

Macroalgae Conversion Workshop Day 2 – Opening Remarks

Marc von Keitz, Ph.D.
Program Director @ ARPA-E

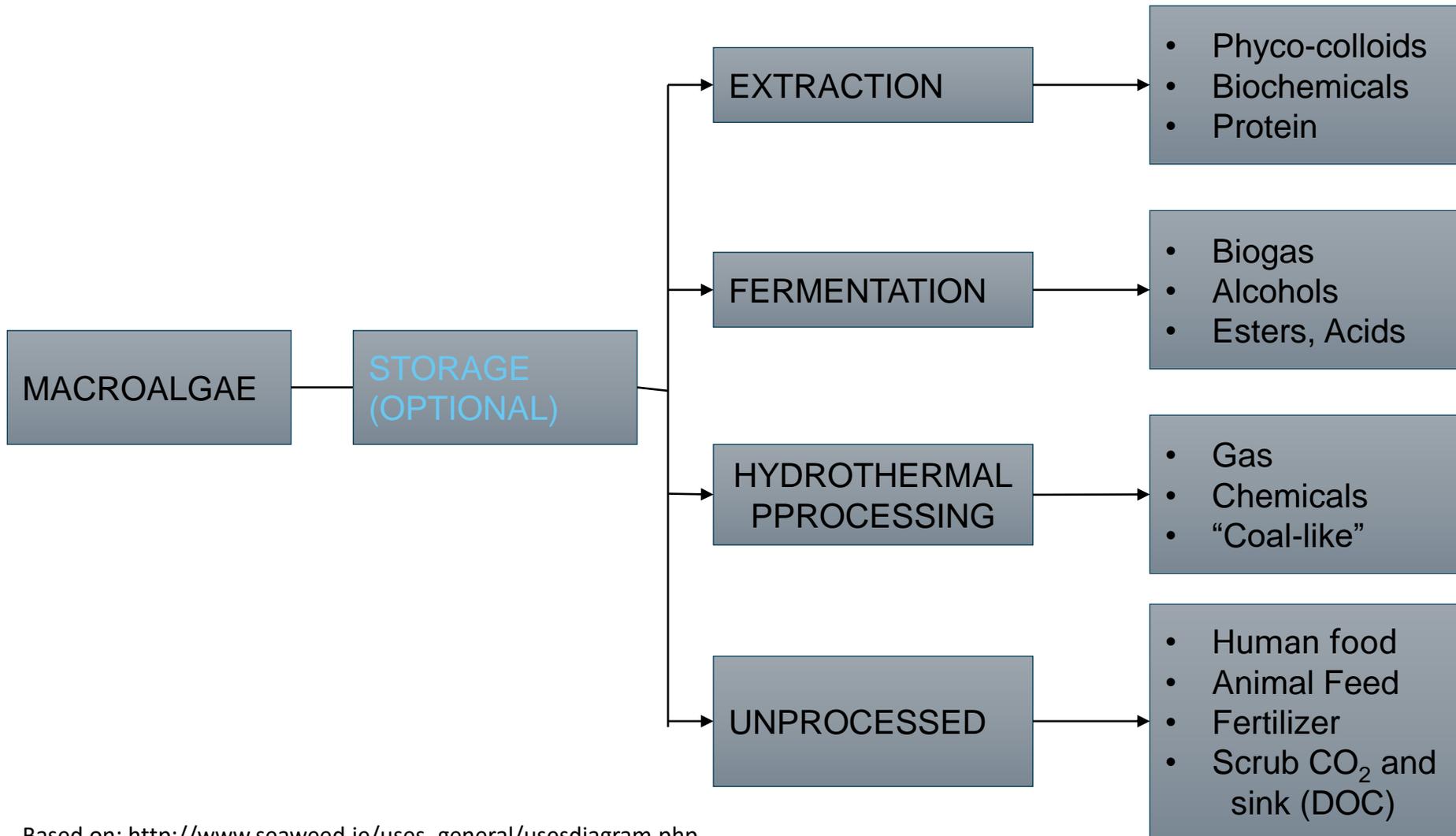
ARPA-E Macroalgae Conversion Workshop

November 18, 2020

Recap from Monday

- ▶ Jack Lewnard:
Opportunities for RNG at prices significantly higher than NG
- ▶ Dan Fishman:
Ongoing need for low-carbon liquid transportation fuel in hard to decarbonize applications
- ▶ Mike Reese:
Renewable Fertilizer can be competitive at the right price and the right formulation. Can seaweed derived fertilizer fit the bill?
- ▶ **Feedback from participants:**
 - Is ARPA-E's vision of Seaweed conversion/productization too narrow?
 - Are we missing important opportunities for seaweed conversion?

Processing and Product Options for Seaweed

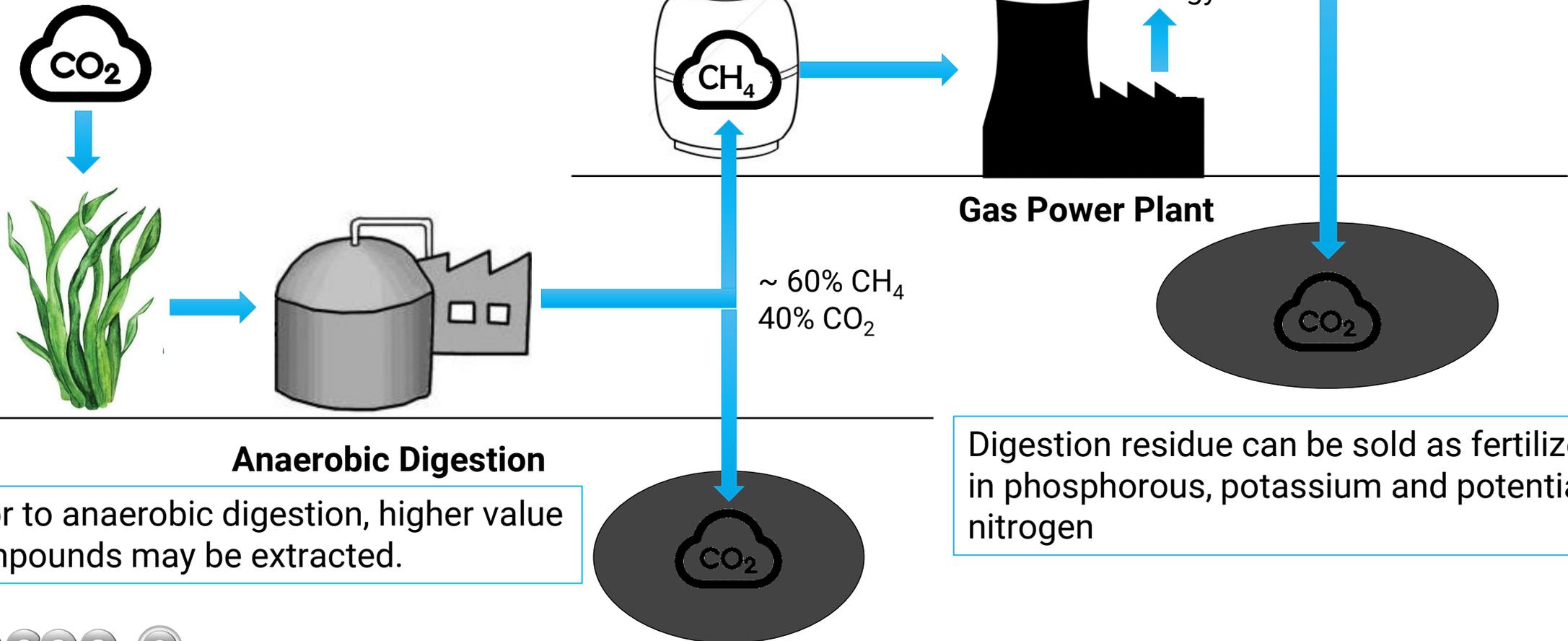


Based on: http://www.seaweed.ie/uses_general/usesdiagram.php

ONE Lens: Large Scale contribution to Deep Decarbonization

Area target to capture 1 GT of CO₂: ~ 200,000 km² (~2% of US EEZ)

1 Ton of Macroalgae (dry) \cong 1 Ton of CO₂ captured



Anaerobic Digestion

Prior to anaerobic digestion, higher value compounds may be extracted.

Digestion residue can be sold as fertilizer rich in phosphorous, potassium and potentially nitrogen

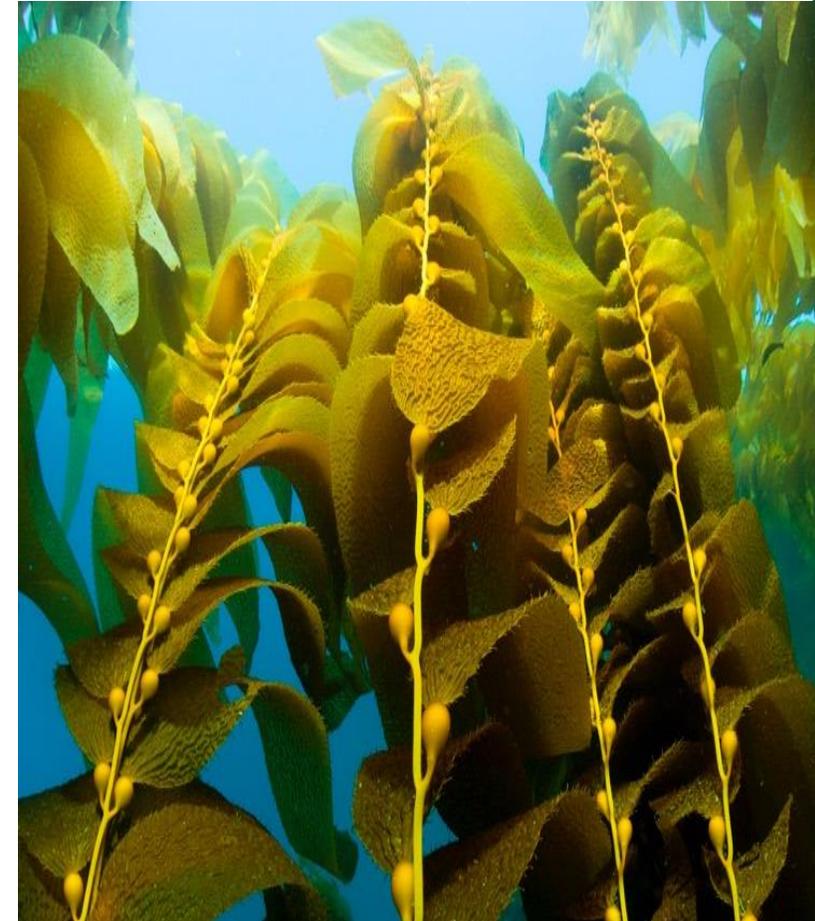
How much methane from farming 1% of the US EEZ?

► Calculation Assumptions:

- 100,000 km² (24,710,000 acres, ~ size of Virginia)
- 3,500 dry metric tons per km² per year*
- Maximum Methane potential: ~200 kg/dry MT**

► Results:

- ~ 70 million MT of CH₄/yr (~3.25 Quads)



Macrocystis pyrifera

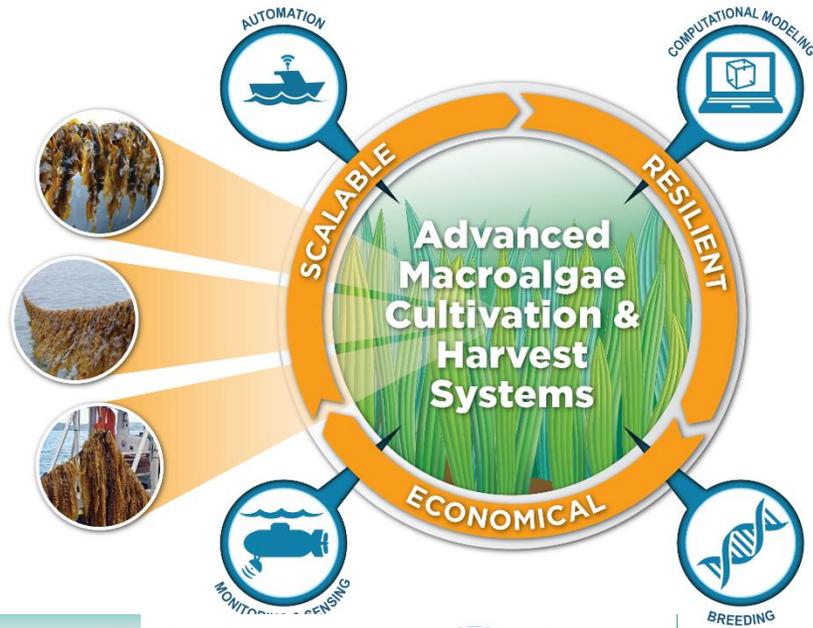
Realizing the potential

Table 11. The theoretical MP from the 'Buswell equation' based on CHNSO and the method of Heaven et al. [56] based on the lipid, protein and carbohydrate content (both including and excluding fibre) together with actual MP and biodegradability index (BI).

	Methane Potential mL CH ₄ g ⁻¹ VS						
	Actual	Theoretical			Biodegradability Index		
		CHNS	Heaven	Heaven ex Fibre	CHNS	Heaven	Heaven ex Fibre
Mixed 'Sargassum'	-24.0	496	461	195	-5%	-5%	-12%
<i>S. natans VIII</i>	145.1	395	449	207	37%	32%	70%
<i>S. natans I</i>	65.8	392	460	187	17%	14%	35%
<i>S. fluitans</i>	112.7	392	464	221	29%	24%	51%

From: J.J. Milledge et al. 2020

Testing key hypotheses of the big picture – long-term vision



Macroalgae Biomass:

No Land

No Freshwater

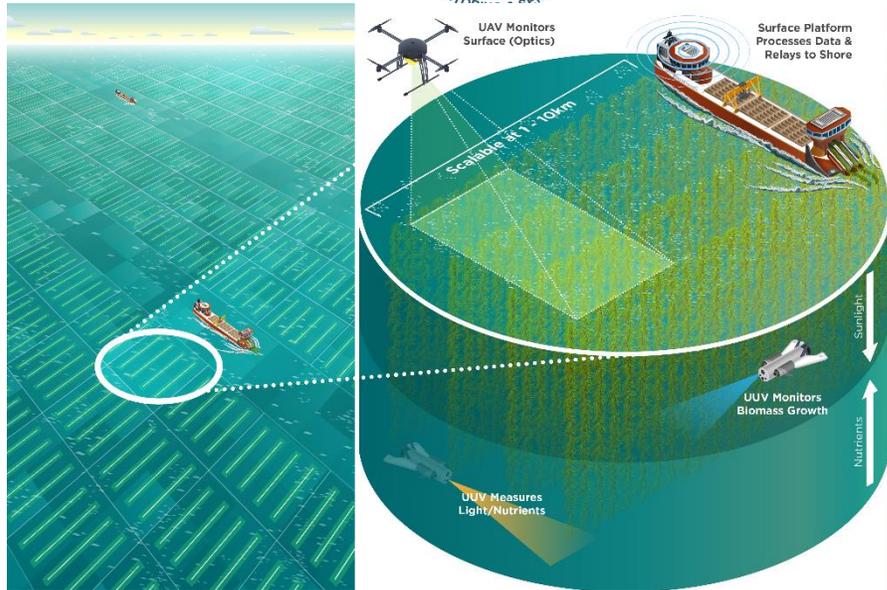
No Fertilizer

MARINER creates new biomass production opportunities for the vast ocean resources of the United States.

Photos copyright (top to bottom):

Daria Barbour/National Geographic; The Island Institute; Ben Smith/Huffington Post

- ▶ Can we extend this vision from production to processing, i.e.
- ▶ No Freshwater for processing
- ▶ Not just No Fertilizer, but returning fertilizer to the land



Workshop structure: Day 2 – Technical Deep Dive

Time (ET)	Session/Speaker	Topic/Comments
1:00 pm	Marc von Keitz	Recap Day 1, Objectives for Day 2
1:10 pm	Michael Schuppenhauer LBNL	Perspective and Challenges of Anaerobic Digestion of Seaweed
1:25 pm	Hal May, Medical U South Carolina Kevin Sowers, UMD Baltimore County	Harnessing the Power of Microbial Consortia
1:40 pm	Lieve Laurens NREL	Kyphosid Ruminant Microbial Biodigestion of Seaweed (KRuMBS): Harnessing the Biological Model of Herbivorous Fish Gut Microbiome to Improve Seaweed Bioconversion
1:55 pm	Break for questions.	
2:00 pm	Justin Billing & Dan Anderson PNNL	Challenges and Opportunities for Hydrothermal Liquefaction of Macroalgae
2:15 pm	Juan Josse Anaergia	Marine Macroalgae Anaerobic Digestion for Resource Recovery
2:30 pm	Brian Saldanha Chemours	Challenges in Materials of Construction and Equipment Design for HTL Processes in Saltwater Environments
2:45 pm	Break for questions. Transition to breakout session.	
3:00 pm	Breakout session	Discussion of technical needs and target metrics
	Group A ₁ , A ₂	Focus on saltwater anaerobic digestion
	Group B	Focus on saltwater HTL
	Group C	Focus on Nitrogen/Fertilizer recovery strategies
4:15 pm	Break. Transition to main meeting	
4:20 pm	Breakout Session Reflections and Discussion	
4:50 pm	Marc von Keitz	Closing Remarks
5:00 pm	End of Workshop – Please contact us at matthew.mattozzi@hq.doe.gov to schedule meetings with the ARPA-E team.	