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Innovating for the Earth

Calix News

December 2022

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Because Mars is for Quitters.

Phil Hodgson
CEO

Welcome to
Issue 43 of the Calix Newsletter

The last quarter of the calendar year has been just as busy as the first three!

We continued our investment in new talent, with 14 new staff members featured in the newsletter, including our new Chief Technology Officer, Dr Louise Keyte. I am sure that as you read our new teams' backgrounds, you will be impressed with the depth and breadth of talent that Calix continues to attract. Our people are our most important asset, and we have grown the team considerably over the last 6 months. They are the future of this company and we welcome them to the team !

Also featured in this newsletter is the now formal Joint Venture arrangements with Pilbara Minerals Limited (ASX:PLS) to develop a low carbon lithium salt demonstration facility using Calix's unique electric kiln technology. The agreement is the culmination of many months of hard work, in parallel with the great engineering and test work being undertaken to develop the project to a final investment decision for a 3,00 0 tonne per annum facility targeting June 2023. Both Calix and Pilbara Minerals see huge opportunity in the supply of low carbon lithium salt from Australia, and look forward to working together to capitalise on this significant opportunity.

Our technology and its application to cement and lime decarbonisation – "Leilac" – is also featured in this newsletter, with a feature on our first-of-a-kind global, perpetual licence deal with Heidelberg Materials, our new developments into clay / clinker substitutes, CALIPSO, and the development of three Leilac projects with Cemex. The Heidelberg Materials licence deal is of significance, in that it is the first time our royalty-based business model has been validated, with one of the world's premier cement companies. In addition, three projects covering Europe and US, and a second global licence agreement (currently under negotiation) are being developed with Cemex, another of the world's premier cement companies. And we are continuing our development of additional solutions for the cement industry, with our CALIPSO application of our core technology to produce calcined clays, which can partially substitute traditional clinker at lower carbon footprint.

Also featured in this newsletter is our ZESTY zero emissions steel technology – one of our latest applications of the core technology into the decarbonisation of iron and steel. With positive results during 2022 in converting iron ore to iron, using hydrogen instead of coal, as well as the recent award of a ~$1m ARENA grant to help cover the front-end engineering and design costs of a demonstrator scale ZESTY plant, we are further encouraged to develop ZESTY as quickly as possible, and will be planning new test runs in our converted pilot facility in early 2023.

As 2022 draws to a close, it is also timely to look back upon another great year for the company, in our mission to solve global challenges, and in particular on our sustainability performance. Calix has released our second sustainability report – the United Nations Global Compact Communication on Progress ("COP"). This newsletter features a summary of our latest COP report, which is also be available in full via a link.

Lastly, the Calix team would like to thank all our shareholders and stakeholders for your continued support through a tumultuous 2022. The company's considerable achievements, with your support, have been that much more remarkable given global volatility. We look forward to 2023 and advancing rapidly on multiple opportunities, and in the mean time wish you, your families and friends a safe and enjoyable Christmas and New Year.

The Team is Growing!

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Meet **Vanessa Mayne**
Systems and Communications Administrator

Vanessa holds a bachelor of Media and Communications from Swinburne University, and has a strong administrative background working across the medical and finance industries. She is passionate about sustainability and is very excited to join the Calix team where she feels she can participate in finding solutions to mitigate the climate crisis.

Outside of work Vanessa enjoys playing football, keeping active and travelling.

Meet **Chloe Lian**
Senior Process Engineer

Chloe joined Calix as a Senior Process Engineer and has over 9 years of experience as a design and operations process engineer in the gas processing industry.

Chloe graduated from Imperial College London with a MEng in Chemical Engineering. She believes that sustainable processing is a big challenge that the world needs to tackle right now and is excited to take on this task together with Calix.

Outside of work, Chloe enjoys playing with her puppy, hiking and scuba diving. She also loves making sweet treats!

Meet **Ayub Isse**
Process Plant Engineer

Ayub completed his studies at RMIT University with a bachelor of Chemical Engineering and a specialisation in polymer and environmental engineering. At Calix, he is involved in the operation, planning and improvement of the BATMn reactor.

Outside of work, Ayub is an avid fan of soccer/football as well as basketball which he also plays regularly.

Meet **Dr Andrew Adipuri**
Technology Development Engineer

Andrew is a chemical, electrical and metallurgical engineer with over fifteen years experience in iron and steel making and the mining and minerals processing industry specifically in a complete project life cycle starting from business development, desktop study, pilot plant testing and scale-up, to turnkey industrial plant commissionig, its operation and production.

Outside work, he enjoys outdoor 4WD activities and is passionate about sustainability.

Meet **Warren Penny**
EPC Planning Lead

Warren started his career as design draftsman working on a wastewater treatment biogas facility in the UK. He then moved to engineering and project management – with a strong focus on driving compliance on HSEQ policies and procedures within the minerals processing industry in Australia and globally. At Calix, Warren is responsible for supporting the team through engineering, procurement and construction phases of the technology projects, across all business lines.

Warren is passionate about sustainable technologies working towards net zero emissions and contributing to a transition to a clean energy future.

Meet **Rohan McDonald**
Process Plant Engineer

Rohan graduated from RMIT University with a bachelor of Chemical Engineering, specialising in water treatment and environmental engineering. At Calix, he works on the operation, planning and improvement of the BATMn reactor.

In his spare time, he enjoys cooking and music including playing guitar, bass, seeing live gigs and occasionally performing live music himself.

WE ARE HIRING
To learn more and apply, email: hr@calix.global or check out our LinkedIn page:
https://www.linkedin.com/company/calix-limited/

Leilac

Meet **Gael Le Piver**
Combustion Development Lead

Gael is a senior pyro process expert, previously holding the position of deputee Technical Director at Fives Pillard. Key experience includes, mineral processing and in particular knowledge of the cement process; development of kiln burners, combustion solution for precalciner, hot gas generator, fuel preparation, ASF solution, DeNOx system; and R&D project management (from technical feasibility, marketing specification, first prototype, to communication plan).

The possibility to continue to develop expertise on combustion, with mitigation of CO_2 was for Gaël a unique opportunity to add sense to his job.

Meet **Scott Lee**
Senior Project Manager

Scott has over 15 years' experience in a variety of roles across Project Management – capital projects and upgrade works, Operations and Service manager, Site Manager, product development, business management and sales, having worked across Australia and Asia. Scott will be the Project manager for CO_2 projects, Adbri and Boral. He has a vast range of experience of delivering projects in material handling, minerals processing and Cement & Lime kiln industries.

Outside of work Scott enjoys camping with his family, playing soccer for his local soccer team and restoring / modifying vintage vehicles.

Meet **Mohsen Sarafraz**
Technology Development Engineer

Mohsen holds a PhD in Mechanical Engineering from the University of Adelaide. He developed the first generation of a novel technology referred to as "Liquid Chemical Looping Gasification" to co-produce hydrogen, ammonia and synthetic fuel via renewable energy and biomass. As a process engineer, he contributed to several commercial energy projects including ASTRI and ARENA renewable energy projects, eutectic energy storage plant, integrated solar thermal systems for chemical processing and thermal/non-thermal plasma technology for space programs in the European Research Council "ERC-810182" project. At Calix, he leads new energy technology programs relevant to gasification, CO_2 capture, energy storage and process engineering.

Outside of work, he loves to spend time with family, do creative arts and DIY projects, read, camp and take walks in nature.

Meet **Thibaud Van Den Moortel**
EMEA Commercial and Business Development General Manager

With a principal background in Mechanical engineering, Thibaud brings over 25 years of experience in academic applied research, project management, operational management and Sales. Thibaud has a PhD from the Université de Provence in Marseille in Circulating fluidized beds flow characterization and worked for different core business companies in different markets such as water tubes and CFB boilers, waste incineration plants, polyethylene and burners for the mineral industries.

Prior to joining Leilac, Thibaud oversaw sales and business development in SE Asia cement and lime market for Fives Pillard, one of the world leading combustion system companies.

Meet **Justin Driver**
Process Engineer - R&D

Justin holds a PhD in Chemical Engineering from the University of Sheffield and has had experience in projects spanning heterogeneous catalysis, material characterisation and process development. He was focused on the decarbonisation of heavy industries toward net zero, with a particular emphasis on the cement and steel sectors. At Calix, he works to characterise the performance of Calix's technologies with process simulation and technoeconomic assessment.

As an amateur homebrewer, Justin loves making different styles of beer. He also enjoys watching rugby and keeping active at the gym.

Meet **Laurentiu Paun**
Senior Process Engineer

Lau graduated in 2009 as a Robotics Engineer. At the end of 2009 he started working for Lafarge Romania as a Process Engineer at one of their cement plants, where he was tasked with optimising the expert control system driving the kiln line and mills. He has worked on many projects for cement plant optimisation with notable results, and has worked with a multitude of plant equipment ranging from crushers, ball mills, vertical mills to pyro processing related equipment like heat exchangers, rotary kilns and calciners, burners and fuel processing, abatement systems and gas conditioning and filtration, etc.

"I'm really excited to join the team here at Calix and I hope I get to meet and work with all of you on different challenges and solutions."

Meet **Aidan McGuinness**
Senior Process Engineer

Aidan joined Calix in September as a Snr. Project Engineer to work primarily with the Leilac group. In the 13 years prior to joining Calix, he worked in project management, procurement category management and mechanical design engineering roles.

Outside of work he enjoys spending time with his wife and two boys and getting out to play the odd game of football.

Industrial decarbonisation

The decarbonisation of industry in the pursuit of a net zero economy is one of the greatest global challenges. Industries such as cement, lime, iron and steel provide the foundations of our societies and economies. They also represent approximately 15% of global CO_2 emissions and require urgent, affordable and scalable decarbonisation solutions.

The transition to net zero will also require vastly increased use of minerals essential to the decarbonisation of economies. From lithium for batteries to metals used in advanced manufacturing, the materials of the future also require sustainable processing solutions.

Calix is applying its unique calcination technology to enable the urgent and economical decarbonisation of essential industries. By separating the heat source from the chemical reaction, Calix's technology is enabling the electrification of industry, the efficient capture of unavoidable CO_2 emissions, and green industrial processing solutions.

Calix appoints Dr Louise Keyte as Chief Technology Officer and General Manager, Sustainable Processing

A leader in innovation

Dr Keyte is a senior executive with a background inresearch and development, strategy and innovation. She has a strong track record of managing diverse stakeholders, delivering complex projects to drive commercial outcomes and has demonstrated the ability to successfully develop and grow new business from concept to commercialisation and profitability. With more than 20 years experience in heavy industry and building materials, Dr Keyte has previously held roles in innovation development, research and development and product development. Most recently, she was the General Manager, Innovation, at Australia's largest integrated construction materials company, Boral.

As the Calix Chief Technology Officer (CTO), Dr Keyte will drive the efficient innovation, commercialisation and deployment of all applications of the Calix technology. As General Manager (GM), Sustainable Processing, Dr Keyte will lead the development and execution of the strategy for one of Calix's key industrial decarbonisation business lines, leveraging the Calix technology platform for applications in minerals and chemical processing. Additionally, Dr Keyte will join the Calix Executive Team, making a valuable contribution to the achievement of Calix's safety, health, environment, governance and sustainability goals.

"I am very pleased to be joining Calix and its purpose-driven team to help the company achieve its potential as a leading global innovator of industrial solutions for the environment, addressing some of our most pressing global challenges. I strongly believe that Calix's technology platform offers unique capabilities to decarbonise our essential industries and help to create the sustainable materials of the future."

Dr Louise Keyte, Calix CTO and GM Sustainable Processing

"We are delighted to welcome Dr Keyte to the roles of CTO and GM, Sustainable Processing. Dr Keyte brings exceptional experience and a strong track record of delivering commercialisation of innovative technology solutions for more sustainable practices in carbon intensive industries.

We believe Dr Keyte is ideally suited to lead further innovation of the Calix technology platform and develop and implement commercialisation strategies for our Sustainable Processing line of business. We are thrilled to have her join us as we continue to realise the potential of Calix's technology and work towards our shared vision of sustainable minerals and chemical processing."

Phil Hodgson, Calix Managing Director and CEO

Calix and Pilbara Minerals execute joint venture

Calix and Pilbara Minerals have executed a formal joint venture agreement for an innovative decarbonised lithium refining project that aims to create a new, high value and low carbon intensity lithium product in the Pilbara. The joint venture follows a successful joint initial scoping study, and a close working relationship built over the past 18 months.

"Calix is delighted to formally announce our joint venture agreement with Pilbara Minerals for the development of a sustainable, high value mid-stream lithium product. Calix is focused on decarbonising our essential industries, utilising our core technology's ability to electrify industrial processing, and minimise the waste and CO_2 footprint of minerals. We are excited to join forces with Pilbara Minerals and formalise our close working relationship built over the past 18 months. We will apply our combined capabilities to generate a more sustainable and valuable Australian lithium product."

Phil Hodgson, Calix Managing Director and CEO

"It's a great privilege to enter this partnership with Calix. The Mid-stream project has the potential to be a game changer for our industry. If successful, we will be able to deliver a superior product to market, that will attract a premium compared to spodumene concentrate, as well as a reduction in Scope 3 emissions within the lithium supply chain."

Dale Henderson, Pilbara Minerals' Managing Director and CEO

An innovative "mid-stream" process

The "mid-stream" project aims to produce a superior lithium export product via Calix's calcination technology for sustainable processing of minerals. The proposed renewably powered at-mine processing innovation is targeting a refined lithium salt product that greatly reduces the cost, waste, and CO_2 footprint of Australian lithium, creating a significantly higher value export product.

The project includes the potential development of a demonstration plant at Pilbara Minerals' Pilgangoora Project and is supported by A$20m in Australian Government funding announced under the Modern Manufacturing Initiative. A Financial Investment Decision on the proposed demonstration plant is planned before the end of FY23.

Australia currently produces nearly half the world's lithium, with the global market for lithium carbonate and equivalents projected to grow six times by 2030. Industrial decarbonisation tailwinds also continue to drive demand for renewably powered, low waste processing solutions for the materials of our future economy. A successful "mid-stream" project will enable the joint venture to license the technology to the global spodumene processing industry.

"This is world-first Australian technology, being developed by two great Australian companies on Australian soil, with the support of the Australian Government – this is an exceptional opportunity for all of us."

https://calix.global/sustainable-processing/phil-hodgson-on-the-opportunity-of-decarbonising-australian-lithium-with-pilbara-minerals/

CALIPSO™ - Calcined Clay for the Cement Industry

With an increasing global population and vast regions of the world experiencing unprecedented levels of growth and prosperity (ie Asia), it is evident that the world will require record levels of urbanisation now and into the future.

According to UNIDO (United nations industrial development organization) a specialised agency of the United Nations, the world is expected to build a New York City equivalent every month for the next 40 years. This level of infrastructure demand will inevitably place a significant strain on the raw material supply chain and lead to more direct and indirect carbon emissions of businesses involved in processing and supplying the raw materials for this infrastructure boom.

Cement is one key ingredient that will be used to satisfy this insatiable demand, but with global carbon emissions of 8% directly related to its processing and production, there is an immediate need to begin decarbonising this process now and introduce new technologies to reduce intense carbon emissions.

Calix has been working with industry to reduce these carbon emissions by developing clinker substitutes that have characteristics on-par with OPC (Original Portland Cement) when utilised as a supplementary cement material (SCM).

The use of calcined clay blends as an SCM is an emerging technology showing promise as a sustainable substitute (e.g. LC3 technology or Limestone Calcined Clay Cement). When calcined clay is manufactured using Calix technology, it is activated so it can be used successfully as an SCM in cement and/or concrete production.

In the Calix Flash indirect heating process, a patented design, the clay particles do not come into direct contact with the heat source. This ensures the following:

1. High conversion of clay
2. Highly stable clay product
3. High process energy efficiency
4. High Yields and throughputs
5. 100% off-gas capture

The resulting calcined clay product, when used in blends such as LC3 cements (30% clay, 15% lime, 5% gypsum and 50% clinker), exhibits characteristics that are on-par with OPC. In Europe, new building codes incorporate the use of 50% clinker blends and in the US, the ASTM standards for 50% clinker blends are starting to be incorporated.

The use of SCM's in cement and concrete are crucial in decarbonising the economy and unlocking between US $800 billion to US $1.9 trillion in the green built environment value pool (McKinsey and Company, 2022). Fly ash is one such SCM that has shown to be used satisfactorily in limited clinker substitution but with the shutting down of coal fired power plants across the globe due to increased regulatory pressures and emissions intensiveness, means output will be significantly reduced.

The US Energy and Information Administration (EIA, 2022) has reported that a significant reduction in fly ash production in the US by 30 million short tons (27.7 metric tonnes) is to be expected in 2023 from 2022 alone, which drastically reduces output of this SCM based cement.

Silica fume being another SCM used in cement production has great properties with regards to corrosion resistance to chemicals and high salty environments as experienced in marine environments, but requires specialist attention during construction phases of a project and its clinker substitution content (percentile) is significantly lower than that of clay. By using Calix's patented electric calciner design for the calcination of clay for SCM based cement, the industry is well on the way to achieving the following goals.

1. Improved energy efficiency
2. Switching to low carbon intensive fuels
3. Reducing clinker content in cement
4. Formulations for use in batching plants

These are important goals if the world is to meet 2050 global emissions targets and to keep the temperature increases to below 2°C as outlined by the Paris Climate Agreement.

Leilac announces global licence agreement with Heidelberg Materials and three new projects with CEMEX

The innovative licence agreement for Leilac's ground-breaking technology applies to any Heidelberg Materials facility where the Leilac decarbonisation technology is installed. Heidelberg Materials operates 149 cement plants across 5 continents.

"It forms the basis for the technology's use throughout Heidelberg Materials, providing a model for the commercialisation of the technology at global scale. Together, Leilac and Heidelberg Materials continue to de-risk, prove and scale Leilac's decarbonisation technology. The agreement is an important step in our journey towards providing cement and lime producers with access to a low cost carbon abatement solution, allowing them to take urgent action against climate change and protect their industries' jobs and prosperity."

Daniel Rennie, Leilac CEO

Heidelberg Materials is a founding and key member of a consortium of companies and institutions partnering to develop and apply the Leilac technology. The global licence agreement with Heidelberg Materials follows many years of close collaboration and partnership.

Leilac's commercialisation strategy

The agreement with Heidelberg Materials is a key milestone in Leilac's commercialisation of the Leilac technology, and Calix's strategy to develop great businesses that deliver positive global impact.

The technology licence fee is a first-of-a-kind for the industry, and comprises a royalty floor, variable component linked to carbon price/value, and a royalty cap linked to costs versus alternative technologies. The terms of the agreement with Heidelberg Materials require the royalty quantums to remain commercial-in-confidence. Calix will retain all improvements to Calix intellectual property.

Calix Managing Director and CEO, Phil Hodgson said, "The agreement with Heidelberg Materials for the commercial use of the Leilac technology represents the next chapter of a long and successful partnership. It is a partnership based on shared values, and a shared mission to urgently and affordably decarbonise the production of cement. We are grateful for their support and collaboration in the development of this globally important technology."

"Heidelberg Materials has been working together with Leilac since 2014, developing this promising technology as a means of decarbonising the cement sector's unavoidable CO_2 emissions. We look forward to our continued collaboration towards developing and implementing the technology at full scale, with this global, perpetual licence agreement marking an important milestone and commercial framework for the widespread use of the technology."

Antonio Clausi, Head of Heidelberg Materials' Global Competence Centre Cement

To read more, visit:

https://www.leilac.com/news/global-licence-agreement-heidelberg-materials/

Leilac is also pleased to announce three decarbonisation projects in partnership with global building materials company, CEMEX. The projects aim to deploy Leilac's unique technology to capture unavoidable process emissions released in the production of cement.

"Leilac is delighted to announce three ambitious decarbonisation projects with long-time partner, CEMEX. Spanning three countries and two continents, the projects with CEMEX represent the next stage of commercial scale implementation of the Leilac technology as we seek to deliver impactful CO_2 abatement across the globe."

Engineering studies are currently under way for Leilac carbon capture projects based at CEMEX plants in Germany, Poland and the USA.

Leilac is working closely with CEMEX to progress the projects as well as a global licence agreement, currently under negotiation, covering CEMEX's global operations.

Leilac and CEMEX have a longstanding partnership. CEMEX is a founding and valued member of a consortium of companies and institutions partnering to develop and apply the Leilac technology through the Leilac-1 and Leilac-2 projects.

"Leilac and CEMEX have a successful history of collaboration and we are grateful for their continued leadership in the transition to a net zero construction industry. We look forward to continuing to work with CEMEX towards our shared goal of sustainable cement."

Follow Leilac to learn about the Leilac technology and projects, as well as other company and industry news:

www.leilac.com

www.twitter.com/Leilac_Global

www.linkedin.com/company/leilac/

https://youtu.be/QsBLdiZ8nSk

Thanks to Simon Clark for his insights on why Carbon Capture Usage and Storage (CCUS) is urgently needed for the decarbonisation of the construction industry and his feature on Leilac's efficient & scalable solution for cement and lime.

ALKA-Mag+

*In 2022, AMALGAM-60 was renamed ALKA-Mag+, improved stability, flowability and reactivity from IER & Calix's synergy.

Converting from caustic to magnesium hydroxide

in a Membrane Bioreactor (MBR) system

Introduction

Spokane County Regional Water Reclamation Facility operated by Jacobs, processes 8 million gallons per day (mgd) of wastewater collected from both incorporated and unincorporated areas around the Spokane Valley. This facility has a National Pollutant Discharge Elimination System (NPDES) permit to discharge to the Spokane River. Wastewater is treated with a state-of-the-art Membrane Bioreactor (MBR).

Objectives

Replacement of caustic soda (NaOH) with magnesium hydroxide ($Mg(OH)_2$) for cost, safety and performance benefits.

CHALLENGES

Jacobs was using ~1400 gpd of 25% NaOH and wanted to find a safer and more cost-effective alternative for pH and alkalinity control

SOLUTION

- IER, a Calix company proposed AMALGAM-60 (60% $Mg(OH)_2$) as the alternative.
- After seeing usage reduction in bench top experiments, Jacobs was interested in performing an on-line trial of AMALGAM-60.
- IER provided and installed the equipment needed for a 90-day trial. This included two 1000 gallon poly tanks with agitators and a metering pump with associated feed lines and valves.

BENEFITS

- The conversion from caustic to AMALGAM-60 resulted in a 68% reduction in chemical usage (by volume).
- The coagulation properties of AMALGAM-60 provided a reduction in sludge volume, which resulted in a reduction of sludge hauling costs.

Read the full Customer Story:

https://ierwater.com/what-we-have-done/converting-from-caustic-to-magnesium-hydroxide/

Calix technology for zero emissions iron and steel ZESTY

Iron and steel production is the second largest source of man-made industrial CO_2 emissions, responsible for an estimated 2.6 billion tonnes per year, or approximately 7%* of global industrial emissions. Mitigating CO_2 emissions from the iron and steel industry will be critical to ensuring we can simultaneously meet our goals for social, economic and environmental sustainability.

The challenge

Between 80 and 85% of the industry's CO_2 footprint is linked with the production of iron, as 90% of all iron is produced by metallurgical coal- and coke-fuelled blast furnaces, producing nearly 1.8 tonnes of CO_2 per tonne of iron produced.

Iron produced via direct reduction of iron ore using a 'syngas' of hydrogen and carbon monoxide (made from natural gas) in a shaft furnace is a less CO_2-intensive method, at around 0.6 tonnes of CO_2 per tonne of iron; however, this process route has traditionally been more expensive, and hence only 10% of the world's iron is produced by this method. The method requires cheap natural gas, as well as pelletisation of iron ores to prevent fines loss.

Methods to lower the carbon footprint of iron production have started to consider using green hydrogen as the major reductant instead of natural gas and coal. The use of hydrogen in blast furnaces is being tested, but there are limits on the amount of coal it could replace due to a reduction in the conversion rate of iron ore to iron.

Our solution

Calix's ZESTY uses green hydrogen in a renewably powered reactor to produce green iron and ultimately, green steel.

ZESTY's unique, indirect heating approach not only enables efficient electrification, but means hydrogen is not consumed as a fuel, only a reductant, and is easily recycled in the process. This significantly lowers operating temperatures and potentially enables the most efficient and economical use possible of hydrogen.

ZESTY's ability to handle small particle sizes has the potential to more easily remove impurities compared with other direct reduced iron (DRI) processes, which require pelletised and typically higher grade iron ores.

The ZESTY process produces green iron from multiple ore types for use in either conventional blast furnaces for lower carbon steel products or directly in electric arc furnaces (EAF) for zero emissions steel.the The ZESTY Steel process uses zero emissions lime produced by a Leilac kiln, while the lime can also scrub excess carbon dioxide as well as other pollutants from the exhaust gases.

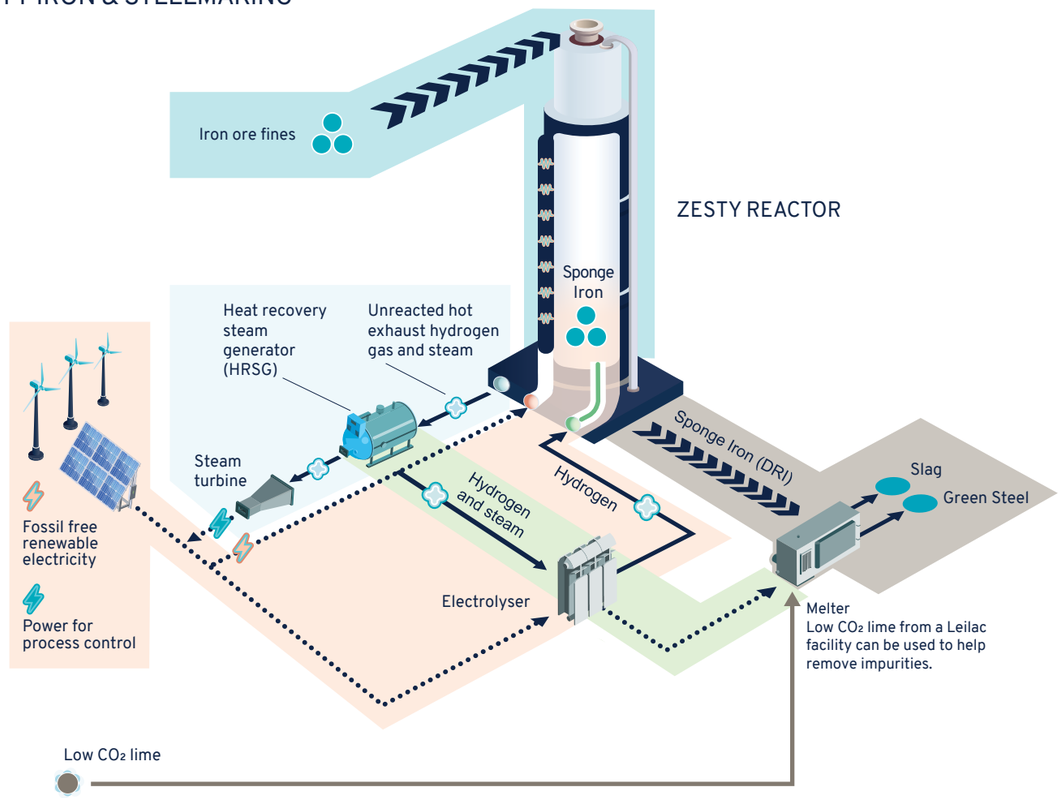
ZESTY features:

- Hydrogen reduction of iron ore;
- Can be easily and efficiently renewably powered;
- Targeting theoretical minimum hydrogen use;
- Compatible with multiple ore types;
- Processes fines <~0.3mm, no pelletisation;

*Source:

Climate change and the production of iron and steel. World Steel Association. 2021

ZESTY IRON & STEELMAKING



ZESTY Process steps

1

Iron ore is inserted into the top of the ZESTY reactor where it is exposed to preheated green hydrogen. The hydrogen strips the oxygen from the iron ore, producing metallic iron (sponge iron or Direct Reduced Iron) and steam.

2

The carbon free ZESTY process uses renewable electricity and a heat recovery steam generator to power the reactor, electrolyser and electric arc furnace.

3

Direct Reduced Iron is hot discharged into the electric arc furnace to produce green steel with zero CO_2 emissions.

4

A heat recovery generator converts energy from the hot exhaust gas back into electricity.

5

Excess hydrogen is recycled back to the ZESTY reactor. Steam produced by the reactor is condensed and then split by the electrolyser, producing hydrogen for the reactor and oxygen for the electric arc furnace.

Watch how ZESTY - Calix Zero Emissions Steel Technology - works.

https://youtu.be/kwi9ilPqKxs

Calix releases its second Sustainability Report

With a focus on innovative industrial decarbonisation and environmental solutions, sustainability sits at the core of our business. It is integral to our culture and values, and deeply embedded in the reason we exist...because Mars is for quitters.

Sustainability is what drives our people and permeates both the work we do and how we do it. So, it is only natural that we are committed to operating sustainably, across the full spectrum of environment, social and governance. We are committed to meeting our own needs without compromising the ability of future generations to meet their own needs.

Since 2020, Calix has been a member of the United Nations Global Compact (UNGC), the world's largest corporate sustainability initiative, driving action to support the achievement of the Sustainable Development Goals by 2030. In FY22, Calix renewed its commitment to the UNGC and has made progress toward embedding its Ten Principles on human rights, labour, environment and anti-corruption in our strategy, culture, and day-to-day operations.

Of particular importance is the integration and alignment of the SDGs with our business strategy and objectives and the adoption of four SDG Ambition Benchmarks as sustainability priorities for Calix. It reflects the key focus areas of a freshly developed Sustainability Strategy:

1. Science-based emission reduction in line with 1.5 C pathway.

SDG IMPACT	TIMELINE	SCOPE
3, 9, 12, 14, 15	5- 15 Years	● Operations ● Value Chain ● Products & Services

2. Zero incidents of bribery and corruption.

SDG IMPACT	TIMELINE	SCOPE
Cross-cutting	2030	● Operations ● Value Chain ● Products & Services

3. Diversity across all levels of management.

SDG IMPACT	TIMELINE	SCOPE
1, 4, 5, 8	2030	● Operations ○ Value Chain ○ Products & Services

4. 100% sustainable material inputs that are renewable, recyclable, or reusable.

SDG IMPACT	TIMELINE	SCOPE
6, 9, 11, 13, 14, 15, 17	2030	● Operations ○ Value Chain ● Products & Services

We have started to measure and reduce our greenhouse gas (GHG) footprint and address the potential financial impact of climate change on our business. This work will help us develop a roadmap towards net zero in alignment with the United Nations' Race to Zero Campaign.

Our annual Communication on Progress Report shares the progress we have made towards the Ten Principles and greater corporate social responsibility. The UNGC's COP reporting standards are aligned with globally recognised environmental, social and governance (ESG) reporting guidance and standards including the Taskforce on Climate-related Financial Disclosure (TCFD) and the Global Reporting Initiative (GRI).

The 2022 Sustainability Report encapsulates our purpose – which is to solve global challenges by developing innovative solutions for industry – and our commitment to making a positive difference for the long-term; it references Sustainable Development Goals of the United Nations.

Calix recently installed solar panels at our Bacchus Marsh operations in Victoria, Australia with a maximum capacity of 334KW. The installation will generate ~408MWh/year, preventing an estimated 437 tonnes of CO_2 equivalent emissions per year.

The solar installation is designed to cover the annual energy consumption of BATMn, Calix's all-electric calciner that is pioneering solutions for the transition of carbon intensive industries to a renewably powered future.

FY22 highlights

100,000tpa of CO_2
Financial Investment Decision passed for new carbon capture facility for cement.

A$20m
Funding granted for sustainable processing of lithium salts.

Approved
Low-toxicity fertiliser that assists crop protection.

~250 billion
litres of water & wastewater treated. *

* Assumes consumption of all product sold in FY22.

Our footprint

Emissions

Calix has committed to measuring, monitoring, and reducing our carbon footprint, in line with the Paris Agreement and the 1.5°C pathway. To this end, the Sustainability Team is working with external consultants to develop an emissions reduction roadmap in the 2023 financial year (FY23).

We have partnered with Pangolin Associates to help us navigate organisational boundaries, operational control and reporting frameworks. Pangolin Associates is a national energy and carbon management consultancy and one of the very few companies in Australia that provides strategic climate change action through science-based targets.

The GHG Assessment will cover scope 1 & 2 emissions and all relevant scope 3 emission sources for a year's operations and rigorously complies with international standards and Australian regulations, including:

- Greenhouse gas Protocol's Corporate Accounting and Reporting Standards
- ISO 14064-1
- NGER
- Climate Active
- CDP

This first GHG assessment will allow Calix to understand the most material emissions to our business, and be well positioned to implement a clear, targeted and appropriate emissions reduction strategy.

Waste

Calix has committed to measuring and reducing the total amount of waste generated by our Australian operations in FY23, with an ambition to reach 100% sustainable material inputs that are either renewable, recyclable or reusable by 2030.

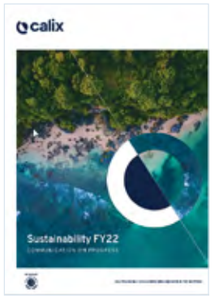
Sustainability is in our DNA

Solving Global Challenges has been the basis of Calix's passion and business for more than a decade, with a mission to urgently develop great businesses, leveraging our patented technology, that deliver positive global impact.

By aligning innovation and development initiatives with the UN Sustainable Goals (SDGs), Calix is driven to make an impactful and meaningful contribution to the environment.

Calix materials are being used to improve the sustainability of water treatment, aquaculture, agriculture but also human health and battery technologies. Calix technology also allows for the direct separation of CO_2, allowing it to be used for carbon dioxide reduction in traditionally carbon dioxide intensive industries, such as lime and cement production. Calix's technology can help improve the sustainability of existing industrial processes through a more optimised use of mineral and chemical resources, and the use of renewable sources of energy.

https://youtu.be/68OXVEyXj9s



Read our
FY22 Sustainability Report FY22:

https://calix.global/news/calix-sustainability-report-fy22/

UNGC Communication on Progress 2022:

https://cop.unglobalcompact.org/view/9420

We believe our people are key to achieving our purpose.

Introducing Dabin Wang

Materials Engineer

Dabin Wang joined Calix in February 2020 as a Materials Engineer. He brings to the company over 8 years experience in material synthesis, characterisation and development for various energy storage applications including hydrogen storage and fuel cells, supercapacitors, batteries and electrocatalysts. Dabin holds a PhD degree in Chemistry from Monash University where he worked on electrocatalysts development for electrochemical synthesis of ammonia from nitrogen under ambient conditions.

Since joining he has been involved with a number of battery programmes including CRC-P, FBI-CRC and storEnergy, collaborating with universities and industrial partners to deliver research and development outcomes to advance Calix's Advanced Batteries business.

In his spare time, Dabin enjoys cooking at home and also exploring the outdoors going camping and hiking with friends.

https://youtu.be/cYIAUM8uRSE

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Mars is for quitters.

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