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Research and Development Strategy
Phytoplankton Carbon Solutions

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14 October 2025

Purpose and Agenda for Today's Webinar

- Overview of the project purpose
- Summary of the draft Phytoplankton Carbon Solutions project recommendations
- Q & A about project purpose, process and contents

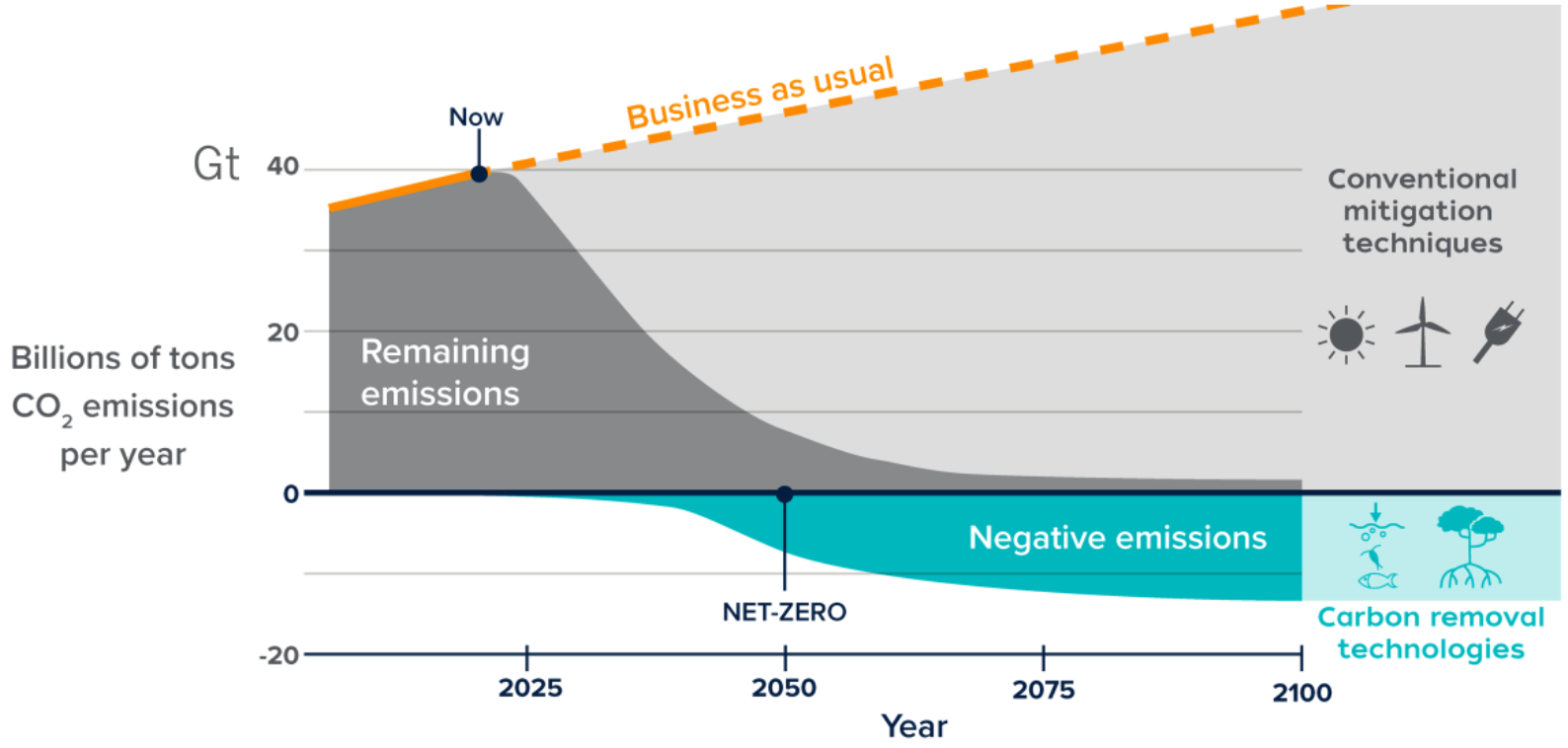
  (Zoom: Raise hand and Q&A function)
- Summarize comment opportunity and next steps

Draft Report Release Process and Timeline

- Draft introduced September 30, 2025
- Webinars today
- Concurrent Public Comment Period through October 30th
- Final Report Anticipated in mid November
- Phase Two of the R&D Program to follow

The Role of Carbon Dioxide Removal

- Builds on the transition to Net Zero
- Necessary for return to safe historic CO_2 levels



Source: Woods Hole Oceanographic Institute

Phytoplankton Carbon Solutions (PCS)

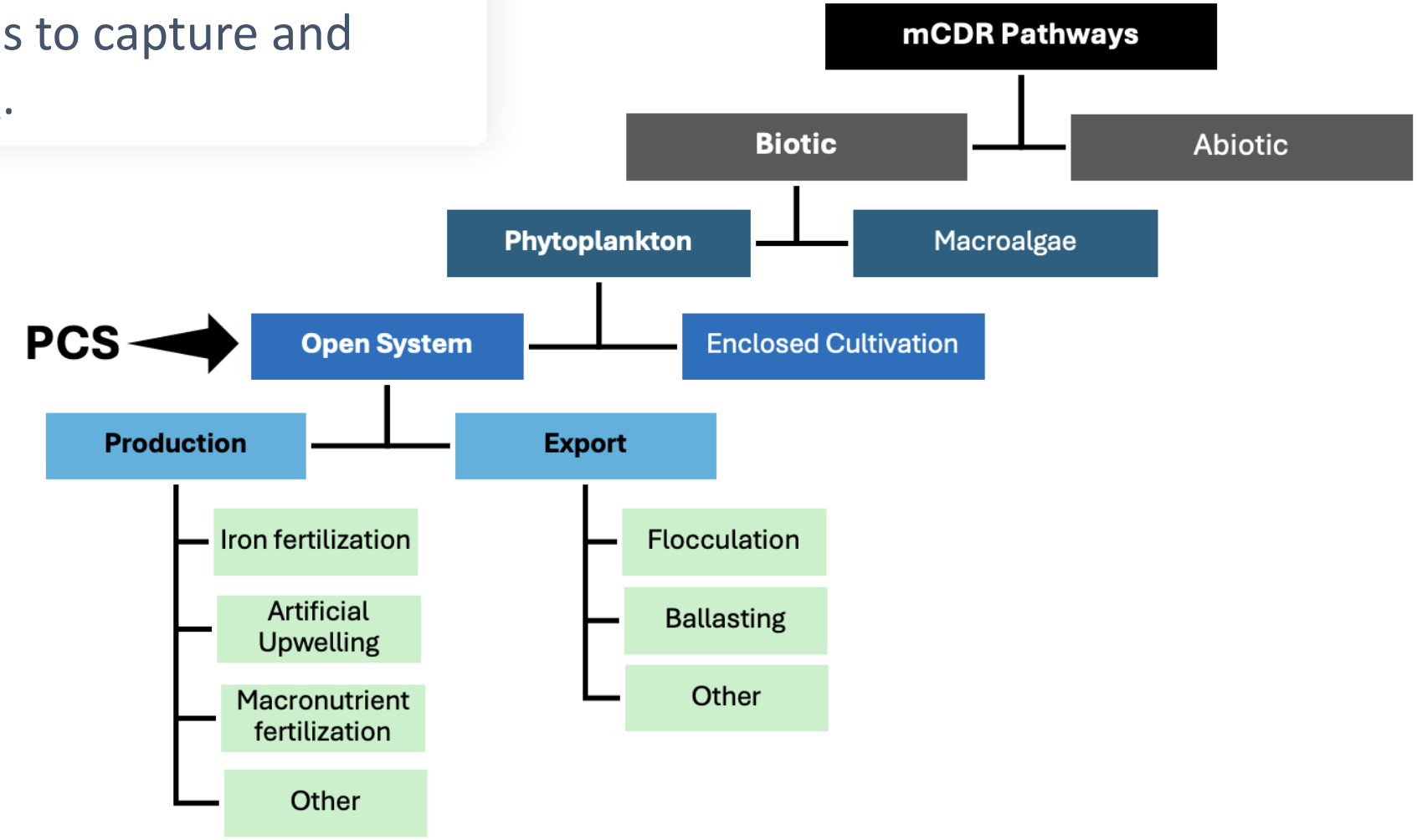
CDR pathways that seek to leverage **open ocean** phytoplankton communities to capture and sequester atmospheric CO_2.

Includes:

- **Ocean iron fertilization**
- Macronutrient fertilization
- Artificial upwelling

Excludes:

- Enclosed phytoplankton cultivation in the ocean or on land



Source: Ocean Visions

WHY are we looking at PCS?

- **We are not on track** for a global CDR portfolio needed to meet estimated removal of 10 Gt CO_2 needed per year by 2050
- CDR strategies in use or under development all have various scaling potential, cost, material and energy inputs requirements, and environmental and socioeconomic implications
- Recommendations like the 2021 NASEM Report shows PCS have a **high potential to scale** with relatively **low energy and material inputs**
- **Now is the time to better understand risks and opportunities** of PCS as a part of a global CDR portfolio

WHAT is this project?

- A one-year effort to **design** a five-year R&D program to enable societal decisions about future use of PCS in a global CDR portfolio
- Builds on the wide range of work already underway
- Seeks to build greater focus on the pathways of greatest potential and the priority work needed to inform future decisions

WHAT did we do?

Research

- Developed PCS definition and taxonomy
- Reviewed scientific literature and mCDR strategy reports
- Conducted a landscape assessment of PCS-relevant projects and experts
- Identified gaps and priorities
- Interviewed experts and tested hypotheses and refined priorities

Broader Engagement

- Ocean Visions Summit Workshop to inform goals and priority research questions
- Presented at 57th Liège Colloquium on Ocean Dynamics, ExOIS Webinar, New York Climate Week
- Public feedback on draft report and webinars

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WHO worked on this project?

Project Leads

Eric Schwaab

CEA

Dr. Lydia Kapsenberg

CEA

Shimul Bijoor

CEA

Lauren Apollaro

Steering Committee

Brad Ack

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Advisory Board

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Prof. Anna-Maria Hubert

Brad Warren

Dr. Mattias Cape

Prof. Leticia Cotrim da Cunha

Communications Lead

wonder strategies for good

Elysha Davila

Funding Source

Ocean Resilience & Climate Alliance

[Draft] Implementation Recommendations

Program Aim

Fund and coordinate activities that collectively inform a **risk-benefit assessment** to support decision-making on whether, or which, and under what conditions PCS pathways should be part of a global CDR portfolio.

The Program is focused on independent scientific inquiry and designed to be outcome agnostic.

Key Considerations

Decisions on 5-10 year timeline

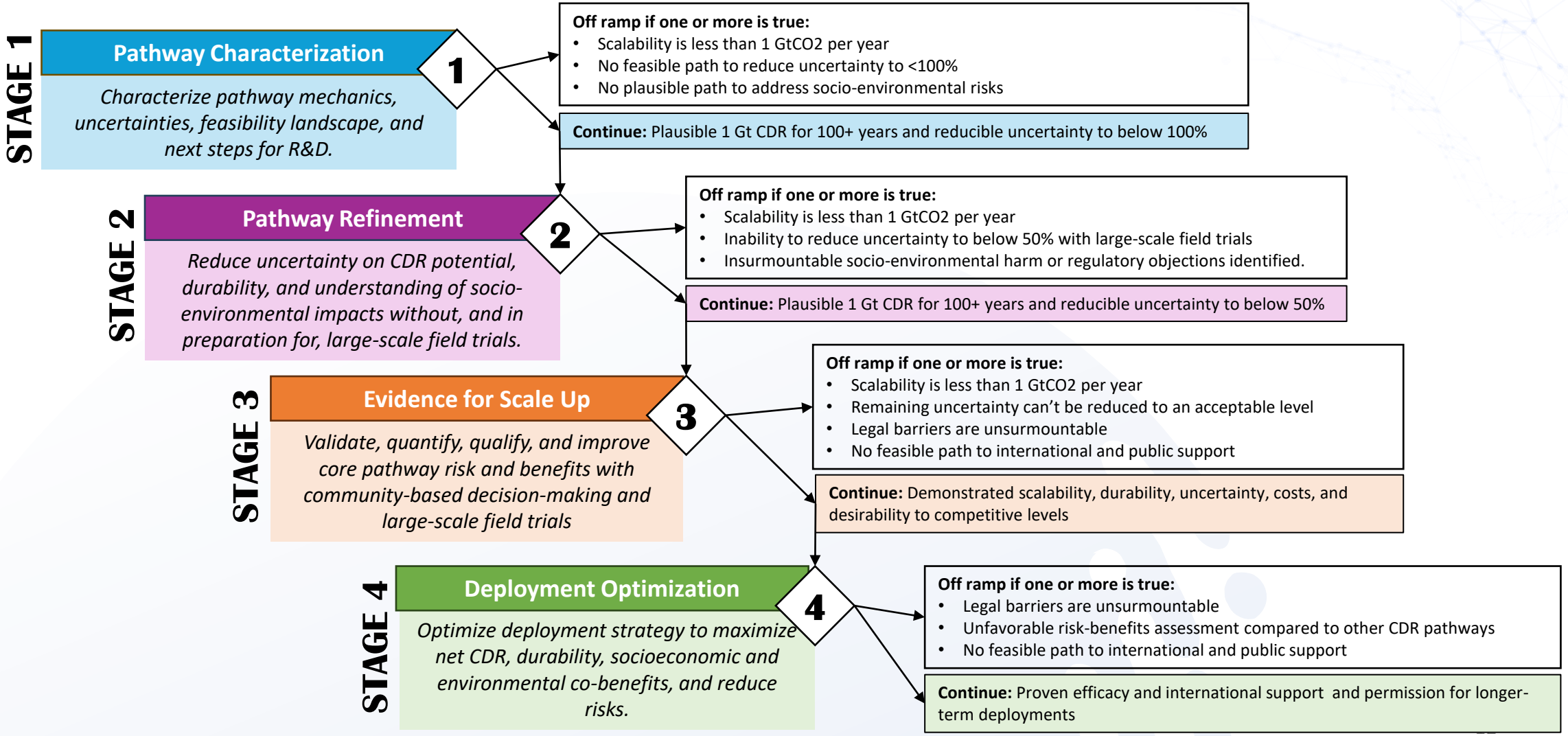
Viable PCS solutions must be:

- Scalable — 1 Gt per year
- Durable — 100-1000+ years
- Measurable — <50% uncertainty
- Desirable*

Decision to implement PCS is a socio-political, legal, and ethical decision and requires a deep understanding of the **socio-economic and **environmental risks** and **co-benefits** that could impact different natural and human communities.*

[Draft] Implementation Recommendations

Stage Gate Framework



[Draft] Implementation Recommendations

Engagement and Decision-making

- **Co-design Research to Inform Decision Making** – Local involvement is essential

- **Enable Coastal Communities and Fisheries Engagement** – Capacity to participate is lacking within key communities

- **Ensure Consideration of PCS Impacts Against Alternative Actions** – Future PCS, mCDR and CDR decisions will not be made in a vacuum

[Draft] Research Recommendations

[Draft] Research Recommendations

Comprehensive Priorities

- **Reduce Uncertainty on Net Carbon Dioxide Removal** – Can we measure impact?
- **Improve Utility of Biogeochemical Models for PCS Evaluation** – How do we inform far reaching and long-term effects?
- **Improve Understanding of the Ocean's Natural BCP** – Ensure risk-based evaluation against business as usual.

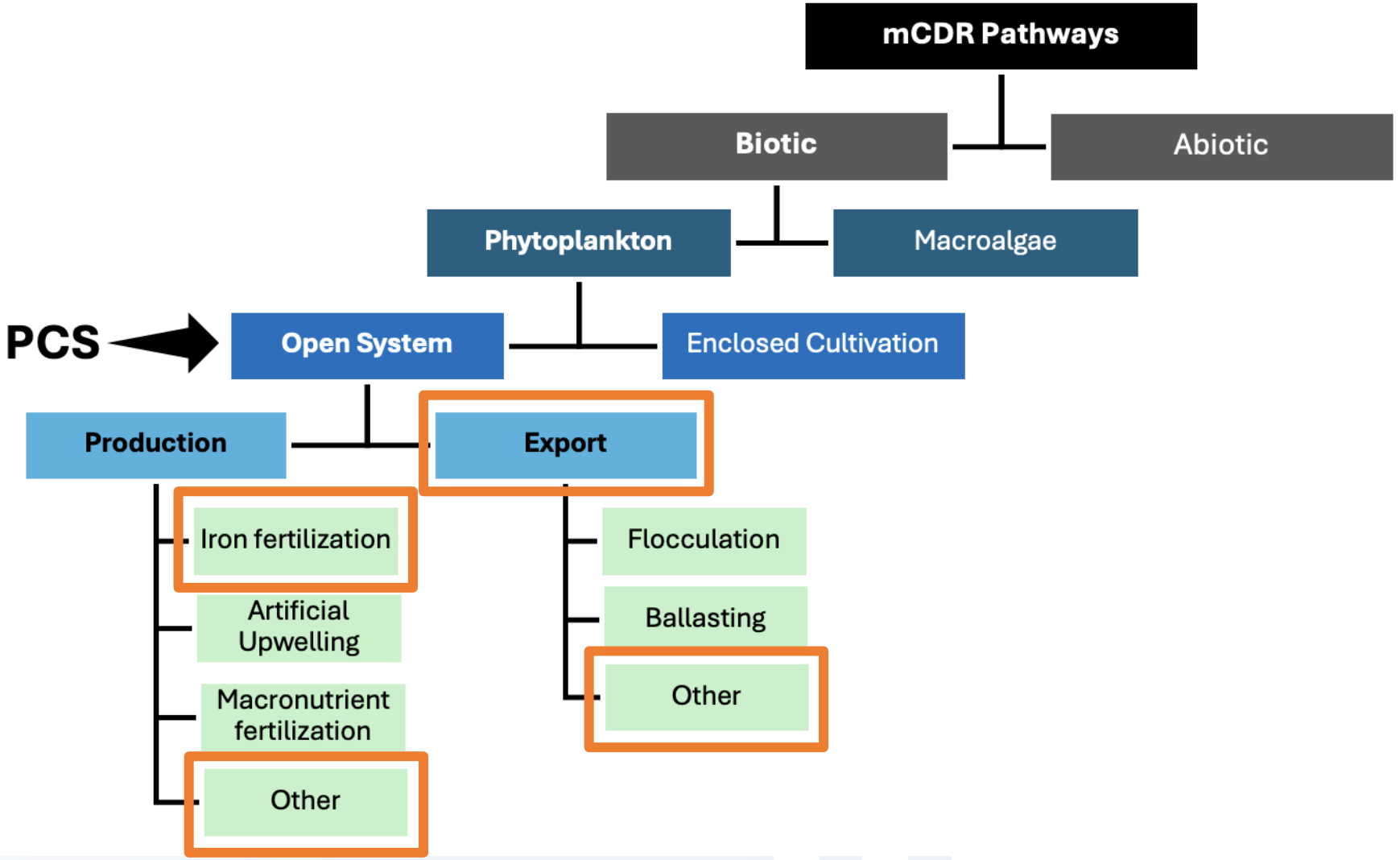
[Draft] Pathway-Specific Research Recommendations

Taxonomic Focus

1. Strong agreement in the scientific literature, mCDR reports, and experts that **ocean iron fertilization** has the greatest CDR potential among PCS pathways.

2. Innovation in **export** could help reduce uncertainties in carbon sequestration.

3. Program must monitor for **other** emerging approaches



[Draft] Pathway-Specific Research Recommendations

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Ocean Iron Fertilization

- **Improve Understanding of Southern Ocean OIF Potential** – Refine expectations around CDR benefit and ocean biological pump risk
- **Improve Understanding of Subtropical Nitrogen Fixation–Based OIF** – An emerging area of investigation with potential nitrogen and CDR benefits
- **Support Preparatory Activities of the Northeast Pacific OIF Field Trial** – e.g., social engagement, navigating regulatory frameworks

Other PCS Pathways

- **Catalyze Innovations that Enhance "Export" of Phytoplankton Carbon** – Address a major source of CDR uncertainty of PCS pathways
- **Monitor and Assess Emerging PCS Pathways** – What innovations are around the corner?

The State Gate Framework would apply to all pathway-specific funding decisions

Thank you!

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Link to Feedback Form

https://oceanvisions.org/phytoplankton-carbon-solutions/