Partnering on ceramics to tackle climate change

A budget airline teaming up with an aviation manufacturer for a carbon-removal initiative involving direct air capture (DAC).[1] An oil major collaborating with a carbon capture venture to spearhead decarbonisation efforts in the Middle East.[2] A luxury automaker working with a start-up to source CO2-free steel produced using green hydrogen.[3]

These instances exemplify a recent surge in partnerships within climate technology, driven by the imperative to combine expertise and resources to achieve global-scale decarbonisation.

Fostering open innovation will be vital in advancing low-emission technology. The International Energy Agency emphasises that collaboration helps "identify common priorities as well as share best practices to improve performance, reduce costs and deploy key energy technologies."

In a 2023 report, the Global CCS Institute, a think tank specialising in carbon, capture and storage (CCS), writes that "multiparty partnerships to develop and deploy complex projects continue to grow to offer deep emissions reductions across various industries."

The NAS® battery system is known for its high energy output and long duration

Cooperative ecosystems can help drive the climate transition. NGK Insulators, Ltd., a global ceramics manufacturer, exemplifies this trend.

Partnerships for capturing carbon and enabling renewables

"Partnerships are essential for carbon neutral technologies because the type of technological needs to realise carbon neutrality remains unclear; no one company can do everything," says Shigeru Kobayashi, NGK's president. "We are pivoting towards open innovation and collaborating with others on various solutions."

NGK is working with various partners on ceramic-based climate technologies, including CCUS (carbon capture, utilisation and storage), DAC, renewable energy storage, next-generation solar power, and producing hydrogen, methane and e-methanol as alternative fuels or feedstocks.

"Ceramics has been attracting more attention for climate tech recently because, although initial investment outlays may be higher for ceramics than organic material, it is highly durable, making it more sustainable and cost-effective long-term," says Kobayashi. He highlights that ceramics can also withstand severe environments such as high heat and acidity, which occur in CCUS processes.

As customers recognise these qualities, NGK has seen an uptick in inquiries.

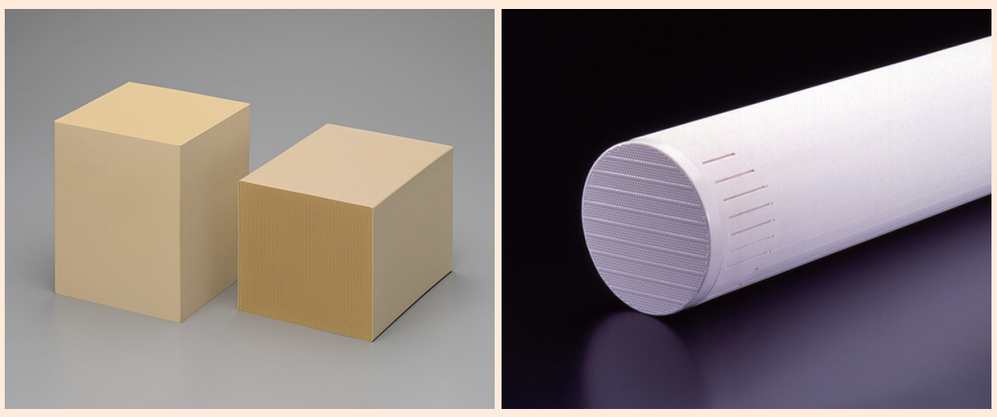
Direct air capture, a promising and rapidly evolving technology that uses chemical or physical processes to extract carbon dioxide from the air, is one area where ceramics shows its value.

Several DAC plant players, research institutions and start-ups with novel carbon dioxide absorbent technologies are collaborating with NGK to develop an efficient DAC system using ceramic-based honeycomb structure sorbent material. Kobayashi says NGK is fashioning prototypes and shipping them at a good clip to achieve demonstration tests by 2025.

These honeycomb-structured ceramics are based on substrates used for automotive catalytic converters, of which NGK is the world's leading supplier. The company aims to utilise its global network of existing plants to supply millions of litres of honeycomb, which will be required when DAC is scaled. Few other companies have the production capacity to meet the necessary volumes.

Shigeru Kobayashi,
President, NGK Insulators, Ltd.

One area where partnerships are delivering results is the company's unique sub-nano ceramic membranes, 'sieves' that separate gases at a molecular level for CCUS. A Japanese engineering company and government agency are working with NGK to field-test ceramic membranes to separate and recover CO2 from natural gas in an oil field.



Honeycomb ceramic substrates (left) used in direct air capture and Sub-nano ceramic membranes (right)

In April, NGK started working with Mitsubishi Heavy Industries on a system for purifying hydrogen. The system uses membranes to separate the mixed gas of hydrogen and nitrogen generated after ammonia cracking. Developing and commercialising this technology will help build a hydrogen and ammonia supply chain for the global transition from fossil fuels.

Elsewhere, a Japanese bioeconomy company is partnering with NGK to develop microalgae separation technology using a ceramic membrane. Microalgae are expected to contribute to carbon neutrality as they absorb CO2 when producing.[4]

Another area of interest is the development of grid-scale storage for renewable energy. The IEA estimates that storage capacity for renewable energy must expand 35-fold between 2022 and 2030 to achieve climate goals. Here, too, joined-up efforts are vital.

To this end, NGK is forming global partnerships around its NAS® battery, a sodium-sulphur-based grid-scale storage battery. With over 20 years of deployment to date, NAS is notable for its high energy output and long duration.[5]

A raft of new orders for NAS in recent years point to renewed global interest.

In February 2023, an Australian mine operator employed NAS at a cobalt-nickel mine, with the technology monitored by university researchers to verify its performance in high-temperature environments.[6] A South Korean Power to Gas (P2G) system provider also ordered the battery to stabilise power in producing hydrogen from renewable energy.[7] Working with a Japanese engineering company, NAS will be delivered to an off-grid desalination plant using solar power in the Maldives.[8] The battery will also be delivered for a large-scale project to produce green hydrogen generated from renewable energy sources on the Baltic coast in northern Germany. This delivery is the first delivery batch of the NAS batteries with a total capacity of more than 230 megawatt-hours reserved by German green hydrogen producer HH2E.

These NAS orders, and others, have been facilitated by NGK's sales partnership with the German chemical company BASF.

"Thanks to its unique properties, the sodium-sulphur technology is ideally suited for the steadily growing market for long-duration energy storage," BASF says in a statement. "We want to broaden the application spectrum for these batteries significantly."

Basic research, material informatics and co-innovation

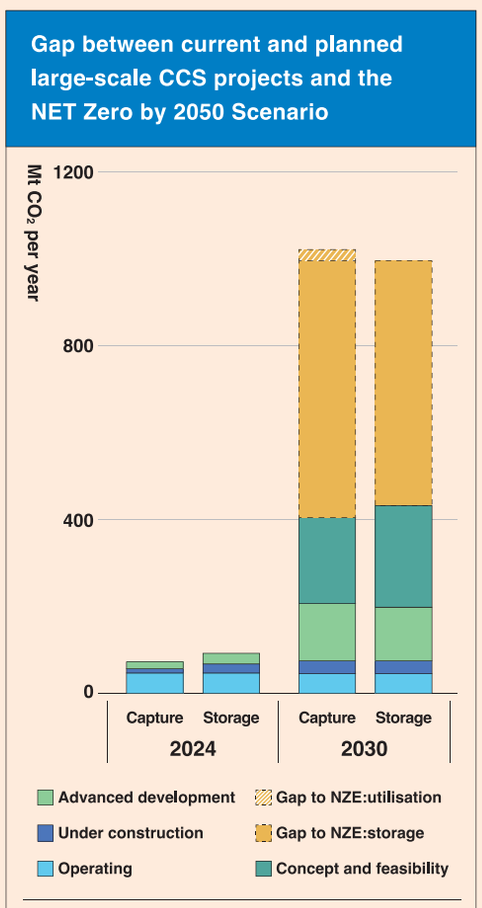
Climate tech requires collaboration in application, deployment and commercialisation as well as in the earliest stages of research. Kobayashi explains how NGK is working intensely with external researchers. Recent examples include investment in a spin-off company from Kyoto University, developing next-generation perovskite solar cells.

Another driver enabling tech partnerships is the adoption of material informatics (MI) – using advanced algorithms and data analytics, including AI – to dramatically shorten research times in developing new properties and materials. Since 2021, NGK has been developing MI from its trove of data from over 10,000 experiments, mainly on ceramics, which spans over a century. The company has already succeeded in reducing the time to develop new ceramic material to a third through MI and hopes to shorten this to a tenth.

To collaborate with potential partners to discover the expanding possibilities of ceramics, NGK is constructing a "co-creation centre" and developing research areas for carbon neutrality-related products at its head office.

"As we partner with outside companies, the pace in which we are creating new businesses has been dramatically accelerated," says Kobayashi.

Gap between current and planned large-scale CCS projects and the NET Zero by 2050 Scenario



source:https://iea.blob.core.windows.net/assets/d0cb5c89-3bd4-4efd-8ef5-57dc327a02d6/CCUSPoliciesandBusinessModels.pdf, PAGE 22

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