The Prospect of a Zero-Emission Coal-Fired Power Plant

Jimmy Brock
President and CEO

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About CONSOL Energy Inc.

Overview

- **Publicly-traded (NYSE:CEIX) coal producer and exporter based in Canonsburg, PA**
- **Assets include:**
  - Pennsylvania Mining Complex (PAMC)
  - CONSOL Marine Terminal (CMT) in Baltimore, MD
  - Itmann Mine Project in Wyoming County, WV
  - 1.5 billion tons of undeveloped coal reserves(1) in the Northern Appalachian, Central Appalachian, and Illinois Basins
- **PAMC is the largest underground coal mining complex in North America, consisting of the Bailey, Enlow Fork, and Harvey coal mines and related infrastructure**
  - 669 mm tons of reserves in the Pittsburgh No. 8 coal seam(2)
  - Five longwalls and 15-17 continuous mining sections
  - Central prep plant (8,200 raw tons/h) and rail loadout (9,000 clean tons/h)
  - 2019 production = 27.3 million tons
- **CMT transloaded 12.6 million tons of coal in 2019**
- **Itmann began development mining in April 2020 (low-vol met coal)**

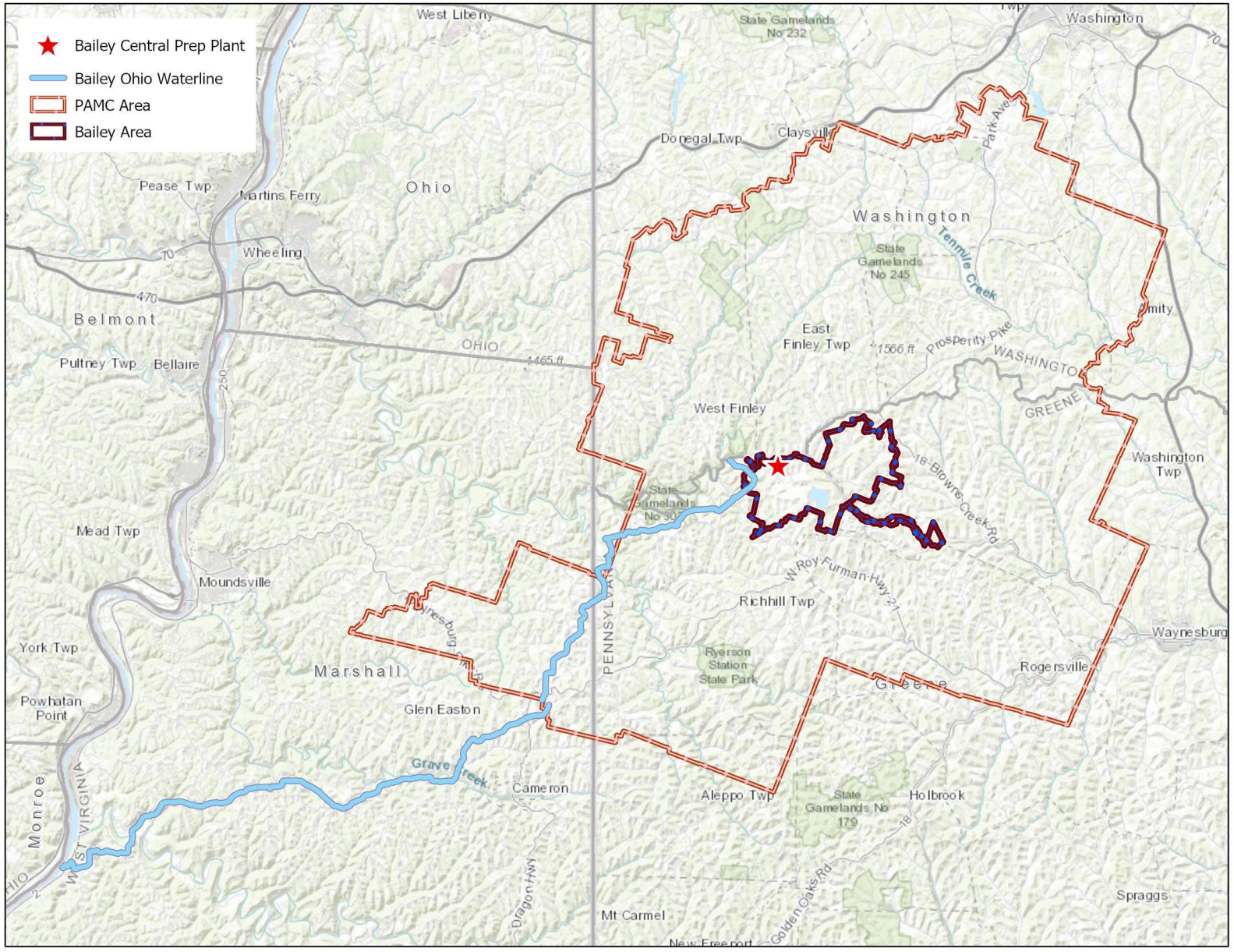
(1) Undeveloped reserves do not include any of the 669 million tons of reserves associated with PAMC or 21 million tons of reserves associated with Itmann
(2) As of December 31, 2019.

Executive Summary

Overall objective is to develop the coal-based power plant of the future, which can be commercially viable in the U.S. power generation market, has the potential to be commercially demonstrated in the next 5-10 years, and can begin achieving market penetration by 2030.

- **Conducted under the U.S. Department of Energy's Coal FIRST program**
  - Focused on developing a coal-based power plant of the future that is Flexible, Innovative, Resilient, Small, and Transformative
- **Technology concept: Supercritical pressurized fluidized bed combustion (PFBC) power plant with carbon dioxide capture and storage**
- **Envisioning ~300 MWe net power plant sited at or near CONSOL's Pennsylvania Mining Complex**
  - Environmental aspects include near-zero emissions of regulated air pollutants, zero liquid discharge
- **Goal is to capture and permanently sequester 97% of CO_2 emissions, and achieve net neutral or negative CO_2 emissions via bioenergy with carbon capture and storage (BECCS)**
- **Among the fuels acceptable for use with this process is "waste" coal, which provides a reliable on-site fuel supply with very low cost**
  - Biomass will serve as a secondary fuel at up to 10% of the feed
- **Integration with existing mine site infrastructure enhances project value and promotes sustainability of the power generation supply chain**
  - Use of "waste" coal eliminates an environmental liability and reduces risk associated with tailings facilities
  - Potential opportunity for integration into PAMC water balance, to further reduce footprint
  - Dry, solid byproducts with potential commercial applications support project circularity
- **Project has successfully advanced through Phases 1 & 2 of the Coal FIRST program and has just been selected for Phase 3 funding**

Pennsylvania Mining Complex Footprint & Pipeline Right-of-Way to Ohio River



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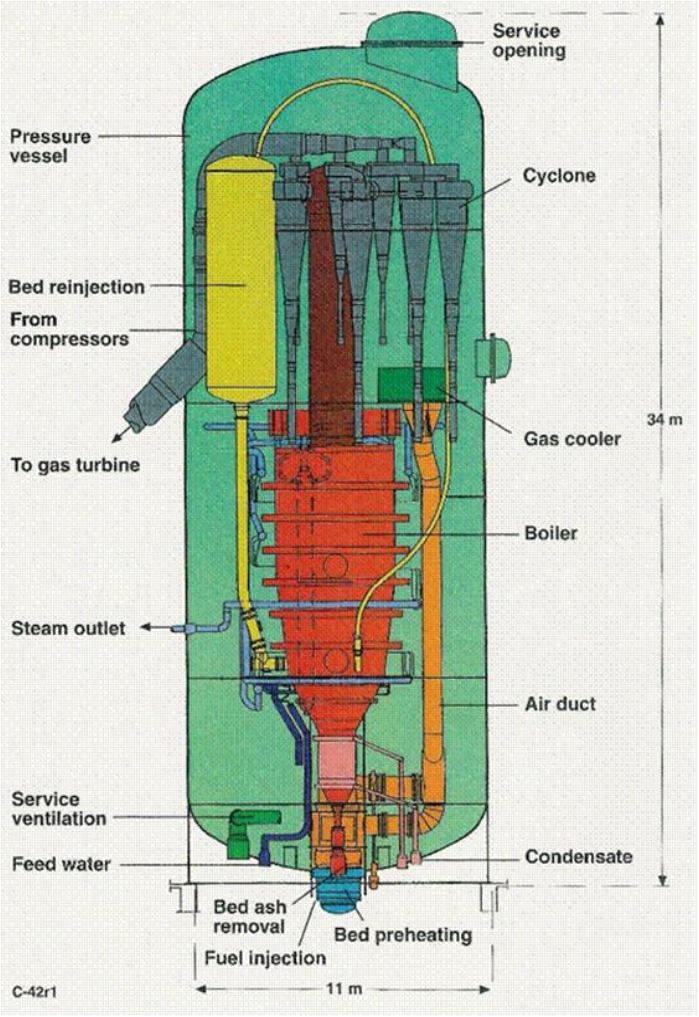
Advanced PFBC with Carbon Capture: Key Features

- **Base technology has been commercially proven**
  - Stockholm, Sweden (135 MWe, 2 x P200, subcritical, 1991 start-up)
  - Cottbus, Germany (80 MWe, 1 x P200, subcritical, 1999 start-up)
  - Karita, Japan (360 MWe, 1 x P800, supercritical, 2001 start-up)
- **High efficiency (42.3% efficiency HHV demonstrated at Karita without CO_2 capture)**
- **Low emissions**
  - Sulfur capture is 98% at the Värtan plant in Stockholm without a scrubber
  - NOx emissions at Värtan are 0.05 lb/million Btu using SNCR
- **Opportunities for byproduct reuse (ash from the Karita PFBC is used as aggregate for concrete manufacture)**
- **Designed for small modular construction**
- **Capable of firing a wide range of fuels, including:**
  - Fine, wet waste coal
  - Wet biomass
  - Other opportunity fuels
- **Well-suited for CO_2 capture**
- **Use of wet, fine waste coal demonstrated at pilot scale (1 MWt) at CONSOL R&D without CO_2 capture (2006-2007) and with potassium carbonate-based CO_2 capture (2009-2010)**



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CO_2 Disposition Plan

- **CO_2 disposition strategies include on-site geologic sequestration, integration into regional CCUS infrastructure**
  - CO_2 "industry" is evolving rapidly
  - CO_2 pipelines and regional "hubs" likely to be established in the next 5-10 years, could expand markets for CO_2
- **Characterization of On-Site Geologic Storage Opportunities**
  - Potential storage zones exist under CONSOL's PAMC
  - Detailed characterization of deeper reservoirs within study area to assess CO_2 storage capacity
  - Evaluate and confirm feasibility of deep well injection options
  - Preparation of detailed plans associated with potential 15,000-20,000 ft. CO_2 injection well located on the project site
- **Evaluation of Regional CO_2 Transport and Utilization Opportunities**
  - CONSOL's PAMC located in proximity to extensive oil and gas production infrastructure
  - Significant opportunity to utilize CO_2 for enhanced gas or oil recovery or to convert existing shale wells into CO_2 storage facilities
  - Explore strategies for offsite transport and utilization of some or all the CO_2
  - Local and regional capture, transport, and storage inputs will be parameterized and modeled using the SimCCS platform
- **Economic Optimization**
  - Identify economically optimal solutions and infrastructure designs for integrated CCUS systems and technologies
  - Comparison of on-site CO_2 storage strategy to other options for regional CCUS deployment will inform and de-risk investment case

Recap: Overall Goals and Next Steps

- **Reinvent the way a traditional resource (coal) can be used to sustainably generate electricity**
- **Promote sustainable power generation, based on net positive environmental impact of project with beneficial air, water, and waste profiles**
- **Significantly advance the state of carbon capture technology, with a full-scale installation capturing > 2 million tons/year**
- **Provide needed advances in the understanding of carbon storage opportunities in the Northern Appalachian basin, with benefits extending far beyond this project**
- **Demonstrate BECCS on a commercially-relevant scale**
- **Be cost competitive with other CO_2-neutral power generation options that are capable of providing reliable, resilient, baseload electricity supply**
- **Proposed schedule:**
  - Design optimization and FEED study to be completed in January 2021 – June 2023
  - Target is to allow construction to begin in ~2024 and commissioning in ~2028 if the project is successful

For the prospect of a zero-emission coal based power plant to become reality, we will need continued support, cooperation, and encouraged investment. This project can be a model for the country to clean up coal waste while generating zero-emission power.