
Mitchell, Indiana

Develop an integrated carbon capture, transport, and storage project at the newly modernized Mitchell Cement Plant

2 million

mt CO_2 p.a.

Amine-based CO_2 removal system, targeting 2mt CO_2 annually at 95% rate

Objective: The first full-scale carbon neutral cement plant in the United States

Technology: MHI KM CDR Process™ which has previously been demonstrated at Petra Nova

Budget: $1,085m
(Federal Share $500m)

Status: FEED studies for capture and onsite storage; four (4) DOE grant awards

Heidelberg Materials

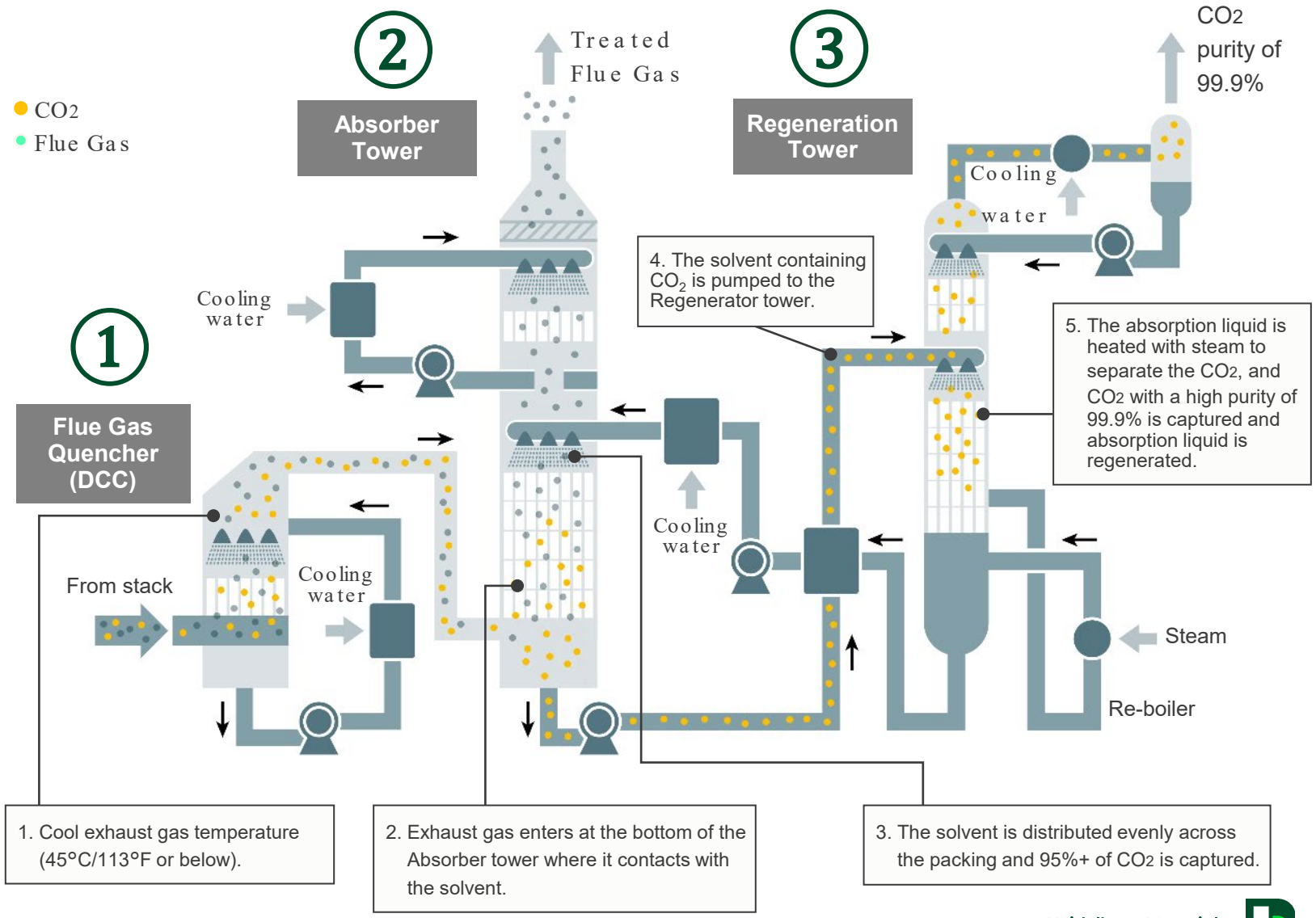
Initial CO_2 Capture FEED Study – DE-FE0032222

- Cost share 80/20. Total $4.8M, DOE $3.7M, Cost share $1.1M (in kind) with Heidelberg Materials labor
- Prime = Heidelberg Materials, Technology = MHIA, Engineer = Sargent & Lundy (S&L)
- 18-month budget period
- Tasks to be completed under the Statement Of Project Objectives (SOPO) include the following:
    - Project Management Plan
    - FEED Study including: Capture Island Engineering & Design, BOP Engineering & Design, Engineering Studies, and Cost Estimating
    - Business Case Analysis
    - Life Cycle Analysis
    - Environmental Health & Safety Analysis
    - Environmental Justice Analysis
    - Economic Revitalization and Job Creation Analysis

Flow diagram

KM CDR Process™

- KM CDR Process™ = ***Kansai Mitsubishi Carbon Dioxide Recovery Process***
- Amine-based technology
- Capable of capturing 95+% CO_2 from combustion gas (depending on source)
- Automatic load adjustment control (ALAC)
- Amine filtration and purification systems
- Tower design capability for even gas/liquid distribution



Stack testing – Gas constituents

- Testing requirements
- Mill ON / Mill OFF conditions
- Typical testing vs CCS testing
- SO_3 / NO_2 / NH_3 / PSD
- Two testing periods
  - 25th Oct – 2 weeks
  - 6th Nov – 1 week
- Stack test results expected mid - Nov for the first testing campaign.

Critical Components	Testing Methods	Required Impurities Detection Limit
CO_2	EPA Method 3A (Instrument, NDIR)	-
O_2	EPA Method 3A (Instrument)	-
H_2O	EPA Method 4	-
SO_3	EPA Method 8A (Controlled Condensate Sampling)	0.1 ppm
Ammonium Sulfate as NH_3	EPA Method 5 (Filtration - IC)	0.01 ppm as NH_3
SO_2	EPA Method 6C (Instrument)	0.1 ppm
NO_2	EPA Method 7E (Chemiluminescence)	0.1 ppm
Hydrogen Halides	EPA Method 26A (Filtration & Absorbing Solution)	0.04 ppm
Halogens	EPA Method 26A (Filtration & Absorbing Solution)	0.04 ppm
Hg	EPA Method 30B (Sorbent Trap)	0.1 µg/Nm³
Heavy Metals	EPA Method 29	1 µg/Nm³
PM (FPM/CPM)	EPA Method 5 (Filtration)/EPA Method 202	0.1 mg/Nm³
Particle Size Distribution	CARB 501 (Cascade Impactor)	0.25 to 10 µm
NH_3	EPA Method CTM-27 (Absorbing Solution/IC)	0.1 ppm
VOCs	EPA Method 25A	Same as regulation level
Unburned Hydrocarbon	EPA Method 18	-
Component of Condensable PM	Ion chromatography for anion (F^-, Cl^-, Br^-, NO_3^-, $SO4^{2-}$) and cation (K^+, Ca^{2+}, Na^+ Mg^+, NH_4^+) and unburned hydrocarbon for CPM taken by EPA Method 202A.	0.1 mg/Nm³
Ammonium Sulfate in Filterable PM	Ion chromatography for NH_4^+ and Unburned hydrocarbon analysis for FPM taken by EPA Method 5 (Assumed NH_4^+ in FPM is as $(NH_4)_2SO_4$)	0.1 mg/Nm³
PAHs	EPA Method TO13A	-

Basic Engineering Design

- In progress
- Validate with stack testing
- Flue gas Pretreatment (optional possibilities)
  - Wet Scrubber or ESP
  - SCR
  - Catalytic Reduction

Site Elevation [m]	201.17
Atmospheric Pressure [mbar]	939.32
Dry Bulb Temperture [°C]	-20 to +40

Flue Gas Source	Design (Normal)	Range (Min and Max)
Flow Rate (Nm^3/hr)	1,013,392	50%-110% normal
Temperature (°C)	107	(80-200)
Composition (vol%-wet)		
N_2	62.2	(56-64)
Ar	0.0	0
CO_2	11.3	(10.5-12)
O_2	10.4	(9.5-14)
H_2O	16.1	(15-18)
Composition (ppm vol wet) (*2)		
SO_2	24	(1-230)
SO_3	-	-
NOx	125	(16-380)
NO_2	-	-
CO	175	(41-387)
NH_3	-	-
Unburned Hydrocarbons	7.2	(0-83.7)
Particulate Loading (mg/Nm^3-dry)	3.0	(1.5-10)
VOC (if regulation is required)		

DOE Grants

1-2 **DOE Office of Fossil Energy Carbon and Management (FECM)**

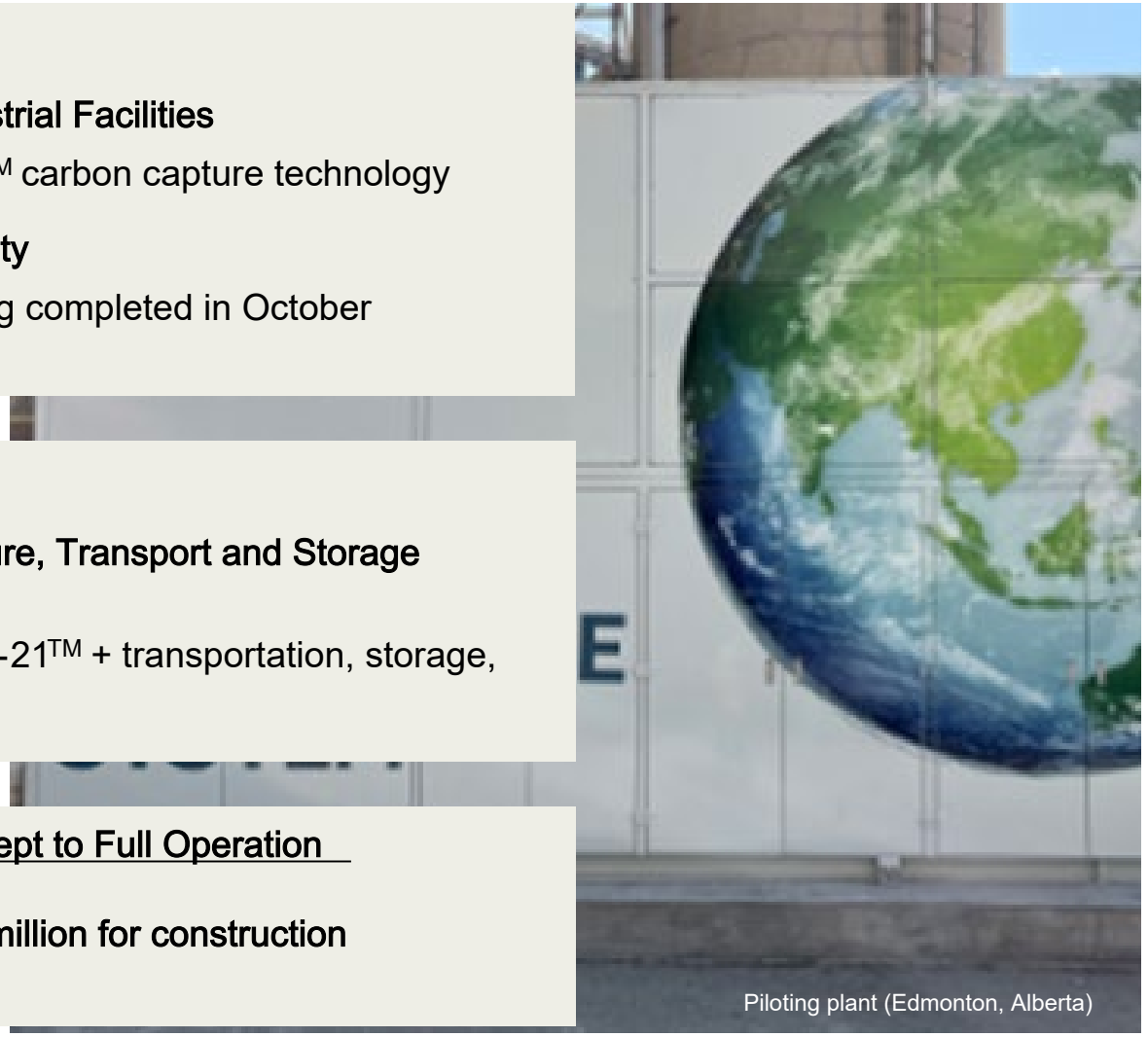
1. **DE-FE0032222 FEED Studies for Carbon Capture Systems at Industrial Facilities**
   - 18-month FEED study for amine solvent using MHI's KS -21™ carbon capture technology
2. **DE-FE0032268 CarbonSAFE Phase II – Storage Complex Feasibility**
   - Completed over 50 miles of 2D seismic in June. data processing completed in October
   - Plan to initiate test well drilling Q2 2024

3 **DOE Office of Clean Energy Demonstrations (OCED)**

1. **DE-CD0000009 Demonstration Projects for Integrated Carbon Capture, Transport and Storage Systems**
   - Integrated FEED studies for amine solvent using MHI's KS -21™ + transportation, storage, & Class VI permitting

4 **DOE OCED "Demonstration to Deployment" All Four Phases – Concept to Full Operation**

1. **DE-CD0000090 Selection announced March 25th for up to $500 million for construction**



Piloting plant (Edmonton, Alberta)

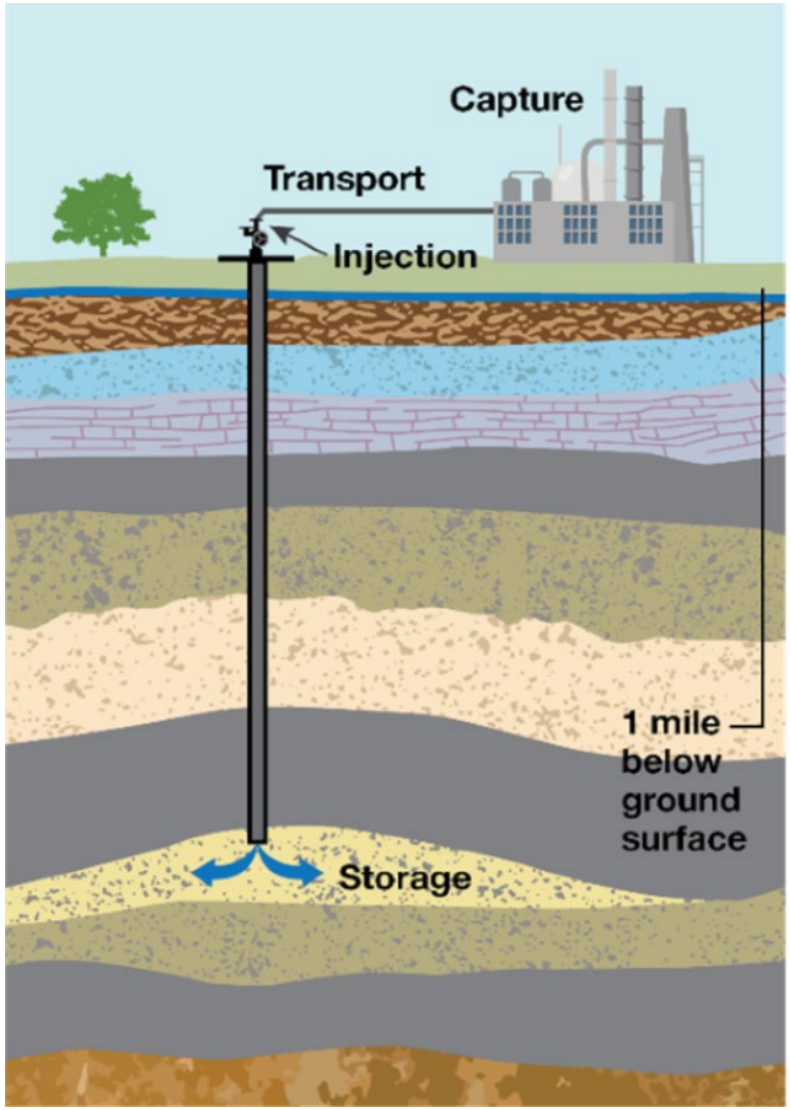
CarbonSAFE Phase II Site Characterization – DE-FE0032268

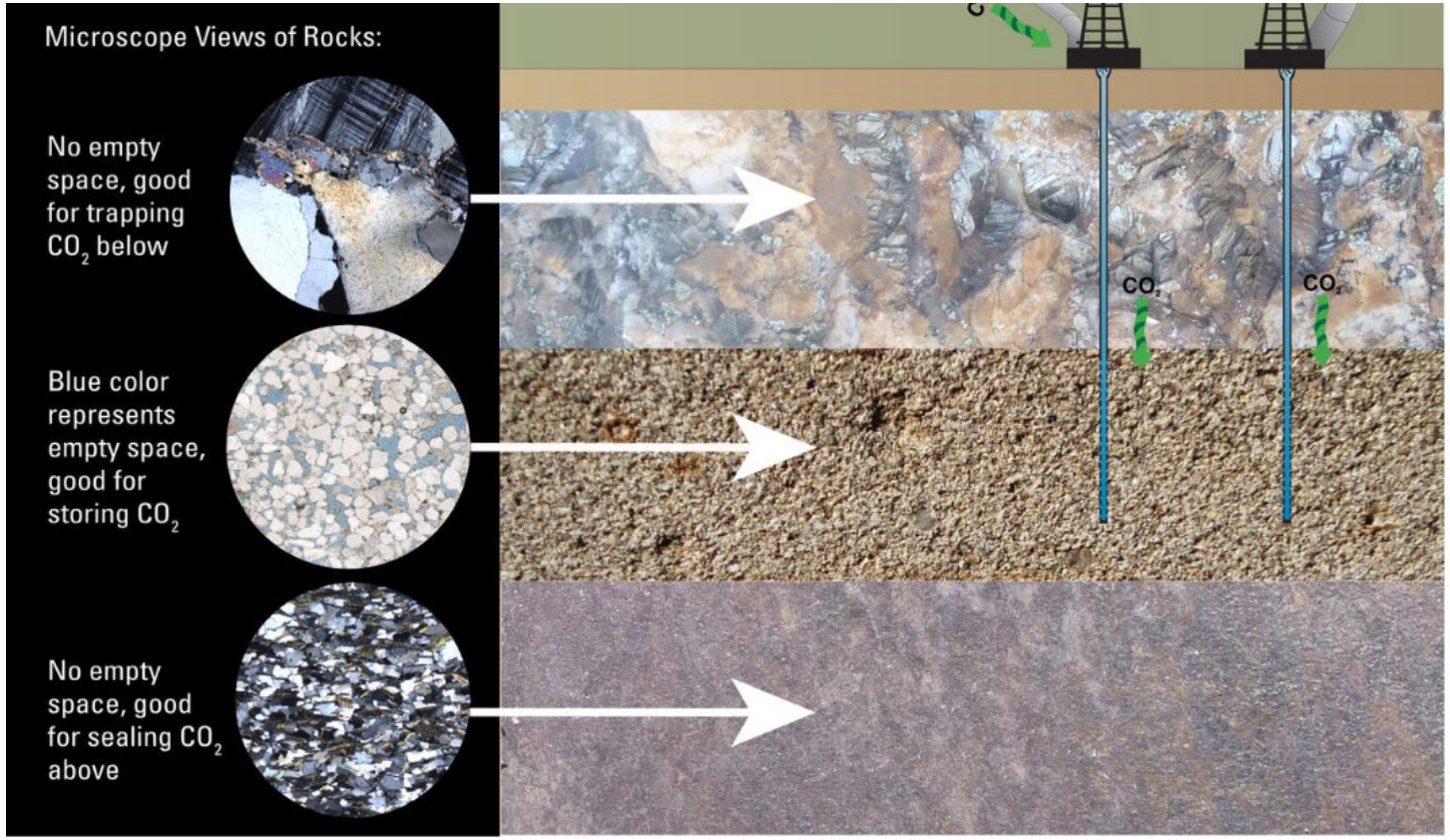
- Cost share 80/20. Total $11.1M, DOE $9M, Cost share ISGS $.6M, Heidelberg Materials $1.5M labor, in -kind, cash
- Prime = ISGS, Heidelberg Materials = Host site and industrial partner, Drilling = Projeo, and smaller team members including: Indiana Geological & Water Survey, Trimeric, and Gnarly Tree Sustainability Institute
- 18-month budget period
- Tasks to be completed under the Statement Of Project Objectives (SOPO) include the following:
    - Drill a 7,250 test well to geologically characterize formations beneath our Mitchell cement plant for carbon storage
    - Evaluate formations, seals, and structural settings
    - Acquire and analyze data to develop defendable geological and numerical models to predict site performance
    - Conduct a risk assessment and develop mitigation strategies
    - Examine potential environmental justice issues, identify stakeholders and develop an engagement strategy for their input
    - Assess the technical and economic feasibility of the CCUS project at Mitchell
    - Identify data gaps and develop a plan to fully characterize to prepare for a Class VI permit application

Test Well Site

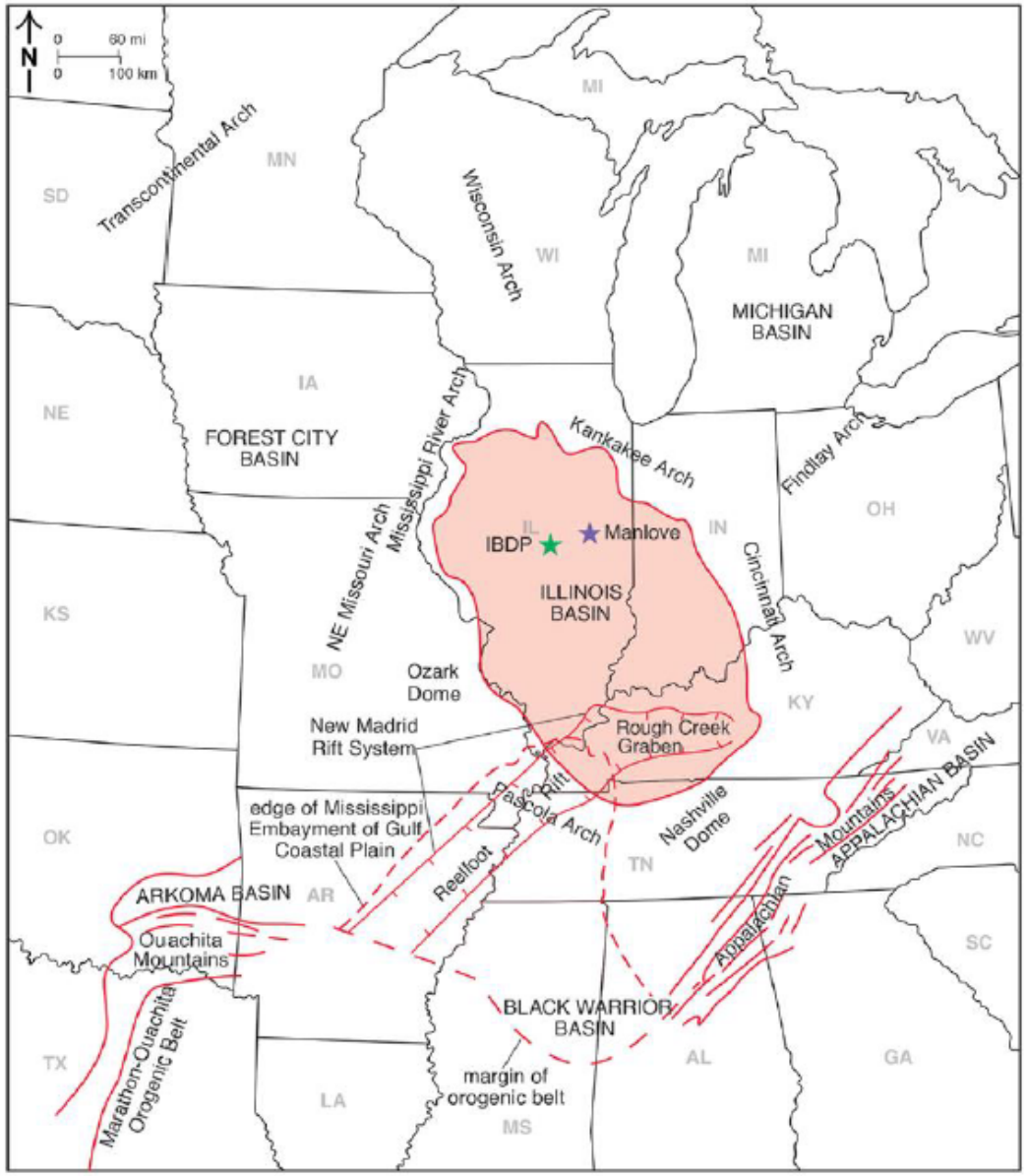
Heidelberg Materials

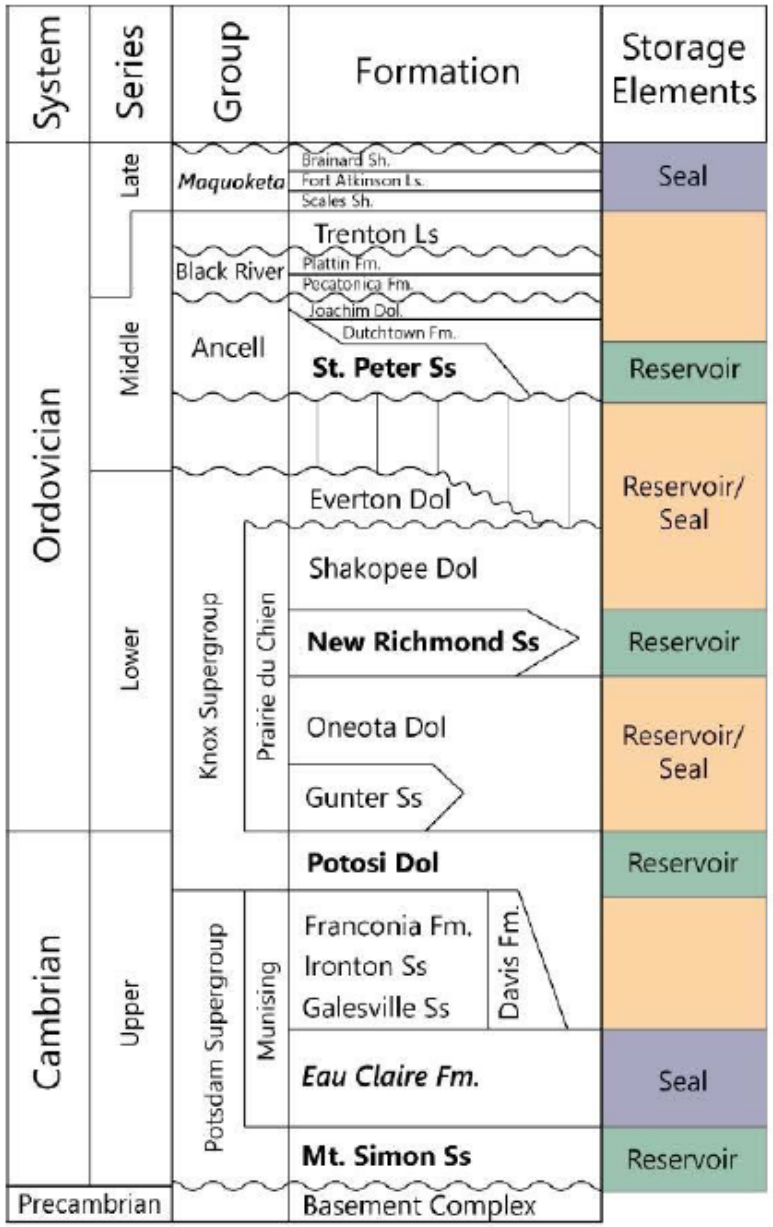
Storage


Capture
Transport
Injection
1 mile below ground surface
Storage


Microscope Views of Rocks:
No empty space, good for trapping CO_2 below
Blue color represents empty space, good for storing CO_2
No empty space, good for sealing CO_2 above
CO_2
CO_2

ILLINOIS BASIN REGIONAL GEOLOGY

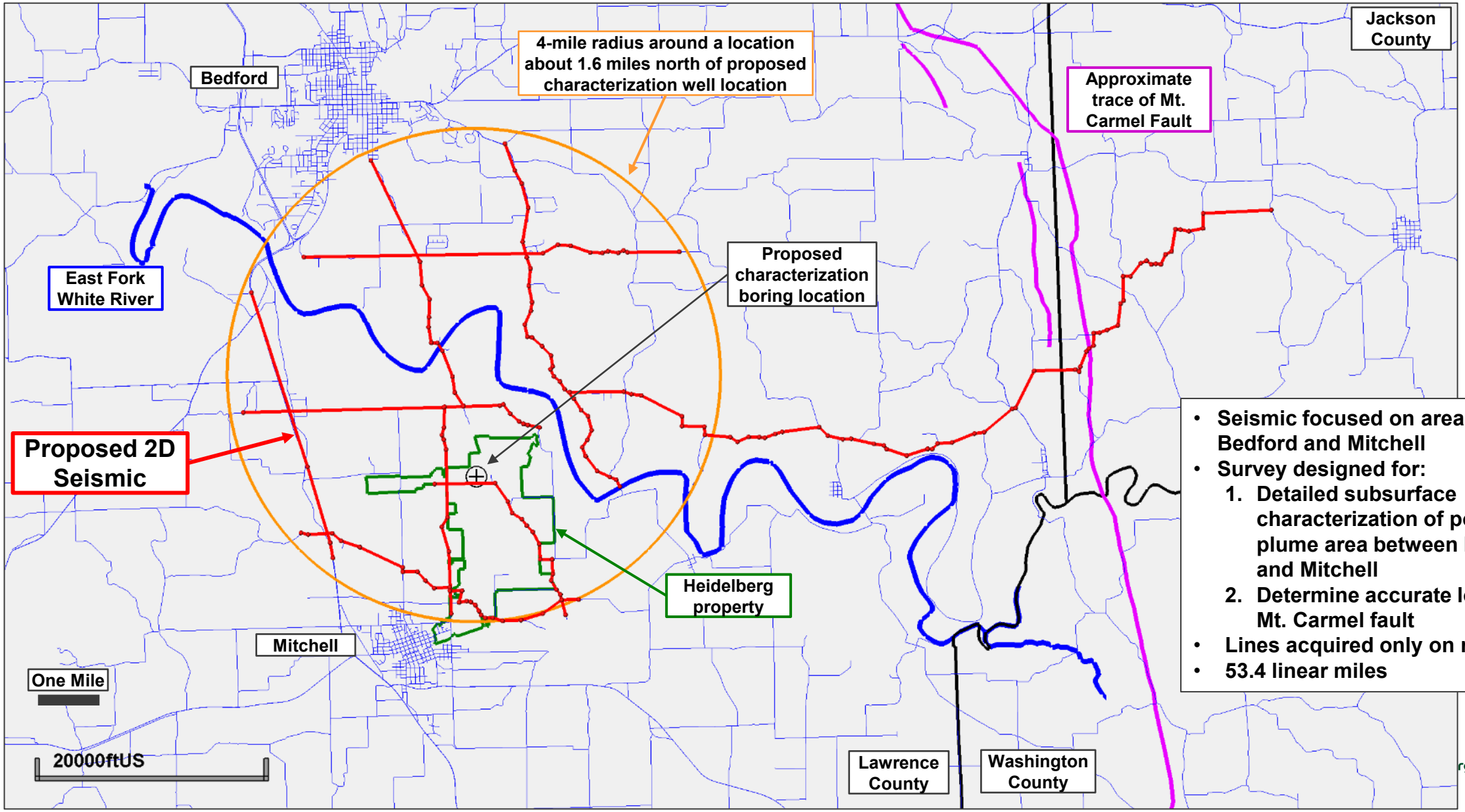




Cambro-Ordovician Storage Complex

ILLINOIS
Illinois State Geological Survey
PRAIRIE RESEARCH INSTITUTE

Mitchell 2D Seismic Survey



- Seismic focused on area between Bedford and Mitchell
- Survey designed for:
  1. Detailed subsurface characterization of possible CO_2 plume area between Bedford and Mitchell
  2. Determine accurate location of Mt. Carmel fault
- Lines acquired only on roads
- 53.4 linear miles

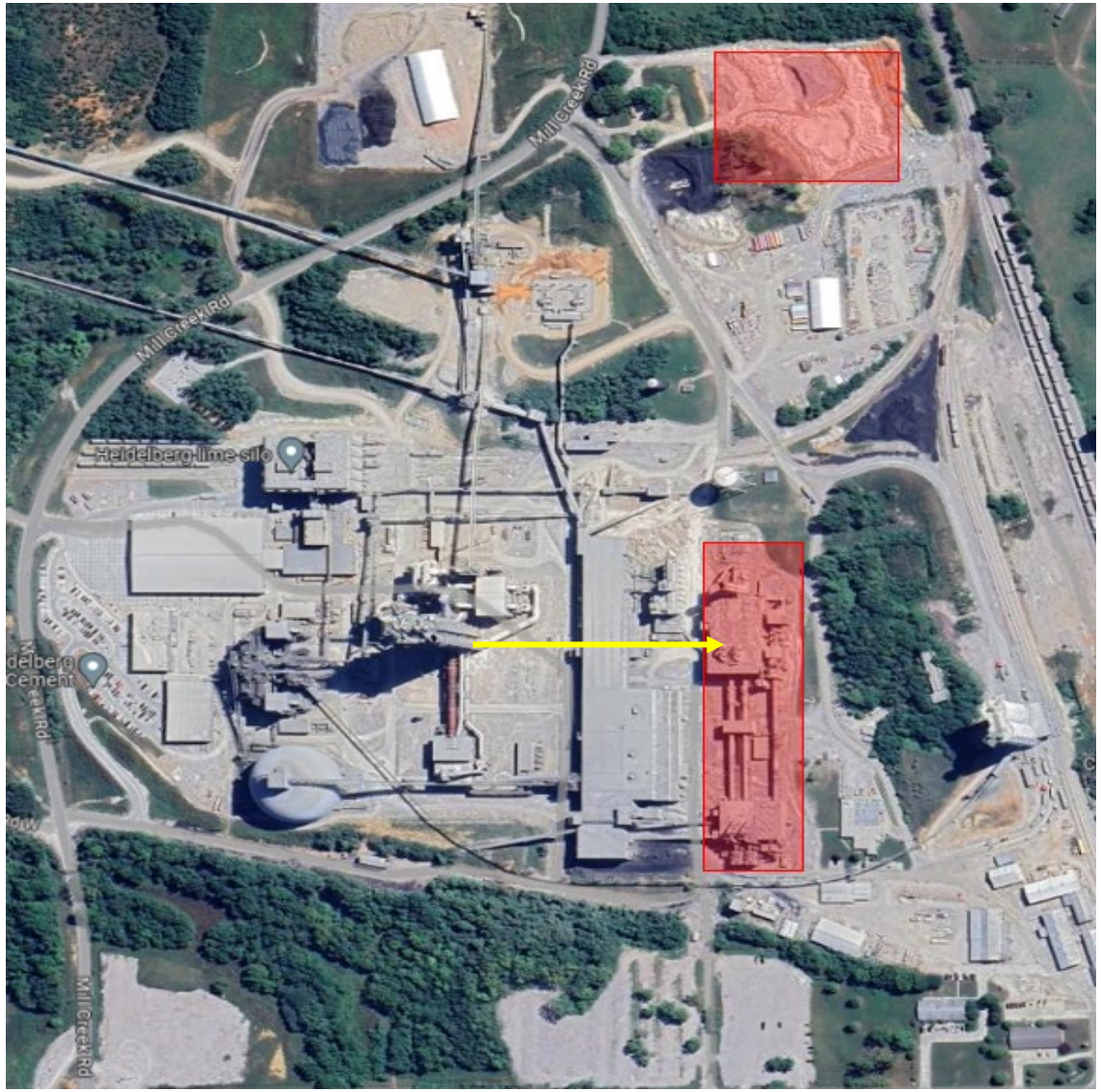
Seismic Study

2-D Seismic Study

Overall Project Location

1. Carbon Capture Plant on bottom right (red outline)
2. Geological test site location on left (red outline)
3. CO_2 product transport distance ~4000 m, within plant boundary
4. Geologic testing scheduled to begin Summer 2024
5. Results will inform next steps and help verify feasibility

Preliminary Carbon Capture Plant Site



1. Flue gas duct route ~200 m (stack to CCP).
2. 300 m x 80 m – bottom rectangle, planned area for CC and steam facility
3. 100 m x 150 m – top square, planned area for water cooling system and other auxiliaries
4. More work to be completed to design facility and develop refined cost estimate during FEED Study that is ongoing and will be completed over coming ~18 months

Demonstration Project Phase I FEEDs for Integrated CO_2 Capture, Transport and Storage Systems – DE-FOA-0002738

- Cost share 50/50. Total $ 10M, DOE $5M, Cost share $ 5M with in kind Heidelberg Materials labor ($1.5M) and cash ($3.5M)
- Prime = Heidelberg Materials, Technology = MHIA, Engineer = Sargent & Lundy (S&L), Constructability = Kiewit, Class VI application = ISGS, Storage System Development = Baker Hughes, Community Benefits/EJ = GTI Energy
- 18-month budget period
- Tasks to be completed under the Statement Of Project Objectives (SOPO) include the following:
    - Develop a site -specific FEED of MHIA's carbon captur e technology at our new Mitchell cement plant
    - Expand on the work already underway by project DE -FE0032222
    - Evaluate the cost and performance of retrofitting the Mitchell cement plant with CC technology
    - Develop an AACE Class 3 estimate (±15%) for the entire project (capture transport, storage)
    - Prepare major permits such as Title V and Class VI injection well permit to construct
    - Execute the Community Benefits Plan

Application for DOE Industrial Decarbonization and Emissions Reduction Demonstration-to-Deployment Funding Opportunity Announcement

Facility -level Large Installations and Overhaul Retrofit Demonstrations Large-scale overhauls for existing facilities, common technologies across multiple facilities, or new builds with accelerated planning, development, permitting, and financing strategies.

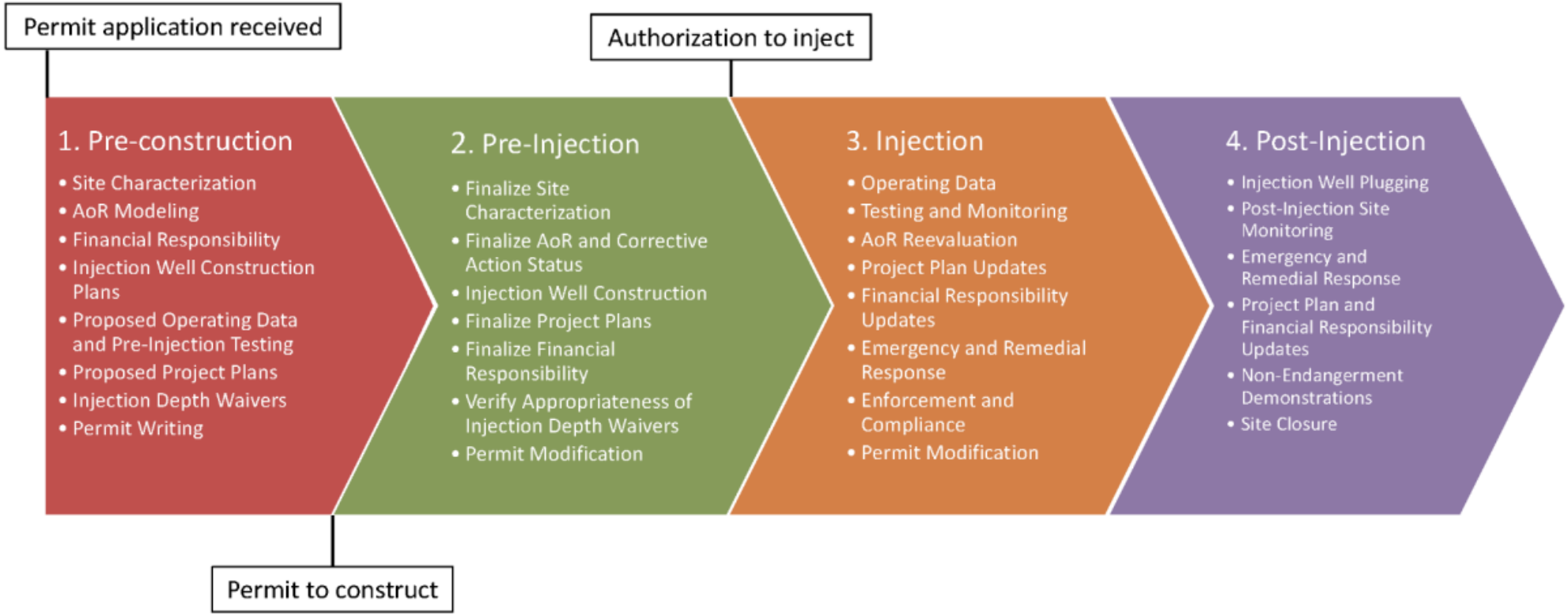
$75M-500M DOE grant opportunity

Application Submitted August 2023

Permitting

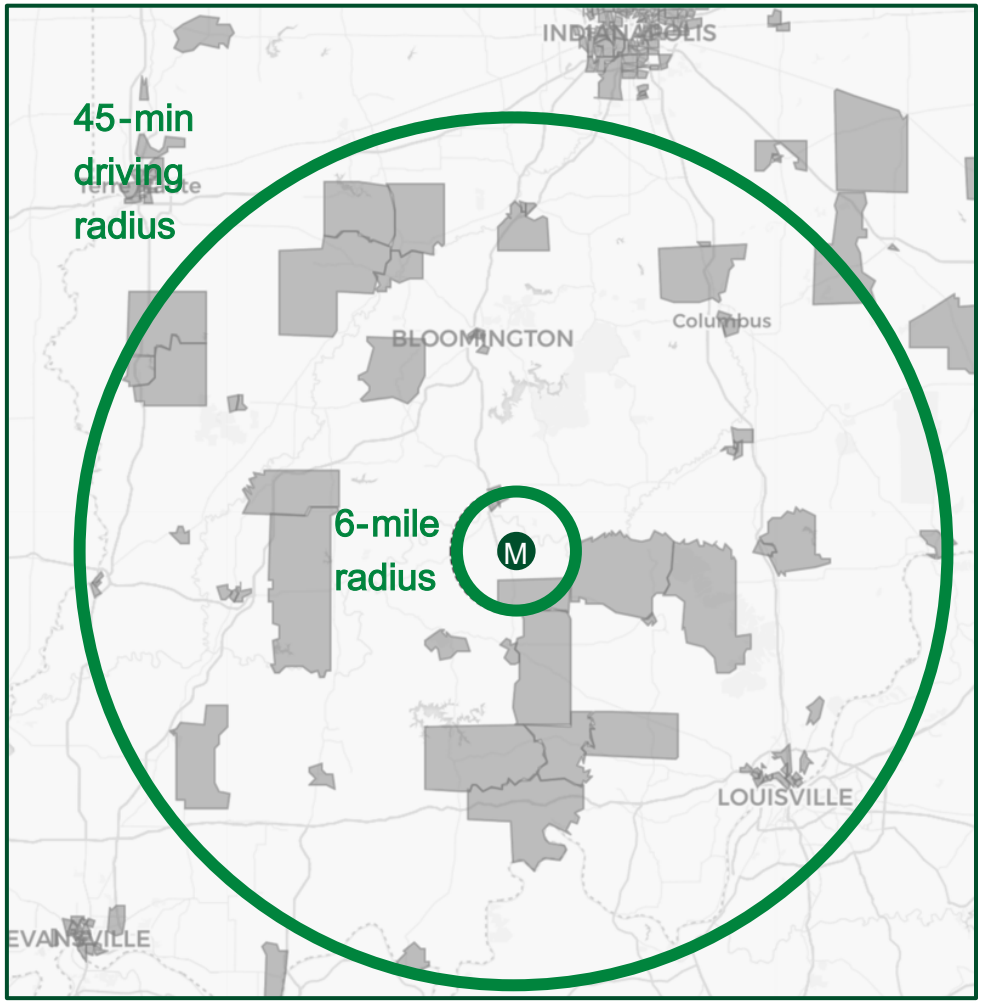
- Test Well
  - Application for test well submitted to IDNR. Authorization is pending
- Air Permitting
  - Approximately 12 months to prepare a permit application package once engineering and design phase is complete
- Injection Well
  - Class VI injection well permit required for CO2 storage
  - EPA has permitting authority (Indiana will not pursue primacy)
  - Indiana will have state permit for injection

Class VI Permitting Timeline



Outreach and Engagement

Delivering community benefits



Disadvantaged communities (DACs)

Two-way engagement with Community Advisory Panel (CAP)

Education and Outreach-Purdue Extension

Project to boost local economy & businesses

1,000+ construction jobs & 25+ permanent jobs

95% GHG emission reduction in cement production at state-of-the-art cement plant. Further reduction of NOx and SO_2 emissions

Decarbonize cement industry at full scale

Delivering community benefits

Community Priorities and Needs

- Community engagement on CCS from previous awards
- Continuity of CBP leadership & activities across awards and through all phases

Community Advisory Panel (CAP)

- Community Advisory Panel
- Publicly accessible information
- Negotiation of agreements
- Jobs analysis on skill gaps
- DEIA hiring strategies

Quality jobs and training

- Ramp up CAP engagement, construction hiring, and mitigation of environmental burdens
- Promote DEIA and EJ
- Partner with MSIs
- J40 data tracking dashboard

J40 data tracking

- Continue efforts on equitable quality jobs
- Clean energy access and adoption parity
- Update J40 dashboard

Phase 1 | Phase 2 | Phase 3 | Phase 4

Lunch and Networking

Heidelberg Materials

Mitchell Quarry Operations

Mitchell Quarry Operations

Mitchell Quarry Operations

Heidelberg Materials