

Clean-Tech Innovation Is a Marathon Not a Sprint at ARC2023

By Lisa Taylor

- Innovations and funding for low-carbon cement have skyrocketed
- Africa needs to avoid the mistakes of developed nations

Tackling the roadblocks preventing the decarbonization of sectors such as aviation, cement and long-duration energy storage is no mean feat, which is why Peter Schniering, founder of Future Cleantech Architects (FCA), likens it to a marathon.

This particular marathon is already under starter's orders, with the German city of Remscheid again hosting companies, investors and researchers from across the globe on June 6-7 at the ARC Cleantech Innovation Festival.

Since Schniering completed a PhD on Climate Policy and Technology at Bonn University, he has been involved in clean-tech innovation. He is an Advisory Board Member to the World Economic Forum's Sustainable Energy Innovation Panel, regularly publishes articles on energy innovation and in 2022, was awarded membership in the Futurity Fellows cohort by BMW Foundation and was subsequently invited to their global responsible leaders' network.

Lab work unveils promising early stage tech

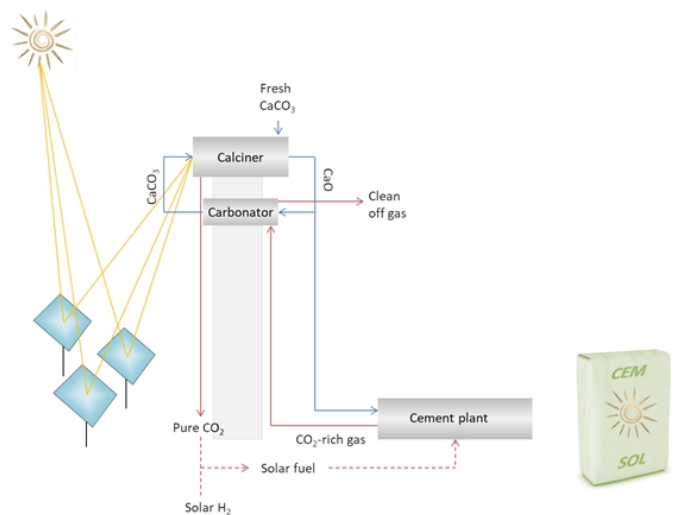
FCA is an interdisciplinary think tank comprising economists, engineers and policy experts. Some employees come from laboratories, research institutes and other creative hotspots to identify critical fields of innovation where sustainable solutions are still in their very early stages. The scope of research spans fundamental studies to process innovations helping decarbonize emission-intensive industrial operations.

This is done on a technology-agnostic basis, without commercial intentions, independent of political

consideration, says Schniering. The onus is to actively drive high-level research consortia on critical technologies for neglected industries, while working with high-level policy makers to ensure research and development activity is effectively ramped up.

One example of this is CemSol, a consortium focused on using concentrated solar heat to substitute fossil fuels for high-temperature heat in the calcination process.

CemSol calcium looping process to cut cement CO2



Source: DLR Institute of Future Fuels (CC BY-NC-ND 3.0.). Note: Schematic Integration of solar calcination and calcium looping into a cement process.

In combination with the concentrated solar side of the project, the DLR Institute of Future Fuels is developing a calcium looping system for cement production and FCA is evaluating the scalability and coupling

capability of the technology. It will also identify fields in which the technology can be implemented and lead the techno-economic study providing indications of the further scale-up potential versus the reference processes.

ARC 2023's lens on hard-to-abate industries

This year's ARC cohort clearly all have their work cut out, as the focus is on hard-to-abate sectors, such as aviation, cement and long-duration energy storage. Yet, the technological, regulatory and financial obstacles don't daunt Schniering. He finds inspiration in Germany's coal-fired power plants having all but disappeared in the past 20 years, prior to the war in Ukraine, and how the country embraced solar power before almost anywhere else in the world, to the extent that its thousands of solar panels recently set a new record for power generation.

ARC2023 speakers comprise policy officers from the Deutscher Bundestag, the European Commission and the International Renewable Energy Agency. There are also Columbia and Nottingham university professors, the Clean Air Task Force and divisional heads from major corporates including DHL, SAP SE, GKN, Deutsche Lufthansa AG and Thyssenkrupp AG. Investment funds such as EIT InnoEnergy and Planet A Ventures, already partnering with European greentech startups, will explain how they aim to have a significant positive impact as they build scalable businesses globally.

Driving clean-tech innovation

The ARC also features innovators hand-picked for their promising breakthrough technologies, including a BNEF Pioneer recipient, SaltX, a Swedish company operating in large-scale energy storage solutions and electrification technology, mainly for the lime and cement industry.

Clean-tech innovators at ARC

Company	Technology
ecoLocked	Turning sequestered carbon into a valuable resource for the construction industry
Spark e-Fuels	Produces sustainable and affordable e-fuels at scale for the aviation industry
Sunfire	Provides electrolysis solutions to help energy-intensive industries and climate-conscious businesses decarbonize entire value chains
Qnetic	Designed a revolutionary flywheel energy storage system as a low-cost solution
Energy Dome	Showcases cost-effective electricity storage without emissions using carbon dioxide in a closed thermodynamic process
Unbound Potential	Developing large-scale redox flow batteries ("redox" refers to chemical reduction and oxidation) for long-duration energy storage
Seratech	Capturing industrial CO2 emissions directly from flues to produce a carbon-negative cement replacement
Kraft Block	Its energy storage systems enable the switch from fossil fuels to renewable energy in industrial processes and waste-heat recycling
H2scan	Provides hydrogen-sensing technology for safe and effective operations in critical energy applications
Polycare	Produces reusable building blocks that eliminate cement as a binder for the construction industry to substantially reduce its carbon footprint

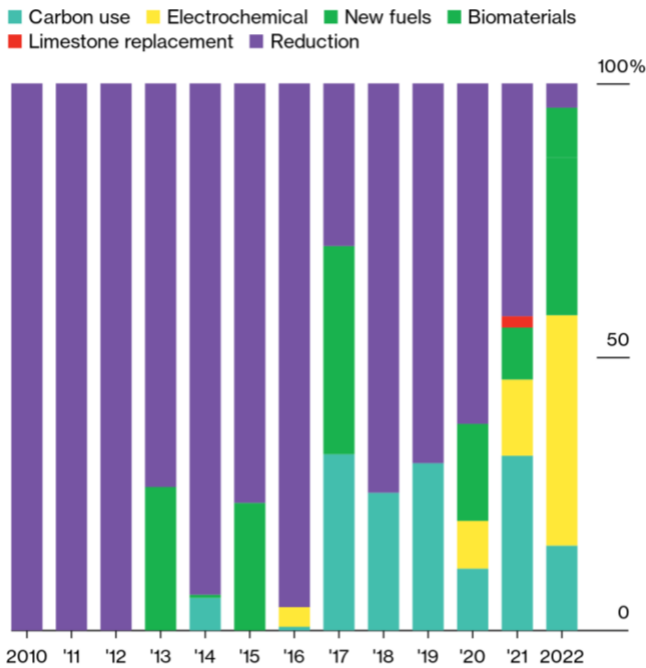
Source: ARC Cleantech Innovation Festival, BloombergNEF.

BloombergNEF's *Tech Radar: Low-Carbon Cement* shows how innovations and funding for low-carbon cement have accelerated since 2020, with a total of \$900 million raised in investments and grants for low-carbon cement and concrete. Funds raised annually since 2020 are as much as 17 times higher

than the average for 2010-2019. BNEF sees these companies having the potential to scale dramatically as the \$1 trillion cement industry faces pressure to decarbonize. Indeed, they are now starting to reach a

scale that could fundamentally change the industry and have a meaningful impact on emissions.

Low-carbon cement funds raised by type of solution



Source: BloombergNEF, PitchBook.

Helping Africa avoid the developed world's mistakes

After water, concrete is by far the most-used substance on Earth, which means that decarbonizing construction and exploring how the world could exist without concrete is vital. Preventing the same mistakes already made across the developed world has inspired the ARC 2023 session "Perspectives from Africa" and the question of why geography matters in assessing the opportunities and challenges specific to this region. Energy manager Hazem Moshir Khater will represent Egypt's Arabian Cement Co. discussing how African nations can chart a different, more sustainable path, while still supporting development.

Is it feasible to reduce greenhouse gas emissions in aviation?

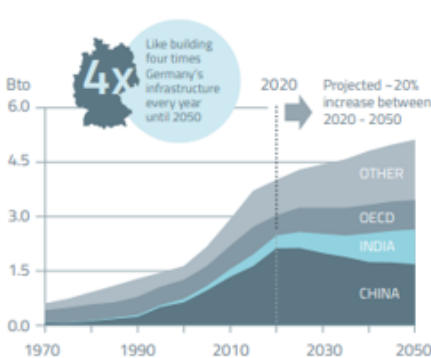
ARC is also going to examine the regulatory framework for large-scale deployment of alternative fuels, while hearing from industry players what can be realistically expected from low-carbon fuels, and more importantly, when. It will discuss the alternatives from new aircraft designs to night trains. The non-CO2

Cement and climate change: The key challenges

Global cement demand

With global development, demand for concrete and therefore cement is expected to continue to increase.

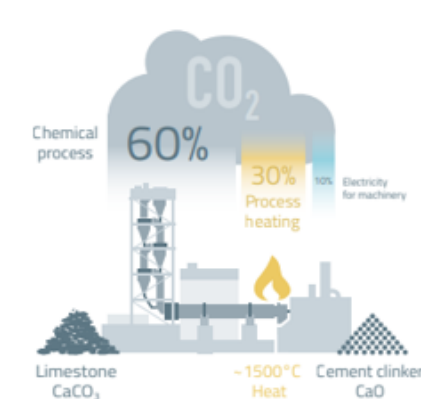
Global cement demand (billion tons/year)



Process emissions

60% of the emissions come from the basic chemical reaction.

Basic cement process and distribution of emissions



High-temperature heat

Hard to reach without fossil fuels - the low-carbon alternatives are not ready.

Selection of high-temperature industrial heat technologies for cement production

Technology	Current share	Mature	Scalable*	Cost
COAL, OIL, GAS	92%	✓	✓	\$
BIO MASS, WASTE	8%	✓	✗	\$
H ₂	0%	✗	?	\$\$\$

*Considers resource availability (e.g. biomass) and geographical restrictions (e.g. concentrated solar).

Source: Future Cleantech Architects

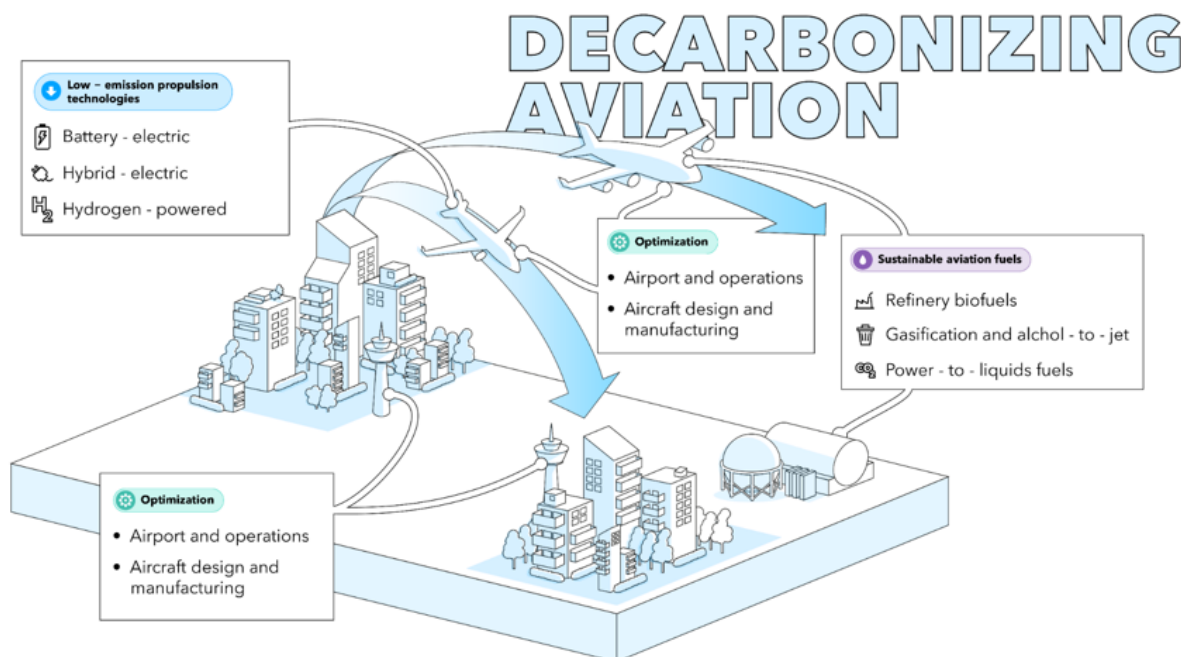
effects of aviation will also be assessed to ensure climate integrity is maintained on the road to net zero in 2050.

The extent of this particular roadblock is summed up in a May 2023 study from sustainable transportation advocacy group Transport & Environment, showing that pig-fat fueled flights risk creating a surge in palm-oil output, given a flight from Paris to New York powered solely by waste biofuels such as animal fats would require some 8,800 dead pigs.

As palm oil is the most likely alternative, a new environmental fallout beckons. The research highlights the difficulty of cleaning up an aviation industry whose share of CO2 emissions, now between 2% and 3% globally, is on track to rise in coming decades.

The ARC Cleantech Innovation Festival is co-hosted by United Nations Climate Change, the UN Industrial Development Organization, EIT InnoEnergy and the Unido Network of Investment and Technology Promotion Offices. Remscheid is one of North Rhine-Westphalia's last industrial cities and is known for tool development and manufacturing, mechanical engineering, and steel production.

Complexities of flying and the potential solutions



Source: BloombergNEF

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