Carbon Utilization and Project Synergies at the Illinois Sustainable Technology Center

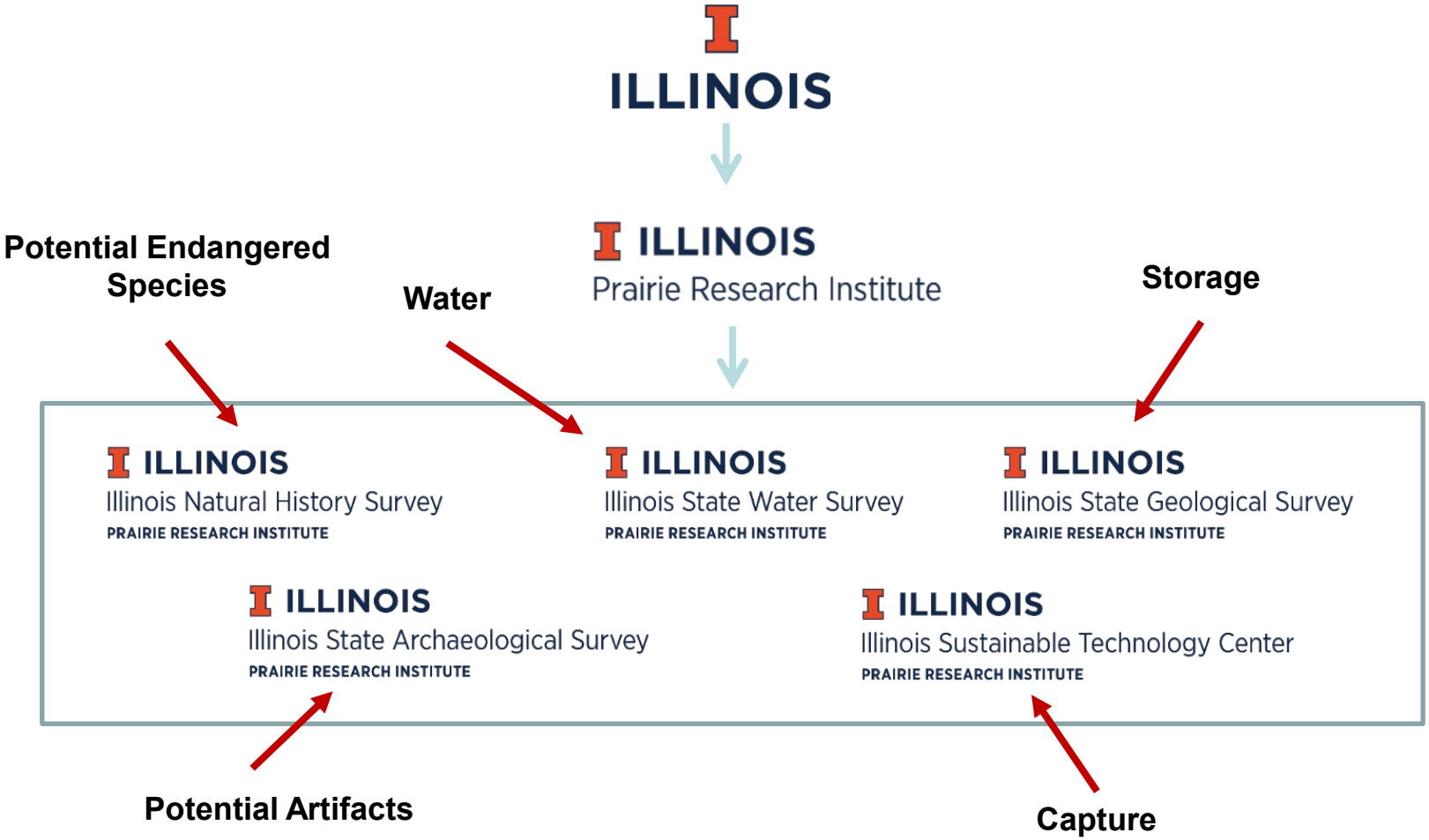
Presented by Ryan Larimore - Assistant Research Scientist

Presentation for the USEA Midwest Regional Carbon Conversion/Utilization Procurement Grant Workshop

Illinois Sustainable Technology Center | ILLINOIS

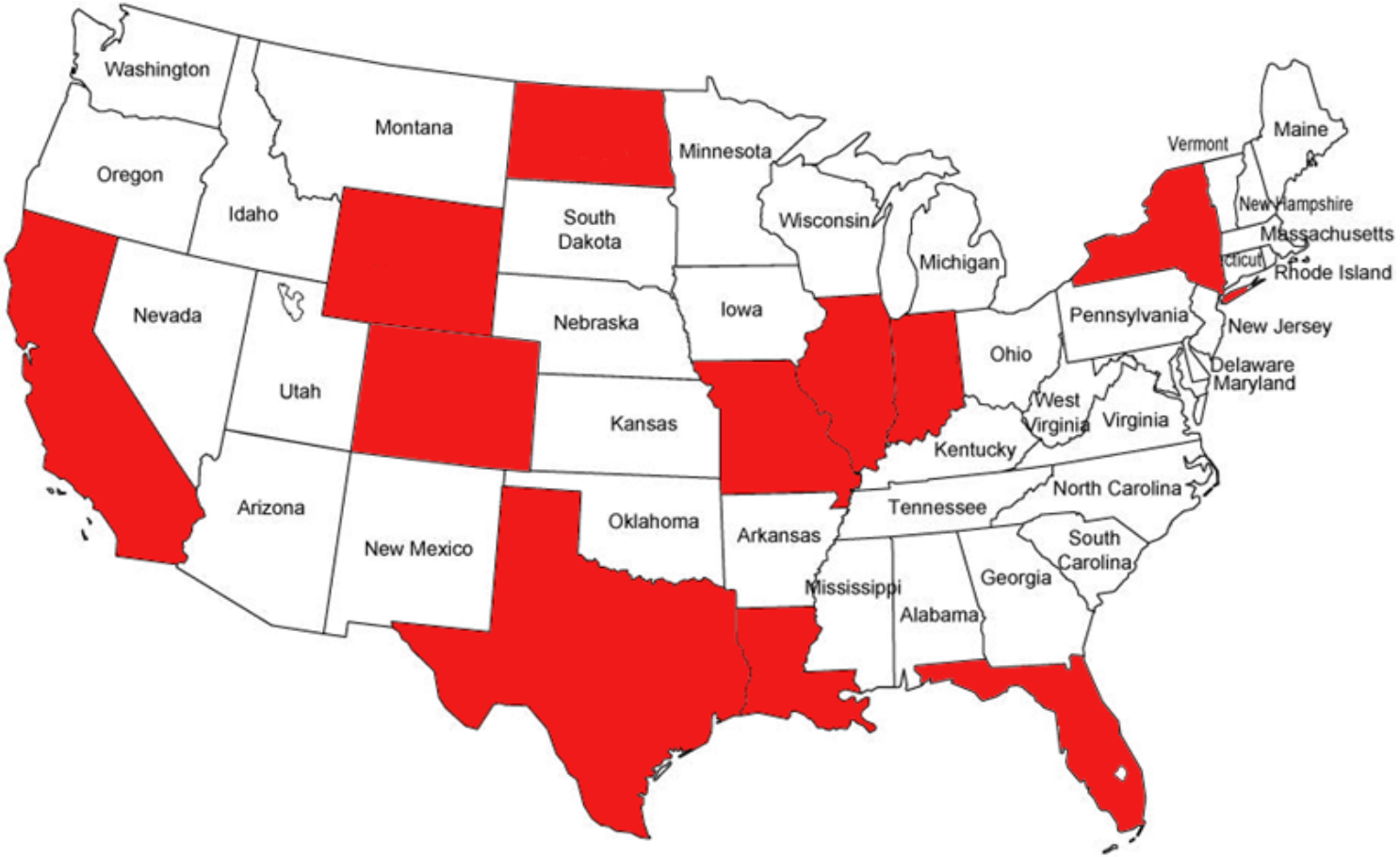
Prairie Research Institute (PRI): Experts in CCUS

"One-stop shop" to address project needs



States Where UIUC Leads CO2 Capture and Utilization Projects

Marked in Red



UIUC Capture and Utilization Project Portfolio

Color code: Complete / In Process

FEED	Build/Operate
816 MW FEED (largest capture FEED in the world)	10 MW – Build / Operate (largest capture pilot in the world)
350 MW FEED – Capture, energy storage, algae, hybrid boiler / gas turbine	Build / Operate 0.5 MW Capture from powerplant
3 Million tonnes/yr from Cement Plant (largest single kiln in the world)	Build / operate 0.7 ton per day CO_2 capture from powerplant
2 Million tonnes/yr from Steel Plant (world's largest and most state-of-the-art Hot Briquetted Iron (HBI) plant)	Build / operate utilize CO_2 from flue gas from powerplant
Direct Air Capture (DAC) + renewables 100,000 tCO_2/yr, 3 sites	Build / operate 2.5 ton per day CO_2 capture from Waste to Energy plant
Direct Air Capture (DAC) + geothermal 5,000 tCO_2/yr.	Build / operate 200 m2 algae pond system to utilize CO2 from flue gas from powerplant
Direct Air Capture (DAC) + nuclear 5,000 tCO_2/yr.	Build / operate algae pilot wastewater treatment system with Direct Air Capture (DAC) of CO2
DAC + excess heat from steel plant+ utilization of CO_2 for cement applications (DACU) 5,000 tCO_2/yr.	
0.5 MW aerosol reduction technologies	
Flue gas desulfurization (FGD) blown-down water recycle	
400 MWh energy storage FEED using NG	
Demonstrate in-vitro animal feed utilization with algae grown on CO2 from flue gas	

CO_2 Utilization Activities at ISTC

Researcher (Scientist):
Lance Schideman, Ph.D

schidema@illinois.edu

Research activities:

- **CO2 utilization by algae cultivation**
- **CO2 utilization in wastewater treatment**
- **Thermochemical biofuel conversion processes**

Algae and Fuel Conversion

Industrials and Commercial Utilization

Researcher (Scientist):
Chinmoy Baroi, Ph.D.

cbaroi@illinois.edu

Research activities:

- **Decarbonization of cement and concrete. CO_2 utilization into cement and concrete.**
- **Conversion of CO_2 to value-added chemicals under moderate reaction conditions.**

ISTC Algae CCUS Projects

Funded by US Department of Energy (NETL)

Lab Scale Algae and Wastewater Project

DE-FE0030822

- $1,249,874
- 10/01/2017 – 09/2021
- Algae via Coal simulated flue gas & Wastewater nutrients
- Promising TEA of full-scale system

Pilot scale project at CWLP Springfield

DE-FE0032098

- $2,499,096
- 10/2021 – 09/2024

~200 m2 outdoor ponds

Construction In progress

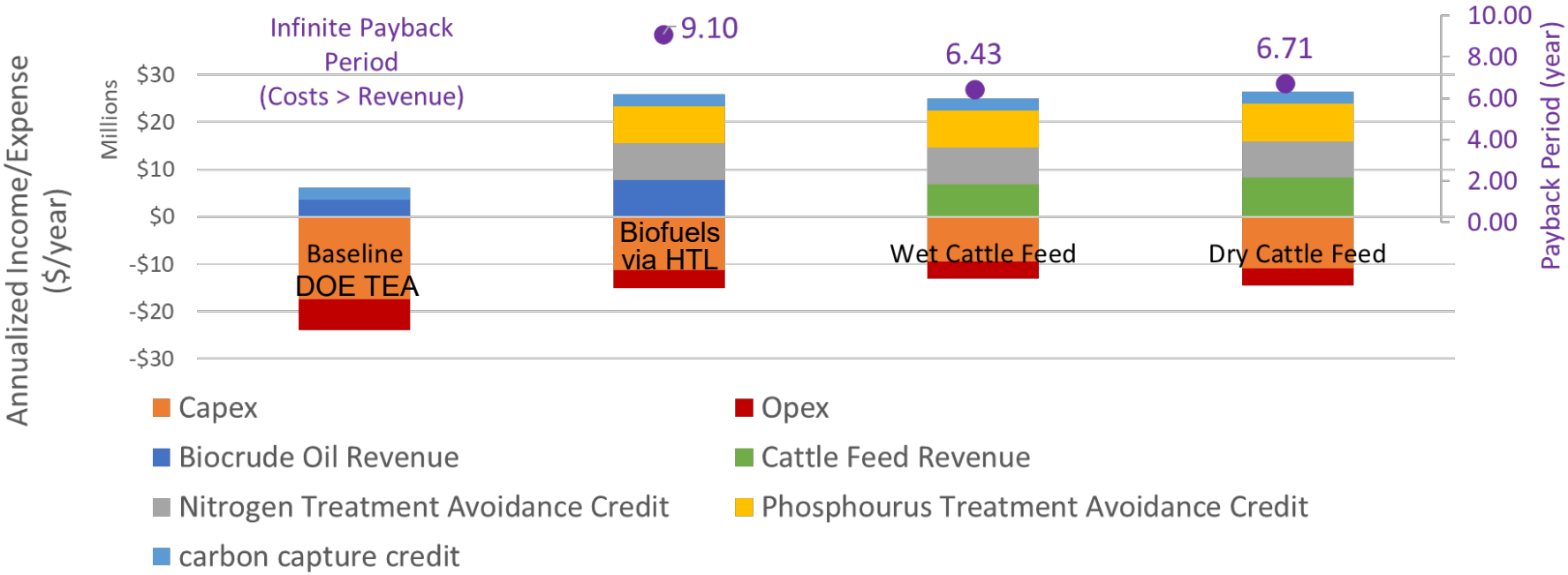
21CPP Large Scale Algae Cultivation

DE-FE0031995

- $25,682,080
- 05/01/2021 – 05/31/2024
- FEED Study – HGCC PP with PCC Subsystem & Algae Subsystem

TEA Scenario Comparison for Algal CCUS

DE-FE0030822 (PI – Dr. Lance Schideman)



- Major revenue sources: Wastewater nutrient removal > animal feed ~ biocrude oil > CO_2 credit
- Further improvements in lowering costs and increasing productivity possible
  - Extraction of other high value algae bioproducts (antioxidants, pigments, PUFA)
  - Reduced energy inputs for algae media mixing and harvesting
  - Potential improvements included in current on-going projects

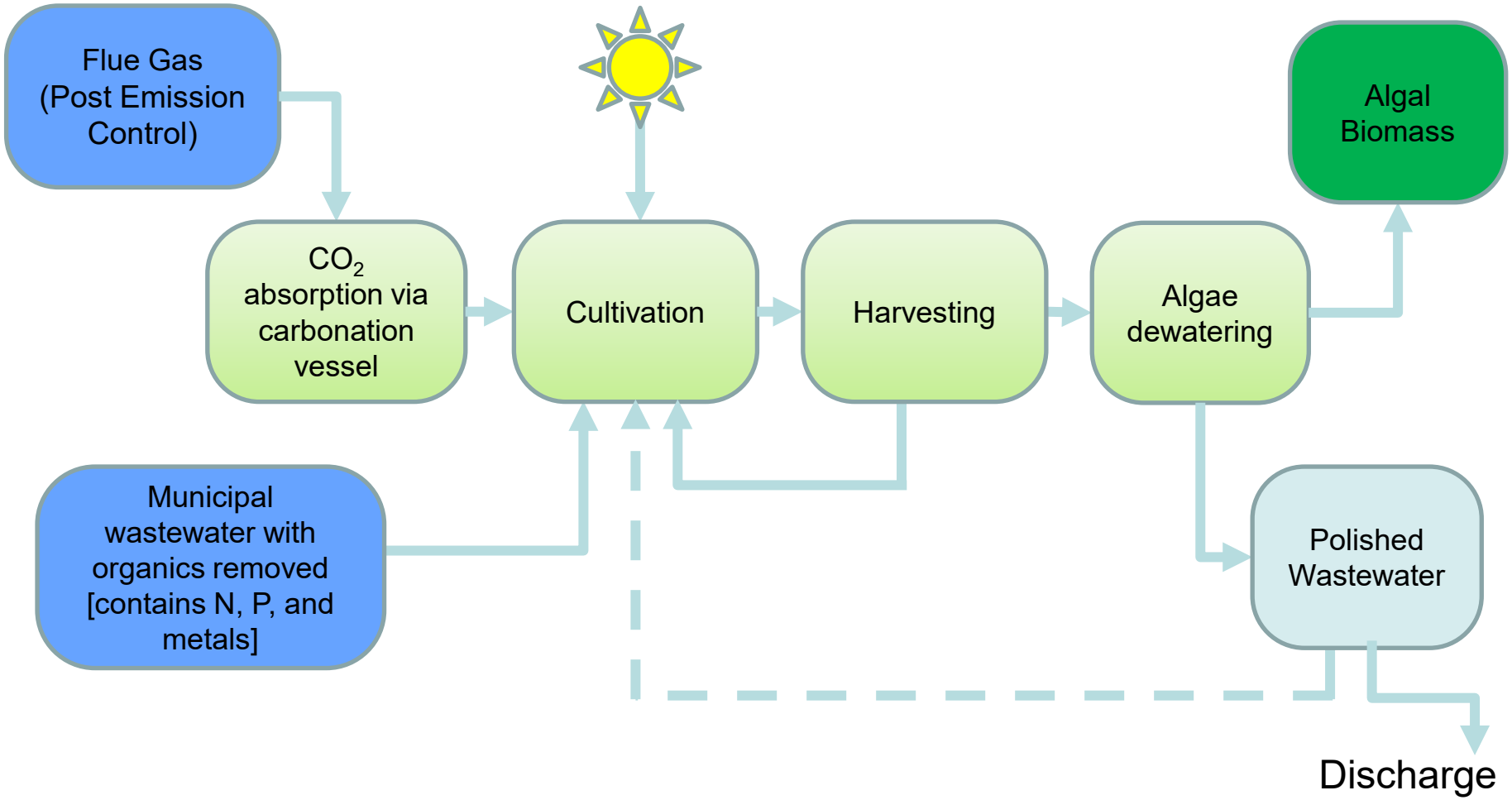
Algae Pilot CWLP - Project Overview

Algae Pilot at CWLP - DE-FOA-0002403

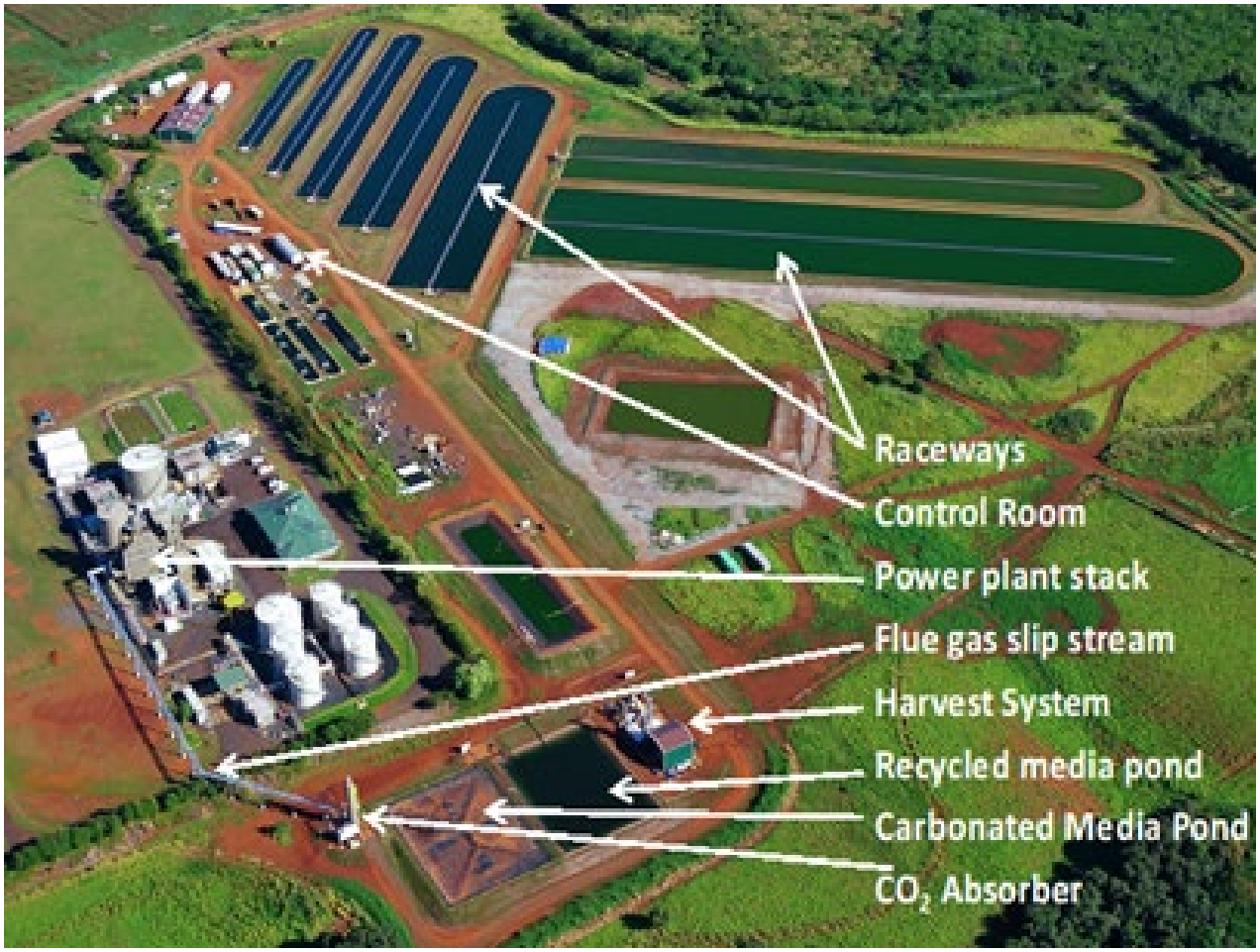
Project Strategy:
Combination of Key Advantages

- Best in Class Algae Cultivation System from GAI
- First Demonstration with GAI System Using Coal Flue Gas
- Improvement of Economics with Use of Wastewater Nutrient Inputs

Technology Background



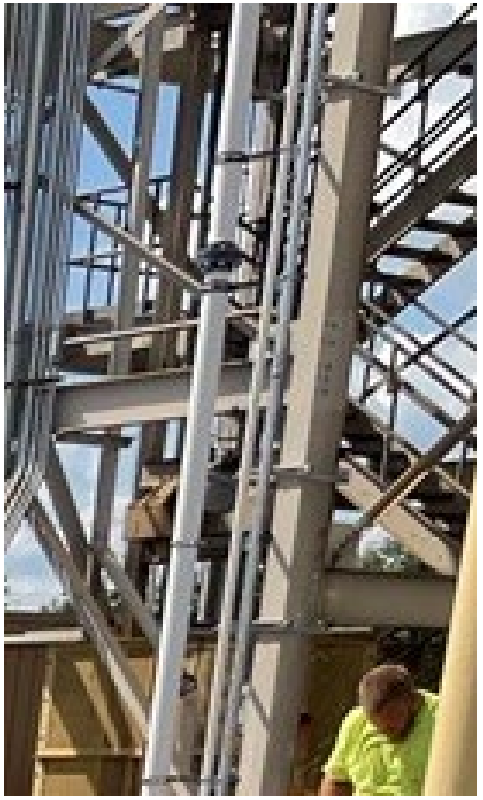
Algae CO2 Utilization Background



GAI's 8-wetted acre Kauai Algae Farm operated using CO_2 from a petroleum fired power plant flue gas since 2014.

CWLP Algae Pilot Project

DE-FE0032098 (PI – Dr. Lance Schideman)



Pond Area (m^2)	Number	Overall Area (m^2)
60	3	180
22	1	22
2	4	8
Total Area (m2)		**210**

CWLP Algae Pilot Project

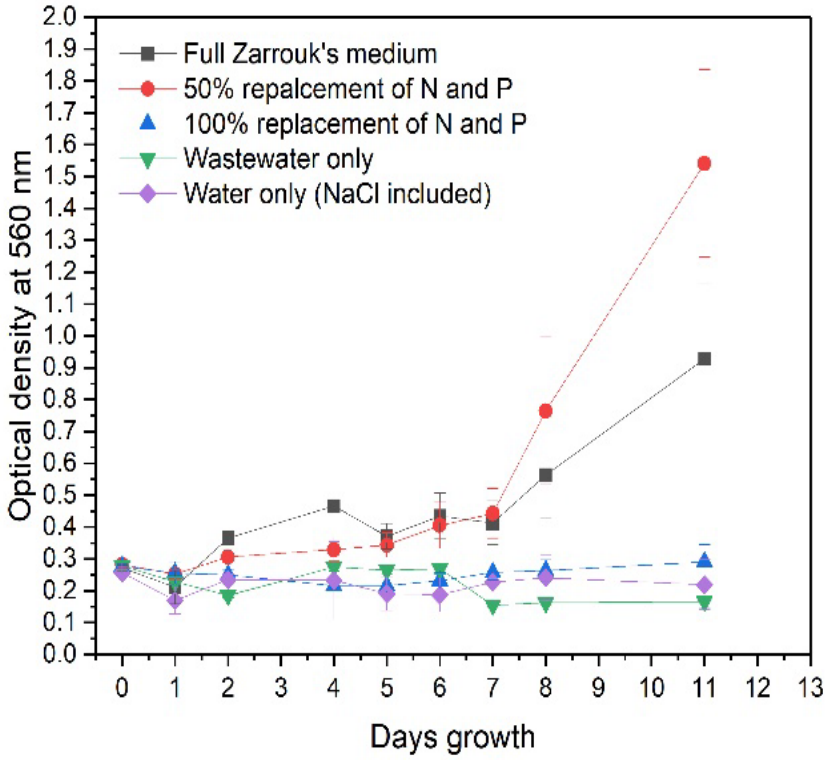
DE-FE0032098 (PI – Dr. Lance Schideman)

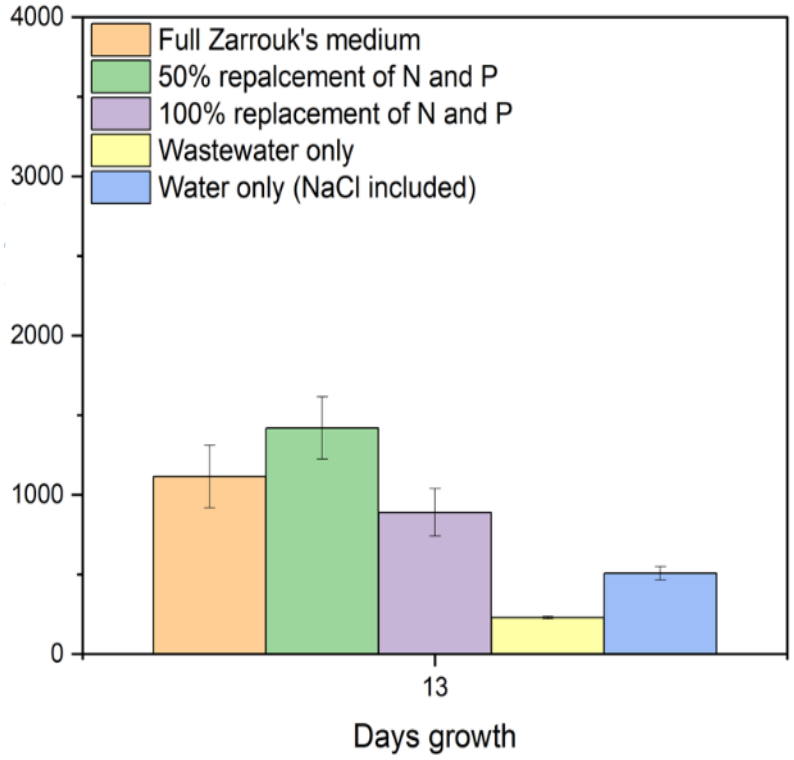
Absorber

GAI Zobi Harvester®

Wastewater Nutrient Replacement

Demonstrated good growth at lab scale of target strain of *Spirulina* with 50% of nutrients provided from a municipal wastewater source in algal inoculation cultures with a spirulina strain produced by GAI.





Animal Feed Testing

University of Illinois - Department Animal Sciences

- Conducting feed characterization
- Estimation of animal feed market value
- Live animal feed testing

Industrial Advisory Board

- Representatives from animal feed industry

Animal Sciences
COLLEGE OF ACES

Testing and Regulatory Collaboration

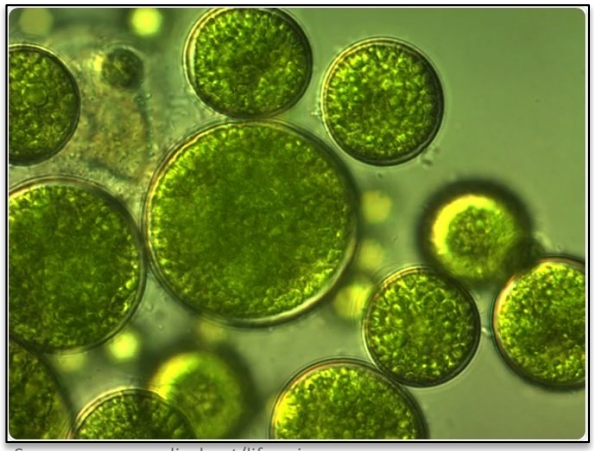
Summary of Algae Pilot at CWLP

Key Project Advantages:

- Wastewater Nutrient Source
- Up to 10x productivity per acre vs conventional agriculture

Project Impact - Animal Feed:

- Testing Achievements
- Economic Demand: Large/Growing Market
- Field Integration of Technologies in a Midwest Climate

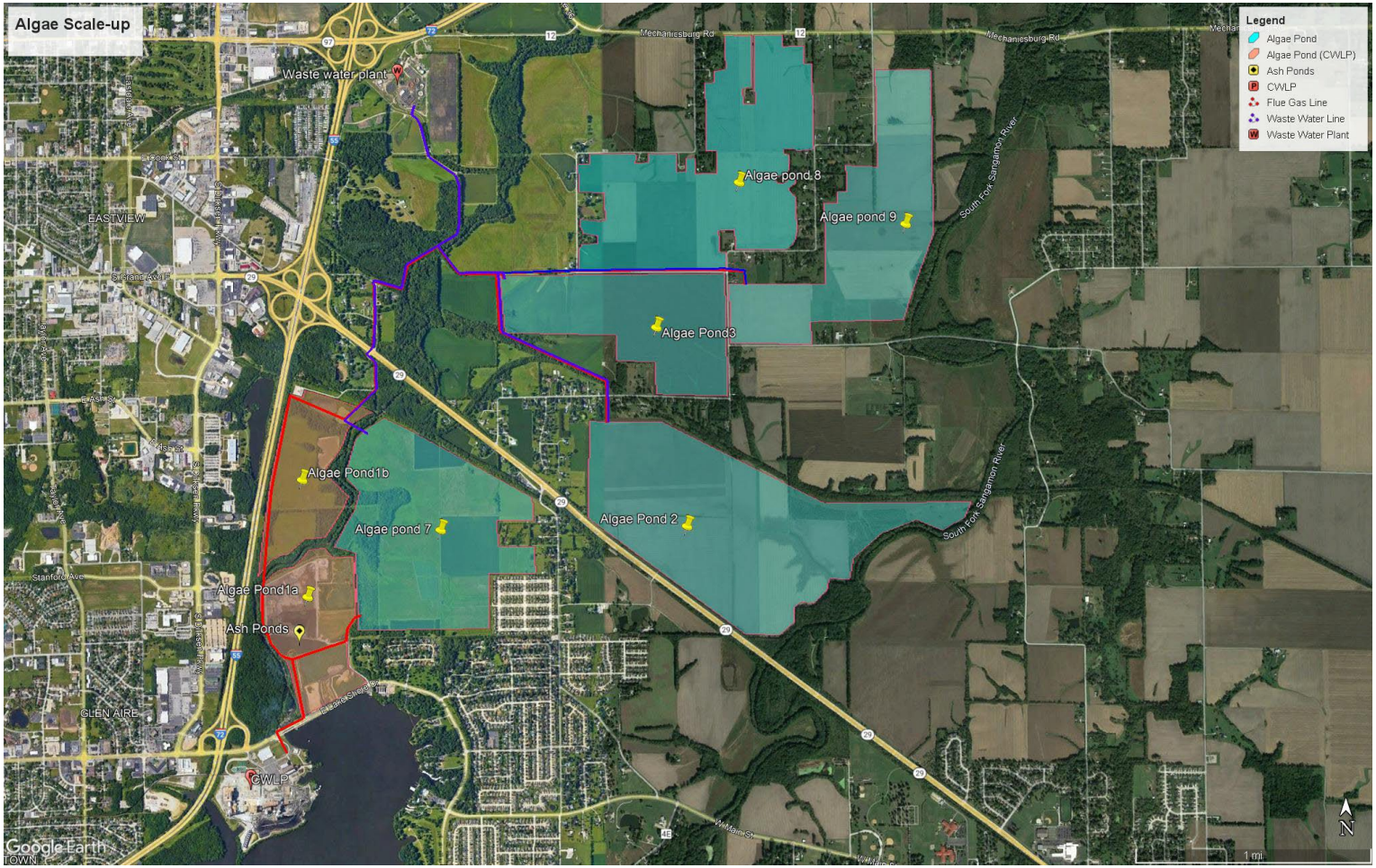


Source: news-medical.net/life-sciences

Source: bicycling.com/health-nutrition

Springfield, IL Projects Overview

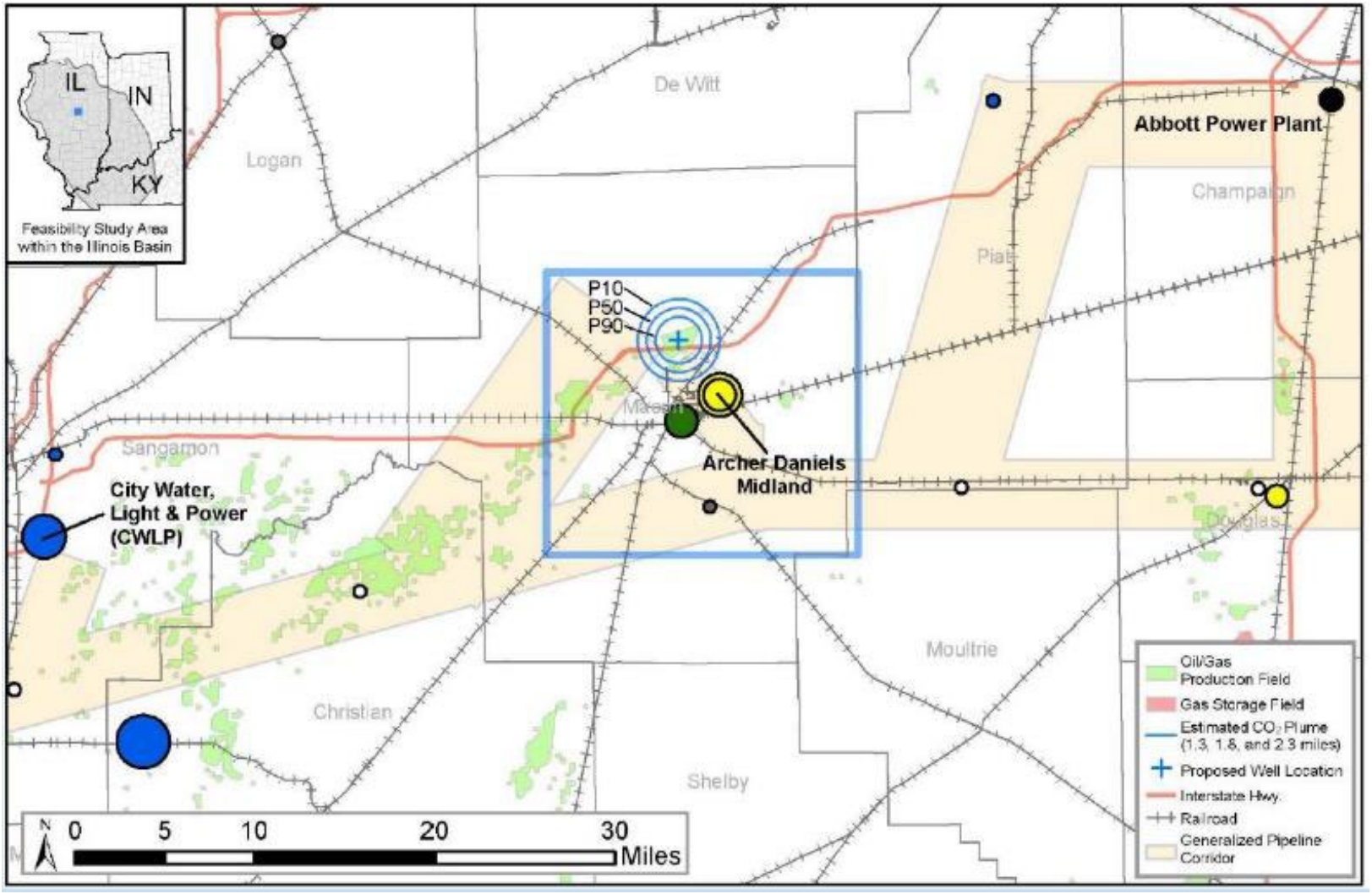
Scale Up Potential



- Large scale algae cultivation of >1500 ac. is possible in the vicinity of Springfield, IL by utilizing a combination of lands from local utilities and private farm land.
- Would require a network of flue gas & water pipelines (Approx.. 5-10 miles each).

Potential CO_2 Transportation Corridors

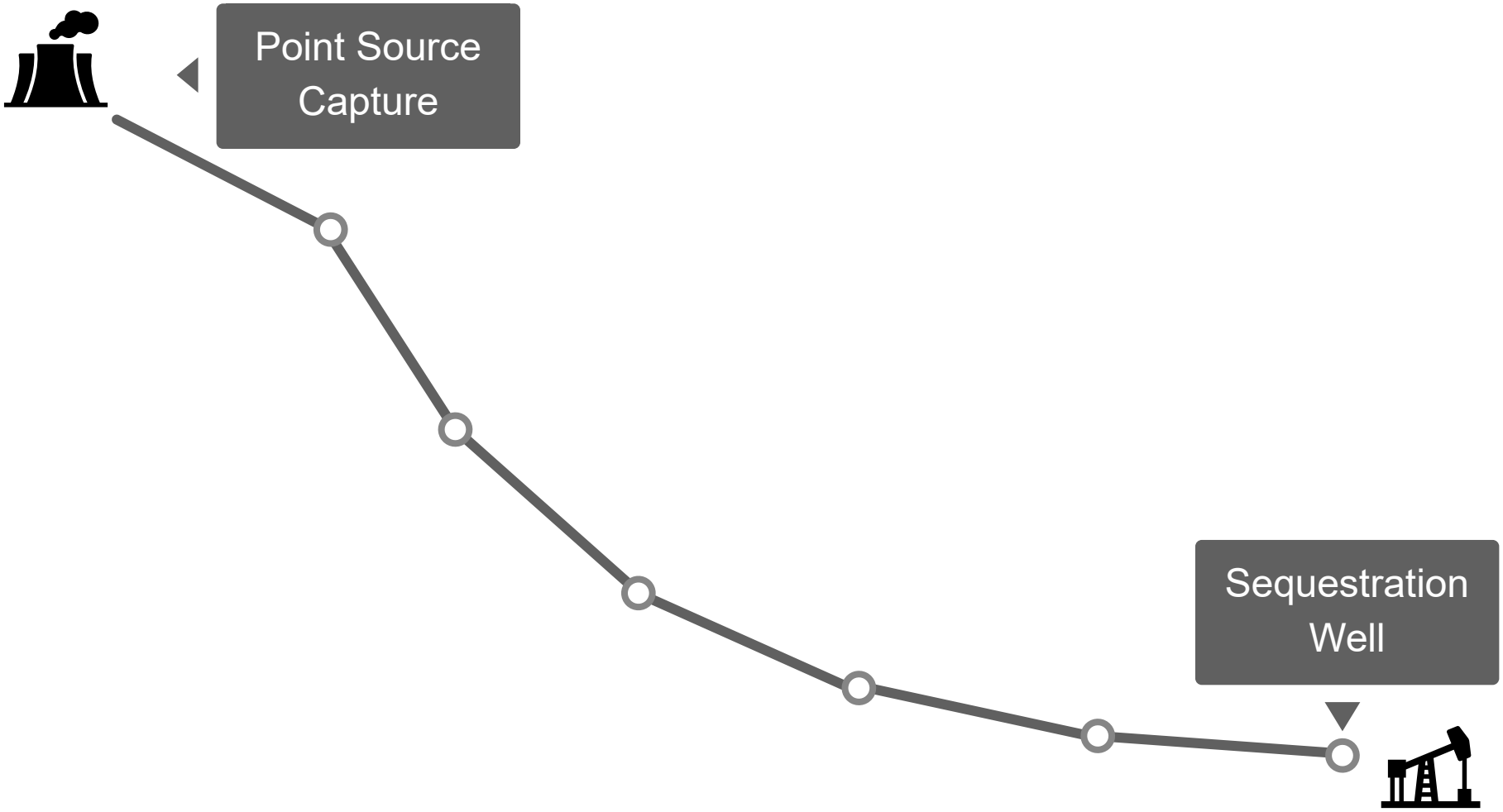
DE-FE0029381 (ISGS CarbonSAFE Project)



Source: CarbonSAFE Illinois, Illinois State Geological Survey

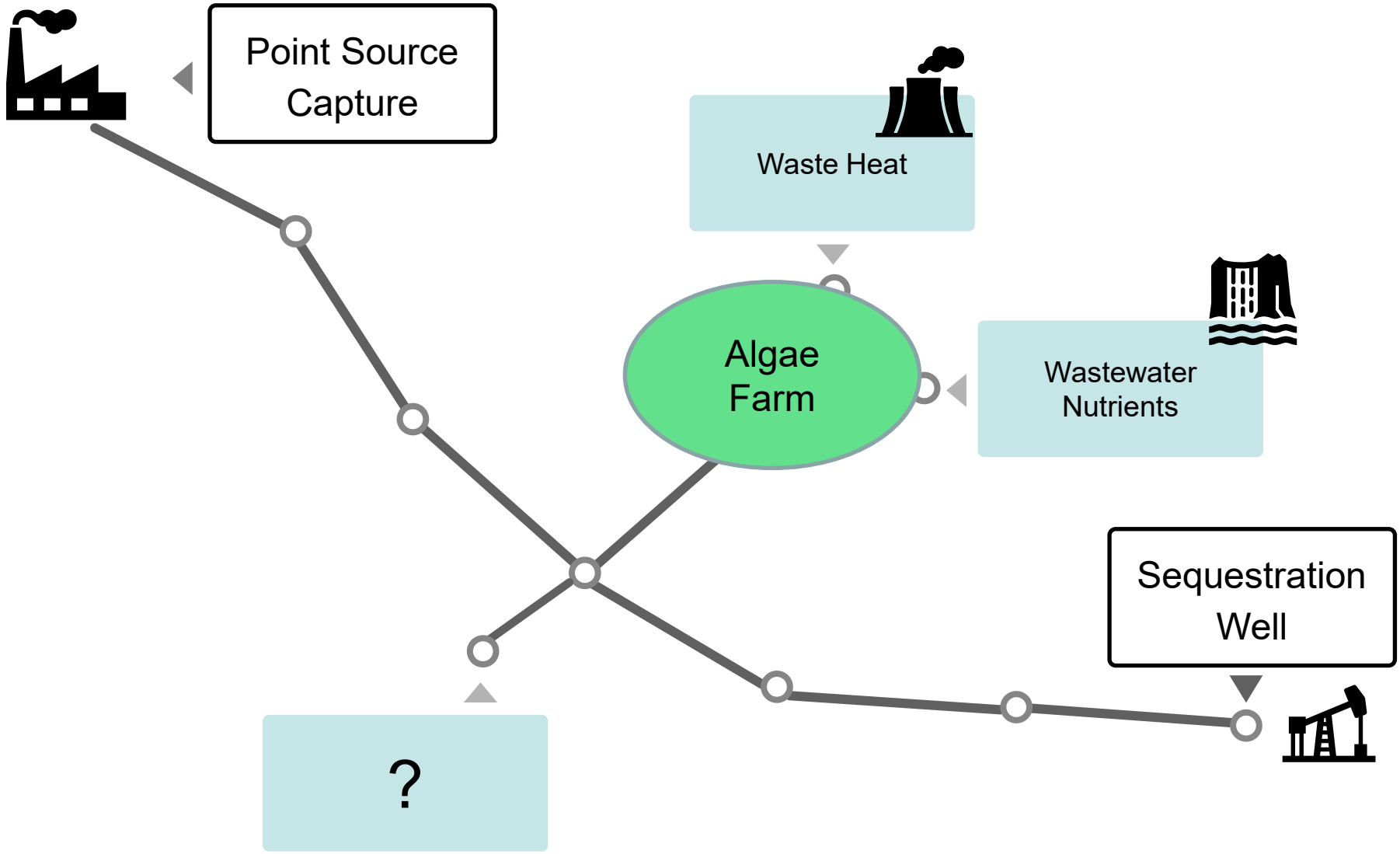
Strategic CO_2 Pipeline and Utilization Synergies

Collaboration Potential



Strategic CO_2 Pipeline and Utilization Synergies

Call for Potential Collaborations



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