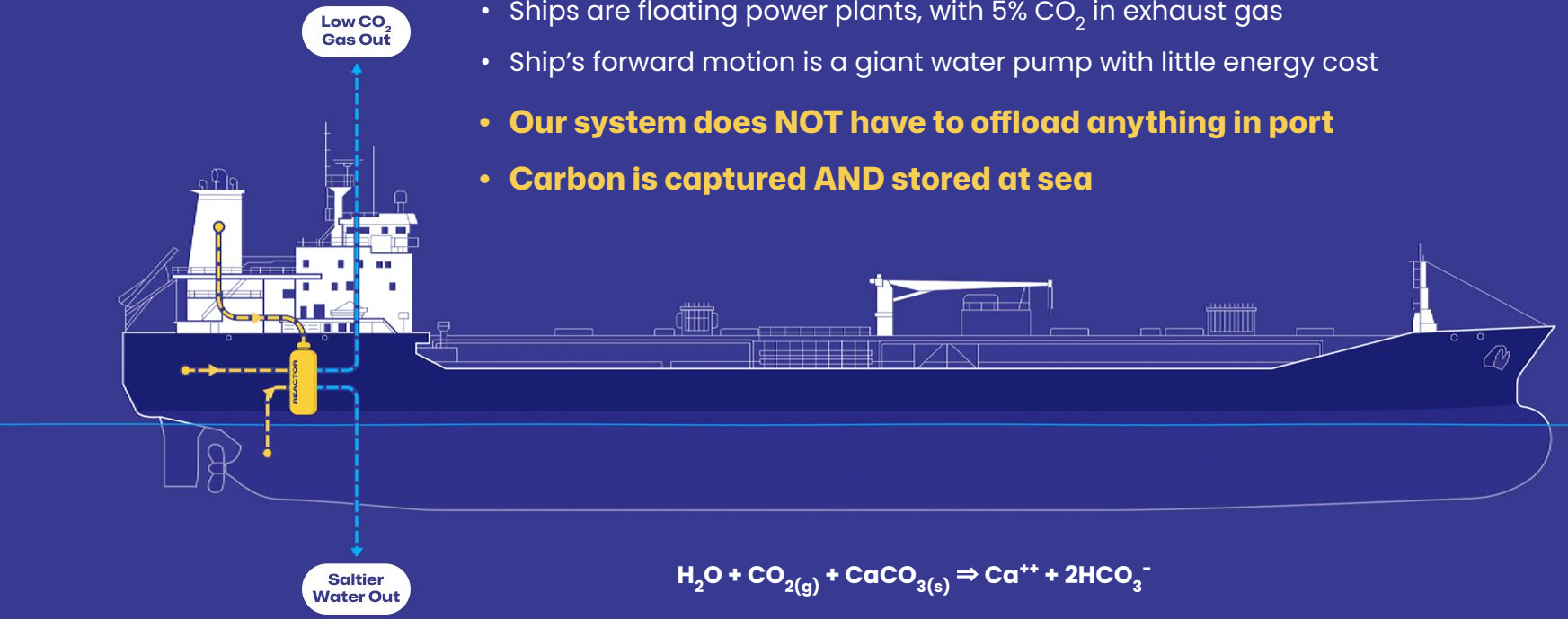
CALCAREA

Accelerating the Earth's natural solution to climate disruption

September 2025

Calcarea's Reactors are a Natural Match with Shipping



- Ships are floating power plants, with 5% CO_2 in exhaust gas
- Ship's forward motion is a giant water pump with little energy cost
- **Our system does NOT have to offload anything in port**
- **Carbon is captured AND stored at sea**

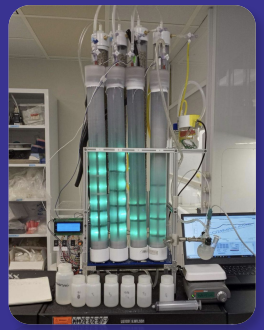
$$H_2O + CO_{2(g)} + CaCO_{3(s)} \Rightarrow Ca^{++} + 2HCO_3^-$$

Technology History

We have scaled up by 100,000x

Ripple 3

Ripple 1



Lab Reactor Caltech

Lab Reactor USC

2011: First Dissolution Rate PhD starts

2015 First Lab Reactor at USC and Catalyst Discovery

2017 Catalyst Proved Ineffective

2018-2021 Lab Reactors at Caltech

2022 Design and Build Ripple 1

Jan. 2023 Calcarea Spun Out of Caltech and USC

Q1 2023: Ripple 1 at USC

Q4 2023: Partnership with LomarLabs

Q1: 2024 Ripple 2 at Altasea

Q2 2024: Win Possidonia Pitch Event

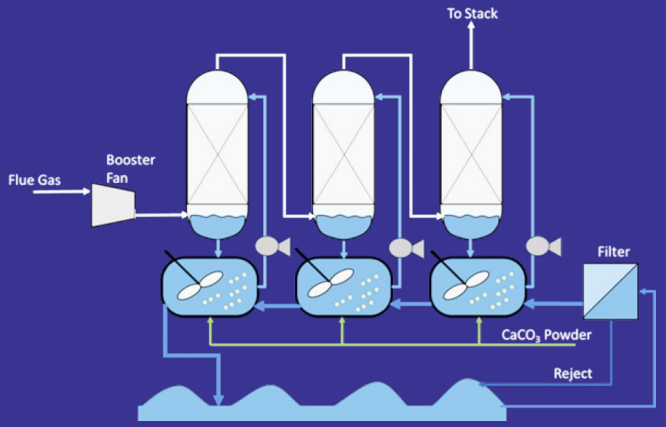
Q3 2024: Northrop Grumman and Sensor Box

Q3 2024: Ripple 3 at Altasea

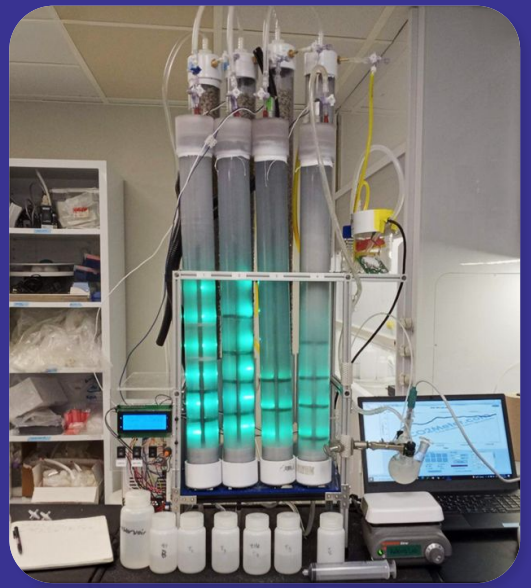
2025-2027 On Ship Pilots

Beginning Lab Work: Gas Adsorbers and Stirred Tanks in Series

A Gas Exchange Column with a Stirred Bed Reactor



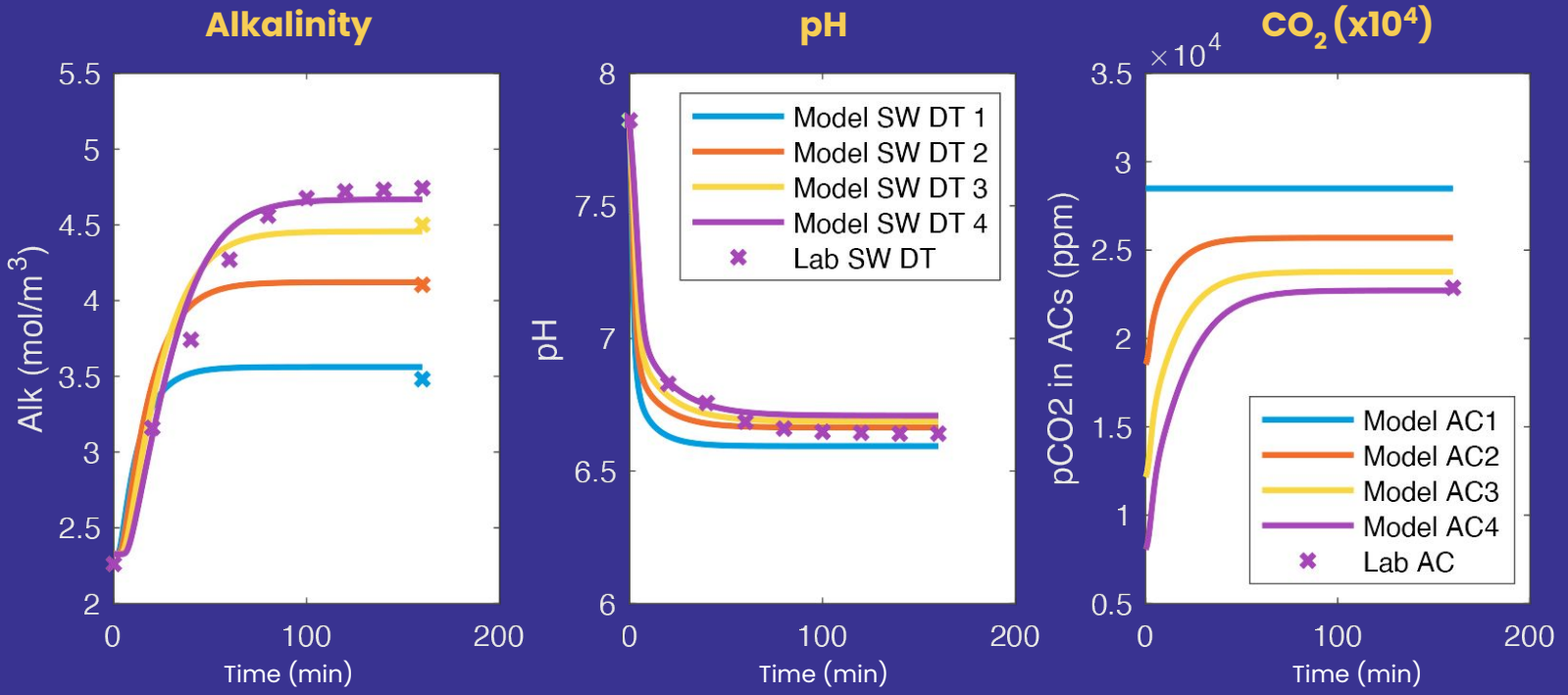
Early Ideation



Lab Reactor Caltech

Dong et al., 2025

Beginning Lab Data: Matches the Model Prediction



Dong et al., 2025

2 Prototypes: Built for Real Time Measurements

Moved to Less Expensive and Rapid Prototyping with **Ripple 2 and 3** at Altasea

‘Ripple 1’

Fluidized Bed Connected to a Diesel Generator

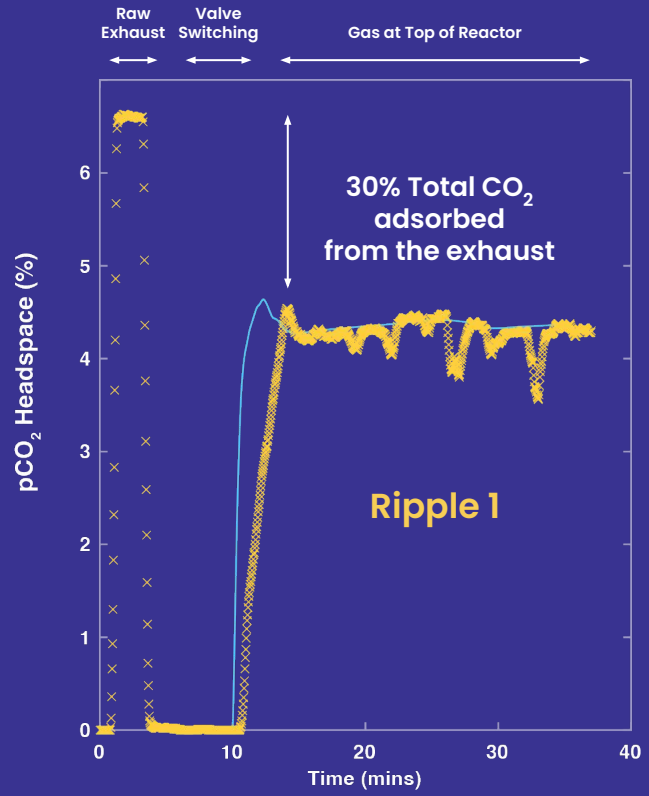
At the University of Southern California (USC)

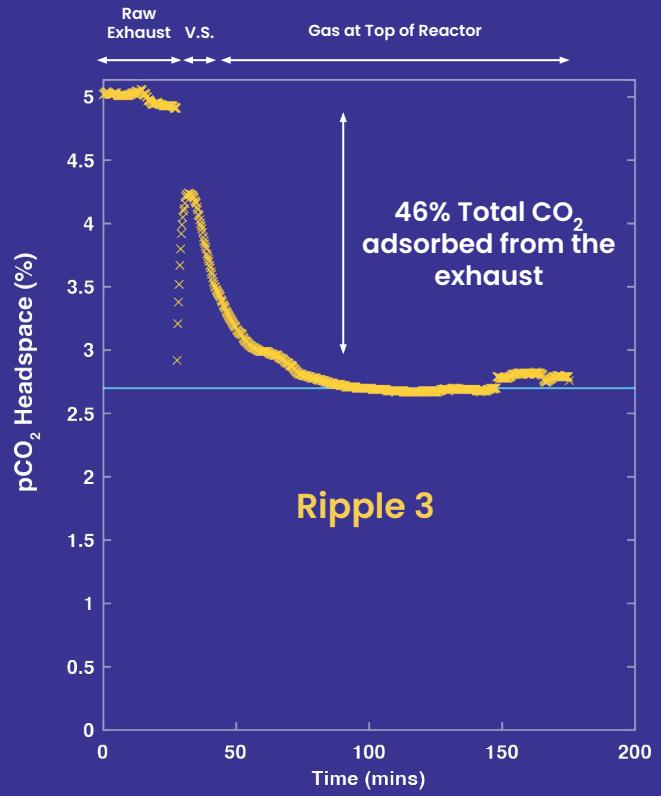
‘Ripple 3’

Separate Adsorber and Packed Columns

At Altasea at the Port of Los Angeles

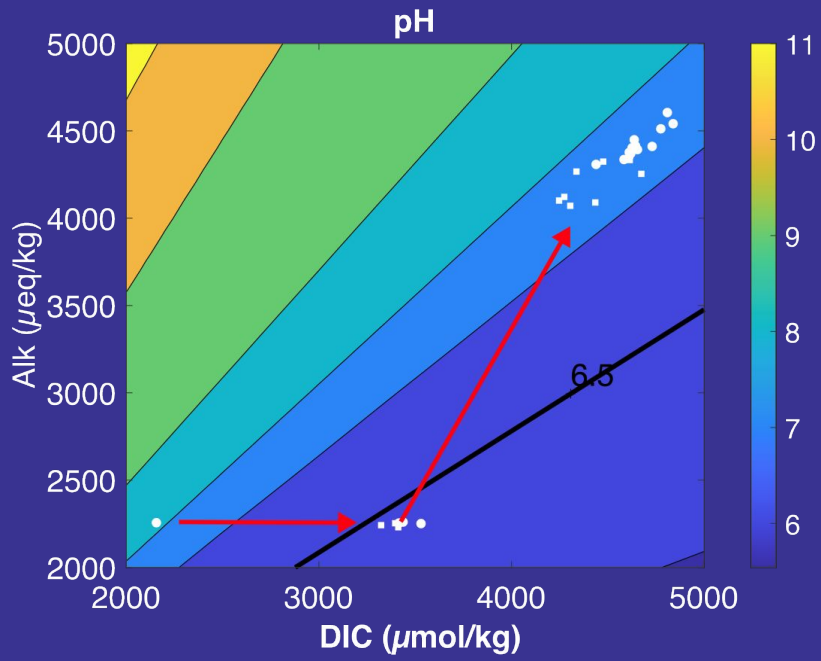
System Captures the Amount of CO_2 We Predict





Ripple 3: Much Larger Bicarbonate Conversion Rates in 2-Step Process

Ripple 3



Here 66% of the $CO_{2(aq)}$ is converted to Bicarbonate.

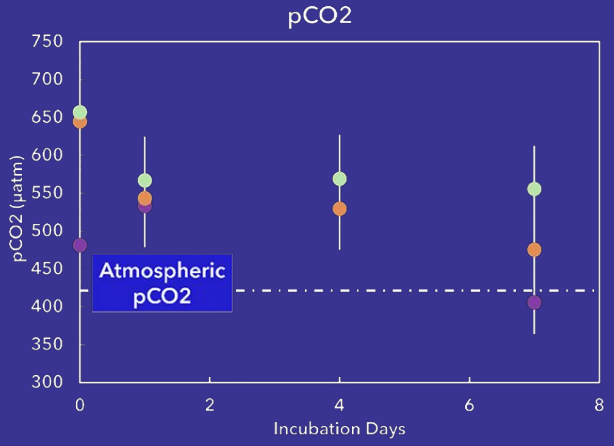
Of the total CO_2 'emitted', 47% is captured from the gas stream and 34% is sequestered as Bicarbonate.

Gas is used in 5% CO_2 and 95% Ambient Air

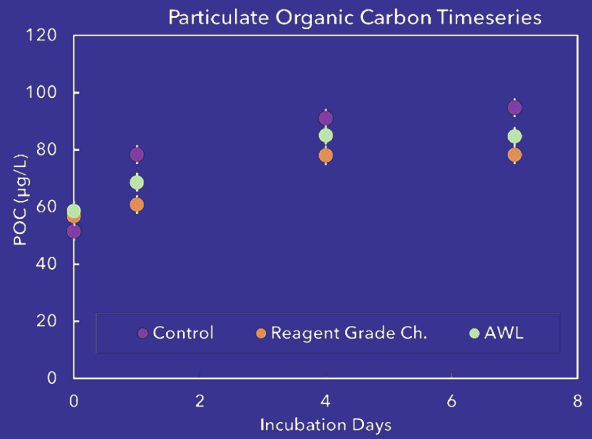
Incubations at Catalina Island: **No Effect of AWL Effluent**

Incubations of Catalina seawater with control, dissolved $CaCO_3$, and Calcarea effluent from Ripple 1

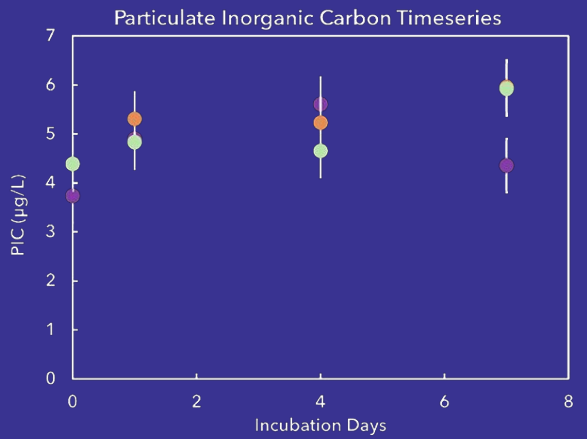
Biological drawdown of CO_2 in first 2 days



Production of organic matter



No extra $CaCO_3$ reprecipitation



No statistical difference between 3 incubations ($p>0.05$)

Source: Wani et al., unpublished

Vision

Purpose-built ships can carry limestone and CO_2

Using CO_2 from point source capture or DAC, we are the ultimate storage solution for a negative emission economy and can outcompete storage underground in many cases

*Image adapted from RINA for the purpose of this slide only. For limited, non-eommercial use in confidential investor materials. No affiiliation or endorsement implied.

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THANK YOU

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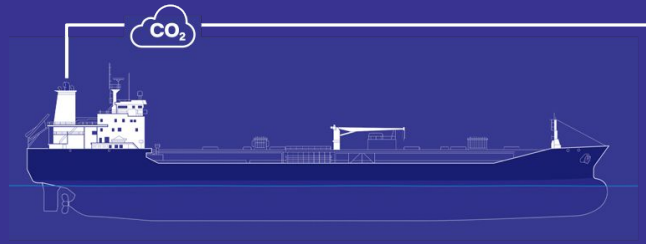
Carbon Cycle Benefits: Mineralization to Bicarbonate

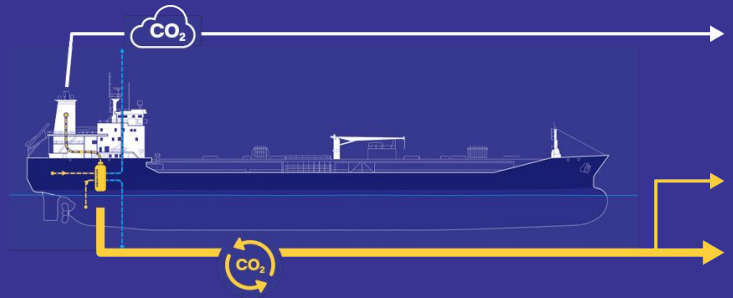
Baseline: **No Capture**



	Immediately	After Months	After 100,000 yrs
Atmosphere	100	50	0
Biomass	0	25	0
pCO_{2aq}	0	25	0
Bicarbonate	0	0	100

- ✘ Increased radiative forcing from CO_2 into atmosphere
- ✘ Ocean acidification from pCO_2 in ocean
- ✘ Carbon slowly stored in ultimate geochemical reservoir

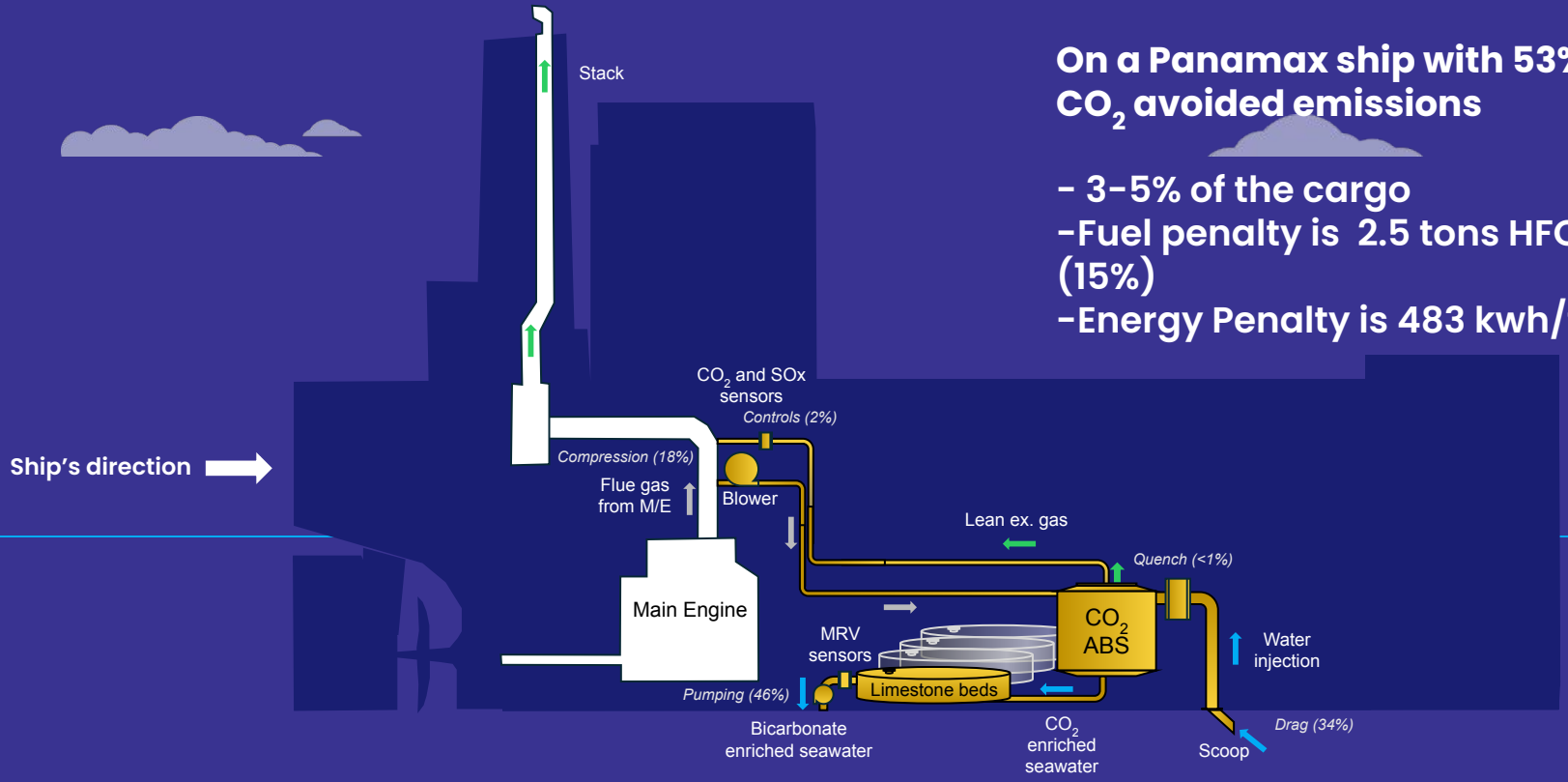
CALCAREA: **Emissions Captured**



Atmosphere	45	30	0
Biomass	0	15	0
pCO_{2aq}	15	15	0
Bicarbonate	40	40	100

- ✔ Reduced radiative forcing from CO_2 into atmosphere
- ✔ Reduced ocean acidification from pCO_2 in ocean
- ✔ Carbon rapidly stored in ultimate geochemical reservoir

Key Issues for the ‘Fit’ on a Ship: **Extra Space and Fuel Penalty**



On a Panamax ship with 53% net CO_2 avoided emissions

- 3-5% of the cargo
-Fuel penalty is 2.5 tons HFO/day (15%)
-Energy Penalty is 483 kwh/ton CO_2

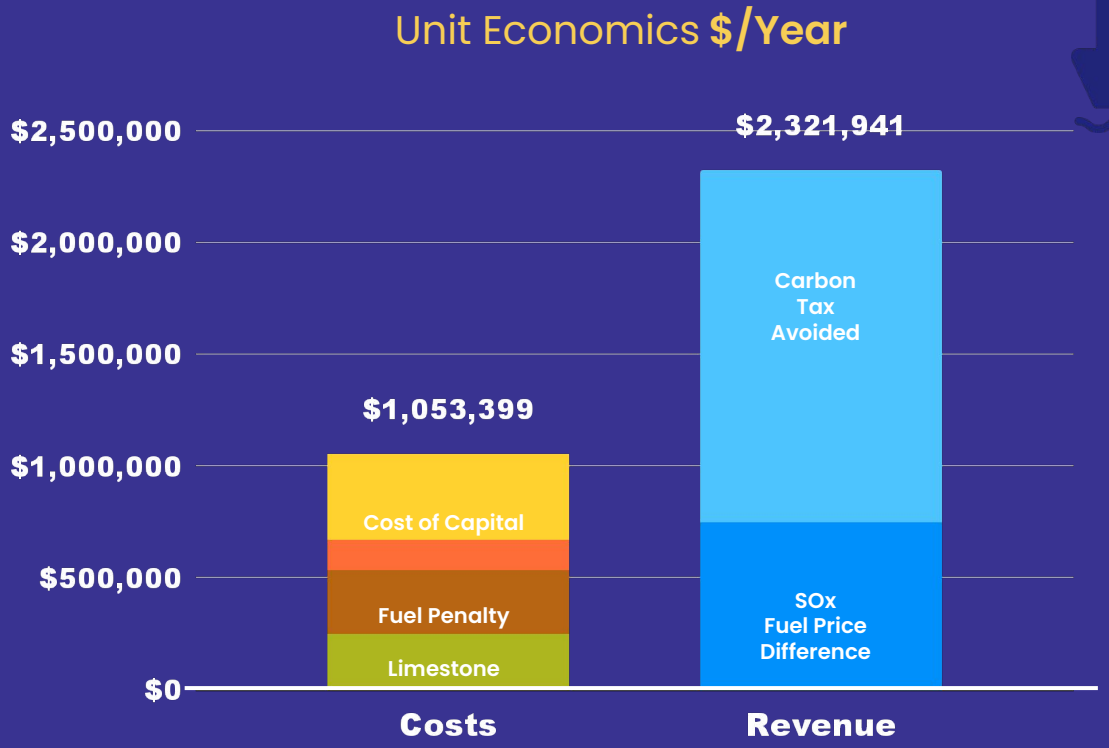
Costs and Revenue for Owners: **We save them money (IMO)**

Key Assumptions

- **$380/ton CO_2 in MEPC83**
- **$140/ton sulfur price difference**
- **$25/ton limestone rock**
- **2,920 tons displaced**

Key Results

- **$170/ton w/ capital.**
- **$99/ton w/o capital**
- **483 kwh/ton**



58% Gross CO_2 emissions avoided

53% Net CO_2 emissions avoided

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