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How can we increase the climate change mitigation benefits of seaweed?

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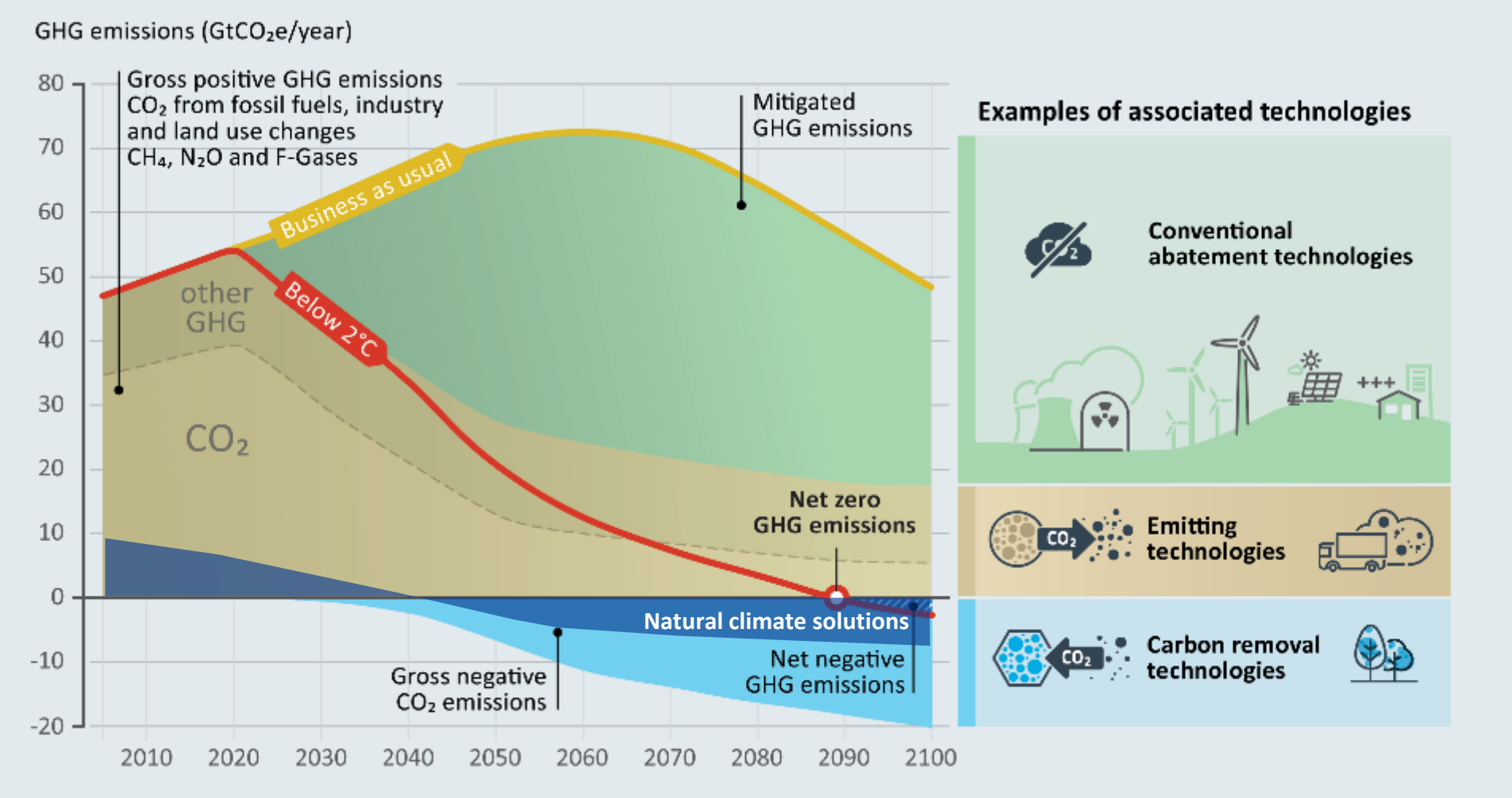
Urgent need to actively remove GHGs from atmosphere



Modified from UNEP, 2017 & IPCC 2021

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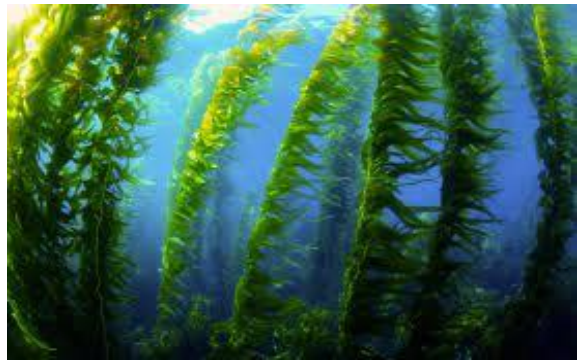
2.5 GtC/yr
2300 GtC
38,200 GtC
Pew Trusts

Blue carbon systems

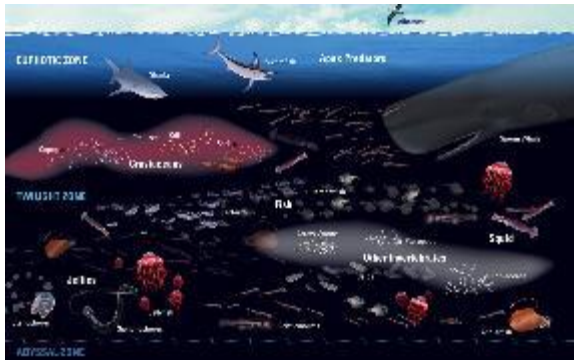
- Carbon storage by ocean ecosystems is called “blue carbon”
- Are there ways to safely accelerate carbon sequestration by ocean ecosystems?

Nearshore systems

Seaweed systems



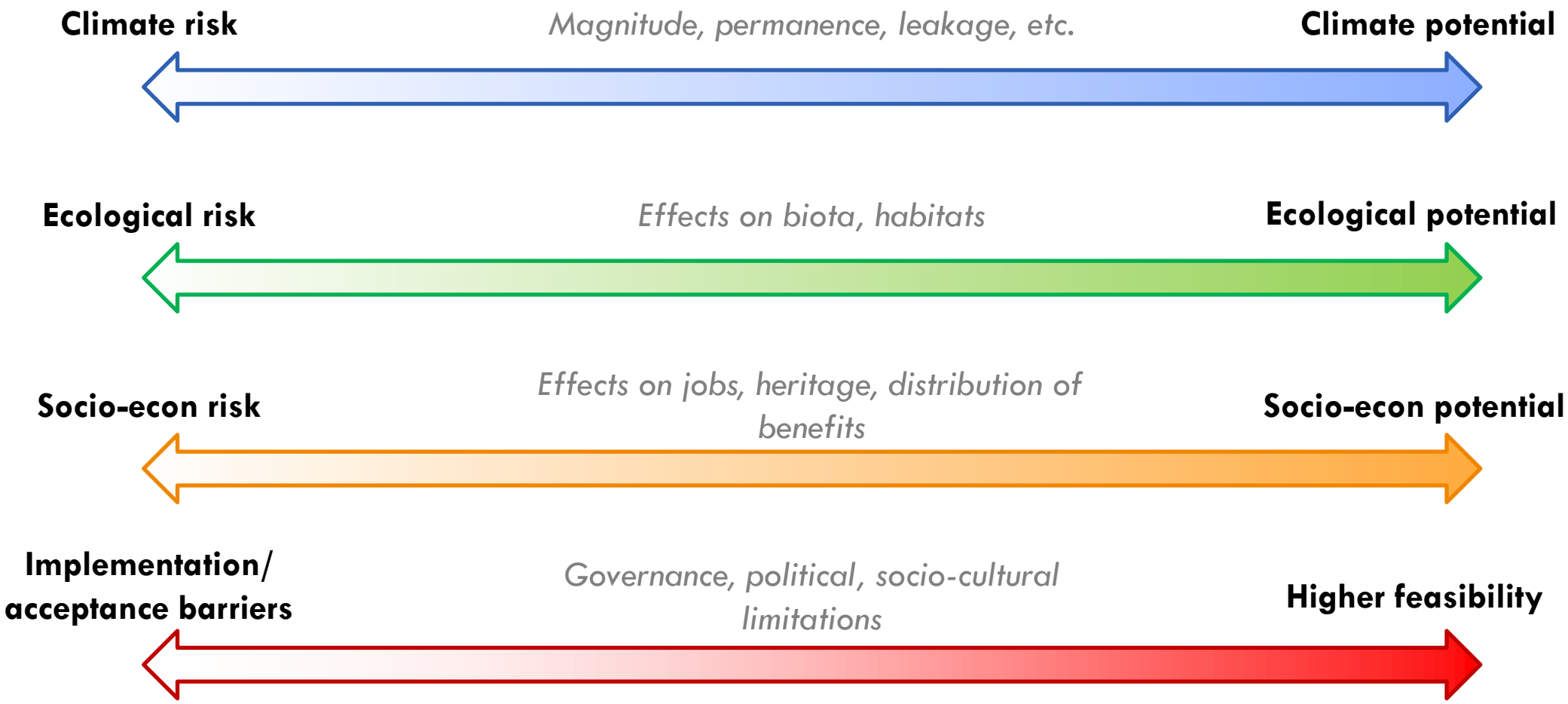
Open ocean systems



Blue carbon interventions

- Conserve and restore nearshore ecosystems
- Conserve and restore epipelagic fish and whales
- Conserve mesopelagic ecosystem
- Conserve ocean sediment carbon
- Expand seaweed farming

Evaluation criteria



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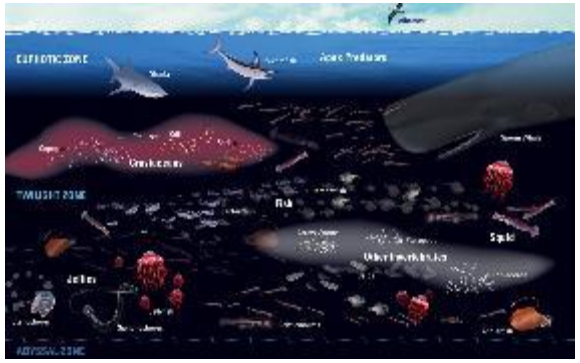
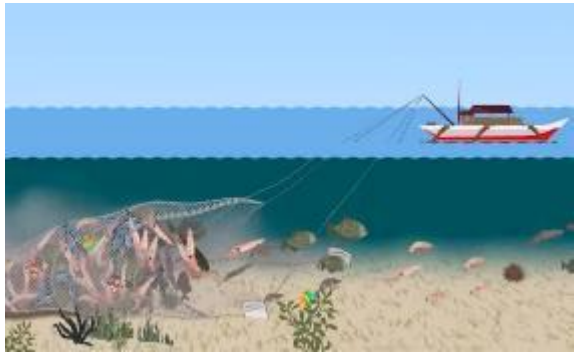
Priority blue carbon interventions

Conserve and restore mangrove forests



Conserve and restore the mesopelagic

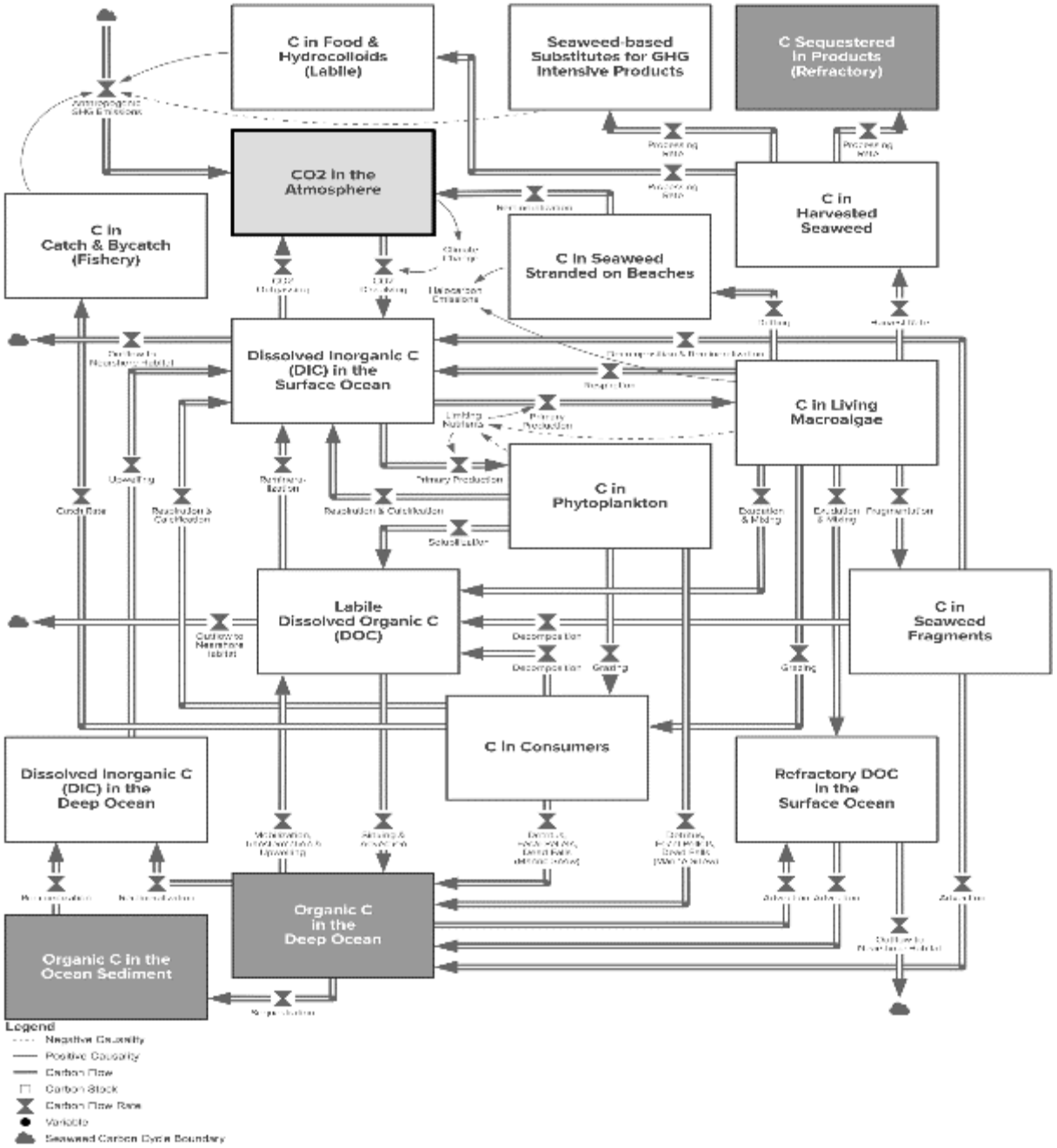


Conserve ocean sediment carbon

Expand seaweed farming

Why seaweed farming?

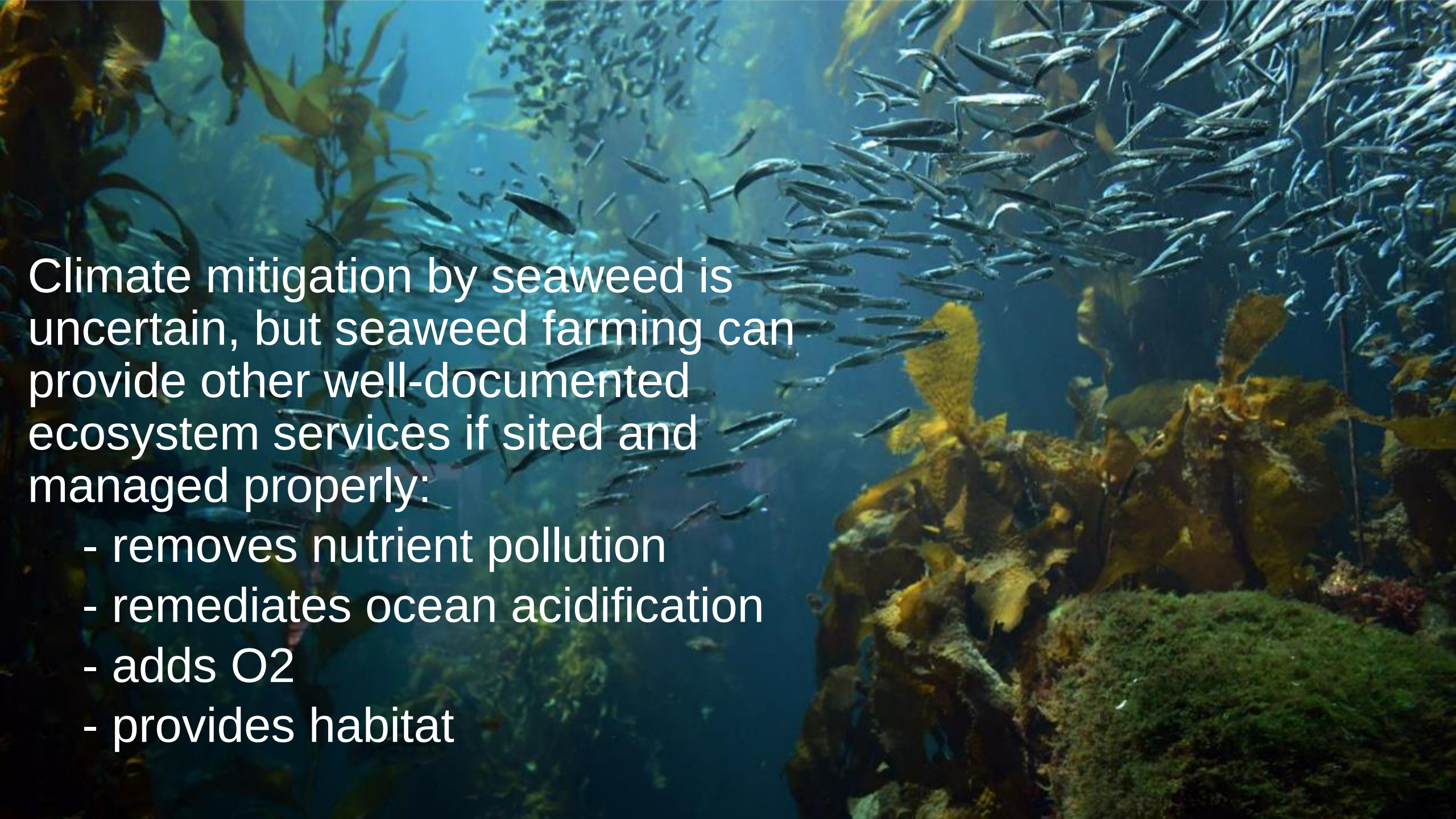
- **Very rapid C absorption and growth rates**
- **Fairly easy to farm without many inputs**
- **Scalable – seaweed can grow anywhere in the ocean where there is sufficient light and nutrients, cost-effective access to markets, and lack of existing claims on marine space**
  - **Biophysical: 130-200 million km^2**
  - **Constrained: 0.22 and 4.89 million km^2**
  - **Current: 2400 km^2**
  - **About 1% of lower end estimate**



- Complex biogeochemical transformations
- Carbon sequestration is a variable fraction of carbon absorbed
- Difficult to measure
- Big barriers to carbon financing
- Harvesting seaweed moves carbon out of the ocean, but into food and colloids and then back into the atmosphere
- Potential to improve climate mitigation benefits and quantify GHG impacts by increasing production of seaweed products with climate mitigation potential

Seaweed Products with Climate Mitigation Potential

- Carbon storage
  - Seaweed adobe
  - MDF panels
  - Concrete pavers
- Avoided GHG emissions
  - Seaweed biostimulants and fertilizers
  - Seaweed bioplastics
  - Seaweed biofuel
- Suppress GHG emissions
  - Animal feed supplements
  - Manure additives
  - Rice field additives



Climate mitigation by seaweed is uncertain, but seaweed farming can provide other well-documented ecosystem services if sited and managed properly:

- removes nutrient pollution
- remediates ocean acidification
- adds O2
- provides habitat

Science-to-action

- Make seaweed farming that is optimized to generate ecosystem services and climate mitigation more profitable
- Document ecosystem services of seaweed farm
- Monetize ecosystem services
- Quantify C sequestration by seaweed farms
- Quantify net GHG impacts of seaweed products
- Develop methodology for high integrity verified carbon reduction credit
- Remove barriers to scaling of seaweed products with climate mitigation benefits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National capital
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Mindoro
Samar
Panay
Leyte
Palawan
Cebu
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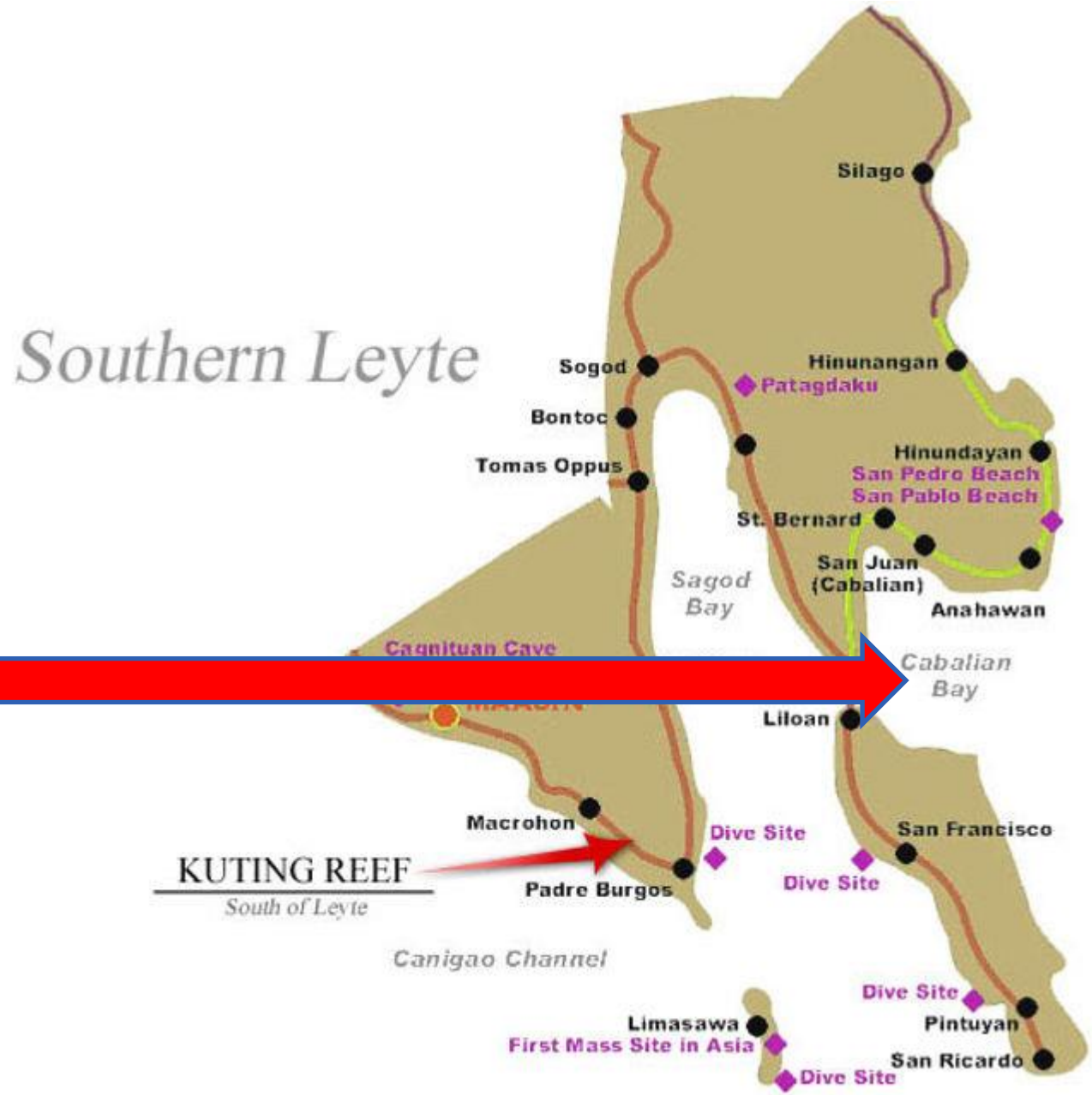
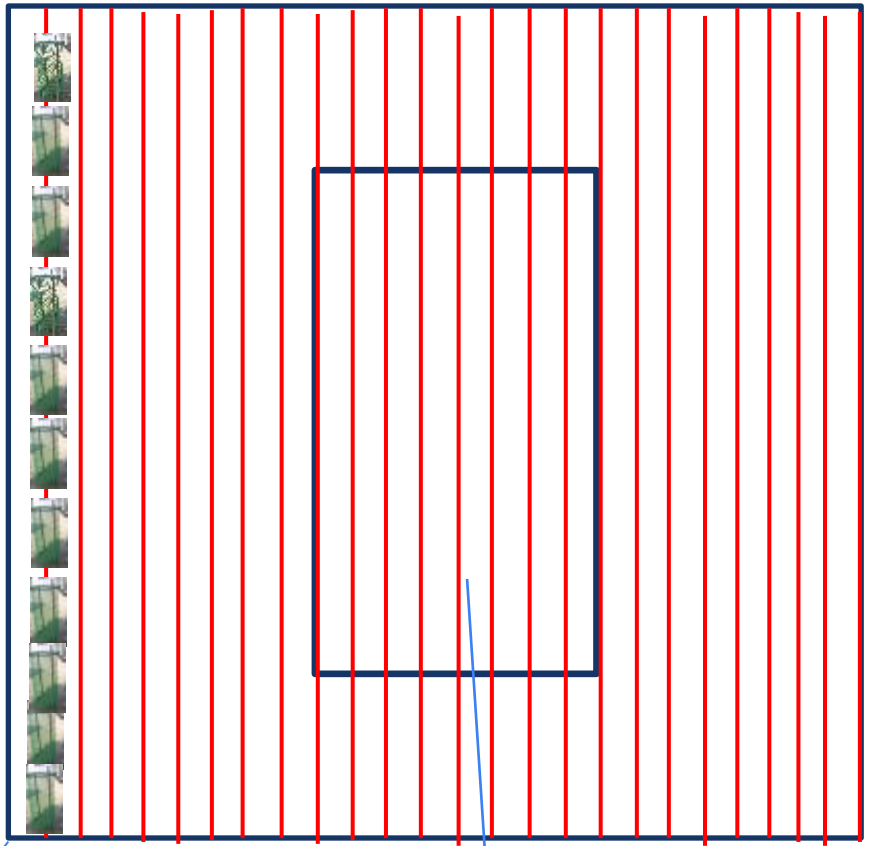
Kota Kinabalu
0 50 100 150 200 km
0 25 50 75 100 mi


Southern Leyte
Silago
Sogod
Hinunangan
Patagdaku
Bontoc
Tomas Oppus
Hinundayan
San Pedro Beach
San Pablo Beach
St. Bernard
San Juan
(Cabalian)
Anahawan
Sagod
Bay
Cagnituan Cave
Cabalian
Bay
Liloan
Macrohon
Dive Site
San Francisco
KUTING REEF
South of Leyte
Padre Burgos
Dive Site
Canigao Channel
Dive Site
Limasawa
First Mass Site in Asia
Pintuyan
San Ricardo
Dive Site

Kappaphycus alvarezii: Farm planted area = 1200 sq m

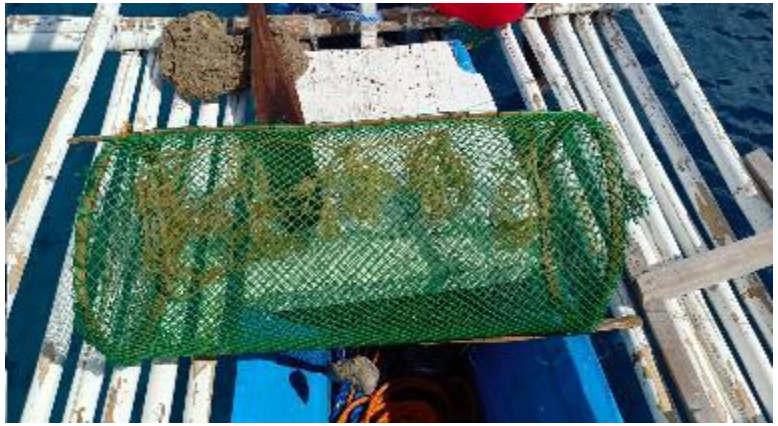
Tube screen with
½ inch mesh



25 lines of 40 m long planted with seaweeds spaced at 8 inches apart, average of each plant is 192 grams

8 lines of 20 m long enclosed by bamboo frame with nets

Cabalian Bay demonstration farm, Philippines



- Demonstration farm infrastructure has been deployed
- Growing green mussels to support food security and profitability, circular economy
- Kappaphycus sporelings have been outplanted
- Monitoring GHG emissions and carbon stocks, flows to estimate net carbon sequestration
- Monitoring pH, DO, nutrients, biodiversity to estimate ecosystem services
- Yield, costs, profits for financial projections

Next Steps

- Field trials of seaweed biostimulant
- Life Cycle Analysis to quantify net GHG impacts
- Prepare methodology proposal for high integrity climate mitigation credit
- Learning Network: Convene seaweed processors, manufacturers, investors to identify and remove barriers to scaling of seaweed products with climate mitigation benefits
- Develop markets and purchase agreements
- Transition farm to private ownership to demonstrate business model and scale

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Thank you

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