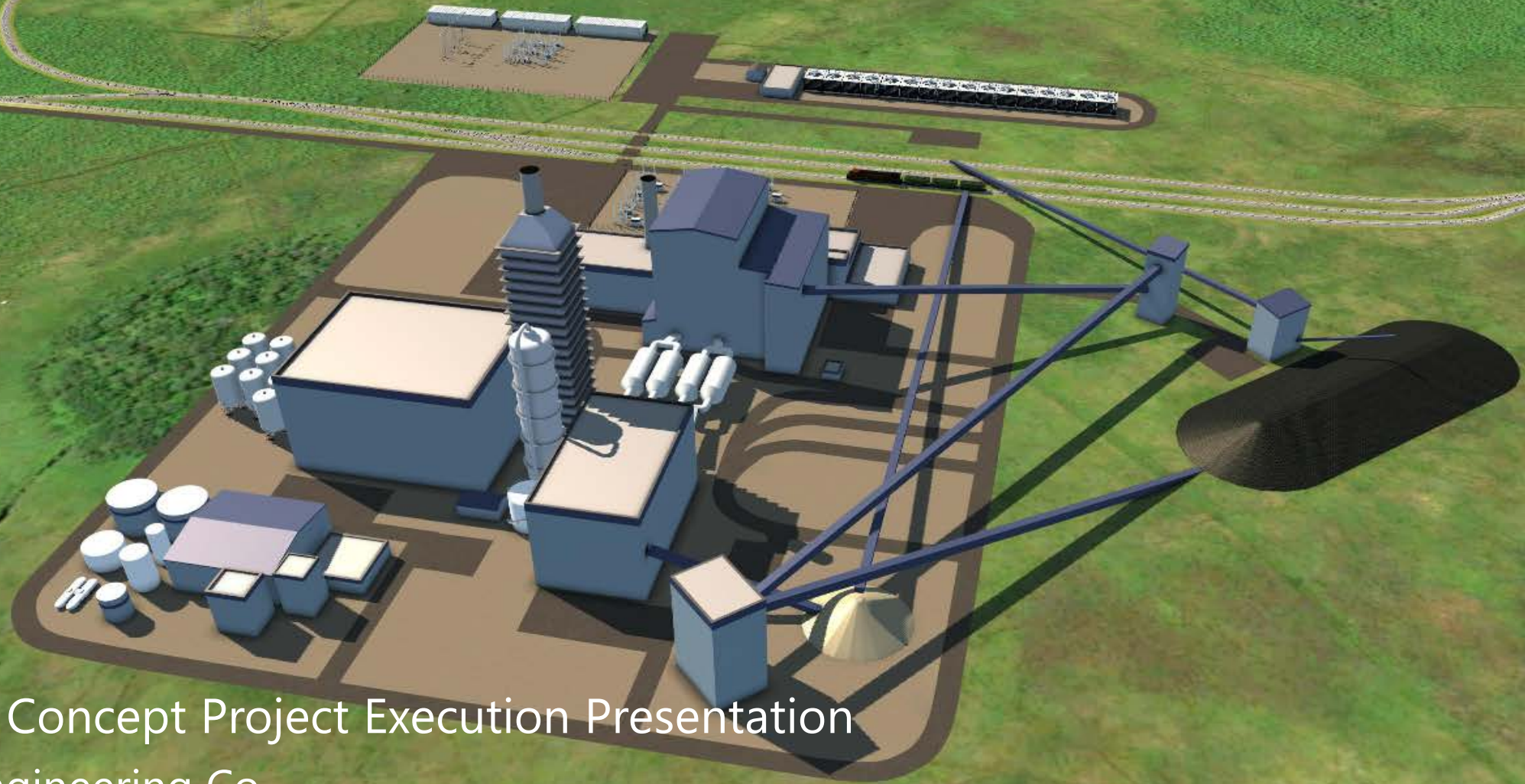


# Coal Plant of the Future



HGCC Concept Project Execution Presentation

Barr Engineering Co.

March 9, 2020

# Presentation Overview

---

- PreFEED design summary
- Overall HGCC Project Execution Plan
- Overall HGCC Schedule
- Prime Contractor
- DOE FEED Study Proposal
- Host utility
- Project Financing Plan
- FEED Study
  - Schedule
  - Division of Responsibility
- FEED Study (continued)
  - Non-commercial component development
  - Site Selection
  - Prospective Permitting Plan
  - Commercialization Plan
- Detailed Engineering, Procurement and Construction

# PreFEED Design Summary

---

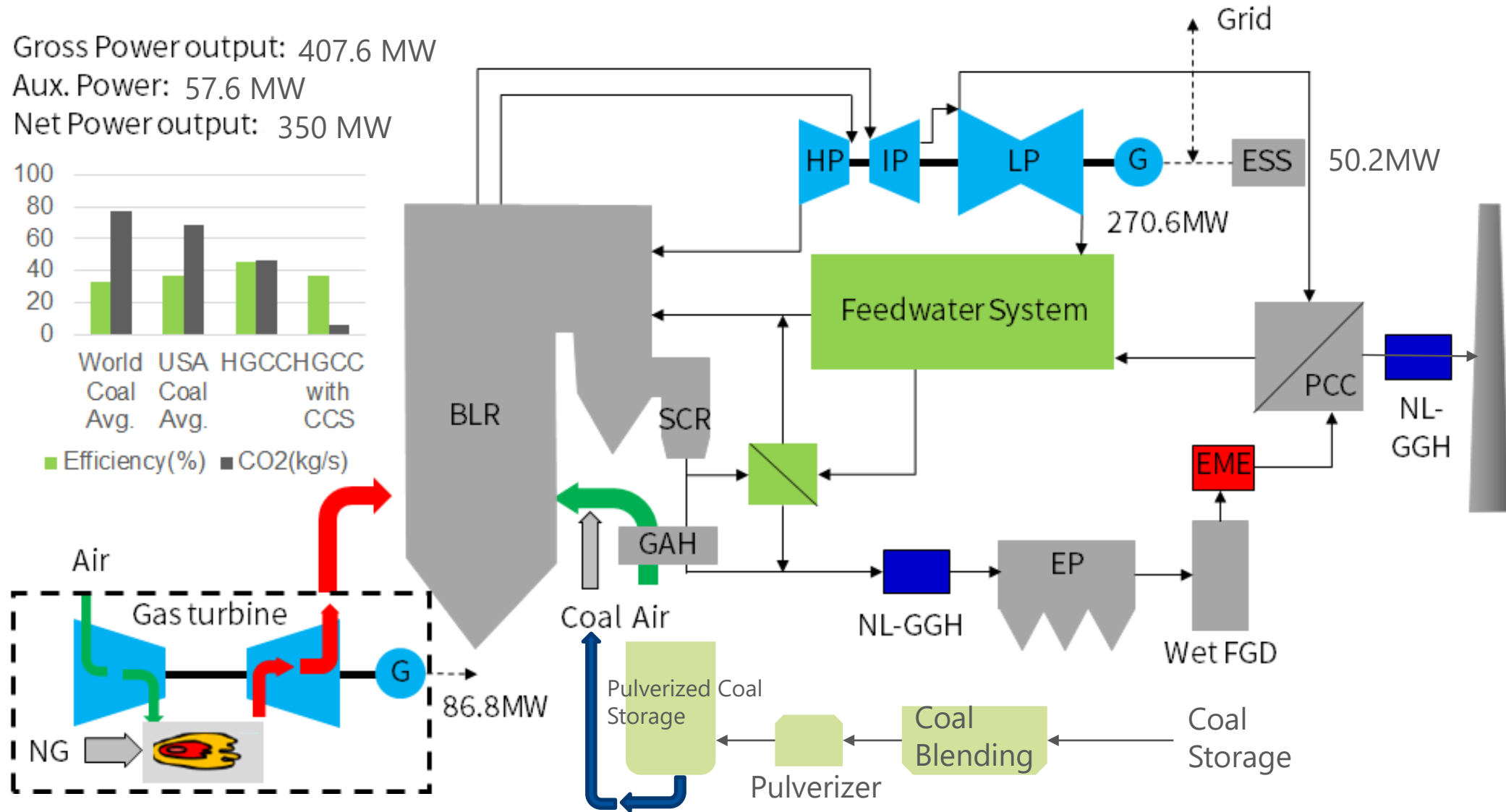
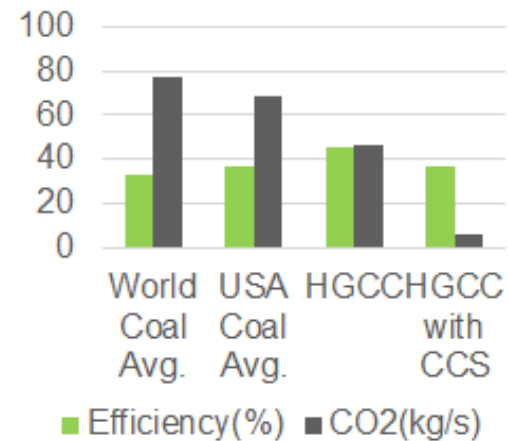
- Boiler/burner size for base case
- Indirect system concept
- Steam and gas turbine
- CO<sub>2</sub> purging for pulverized coal
- Air quality control systems
- CO<sub>2</sub> capture
- Plant water balance and balance of plant
- Class 4 cost estimate
- ESS

# PreFEED Design Summary

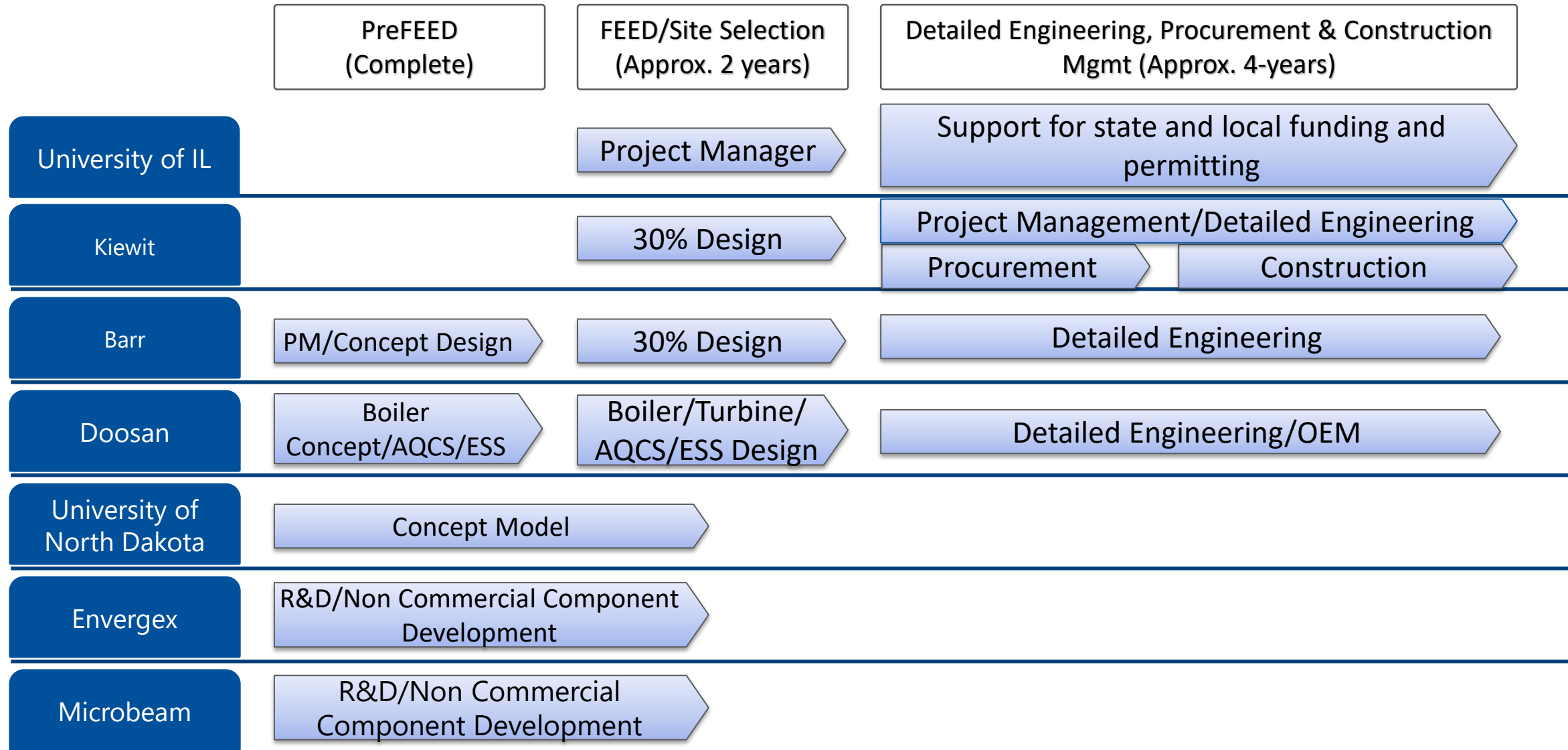
Gross Power output: 407.6 MW

Aux. Power: 57.6 MW

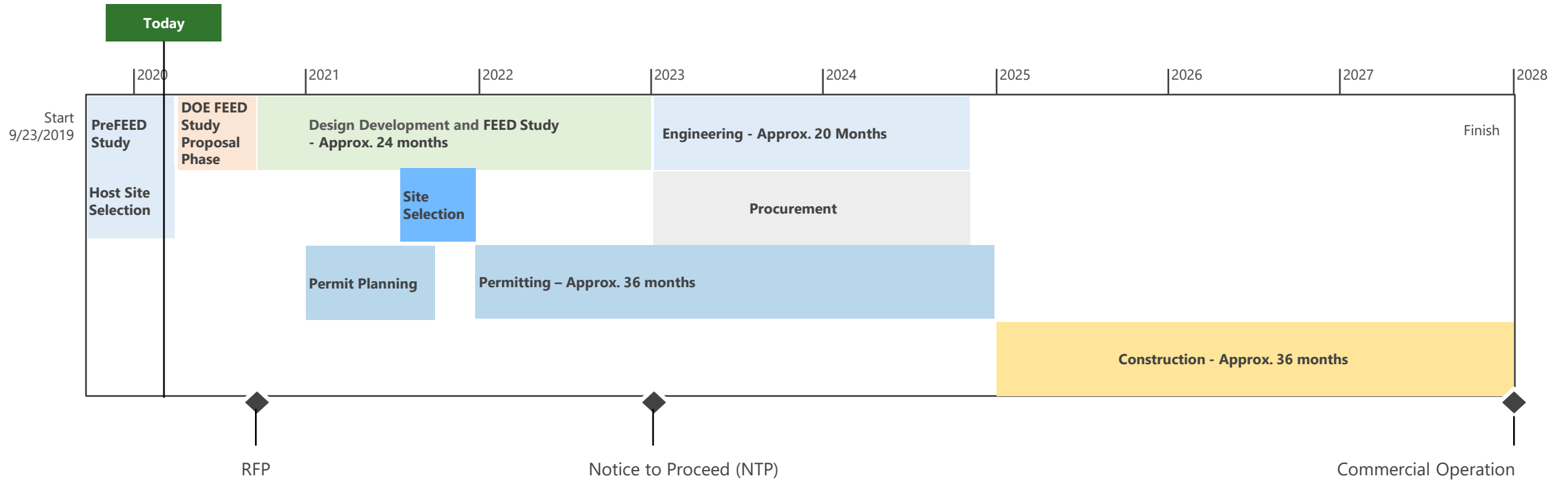
Net Power output: 350 MW



# Overall HGCC Project Execution Plan



# Overall HGCC Schedule



---

Prime Contractor – University of Illinois.....

# Prairie Research Institute

## Illinois-focused Resource Research and Service



# Existing DOE Capture Related Projects in Illinois

*Prairie Research Institute engaged in all projects and awardee in almost all*



## ***Abbott Power Plant : UIUC campus***

- *Aerosol reduction technologies*
- *Bi-Phasic solvent for carbon capture*
- *CO<sub>2</sub> utilization: Algae cultivation for animal feed*



## ***City, Water, Light, and Power (CWLP): Springfield***

- *10 MW Large Capture Pilot*
- *Water recycle and reuse*

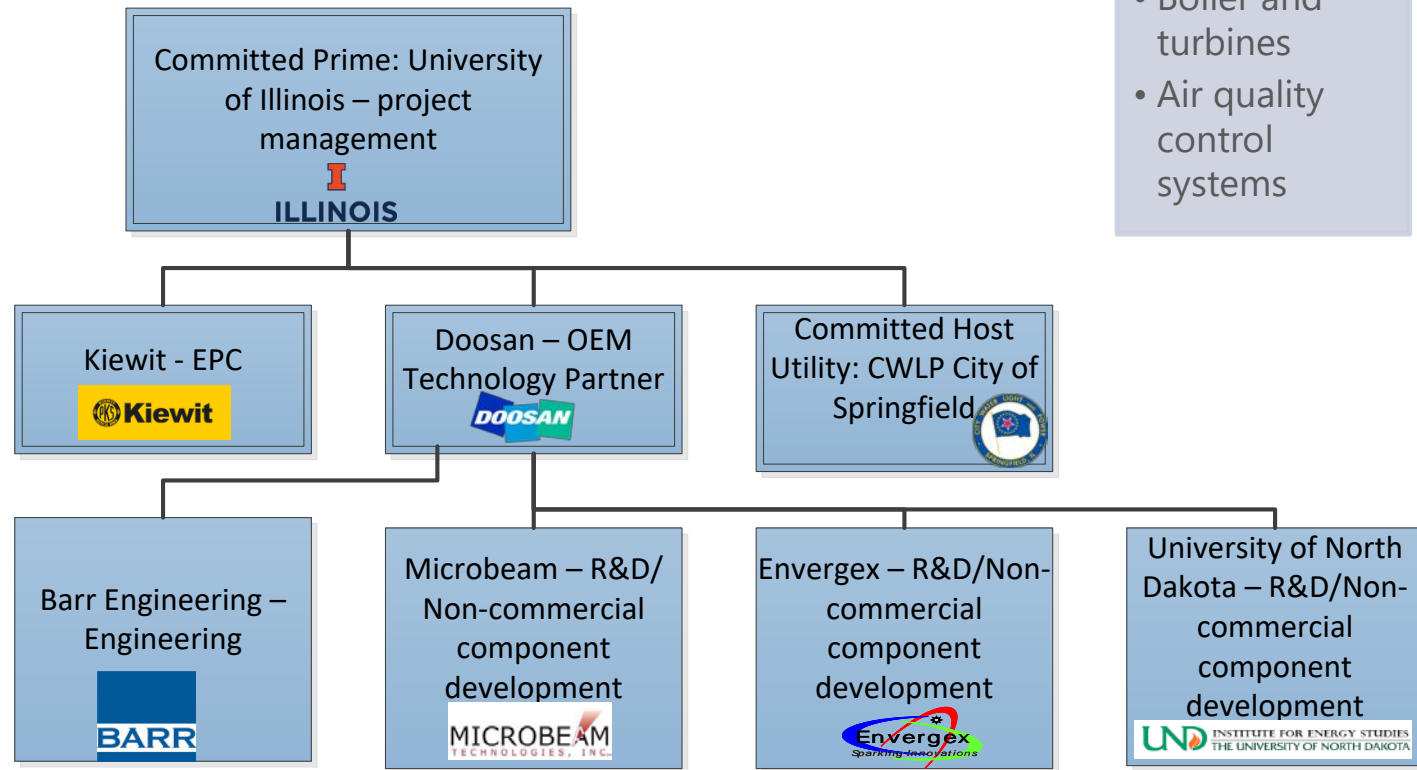


## ***Prairie State Generating Company (PSGC): Marissa***

- *Large FEED – 816 MW*

# DOE FEED Study Proposal

## ■ March-September 2020



## Technology Partners

### Doosan Heavy Industries

- Boiler and turbines
- Air quality control systems

### Doosan Babcock

- CO<sub>2</sub> capture
- Solvent technology

### Doosan Gridtech

- Energy storage system

### Microbeam

- Condition-based monitoring

Bituminous

Sub-bituminous

Lignite

---

Host utility.....

# City, Water, Light, & Power (CWLP)

*Supplies electricity and water to Springfield, IL*

**Dallman #4**



**Unit 31 & 32**

**Unit 33**

- Currently four coal-fired steam turbine-generators with a total nameplate capacity of 578 MW (Units 31 & 32, Unit 33, Dallman #4)
- Three of the four units to be retired as part of Integrated Resource Planning (Unit 31& 32 by 12/31/2020 commissioned in 1968 & 1972)) and (Unit 33 by 9/15/2023 commissioned in 1978))
- Only one unit, Dallman #4 will remain (207 MW commissioned in 2009)
- Dallman #4 is site for 10 MW Large Capture Pilot (DOE funded Phase II FEED ongoing and will be proposed for DOE funded Phase III build/operate)

# Why CWLP is an Excellent Host Site

*Need for generation and physical space will be available*



**Total space  
available for project  
by 2023**

- Proposed Coal FIRST technology could fill “gap” in generating capacity lost due to shut down of older units
- Between shut down on Units 31, 32, and 33 and demolition of Lakeside Power Station sufficient space would be available
- Existing relationship with UIUC on DOE projects
- CWLP has history of interest in new generation and environmentally sound generation technologies
- Strong support by the City of Springfield for technologies such as carbon capture (i.e., City ratified 10 MW large capture pilot for Dallman #4)
- Site details and commitment already in hand

# Proven Means to Select Host Site

*Used in previous DOE projects*

Site Selection Criteria	
Technical	Flue gas availability
	Flue gas CO <sub>2</sub> concentration
	Aerosol concentration in flue gas
	Steam and utility availability for ISBL
	Design costs for OSBL
	Available plot size for ISBL
	Use of domestic coal
	Existing abatement equipment (FGD, ESP, SCR, etc.)
	Logistics of transportation and lifting
Regulatory and Environmental	Permitting requirements
	Permitting timelines
	Supports NEPA
	Safety culture
Financial and Business Agreements	Cost share commitment
	Contractual terms and conditions
	Site interest
	Sign-off requirements
	Potential for capture system to permanently remain
	Interest in serving as future training site
	Personnel support and responsiveness

***CWLP meets all these criteria for the Coal FIRST project***

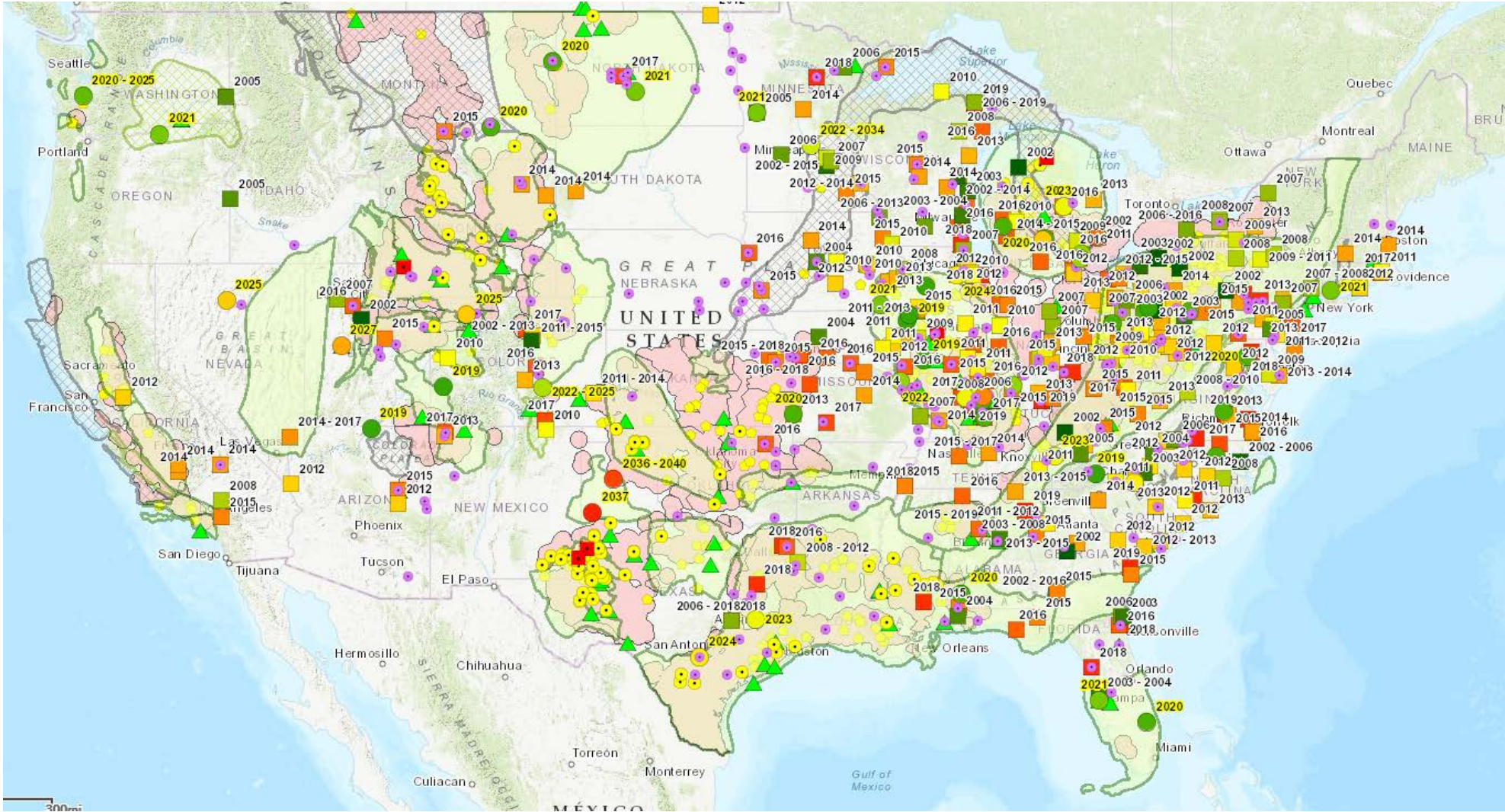
Steam Coal Plants (EIA)

Operating Conventional Steam Coal Plants (EIA860M  
August 2019)

- 2019
- 2020
- 2020 - 2025
- 2021
- 2022
- 2022 - 2025
- 2022 - 2034
- 2023
- 2024
- 2025
- 2027
- 2028
- 2029 - 2030
- 2036 - 2040
- 2037
- Not Provided

Retired Conventional Steam Coal Plants (EIA860M  
August 2019)

- 2002
- 2002 - 2006
- 2002 - 2013
- 2002 - 2014
- 2002 - 2015
- 2002 - 2016
- 2003
- 2003 - 2004
- 2003 - 2008
- 2003 - 2015
- 2004
- 2005

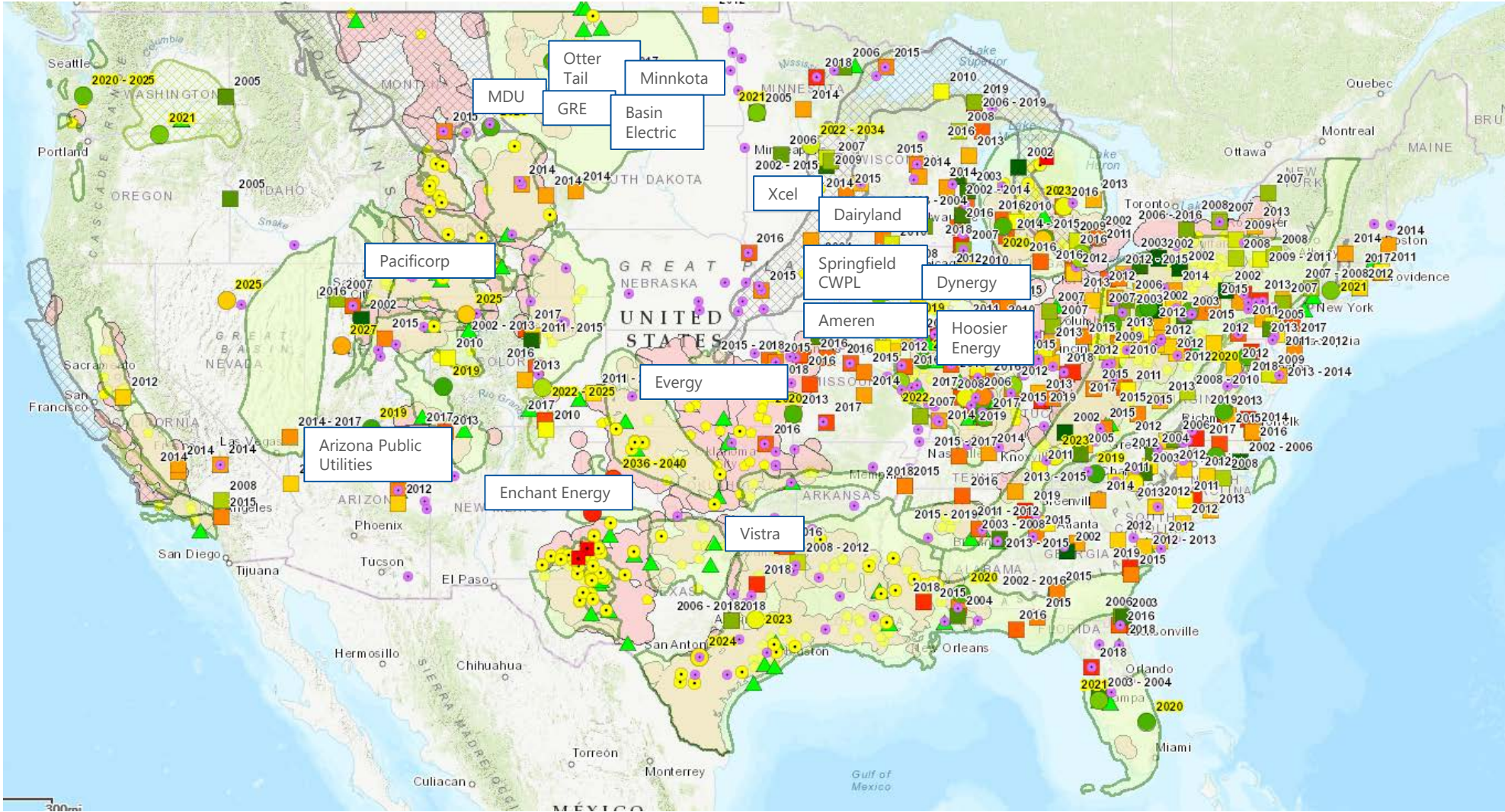


Steam Coal Plants (EIA)

Operating Conventional Steam Coal Plants (EIA860M August 2019)

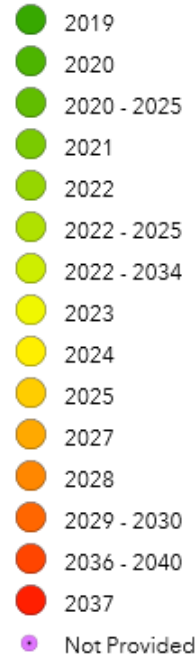


Retired Conventional Steam Coal Plants (EIA860M August 2019)

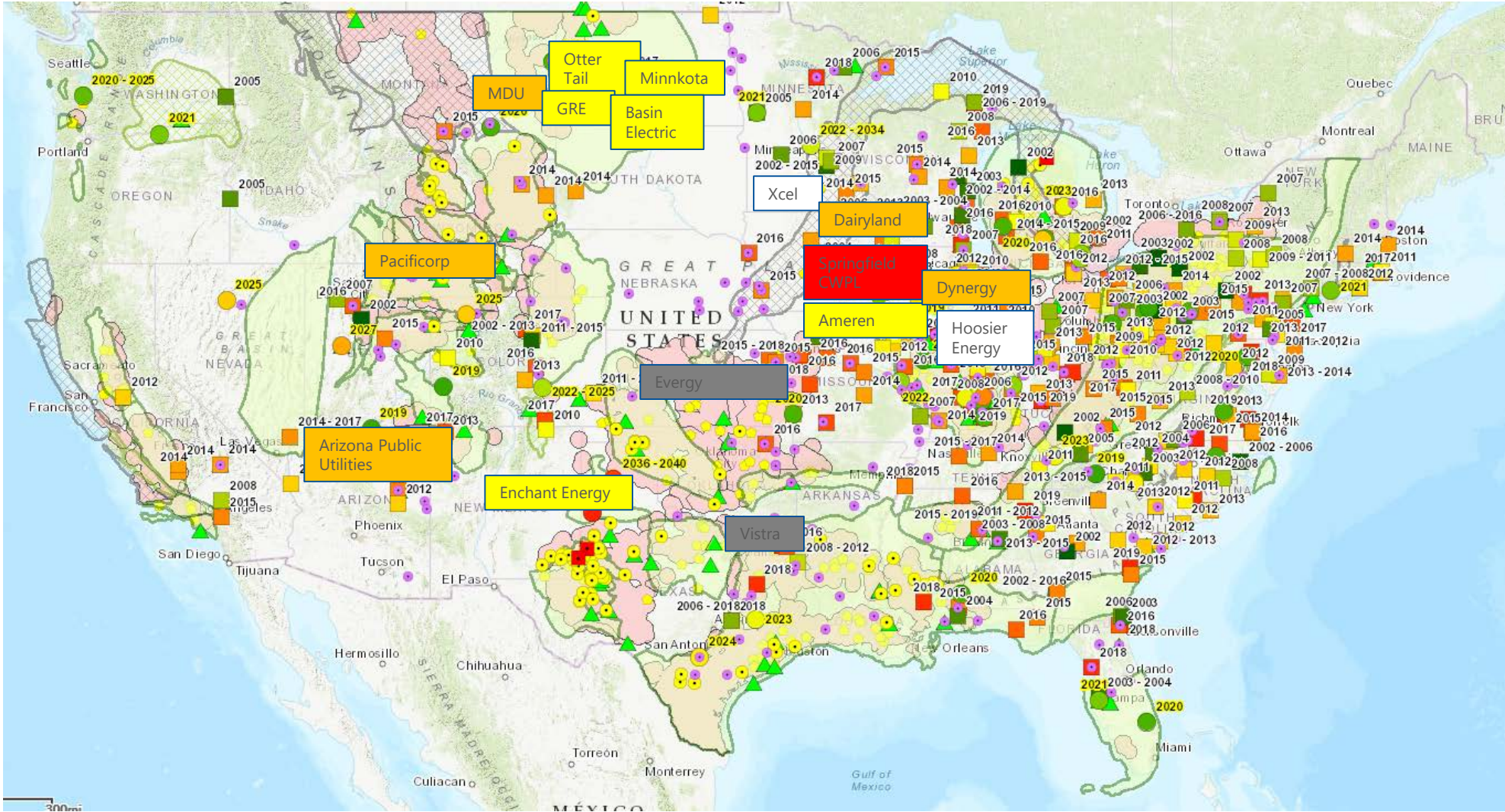


Steam Coal Plants (EIA)

Operating Conventional Steam Coal Plants (EIA860M  
August 2019)



Retired Conventional Steam Coal Plants (EIA860M  
August 2019)



# Project Financing Plan

---

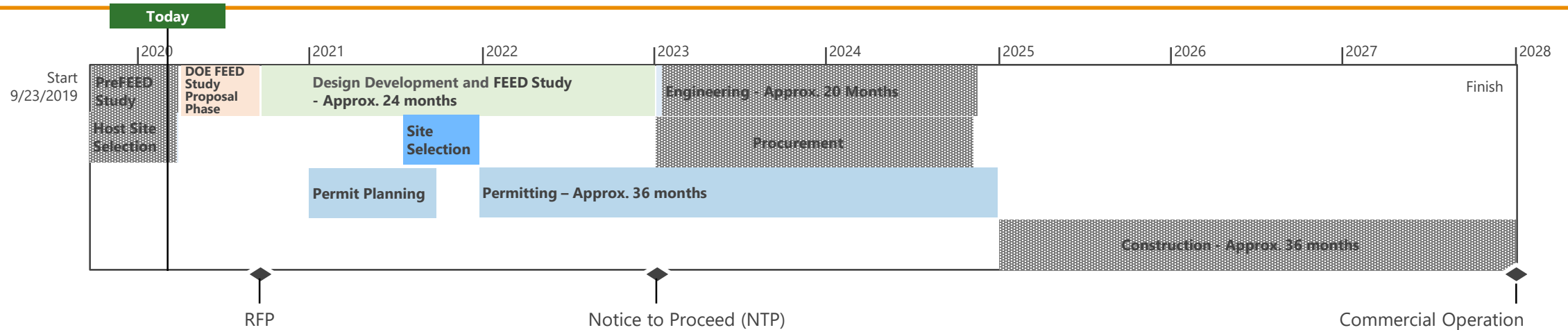
- FEED funding
  - DOE funds
  - 20% cost share
    - Kiewit and Doosan
    - In-kind cost share from utility
- Establish steering committee
  - Created to carry out specific objectives for financing
- Commercialized Project financing
  - RUS loans (if applicable) and DOE/State/Federal grants

# Project Financing Plan – Benefits to Utility

---

- Establishing utility investment
  - Develop financial pro forma plan for HGCC concept
    - Energy storage for peak capacity revenue generation
    - Fuel flexibility using lower cost fuel
  - Monetize revenue streams
    - Power sales
    - CO<sub>2</sub> 45Q credits or sales for EOR
    - Fly ash/bottom ash
    - Gypsum

# FEED Study - Schedule



- September 2020 – December 2023
- HGCC design development
  - 30% Engineering
  - Environmental permitting review
  - Develop financing plan
  - CAPEX/OPEX updates
- Non-commercial development

# FEED Study - Division of Responsibility

## University of IL

- Project management
- FEED study design basis
- Final FEED study package

## Kiewit

- Mechanical, structural, and electrical/I&C design
- Balance of plant
- Combustion turbine package
- Cost assessment

## Doosan

- Boiler, steam turbine, combustion turbine, AQCS, carbon capture package
- ESS system package
- Cost assessment
- Non-commercial development

## Barr

- Water treatment and coal handling package
- Permitting review
- Site civil and electrical
- Cost assessment

## Envergex/UND/Microbeam

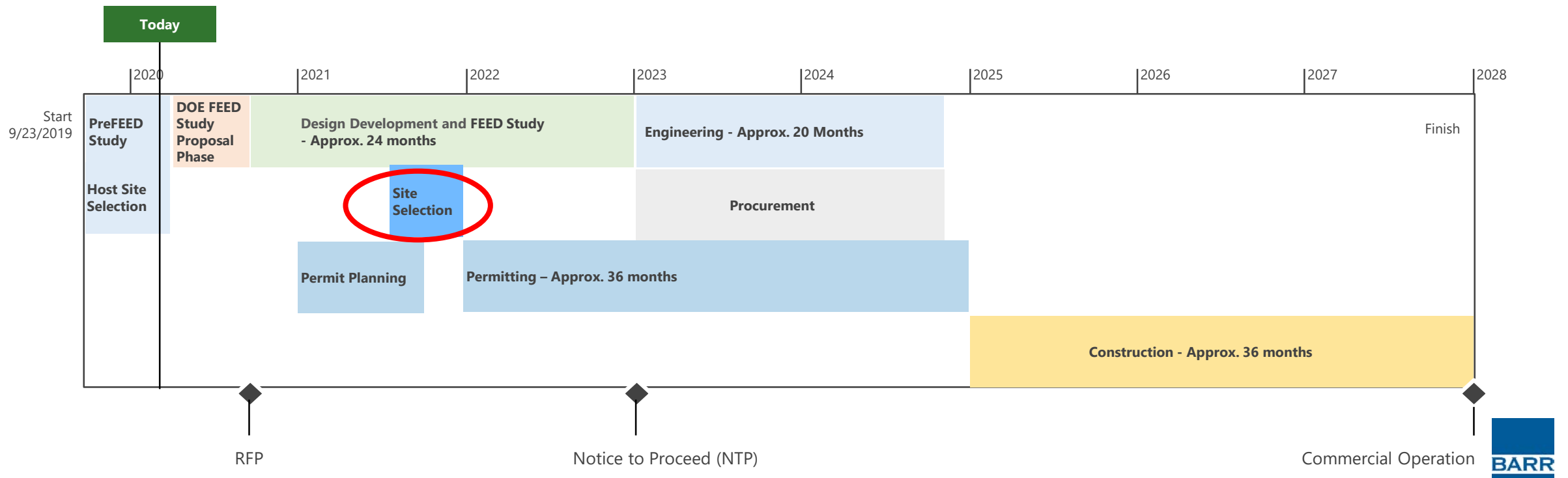
- Non-commercial development/Modeling support

# FEED Study - Non-Commercial Component Development

HGCC System	Indirect Firing	ESS Integration	Environmental
<ul style="list-style-type: none"><li>• Burner optimization with GT flue gas</li><li>• CFD Modeling</li><li>• Unit flexibility</li><li>• Modularization</li><li>• Efficiency optimizing</li></ul>	<ul style="list-style-type: none"><li>• Efficiency optimizing</li><li>• Pulverized coal storage CO<sub>2</sub> purging</li></ul>	<ul style="list-style-type: none"><li>• Cost reviews</li><li>• Load following optimization</li></ul>	<ul style="list-style-type: none"><li>• Emissions profile</li><li>• Water minimization</li><li>• CO<sub>2</sub> capture energy/cost reduction</li></ul>

# Feed Study - Site Selection

- Anticipate 6 months during FEED study for final site for commercialization

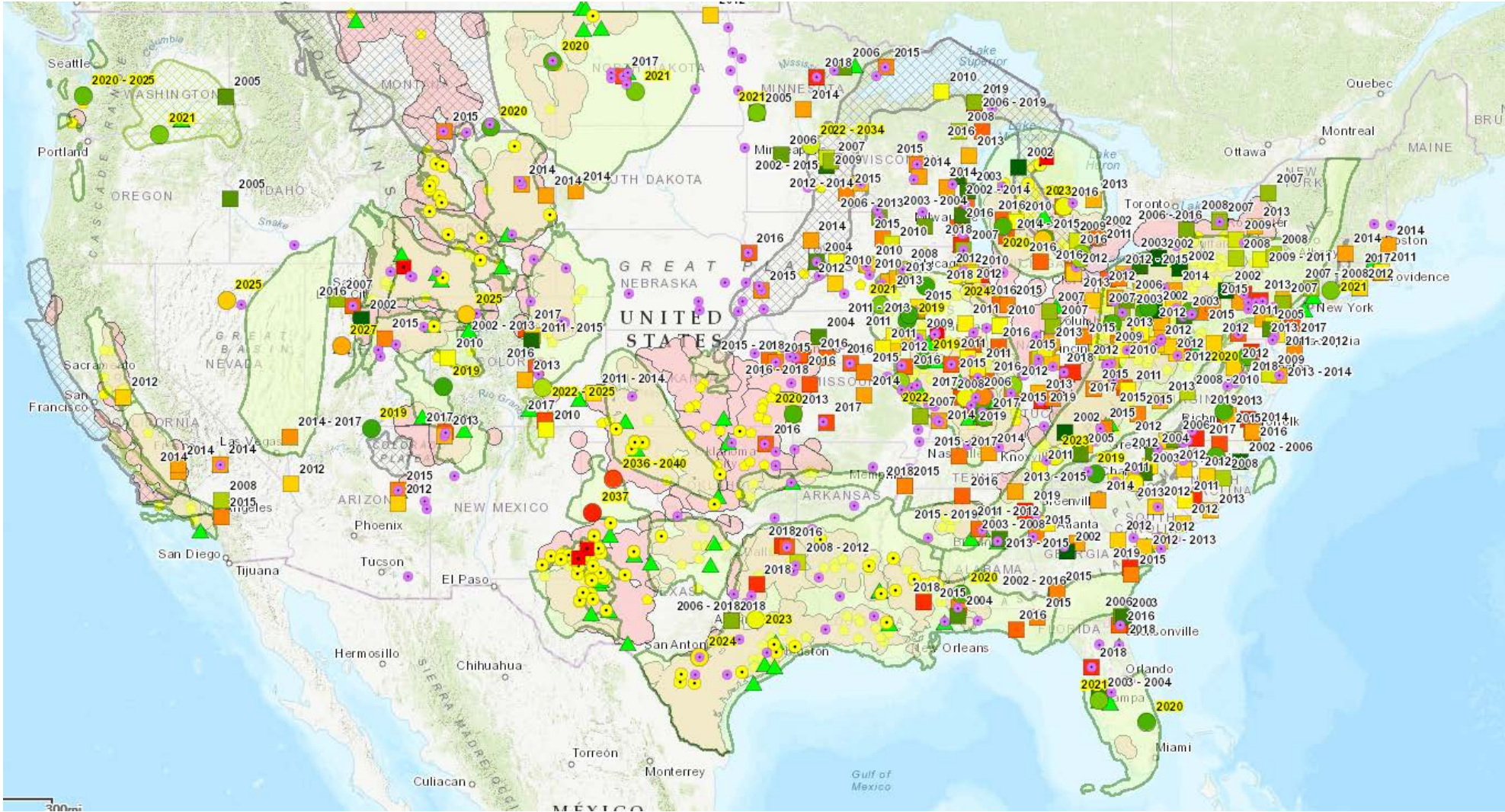


Steam Coal Plants (EIA)

Operating Conventional Steam Coal Plants (EIA860M August 2019)



Retired Conventional Steam Coal Plants (EIA860M August 2019)



# FEED Study - Commercialization Plan

---

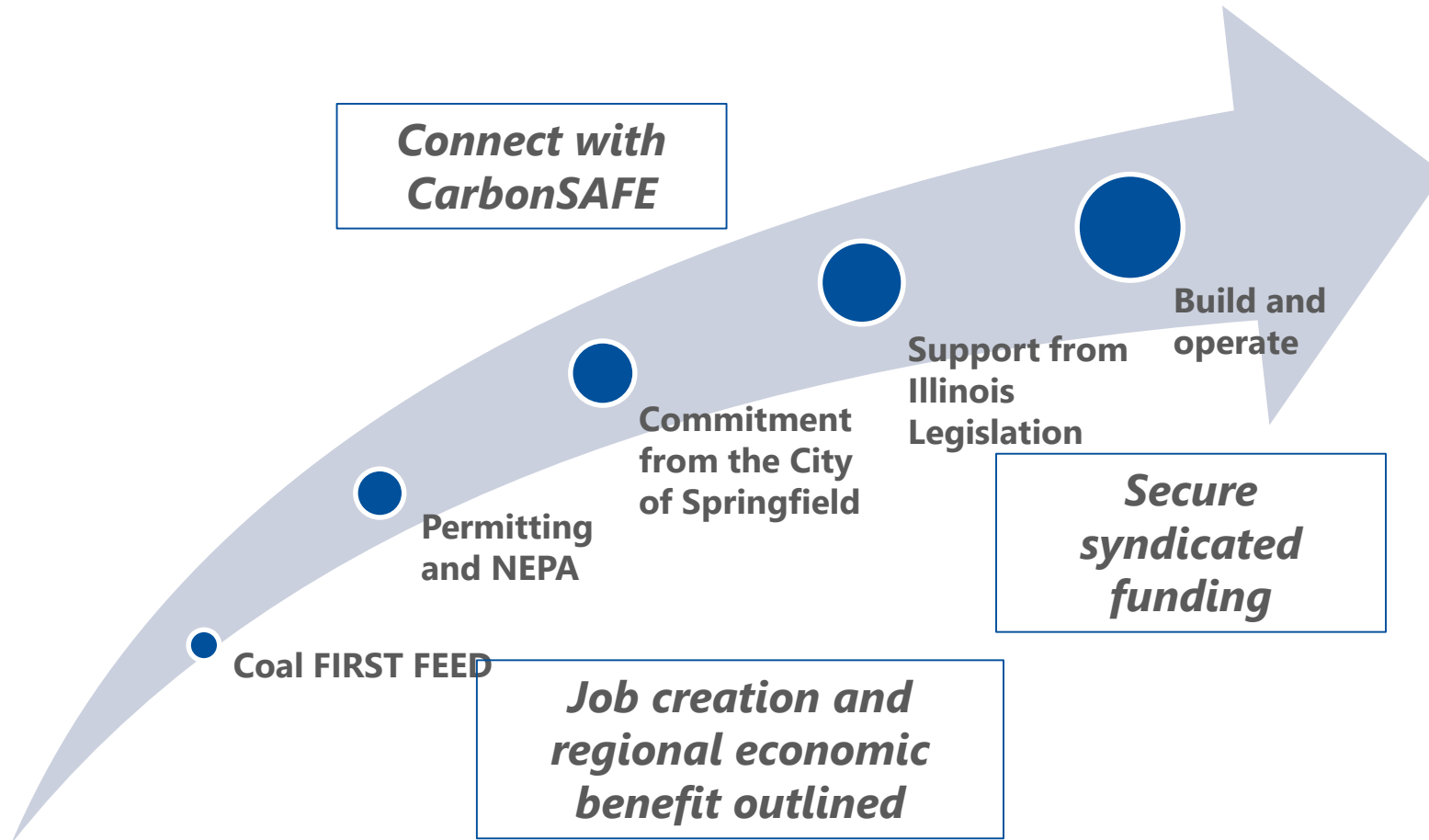
- Site selection for commercialization
- Commercial guarantees
- Letters of intent (equipment & material procurement)

# Responsibilities and Capabilities of Prairie Research / University of Illinois Urbana-Champaign (UIUC)

- Overall project management
  - History of experience with DOE projects
  - Accounting systems in place
  - Proven ability to deliver on time and on budget
  - Proven ability to provide required deliverables
- Permitting agencies and timelines
  - Strong relationships with permitting authorities for this project – Illinois EPA and Sangamon Waste Reclamation District
  - Same groups for existing DOE 10 MW large capture pilot at CWLP
- Interaction with NEPA contractor
  - Existing relationship with NEPA contractor being used for 10 MW Large Capture Pilot at CWLP
  - NEPA considerations well understood at site
- Existing relationships with City of Springfield (owner of CWLP) and state legislators
  - Known pathway for approval – previous obtained for 10 MW Large Pilot
  - Known pathways to legislative support - previous obtained for 10 MW Large Pilot
- Link with CarbonSAFE and utilization activities to assure pathway to sequester or utilize CO<sub>2</sub> for Coal FIRST project
- Legislation at the State Level has stimulated the formation of a CO<sub>2</sub> value chain

# Pathways to Commercialization

*Known pathway with milestones well understood*

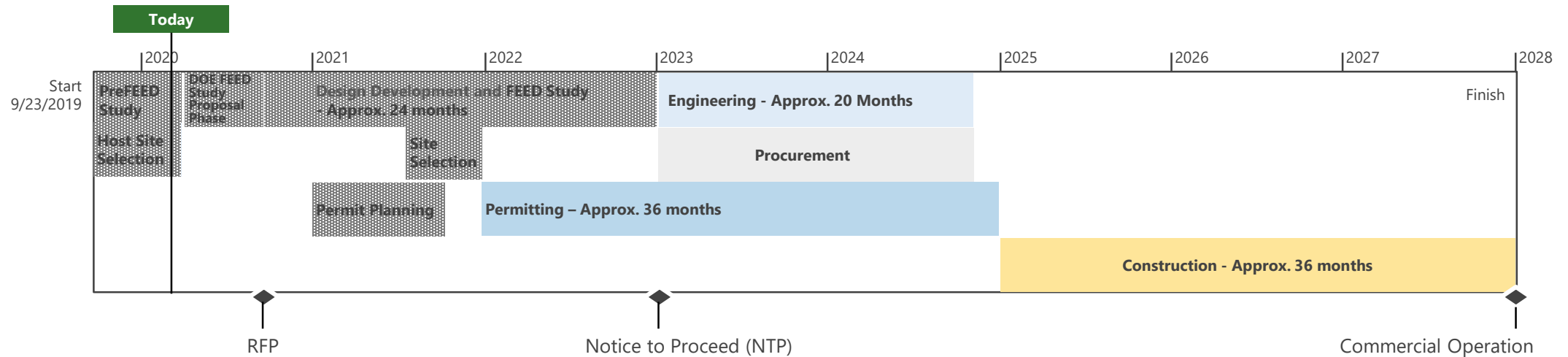


# FEED Study - Prospective Permitting Plan

---

- Permitting will commence post FEED
- Likely Approvals and Permits
  - NEPA review: for federally funded projects, includes EIS
  - State Utility Commission: e.g., siting permit, certificate of need
  - Interconnection studies: independent system operator agreement
  - PDS air permit: state-administered federal permit
  - USFWS approval: federal protected species impacts
  - EPA SDWA or delegated states: Underground Injection Control (UIC) permit
  - Water allocation: state permit
  - NPDES water discharge: assume zero liquid discharge for HGCC
  - Ash disposal: assume beneficial use
  - Local permits: land use, noise, road access, zoning

# Detailed Engineering through Commercial Operation



- December 2023 – February 2028
- Engineering
- Procurement
- Construction
- Permitting
- Startup
- Commercial operation

# Engineering, Procurement, Construction

- December 2023 – October 2025
- Detailed engineering from 30% to 100%
  - 60% review
  - 90% review
  - 100% final
- Equipment procurement
  - Leverage FEED study equipment lists
  - Finalize equipment specs and complete procurement
- DOR will remain similar to FEED study



# Construction & Startup

---

- Early 2025 – 2028
- Kiewit to complete construction as EPC
- Utility lead to complete startup
- Support from vendors and engineering team





*MLJ Consulting*

THANK YOU!



QUESTIONS?

