

PROPOSED JOB-READY INFRASTRUCTURE PROJECTS: CARBON CAPTURE, UTILIZATION AND STORAGE

PROJECT	BENEFITS NEEDS FINANCING	TIMING AND STATUS
<p><i>Lake Charles Methanol</i> is a \$3.8 billion clean energy manufacturing project that will use advanced technology to refine petroleum coke into clean domestic energy and chemical products, including methanol, hydrogen and industrial gases. It will also capture and use CO₂ for EOR.</p>	<p>The project will create 1,500 new U.S. manufacturing and construction jobs starting in mid-2017. Carbon dioxide (CO₂) recovered by the project will be sold and shipped by pipeline to oil fields where it will be used to support 12,500 barrels per day or 4.5 million barrels per year of domestic oil production.</p>	<p><i>Spring, 2017.</i> The project is fully permitted. The project is raising \$1.8 billion in equity financing to go along with a conditional commitment by the U.S. Department of Energy to provide \$2 billion in debt to the project announced in December, 2016. Financial close is expected in the first half of 2017. Construction should commence shortly afterwards.</p>
<p><i>The Texas Clean Energy Project (TCEP)</i> is a coal-based energy and chemicals plant located in West Texas's Permian Basin, a hub of CO₂-EOR. TCEP will integrate proven gasification and carbon capture technologies to achieve a carbon capture rate from the coal feedstock of approximately 90%. Additionally, the project will produce hydrogen, ammonia, urea fertilizer, and other industrial chemicals.</p>	<p>The project would protect coal mining jobs in Wyoming, and create 2,500 new construction jobs and 150 full-time plant jobs in West Texas, while also supporting the sequestration of nearly two million tons per year of carbon dioxide through enhanced oil recovery. TCEP will achieve state-of-the-art reduction in conventional pollutants such as mercury, NO_x, SO_x and particulate matter.</p>	<p><i>Q4 2017.</i> Front end engineering and design work is complete. Summit is currently focused on securing additional financial partners for the project.</p>

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<p><i>The New Steel International Iron-Power-Steel (IPS) Projects in Portsmouth, OH and southern MI make Advanced High Strength (“AHSS”) and Ultra High Strength (“UHSS”) galvanized steel materials; recycle the process heat and use supplemental coal firing to produce low- cost, high-efficiency and low-emitting electricity; and capture and utilize the CO₂ emissions for EOR and potentially enhanced gas recovery.</i></p>	<p align="center">NEEDS ENGINEERING AND FINANCING</p> <p>The availability of low-cost premium quality steel will transform automotive design capabilities. Each plant will produce 4.5-5 million tons of steel per year and 8 million tons per year of pipeline-quality CO₂. The facilities will create a total of over 3,500 direct high-paying long-term jobs, mostly for military veterans; 10,000 construction and construction related jobs; 25,000 indirect jobs, and over 150,000 induced jobs.</p>	<p><i>The intent is to break ground for the first plant later this year and for the second plant early next year.</i> The first IPS plant in Ohio is fully permitted and the addition of carbon capture as planned and proposed can easily be included in an administrative change to the current air permit, likely requiring no more than three months from formal filing.</p>

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<p>LanzaTech (Skokie, Illinois) proposes to partner with U.S. manufacturers to build at least one commercial-scale facility in the United States utilizing steel, refining or other process off-gases that will produce advanced biofuels via LanzaTech's proprietary bacteria-based fermentation process.</p>	<p>NEEDS PERMITTING, ENGINEERING AND FINANCING</p> <p>This technology is energy- efficient and adds value, reducing net process emissions by avoiding flaring and reusing the captured carbon to make new products. Annually it has the potential to produce over1 billion gallons of domestic fuel. Each plant would support over 1000 jobs during construction and 240 during operation (total of direct, indirect and induced jobs), adding \$660M in annual value to local economies while increasing the competitiveness of US manufacturing.</p>	<p>The technology is currently being implemented at commercial scale in Europe and China. Pending EPA pathway approval, a project could be built in 12-24 months.</p>
<p>300MW natural gas-fired NET Power Allam Cycle* Plant (Texas): The project will demonstrate the performance and operation of a novel 300 MW Allam Cycle plant operating on natural gas. Produced CO₂ will be used for enhanced oil recovery in the state.</p> <p>300MW coal-fired Allam Cycle Plant (North Dakota): The project will demonstrate the performance and operation of a novel 300 MW Allam Cycle plant operating on coal using existing coal gasifiers. Produced CO₂ will be used for enhanced oil recovery in the state.</p>	<p>This is a new US-owned natural gas and coal power technology that produces low-cost electricity while co-generating usable CO₂ at lower costs than traditional systems.¹</p> <p>Jobs: Each project will create approximately 545 direct jobs (510 construction; 35 operations), 1,168-4,674 indirect jobs from oil produced through CO₂-EOR, plus associated manufacturing jobs.</p> <p>Energy Security: Each project is capable of producing between 1.2 and 4.9 million barrels of oil per year through CO₂-EOR, while reducing the carbon footprint of fossil fuels by "backfilling" oil fields with power-sector CO₂.</p>	<p>Engineering, site selection and project team finalization is underway for both the natural gas and the coal Allam Cycle full-scale (300 MW) demonstration projects.</p> <p>A Front End Engineering and Design (FEED) Study is being completed by June 2017, and site-specific detailed engineering is expected to begin in Q3 2017 (dependent on funding pathways).</p> <p>Project operation is expected to occur in the 2020-2022 timeframe, depending on ultimate fuel-source selection and other site-specific design characteristics.</p>

¹ Because of these performance benefits, the Allam Cycle has a total addressable global market in power, oil, and industrial gases of \$749 billion and numerous technology-level benefits. Economic Activity: Direct US economic activity of \$23 billion by 2030 through plant construction; export potential of \$30 billion by 2040 with 50% US manufacturing. Jobs: Based on the projected US plant build schedule, 41,420 construction jobs, 2,660 operations jobs, 221,996 oil industry jobs created by 2030. 71,572 high-paying manufacturing jobs created by 2040. Energy Security: The projected Allam Cycle plant build schedule supports enough CO₂-EOR to produce between 95 and 186 million new barrels of oil per year in the US, while reducing the carbon footprint of fossil fuels by "backfilling" oil fields with power-sector CO₂.

Project Tundra (North Dakota)

Allete Clean Energy and Minnkota Power Cooperative are partnering to demonstrate a CO2 capture retrofit technology on an existing Minnkota Power lignite coal unit and will utilize the CO2 to develop Bakken oil and gas fields.

(*The Allam Cycle: a novel technology that produces highly-efficient, low-cost power from natural gas and coal with near-zero emissions.)

Existing Coal Plant Technology Benefits: Proving out commercial-scale CO2 capture retrofits on existing coal units that use the CO2 for EOR will provide significantly more economic value to existing coal units because of the need for CO2 for use in EOR. To date, CO2 capture on lignite coal has not been undertaken at pilot or commercial scale. The U.S. and the world has a significant amount of lignite coal for which this project would allow us to prove out the operation of the technology on lignite coal.

Energy Security Benefits: CO2, CO2 pipeline, and oil infrastructure are needed for tertiary recovery in oil fields of ND, and this project is slated to provide the local source of CO2 necessary to catalyze enhanced oil field production. It is expected that over the life of the project, tens of millions of barrels of oil would be produced using this method.

Site selection and project team are fully developed, and early design assessments have been undertaken.

Feasibility work will begin in 2017.

Front end engineering work and pilot testing is in planning and estimated to be undertaken in 2018-2019. Project construction is estimated to begin in 2020, and the project will be operational by 2021-22.

PROJECT	BENEFITS	TIMING AND STATUS
NEEDS STUDY COMPLETION, PERMITTING, ENGINEERING AND FINANCING		
<p><i>Colstrip (Montana)</i> is an existing PRB coal facility with two units that are facing potential shutdown due to dissolution of asset owners. The facility has multiple owners, including Puget Sound Energy, owner/operator Talen Energy, PGE, Avista, PacifiCorp, and Northwestern Energy.</p>	<p><u>Jobs Benefits:</u> The CO₂ retrofit could lead to the two coal units remaining in operation and retaining approximately 360 jobs in Montana at the power plant, as well as retaining 400 mining jobs. The CO₂ retrofit facility would also create new jobs in construction, new operations at the facility, and the oil and chemical industries.</p> <p><u>Existing Coal Plant Technology Benefits:</u> Proving out commercial-scale CO₂ capture retrofits on existing coal units that use the CO₂ for EOR will provide significantly more economic value to existing coal units because of the need for CO₂ for use in EOR.</p>	<p><i>Unclear.</i> DOE has undertaken a high-level study of costs for a CO₂ capture retrofit to two of the four units at Colstrip, and presented the findings to the Governor of Montana and six utility owners. Currently DOE and the utility owners are considering performing a \$500,000 business case study of CO₂ for EOR, methanol and fertilizer production. If the business case is convincing, utility owners will perform a detailed engineering study.</p>