Announced CCS Projects in the US Power Sector*

Operational

1. **Calpine Delta Energy Center (Pittsburg CA)**
    a. **Entities Involved:** Calpine, ION Clean Energy
    b. **Status:** Operational in 2023
    c. **Feedstock:** Natural gas
    d. **Capture Technology:** Solvent based (ION Clean Energy)
    e. Calpine launched its the $25 million CCS demonstration pilot July 2023 at its 857 MW NGCC power plant in Pittsburg, California. The operational test period could take 13-15 months. The project uses a chemical solvent developed by ION Clean Energy to bind flue gas with carbon dioxide. The pilot project will release the captured carbon instead of storing it. However, future plants can pump and store carbon underground. The engineering design study for the project received a 5.8 million award from DOE.

2. **JCOAL & Kawasaki CCS Project at Wyoming Integrated Technology Center (Gillette WY)**
    a. **Entities Involved:** Basin Electric Power Cooperative, Japan Carbon Frontier Organization (JCOAL), Kawasaki Heavy Industries
    b. **Status:** Operational in 2023
    c. **Feedstock:** Coal
    d. **Capture Technology:** Solid Sorbent Carbon Capture Technology (Kawasaki Heavy Industries)
    e. Japan COAL and Kawasaki Heavy Industries launched their solid sorbent carbon capture test facility at the Wyoming Integrated Test Center in Oct. 2023. The project was announced in 2020 and broke ground in May 2023. With an estimated total cost between $15 and $20 million, the project was commissioned and funded primarily by the Japanese Ministry of the Environment. The separation and capture technology utilizes a proprietary solid amine absorbent developed by Kawasaki which enables the use of lower-temperature steam compared with the traditional liquid amine absorbent method and can thus realize higher energy savings.

3. **NET Power La Porte Test Facility (La Porte TX)**
    a. **Entities Involved:** NET power
    b. **Status:** Operational
    c. **Feedstock:** Natural Gas
    d. **Capture Technology:** NET Power process
    e. The 50 MW test facility was used by NET Power to demonstrate its NET Power process. The process burns fuel with oxygen – instead of air – and uses recirculated supercritical CO2 as a working fluid to drive a turbine. The process doesn't produce by-products such as nitrogen oxides or sulfur dioxide, which can account for as much as 85% of conventional power plant emissions. The excess

* *Projects are listed alphabetically within each category*

high purity CO2 can be easily captured and sequestered. The facility began testing in 2018. It achieved technology validation and accumulated 1,500 hours of total runtime as of Oct. 2022. The facility is undergoing modifications with Baker Hughes to improve combustor and turboexpander demonstrations.

4. **Petra Nova CCS Project (Thompsons TX)**
    a. **Entities Involved:** JX Nippon Oil & Gas Exploration, NRG Energy (former), Mitsubishi Heavy Industries, Sargent & Lundy, The Industrial Company, The University of Texas, Bureau of Economic Geology
    b. **Status:** Began Operating in 2016; Restarted in 2023
    c. **Feedstock:** Coal
    d. **Capture Technology:** Amine Solvent-based
    e. The Petra Nova CCS project began as a 50/50 joint venture between NRG Energy and JX Nippon Oil & Gas Exploration at NRG's WA Parish Generating Station. The project is designed to capture approximately 90% of the CO2 from 240 MW slipstream of flue gas at the plant's coal-fired Unit 8 (650 MW) and demonstrate commercial-scale, post-combustion carbon capture technology. Captured CO2 is dried, compressed, and transported via a 81-mile pipeline to an oilfield in Jackson County TX where it is injected for enhanced oil recovery. The $1 billion project is funded by a $195 million grant from DOE and received $250 million concessionary lending from the Japan Bank for International Cooperation and Mizuho Bank. Petra Nova entered operation in 2017 – the first commercial CCS retrofitted power plant in the US - but was closed in May 2020 due to low oil prices. In Sep. 2022, JX Nippon bought NRG's share of the project and restarted the project in Sep. 2023. A 2020 DOE technical report finds that the facility captured 3.8 million short tons of CO2 in a three-year period – short of developers' 4.6 million target. Although the facility captured 92.4% of CO2 from flue gas slipstream during this period, it failed to meet an 85% capacity factor goal due to technical issues and downtime.

Under Construction

1. **CWLP Dallman Unit 4 (Springfield IL)**
    a. **Entities Involved:** City Water Light and Power, National Energy Technology Laboratory, University of Illinois, Linde Group, BASF, Affiliated Engineers, Affiliated Construction Services
    b. **Status:** Under Construction
    c. **Feedstock:** Coal
    d. **Capture Technology:** Amine Solvent-based (Linde-BASF)
    e. Led by University of Illinois and other partners and supported by DOE's NETL, this pilot project is building a 10 MWe capture system at CWLP's Dallman 4 unit – a 200 MW coal-fired generating unit. The capture system is based on Linde-BASF advanced amine-based capture technology and can capture 200 tons of CO2 per day. The project has completed its FEED study and began construction in Jan. 2023. DOE has allocated $47 million to complete the project while the State of Illinois as committed another $20 million.

2. **MTR CCS Project at Wyoming Integrated Technology Center (Gillette WY)**
    a. **Entities Involved:** Basin Electric Power Cooperative, Membrane Technology and Research Inc. (MTR), University of Wyoming
    b. **Status:** Under Construction
    c. **Feedstock:** Coal
    d. **Capture Technology:** Polaris Polymeric Membrane (MTR)
    e. Opened in 2018, Wyoming Integrated Technology Center is co-located at Basin Electric Power Cooperative's 405 MW Dry Fork Station to help developers test and scale their CCS technology. In 2023, MRT began constructing a pilot project at the center, using its proprietary Polaris polymeric membrane. The pilot project received $15.4 million in federal fundings. MRT plans to capture more than 150 tons of CO2 each day. Additionally, in Feb. 2024, MRT and University of Wyoming received $4.6 million from DOE to conduct a FEED study for retrofitting Dry Fork Station with MRT's membrane technology. The study project aims to capture and store onsite 3 million tons of CO2 annually, achieving at least a 90% capture rate.

In Development

1. **Barry Generating Plant (Bucks AL)**
    a. **Entities involved:** Southern Company, GE Gas Power, Linde, BASF, Kiewit.
    b. **Status:** FEED Study Underway
    c. **Feedstock:** Gas
    d. **Capture Technology:** Amine solvent based (Line-BASF)
    e. Alabama Power's Barry Electric Generating Plant is a NGCC power plant equipped with 2 GE 7F.04 gas turbines. In October 2021, DOE's Office of Fossil Energy and Carbon Management (FECM) awarded GE Gas Power $5.8 million to complete a FEED study to incorporate a 95% commercial carbon capture solution at the plant. GE will research advanced technology and control concepts to retrofit the plant with Linde's Gen 2 carbon capture solution based on BASF OASE blue technology. The retrofittable solution can potentially be applied to the more than 1,500 F-Class gas turbines worldwide.

2. **Baytown Energy Center (Baytown TX)**
    a. **Entities Involved:** Calpine, Shell, Zachry Group, Technip Energies
    b. **Status:** FEED Study Underway
    c. **Feedstock:** Natural Gas
    d. **Capture Technology:** Amine solvent-based (Shell)
    e. Calpine's Baytown Energy Center is a 896 MW natural gas combined heat and power facility that provides steam and power to the nearby Covestro chemical manufacturing facility as well as the Texas electric grid. In Dec. 2023, DOE's Office of Clean Energy Demonstrations selected the plant as one of its 3 Carbon Capture Demonstration Projects with federal funding up to $270 million. The project plans to use Shell's CANSOLV point-source technology to capture up to 2 million metric tons of CO2 annually. The project would become the first full-scale implementation of CCS technology at an American NGCC plant. Phase 1 of

the project began in Jul. 2024 to complete a FEED study for which OCED awarded $12.5 million (total Phase 1 costs $25 million).

3. **Broadwing Energy (Decatur IL)**
    a. **Entities Involved:** ADM, Warwick Carbon Solutions, Mitsubishi Power, Mitsubishi Heavy Industries
    b. **Status:** In Development
    c. **Feedstock:** Natural gas
    d. **Capture Technology:** Unclear (Mitsubishi Heavy Industries)
    e. Broadwing Energy, a subsidiary of Houston-based Warwick Carbon Solutions, and food processing company ADM agreed in Oct. 2023 to build a more than $1 billion power and steam facility. The facility will provide both electricity and steam to ADM's Decatur processing operations and use technology developed by Mitsubishi Heavy Industries to capture CO2 emissions. The companies expect the new facility to sequester 2 million tons of CO2 emissions annually and achieve a capture efficiency of over 90%. Construction is expected to start in 2025 and finish by 2028.

4. **CalCapture/Elk Hill Power Plant (Tupman CA)**
    a. **Entities Involved:** California Resources Corporation, Fluor, EPRI, Next Carbon Solutions
    b. **Status:** In Development
    c. **Feedstock:** natural gas
    d. **Capture Technology:** Solvent based (Fluor)
    e. CalCapture is a CCS project by California Resources Corporation to capture CO2 at its Elk Hill Power Plant – a 550MW NGCC power plant. The project is aiming to capture and permanently store 1.5 million metric tons of CO2 every year in depleted underground reservoirs. To date, 2 FEED studies have been completed - one of them received fundings from DOE. In 2023, EPA released permits for underground CO2 injection.

5. **Cane Run Unit 7 (Louisville KY)**
    a. **Entities Involved:** PPL, EPRI, Kentucky State University, Visage Energy, American Welding & Gas, Vogt Power International Inc., Siemens Energy
    b. **Status:** FEED Study Completed; In Development
    c. **Feedstock:** Natural Gas
    d. **Capture Technology:** Solvent-agnostic process (University of Kentucky)
    e. Unit 7 of PPL's Cane Run Generating Station is a 640 MW NGCC power plant in Louisville KY. This pilot scheme aims at building a 20MW carbon capture unit using advanced solvent-agnostic heat-integrated carbon capture technology – developed by the University of Kentucky. Final products will be purified as used as beverage-grade CO2. In Aug. 2022, DOE provided a $5.8 million grant to conduct a FEED study. In Feb. 2024, DOE selected the project as one of its four Carbon Capture Large-scale Pilot Projects and provided grants up to $72 million.

6. **Coyote Clean Power Project (Southern Ute Indian Reservation CO)**
    a. **Entities Involved:** 8 Rivers Capital, Southern Ute Indian Tribe Growth Fund, NET Power
    b. **Status:** In Development
    c. **Feedstock:** Natural gas
    d. **Capture Technology:** NET Power process
    e. Announced in 2021, Coyote Clean Power Project is a 280 MW gas power plant using Net Power's NET Power process. The process burns fuel with oxygen – instead of air – and uses supercritical carbon dioxide as a working fluid to drive a turbine. This eliminates all emissions and produces pipeline quality CO2 that can be sequestered. The project was at pre-FEED stage as of Feb 2023.

7. **Deer Park Energy Center (Deer Park TX)**
    a. **Entities Involved:** Calpine, Shell, Sargent & Lundy, Electricore, Toshiba, Siemens, B&V
    b. **Status:** FEED Study Underway
    c. **Feedstock:** Natural Gas
    d. **Capture Technology:** Amine solvent-based (Shell)
    e. Deer Park Energy Center is a 1.2 GW NGCC power plant in Deer Park TX. The plant supplies steam to Shell Chemical Company and generate power for the wholesale market. In Oct. 2021, DOE awarded $4.7 million to Calpine, Shell, and other partners to conduct a FEED study to retrofit the plant with Shell's Cansolv CO2 capture system (total study costs $6.1 million). The system is expected capture 95% of total CO2 emissions from flue gas or up to 6.5 million metric tons annually in CO2 offsets. Texas regulators have so far issued the air permits.

8. **Edwardsport Integrated Gasification Combined Cycle Plant (Edwardsport IL)**
    a. **Entities Involved:** Duke Energy
    b. **Status:** FEED Study Underway
    c. **Feedstock:** Coal
    d. **Capture Technology:** Unclear
    e. The 798 MW coal integrated gasification combined cycle plant was completed in 2013. In Sep. 2022, DOE awarded $8.1 million to Duke Energy Indiana to conduct a FEED study for a CCS project at the plant (FEED study total cost is $17.1 million). The study began in Oct. 2023.

9. **Filer City Station (Filer City MI)**
    a. **Entities Involved:** NorthStar Clean Energy (subsidiary of CMS Energy Corporation), Tondu Corp, Babcock & Wilcock
    b. **Status:** In Development
    c. **Feedstock:** Biomass
    d. **Capture Technology:** B&W SolveBright Process
    e. B&W is working to convert Filer City Station – a 73 MW coal-fired power owned by NorthStar Clean Energy and Tondu Corp – into a bioenergy with carbon capture and storage (BECCS) facility. The facility will use sustainable biomass as fuel - coupled with B&W's SolveBright process - to generate power with net-

negative greenhouse gas emissions and is expected to capture up to 550,000 tons of CO_2 annually. In Aug. 2023, DOE granted NorthStar $1.4 million in federal funding to develop a final engineering design package. In Jun. 2024, B&W received a limited notice to proceed (LNTP) to begin initial work from NorthStar Clean Energy.

10. Gerald Gentleman Station (Sutherland NE)

a. **Entities Involved:** Nebraska Public Power District, ION Clean Energy, Sargent & Lundy, Koch Modular Processing Systems, and Siemens
b. **Status:** FEED Study Completed
c. **Feedstock:** Coal
d. **Capture Technology:** Solvent-based (ION Clean Energy)
e. Gerald Gentlemen Station is a 1362 MW coal fire power station owned operated by the Nebraska Public Power District (NPPD). In 2019, DOE awarded NPPD, Ion Clean Energy, and other partners $5.8 million to complete a FEED study for retrofitting the plant with a 600 MW commercial-scale carbon capture system. The system will be based on ION's solvent-based CO2 capture technology using its ICE-21 solvent. The FEED study was completed in Mar. 2023.

11. Kern River Eastridge Co-gen Plant (Kern County CA)

a. **Entities Involved:** Chevron, Fluor
b. **Status:** In Development
c. **Feedstock:** Natural gas
d. **Capture Technology:** Solvent based (Fluor)
e. Chevron is developing a carbon capture and storage (CCS) project at its Eastridge Co-gen facility in San Joaquin Valley, California. Chevron will install CO_2 capture and compression equipment on certain equipment to inject and permanently store CO_2 deep underground. The company estimates the project can capture up to 300,000 metric tons of CO2 each year. In Feb 2024, Chevron announced that it will use Fluor's Econamine FG PlusSM technology.

12. Lake Charles Power Station (Westlake LA)

a. **Entities Involved:** Entergy, Mitsubishi Heavy Industries, Talos Energy
b. **Status:** FEED Study Underway
c. **Feedstock:** Natural Gas
d. **Capture Technology:** Solvent-based (Mitsubishi Heavy Industries)
e. Lake Charles Power Station is a 994 MW NGCC power plant in Westlake LA, developed by Entergy Louisiana. On Mar. 2023, DOE awarded $8.6 million to Entergy and other partners to conduct a FEED study for a full-scale carbon capture project at the plant using Mitsubishi's KS-21 solvent (FEED study total cost $17.3 million). Entergy has also partnered with Talos Energy to develop an offtake agreement. Talos will explore the development of transportation pipelines and a sequestration site 40 miles from the plant. The FEED study began in Jan. 2024.

13. NET Power Odessa Plant (Odessa TX)

a. **Entities Involved:** NET Power, Zachry Group
b. **Status:** FEED Study Underway
c. **Feedstock:** Natural Gas
d. **Capture Technology:** NET Power process
e. NET Power is building the first utility-scale gas-fired power plant with near zero carbon emissions near Odessa TX, using its NET Power process. Announced in Nov. 2022, the 370 MW project is set to remove 860,000 tons of CO2 per year. The plant will cost $1 billion and is expected to come online "sometime between the second half of 2027 and first half of 2028. It is expected to complete its FEED study in 2024 by contractor Zachry Group.

14. Polk Power Station (Mulberry FL)

a. **Entities Involved:** Tampa Electric Company, ION Clean Energy
b. **Status:** In Development
c. **Feedstock:** Natural gas
d. **Capture Technology:** Solvent-based (ION Clean Energy)
e. DOE awarded TEC $5.58 million in Aug. 2022 to conduct a FEED study for retrofitting its Polk Power Station – a 1190 MW NGCC power station in Mulberry FL. The project will use ICE-31 solvent developed by ION to capture nearly 3.7 million metric tons of CO2 per year and achieve a minimum of 95% CO2 capture rate. This FEED study will demonstrate how to equip a large and critical unit with CCS.

15. Prairie State Energy Campus (Marissa IL)

a. **Entities Involved:** University of Illinois, Mitsubishi Heavy Industries, Sargent and Lundy, Kiewit Corporation
b. **Status:** FEED Study Underway
c. **Feedstock:** Coal
d. **Capture Technology:** Amine Solvent-based (Mitsubishi Heavy Industries)
e. The Prairie State Energy Campus is a 1,600 MW coal power plant built in 2012. In 2019, DOE granted $15 million to University of Illinois and other partners to conduct a FEED study for the installation of a 816 MWe carbon capture system at the power plant. The system uses amine solvent-based technology developed by Mitsubishi Heavy Industries. The FEED study was completed and submitted in Aug. 2022.

16. Project Cyclus (Baton Rouge LA)

a. **Entities Involved:** Fidelis New Energy, Babcock & Wilcock, Kiewit Industrial, Capio Sequestration
b. **Status:** FEED Study Underway
c. **Feedstock:** Biomass
d. **Capture Technology:** Orxy-combustion (B&W)
e. Fidelis New Energy is partnering with Babcock & Wilcock (B&W), and Kiewit Industrial to develop a net-negative carbon impact biomass power plant. The planned 200 MW facility – named Project Cyclus – will provide power to Fidelis'

73,000-barrel-per-day Gron Fuels facility which will produce sustainable aviation fuel, renewable diesel, green hydrogen, and bio-plastic feedstock. B&W will provide a 200 MW electric biomass-fueled bubbling fluidized bed (BFB) boiler - which can be fueled by forest litter, construction and demolition waste, or agricultural byproduct - and its OxyBright oxy-combustion technology for CO2 capture. Capio Sequestration, a subsidiary of Fidelis, will sequester the CO2.

17. Project Diamond Vault (Baton Rouge LA)

a. **Entities Involved:** Cleco Power, Sargent and Lundy, Batelle
b. **Status:** FEED Study Underway
c. **Feedstock:** 70% petroleum coke, 30% coal
d. **Capture Technology:** Solvent-based
e. Announced in 2022, Cleco Power's Project Diamond Vault aims at developing a carbon capture facility at its Brame Energy Center. The project plans to retrofit Cleco's 600 MW Madison 3 unit – which burns petroleum coke and coal – to capture up to 95% of its CO2 emissions and sequester them in geological formations. The FEED study will cost $12 million with $9 million coming from congressional appropriation under the 2022 Omnibus Appropriations Bill. Once the study is completed, Cleco plans to raise approximately $900 million in project capital funding via tax credits, private equity investment, and government grants.

18. Project Tundra (Center ND)

a. **Entities Involved:** TC Energy, Minnkota Power, Kiewit, Mitsubishi Heavy Industries
b. **Status:** In Development
c. **Feedstock:** Biomass
d. **Capture Technology:** Solvent-based
e. Project Tundra is a carbon capture system to be developed at the Milton R. Young Station – a 767 MW coal-fired power plant near Center ND. The project is designed to capture up to 4 million metric tons of CO2 annually and store them in saline geologic formations beneath and around the power plant. In Dec. 2023, DOE selected the project as one of its 3 Carbon Capture Demonstration Projects with up to $350 million award. The project is in its final development phase and a final decision on whether to move on with the project is expected by end of 2024.

19. Rocky Mountain Power CCS project (WY)

a. **Entities Involved:** Rocky Mountain Power, 8 Rivers, SK Group
b. **Status:** Under Feasibility Evaluation
c. **Feedstock:** Coal
d. **Capture Technology:** Solid Fuel-fired Allam-Fetvedt Cycle Technology
e. Rocky Mountain Power, 8 Rivers, and SK Group announced in Apr. 2024 that they would collaborate to evaluate a potential carbon capture projects at one of the utility's existing power plants in Wyoming. The project would utilize solid fuel-fired Allam-Fetvedt cycle technology developed by 8 Rivers. The companies would conduct feasibility evaluations at its 332 MW Wyodak plant and its 745

MW Dave Johnston plant with an expectation of advancing to various phases of engineering and design studies after a site is selected.

20. Sutter Decarbonization Project (Yuca City CA)

a. **Entities Involved:** Calpine, ION Clean Energy, 1PointFive Sequestration LLC, SMUD
b. **Status:** In Development
c. **Feedstock:** Natural gas
d. **Capture Technology:** solvent-based (ION Clean Energy)
e. Calpine is retrofitting its 550 MW NGCC power plant near Yuca City CA with a commercial-scale carbon capture system. It plans to use solvent developed by Ion Clean Energy to capture up to 1.75 million metrics tons of CO2 each year and sequester it permanently more than half mile underground in saline geologic formations. The project will be the world's first carbon capture facility to use an air-cooling system which minimizes freshwater usage. In March 2023, the project was selected by DOE's Office of Clean Energy for an award negotiation with up to $270 million federal cost share.

21. Taft Cogeneration Facility (Hahnville LA)

a. **Entities Involved:** Taft Carbon Capture LLC
b. **Status:** FEED Study Underway
c. **Feedstock:** Natural Gas
d. **Capture Technology:** Unclear
e. The Taft Cogeneration Facility is a natural gas-fired 3x1 combined cycled heat and power cogeneration plant owned by Occidental Chemical. DOE OCED awarded $6.5 million in Dec. 2023 to conduct a FEED study for a commercial-scale carbon capture system at the facility (total cost of the FEED study $36.8 million). The system would separate and prepare up to 2.6 million metric tons of CO2 per year for storage with a minimum of 90% capture rate. The FEED study began in Jan. 2024.

Unclear

1. Mustang Station (Denver City TX)

a. **Entities Involved:** Golden Spread Electric Cooperative, University of Texas at Austin
b. **Status:** FEED Study Completed
c. **Feedstock:** Natural Gas
d. **Capture Technology:** Piperazine Advanced Stripper process (UT Austin)
e. Golden Spread Electric Cooperative's Mustang Station is a 925 MW natural gas-fired power plant in Denver City TX. A FEED study – partly funded by DOE in 2019 - was conducted by University of Texas at Austin to test a Piperazine Advanced Stripper (PZAS) process developed by the university. Captured CO2 will be used for enhanced oil recovery. The study was completed in 2022.

2. **Panda Energy Sherman Plant (Grayson County TX)**
    a. **Entities Involved:** Panda Energy Fund, Bechtel National, August Benz, University of Sheffield, University of Kentucky, EPRI, Nexant
    b. **Status:** FEED Study Completed
    c. **Feedstock:** Natural Gas
    d. **Capture Technology:** Solvent-based
    e. Bechtel National and other partners undertook a FEED study for retrofitting Panda Energy Fund's 758 MW NGCC plant in Sherman TX with a carbon capture system. They studied how to integrate a CCS facility as an add-on to the power plant together with the detailed design of an amine-based conventional absorber-stripper scrubbing system with a non-proprietary solvent. The FEED study was published in 2022. It is one of 9 projects selected by DOE in 2019 to receive federal fundings.

3. **Starwood Energy & Elysian & OCGI CCS project (Unclear)**
    a. **Entities Involved:** Starwood Energy Group Inc., OCGI Climate Investments, Elysian Ventures LLC
    b. **Status:** Unclear
    c. **Feedstock:** Natural Gas
    d. **Capture Technology:** Unclear
    e. Starwood Energy Group Inc., OCGI Climate Investments, and Elysian Ventures LLC announced in Apr. 2020 that they had finalized an investment agreement to develop a large-scale carbon capture facility at an existing NGCC plant. The companies plan to apply for Section 45Q tax credits for the deployment of carbon capture projects. The facility is expected to capture 90% of CO2 emissions which will be used for enhanced oil recovery at an existing oil field. There has been no recent updates since 2020.