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# Rock solid climate solutions: Negative emissions technology

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**NEWS RELEASE**
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A team of international researchers plan to turn the greenhouse gas carbon dioxide into rock by permanently injecting it beneath the Earth?s ocean floor through an ambitious, new research partnership announced today by the Pacific Institute for Climate Solutions (PICS) at the University of Victoria.

The $1.5 million, four-year PICS Theme Partnership entitled ?Solid Carbon: A Climate Mitigation Partnership Advancing Stable Negative Emissions? brings together researchers from Canada, the United States and Europe. The team aims to combine state-of-the-art technologies in a way that has never been conceived until now, to deliver safe and reliable carbon dioxide (CO2) removal.

The project team includes scientists, engineers and social scientists from the University of Victoria; Ocean Networks Canada (ONC), a UVic initiative; University of British Columbia; University of Calgary; University of California; Columbia University; the University of Washington; and GEOMAR Helmholz Centre for Ocean Research in Germany. Other project partners include K&M Technology Group, and Carbon Engineering in Squamish, British Columbia.

With climate change scenarios showing that negative emissions technologies are needed to limit warming to two degrees Celsius, PICS Executive Director Sybil Seitzinger says the research is timely and urgent.

?Solid Carbon is a highly ambitious project with many barriers to overcome but if this team can advance the technology to a commercially viable stage by mid-century, it could be a major tool to combat climate change,? she says. ?Drastic reductions in greenhouse gas emissions are not enough?we need large-scale, permanent removal of excess carbon from the atmosphere.?

ONC President and Chief Executive Officer Kate Moran, Solid Carbon?s principal investigator, explains how proven technologies behind renewable energy production, carbon capture, offshore drilling and carbon mineralization will come together in this feasibility study.

"The vision is to extract $CO_2$ from the atmosphere using a direct air capture technology (developed by Carbon Engineering). Then, using deep ocean technology powered by ocean-based wind and solar energy, inject the $CO_2$ into the subseafloor basalt, where it will mineralize and remain permanently as rock,? she says.

Globally, more than 90 per cent of basalt resides in the ocean where it is widely distributed, making the technology ideal for world-wide use. One of the project?s initial focus areas is modelling and laboratory experiments to demonstrate sequestration of $CO_2$ into ocean basalts that lie beneath ONC?s Cascadia Basin site off the west coast of British Columbia.

Curran Crawford, a professor with UVic?s Institute for Integrated Energy Systems, will lead the investigation into what ocean technology design works best for capturing and then injecting the $CO_2$ into ocean basalt. Prototypes will then be built for further evaluation.

?One key design challenge will be adapting direct air-capture technology that has only been used on land to perform reliably on a floating offshore ocean platform that is powered by renewable energy,? he explains. ?Another challenge is that the basalt reservoirs we want to reach are 2,700 metres deep, so our team is engaging with offshore oil and gas drilling experts who have successfully built systems in the deep-sea environment.?

A third component of the project will examine the social, regulatory, and investor acceptance for this project, including gaps in current law. Romany Webb, associate research scholar at Columbia Law School, says existing ocean regulations had not anticipated $CO_2$ sequestration, hence the need for evaluation and future adjustments.

?We need to better understand the laws affecting offshore carbon capture and storage to ensure future projects are conducted in a manner that not only helps to mitigate climate change, but is also safe and environmentally responsible.?

Seitzinger says Solid Carbon has the potential to establish BC as the international technology hub for this climate mitigation solution, and build expertise within Canada as top graduate students are drawn into the project.

The four-year project begins Oct. 1, 2019, with the ultimate goal of designing and delivering a globally applicable ocean-based negative emissions technology by 2050.

## Additional Quotes

**Geoff Holmes, director of business development at Carbon Engineering.** ?Direct air capture, and the broader concept of carbon dioxide removal, is gaining business and policy attention as we all tackle the climate challenge. This work will look at yet another way to deploy these technologies and ideally open up more opportunities to tackle emissions while maintaining affordable energy and competitiveness.?

**Meghan Paulson, principal drilling engineer at K&M Technology Group**. ?I am keen to contribute to this project because the technologies and approaches developed over decades within the oil and gas sector are important to making this solution succeed.?

**Murray Rankin, environmental lawyer**. ?I am delighted to add a Canadian legal perspective to this rock-solid climate change solution. To advance this solution as fast as possible, it is crucial that we forge ahead with regulatory acceptance in parallel with the advancement of the technology. As we?re hearing loudly from kids this week, timely action is needed now."

The **Pacific Institute for Climate Solutions** develops impactful, evidence-based climate change solutions through collaborative partnerships which connect solution seekers with experts from BC?s four leading research universities. The PICS Theme Partnership Program supports research on particularly complex?and critically important?climate mitigation and adaptation challenges, and in the process develops legacy partnerships for BC and beyond. PICS is hosted and led by the University of Victoria in collaboration with the University of British Columbia, Simon Fraser University and the University of Northern British Columbia.

**Ocean Networks Canada**, an initiative of the University of Victoria, monitors the west and east coasts of Canada and the Arctic to continuously deliver data in real-time for scientific research that helps communities, governments and industry make informed decisions about our future. Using cabled observatories, remote control systems and interactive sensors, and big data management, ONC enables evidence-based decision-making on ocean management, marine safety and environmental protection. ONC also works in collaboration with educators, students, communities and Indigenous peoples on ocean monitoring initiatives along BC?s coast and in the Arctic.

Read the University of Victoria release **here**

A media kit containing high-resolution photos, videos and a explainer of the project is available on **Dropbox**

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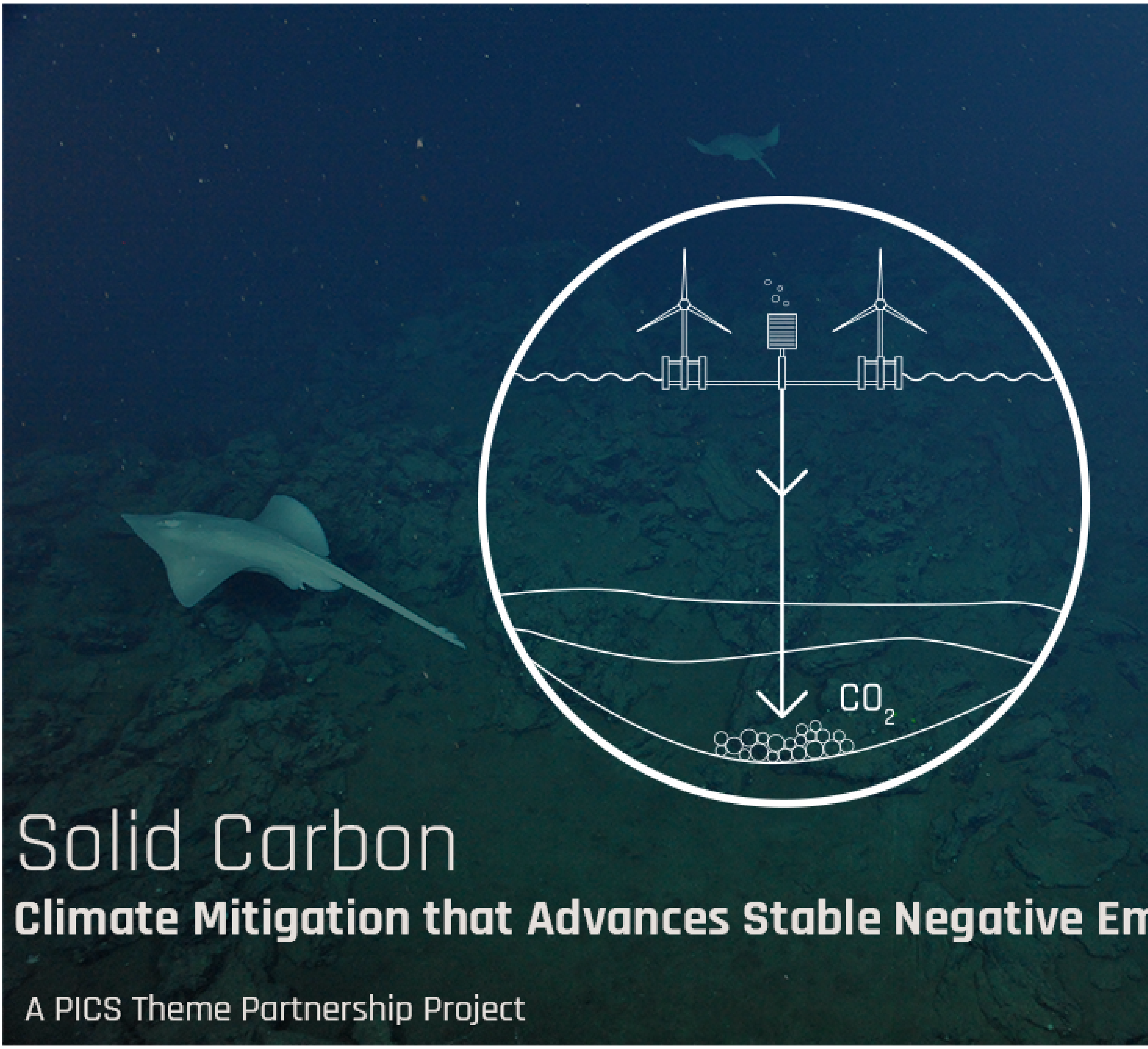


## FAQs: Rock-solid climate solutions

**How did this project originate?**
Solid Carbon is the first project of the new PICS Theme Partnership Program that supports research into particularly complex?and critically important?climate mitigation and adaptation challenges. The project has been externally reviewed by a group of international experts.

**What are negative emissions technologies?**
Negative emissions technologies (NET) are systems that remove and permanently sequester carbon dioxide from the atmosphere. This is different than removing carbon dioxide emitted from a single source such as a coal power plant. The concept of negative emissions is the idea of pulling out more carbon dioxide (CO2) from the atmosphere than what is being emitted.

**Why is it needed?**
It is now well recognized that in order for Earth to stay within the limits set by the Paris

Agreement, NETs must be included on a large scale alongside mitigation efforts to minimize greenhouse gas emissions.

**What is ocean basalt and why is vital to this project?**
More than 90 per cent of all volcanic rock on Earth is basalt and it is a key component of the ocean crust. It is a porous rock formed from cooling lava, which is ideal for injecting fluids. It has been shown that when CO2 is injected into basalt it reacts with minerals (calcium, magnesium and iron oxides) and forms a solid carbonate rock in a short amount of time. Furthermore, above the ocean basalt is a sedimentary layer that can be as thick as 600-800 metres. This sediment layer is nearly impermeable and acts as a natural barrier against any unlikely leakage while the CO2 is reacting to become rock.

**How long does it take for CO2 to turn into rock?**
In 2012, a team of international researchers and engineers began injecting CO2 into porous basalt on land, at an underground test site in southwest Iceland. Two years later, the CO2 had reacted to become carbonate rock. This was described at the World Economic Forum and published in *Science*.

**What makes the Solid Carbon project unique?**
Unlike other carbon storage solutions that inject CO2 on land, this Solid Carbon negative emissions technology project makes use of the world?s largest possible reservoir for CO2 sequestration?ocean basalt. The action of permanently transforming CO2 into basalt rock has been successfully proven on land, but the majority?more than 90 per cent?of basalt on Earth is found beneath the ocean floor in the deep ocean.

**How will this technology actually remove CO2 from atmosphere and inject it into basalt?**
Within five years, Solid Carbon will design a system that makes use of six proven technologies: (1) direct air capture technology installed on an (2) ocean floating platform, powered by (3) wind, solar, and thermal energy, and (4) CO2 injection into subseafloor basalt, (5) using oil and gas drilling technology, where it will (6) react and become stable rock.

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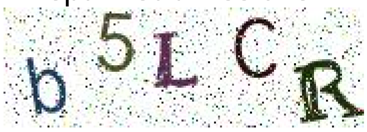


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