MARS IS FOR QUITTERS™

SUSTAINABILITY TREND SERIES – EDITION 1

After identifying six sustainability challenges that we believe the Calix process can be applied towards, this series will dive deeper into each of these challenges in dedicated special features.

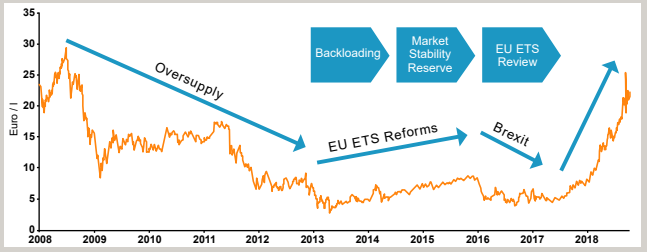
REDUCING CO2 EMISSIONS

It is broadly accepted that reducing man-made carbon dioxide (CO2) emissions is crucial for the future of the planet. In this sustainability trend series issue, we look at the pressures the cement industry, marine shipping, and energy generation face as their CO2 emissions come increasingly under the spotlight. The Calix Process is aiming to help industries and energy producers reduce their CO2 emissions with minimal energy or operating efficiency penalty.

▶ THE EUROPEAN UNION – LEADING THE WORLD IN CO2 REDUCTION

The European Union is targeting an 80% reduction in CO2 emissions by 2050. To drive CO2 emissions reductions, the EU has operated the largest emissions trading scheme in the world since 2005. The European Union Emissions Trading System (EU ETS) is now in its third phase, which will run to 2020, and involves allocating and auctioning CO2 permits to industry. These permits are used to off-set actual emissions, but can also be traded. For example, if a particular CO2 emitter has taken steps to reduce emissions and ends up with a surplus of permits, they can sell them to another emitter who has not taken such steps, and needs the permits. The "cap and trade" system involves an open market price for CO2, which has become a benchmark for the costs of emitting CO2. The European economic slowdown over the last decade or so reduced CO2 emissions below planned targets, resulting in a price slump in these traded CO2 permits since around 2011. However, the imminent ending of the third phase of the EU ETS in 2020, and the commencement of a fourth phase where the overall emissions cap will be progressively reduced by 2.2% each year until 2030, has seen dramatically renewed interest in purchasing CO2 permits, as industry starts to face real and significant costs for CO2 emission. CO2 prices have consequently shot up from a low of around €5 per tonne in 2017, to over €20 per tonne today. These real costs are generating renewed interest from industry in CO2 abatement technologies. The Calix Process is being developed in several different programs in the EU targeting CO2 emissions reduction.

CARBON PRICE DEVELOPMENT SINCE 2008



Refinitiv (formerly known as the Financial and Risk business of Thomson Reuters)
https://www.refinitiv.com/perspectives/market-insights/will-high-european-carbon-prices-last/

▶ REDUCING EMISSIONS FROM THE CEMENT INDUSTRY

FOLLOW CO2 EUROPEAN EMISSION ALLOWANCES PRICE:
https://markets.businessinsider.com/commodities/co2-emissionsrechte

Cement is the second most consumed substance on Earth after water – over 4.5 billion* tonnes per year! The cement industry also accounts for around five percent of global CO2 emissions. About two thirds of those emissions come from the limestone used to make cement and are unavoidable. To meet the European Union target for reduced CO2 emissions, around 60% of European cement plant capacity will need to deploy some form of carbon capture by 2050. Given the pressures from the EU ETS, and also significant R&D funds from the EU Horizon 2020 programme, some cement and lime companies are taking real steps to help develop technologies to deal with their emissions.

For example, Project LEILAC (Low Emissions Intensity Lime And Cement) is supported with €12 million from EU research funds, and involves a consortium, lead by Calix, that includes industrial heavyweights HeidelbergCement, Cemex, Lhoist and Tarmac. Project LEILAC utilises the Calix Process - a world first, patented technology that changes the way the limestone is heated, to enable direct capture of the limestone-produced CO2. It requires no additional chemicals or processes, and is targeting no additional capital or operating penalty for the cement industry. The technology could also be developed with alternative or waste fuels or renewable energy, to ultimately achieve a zero-emissions cement.

*Reference: (Cembureau https://cembureau.eu/cement-101/key-facts-figures).

▶ MAKING WORLD SHIPPING CARBON NEGATIVE

Maritime transport emits around one billion tonnes of CO_2 annually – about 2.5% of global CO_2 emissions – and these emissions are set to grow by between 50% and 250% by 2050*. In line with the European Union's drive to reduce CO_2 emissions, it is calling for a global approach to curbing maritime CO_2 emissions and has commenced mandatory emission reporting for all large ships using EU ports from 2018. A 2011 Transport White Paper by the EU (http://www.transforum-project.eu/en/transforum/white-paper-on-transport.html), calls for CO_2 emissions reductions of 40% from 2005 levels to 2050, and if feasible, 50%. The peak maritime industry body, the International Maritime Organization (IMO) has responded with several greenhouse gas studies, and major shipping manufacturers such as Maersk are leading initiatives to reduce maritime emissions.

The Calix Process is being developed to capture sulphur and CO_2 emissions in ships with a system called RECAST. RECAST involves using a dry exhaust gas scrubber - essentially a Calix Process reactor "in reverse" using lime - which would absorb more than 85 per cent of the CO_2 and most of the sulphur, and recover the heat of absorption to add around 50 per cent to the ship's range. If RECAST technology were applied to the 25 per cent of high-mileage ships, which use 80 percent of global bunker fuel, the theoretical reduction in emissions would make the total world maritime fleet carbon negative. To achieve this, the lime used in a RECAST scrubber must be manufactured in a (shore-based) Calix Process lime producer, which captures the CO_2 from the raw limestone. This technology now being demonstrated at scale in Belgium in the LEILAC Project. Initial estimates suggest RECAST could cost less than $40 per tonne of CO_2 emissions saved, making it cost-effective as well as safe and reliable. Calix is currently seeking funding to develop RECAST.

*Reference: International Maritime Organisation (IMO) GHG3 2014 – Executive Summary and Report (https://gmn.imo.org/wp-content/uploads/2017/05/GHG3-Executive-Summary-and-Report_web.pdf).

▶ THE HYDROGEN ECONOMY

Much has been written about the "hydrogen economy". Hydrogen is a gas that, when burned, produces only water as an emission. Sounds perfect! – but how do you produce enough hydrogen in the first place, to power global energy requirements?

Hydrogen can be produced by "splitting" water into its components - hydrogen and oxygen - but this takes a very large amount of energy. Unless such energy could be provided by vast amounts of renewable power, producing hydrogen for energy could be more emitting than simply burning fossil fuels. Another way to produce hydrogen is from fossil fuels such as natural gas, by splitting methane into carbon and hydrogen. This is a lower energy pathway, and if the carbon could be captured and either utilised or sequestered, is a lower emissions pathway also. Major oil companies, sitting on millions of barrels of fossil fuel assets, are thus naturally interested in such production pathways – for example see https://www.shell.com/energy-and-innovation/the-energy-fuure/ future-transport/hydrogen.html

The Calix Process is being developed to enable hydrogen production with carbon capture. As far back as 2012, Calix started working on the concept after receiving a grant of £5.8m from the UK Department of Energy and Climate Change (DECC). In 2013, the Advanced Solid Cycles with Efficient Novel Technologies (ASCENT) project also commenced, looking at specific carbon sorbents which could be used in the process. After developing the concept to Front-End Engineering Design (FEED) stage, the pilot project stalled as DECC was dissolved and Brexit kicked in during 2016/17 and funding dried up. Recent developments in Australia, including the production of the National Hydrogen Roadmap (https://www.csiro.au/en/Do-business/Futures/Reports/Hydrogen-Roadmap) while focussing on mature technologies, nonetheless indicates a potential development pathway could also be in Australia. Calix will thus continue to look for funding to develop the concept both in Europe and Australia.

INTRODUCING
DR BRIAN SWEENEY

Brian spent 20 years working with Shell around the world, and eight years with the Rolls-Royce Industrial Power Group. Brian's current role is in business development at Calix Europe, and he has been instrumental in helping develop the Calix Process into several CO_2 emissions reduction initiatives. He has been a key Calix team member on numerous successful CO_2 reduction applications grants, including DECC, the LEILAC Project and ASCENT, and he also leads the RECAST initiative. Brian studied engineering at Cambridge University and Columbia University, New York.

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