NJWEA 108th Annual Conference
Session: Air Pollution & GHG
Atlantic City, NJ May 9, 2023

PONC-H2O - Advanced Wastewater Resource Recovery for Enhanced Carbon Reduction at WRRFs

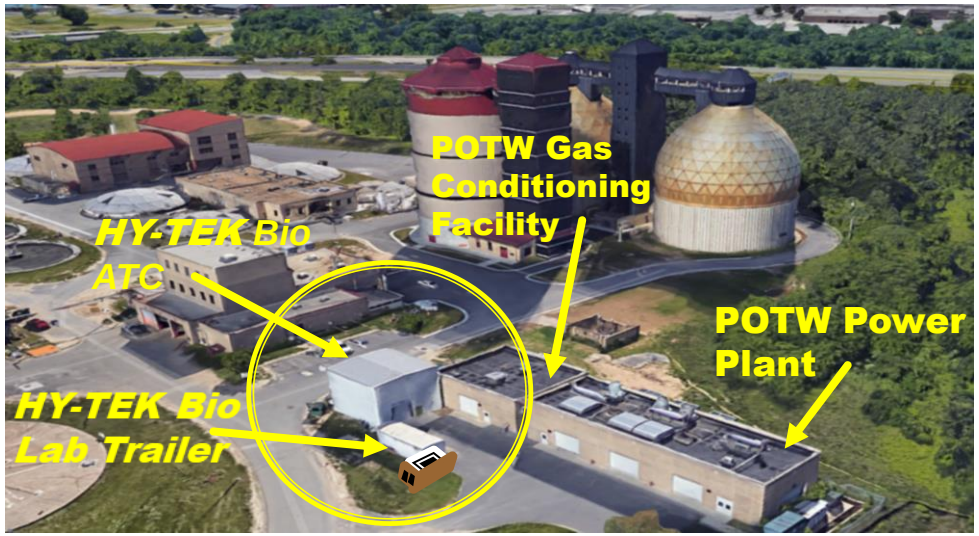
By: Edward Weinberg, P.E., President, ESSRE Consulting, Inc.

Presentation Outline

- Meet **PONCH-H_2O** (**P**hosphorus, **O**xygen, **N**itrogen, **C**arbon, **H**ydrogen for enhanced **H_2O** & air quality)
- Focus on **C**arbon Capture & Utilization and Nutrient **N** & **P** Recovery/Reuse
- GHG **C**O_2 Biogas Reduction Driven by Microalgae
- **PONC-H_2O** Outcomes, Key Takeaways

WRRF CO_2 Capture and Reuse Project
C, N & P, O_2

Mass Cultivation of Microalgae in Photobioreactors – Net Negative C Operations



$$106CO_2 + 16HNO_3 + H_3PO_4 + 78\,H_20 \xrightarrow{\text{light}} C_{106}H_{175}O_{42}N_{16}P + 150O_2$$

Why Algae? - Host of Bioproducts

- Algae and algae oil is used in the following products (partial list)
  - ✓ **Nutraceutical products,** eye nutrients, Omega-3 Fatty Acids
  - ✓ Skin conditioners

  - ✓ Cosmetic and paint thickeners
  - ✓ Bioplastics

  - ✓ Animal and numan food supplements - **PROTEINS**
  - ✓ The HY-TEK Bio algae *s.HTB-1* can bring as much as **$40/lb** from an algae brokerage house

  - ✓ 90-95% **Oxygen** from photosynthesis is a reusable marketable commodity
  - ✓ Direct replacement for Palm Oil

  - ✓ **Fertilizer/Soil Amendment**

Carbon Reuse via Microalgae

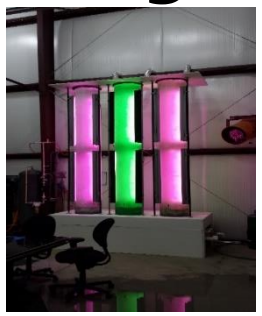
- **Biofuels**
  - Biodiesel, Renewable Diesel, and SAF
- **Bioproducts**
  - *Carotenoids –> Pigments, Nutraceuticals*
  - Proteins
  - Sugars/Starches
  - *Soil amendment/fertilizer - Biochar*

CO_2 Emissions Sources

- Raw Biogas/Landfill Gas Feedstock – 35% - 65% CO_2
- Biogas **CHP** - 8% - 12% CO_2
- Biogas/NG Industrial Steam **Boiler** - 5% - 6% CO_2
- Biogas **Sludge Drying** - 8% - 10% CO_2
- Purified Biogas **RNG** - 97% - 99% CO_2
- Solar **Sludge Drying** - 400 ppm – 1000 ppm CO_2

Waste Heat Recovery

- **Optimum Algae Cultivation = ~ 85° F;** Engine Exhaust = ~1000° F



- **Three Choices of WHRUs**
  - ORC (Electric Power) ⟹ Offset LED Lighting
  - Waste Heat Chiller (Cooling) ⟹ Gas Cooling or Chilled Water
  - Waste Heat Boiler (Heating) ⟹ Drying or Pyrolysis of Wet Algae

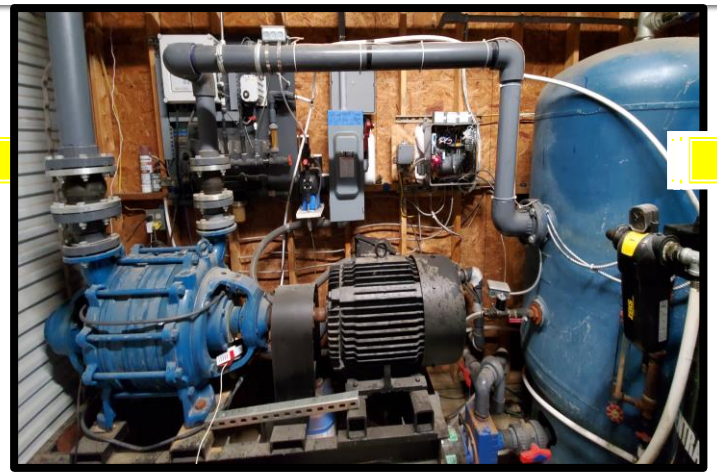
Algal System Technology/Flue Gas Conditioning

FLUE GAS

Flue gas is captured using a slipstream and cooled using Waste Heat Recovery Units (not shown)

FLUE GAS FILTRATION

A simple H2O quench trap cools the water to 85F and traps any particulates



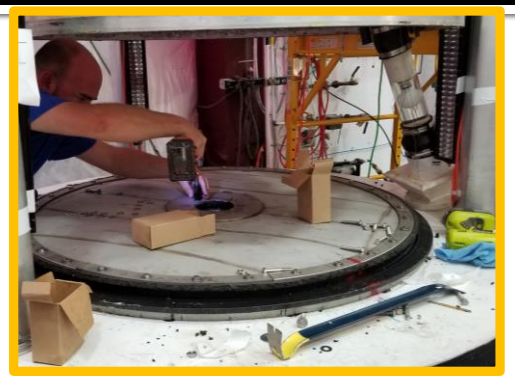
FLUE GAS COMPRESSION

Flue gas is fed to a Liquid Ring Compressor to minimize heat of compression. The water is separated from the flue gas which is then directed to the photobioreactors (PBRs)

WATER CONDITION

Compressor recirculating water is neutralized to pH 7, nutrient and makeup water added and cooled to <70F for re-use through the compressor.

Microalgae Cultivation Technology/Process



FLUE GAS INJECTION

A special gas sparger was developed in-house to ensure rapid transfer of gas chemistry to the culture using micro-bubbles that increase light penetration and enhance tall column mixing throughout

GROWTH ENHANCEMENT

Advanced LED lighting technology developed in-house to enhance growth and nutritional value of the algae via proprietary lighting strategies that "photo-stress" the algae and reduce energy consumption

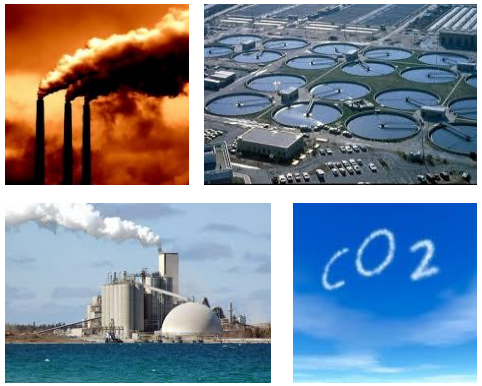
CULTURE HARVEST

When the algae gets too dense for light penetration, the automation drains 10% of the tank to thin out the culture to get more light

CULTURE HOLDING

Harvested algae is centrifuged (not shown) to concentrate the algae into paste product for conversion. Centrate is recirculated to the PBRs.

THE BUSINESS PLAN



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CLIENTS

INVESTORS

PONC-H2O Facilities

Rent/Lease Space; Electric Bills
PROJECT CREDITS
(RECs, RINs, Carbon Credits)

O&M

PROFIT

s.HTB1
ALGAE

ONCE THE INVESTOR IS PAID BACK, THE PONC-H2O FACILITY IS TURNED OVER TO THE CLIENT AT NO COST ALONG WITH % OF THE REVENUE STREAM FROM THE SALE OF THE ALGAE TO PAY FOR O&M PLUS CONTINUED REVENUE STREAMS THAT MAXIMIZE RETURN.

10-Year Algae Production & Financial Projections

- **EXAMPLE: Containerized Algae Facility Adjacent to Biogas Engine Room**

- **PRODUCTION: *1149*Tons Algae p.a.**

- **DETAILS: 10 PBRs; Capital Initial Investment $4.375M;**
  Breakeven Payback by Yr. 3 of operation;
  Total 10-Yr Revenue ~ $39M
  NPV ~$6.25M; IRR% 40.7

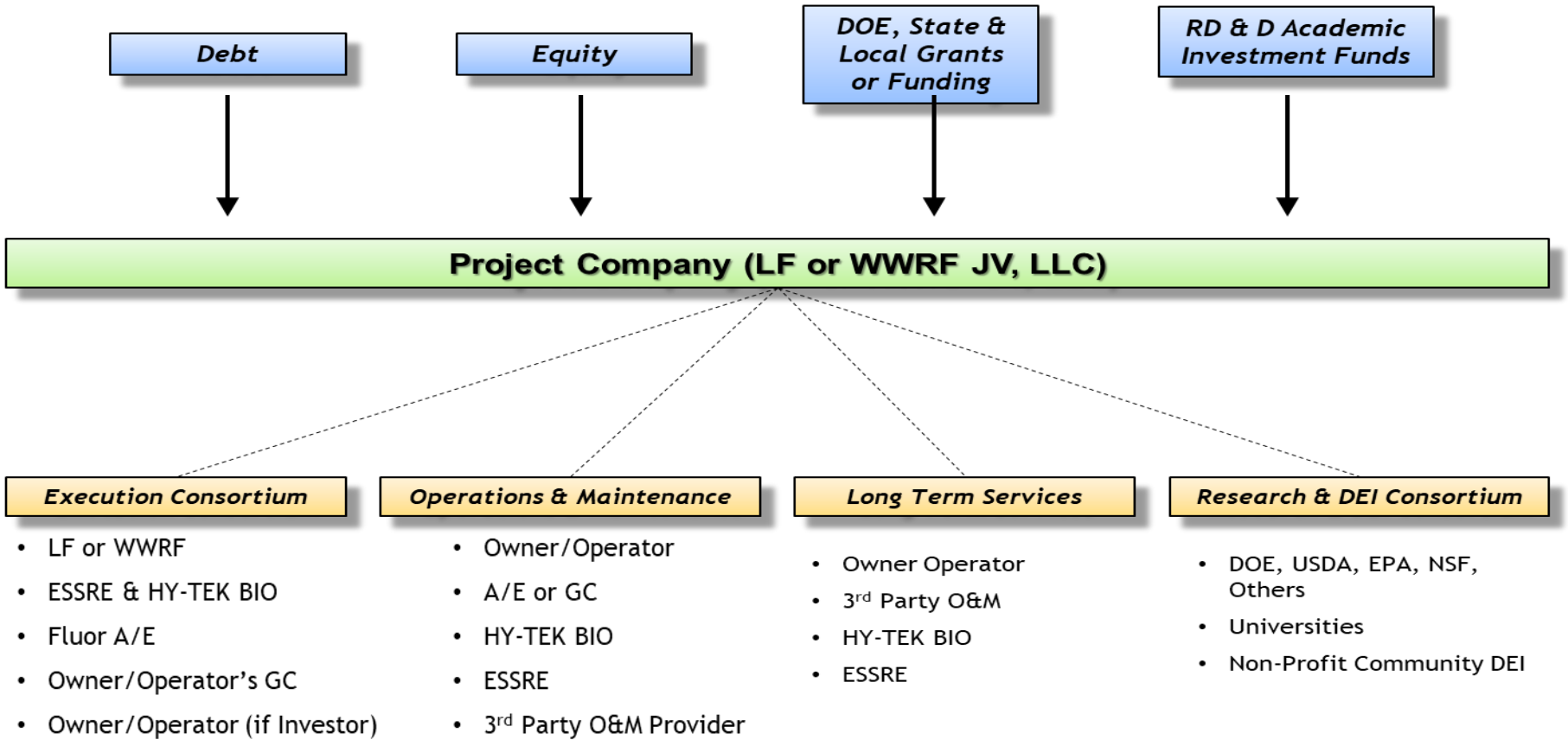
- **INVESTOR OUTCOME: If 15% of Capital Cost, Investor net profit ~$2.8M**

- **CLIMATE OUTCOME: Total Carbon Dioxide Removed, 2095 Tons, p.a**

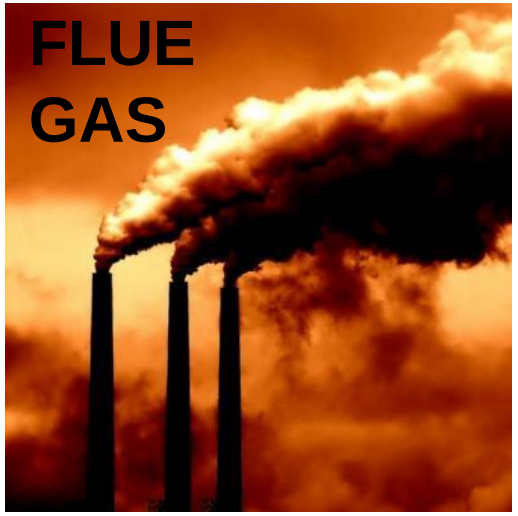
Note: Assume a system availability factor of 75% during year one, otherwise 90% availability factor

PONC-H2O PROJECT ORGANIZATIONAL STRUCTURE

Commercial Demonstration Project (Alpha, Beta, etc.) Structure Overview

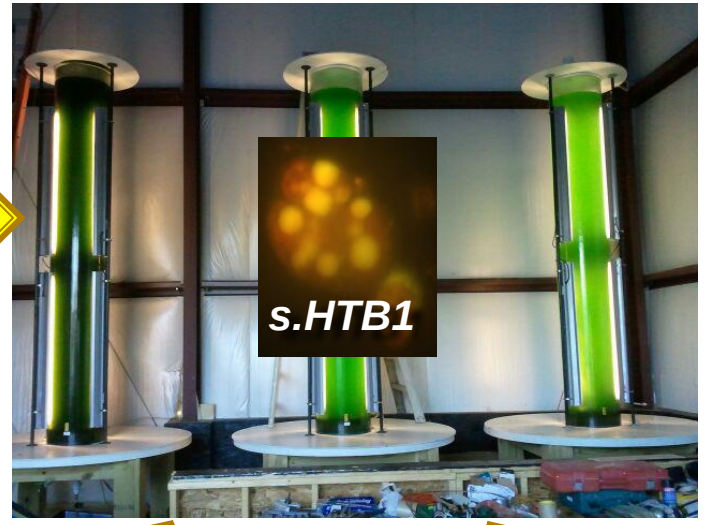


PONC-H_2O Review



Digesters/Landfills
Biogas Engine Exhaust
LFG Engine Exhaust
RNG Waste CO_2 Tail Gas

500 L Pilot Scale Photobioreactors



Recycled N &P from Manure, Wastewater, Digestate & Landfill

Net Negative C Ops

Zero CO_2 Emissions;
Non-Detect NOx Emissions

Key Take Aways

- PONC-H2O = WRRF & Industrial Decarbonization
  - Complete CO2 removal from Biogas, LFG Utilization while maximizing returns
  - Net Negative Carbon, O2 reuse, and "Closing the N, P Loop" for WRRFs
- Regenerative Ag - Carbon Markets
  - PONC-H2O: Transfers Atmospheric CO2 and Sequesters C into Soil for Maximum Impact on Climate Change
- Net Zero GHG Emissions
  - ESG Scope 1, 2 or 3 Emissions wherever fossil fuel is combusted

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Ed Weinberg, PE
ESSRE Consulting, Inc.
ed.weinberg@essree.com

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HY-TEK Bio, Founder & CEO

Questions