 project, is used to estimate the technical specifications, subsequent cost, and procurement needed.

The Leilac-2 FEED study reveals significant improvements, including a lighter and simplified design to support our vision for a low-cost and scalable carbon capture solution for the cement and lime industry. The design aims to use fuels, processes, and efficiencies as close as possible to the host plant. The resulting design supports the project partner's vision for low-cost decarbonisation, and a design that can be scaled to address all a cement plant's process CO_2 emissions.

The key features of Leilac-2's design now include:

- Targeted capture capacity of 100,000 tonnes per year of >98% purity CO_2
- Four calciner tubes in one furnace chamber
- A preheater string for heat transfer from flue gas
- Fuel flexibility, with staged operations for natural gas, through to biomass and ambition for full alternative fuel (AF) use
- Full heat integration with the plant, with safe material conveying
- Use of typical cement plant equipment allowing for easy integration, operation, and maintenance.

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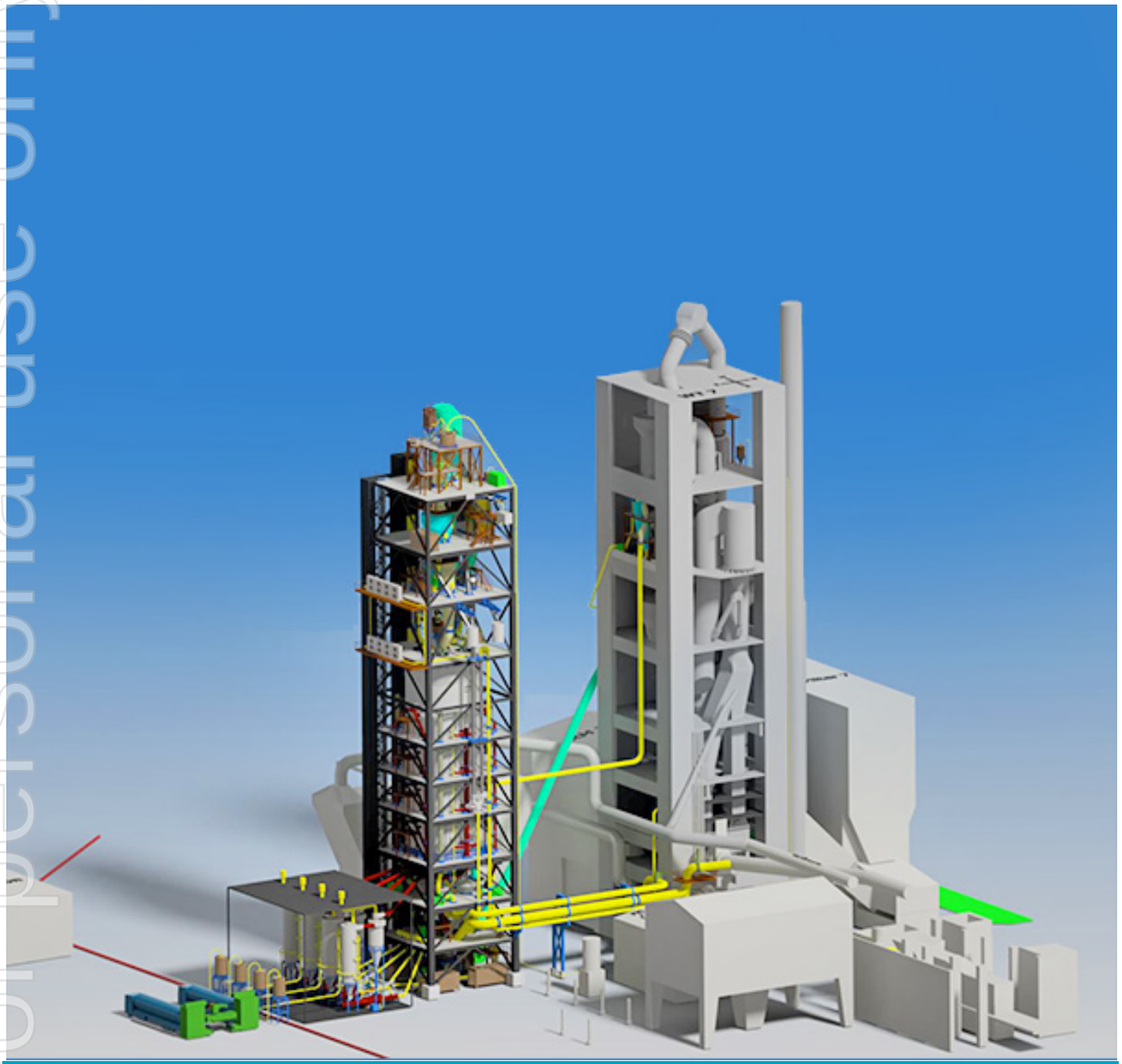
Value Engineered Design | August 2022



- Combined preheat stack
- 4 tube furnace with optimised burners
- Optimised tube length
- Lowered tower, reduced footprint
- Pneumatic conveying
- Centralised combustor

An elegant multi-tube furnace design

As a first-of-its-kind, the development of Leilac-2 involves risks inherent with technology development. In addition, the COVID-19 pandemic, war in Ukraine, ongoing supply chain disruption, and inflationary pressures have had an impact, including delays and increased input costs. A Value Engineering phase, undertaken after the Financial Investment Decision (FID), has helped to mitigate many of these issues with a simplified design. In particular, the development of a replicable multi-tube module within one furnace chamber provides the basis from which Leilac can scale towards its full-scale vision.

“This is a significant milestone for us and our project partners,” said Emma Bowring, Leilac’s General Manager for Engineering. “Leilac-2 is an important de-risking step for the scale-up of our technology, and its design solution will underpin our vision for the technology’s application at full-scale. Ultimately, it is about demonstrating a viable, flexible solution for our industry partners on their journey to net zero.”

Leilac-2 is our vision for a low-cost and scalable carbon capture solution

The Leilac-2 consortium is led by technology provider Calix Limited and its subsidiary, Leilac Limited, along with our partners Heidelberg Materials, Engie Laborelec, IKN, CERTH, LEAP, BGR, CEMEX, POLIMI, Cimpor, Lhoist, Port of Rotterdam, and the Royal Belgian Institute of Natural Sciences. The project is also supported by the GCCA, CEMBUREAU, ECRA, EuLA, VDZ and the University of Clausthal as the External Advisory Board.

The five-year project is funded by the European Commission through a €16M grant from the Horizon 2020 research and innovation programme, (grant no. 884170), and a further €18M contributed by consortium members towards the development of the demonstration plant.

Leilac 2

Partners

The concept of the Leilac technology has been proven at pilot scale through the Horizon 2020-funded Leilac-1 pilot plant at Heidelberg Material’s plant in Lixhe, Belgium. Leilac-1 has the capacity to capture 25 000 tonnes of CO_2 per year at more than 98% purity. This equates to about 5% of a typical cement plant’s process CO_2 emissions.

Building on this success, Leilac-2, which is being built at Heidelberg Materials’ cement plant in Hannover, Germany, will build and validate a replicable module with a capture capacity of 100 000 tonnes of CO2 per year, or about 20% of a typical cement plant’s process CO_2 emissions.

Timeline: Commissioning and testing to start by March 2025

The procurement of long lead equipment items is underway. The commencement of civil works (demolition) has commenced following some permitting delay due to local wildlife considerations. The project team will minimise delays through the Engineering Procurement and Construction (EPC) phase of the project and expects to start commissioning and initial testing in March 2025.

Once built, the demonstration plant will be validated under actual operating conditions, with a staged integration and fuels commissioning programme along with a variety of tests to confirm the technology’s performance and integration, paving the way for full-scale roll-out.

For more information:

- Download the study here
- Eemail contact@leilac.com

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The Leilac-1 pilot plant: **from proof of concept to ongoing R&D**

TThe Leilac-1 pilot plant in Lixhe, Belgium, developed with a consortium of industry partners along with a grant from the European Union's (EU) Horizon 2020 programme, was built to provide a "proof of concept" for the Leilac decarbonisation technology. Since delivering that proof, the Leilac-1 plant has continued to serve as a testbed for further research and development. Several Leilac-1 upgrades have helped shape the final design of Leilac-2 – a 4x scale up demonstration plant in Hanover, Germany – and Leilac-1 will continue to drive the development of further components of the Leilac technology as it is applied at full-scale across the world.

Leilac-1, located at the Heidelberg Materials' Lixhe cement plant, opened in 2019, on time and on budget. It has a design capacity to capture 25 000 tonnes of CO_2 per year and is the largest carbon capture installation for cement operating in the world, outside China.

The list of early Leilac-1 successes include:

- Effective indirect calcination of limestone and cement raw meal
- Successful separation of unavoidable process emissions from cement and lime production with no additional chemicals or processes required for capture
- CO_2 purity >98%, with no air ingress or loss of containment
- Safe and effective performance at required temperatures
- Similar energy requirements to a conventional cement plant
- No negative impacts on the host plant
- No impact on clinker production
- No significant 'coating' of the inner tube by the processed material
- No significant operational deterioration of the Leilac plant over time

Following these initial successes, the Leilac-1 pilot plant has undergone numerous upgrades to support further development of the Leilac technology and reduce risks as it is scaled to demonstration and commercial scale plants.

The Leilac-1 pilot plant was upgraded to include a Hot Air Slide (HAS) and Entrained Flow Conveyor (EFC) in 2022. The HAS is designed for high temperature operation, necessary to maintain product temperature while translating material horizontally. The EFC is a pneumatic conveying system designed to minimize the consumption of conveying air, electrical energy, and heat loss from the conveyed materials.

Both the HAS and EFC have demonstrated good flowability during operations. Testing has enabled further understanding of the conveying systems' operation and optimisation requirements, helping to de-risk their implementation in Leilac-2.

Leilac-1 will continue to serve as an R&D plant for test campaigns that explore critical design parameters and inform further technology development. These include the effect of meal composition, throughput, calciner tube wall temperature, preheater temperature, the addition of air, impurity removal and CO_2 purity, operational parameters, failure modes, maintenance requirements and procedures, and upgrading key equipment.
"Following a successful pilot which proved our indirect heating concept, Leilac-1 is now an important test facility for the continued development and de-risking of our technology," said Simon Thomsen, Leilac's Chief Technology Officer. "I believe Leilac-1 will continue to serve us, and our partners, well."

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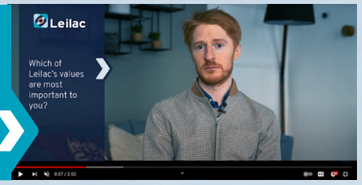
Meet some of
the team

Rana Hawly
Procurement Manager

Tom Hills
Technical Lead - Process Development

Simon Thomsen
Chief Technology Officer



Youssef Aaraj
Project Manager/Process Engineer

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