Framing a discussion about AI use in CDR

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About [C]Worthy

[C]Worthy is an independent US-based 501(c)3 non-profit R&D organization building open-source models and datasets to support research and quantification of intentional ocean-based CO_2 removal and ocean carbon storage.

Regional Modeling for mCDR

Developing C-Star, a regional ocean-biogeochemical modeling system for ocean CDR.

Datasets for mCDR

Producing model-based datasets for the mCDR community.

mCDR R&D

Conducting R&D to to advance the knowledge base and practical understanding of mCDR research and practice.

[C]Worthy Funding Profile

Philanthropic Support

ALFRED P. SLOAN FOUNDATION

Carbon to Sea Initiative

Chan Zuckerberg Initiative

climateworks FOUNDATION

Environmental Defense Fund

Founders Pledge

Grantham Foundation for the Protection of the Environment

The Navigation Fund

OCEAN RESILIENCE & CLIMATE ALLIANCE

Patrick J McGovern FOUNDATION

stripe

Competitive Federal Grants

ARPA-E

NOAA

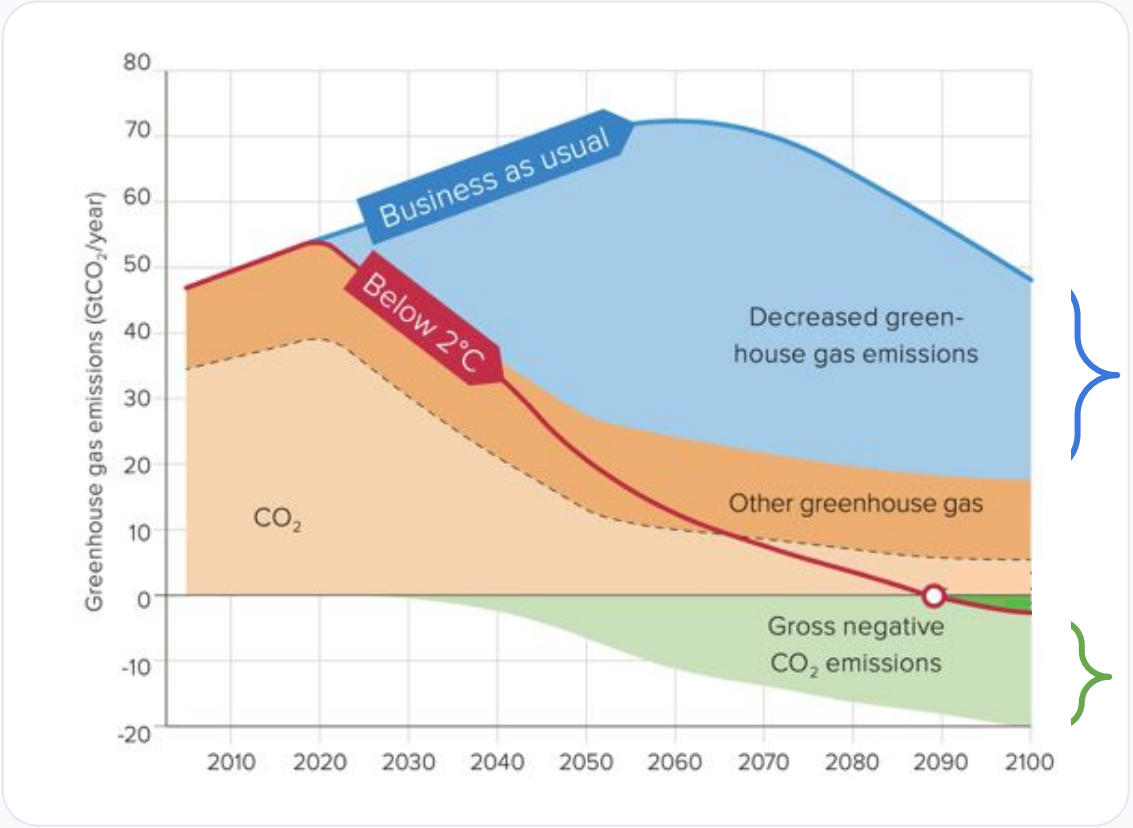
High Performance Computing

ACCESS

NERSC

U.S. DEPARTMENT of ENERGY

Gigatons of CDR are required to stabilize global temperatures

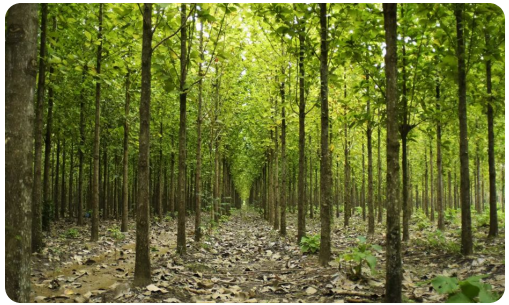


Adapted from on the Intergovernmental Panel on Climate Change's (IPCC) Sixth Assessment Report (AR6)

Worthy

What does carbon dioxide removal look like?

“Conventional” CDR



- Afforestation / Reforestation
- Improved forest management
- Soil carbon sequestration

“Novel / Durable” on Land

- Direct Air Capture
- Biochar
- Bioenergy with carbon capture and storage (BECCS)
- Enhanced Rock Weathering
- etc

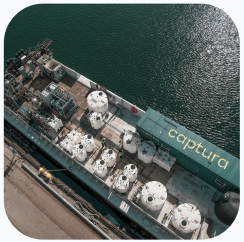
.... and in Oceans/Rivers

- Ocean Alkalinity Enhancement
- Direct Ocean Removal/Capture
- River Alkalinity Enhancement
- Wastewater Alkalinity Enhancement
- Macro/micro-algae cultivation and sequestration
- Nutrient Fertilization

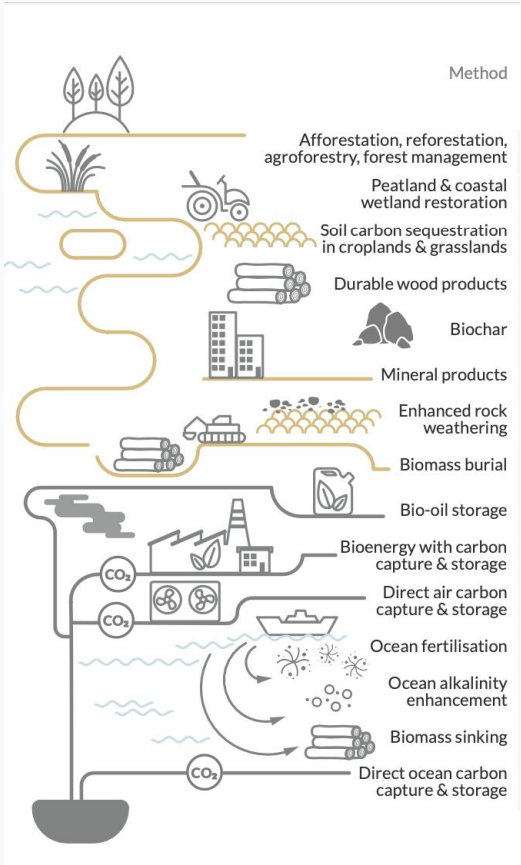
No one type of CDR is “best” – a portfolio of removal pathways is needed

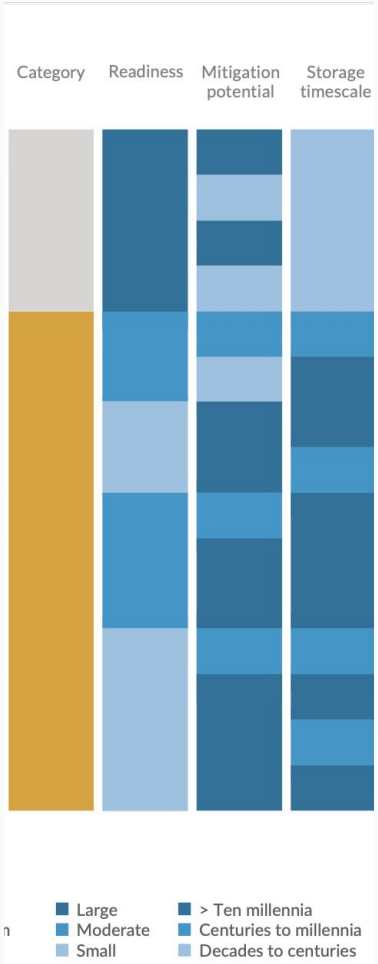




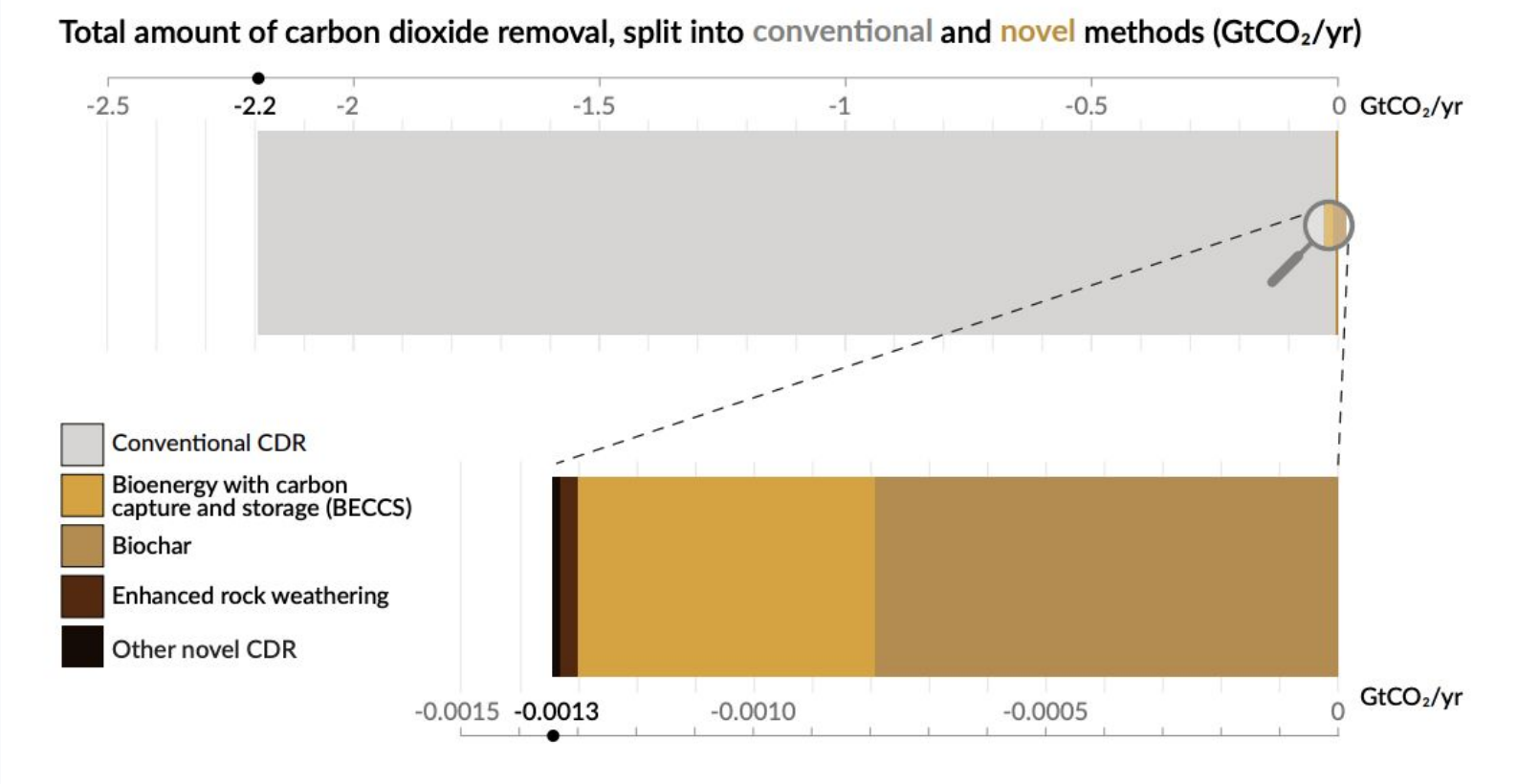






The State of CDR, 2nd Ed (2024)

Where are we now?



The State of CDR, 2nd Ed (2024)

Can AI accelerate the race to scale?

Science and Research

Accelerating fundamental discovery

- Materials identification
- AI-based modeling
- Knowledge discovery

Process Engineering

Optimizing project operations for CDR projects

- Efficiency
- Safety
- regulatory compliance

Monitoring, Reporting, Verification

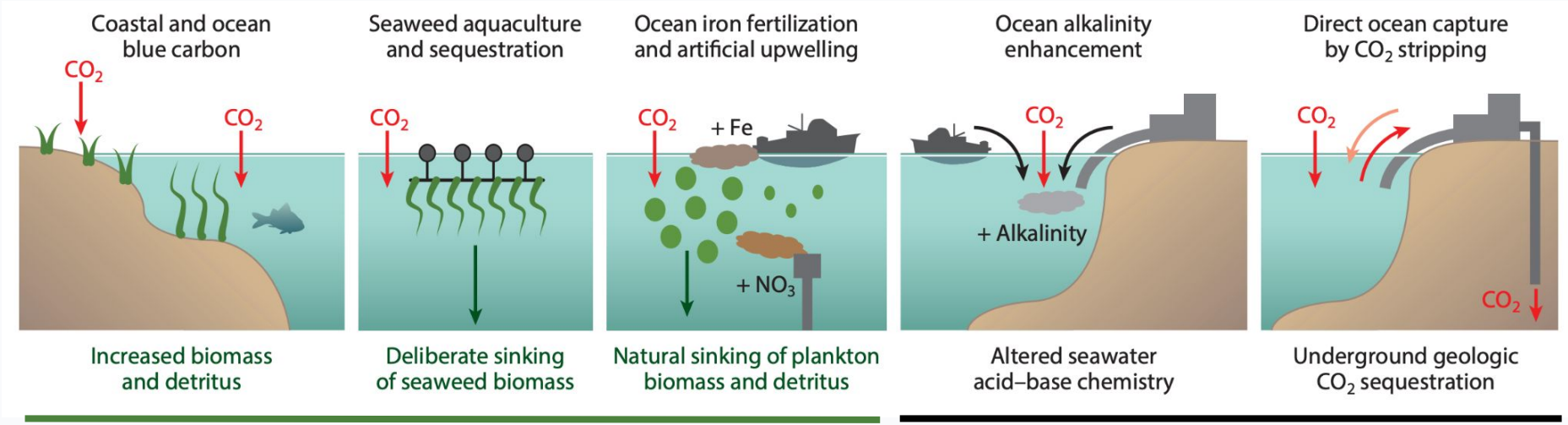
Enhancing quantification practices for ensuring removals are equivalent to claims and legible to markets and the public

Market Transactions

Facilitating transparent and efficient carbon credit trading and exchange.

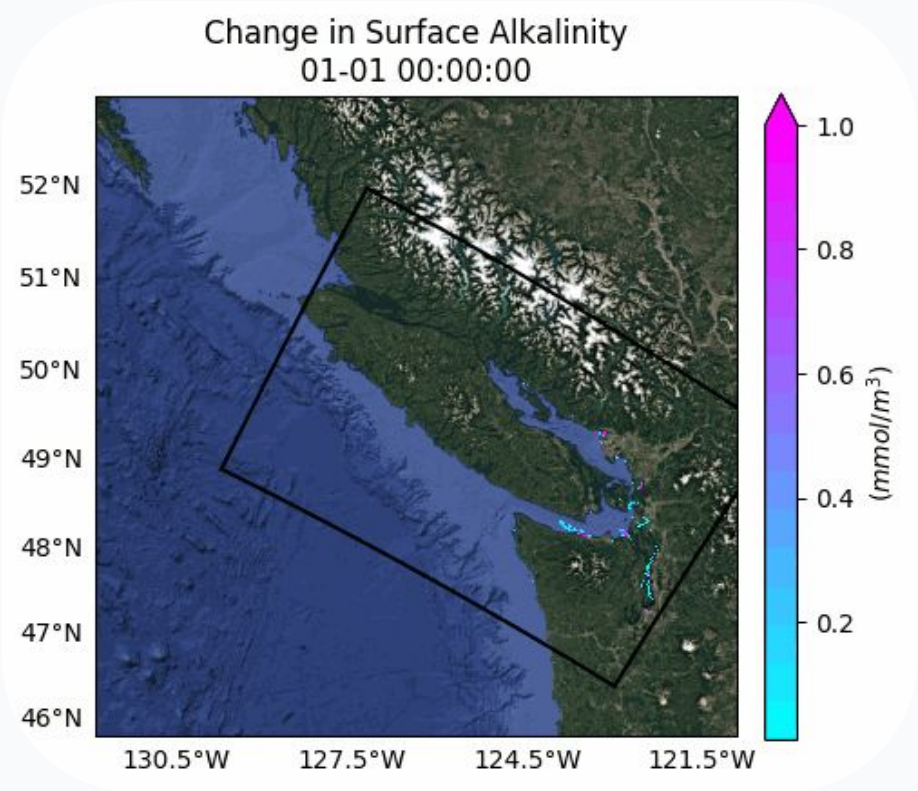
AI in ocean CDR – examples from one pathway

Ocean CDR (mCDR) pathways



Doney et al., Annu. Rev. Mar. Sci. 2025. 17:55–81

What's special about the ocean CDR pathways?



- The carbon storage and removal is dynamic
- Measurement + model quantification process
- The oceans are a common:
  - Deployments must be managed alongside other ocean use cases and priorities
  - Coastal communities/governments are key constituents
  - Trust and communication is central!

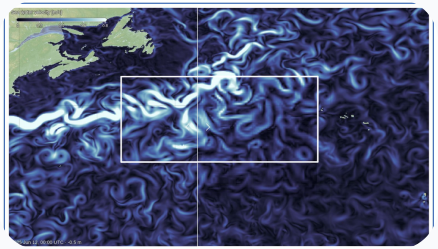
Courtesy of Abigale Wyatt, [C]Worthy

Potential for AI: observing CDR in the ocean

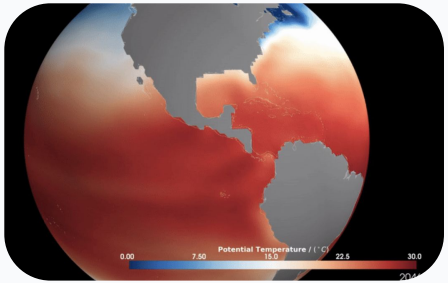
- Sensor calibration (ML)
- Mission optimization for ocean sensor platforms (e.g. neural networks, reinforcement learning)
- AI navigation for safety – obstacle avoidance on autonomous vehicles (computer vision, neural networks, sensor fusion)
- Underwater image monitoring of ecosystem health (computer vision, image classification)

Engineers at Dalhousie University, Halifax, Nova Scotia

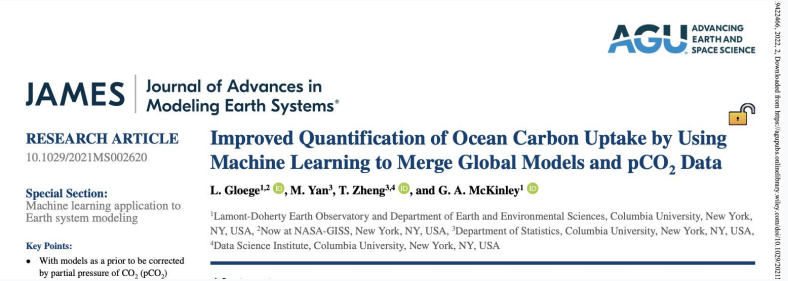
Potential for AI: AI/ML in ocean modeling

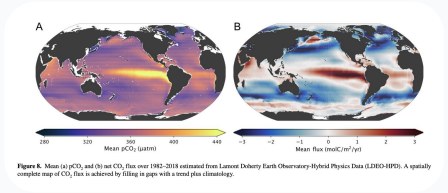


AI emulators for ocean forecasting (10-day)



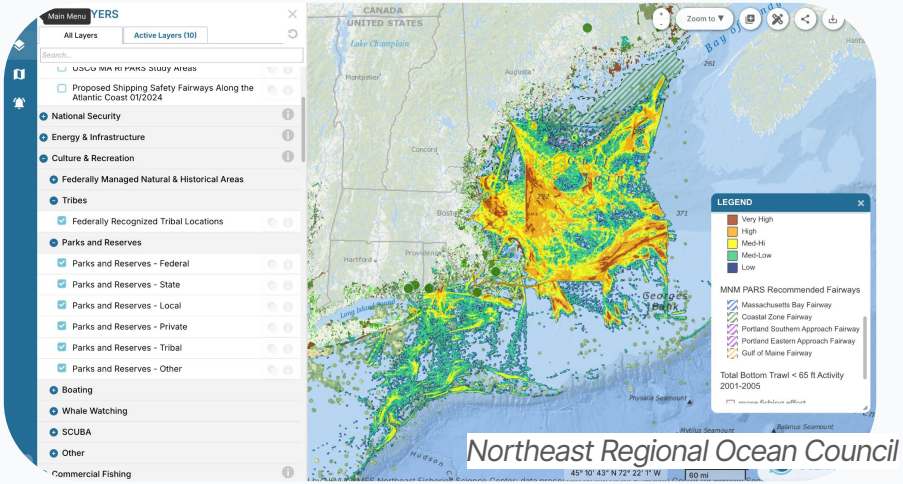
AI emulators for climate (multi-decade)





ML for reconstructing historical records of ocean CO_2 flux

AI for addressing mCDR within the context of a commons

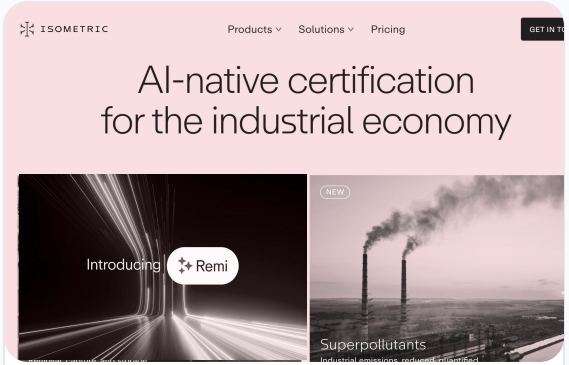


Northeast Regional Ocean Council

Geospatial AI for marine spatial planning support. Development of interactive tools for tracking permits.

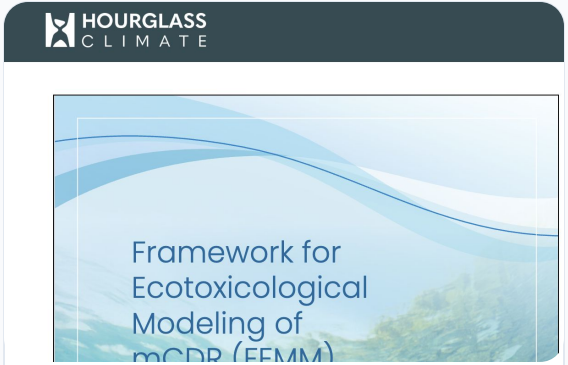
Multifaceted communities discuss/deliberate – AI is already being used to help track and synthesize complex viewpoints

AI creates the potential for faster, more accurate, more accessible synthesis of project data



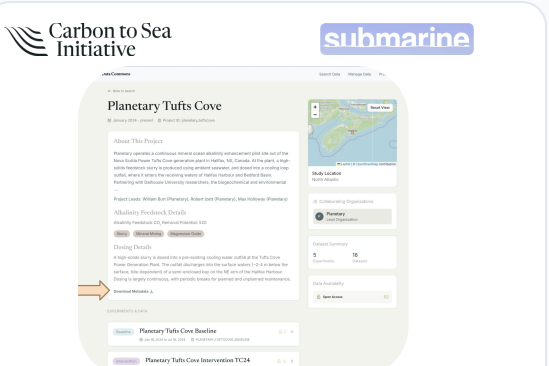
Diligence and Certification

Streamlining the verification process help ensure documentation is complete and meets requirements



Safety Standards

AI-powered automated tools for generating project-level ecosystem impact assessments



Open Data Commons

Reducing the friction of voluntary data sharing: unstructured information (e.g., projects proposals, websites, data sets, sensor spec sheets, etc) can be drafted into fixed schema