

# AN ALKALINE SOLUTION FOR HALIFAX

As alarm about climate change grows, scientists explore a strategy for drawing excess carbon dioxide into the ocean

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**DALHOUSIE**  
UNIVERSITY

Published in



**Dr. Will Burt**



**PLANETARY**

# Background

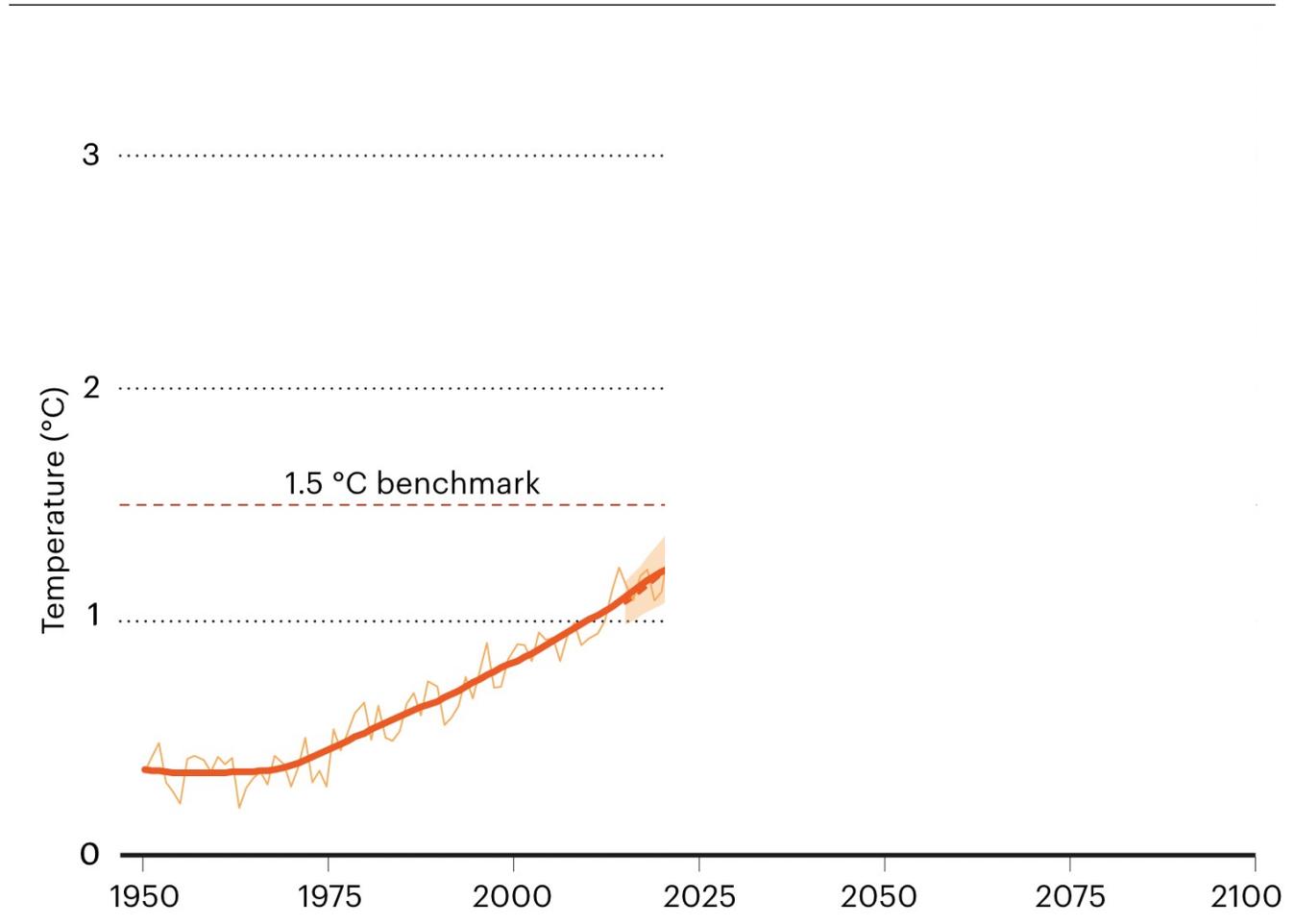
As of now, atmospheric CO<sub>2</sub> is 50% larger than preindustrial levels.

As a result, average global temperatures were 1.3°C above preindustrial in 2022.

197 nations have pledged to keep global warming below 1.5°C above preindustrial (2015 Paris agreement).

Our total emissions so far seem to be enough for 1.5°C warming.

Even with drastic emission reductions (current pledges), models estimate 2.4 to 2.6°C by 2100. Emission reductions are being implemented too slowly.



Tollefson, Nature, 2023

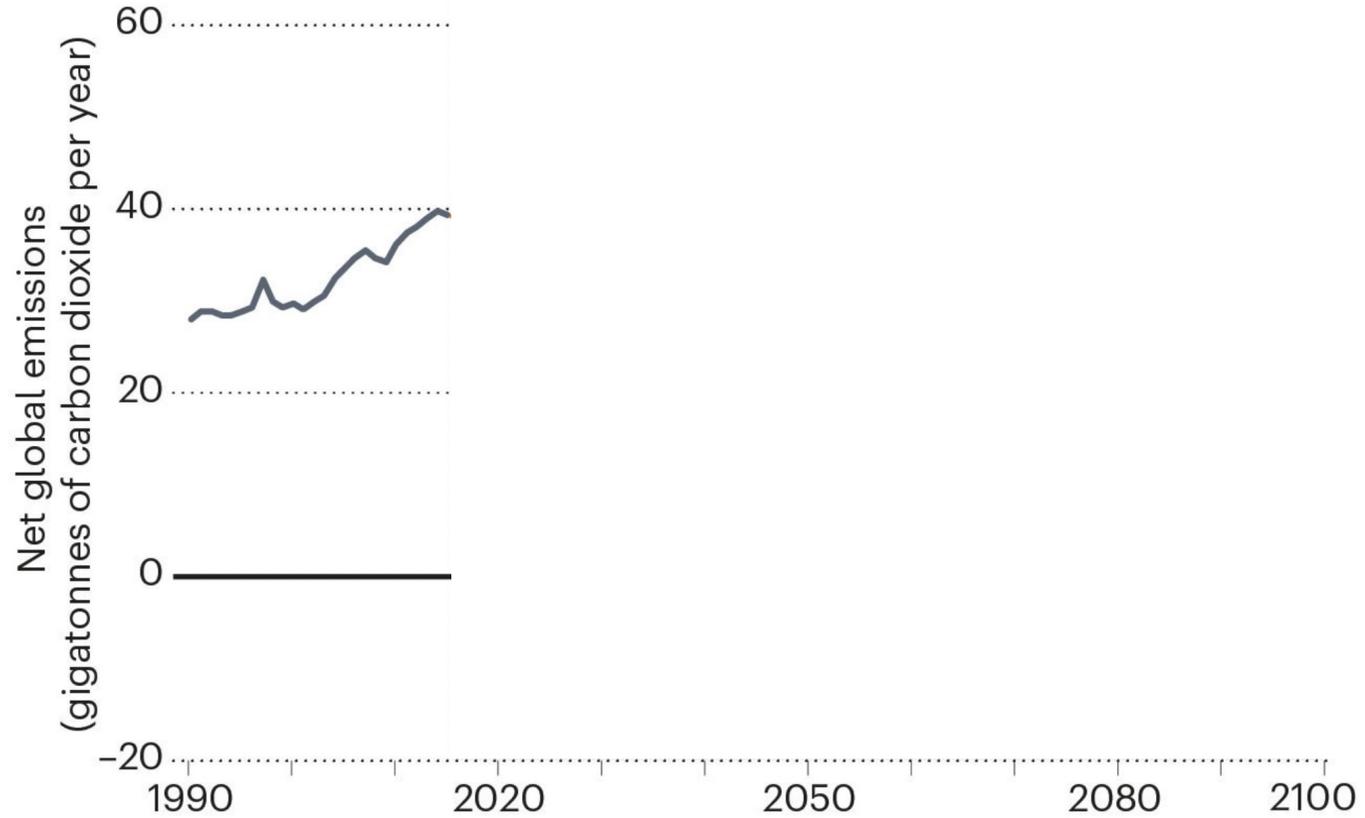
# Background

Over the past decade, we emitted >35 billion tons of CO<sub>2</sub>/yr  
(1 billion: 10<sup>9</sup> t CO<sub>2</sub> = 1 Gt CO<sub>2</sub> = 1 Pg CO<sub>2</sub>)

Need drastic emission reductions asap,  
but they won't be coming fast enough.

We will overshoot on our “allowable”  
emissions and need Carbon Dioxide  
Removal (CDR) for legacy emissions.

No CDR technology has been demonstrated  
to work on climate relevant scale.

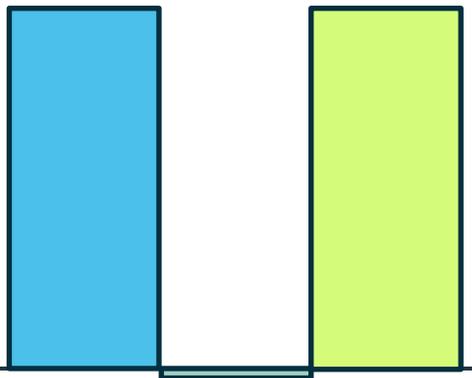


Tollefson, Nature, 2023

# Current emissions

CO<sub>2</sub> emissions

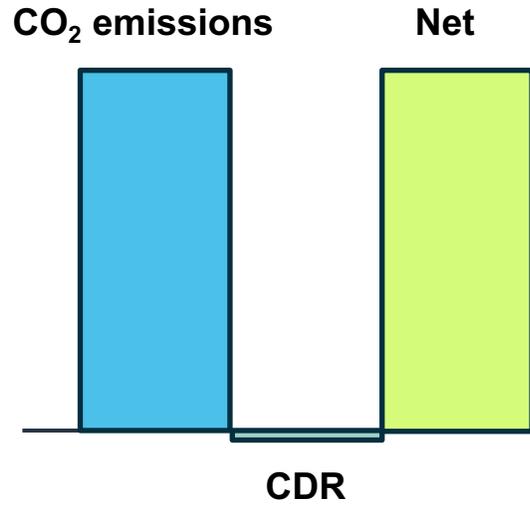
Net



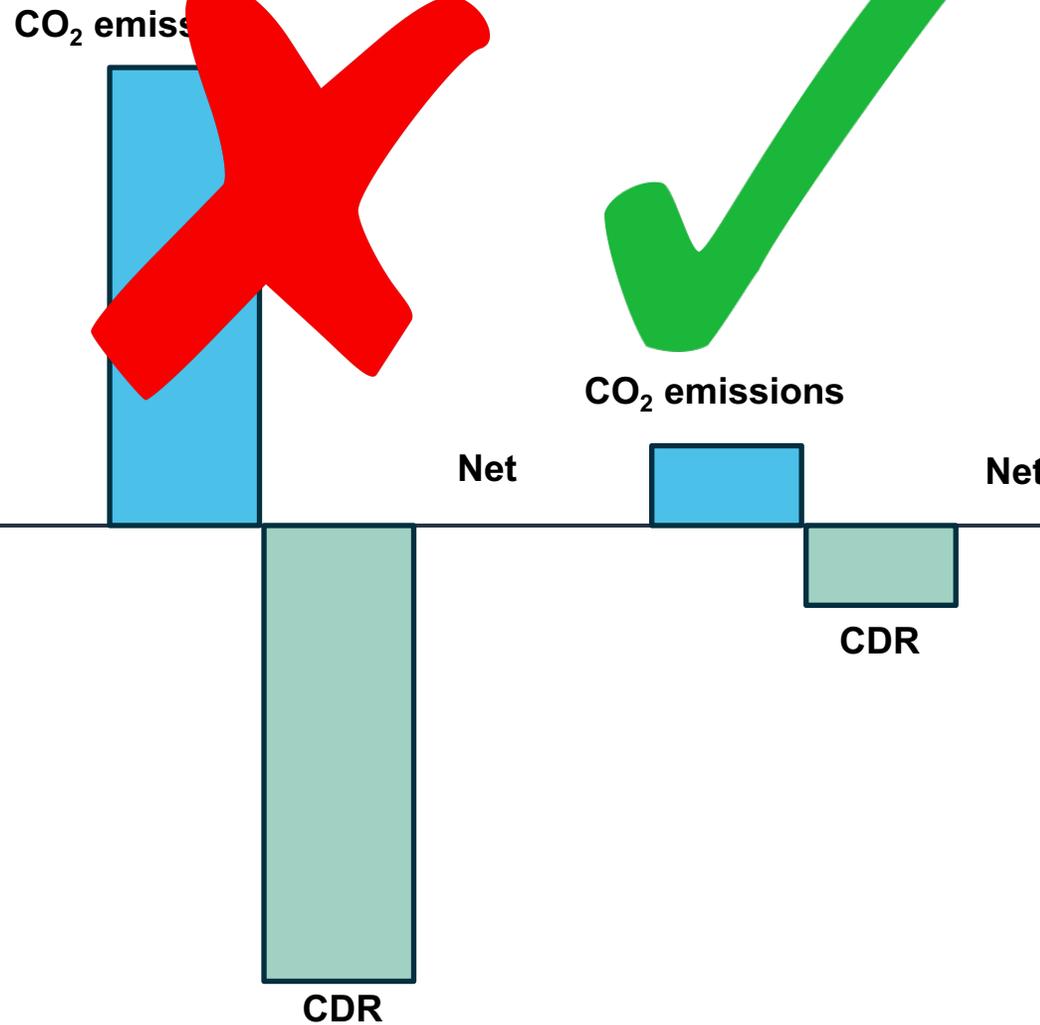
CDR

Net zero

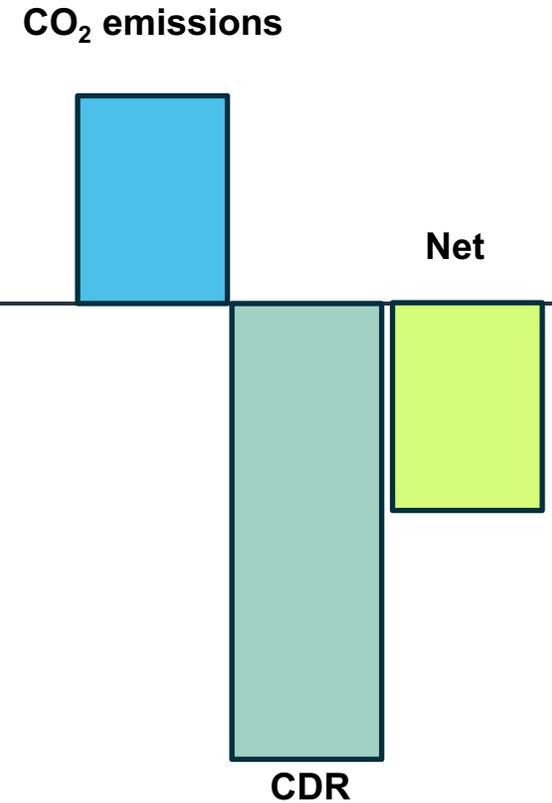
# Current emissions



# Bad and good notions of net-zero



# Correcting for overshooting

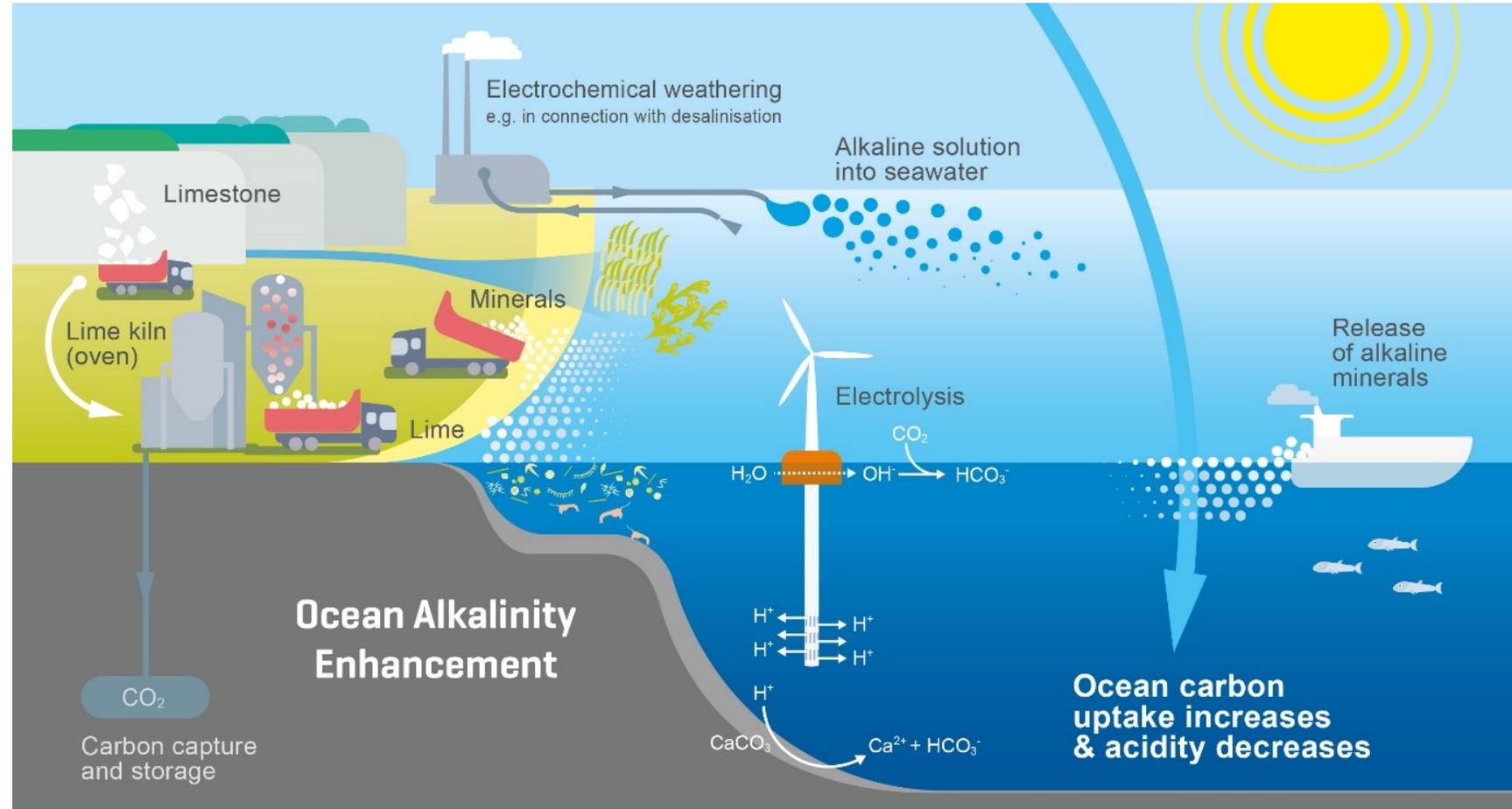


# Ocean Alkalinity Enhancement (OAE)

Abiotic, acceleration of a naturally occurring process.  
High durability/permanence.  
Based on well-understood carbon chemistry in seawater.  
Does not exacerbate ocean acidification and deoxygenation.

Lots of open questions:

- Life Cycle Analysis (LCA)
- Monitoring, Reporting, and Verification (MRV) approaches
- Scalability, potential ecological harms and benefits



Several start-up companies are pursuing OAE, including two in Nova Scotia:

- Planetary Technology
- Carbon Run

 **PLANETARY**

 **CarbonRun**

# NSERC Alliance Missions

PIs: Katja Fennel (lead), Douglas Wallace, Christopher Algar, Jinyu Sheng

Award in 2021: \$585,000 over 3 years

- build assessment and verification tools for ocean-based CDR and integrate them in a framework within Halifax Harbour
- apply the framework to verify carbon uptake and assess downstream effects of OAE in Halifax Harbour

Lead institution:



Partners:



CIOOS ATLANTIC  
REGIONAL ASSOCIATION OF THE  
CANADIAN INTEGRATED OCEAN OBSERVING SYSTEM



# Carbon to Sea

PIs: Katja Fennel (lead), Dariia Atamanchuk, Douglas Wallace (senior advisor) + 7 others from Germany and Australia

Awarded in 2023: \$15M over 5 years

Themes:

- Efficiency and permanence of CO<sub>2</sub> removal
- Risks and co-benefits
- Monitoring and verification

Six partner institutions:



Universität Hamburg

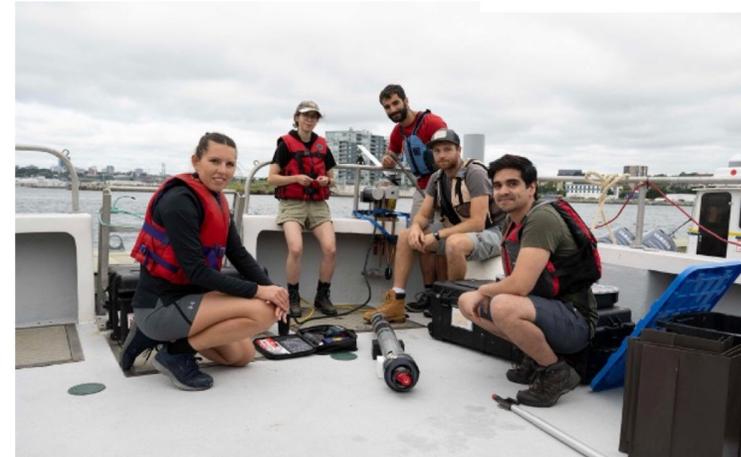
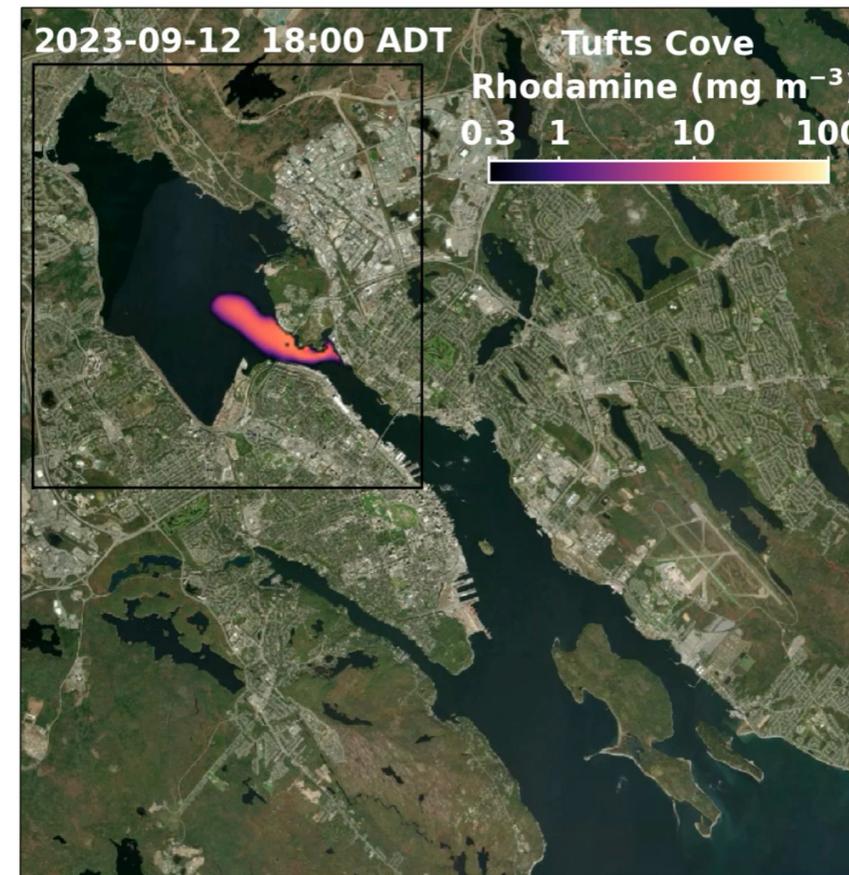
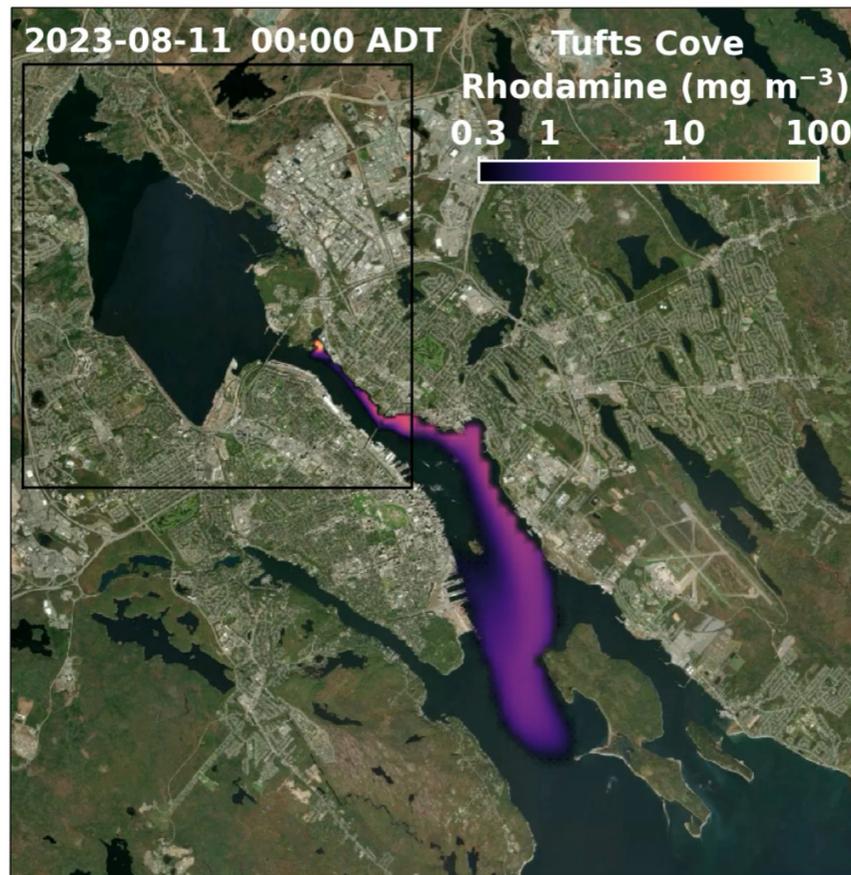
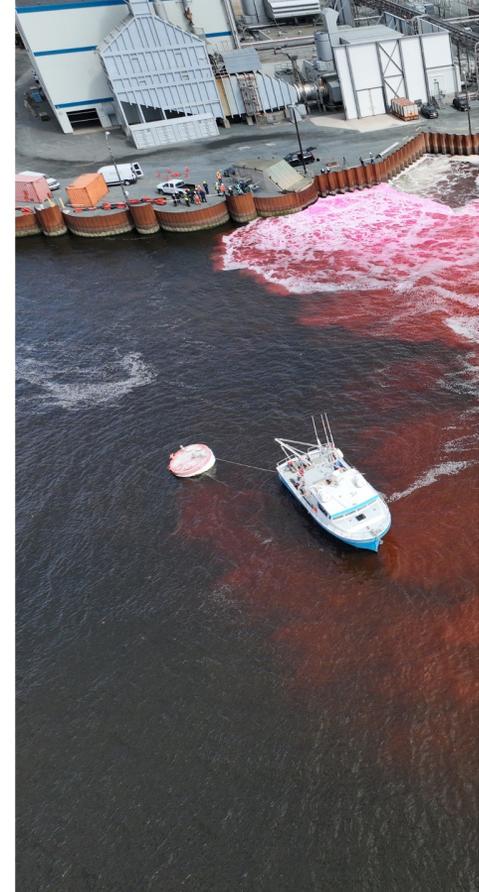




Dalhousie field team carried out first Rhodamine dye tracer study in Aug 2023. Predictive model simulation guided field sampling.

Over 30 field days on the boat, over 400 water samples.

Local and some international news: [alkalign.ocean.dal.ca/news](http://alkalign.ocean.dal.ca/news)



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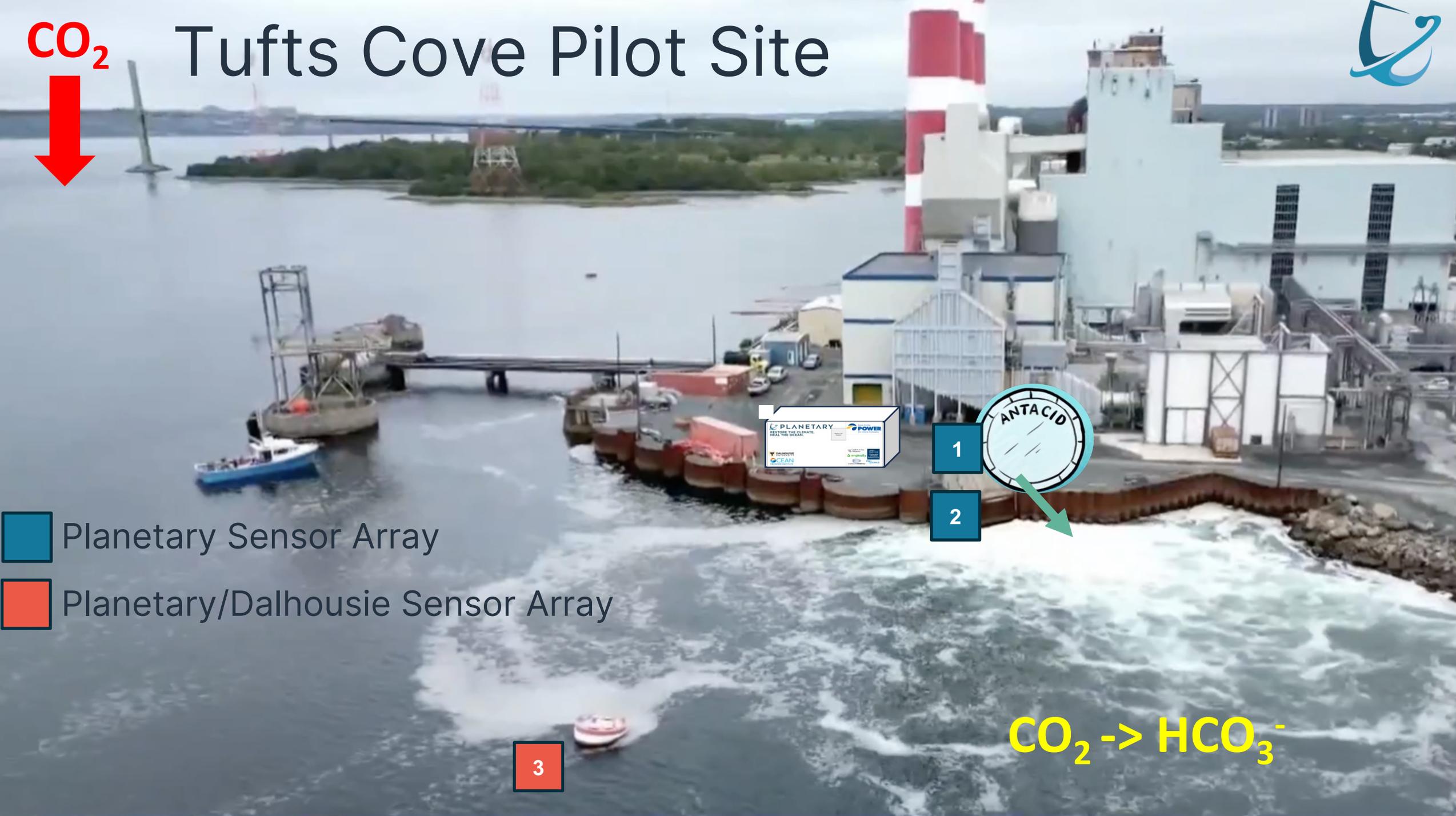
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CO<sub>2</sub>



# Tufts Cove Pilot Site



1

2



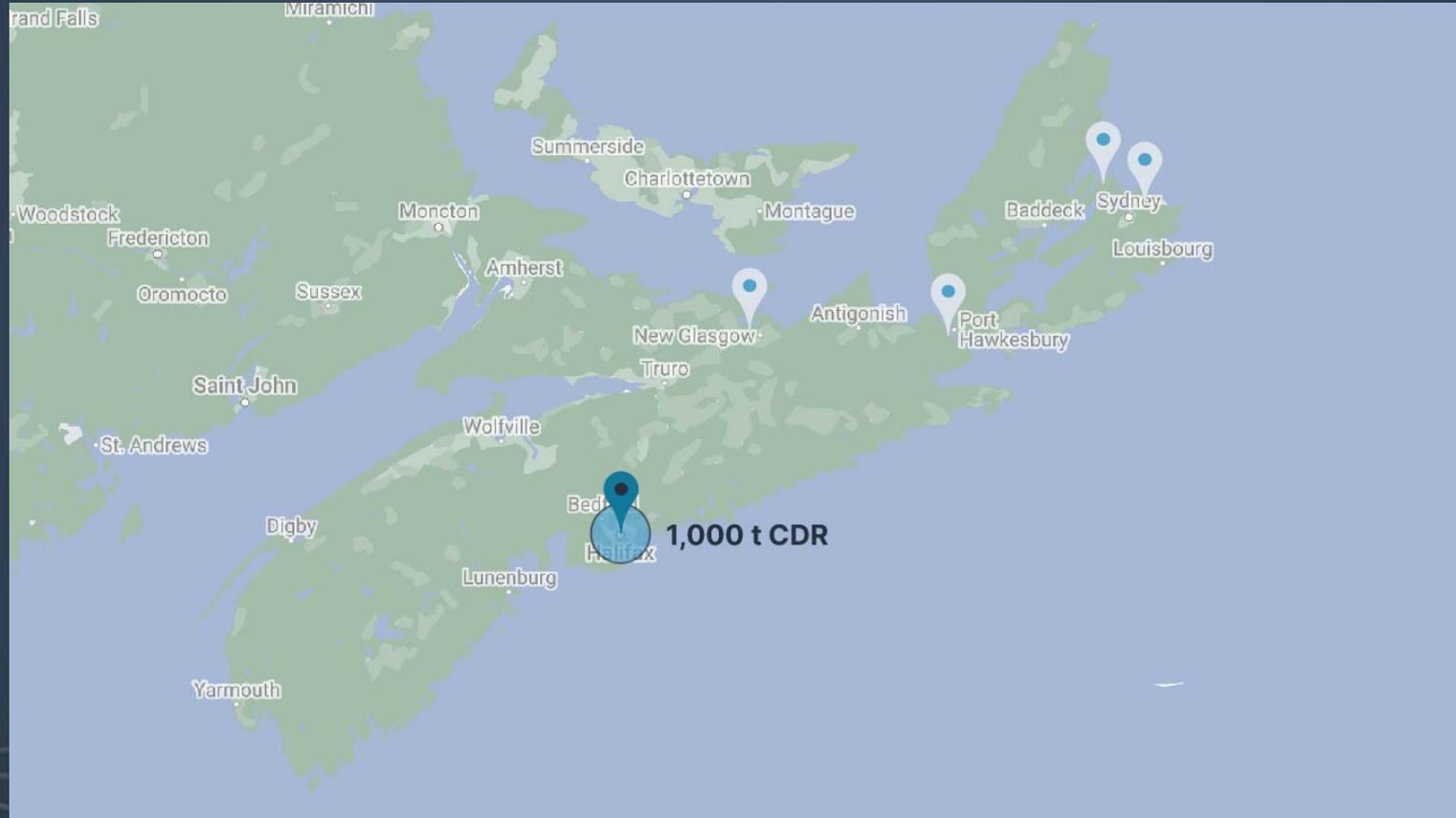
 Planetary Sensor Array

 Planetary/Dalhousie Sensor Array

3



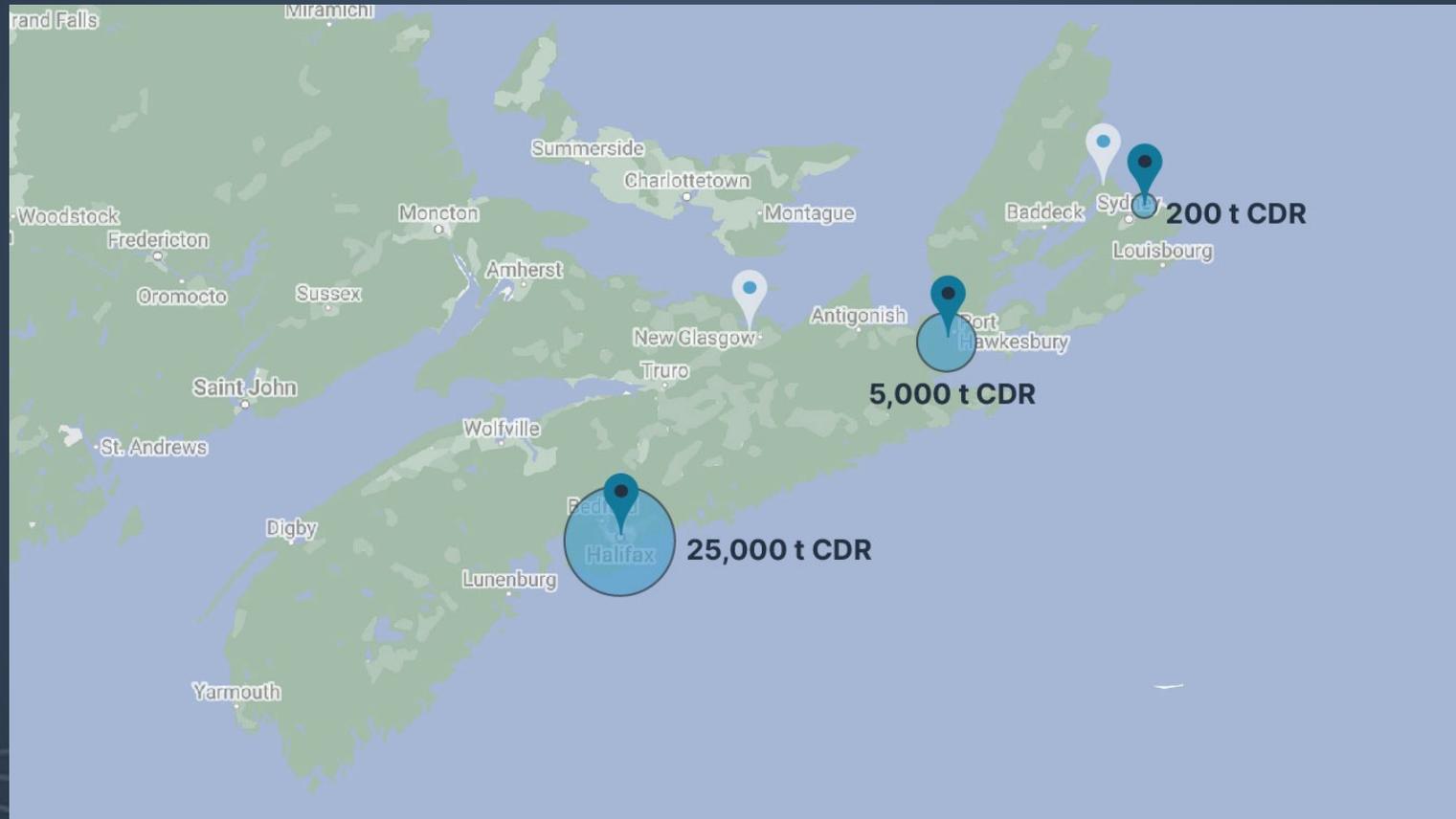
# Scaling Potential within Nova Scotia



Total of 250,000 to 500,000 or more tonnes of permanent carbon removal by 2030

2024: Pilot sites in Vancouver, USA, and UK

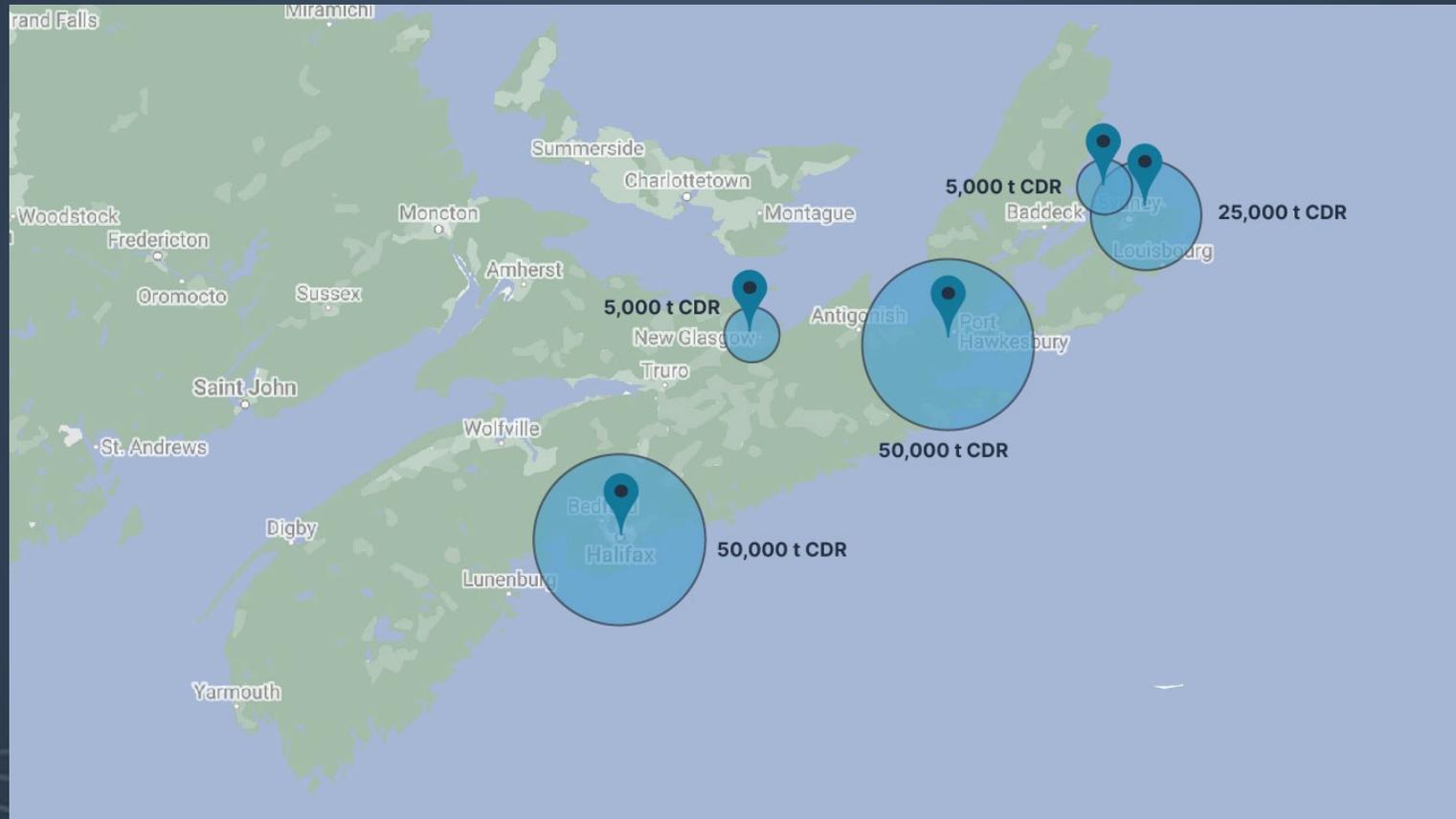
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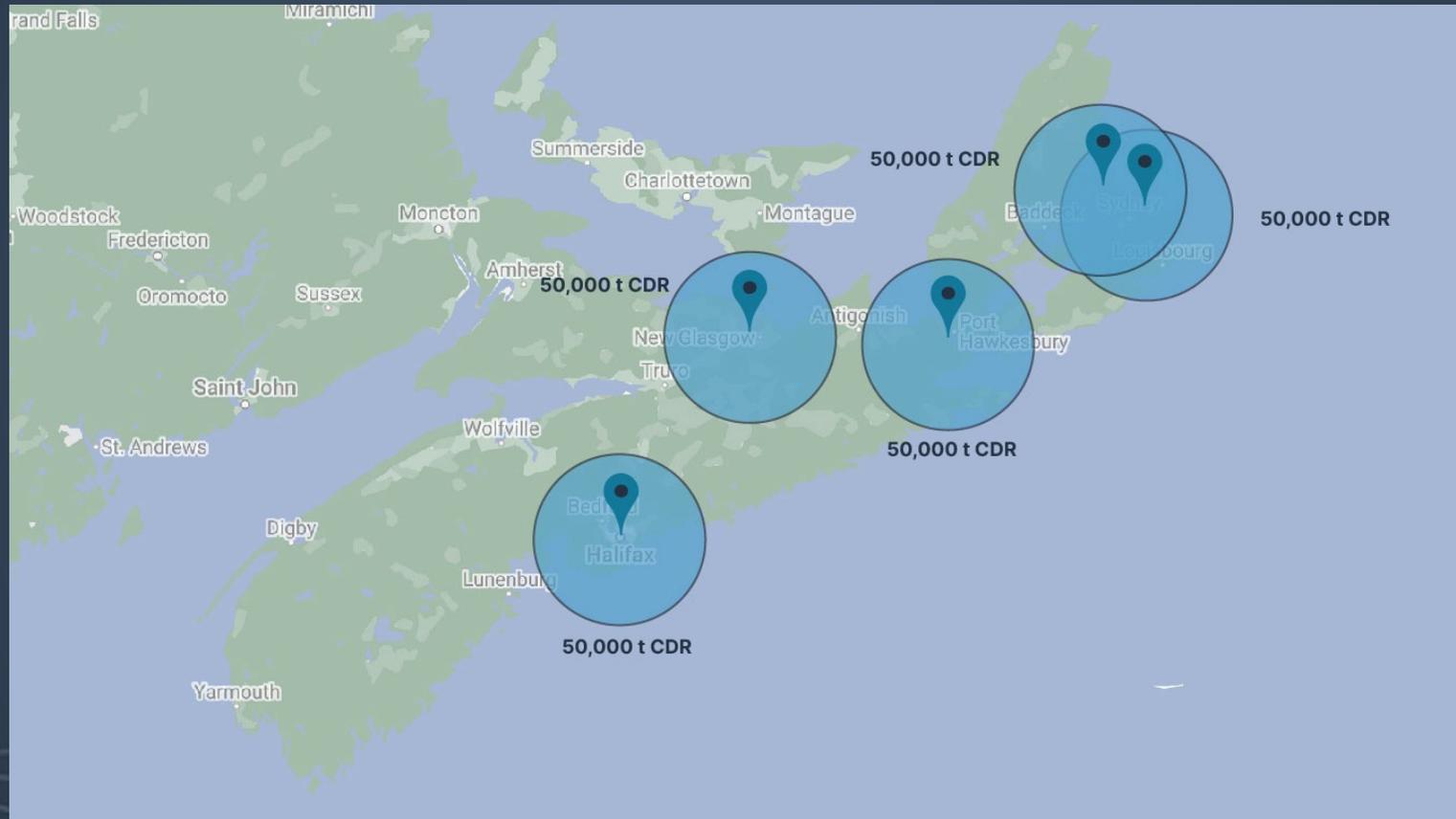
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# Benefits for Halifax

## Climate

- CO<sub>2</sub> removal for 100,000 years
- Reduce local ocean acidification to improve fisheries

## Economics

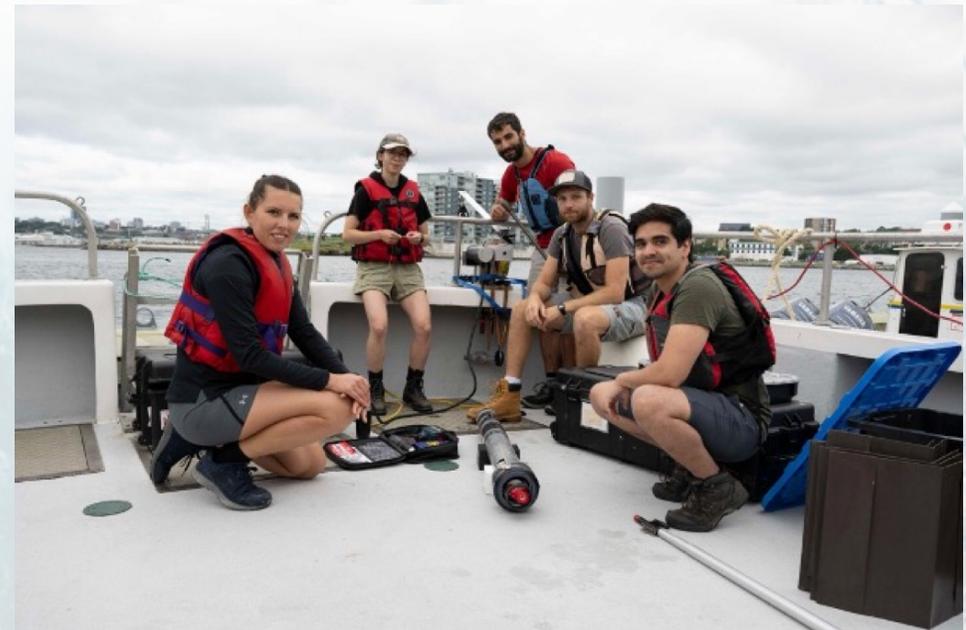
- Local employment across the skill spectrum
- Direct income generation in the hundreds of millions of dollars
- Talent attraction
- Increased international profile

## Education

- Large research funding already in place with more to come
- Education opportunities at Dalhousie and in the field
- Creation of foundational knowledge for academia and industry



Thank you!



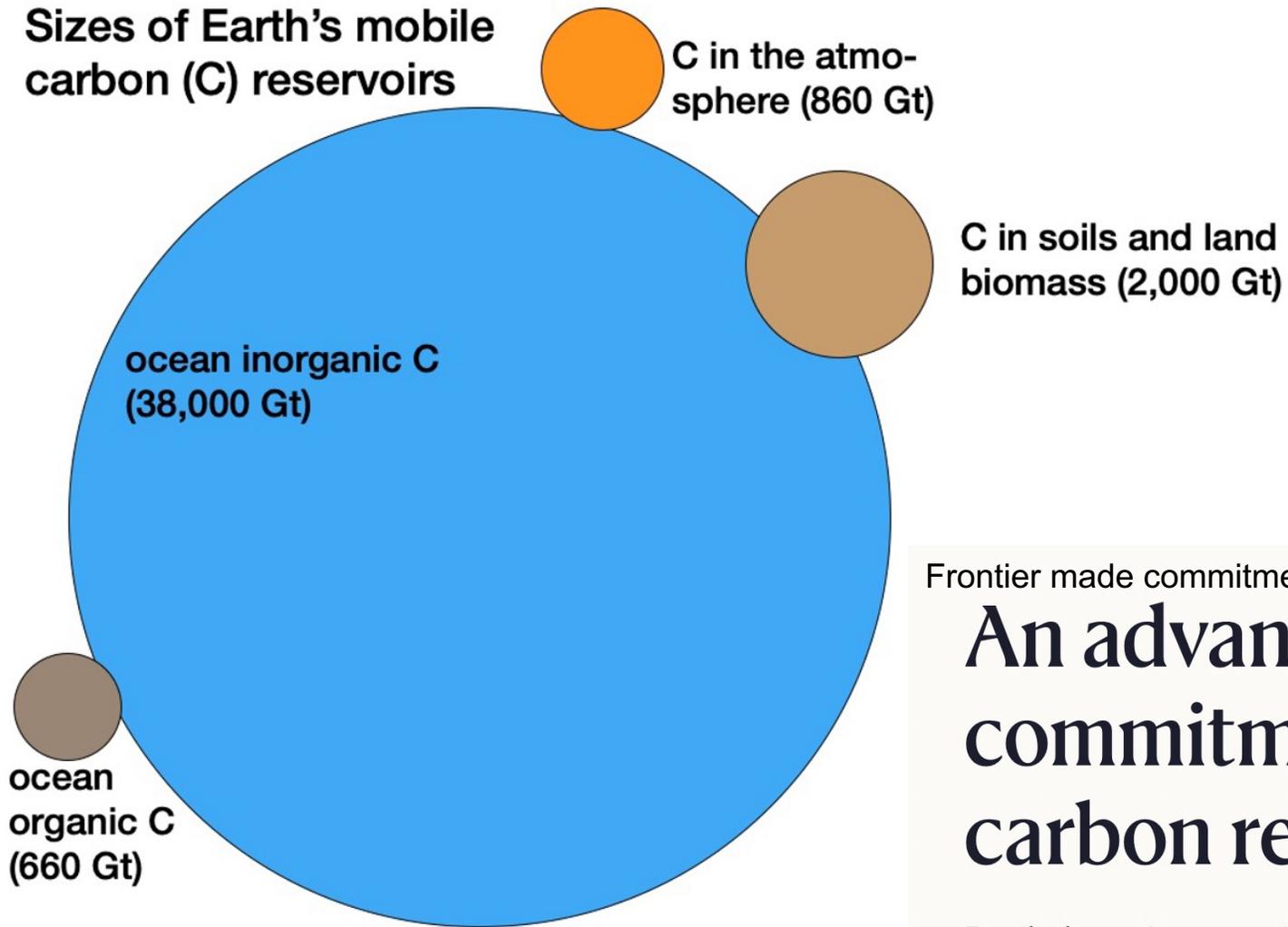


Extra Slides as  
needed

## Detailed Project Emissions Breakdown



## Sizes of Earth's mobile carbon (C) reservoirs



Frontier made commitment to buy US\$1B+ advance permanent carbon credits:

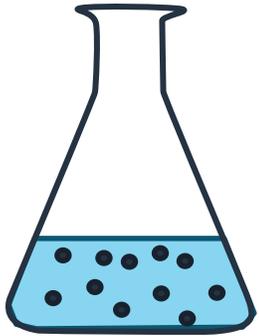
# An advance market commitment to accelerate carbon removal

Frontier is an advance market commitment to buy an initial \$1B+ of permanent carbon removal between 2022 and 2030. It was founded by Stripe, Alphabet, Shopify, Meta, McKinsey and tens of thousands of businesses using Stripe Climate.



## Main research questions

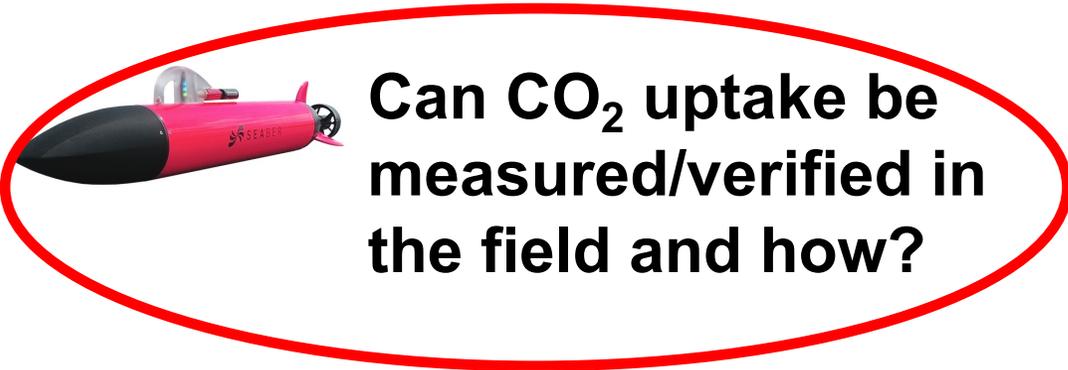
<https://alkalign.ocean.dal.ca/>



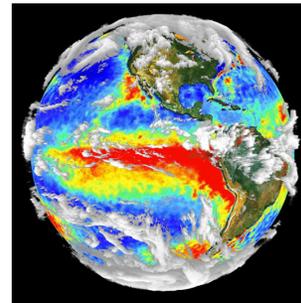
**How does mineral dissolution kinetics; stability of alkalinity affect efficiency and permanence of CO<sub>2</sub> removal?**



**How does OAE affect planktonic food webs and benthic communities?**



**Can CO<sub>2</sub> uptake be measured/verified in the field and how?**



**How does scaling up of OAE affect efficiency, permanence and environmental safety?**