



Global CO₂ Initiative

Great Lakes Carbon Offset Markets Project

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November 17, 2022

Agenda

Introductions

- Conference of Great Lakes St. Lawrence Governors and Premiers
- Global CO₂ Initiative

Review Problem Statement and Method

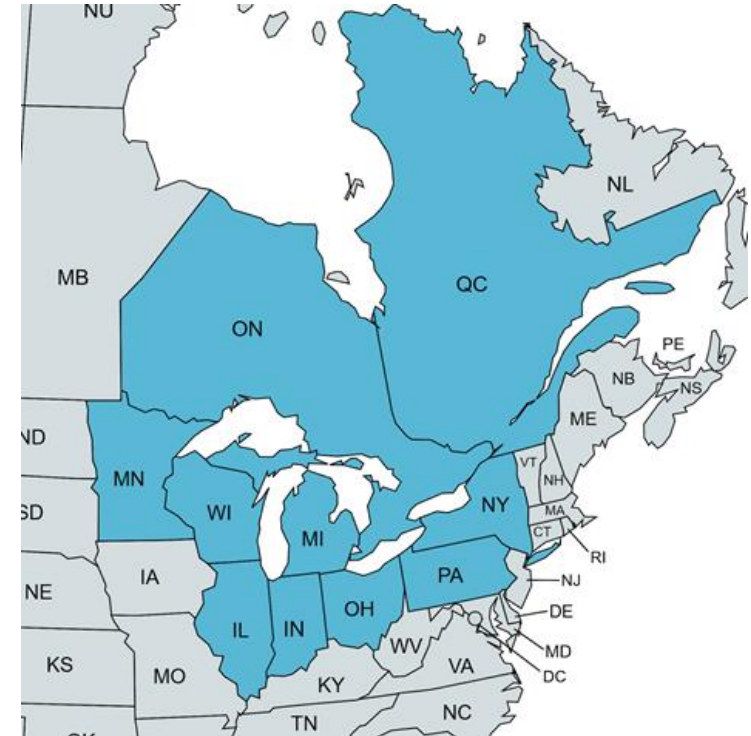
Results

Recommendations

Q&A

Conference of Great Lakes St. Lawrence Governors and Premiers

- Unites the chief executives from Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Ontario, Pennsylvania, Québec and Wisconsin
- Governors and Premiers work as equal partners
- Mission: Grow the region's \$6 trillion USD economy and protect the world's largest system of surface fresh water



Global CO₂ Initiative

Vision: CO₂ capture and utilization is a mainstream carbon management solution

Mission: Provide the intellectual leadership necessary to establish the new industry of CO₂ capture and utilization through research, assessment, education, training, and outreach

Problem Statement







Assess the potential for carbon offset supplies in the Great Lakes region that have the potential to drive new economic revenues in the voluntary carbon markets as well as offer additional co-benefits

Make recommendations on how to make the region a go-to area for high quality carbon offsets

Global Markets for Carbon-Utilized Products

New 2022 CCU Market Study Summary, full report and webinar are here.



Annual potential in 2050:		Utilization of 2 to 27 gigatonnes of CO ₂ Market opportunity of \$1,100 to \$4,400 billions		
		Annual market opportunity (\$ billions)	Annual CO ₂ consumption (gigatonnes)	
Track 1	 Construction materials Precast concrete, aggregates	800 - 1,000	1.0 - 9.5	CO ₂ is a new ingredient
Track 2	 Fuels Jet fuel, methane	21 - 2,060	0.28 - 10.80	
Track 2	 Chemicals Formic acid, methanol	100 - 180	0.26 - 0.58	CO ₂ replaces fossil carbon
Track 1 or 2	 Pure carbon materials Carbon black	14 - 66	0.04 - 0.20	
Track 1 or 2	 Polymers Polyurethane	130 - 190	0.002 - 0.013	
Track 2	 Food Animal feed	18 - 920	0.005 - 0.400	CO ₂ is a new ingredient



Regional Markets Assessment: Methodological Approach

Quantitative Analysis - GOALS	METHOD
Categorize and describe demand side voluntary carbon market (VCM) market drivers	Studied corporate carbon neutrality commitments and emissions reductions plans, websites and reports
Identify high quality, additional carbon storage options for the region that will also support economy	Published papers and resources such as the CDR primer, Department of Energy Reports, Ministry reports, Carbon Registries, etc
Create first order estimates of supply-side carbon storage potential and associated revenues	Government sources, published papers and reports, interviews
Describe historical carbon offset transactions	Berkeley/Carbon Direct Database
Describe criteria for high quality carbon offsets	Microsoft criteria, regional factors, and carbon registries
Qualitative Analysis - GOALS	METHOD
Find non-published pathways to connect with current activities on the supply side and demand side	Interview a broad range of stakeholders

Summary of Key Information Sources

Quantitative: Published Information	Qualitative: Interviews
Corporate ESG reports - Microsoft, Shopify, All Birds, Steelcase, Ben & Jerry's, Ford, with evaluation of at least 2 companies in each state/province	Supply Side: 7 State Forestry Departments, nature NGO's
Other key publications: CDR primer, IPCC reports, US EPA reports, California Low Carbon Fuel Standard (LCFS) , DOE Reports, Regional Greenhouse Gas Initiative (RGGI), Ecosystem Marketplace report, published papers for aggregates	Supply Side: 6 Project Developers
GIS Data: US Department of Energy, Carbon 180, Nature Conservancy	Supply and/or Demand Side: 10 Companies
Databases: Berkeley Voluntary Carbon Registry Offsets	11 Others: Carbon registry, national lab, EPA, researchers in nature based and engineered solutions, cities, NGO's

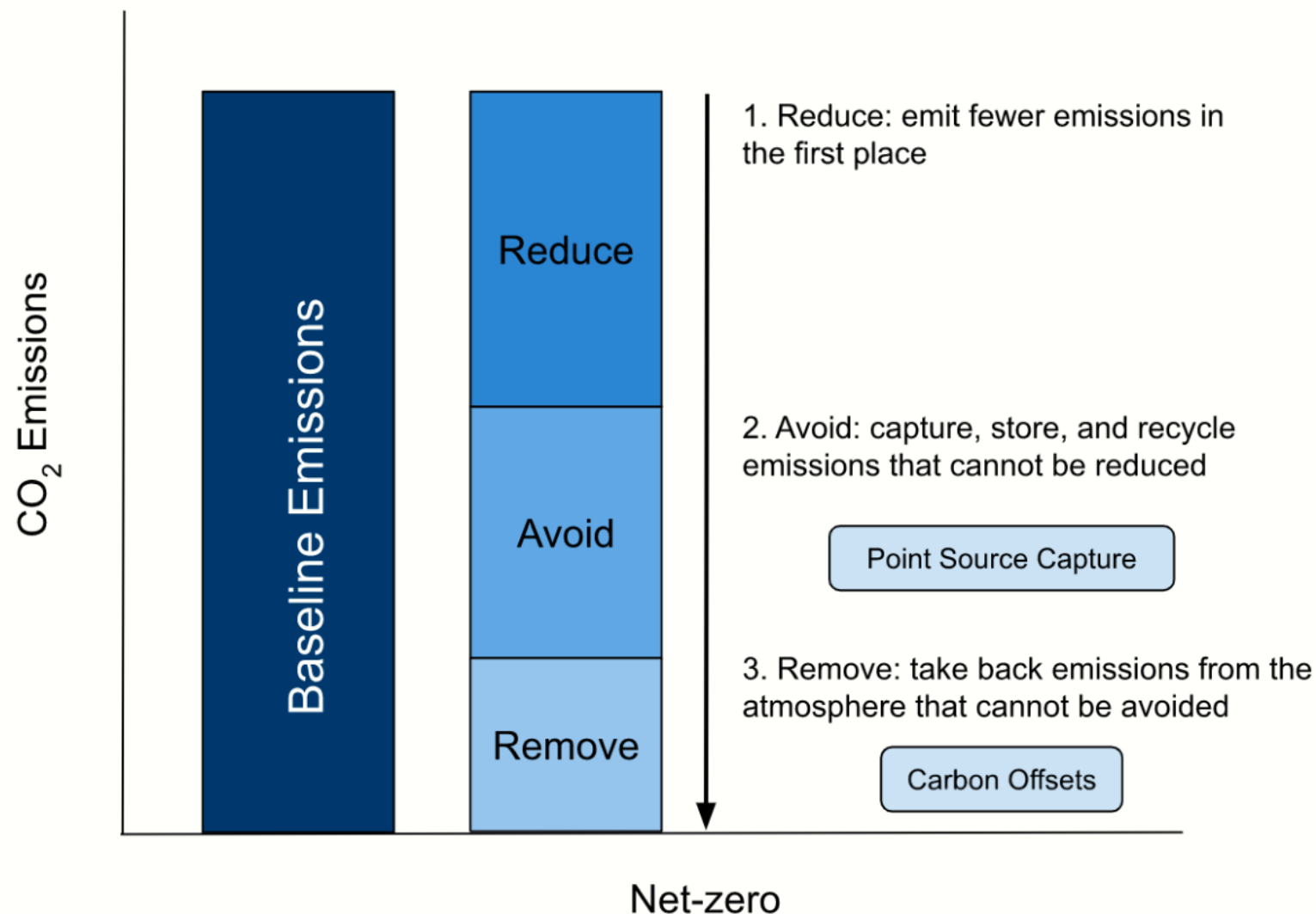


Many Types of Voluntary Carbon Offsets in Markets



Source: Ecosystem Marketplace Website

Where Do Carbon Offsets Fit in to Carbon Neutrality Plans?



Carbon offsets are there to get the last 10-20% of a carbon neutrality plan....DAC (direct air capture) at the end is very attractive, even at \$200 a ton, then we can get to net-zero.”

Senior Engineer, Large Industrial Manufacturer

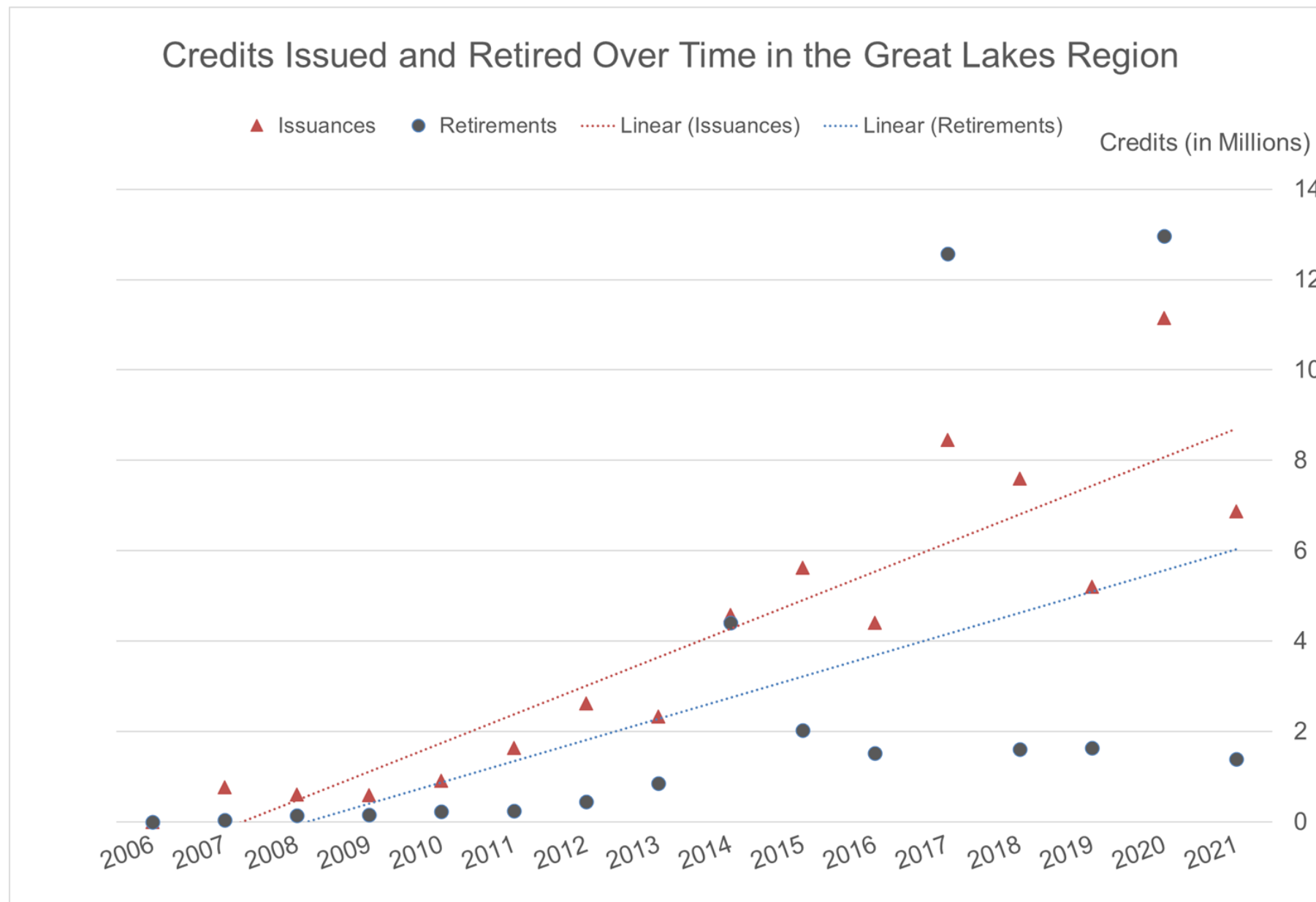
What is a Quality Carbon Offset? Criteria

- Should be a *carbon negative* process
- Based on Life Cycle Assessment (LCA) to ensure carbon negativity
- Additionality - project *should be additive and incremental* - the financial investment results in newly removed carbon dioxide from the biosphere
- No double counting - multiple entities cannot claim the same carbon credit
- Reliable measurement, reporting and verification (MRV), with independent audits over the credit's promised lifetime
- Durability - carbon stored long term with a low risk of carbon re-entering the atmosphere
- Account for environmental justice and holistic social ethics

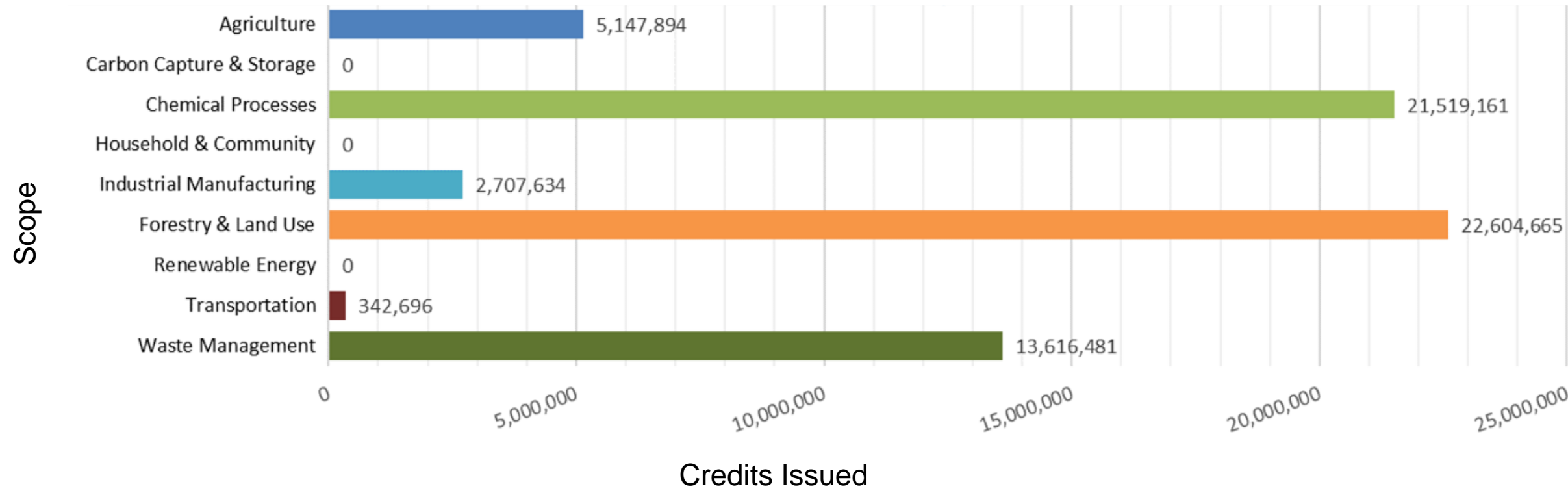
Backcast of Carbon Offset Deals in the Great Lakes Region

393 Total Projects in Region from 2003 - 2021

Source: Berkeley Carbon Trading Project Voluntary Registry Database

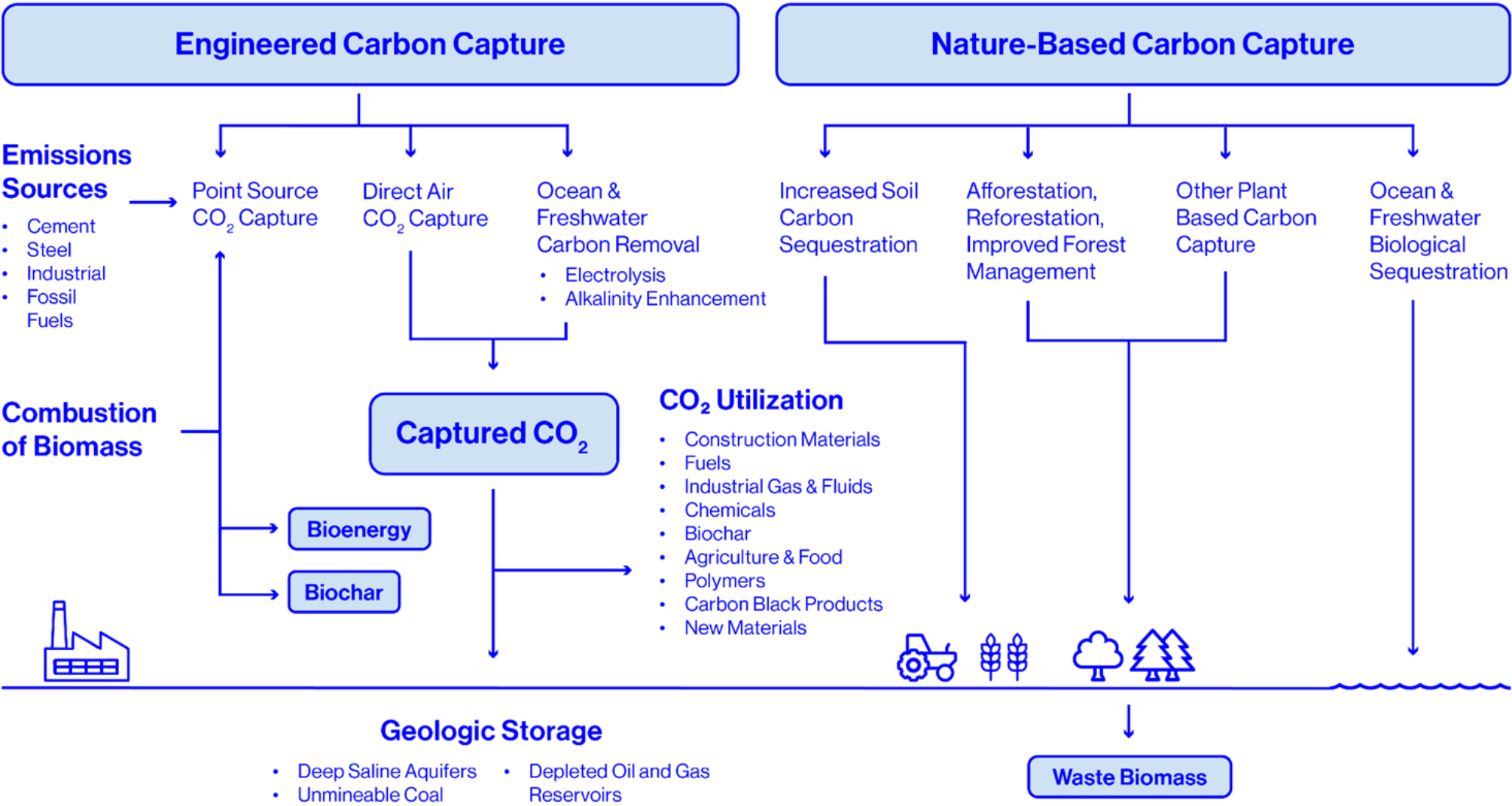


Regional Carbon Credits Issued by Scope

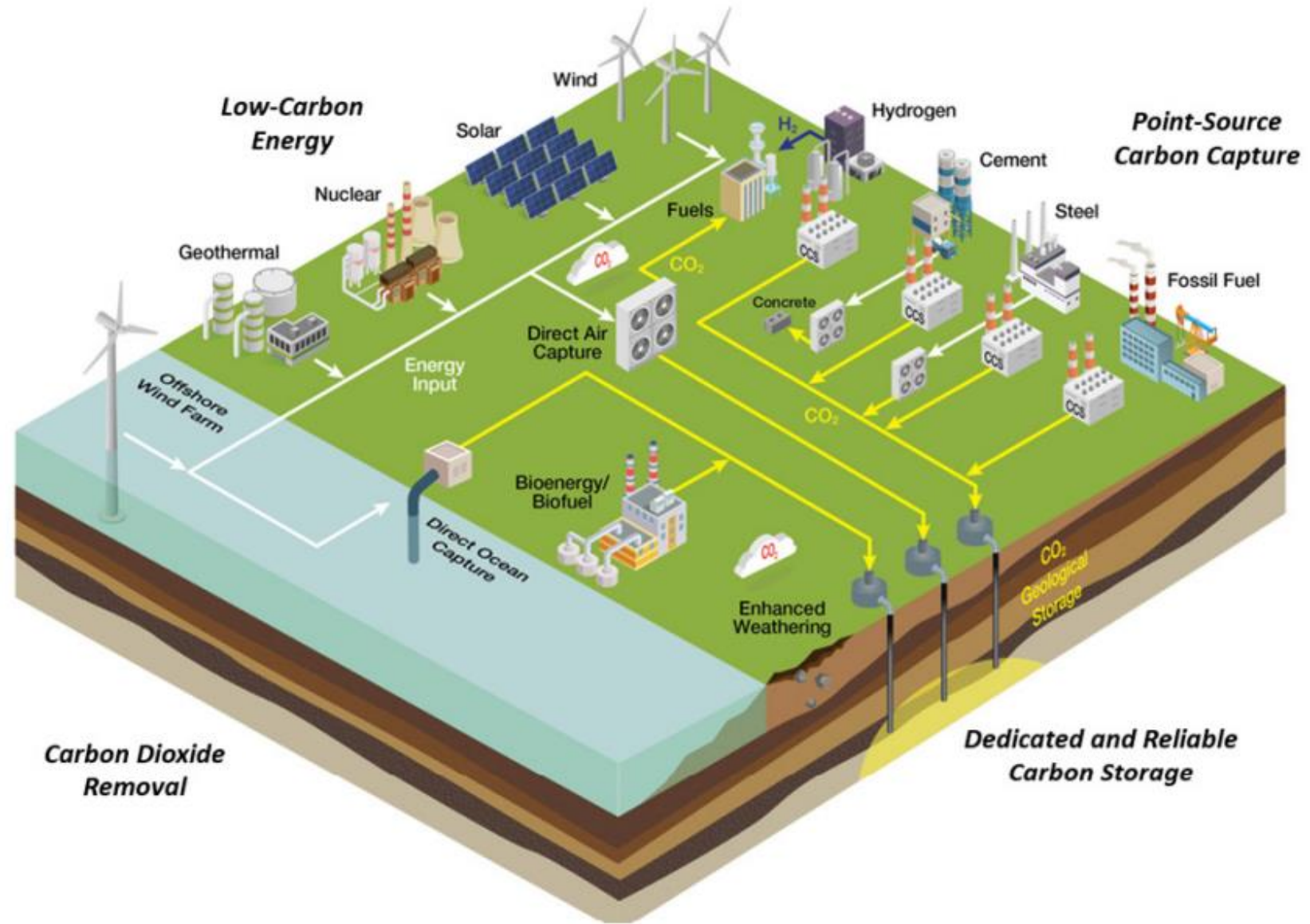


Source: Berkeley Carbon Trading Project Voluntary Registry Database

Supply Side Options: Nature-based & Engineered



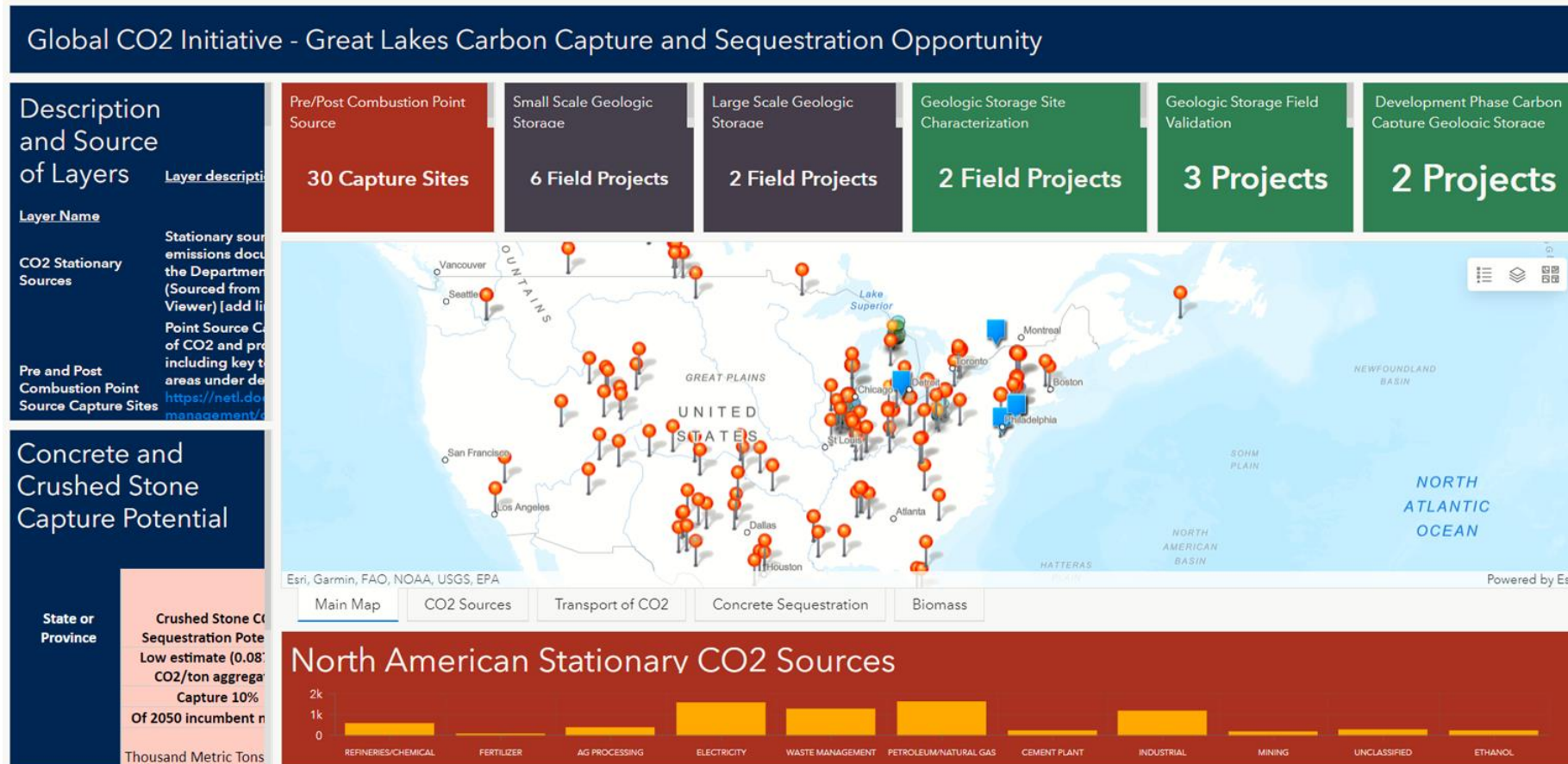
Supply Side Ecosystem for Engineered Solutions







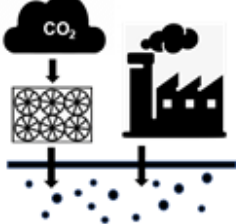
Source: DOE Fossil Energy Strategic Vision 2022

GIS Map Overview

- Created by Richard Greeley to support visualizing tonnage potential
- Available on Global CO₂ Initiative and GSGP websites shortly with publication of final report




Total Market Potential 2022 - 2050

Total Great Lakes Region Potential 2022-2050		Revenue: \$205 - \$783 billion Carbon Utilization: 14.4 - 52 gigatonnes CO ₂	
		Cumulative Revenue (billions \$USD)	Cumulative CO ₂ Removal (gigatonnes)
	Reforestation - Public Lands	\$0.85	0.034
	Reforestation - Private Lands	\$5.5 - \$55	0.2 - 2.2
	Aggregates for Construction and Concrete	\$2.6 - \$12.6	0.16 - 0.79
	Precast Concrete	\$0.003 - \$0.150	0.0001 - 0.0052
	Geologic Storage	\$196 - \$714	14.0 - 51.0

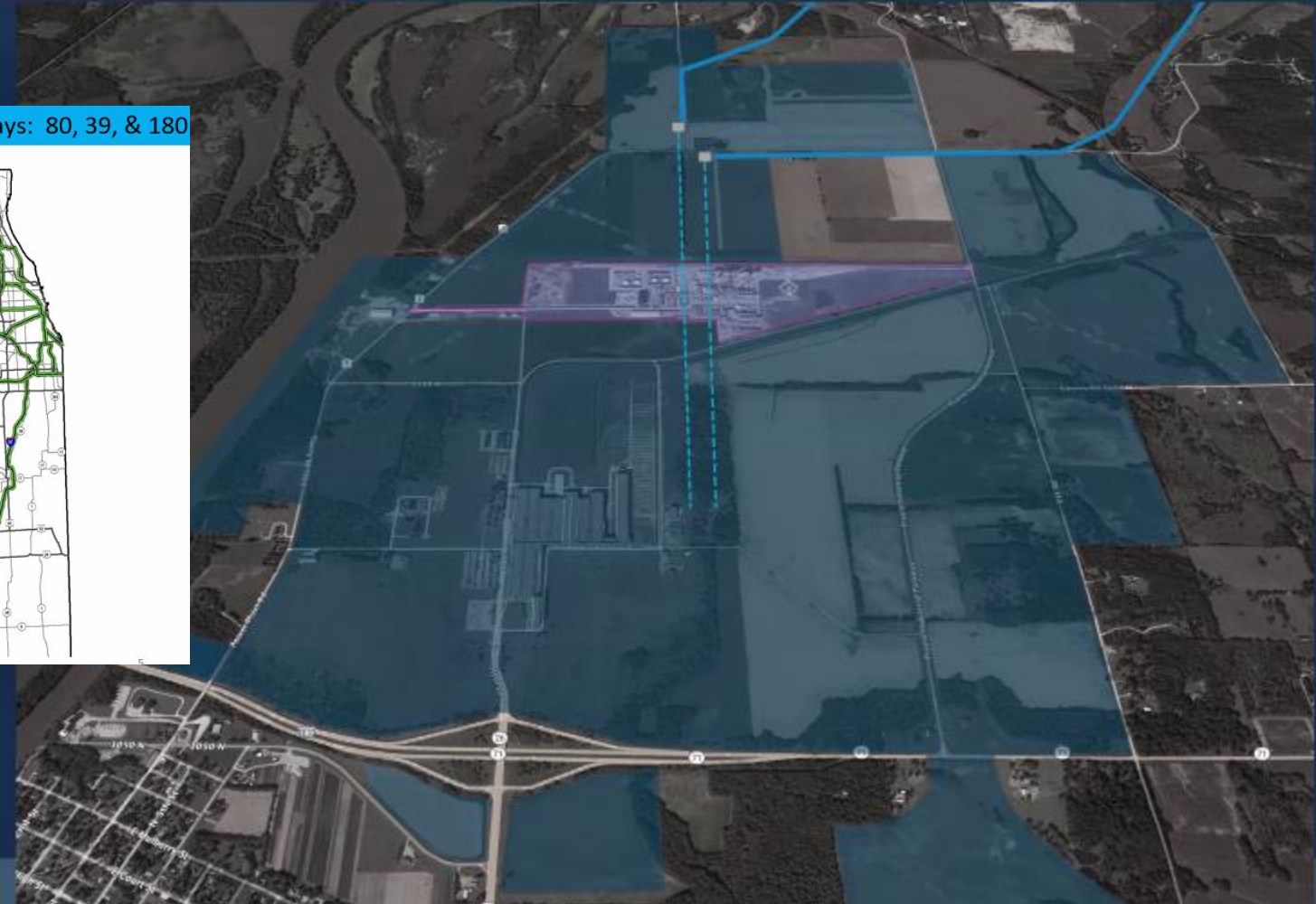
“The Great Lakes St. Lawrence Governors and Premiers can differentiate the region on the climate trajectory as a revenue source rather than a social cost”

Great Lakes Environmental and Economic Consultant

Marquis Complex: Centralized Hub Example

 MARQUIS

Marquis Industrial Complex



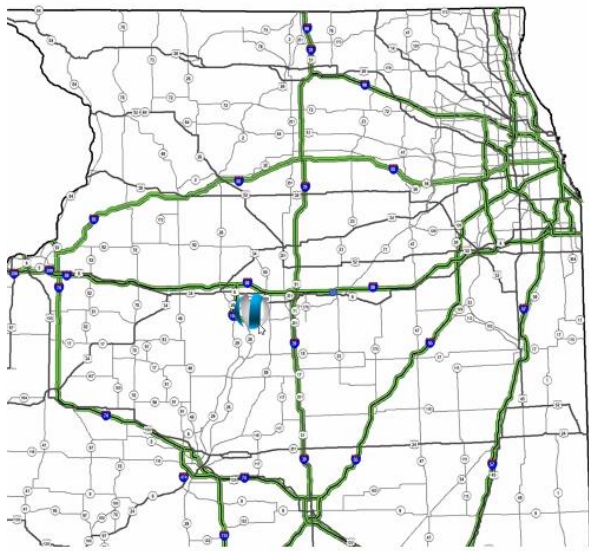
“Marquis Industrial Complex to be the world’s first carbon-neutral industrial complex with on-site carbon injection.”

Vision: To bring together like-minded low carbon industries and grow the low carbon economy together.

The Perfect Storm

- Two Natural Gas pipelines
- Major Power Lines
- Truck Transport
- Rail Transport
- Barge Transport
- 3300 Acres owned
- More than 5000 acres with pore space rights procured

Interstate Highways: 80, 39, & 180



Decentralized Examples



Photo: Sayumi Take for Nikkei Asia

“We should
recycle CO₂ as
we recycle any
other commodity”

*National
Laboratory Senior
Scientist*

Nature-Based Carbon Offsets

Strengths	Weaknesses
Relatively easy to implement	Difficult to measure actual carbon stored
Co-benefits such as biodiversity, recreation, cleaner water, etc	Invasive species, wildfires, pests, diseases
Options available in every region	Bridging, not permanent carbon storage
Relatively inexpensive	Aging owners, private lands will change hands in the next 15-20 years to the next generation
Easy to market and sell, a good story for customers, investors, and employees	Competition between carbon storage and other uses for land such as food production

Engineered Carbon Offsets

Strengths	Weaknesses
Many tens of gigatons of storage available	Cost - carbon capture at hub scale is hundred of millions of dollars
Permanent, durable carbon storage possible	Creates additional demand for low carbon energy (also needed for electrification)
Possible to measure carbon removal	In some cases CCU needs green hydrogen which is not yet readily available
Can take advantage of U.S. tax credits for qualifying projects	Story potentially less appealing to companies, especially for geologic storage projects
When captured CO ₂ is included in a product, provides economic revenue and jobs	Can be seen as extending the usage of fossil fuels for point source capture projects



45Q Tax Credit in the US

- Passed by Congress in 2022, the **Inflation Reduction Act (IRA)** is the most historic piece of energy legislation in U.S. history
- Offers \$369B USD for climate action through tax credits
- Allows all CCUS **projects that begin before 2033** to qualify under the 45Q Tax Credit

Prior to the IRA: \$12 - \$50 per ton of CO₂ captured

Post IRA: \$60 per ton (utilization) - \$85 per ton (sequestration)

Post IRA DAC: \$130 per ton (utilization) - \$180 per ton (sequestration)

“Recognize that this is a 40-year problem, it is daunting, and you will get there in steps.”

Senior National Laboratory Scientist

What Are Regional Barriers to Better Voluntary Carbon Markets?

- **Lack of awareness amongst many stakeholders** about what carbon removal is and how addressing it can create new revenue sources
- **Lack of planning and coordination amongst emissions sources and sinks**, entities that can use the CO₂ to place underground or make products
- **Lack of profitability for new supply side carbon solutions** - truly additional solutions just entering the market without the advantage of volume
- **Lack of supporting infrastructure** (pipelines, easy access to class VI well permits, low carbon energy sources, green hydrogen)



Recommendations

1. U.S. states with significant geologic potential to store CO₂ in Class VI wells should **submit a primacy application to the US EPA** now
2. **State and provincial agencies should coordinate with “hard-to-abate industries”** such as iron, steel, cement - and ideally all industry actors for emissions abatement planning
3. The Great Lakes region should **hold 45Q Tax Credit, carbon emissions reduction, and carbon offset seminars** to inform regional companies and individuals of the opportunities for carbon storage and utilization and to facilitate collaboration

“A key enabler is advocacy at the state, regional and local levels, and cross-borders to lower the hurdles to get carbon neutral technologies in place”

Senior Engineer, Large Industrial Products Manufacturer



Recommendations (continued)

4. **The Great Lakes St. Lawrence region should create a program** similar to the Québec Cap and Trade System or Regional Greenhouse Gas Initiative (RGGI) to **establish a regulated carbon market**

5. **The Great Lakes St. Lawrence region should develop and support a sovereign wealth fund** as a means to protect the environment while accruing economic benefits for future generations.

“The Great Lakes has a lot of diversity – a lot of shipping, industry, universities, lumber, cars, and high population density that will grow over time. And it is an area of the world that is uniquely free of climate disasters, wildfires, floods, and mudslides and so it will be a promising economic zone. There is no clear leader in the Great Lakes region, and it makes sense to plan due to the natural resources and industry.”

Chief Scientist, Global Non-Profit Organization



Areas for Follow-up Study

- Investigate **what it would take to deploy carbonated aggregates and pre-cast concrete production as new commercial industries** in each state and province
- Launch a study to assess **decarbonizing the great lakes water bodies**
- Create a study on **where to locate future direct air capture plants** near storage sites, renewables/low carbon energy sources and CCU producers
- Study the **best usage for waste biomass in the region**: fuels, biochar, energy/BECSS
- Create a **regional forest carbon strategy** for ecosystem services and economic goals
- Assess **additional geologic storage** potential in the region
- Assess the feasibility of **operator cost recovery for installing carbon capture** systems with regional grid operators and others
- Assess the capital and infrastructure needed to deliver the markets in this study



Key Findings

- From 2022-2050, a total of **14.5-52 gigatonnes of high quality carbon storage available** that can be sold into the carbon markets. Can balance annual regional emissions of 1.5 gigatonnes with extra to sell
- **This region has an opportunity to lead the world in CCUS products, revenue, and employment - and be a prototype for the rest of the world**