

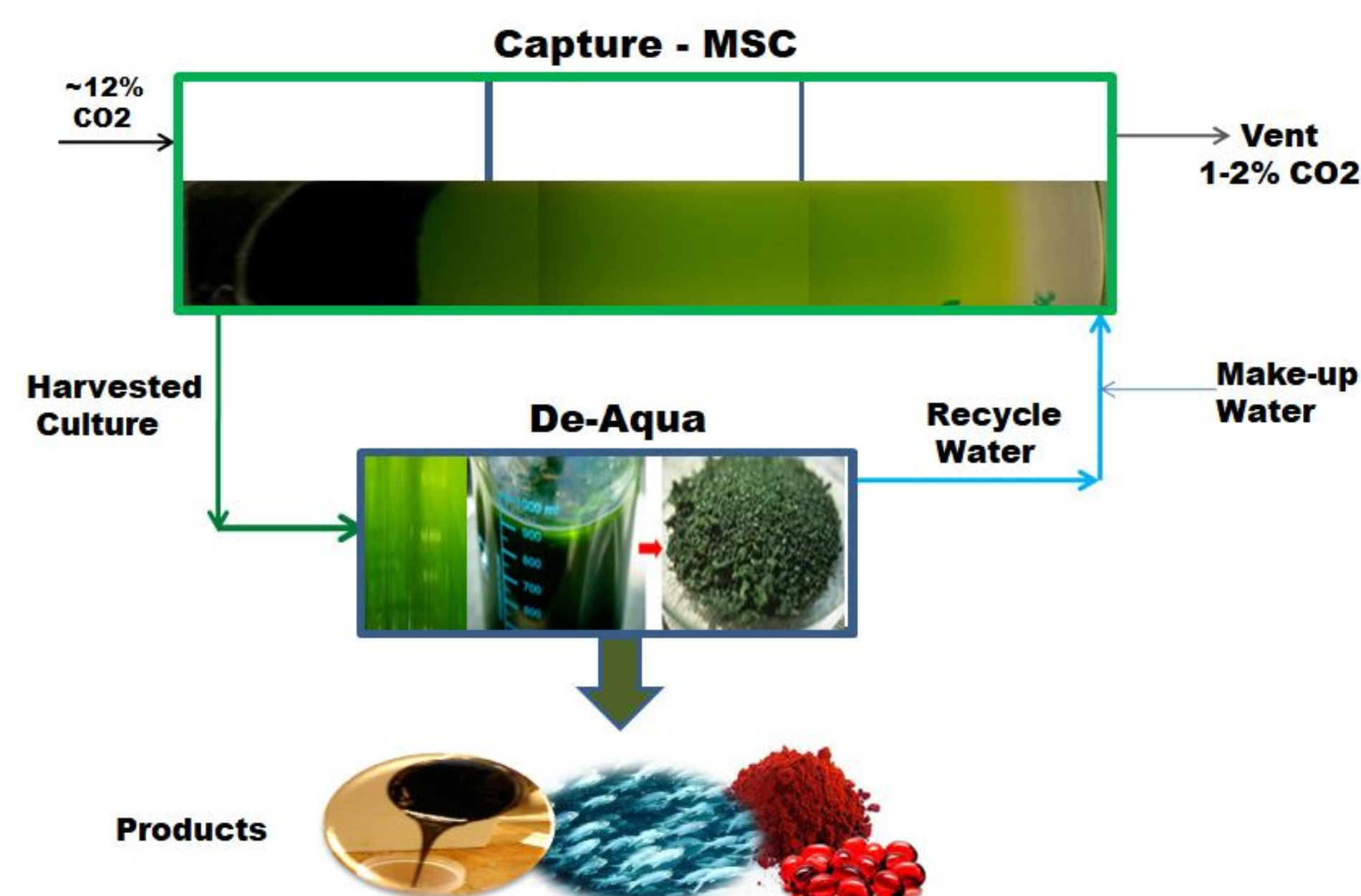
Project Overview

For CO₂ capture to be cost competitive, a revenue stream is required to offset cost of capture

Overall Objectives

1. Develop scalable, multi-stage, & continuous algae technology (MSC) for high CO₂ capture efficiency and high productivity from coal flue gas
2. Reduce capture cost via operational efficiency, credits and product revenue

Concept Schematic

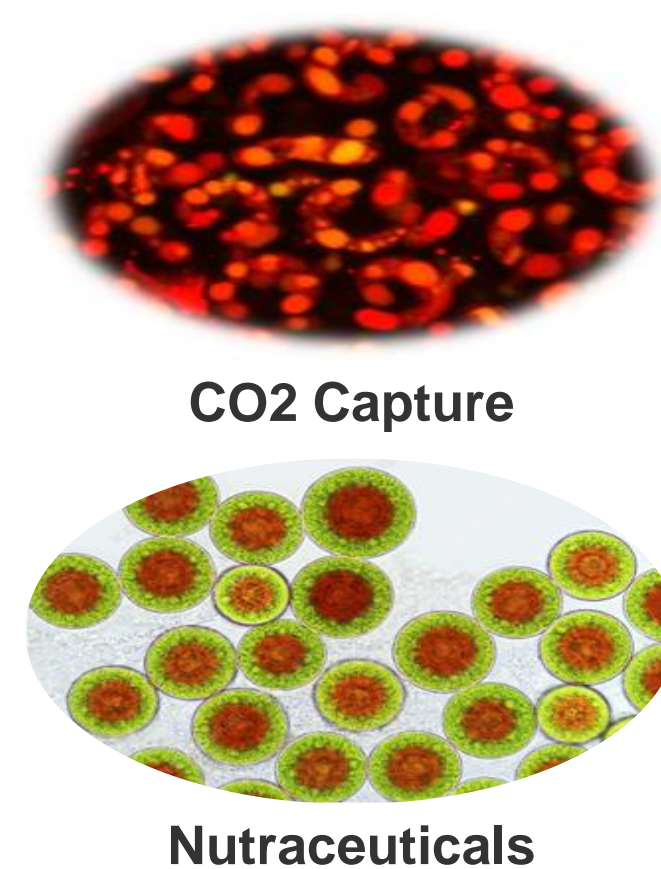
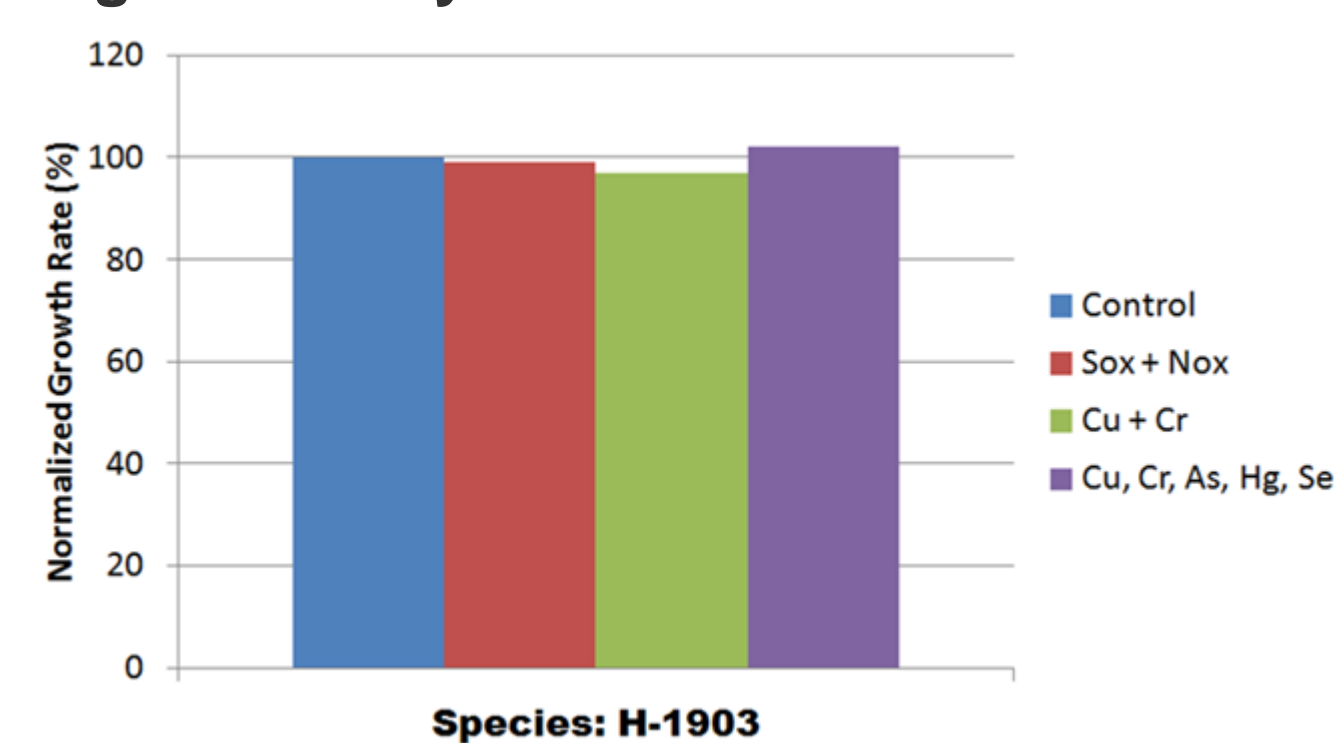


Specific Project Objectives

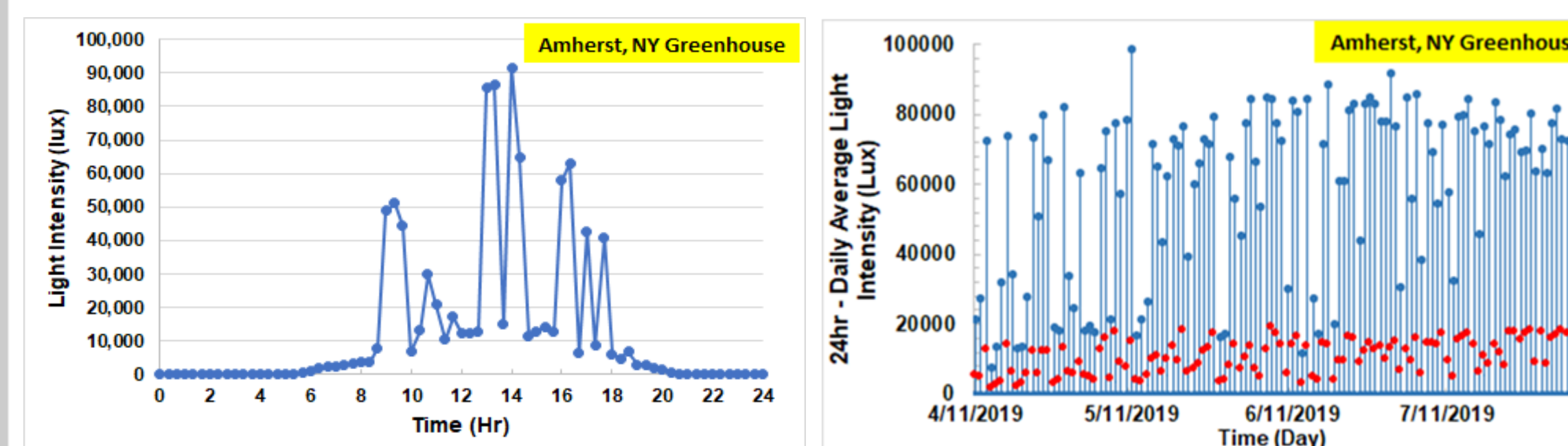
- Develop & demonstrate scalable, high performance MSC design
- Validate potential to produce 2 nutraceuticals with high value
- Develop dewatering technology with 50% reduction in energy use
- Conduct field test of MSC with real flue gas
- LCA and validate potential for significant net CO₂ reduction
- Perform TEA and demonstrate modeled algae production cost <\$200/ton

Algae Species Selection

Algae Stability in Post FGD Flue Gas



Sunlight Variation – Amherst, NY



Large intra- and inter-day sunlight variation observed

Month	Month Average Light Intensity (Lux)	
	Internal GH	External GH
Apr-19	6893	
May-19	9423	
Jun-19	11306	
Jul-19	12877	23243

- Substantial inter & intra-day variation
- Improving sunlight from spring to summer
- ~2x light loss from outside to GH

MSC Background

Key Features

- Continuous process
- Natural sunlight, top lit
- Closed system
- Stable algae concentrations
- High water recycle
- Scalable, predictable, controllable



PBR Type	Light Source	Light Intensity Avg (Lux)	Feed Gas CO2	Post FGD Cont	# of Stages	Overall Performance	
						% Productivity of Target	Total CO2 Cap Eff (%)
E	Artificial	~9,000	12.0%	N/A	3	56%	54%
R	Artificial	~9,000	12.0%	N/A	3	80%	80%
H	Sunlight	~11,000	12.0%	SOX/NOX + HM	3	85%	73%
C	Sunlight	~14,500	12.0%	SOX/NOX + HM	2	123%	74%

Performance dependent on sunlight and PBR design/operation

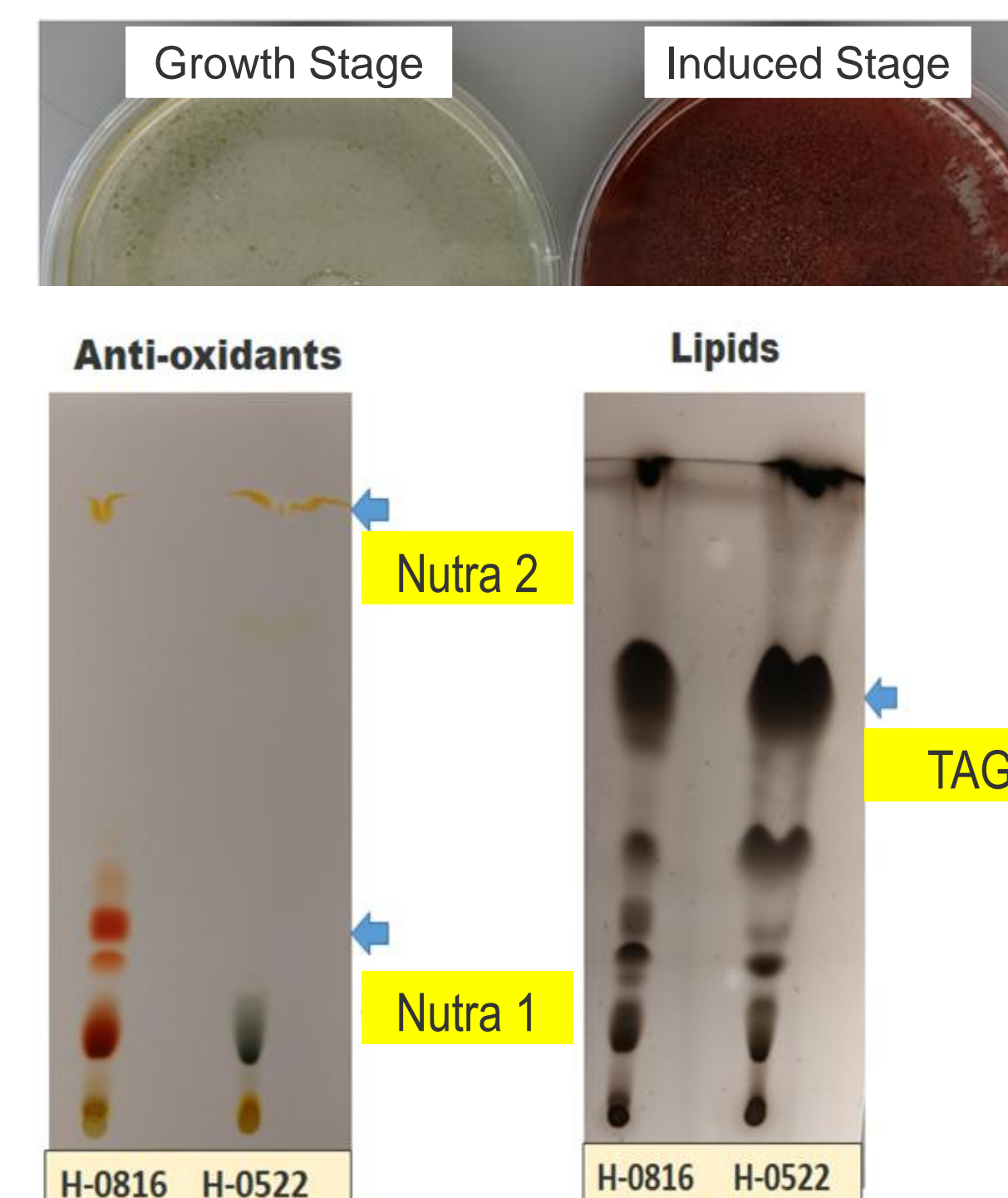
Product Generation

Strain Features:

- Strains are product dependent
- CO₂ capture and productivity
- High protein content
- High value product content

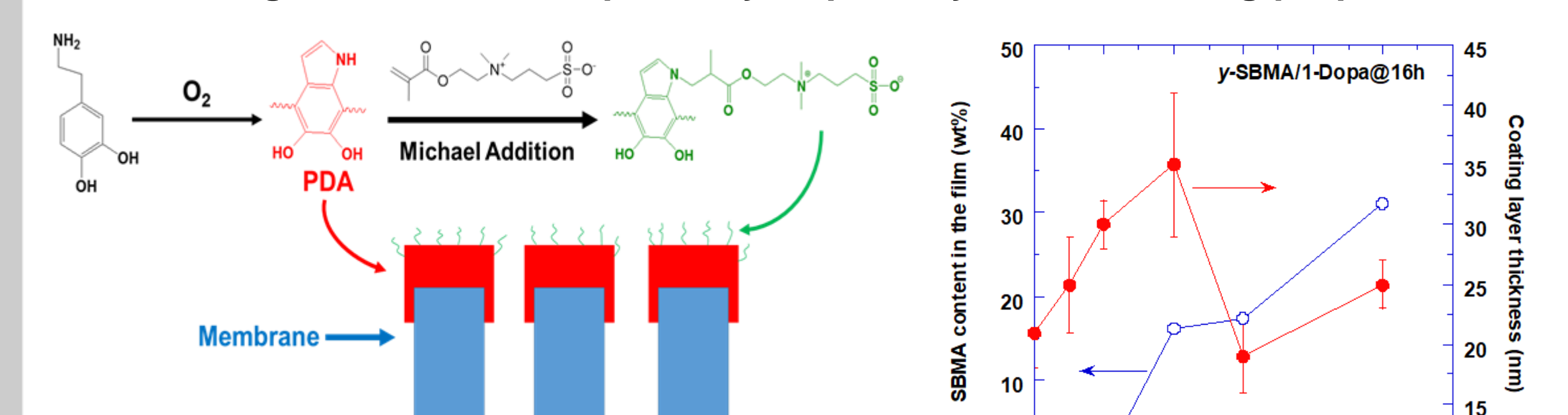
Products:

- Nutraceuticals, Food additives
- Animal/Aquaculture Feed
- Biofuels



Algae Dewatering: Anti-fouling Membrane

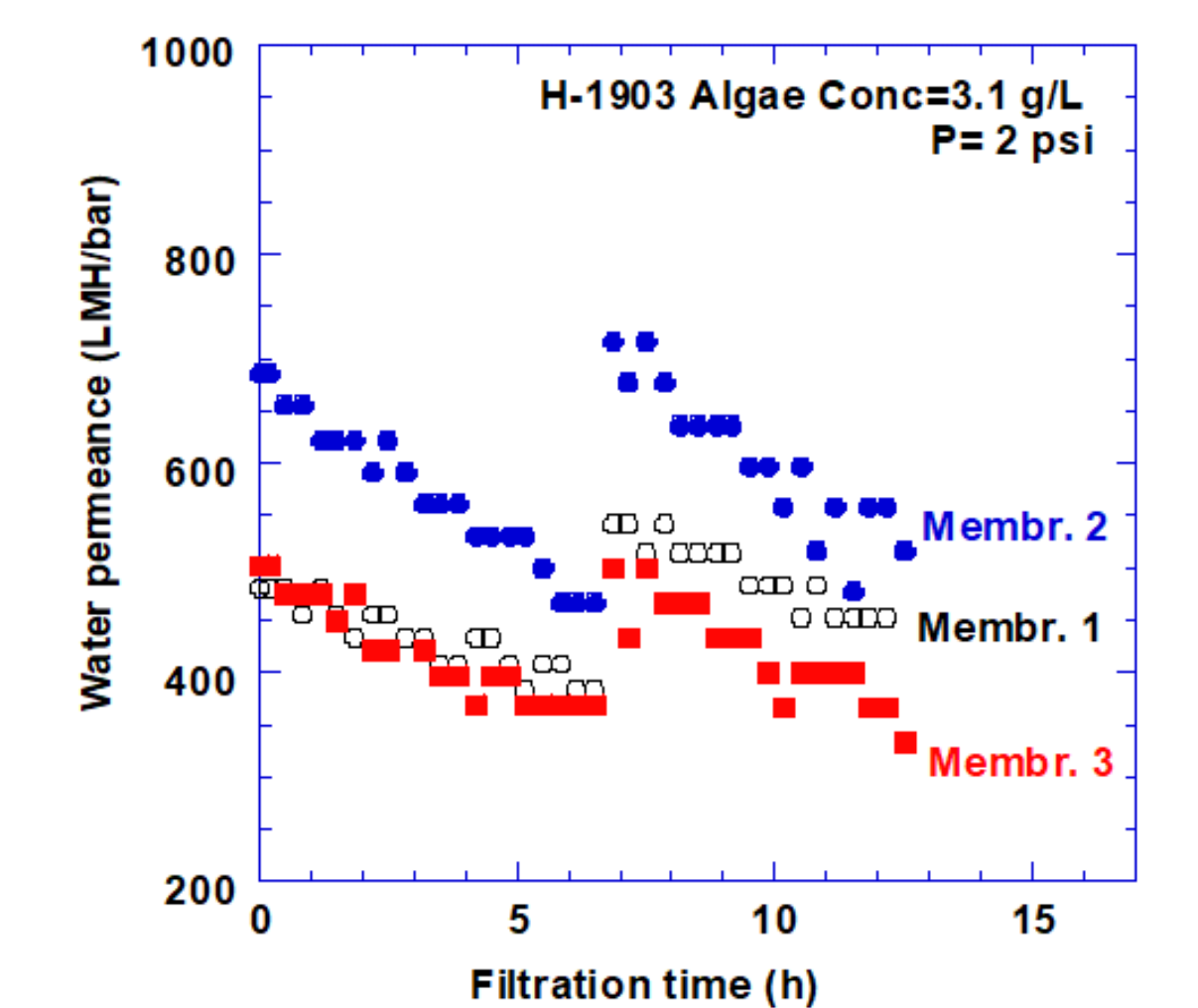
Grafting zwitterions to improve hydrophilicity and antifouling properties



Advantages:

- Simple at room temperature in the aqueous solutions
- Covalent bonds to achieve long-term stability

Algal membrane dewatering tests using crossflow apparatus



- Multi-stage process incorporating membrane
- Long-term goal: Dewater culture to concentrations required for downstream applications

Project Partners



Acknowledgement

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* Contacts