CONTENTS

FIGURES

TABLES

ABBREVIATIONS

AADT - annual average daily traffic
ac - acre
ac-ft - acre-feet
AR - access road option (e.g., AR1)
C.F.R. - Code of Federal Regulations
CCPI - Clean Coal Power Initiative
cm - centimeter
CO- carbon monoxide
CO_2 - carbon dioxide
dBA - A-weighted decibels
DOE - U.S. Department of Energy
EIS - environmental impact statement
EOR - enhanced oil recovery
EPA - U.S. Environmental Protection Agency
ERCOT - Electric Reliability Council of Texas
FM - Farm-to-Market Road (e.g., FM 866)
FSH - Fort Stockton Holdings
ft - foot
ft^3 - cubic foot
gal - gallon
GCA - Gulf Coast Waste Disposal Authority
H_2 - hydrogen gas
H_2S - hydrogen sulfide
H_2SO_4 - sulfuric acid
ha - hectare
HAP - hazardous air pollutants
Hg - mercury
I - Interstate (e.g., I-20)
in - inch
IGCC -integrated gasification combined-cycle
km - kilometer
KOP - key observation point
kV - kilovolt
L - liter
Ldn - day-night level
LOS - level of service
m - meter
m^3 - cubic meter
mi - mile
MVA - monitoring, verification, and accounting
MW - megawatt
n/a - not available
N_2 - nitrogen gas
NAAQS - National Ambient Air Quality Standards
NEPA - National Environmental Policy Act
NETL - National Energy Technology Laboratory
NG - natural gas pipeline option (e.g., NG1)
NH_3 - ammonia
NRHP - National Register of Historic Places
OSHA - Occupational Safety and Health Administration
Oxy Permian - Oxy USA-W Texas Water Supply
pH - measure of acidity or basicity
PM - particulate matter
PM_{10} - particulate matter with aerodynamic diameter equal to or less than 0.00039 inch (10 micrometers)
$PM_{2.5}$ - particulate matter with aerodynamic diameter equal to or less than 0.000098 inch (2.5 micrometers)
polygen - polygeneration
ROI - region of influence
ROW - right-of-way
RR - railroad option (e.g., RR1)
SPCC - spill prevention, control, and countermeasures
Summit - Summit Texas Clean Energy, LLC
SWPPP - storm water pollution prevention plan
t - metric tonnes
TCEP - Texas Clean Energy Project
TCEQ - Texas Commission on Environmental Quality
TL - transmission line option (e.g., TL1)
tn - ton
TxDOT - Texas Department of Transportation
U.S. - United States
UPRR - Union Pacific Railroad
WL - waterline option (e.g., WL1)
ZLD - zero liquid discharge

This page intentionally blank

1 PURPOSE AND NEED

1.1 Introduction

The United States (U.S.) Department of Energy (DOE) proposes to award financial assistance to Summit Texas Clean Energy, LLC (Summit) for the Texas Clean Energy Project (TCEP or project), a proposed coal-based electric power and chemicals production plant (referred to as a polygeneration or polygen plant). Summit would plan, design, construct, and operate the TCEP, including a three-year demonstration phase at the beginning of plant operations. The plant is expected to operate for at least 30 years. Plant design would combine carbon dioxide (CO_2) capture with an integrated gasification combined-cycle (IGCC) power production system, and captured CO_2 would be sold on the regional market for enhanced oil recovery (EOR), resulting in permanent sequestration of the CO_2.

The project would be located approximately 15 miles (mi) (24 kilometers [km]) southwest of the city of Odessa in Ector County, Texas. Summit would build the polygen plant on a 600-acre (ac) (243-hectare [ha]) site adjacent to the community of Penwell and north of Interstate 20 (I-20) along a Union Pacific Railroad (UPRR) line (Figure S1-1). Summit chose this site primarily because of its proximity to an existing CO_2 pipeline and multiple EOR sites.

DOE selected Summit's proposed TCEP for an award of financial assistance through an open and competitive process under the third round of its Clean Coal Power Initiative (CCPI) program. DOE initiated the CCPI in 2002 to stimulate investment in low-emission, coal-based power generation technologies through successful commercial-scale demonstrations. The goal of the CCPI, a cost-shared collaboration between the federal government and industry, is to accelerate the readiness of new coal technologies for commercial use, ensuring future access to clean, reliable, and affordable power in the U.S. The CCPI is consistent with the Energy Policy Act of 2005 (Public Law 109-58) and directly supports the national Climate Change Technology Program, a multi-agency research and development program, in its efforts to reduce CO_2 emissions.

DOE's financial assistance would occur through cost-sharing with Summit. DOE would apply approximately $450 million in co-funding to the project from the American Recovery and Reinvestment Act of 2009 (Public Law 111-5), with the specific terms and conditions of the financial assistance described in an agreement between DOE and Summit.

DOE has prepared this environmental impact statement (EIS) to provide an analysis of the potential environmental impacts associated with DOE's Proposed Action of providing financial assistance to Summit's proposed TCEP. The EIS has been prepared in accordance with the National Environmental Policy Act (NEPA) of 1969, as amended (42 United States Code [U.S.C.] § 4321 et seq.), NEPA-implementing regulations promulgated by the Council on Environmental Quality (40 Code of Federal Regulations [C.F.R.] Parts 1500–1508), and DOE's NEPA procedures (10 C.F.R. Part 1021). DOE will use this EIS and other information to decide whether to provide a total of $450 million in co-funding for Summit's TCEP.

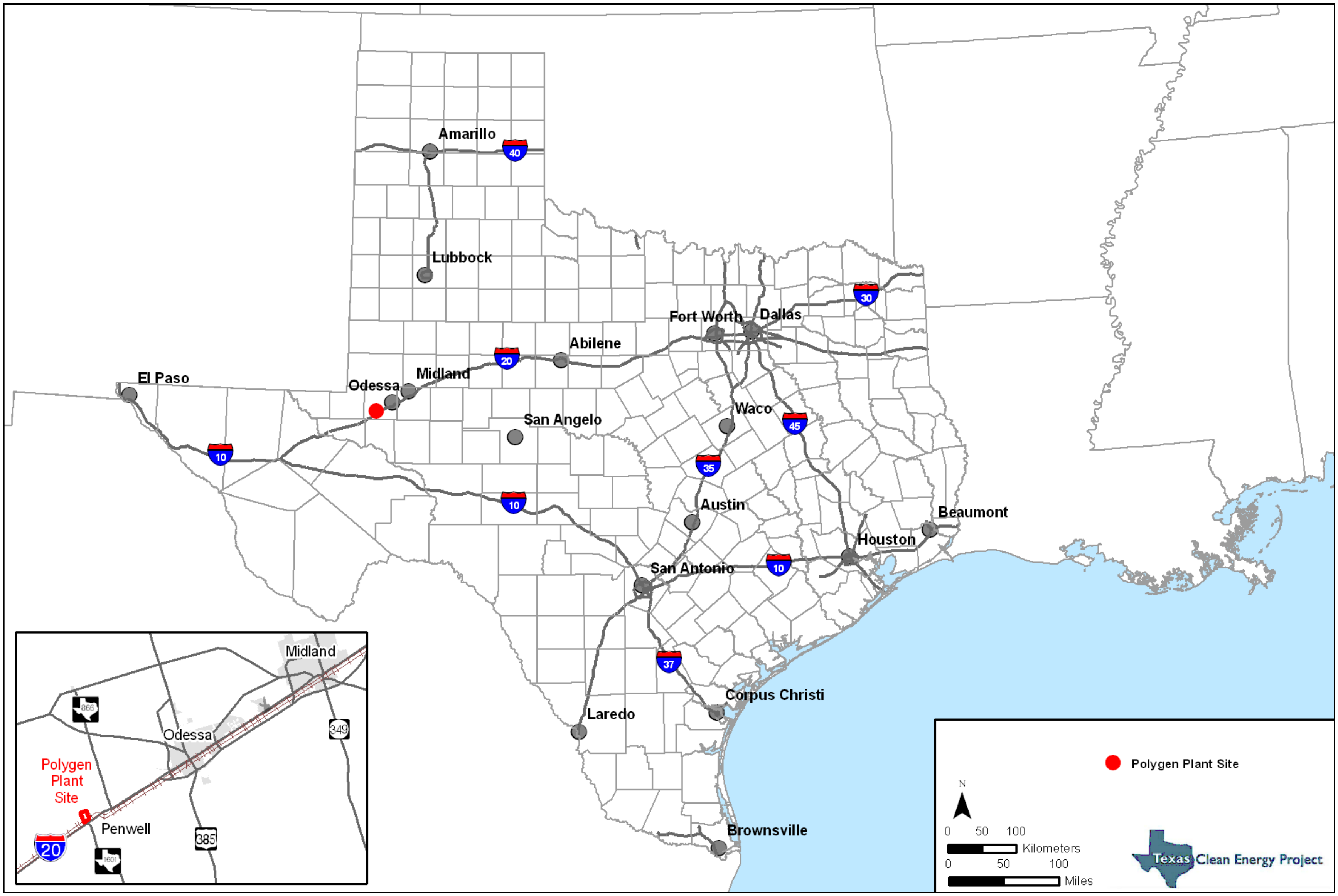

Figure S1-1. General location map.

1.2 DOE's Purpose and Need

DOE's purpose for its Proposed Action in the context of the CCPI Round 3 program is to advance the program by funding projects that have the best chance of achieving the program's objectives as established by the U.S. Congress. These objectives include the commercialization of clean coal technologies that advance efficiency, environmental performance, and cost competitiveness well beyond the level of technologies that are currently in service. Programmatically, DOE selected Summit's proposed project under the CCPI program as one in a portfolio of projects. That portfolio represents the most appropriate mix of projects to achieve CCPI program objectives and meet legislative requirements. Specifically, DOE's purpose and need for selecting the TCEP is to demonstrate the commercial-readiness of CO_2 capture and geologic sequestration paired with a utility-scale electric power and chemicals polygen plant that uses IGCC technology. The technical, environmental, and financial data generated from the design, construction, and operation of the polygen plant would result in a commercial reference plant for the technology.

1.3 Industrial Participant's (Summit's) Purpose and Need

Summit's primary business is the development of low- and zero-carbon power projects, including wind projects, solar power projects, and combined-cycle gas-fueled power projects. In addition to continuing and expanding this business strategy, the purpose of the TCEP is to add low CO_2 emissions base-load power to the nation's electricity generation mix. This power would provide supply stability to offset the irregular nature of West Texas' wind generation, and to geologically store captured CO_2 through a beneficial use, in this case by using it to boost production of oil wells in the Permian Basin.

Summit is responding to a regional need for base-load electric power and peaking capacity during summer months. Unlike proposed renewable energy projects, the TCEP would produce base-load electric power. Summit believes that the operation of the TCEP would allow intermittent, renewable energy projects to be more viable by providing a nonfluctuating, stabilizing power source to help anchor renewable power generation in West Texas.

Summit is also responding to a regional need for CO_2 to support the ongoing EOR operations within the Permian Basin. The TCEP would capture approximately 3 million tons (tn) (2.7 million metric tonnes [t]) of CO_2 per year, which would be transported by pipeline to EOR industry buyers. Should the TCEP demonstrate the feasibility of utility-scale electric power generation with CO_2 capture, it could result in the incorporation of CO_2 capture in future power plant construction, with the resulting reduction in CO_2 emissions from new electricity generating capacity built in the future.

1.4 DOE Scoping Process

DOE has undertaken public and agency involvement efforts to solicit input to the EIS. On June 2, 2010, DOE published a Notice of Intent in the *Federal Register* of its plan to prepare the EIS (75 *Federal Register* 30800). Publication of the Notice of Intent initiated a 30-day formal public and agency scoping period, during which DOE solicited comments regarding the project and its potential impacts. On June 17, 2010, DOE and Summit held an open house and public scoping meeting for the project. Approximately 75 people attended the meeting, and 10 provided oral comments whereas three wrote comments on forms.

In addition to the comments received at the scoping meeting, DOE received comments throughout the scoping period. In total, 218 comments were received from 23 commenters from June 3, 2010 through July 2, 2010. Of the 23 commenters, 10 represented local, state, and federal government agencies and municipalities; two represented organizations; two represented businesses; and nine individuals represented themselves. A number of commenters stated their general support for or opposition to the proposed project, made rhetorical statements, asked questions, or provided statements of opinion. All comment submissions were reviewed to identify specific issues, concerns, and questions and to ensure the consideration of all substantive concerns. These substantive comments included the following:

- Need for the TCEP, considering current and future energy demands, regulations, and the availability of alternative energy generation sources such as solar, wind, nuclear, and conventional coal-fueled power plants.
- Information on the proposed polygen processes and facility infrastructure requirements, CO_2 monitoring systems for EOR, labor mix, and utility and resource requirements.
- Consideration of alternative technologies for various chemical processes, including ammonia (NH_3) production and mercury (Hg) removal, as well as technologies that reduce particulate matter (PM) emissions.
- Potential direct, indirect, and cumulative effects of process inputs, oil and gas operations, and products to natural and human environmental resources such as air quality, water resources, biological resources, and human health.
- Effects of the project on the local community such as land use impacts to the rural character of the area, effects on historic structures and prehistoric resources, effects on recreational hunting and mineral rights ownership, and socioeconomic effects.
- Information on whether the net benefits of CO_2 sequestration through EOR efforts would be offset by full life-cycle CO_2 impacts associated with the recovered oil.
- Petroleum issues including the EOR process and CO_2 monitoring methods, as well as clarification on the liability and guarantees associated with the CO_2 monitoring system.

1.5 Consultation and Coordination

1.5.1 Coordination with Federal and State Agencies

DOE contacted the following federal and state agencies to initiate consultation regarding particular environmental resources in their jurisdictions or areas of special expertise:

- U.S. Department of the Interior, Regional Environmental Office
- U.S. Environmental Protection Agency (EPA), Region 6, Regional Environmental Review Coordinator, Office of Planning and Coordination
- Texas Commission on Environmental Quality (TCEQ), Region 7, Midland
- U.S. Army Corps of Engineers, Fort Worth District
- U.S. Fish and Wildlife Service, Austin Ecological Services Field Office
- U.S. Department of Transportation, Federal Highway Administration
- Texas Department of Transportation (TxDOT), Office of Planning and Development

- Texas State Historic Preservation Office, Texas Historical Commission
- Texas Parks and Wildlife Department, Wildlife Habitat Assessment Program

No agencies requested to participate as a cooperating agency for this EIS.

1.5.2 Consultation with Native American Tribes

DOE also contacted the following federally recognized Native American tribes inviting them to attend and participate in the scoping process:

- The Apache Tribe of Oklahoma
- The Comanche Tribe of Oklahoma
- The Kiowa Tribe of Oklahoma
- The Lipan Apache Tribe of Texas
- The Fort Sill Apache Tribe of Oklahoma
- The Wichita Tribe of Oklahoma
- The Ysleta Del Sur Pueblo of Texas
- The Mescalero Apache Tribe of New Mexico

DOE received a response from the Ysleta Del Sur Pueblo of Texas requesting consultation in compliance with the Native American Graves Protection and Repatriation Act (Public Law 101-601) if human remains or artifacts were unearthed during the construction of the TCEP.

2 PROPOSED ACTION AND ALTERNATIVES

2.1 DOE's Proposed Action

DOE's Proposed Action is to provide, through a cooperative agreement, a total of approximately $450 million in co-funding for Summit's proposed TCEP. The funds would be provided on a cost-share basis for the planning, design, and construction of the project and a three-year testing and operation demonstration phase.

2.1.1 Alternatives Determined to be Reasonable by DOE

Section 102 of NEPA requires that agencies discuss the reasonable alternatives to the proposed action in an EIS. The term *reasonable alternatives* must be determined in the context of the funding program and its underlying legislation.

CCPI legislation (Public Law 107-63) has a narrow focus in directing DOE to demonstrate the commercial viability of improved technology that may reduce the barriers to continued use of coal. Under the CCPI, coal must provide at least 75 percent of the fuel for power generation. Therefore, other technologies that cannot serve to carry out the goal of the CCPI (e.g., natural gas, wind power, conservation) are not relevant to DOE's decision of whether or not to provide cost-shared funding support for the TCEP and, therefore, are not reasonable alternatives.

The CCPI only allows for federal co-funding of proposed private sector/industry projects for which an application has been submitted, selected, and awarded in response to a formal funding opportunity announcement issued by DOE. DOE issued the CCPI Round 3 funding opportunity announcement in August 2008, which included a requirement for the capture and sequestration or beneficial use of CO_2. As part of DOE's American Recovery and Reinvestment Act implementation, CCPI Round 3 was reopened in June 2009. After CCPI Round 3 was reopened, 38 project applications were received, and 25 met all the mandatory eligibility requirements of the solicitation. Summit's proposed TCEP was one of three projects initially selected for further consideration under this reopening of Round 3.

DOE's preferred alternative is to provide financial assistance to the TCEP in the form of co-funding under the CCPI cooperative agreement. DOE does not have a preference among the options considered for utility and transportation infrastructure necessary to support the project. If DOE ultimately selects the preferred alternative, the department would then determine whether mitigation of certain potential impacts would be required.

2.2 Summit's Proposed Project

Summit's TCEP would include the construction and operation of a polygen plant and associated linear facilities (collectively, the project). The various linear facility options would consist of an electric transmission line (Transmission Line [TL] Options 1–6), one or more process waterlines (Waterline [WL] Options 1–4), a natural gas pipeline (Natural Gas [NG] Option 1), a CO_2 pipeline connector (CO_2 Option 1), access roads (Access Road [AR] Options 1 and 2), and a rail spur (Railroad [RR] Option 1). These linear facilities would connect the plant to existing utilities, a CO_2 pipeline, roadways, and a rail line. The locations of the proposed polygen plant site and associated linear facility options are identified in Figure S2-1 and are described in Section 2.2.5.

2.2.1 Process Description

The TCEP polygen plant is being designed to use low-sulfur, Powder River Basin sub-bituminous coal from Wyoming as the feedstock for the gasification island, which would use two Siemens gasifiers to convert that feedstock into synthesis gas (syngas) for downstream use. After further cleaning, chemical conversion, and processing of the syngas, followed by capture and removal of CO_2, the hydrogen (H_2)-rich syngas would be used in the power island to generate 400 megawatts (MW) (gross) of electrical power. Under maximum power output conditions, approximately 213 MW (net) of the power generated would go to the regional electricity grid. The remainder would be used to power polygen plant operations, including in the urea plant to produce urea for fertilizer.

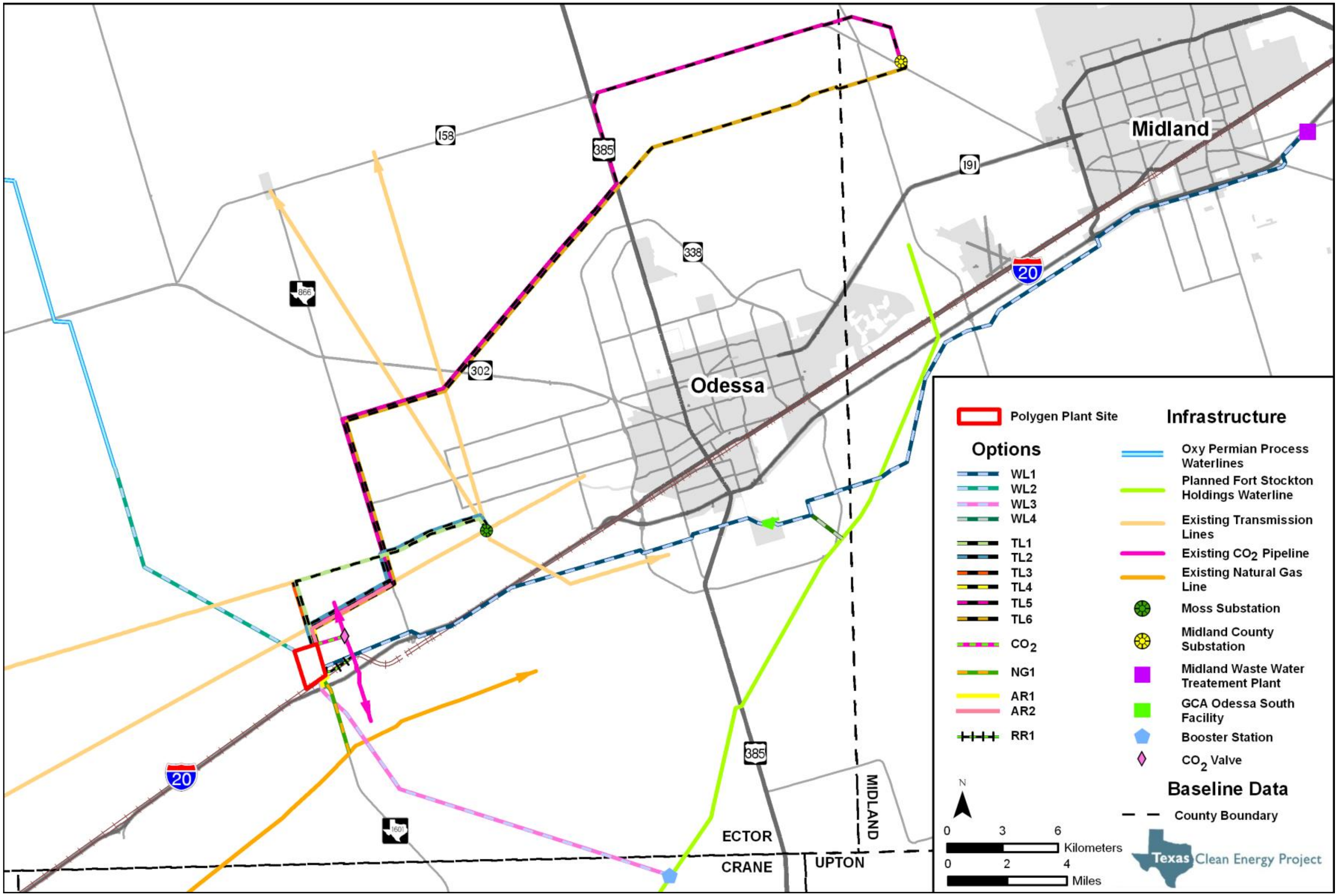

Figure S2-1. Polygen plant site and associated linear facility options.

The captured CO_2 would be further cleaned and compressed. It would then be transported through a short connector pipeline to an existing, regional CO_2 pipeline for dispersal to oil fields in the Permian Basin. Captured sulfur compounds would be converted into sulfuric acid (H_2SO_4), which would be made available for commercial sale. Argon gas would be captured by the air separation process and would be made available for commercial sale. The other product of the gasification process would be inert nonleachable slag. Inert slag would also be available for commercial sale to manufacturing and construction industry buyers.

2.2.2 Process Components and Major Equipment

Major process components of the plant would include

- an air separation unit (for oxygen gas and nitrogen gas [N_2] production),
- syngas cleanup systems (including water-gas shift reactors, sulfur recovery, Hg removal, and CO_2 capture),
- CO_2 compression,
- an H_2SO_4 plant,
- fuel processing equipment, and
- material handling systems.

A simple representative diagram of how these technologies are integrated is shown in Figure S2-2. Table S2-1 provides a summary of each process component and major equipment items that would be used in these technologies. Unless otherwise noted, the source for the process description is the *Texas Clean Energy Project Initial Conceptual Design Report,* dated September 2010 (Summit 2010a).

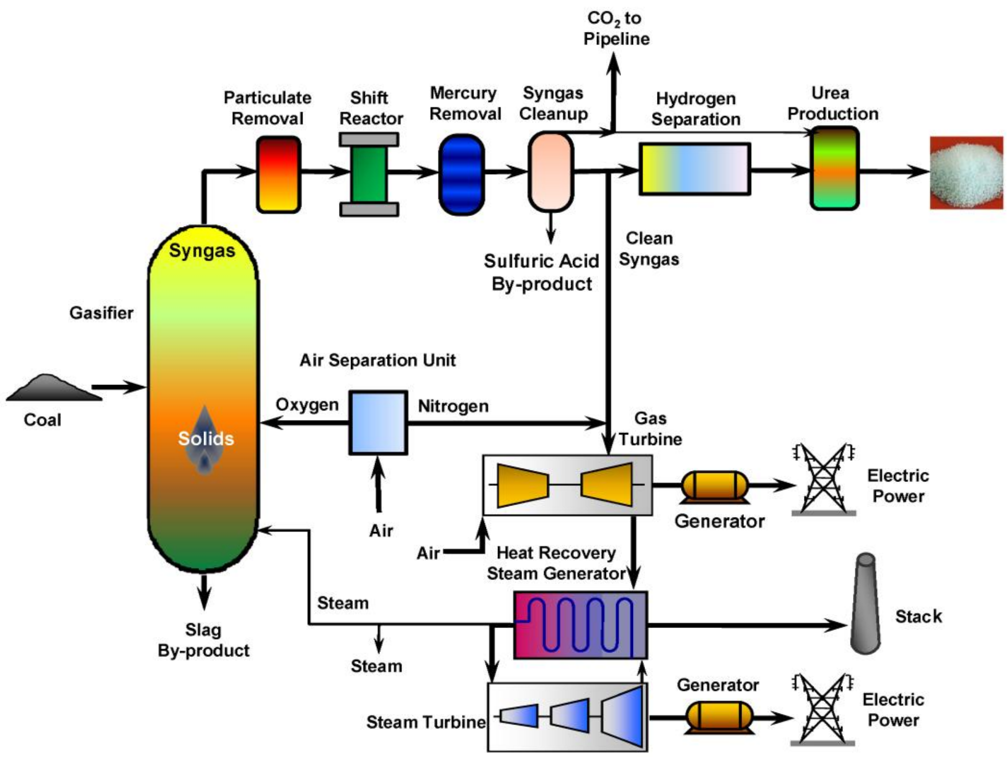

Figure S2-2. Illustration (simplified) of the TCEP's gasification, power generation, and urea production.

Table S2-1. TCEP Process Components and Major Equipment

Component, Equipment	Description
Coal Receiving, Storage, and Handling	Coal would be delivered to the polygen plant site by rapid-discharge bottom-dumping railcars. Belt feeders and conveyor belts would transfer coal from the unloading hoppers to the active coal storage pile. From the coal piles, coal would be fed into the crushing system. Conveyors would transfer crushed coal from the crushers to the coal grinding and drying feed silos.
Coal Drying and Grinding System	Coal would be dried to approximately 8 weight percent moisture and ground to less than 0.008 inch (in) (200 micrometers) in diameter in two bowl mills. The dry, ground coal would be pneumatically conveyed to the individual storage bins that serve each gasifier.
Air Separation Unit	Atmospheric gases would be cryogenically separated to produce 1) high purity oxygen gas for use as an oxidant in the gasifiers and 2) high purity N_2 for use in the N_2 wash of the acid gas removal, for producing urea, and as a diluent in the combustion turbine. N_2 would also be used as a carrier gas for the coal and for purging purposes in the gasification island.
Gasification Island	
Gasifiers	Coal would be converted into gases (syngas) at high temperature and pressure for production of power and urea. The inorganic materials in the coal would melt to form slag. The raw syngas and the slag would leave the gasifier (reactor) and flow into separate quench sections, where they would be cooled.
Black water treatment plant	"Black water" would be formed during the syngas and slag quenching processes. A flash vessel would remove excess dissolved gases and cool the black water. Chemicals would then be added to precipitate and flocculate materials from the black water, which would then be filtered out. Most of the dried filter cake (containing a large fraction of carbon) would be recycled through the gasifiers to produce more syngas; the remaining small amount would be properly disposed of in a landfill. Some of the clear effluent would recycle back into the gasification island, and the remaining effluent would be piped to the zero liquid discharge (ZLD) waste water treatment system for cleaning before it is recycled.
Slag handling, storage, and loading	Inert slag would be collected and conveyed to a storage area and ultimately marketed or properly disposed of in a landfill.
Water-gas Shift, Low Temperature Gas Cooling, and Hg Removal Units	
Water-gas shift unit	The carbon monoxide (CO) in the syngas would react with steam over a catalyst for conversion to CO_2. The reaction would also increase the H_2 content. The syngas would still contain sulfur compounds, which would be subsequently removed in the acid gas removal process. Carbonyl sulfide in the syngas would be converted to hydrogen sulfide (H_2S), which would be more easily removed in the acid gas removal process.
Low-temperature gas cooling unit	Syngas leaving the water-gas shift unit would be cooled further in the low-temperature gas cooling unit. Water would condense from the syngas as it is cooled, and the condensate would be collected, heated, and returned to the gasification island. The cooled syngas would be sent to the Hg removal unit.
Hg removal unit	The syngas would pass through sulfur-impregnated activated carbon beds where the Hg compounds would be adsorbed and converted to stable mercuric sulfide. At the end of their useful life, the carbon beds would be removed and transported off-site to appropriate facilities for disposal or recovery of the Hg compounds. The unit would achieve greater than 95 percent Hg removal.

Table S2-1. TCEP Process Components and Major Equipment

Component, Equipment	Description
Acid Gas Removal	The H_2S and CO_2 would be captured and removed from the syngas using Rectisol® technology (using chilled methanol). The Rectisol® process would physically absorb the acid gases, capturing and removing H_2S and CO_2 in separate concentrated streams. The acid gas removal would include a N_2 wash to remove trace chemicals, including residual methanol. The resulting clean H_2-rich syngas would be sent to the power block and urea facility.
Sour Water Treatment	The sour (sulfur-bearing) waste waters from the gasification process would enter a degassing drum, where dissolved gases would be released, and entrained oil and solids would be removed. After degassing, the water temperature would be increased using a heat exchanger. The heated sour water would be fed to the sour water stripper. Most of the NH_3 in the sour water feed would be removed in this column. Sodium hydroxide would be injected, as needed, to facilitate the release of NH_3 from the condensate. Stripped sour water would then be sent to the ZLD system for cleaning.
H_2SO_4 Plant	Sulfur compounds from the acid gas streams leaving the acid gas removal and sour water treatment units, along with flash gas from the gasification island, would be recovered using a catalytic process to generate commercial-grade, concentrated H_2SO_4. Once cooled, the concentrated H_2SO_4 product would be stored in a carbon steel tank coated with a fluorinated polymer and transported off-site by rail.
CO_2 Compression and Drying	The CO_2 captured by the Rectisol® process would be dried, compressed, and split into two streams. Most of the CO_2 would be transported off-site for EOR; the remainder would go to the urea facility.
NH_3 Synthesis Unit	A portion of the H_2-rich syngas stream leaving the acid gas removal would be compressed, cooled, and processed through a multi-bed catalytic reactor to produce liquid NH_3. The liquid NH_3 would be pumped to storage.
Urea Synthesis Unit	NH_3 would be converted to urea. Some of the CO_2 from the acid gas removal unit would be compressed and sent to a urea reactor where it would combine with liquid NH_3 from the NH_3 synthesis unit. Ammonium carbamate would be formed and then allowed to decompose to urea. Using a granulator bed, the urea would be made into granules for commercial sale.
Urea Handling	Urea granules would be transferred by conveyors from the urea synthesis unit to four storage domes and then on to a loadout bin. The urea would be loaded into railcars for shipment to market.
Combined-cycle Power Block	H_2-rich syngas from the acid gas removal, along with nitrogen diluent, would be sent to the Siemens SGT6-5000F3 combustion turbine generator for primary power generation. The combustion turbine would also be configured to use natural gas as a startup and backup fuel. Waste heat from the combustion turbine exhaust would be captured by the heat recovery steam generator, producing steam, which would subsequently be used in the steam turbine-generator for supplemental power generation in combined-cycle mode. A mixture of syngas and N_2 wash system offgas would be sent to a duct burner located in the heat-recovery steam generator as a fuel for production of additional steam.

2.2.3 Utility Systems

Table S2-2 describes the TCEP utility systems.

Table S2-2. TCEP Utility Systems

System	Description
Cooling System	Two types of cooling systems would be used at the polygen plant: wet and dry cooling. An air-cooled (dry) condenser would be used for the combined-cycle power block. For the chemical process portion of the polygen plant, units requiring cooling to temperatures less than 140 degrees Fahrenheit (60 degrees Celsius) may use wet cooling. Makeup water for the wet cooling tower would be obtained from treated municipal waste water or ground water. Cooling tower blowdown would be directed to the ZLD system. The cooling tower would be equipped with a drift eliminator designed to limit drift losses to 0.001 percent of the circulation rate.
Flare Systems	Two gasification island flares, each approximately 200 feet (ft) (61 meters [m]) high, would be designed to combust various process gases vented during cold plant startups, gas-fired startups, plant shutdowns, catalyst change-outs, and upset events. As part of the design of the flare systems, a natural gas–fueled pilot would remain lit on each flare during normal operation to ensure the flares are available if needed. During normal operation, heat input to each flare would include 300 standard cubic feet (ft^3) per hour (27.8 cubic meters [m^3]) of natural gas used for pilot lights.
Auxiliary Boiler	The auxiliary boiler using natural gas for fuel would have a maximum firing capacity of 250 trillion British Thermal Units per hour (higher heating value). It would primarily be used during startup and shutdown.
Waste Water Systems	
ZLD system	The ZLD system would receive process waste water that is not immediately reused in the polygen plant. The ZLD system would consist of a brine concentrator, a filter press, a de-carbonator, a reverse osmosis system, and a crystallizer, which would remove water from liquid wastes and form a solid cake. The cake would be transported to a licensed landfill for final disposal. An alternative ZLD system is also being considered and would require the use of solar evaporation ponds instead of the brine concentrator and filter press system. Concentrated liquid wastes would be placed in a minimum of two lined, on-site ponds, which would be constructed of multiple individual cells. Remaining concentrated solids from the solar evaporation ponds would be periodically transported to a licensed landfill for disposal.
Deep well injection of nonhazardous waste water	Concentrated salts from the reverse osmosis treatment process could be disposed of using on-site deep injection wells.
Emergency Diesel Engines	One 350-horsepower, diesel-fueled, fire-water pump and two 2,205-horsepower, diesel-fueled, emergency generators would be located at the polygen plant site.
Storm Water Management	Storm water runoff would be directed to on-site retention/settling ponds to control peak discharge. The ponds would be sized based on the area of impervious surface on the polygen plant site and the maximum design storm-flow volumes. Where appropriate, storm water would be routed through an oil/water separator before entering the retention ponds.
Control Systems	Monitoring and control of the polygen plant would be accomplished from a central control room.

2.2.4 Marketable Products

2.2.4.1 ELECTRICITY

The TCEP would generate 400 MW (gross) of electric power, with approximately 213 MW (net) transported either to the Electric Reliability Council of Texas (ERCOT) or Southwestern Power Pool power grid under maximum power output conditions. There are four transmission line options under ERCOT (TL1–TL4 linear facilities) and two under Southwestern Power Pool (TL5 and TL6 linear facilities) that would connect the plant to either grid.

2.2.4.2 CARBON DIOXIDE

The TCEP's captured CO_2, up to a maximum of approximately 3 million tn (2.7 million t) per year, would be transported by a short pipeline that connects with the existing Kinder Morgan Central Basin pipeline, located 1.0 mi (1.6 km) east of the proposed polygen plant site. A significantly smaller additional amount (approximately 400,000 tn [362,874 t] per year) would be sent to the urea synthesis plant.

In the Kinder Morgan pipeline, TCEP's CO_2 would comingle with CO_2 from other sources and would be transported throughout the Permian Basin oil fields. Buyers would take a purchased quantity of CO_2 from the Kinder Morgan pipeline. In the Permian Basin, CO_2 is a commodity sold on a regional market. EOR using CO_2 is a commercially proven and long-established means of tertiary production of oil (i.e., the third stage of production) at existing oil-producing fields. It is likely that all the TCEP's captured CO_2 would be sold to buyers that already use CO_2 for EOR. Other buyers could include oil producers that have not yet started tertiary production of oil but may in the future.

Under the cooperative agreement with DOE, monitoring, verification, and accounting (MVA) measures would be required to provide an accurate accounting of stored CO_2 and a high level of confidence that the CO_2 is not being released or leaked to the surface above the well fields. MVA measures could include EOR system material balance accounting, modeling, plume tracking, and leak detection. Summit intends to seek tax incentives under Texas House Bill 469 and, to meet the requirements of that legislation, is working with Texas Bureau of Economic Geology to develop MVA procedures. Summit would include MVA requirements as a condition to its CO_2 offtake agreement (or agreements).

2.2.4.3 UREA

The TCEP would produce 1,485 tn (1,347 t) of granulated urea per day (542,025 tn [491,717 t] annually at maximum capacity). Up to seven days of urea production may be stored on-site.

2.2.4.4 ARGON

The TCEP would produce a small, undetermined amount of argon gas as a product of the air separation process. Up to seven days of argon production may be stored on-site and loaded into rail tank cars for sale and transportation off-site.

2.2.4.5 SULFURIC ACID

The TCEP would produce up to 56 tn (51 t) of H_2SO_4 per day, which would be temporarily stored on-site before sale or disposal.

2.2.4.6 SLAG

The TCEP would produce approximately 489 tn (444 t) of slag per day, which would be temporarily stored on-site and could be marketed to the construction industry.

2.2.5 Resource Requirements

Resource requirements for the TCEP would include coal, land area, water treatment chemicals, natural gas, potable water, process water, transmission facilities, and transportation. The polygen plant would produce products that would also require transportation or transmission. A description of the resource requirements for the TCEP is provided in Table S2-3. The location of the linear facilities options is shown in Figure S2-1.

Table S2-3. TCEP Resource Requirements

Type	Description
Coal	
Plant requirements	TCEP would use 5,800 tn (5,262 t) per day or 2.1 million tn (1.9 million t) per year of sub-bituminous coal from the Powder River Basin in Wyoming. The coal pile would be sized for about 45 days of total storage capacity, with approximately nine days of active storage and 36 days of inactive storage.
Transportation requirements	A maximum of up to five 135-car-unit trains per day could come on-site, with an average of three 115-car-unit trains per week.
Commercial Products	
Transportation requirements	**Argon:** Argon gas would be transported in rail tank cars. **Slag:** If commercially sold, up to five railcars per day would be sent to distant buyers; otherwise, an average of twenty 25-tn (23-t) trucks per day would transport slag off-site to either local buyers or a licensed landfill. **H_2SO_4:** Up to one-half railcar per day would be filled and sold. **Urea:** Up to 15 railcars per day would be required for the transportation of urea to buyers.
Linear facility requirements	**CO_2:** A 1.0-mi (1.6-km) CO_2 pipeline measuring 12 in (30 centimeters [cm]) in diameter would be constructed to connect plant facilities to the existing Kinder Morgan Central Basin CO_2 pipeline east of the polygen plant site. A maximum of 12.2 ac (4.9 ha) could be temporarily affected during construction, and 6.1 ac (2.5 ha) could be permanently affected by right-of-way (ROW) maintenance.
	TL1: A 9.3-mi (15.0-km) transmission line would be constructed between the polygen plant site and the existing Moss Substation to connect to the ERCOT grid. Seventy-five percent of the length of the transmission line would parallel an existing U.S. Geological Survey section line and an existing 138-kilovolt (kV) power line. A maximum of 116.6 ac (47.2 ha) could be temporarily affected, and 60.6 ac (24.5 ha) could be permanently affected by ROW maintenance.

Table S2-3. TCEP Resource Requirements

Type	Description
	TL2: An 8.6-mi (13.8-km) transmission line would be constructed between the polygen plant site and the existing Moss Substation to connect to the ERCOT grid. Ninety percent of the line would parallel a U.S. Geological Survey section line, Farm-to-Market Road (FM) 866, and an existing 138-kV power line. A maximum of 117.8 ac (47.7 ha) could be temporarily affected, and 65.5 ac (26.5 ha) could be permanently affected by ROW maintenance. **TL3:** A 2.2-mi (3.5-km) transmission line would be constructed between the polygen plant site and an existing 138-kV transmission line (due north of the site) to connect to the ERCOT grid. The line would require a new ROW. A maximum of 31.5 ac (12.7 ha) could be temporarily affected, and 18.0 ac (7.3 ha) could be permanently affected by ROW maintenance. **TL4:** A 0.6-mi (1.0-km) transmission line would be constructed between the polygen plant site and an existing 138-kV transmission line (due north of the site) to connect to the ERCOT grid. The line would require a new ROW. A maximum of 11.7 ac (4.7 ha) could be temporarily affected, and 8.1 ac (3.3 ha) could be permanently affected by ROW maintenance. This is Summit's preferred transmission line option. **TL5:** A 36.8-mi (59.2-km) transmission line would be constructed between the polygen plant site and the Midland County Substation to connect to the Southwestern Power Pool grid. The line would parallel a U.S. Geological Survey section line, existing transmission lines, and roads, and the line would partially require a new ROW. A maximum of 459.2 ac (185.8 ha) could be temporarily affected, and 236.2 ac (95.6 ha) could be permanently affected by ROW maintenance. **TL6:** A 32.8-mi (52.8-km) transmission line would be constructed between the polygen plant site and the Midland County Substation to connect to the Southwestern Power Pool grid. The line would parallel a U.S. Geological Survey section line, existing transmission lines, and roads, and the line would partially require a new ROW. A maximum of 455.5 ac (184.3 ha) could be temporarily affected, and 212.0 ac (85.8 ha) could be permanently affected by ROW maintenance.
Land Area	
Plant requirements	The polygen plant site would be constructed on approximately 600 ac (243 ha). It is assumed that 300 ac (121 ha) of the site would be permanently developed.
Linear facility requirements	All linear facility options would have an estimated 100-ft-wide (30-m-wide) construction ROW and a 50-ft-wide (15-m-wide) operational ROW. Temporary impacts during construction could range from 249 to 1,119 ac (101–453 ha), whereas permanent impacts from operations could range from 134 to 576 ac (54–233 ha) based on the smallest combination (WL2, TL4, CO_2, NG1, AR1, AR2, RR1) and largest combination (WL1, WL4, TL5, CO_2, NG1, AR1, AR2, RR1) of the linear facility options.
Materials And Chemicals	
Plant requirements	The polygen plant would require materials such as concrete, asphalt, aggregate and fill material, steel, piping, and process units for the construction of the polygen plant and linear facilities. During operations, the plant would handle coal, natural gas, chemicals, and hazardous materials including relatively small quantities of petroleum products, liquid oxygen gas and N_2, sulfur, catalysts, flammable and compressed gases, methanol, water treatment chemicals, and minor amounts of solvents and paints. Table S2-4 provides a list of chemicals and their storage quantities.

Table S2-3. TCEP Resource Requirements

Type	Description
Transportation requirements	The TCEP would require an average of 26 trucks per day and two trains per week for construction materials that are needed to construct the polygen plant and linear facilities, including the process water, CO_2, and natural gas pipelines, turbines, generators, separators, heat exchangers, and other infrastructure. Chemicals required for plant operation would be delivered to and removed from the polygen plant site either by truck or rail.
Natural Gas	
TCEP requirements	The TCEP would require up to 2 trillion British Thermal Units of natural gas annually for coal drying and gasifier pilots.
Linear facility requirements	**NG1:** Oneok WesTex would provide natural gas to the TCEP from an existing 20-in-diameter (51-cm-diameter) pipeline south of the polygen plant site. A 2.7-mi (4.3-km), 12-in-diameter (30-cm-diameter) connector pipeline would be constructed along FM 1601 to connect to the Oneok WesTex pipeline. Approximately 32.7 ac (13.2 ha) could be temporarily affected during construction, and 16.4 ac (6.6 ha) could be permanently affected by ROW maintenance.
Potable Water	
Plant requirements	Daily usage during peak construction (1,500 workers) would be approximately 45,000 gallons (gal) (170,344 liters [L]) per day. Daily usage during operation (150 workers) would be approximately 4,500 gal (17,034 L) per day.
Transportation requirements	A maximum of forty-two 25-tn (23-t) trucks of potable water per week would be delivered to the polygen plant site during construction. A maximum of five 25-tn (23-t) trucks of potable water per week would be delivered during operations.
Process Water	
Plant requirements	The TCEP would require a minimum of 3.5 million gal (13.2 million L) per day (3,923 ac-ft per year) and a maximum of 5.5 million gal (20.8 million L) per day (6,165 ac-ft per year) of water for all polygen plant uses.
Linear facility requirements	**WL1:** Gulf Coast Waste Disposal Authority (GCA) would provide raw process water to the TCEP from treated effluent at the GCA Odessa South Facility, a waste water treatment plant in the city of Odessa. The process water would come from a combination of waste water from the city of Odessa and the city of Midland, which would be piped to and treated at the GCA Odessa South Facility. The GCA Odessa South Facility would still maintain the existing minimum flow of effluent discharge into Monahans Draw. This is Summit's preferred water option for the TCEP. A 41.2-mi (66.3-km), 20- to 24-in-diameter (51- to 61-cm-diameter) pipeline would be constructed south of I-20 from the Midland Wastewater Treatment Plant to the GCA Odessa South Facility and from there to the polygen plant site. A maximum of 501.9 ac (203.1 ha) could be temporarily affected during construction, and 252.4 ac (102.1 ha) could be permanently affected by ROW maintenance.
	WL2: Oxy USA-W Texas Water Supply (Oxy Permian) would provide process water to the TCEP from their existing network of pipelines that provides brackish (highly saline and nonpotable) ground water from the Capitan Reef Complex Aquifer for EOR water flood projects in the Permian Basin. This brackish water would require treatment to meet gasifier manufacturer specifications. A 9.3-mi (15.0-km), 16-in-diameter (41-cm-diameter) pipeline would be constructed to connect to an existing Oxy Permian pipeline northwest of the polygen plant site. A maximum of 113.5 ac (45.9 ha) could be temporarily affected during construction, and 56.3 ac (22.8 ha) could be permanently affected by ROW maintenance.

Table S2-3. TCEP Resource Requirements

Type	Description
	WL3: Fort Stockton Holdings (FSH) would provide process water to the TCEP from their main waterline, which is an independent proposed project that would provide drinking water to the cities of Midland and Odessa. The TCEP could use 10 percent of the total water that would be available through the main FSH waterline. The FSH water source would be ground water from the Edwards-Trinity (Plateau) Aquifer located near the city of Fort Stockton, approximately 66 mi (106 km) southwest of the TCEP. Water from the FSH option would require treatment to meet gasifier manufacturer specifications. A 14.2-mi (22.9-km), 16-in-diameter (41-cm-diameter) pipeline would be constructed to connect to the proposed FSH main waterline project southeast of the polygen plant site. A maximum of 172.4 ac (69.8 ha) could be temporarily affected during construction, and 86.6 ac (35.0 ha) could be permanently affected by ROW maintenance.
	WL4: FSH would provide process water from their proposed main waterline project to the GCA Odessa South Facility to be used as a backup to WL1. The source would be the same as in WL3 (ground water from the Edwards-Trinity [Plateau] Aquifer). Treatment would occur at the GCA Odessa South Facility, and treated water would be piped to the TCEP through the WL1 pipeline. A 2.7-mi (4.3-km), 16-in-diameter (41-cm-diameter) pipeline would be constructed from the proposed FSH main waterline to the GCA Odessa South Facility. A maximum of 34.3 ac (13.9 ha) could be temporarily affected during construction, and 18.1 ac (7.3 ha) could be permanently affected by ROW maintenance.
Transmission	
Plant requirements	Approximately 187 MW would be used to operate the plant, compress CO_2, and produce urea fertilizer. Prior to operations, the TCEP would require power during construction and would connect to an ERCOT distribution line.
Transportation	
Plant requirements	**Rail:** The TCEP would require rail delivery of coal and some construction materials and equipment. The project may require rail transport off-site of construction and operational wastes and commercial products including argon, H_2SO_4, urea, and slag. **Truck:** The TCEP would require truck delivery for potable water, operations chemicals, and some construction materials and equipment. The project may also require truck transport off-site of construction and operational wastes and commercial products including argon, H_2SO_4, urea, and slag.
Linear facility requirements	**AR1:** Use of FM 1601 would be used primarily for emergency vehicle access, plant administrative personnel, and visitors (5 percent use expected). Access from FM 1601 to the plant site would require construction of an underpass, overpass, or at-grade intersection with the UPRR. AR1 would be constructed from the eastern corner of the polygen plant site to County Road 1216 (Avenue G) and would be improved from County Road 1216 and FM 1601 to I-20, totaling 0.6 mi (1.0 km). A maximum of 7.2 ac (2.9 ha) could be temporarily affected during construction, and 4.0 ac (1.6 ha) could be permanently affected by ROW maintenance. **AR2:** Access to the polygen plant site would be primarily from FM 866 (95 percent use expected). AR2 would be constructed from FM 866 along an existing 138-kV transmission line to the northeast corner of the polygen plant site, totaling 3.7 mi (6.0 km). A maximum of 58.0 ac (23.5 ha) could be temporarily affected during construction, and 35.5 ac (14.4 ha) could be permanently affected by ROW maintenance.

Table S2-3. TCEP Resource Requirements

Type	Description
	RR1: The TCEP would require the use of a rail spur that would connect the existing UPRR line to an on-site rail loop to facilitate the unloading of coal; the loading of H_2SO_4, urea, and slag; and the loading and unloading of construction and operations materials. Track layout design has not yet been finalized but would include the rail spur, on-site rail loop to accommodate at least two coal trains and two urea unit trains, a locomotive refueling location and road access for a tank truck, and an area for railcars needing repairs with access for a railcar repair contractor. A 1.1-mi (1.8-km) rail spur would be constructed to connect the existing UPRR line to the on-site rail loop. A maximum of 13.4 ac (5.4 ha) could be temporarily affected during construction, and 6.7 ac (2.7 ha) could be permanently affected by ROW maintenance.

2.2.6 Materials, Discharges, and Wastes

Natural gas would be used as a startup and backup fuel and to heat drying gases, supply an auxiliary boiler, and provide burner pilot flames (e.g., flares). It would be delivered to the plant site by a 12-in-diameter (30-cm-diameter) pipeline, which would interconnect to the existing natural gas pipeline located approximately 2.7 mi (4.3 km) south of the polygen plant site. Natural gas would not be stored on-site. H_2-rich syngas would be used on-site (as generated) with no on-site storage. Bulk quantities of liquid oxygen gas and N_2 would be stored in tanks in the air separation unit. Other gases stored and used at the polygen plant would include those typically used for operational and maintenance activities; these would be stored in approved, standard-sized storage vessels located in appropriate locations. Small quantities of water and waste water treatment chemicals would also be stored on-site.

Toxic and hazardous materials that would be used or stored for project operations are shown in Table S2-4.

Table S2-4. Toxic and Hazardous Materials and Estimated Storage at the Polygen Plant Site

Chemical	Estimated Storage on Polygen Plant Site	
	Volume (ft^3 [m^3])	Mass (pounds [kilograms])
General Plant Usage		
Anhydrous NH_3	1,365,988 (5,170,827)	7,249,454 (3,288,297)
Aqueous NH_3	31,231 (188,222)	232,529 (105,473)
Caustic	29,802 (112,813)	301,153 (136,601)
H_2SO_4 (raw water treatment use)	54,062 (204,647)	815,176 (369,759)
H_2SO_4 Plant		
Hydrogen peroxide	9,725 (36,813)	89,700 (40,687)
Gasification		
Hydrochloric acid	13,981 (52,924)	131,637 (59,710)

Table S2-4. Toxic and Hazardous Materials and Estimated Storage at the Polygen Plant Site

Chemical	Estimated Storage on Polygen Plant Site	
	Volume (ft^3 [m^3])	Mass (pounds [kilograms])
Raw Water Treatment		
Anti-scalant	157 (594)	1,342 (609)
Calcium hydroxide (dry)	n/a	225,927 (102,479)
Ferric chloride	898 (3,399)	10,491 (4,759)
Hydrochloric acid	16,779 (63,515)	159,003 (72,123)
Nalco 7341 (sodium hypochlorite [bleach])	516 (1,953)	5,109 (2,317)
Sodium bisulfite	142 (538)	1,560 (708)
Sodium carbonate (dry)	n/a	409,968 (185,958)
Waste Water Treatment		
Acetic acid	11,011 (41,681)	97,500 (44,225)
Ferric chloride	22 (83)	273 (124)
Hydrochloric acid	875 (3,312)	8,323 (3,775)
Nalco 7341 (sodium hypochlorite)	52 (197)	507 (230)
Organo sulfide	52 (197)	429 (195)
Phosphoric acid	90 (341)	1,248 (566)
Cooling Tower		
Nalco 3DT120	3,463 (13,109)	29,452 (13,359)
Nalco 3DT177	1,070 (4,050)	11,781 (5,344)
Nalco 7341 (sodium hypochlorite)	4,960 (18,776)	49,177 (22,306)
Nalco 90005	254 (961)	2,003 (909)
Nalco 71D5	524 (1,984)	3,640 (1,651)
Urea Synthesis		
UF85 (formaldehyde/urea/water)	23,863 (90,331)	260,000 (117,934)
Water-gas Shift		
Dimethyl disulfide	591 (2,237)	5,200 (2,359)
Power Block*		
Ammonium-ethylenediaminetetraacetic acid disodium salt (dry)	n/a	18,200 (8,255)
Antifreeze (propylene glycol or ethylene glycol)	5,057 (19,143)	43,409 (19,690)
Ethylenediaminetetraacetic acid disodium salt	778 (2,945)	6,500 (2,948)
Hydrazine	875 (3,312)	7,377 (3,346)

Table S2-4. Toxic and Hazardous Materials and Estimated Storage at the Polygen Plant Site

Chemical	Estimated Storage on Polygen Plant Site	
	Volume (ft^3 [m^3])	Mass (pounds [kilograms])
Sodium borate (dry)	n/a	30 (14)
Trisodium phosphate	524 (1,984)	4,335 (1,966)
Fuel		
Coal dust suppression polymer	to be determined	to be determined
Diesel	1,997 (7,559)	16,000 (7,257)

Note: n/a = not available.

*The power block would consist of the electric generation unit, combustion turbines, heat recovery steam generator, and associated equipment.

The TCEP would feature IGCC technology with comprehensive gas cleanup, including CO_2 capture that would allow the conversion of coal to a H_2-rich syngas. H_2-rich syngas would burn with substantially less air pollution as compared to other fuels. Because H_2 constitutes most of the fuel, much of the exhaust from the combustion turbine would be water vapor. Table S2-5 summarizes the permitted air pollutant emissions from the TCEP.

Table S2-5. TCEP Permitted Air Pollutant Emissions

Type	Emissions (tn [t]/year)
Criteria Air Pollutants	
CO	1,173.00 (1,064.00)
Lead	0.02 (0.018)
Nitrogen oxides	225.20 (204.30)
PM	416.10 (377.50)
PM_{10}	384.30 (348.60)
$PM_{2.5}$	373.40 (338.70)
Sulfur dioxide	251.10 (233.20)
Volatile organic compounds	39.60 (35.90)
Hazardous Air Pollutants (HAP)	
Carbonyl sulfide	2.61 (2.38)
Formaldehyde	2.96 (2.69)
Hydrochloric acid	1.39 (1.26)
Hydrofluoric acid	0.83 (0.75)
Hg	0.01 (0.009)

Table S2-5. TCEP Permitted Air Pollutant Emissions

Type	Emissions (tn [t]/year)
Other Air Pollutants	
NH_3	363.00 (329.30)
H_2S	3.20 (2.90)
H_2SO_4	14.60 (13.20)

Source: Summit (2010b).

Note: PM_{10} = PM 0.00039 in (10 micrometers) in diameter and $PM_{2.5}$ = PM 0.000098 in (2.5 micrometers) in diameter.

Primary waste water sources for the TCEP would include the oil water separator, urea condensate, gasification gray water purge, acid plant tail gas scrubber effluent, shift stripper purge, Rectisol® waste, cooling tower blowdown, contact and noncontact storm water, and miscellaneous polygen plant washdown wastes.

Industrial waste water from the TCEP would be treated and disposed of through a ZLD system consisting of either a mechanical crystallizer or solar evaporation ponds. An alternative disposal method using on-site deep-well injection is also being evaluated. Noncontact storm water would be directed to an on-site retention pond designed to hold runoff from the polygen plant site. Any storm water runoff that would have potential to come in contact with oil (e.g., water runoff from parking lots) would be directed to a separate storm water pond that would direct storm water to an oil-water separator before sending it to the ZLD system. Sanitary wastes would be collected and discharged directly to an on-site, underground septic disposal field.

The ZLD processes result in a solid filter cake material, which would be collected and transported off-site to appropriate facilities for disposal. The filter cake would be nonhazardous but would be tested to confirm its characteristics. Other solid and municipal-type wastes generated would be managed in accordance with applicable regulations, good industry practice, and internal company procedures. Hazardous and nonhazardous wastes would be properly collected, segregated, and recycled or disposed of at approved waste management facilities. Solid wastes and their disposal methods are shown in Table S2-6.

Table S2-6. Solid Wastes from the Polygen Plant

Waste	Annual Quantity	Disposal Method
Slag from gasifier	178,485 tn (162,060 t)	To be sold (landfill)
Clarifier sludge and solids (filter cake)	23,360 tn (21,191 t)	Industrial landfill
Sanitary waste	3,011,250 gal (11,398,820 L)	On-site leach field
Solid waste (office and break room waste) *	252 tn (229 t)	Municipal/industrial Landfill
Black water system filter cake	86,870 tn (78,973 t) if filter cake recycle is not feasible 9,259 tn (8,400 t) if filter cake recycle is feasible	Industrial landfill

*Quantity estimated for 200 workers using an industrial waste generation rate of 9.2 pounds (4.2 kilograms) per day per worker (California Integrated Waste Management Board 2006).

A plan for pollution prevention and recycling would be developed during the detailed design and permitting stages. The plan would be put into practice during construction and operations.

2.2.7 Construction Plans

Construction of the TCEP and its associated linear facilities would take up to 36 months. Before construction begins, the polygen plant site and the linear facility corridors would be surveyed and inventoried for environmentally sensitive areas, and a storm water pollution prevention plan (SWPPP) would be developed and used. Initial site preparation would include building access roads, clearing brush and trees, leveling and grading the site, and connecting to utilities. Construction would involve the use of large earthmoving machines to clear and prepare the site. Summit expects the TCEP to be operational in July 2015. Key dates for the polygen plant construction are as follows:

- December 2011–February 2012: Site mobilization and preparation
- February–July 2012: Construction of main foundations
- March–August 2012: Construction of steel
- November 2012–March 2013: Construction of transmission interconnection
- March 2013–April 2014: Construction of power island
- April 2013–September 2014: Construction of gasification island

An average of approximately 26 trucks per day and approximately two trains per week would deliver materials to the polygen plant site. In addition to the required construction materials, utilities, and water would need to be supplied during construction. Temporary utilities would be extended to construction offices, worker trailers, laydown areas, and construction areas. Water would be supplied for personal consumption and sanitation, concrete formulation, preparation of other mixtures needed to construct the facilities, equipment washdown, general cleaning, dust suppression, and fire protection.

Construction of the TCEP would generate construction wastes typical of the construction of any large industrial facility. Potential wastes would include soil and land-clearing debris, metal scraps, electrical wiring and cable scraps, packaging materials, and office wastes. Potentially reusable materials would be retained for future use, and the recyclable materials would periodically be collected and transferred to local recycling facilities. Materials that could not be reused or recycled would be collected in dumpsters; they would be periodically trucked off-site by a waste management contractor and disposed of at a licensed landfill.

Based on other coal-fueled power plant construction projects, Summit estimates that an average of approximately 650 construction workers would be employed throughout the project. However, during peak construction, the number of on-site workers could be as many as 1,500. Construction workers would work a 50-hour work week, and construction activity would normally occur during daylight hours, but would not always be restricted to these hours.

The TCEP would be subject to U.S. Occupational Safety and Health Administration (OSHA) standards during construction (e.g., OSHA General Industry Standards [29 C.F.R. Part 1910] and the OSHA Construction Industry Standards [29 C.F.R. Part 1926]). During construction, risks would be minimized by the TCEP's adherence to OSHA procedures and policies. These laws and regulations would form the basis of TCEP construction safety policies and programs. In addition, Summit would develop overall site- and project-specific environmental health and safety policies and programs for the TCEP. These would be incorporated into all project construction contracts, and construction contractors would be required to adhere to them.

Emergency services during construction would be coordinated with the local fire departments, police departments, paramedics, and hospitals.

The natural gas and CO_2 pipeline facilities would be designed, constructed, tested, and operated in accordance with applicable requirements included in the U.S. Department of Transportation regulations (Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards [49 C.F.R. Part 192]) and other applicable federal and state regulations, including OSHA requirements.

2.2.8 Operation Plans

Following construction, Summit would begin initial startup, followed by a three-year demonstration phase at the beginning of plant operations. The TCEP would operate for at least 30 years and possibly up to 50 years.

The TCEP operational workforce would include a mix of plant operators, craft workers, managers, supervisors, engineers, and clerical workers. Workforce size would vary between the demonstration period and the period of commercial operation. Operations workforce would be assembled for training during the last 18 months of construction and to assist with startup of the facilities. The TCEP workforce would consist of approximately 150 full-time workers.

Polygen plant design features and management programs would be established to address the following:

- Hazardous materials storage locations
- Emergency response procedures
- Employee training requirements
- Hazard recognition
- Fire control procedures
- Hazard communications training
- Personal protective equipment training
- Reporting requirements

When the plant is no longer an economically viable energy producer, a plan would be developed for permanent closure. Depending on conditions at the time, decommissioning the TCEP could range from mothballing to the removal of all equipment and facilities. The closure plan would be provided to state and local authorities as required.

2.3 Avoidance and Mitigation Measures

For all environmental resources, the mitigation of potential adverse impacts from project activities would be achieved through adherence to permit requirements and to other federal, state, or municipal regulations and ordinances. In addition to compliance with regulatory requirements, Summit has committed to mitigation measures for the TCEP to further reduce environmental impacts. Table S2-7 describes the specific mitigation measures that Summit would implement for each resource area, including those required under federal, state, or local regulations.

Table S2-7. The TCEP's Incorporated Mitigation Measures

Resource	Mitigation Measure
Air Quality and Climate	Construction During construction, Summit would implement the following practices: • Using dust-abatement techniques such as wetting soils • Surfacing unpaved access roads with stone whenever reasonable • Covering construction materials and stockpiled soils to reduce fugitive dust • Minimizing disturbed areas • Watering land prior to disturbance (excavation, grading, backfilling, or compacting) • Revegetating disturbed areas as soon as possible after disturbance • Covering material in dump trucks before traveling on public roads • Minimizing the use of diesel or gasoline generators for operating construction equipment Operation Summit would implement the following process modifications and improved work practices to mitigate emissions: • To reduce nitrogen oxides: Using diluent injection in the combustion turbine in addition to selective catalytic reduction; incorporating good flare design; limiting the hours of operation of the fire pump and emergency generators • To reduce CO and volatile organic compounds: Implementing good combustion practices in the combustion turbine; incorporating good flare design; limiting the hours of operation of the fire pump and emergency generators • To reduce sulfur dioxide: Using clean syngas in the combustion turbine; incorporating good flare design; limiting the hours of operation of the fire pump and emergency generators; using low-sulfur diesel in the fire pump and emergency generators • To reduce H_2SO_4: Using clean syngas in the combustion turbine • To reduce PM: Implementing good combustion practices in the combustion turbine; incorporating high-efficiency drift eliminators in the cooling towers; incorporating good flare design; limiting the hours of operation of the fire pump and emergency generators; using low-sulfur diesel in the fire pump and emergency generators • To reduce CO_2: Capturing as CO_2 90 percent of the carbon entering the plant with compression and pipeline transportation of the CO_2 for use in EOR; limiting use of the CO_2 bypass vent to 5 percent of the year • To reduce Hg: Using clean syngas in the combustion turbine
Geology and Soils	Construction Summit would develop and implement an approved SWPPP to reduce erosion, control sediment runoff, reduce storm water runoff, and promote ground water recharge. The SWPPP would be submitted to the TCEQ for approval prior to the initiation of any construction activities. Summit would stockpile and cover excavated topsoil until reuse, install wind and silt fences, and reseed disturbed areas. Operation Summit would continue to implement relevant parts of its approved SWPPP. Summit would develop and implement a spill prevention control and countermeasure (SPCC) plan covering TCEP operations, as required by TCEQ under the Clean Water Act (Public Law 92-500).

Table S2-7. The TCEP's Incorporated Mitigation Measures

Resource	Mitigation Measure
Ground and Surface Water Resources	<u>Construction</u> Summit would develop and implement an approved SWPPP for construction activities. The SWPPP would address the polygen plant site, laydown areas, and construction along linear facilities. Summit would implement dust suppression and sedimentation control measures. For construction of linear facilities, Summit would apply for appropriate permits for all stream and water crossings and would implement required mitigation measures. <u>Operation</u> Summit would continue to implement relevant parts of its approved SWPPP. Summit would develop and implement effective measures, in accordance with an SPCC plan, to mitigate potential impacts caused by the release of petroleum products. As needed, Summit would develop a water management plan to minimize potential impacts on water resources as a result of the TCEP's withdrawals of water for the plant.
Floodplains	<u>Construction</u> Summit would develop and implement an approved SWPPP to minimize sedimentation and the filling of any downstream floodplains. <u>Operation</u> Summit would develop and implement an approved SWPPP to minimize sedimentation and the filling of any downstream floodplains.
Wetlands	<u>Construction</u> Summit would develop and implement an approved SWPPP to minimize potential impacts on wetlands. Mitigation of wetland impacts would take place in the form of direct replacement or through the purchase of credits via an approved wetland bank under U.S. Army Corps of Engineers and TCEQ requirements and guidance. A Combined Wetland Permit Application, as applicable, would be submitted to applicable federal, state, and local regulatory entities and would include design details on any wetland replacement sites, wetland banks, and sources of wetland credits for the project. Mitigation requirements would be determined during the wetland-permitting phase of the project following the NEPA process and before construction activities begin. <u>Operation</u> Summit would continue to implement relevant parts of its approved SWPPP to minimize potential impacts on wetlands. Summit would develop and implement effective measures, in accordance with a SPCC plan, to reduce the risk of contamination of wetlands. Summit would use a ZLD system or wells for underground disposal of waste water, which would eliminate any discharges of process water and cooling tower blowdown into any water bodies and would, therefore, eliminate water-quality impacts to wetlands.
Biological Resources	<u>Construction</u> Summit would develop and implement an approved SWPPP that would minimize potential impacts on wildlife using downstream water resources, wetlands, and floodplains. Summit would use dust suppression and sedimentation control measures. Summit would comply with the provisions of the federal Migratory Bird Treaty Act, which could include limiting land-clearing activities to periods outside of the nesting season. Summit would coordinate with the Texas Parks and Wildlife Department with regard to state-listed species and sensitive habitats listed in the Texas Parks and Wildlife Department Natural Diversity Database. Mitigation of impacts to state-listed species could incorporate a variety of options ranging from passive measures (e.g., construction timing outside critical breeding periods and permanent

Table S2-7. The TCEP's Incorporated Mitigation Measures

Resource	Mitigation Measure
	protection of known habitats elsewhere that contain the resource to be affected) or more aggressive measures (e.g., complete avoidance of impact). Operation Summit would continue to implement relevant parts of its approved SWPPP to help minimize impacts to certain biological resources. Summit would develop and implement effective measures, in accordance with an SPCC plan, to mitigate potential impacts caused by the release of petroleum products. Summit would ensure evaporative ponds are covered with netting to prevent wildlife access, if chosen as the ZLD system.
Aesthetics	Construction Summit would develop and implement an SWPPP to reduce erosion and minimize landscape scarring. Summit would employ dust-suppression techniques. Operation Summit would plan and install an outdoor lighting system that would minimize TCEP's nighttime, off-site illumination and glare.
Cultural Resources	Construction In accordance with Section 106 of the National Historic Preservation Act (Public Law 89-665), Summit has provided surveys and cultural resource assessments for the proposed polygen plant site and preliminary assessment recommendations for linear facilities to the Texas Historical Commission and other appropriate agencies for review and comment. With regard to the roads, rail lines, high-voltage transmission lines, and other linear facilities, archaeological surveys would only be conducted for corridors identified by state agencies as needing such surveys. Surveys would be completed if DOE issues a favorable Record of Decision.
Traffic and Transportation	Construction To prevent unnecessary traffic congestion and road hazards, Summit would coordinate with local authorities and employ safety measures, especially during the movement of oversized loads, construction equipment, and materials. Where traffic disruptions would be necessary, Summit would coordinate with local authorities and implement detour plans, warning signs, and traffic-diversion equipment to improve traffic flow and road safety. Operation Summit would make road improvements, where necessary, to minimize traffic congestion and road hazards. Improvements may include adding lanes for turning and acceleration.
Safety and Health	Construction/Operation Summit would comply with OSHA requirements as they apply to the project during construction and operations activities.

Table S2-7. The TCEP's Incorporated Mitigation Measures

Resource	Mitigation Measure
Noise	<u>Construction</u> Summit would equip steam piping with silencers to reduce noise levels during steam blows by up to 20–30 A-weighted decibels (dBA) at each receptor location. <u>Operation</u> Summit would equip silencers on the relief valves. Summit would perform a noise survey to ensure that operations are in compliance with applicable noise standards. Summit would locate and orient plant equipment to minimize sound emissions; provide buffer zones; enclose noise sources within buildings; install inlet air silencers for the combustion turbine; and include silencers on plant vents and relief valves.

2.4 DOE's No Action Alternative

Under the No Action Alternative, DOE would not share in the cost of the TCEP beyond the project definition phase; in other words, DOE would not share in the costs of detailed design, construction, or the three-year demonstration-phase testing and operations. In this case, some amount of the money withheld from partial funding for the TCEP may be applied to other current or future eligible projects that would meet the objectives of the CCPI program. In the absence of partial funding from DOE, Summit could still elect to construct and operate the TCEP if it could obtain private financing as well as the required permits from state and federal agencies. Therefore, the DOE No Action Alternative could result in one of three potential scenarios:

- The TCEP would not be built.
- The TCEP would be built by Summit without the benefit of partial DOE funding.
- The TCEP would not be built by Summit, and the site would be sold for industrial, commercial, or residential development, the impacts of which would depend upon the type of development pursued.

DOE assumes that if Summit were to proceed with development in the absence of partial funding, the project would include all the features, attributes, and impacts as described for the proposed project; however, without DOE participation, it is likely that the proposed project would be canceled. For the purposes of analysis in this EIS, the DOE No Action Alternative is assumed to be equivalent to a no-build alternative, meaning that environmental conditions would remain in their current condition (no new construction, resource use, emissions, discharges, or wastes generated).

If the project were canceled, the proposed technologies of the TCEP (demonstration of commercial-scale IGCC integrated with CO_2 capture and geologic storage of CO_2 using EOR, and manufacture of urea from gasified coal) may not be implemented in the near term. Consequently, commercialization of the integrated technologies may be delayed or may not occur because utilities and industries tend to use known and demonstrated technologies rather than new technologies. This no-build scenario would not contribute to the CCPI program goals of accelerating the commercial readiness of advanced multi-pollutant emissions control; combustion, gasification, and efficiency-improvement technologies; and demonstrating advanced coal-based technologies that capture and sequester, or put to beneficial use, CO_2 emissions.

3 AFFECTED ENVIRONMENT AND ENVIRONMENTAL IMPACTS

The proposed polygen plant site is a nearly rectangular, 600-ac (243 ha) parcel of land. Site elevation ranges from 2,920 to 2,969 ft (890–905 m) above mean sea level, with a ground slope of less than 0.5 percent. The site is located in a rural setting that historically has been occupied by ranching and oil and gas industry activities; it is dominated by Mesquite Shrub-Grassland flora, which is not rare or unique in this region.

Six permitted or developed natural gas and oil wells are located on the proposed polygen plant site; although only one oil well and one gas well remain active. Crude oil pipeline, natural gas pipeline, and condensate pipeline systems are also present on the site. Other existing structures on the site include gravel roads, abandoned oil- and gas-related structures, and overhead electricity distribution lines. No other structures or improvements are known to have historically occurred at the site. No prime or unique farmland soils exist in the plant site, and the site is free from hazardous or radioactive materials, chemicals, or wastes that would be subject to regulation under the Comprehensive Environmental Response, Compensation, and Liability Act; the Resource Conservation and Recovery Act; or the Nuclear Regulatory Commission.

The polygen plant site's southern border is less than 0.5 mi (0.8 km) from I-20, with an improved roadway, County Road 1216, bordering the property. A UPRR line also runs along the site's southern border.

Oil and gas development and ranching activities are the predominant land uses in the area. Remnant oil well pad sites and associated industrial structures are present in the area around the polygen plant site, with concentrations occurring mainly west and south of the site. Neighboring properties include undeveloped industrial space and facilities that support the oil and gas industry. The small, nearly abandoned and unincorporated community of Penwell, Texas, is located immediately south of the polygen plant site. The community has an estimated population of 41 individuals, but recent accounts indicate that as few as a dozen people remain in residence in the community. There are seven occupied residences in Penwell, the closest of which is approximately 0.25 mi (0.4 km) from the polygen plant site. The community has four to five businesses, including a post office and operating oil and gas industrial entities.

Summit's proposed TCEP and its options could cause changes or modifications to the existing environment. For its analysis of potential environmental impacts of the project, DOE used data gathered during field surveys, existing data, and appropriate scientific methodologies. DOE conducted a site reconnaissance of the polygen plant site on April 7 and 8, 2010, followed by a data collection survey of the project area from July 5 through 9, 2010. A third field investigation was conducted on November 2 and 3, 2010. DOE documented the existing conditions on the proposed polygen plant site and along the various proposed linear facilities.

Available existing data that were used in the analysis include but are not limited to landscape-level data such as U.S. Geological Survey land use/land cover data; Texas Natural Resources Information System public spaces and parks data, National Hydrography Dataset data, Soils Survey Geographic Database soils data, state agency information on wildlife habitat boundaries, and available county parcel zoning data. An air quality analysis, including dispersion modeling, was also conducted using data prepared for Summit's air emissions permit application.

The TCEP would be constructed on a site and in an area that has already been disturbed by oil and gas production and ranching activities. It would be designed to operate in a manner that would significantly reduce discharges and wastes, including air emissions, waste water effluents, and solid wastes compared to conventional coal-fueled power plants. Minimizing discharges and wastes would be based on the integration of mature technologies, emissions controls, and design of chemical processes that would allow the transformation of what would otherwise be discharges and wastes into commercially marketable products, such as CO_2, urea, and H_2SO_4. In addition, Summit has committed to implementing mitigation measures to reduce environmental impacts to the extent practicable. As a result, the environmental impacts of the construction and operation of Summit's TCEP are expected to be minor.

Table S3-1 summarizes the potential environmental impacts of Summit's proposed TCEP and the No Action Alternative.

Table S3-1. Summary of Impacts from Summit's Proposed Project and the No Action Alternative

Resource	Summit's Proposed Project	No Action Alternative*
Air Quality	<u>Project Emissions during Construction</u> Operation of worker vehicles and construction equipment and vehicles would result in criteria pollutant emissions. Land clearing and excavation, road surface construction, and cut and fill operations would generate dust (PM_{10} and $PM_{2.5}$). Impacts resulting from dust emissions would be localized and short term. <u>Project Emissions during Operations</u> Wet cooling towers would emit PM as drift from the evaporative cooling process. Coal delivery trains would emit a small amount of pollutants from the train exhaust and potentially during coal unloading and handling; control devices for transfer, conveyance, and loading would minimize PM emissions. For the plant itself, maximum annual emissions (tons per year), including startup, shutdown, and maintenance emissions, would be as follows: NO_2: 225 tn (204 t) per year (2 percent increase over existing sources in Ector County) CO: 1,173 tn (1,064 t) per year (4 percent increase over the same) SO_2: 251.1 tn (228 t) per year (20 percent increase over the same) PM_{10}: 380 tn (345 t) per year (6 percent increase over the same) $PM_{2.5}$: 367 tn (333 t) per year (20 percent increase over the same) H_2SO_4: 15 tn (14 t) per year Note that only those air contaminants that pertain to the TCEQ-approved air permit are addressed here. Maximum annual emissions would be above both PSD and Clean Air Act Title V Major Source thresholds (100 tn [91 t] per year) for NO_2, SO_2, CO, PM_{10}, and $PM_{2.5}$. Plant-wide emissions of HAPs would be below the individual HAP major source thresholds (10 tn [9 t] per year) as well as the total combined HAPs threshold (25 tn [23 t] per year). **Incremental contributions to National Ambient Air Quality Standards (NAAQS) exceedances**: Operational emissions from the TCEP would not contribute to a PSD exceedance or violation of NAAQS for any criteria pollutants in the region. However, project emissions would incrementally increase the ambient air concentrations of criteria pollutants as demonstrated using dispersion modeling, ranging from an increase (over background concentrations) of up to 9 percent for PM_{10} to 200 percent for NO_2 at the points of maximum impact. **ESLs**: Maximum predicted concentrations for all identified compounds that could have a negative impact to human health were below their respective ESLs, except for Tier I short-term coal dust. However, per the TCEQ, the coal dust concentrations would meet the Tier II requirements.	Rural land uses, including residential development, grazing, dispersed recreation, and light commercial and industrial development, would continue in the air quality region of influence (ROI). No exceedances or violations of NAAQS would occur as a result of the current land uses. Risks from HAPs in the project area would continue to be very low.

Table S3-1. Summary of Impacts from Summit's Proposed Project and the No Action Alternative

Resource	Summit's Proposed Project	No Action Alternative*
	Hg: TCEP operations would produce approximately 0.02 tn (0.018 t) of Hg emissions per year. **GHGs**: Annual noncaptured CO_2 emissions from TCEP operations would be approximately 300,000 tn (272,155 t) per year. **Proximity to Class I area**: PSD Class I visibility impairment analysis was not required for TCEP because the site would be greater than 62 mi (100 km) away from the nearest Class I area. Local Plume Visibility, Shadowing, Fogging, and Water Deposition The project is designed to use air cooling for the power block and mechanical draft wet cooling towers for the chemical processes. No plumes or fogging would result from the use of the dry cooling tower. Water droplets carried with the water vapor plume from the cooling tower (drift) would have the same chemical composition as the water entering and circulating through the tower. Circulating water could contain anti-corrosion, anti-scaling, anti-fouling, and biocidal additives that could create emissions of volatile organic compounds, PM, and toxic compounds in low concentrations. The drift would not cause excessive pitting or corrosion of metal on nearby structures or equipment because of the relatively small amount of water released and the low concentrations of anti-corrosion additives. Similarly, the treatment additives would not cause noticeable adverse impacts on local biota because of the very small amounts released. Potential deposition of solids would occur because the TCEP would use process water, which may contain dissolved and suspended solids. Effects from vapor plumes and deposition would be most pronounced within 300 ft (91 m) of the vapor source and would decrease rapidly with distance from the source. The drift rate and associated deposition of solids would be reduced with drift eliminators; losses would be limited to less than 0.01 percent of the circulation rate. The TCEP would also comply with Texas Administrative Code visibility and opacity requirements to minimize visible NO_x and PM in tower emissions. Odor Two odorous compounds that are regulated by the TCEQ would be emitted from the TCEP in small quantities: H_2S and NH_3. The wind may carry small volumes and may create a nuisance for residents within 1.0 mi (1.6 km) of the polygen plant.	
Climate	Severe Weather **Construction**: Severe temperature or weather conditions could cause a delay in some aspects of construction as well as in materials deliveries. Impacts, if any, would be minimal and temporary because the region's climate is relatively mild and severe climatic conditions would not adversely impact the TCEP. Weather events such as severe thunderstorms, flooding, and/or tornados could also delay construction. If an extreme drought were to occur during construction, increased use of water trucks would be required for fugitive dust control and support of other construction activities. Workers would also be required to wear protective dust masks. **Operations**: It is unlikely that weather extremes, such as very high or very low temperatures or snowfall, would affect operations. It is also unlikely that flooding would affect operations because the polygen plant site would be outside the 100-year floodplain. Relatively frequent tornados in the region do pose a low potential for both direct and indirect impacts to operations. Severe or extreme drought conditions could occur over the planned life of the project and cause increased ambient air concentrations of PM_{10} and $PM_{2.5}$.	Existing climate and meteorological conditions in the project area would continue. This area historically experiences a wide spectrum of weather phenomena, including cold and hot days, high winds, heavy rainfall events, thunderstorms, localized floods, and tornadoes.

Table S3-1. Summary of Impacts from Summit's Proposed Project and the No Action Alternative

Resource	Summit's Proposed Project	No Action Alternative*
	Operations: Wet cooling towers could cause local shadowing and under certain meteorological conditions could cause local ground-level fogging or icing. Such localized occurrences would be infrequent, usually lasting only a few hours. **Technology options:** Among the cooling tower options for the chemical process part of the plant, wet cooling towers could cause shadowing and under certain weather conditions could cause ground-level local fogging and icing. Of the three concentrated brine disposal options, solar evaporation ponds could cause ground-level fogging under certain weather conditions.	
Soils, Geology, and Mineral Resources	<u>Soils</u> Potential impacts to soils would be site-specific and primarily occur during construction and would include erosion or compaction, contamination in the event of hazardous material spills, and composition changes due to the introduction of fill material. Spills of hazardous materials would be minimized through the use of controls and measures. Following construction, and as disturbed areas are revegetated, soil impacts would be negligible. **Technology options:** Among the cooling tower options, there could be a slight deposition of salt on surface soils from drift from the wet cooling tower. Of the three concentrated brine disposal options, there would be a potential for local soil contamination at the solar evaporation pond site if the pond liner were to leak. <u>Geology</u> **Polygen plant site**: No impacts to or from geologic features are anticipated. **Linear facilities**: No impacts to or from geologic features would occur. **Technology options:** Of the three concentrated brine disposal options, deep well injection could pose a slight risk of induced seismic events as a result of increased fluid pressures in the injection reservoirs. Therefore, careful monitoring and control of the fluid pressures in geologic reservoirs would be required to reduce the likelihood of these events. Injected brine and displaced native fluids could migrate from the target strata into other adjoining strata; however, there would be a very low risk of noticeable harm because the water in all of these deeper strata is highly saline. **EOR sequestration site (or sites)**: EOR-related seismic events could occur, but careful monitoring and control of the fluid pressures in geologic reservoirs greatly reduces the likelihood of these events. No other impacts to or from geologic features would occur. <u>Mineral Resources</u> **Polygen plant site**: No impacts to or from mineral resources would occur. **Linear facilities**: Minor obstructions to mineral resources access along the linear facilities could occur during construction and operational phases of the project. No impacts to or from mineral resources would occur. **Technology options**: Of the three concentrated brine disposal options, deep well injection of brine could displace hydrocarbons; however, there would be a very low risk of noticeable harm because the target strata and surrounding strata have been explored for hydrocarbons and found not to have economical deposits in the vicinity of the plant site. Brine water would be injected into formations that are not known to be oil-bearing. **EOR sequestration site (or sites)**: CO_2 from the TCEP would be used by the ongoing EOR industry in the Permian Basin. This use of CO_2 is a well-developed and documented industrial process that would serve as final sequestration for the	Soil and geological resources would remain unchanged, mineral development would continue, and EOR would continue throughout the Permian Basin using natural sources of CO_2.

Table S3-1. Summary of Impacts from Summit's Proposed Project and the No Action Alternative

Resource	Summit's Proposed Project	No Action Alternative*
	captured CO_2 from the TCEP. Operation of the polygen plant site would benefit the recovery of oil and gas in the portions of the Permian Basin that would receive CO_2 from the TCEP. Concentrations and pH of dissolved mineral matter could change and potentially hinder access as a result of injected CO_2; however, negligible impacts would occur if suitable drilling practices, well casing materials, and well casing cements are used on wells that penetrate through the CO_2 floods to reach deep petroleum resources.	
Ground Water Resources	<u>Ground Water Quantity</u> **Polygen plant site**: Impervious areas at the plant site would have negligible impacts to aquifer recharge. The TCEP could affect two ground water aquifers, one supplying brackish water for Oxy Permian and the other proposed to supply the FSH main waterline with slightly brackish water. If either of these water supply options is chosen, the TCEP would have a small effect on the total water supply in the region and would represent a small fraction (0.7 percent) of the total water demand in the region (based on the *2011 State Water Plan: Summary of Region F* [TWDB 2010]). The Midland Wastewater Treatment Plant's land application of waste water, as a means of waste water disposal, may be reduced or terminated altogether if WL1 were chosen. **Linear facilities**: Minor impacts to ground water quantity from the water supply options could occur as a result of impervious areas associated with access roads. **Technology options:** Among the cooling tower options, wet cooling towers would have a higher water demand than dry cooling towers. Of the three concentrated brine disposal options, the brine concentrator and filter press option may minimize the plant's demand for water. <u>Ground Water Quality</u> **Polygen plant site**: No impacts during construction would occur, and risks of long-term impacts during operations are limited. Given the good geologic information and uniformity of strata, there would be a low potential for contamination of overlying aquifers by an injection well constructed and operated to Railroad Commission of Texas and TCEQ standards. **Linear facilities**: No temporary or permanent long-term impacts to ground water quality would occur from the construction or operation of the linear facility options. **Technology options:** Of the three concentrated brine disposal options, the brine concentrator and filter press option as well as the solar evaporation ponds option would provide the potential for the leaching of salt into ground water at any landfill site where the crystallized salt has been placed. Furthermore, there would be a potential for local, shallow ground water contamination at the solar evaporation pond sites should a liner leak. If deep well injection were chosen, there would be a remote possibility for injected brine to displace native fluids to shallow aquifers or for injected brine to migrate into shallow aquifers. **Sequestration sites**: There would be a risk for potential ground water quality impacts associated with 1) the limited potential for upward migration of CO_2, or 2) displaced native fluids through improperly abandoned deep wells or through natural fractures and faults in the rock. However, this risk would be low due to the relatively low-pressure drives associated with EOR activities, the monitoring requirements for oil and gas injection wells, and the types of geologic formations found in the Permian Basin.	Existing activities, such as oil and gas production and land development, would continue in the region with a continuation of the existing trend of impacts. EOR activities would continue on a regional scale, with CO_2 for EOR from natural geological sources rather than from industrial sources.

Table S3-1. Summary of Impacts from Summit's Proposed Project and the No Action Alternative

Resource	Summit's Proposed Project	No Action Alternative*
Surface Water Resources	Wetlands, Waterways, Water Bodies, and Surface Water Quality **Polygen plant site**: No surface water resources are present at the proposed polygen plant site, and no impacts to surface waters would occur. **Linear facilities**: Four wetlands are present within the proposed WL1 and WL3 corridors, with a combined area of 2.16 ac (0.87 ha). Construction activities are likely to result in short-term impacts such as increased turbidity, sedimentation, streambed disturbance, and streambank vegetation removal. After construction is complete, no long-term impacts would occur. **Technology options:** Of the three concentrated brine disposal options, the brine concentrator and filter press option as well as the solar evaporation ponds option would provide a slight potential for the leaching and conveyance of salt into surface water at any landfill site where the crystallized salt has been placed. Floodplains No impacts to floodplains would occur.	Oil and gas exploration, land development, ranching, and other existing activities and uses would continue to affect surface water resources in the ROI.
Biological Resources	Terrestrial Species **Polygen plant site**: Construction and operations could result in the permanent loss of up to 300 ac (121 ha) of the Mesquite Shrub-Grassland vegetation community and associated habitat functions. Construction equipment and activities could unintentionally disperse invasive seeds, noxious species seeds, or both. Construction activities could result in direct mortality of slow-moving terrestrial species not able to escape the path of construction equipment. Noise associated with construction could result in wildlife displacement and behavioral changes that could have minimal impacts on reproductive success. Noise associated with plant operations would have negligible effects on wildlife. **Linear facilities**: Construction of the linear facilities would result in the permanent removal of 134–576 ac (54–233 ha) of the Mesquite Shrub-Grassland community and associated habitat functions, based on the smallest and largest combinations of the linear facility options. An additional 115–543 ac (47–220 ha) of habitat could be temporarily removed or disturbed during construction. Impacts to terrestrial species would be similar to those described above. Aquatic Species **Polygen plant site**: No impacts to aquatic species from construction or operation of the polygen plant site would occur. **Linear facilities**: Impacts to aquatic species from construction of WL1 and WL3 could occur as a result of the impacts described for surface waters. Any water quality degradation associated with surface waters would also have the potential to adversely impact aquatic species using those water bodies. Migratory Birds **Polygen plant site**: Up to 300 ac (121 ha) of suitable habitat for scrubland-nesting migratory birds and their nesting sites would be permanently removed. Introduced species (European starlings [*Sturnus vulgaris*] and house sparrows [*Passer domesticus*]) commonly associated with development activities (e.g., maintained landscaping, open trash receptacles) could encroach on the plant site and displace or outcompete native songbird species. Migratory birds could experience similar indirect impacts as those described for terrestrial species Overall, there would be no major features at the polygen plant site that would attract migratory birds. **Linear facilities**: Habitat loss could occur from the construction and operation of some of the linear facility options. Disturbance from construction and operation	Oil and gas exploration, land development, ranching, and other existing activities and uses would continue to affect biological resources in the ROI.

Table S3-1. Summary of Impacts from Summit's Proposed Project and the No Action Alternative

Resource	Summit's Proposed Project	No Action Alternative*
	noise could displace migratory birds from areas adjacent to the linear facilities. Bird mortalities due to collisions with man-made structures associated with the TCEP (e.g., transmission lines) could occur during operation. **Technology options:** Of the three concentrated brine disposal options, solar evaporation ponds could affect water fowl by enticing them to land thereby exposing them to concentrated brine water; however, covering the ponds with netting would deter birds from landing in the brine. Bats Bat mortalities due to collision with man-made structures associated with the TCEP could occur during operation. Rare, Threatened, and Endangered Species **Polygen plant site**: Construction and operation of the polygen plant would result in the loss of 300 ac (121 ha) of Texas horned lizard (*Phrynosoma cornutum*) (state listed, threatened) habitat as well as suitable habitat for 11 state-listed rare species. **Linear facilities**: Construction and operation of linear facilities would result in the loss of Texas horned lizard habitat as well as potential loss of habitat for 11 state-listed rare species. Total acres affected would vary by facility option. Impacts during operation of buried pipelines would be unlikely, and impacts due to operation of transmission lines would be primarily associated with maintenance activities and avian strikes.	
Aesthetics	Polygen Plant Site **Daylight conditions**: The impacts to Key Observation Points (KOP) 1, 3, 4, 5, and 6 from the polygen plant would be no more than minor, depending on local lighting conditions and atmospheric haze (KOP 1 is Monahans Sandhills State Park). Impacts to KOP 2 (1.6 mi [2.5 km]) east of the polygen plant site, view looking west across the topographic basin) would be different than those affecting the other KOPs. During construction, exposed soil and construction materials would create line and color contrasts. Fugitive dust could create localized haze that may reduce visibility. Impacts would be moderate, direct, and adverse because the size of the site and its proximity to I-20 would attract viewer attention and be a focus of view for westbound and eastbound motorists. During operations, the height and size of the plant structures, cooling towers, and coal storage piles would create moderate, adverse, direct impacts to KOP 2 aesthetics because of the strong form, color, and line contrasts with the surrounding landscape. Water vapor emitted from the cooling tower would increase the degree of contrasts with the surrounding landscape by creating a form and color-contrasting plume. **Night sky conditions**: Adverse impacts to night sky conditions could occur during both construction and operations due to the installation of high-intensity lighting within and around the site. Light reflected upward would create regionally visible light pollution and skyglow. FAA-required strobe lighting (if required) on the top of the cooling tower and the higher polygen plant structures would adversely affect night sky conditions by imposing highly visible, high-intensity flashing lights that would be regionally visible. Linear Facilities **Transmission line**: Direct adverse impacts would occur because the transmission line structures would create visible, intrusive vertical form contrasts in the landscape, and would be visible from major travel routes. Impacts would be minor	No impacts to aesthetics beyond existing trends (which have stagnated since the 1960s and 1970s when Penwell became largely abandoned) and conditions would occur.

Table S3-1. Summary of Impacts from Summit's Proposed Project and the No Action Alternative

Resource	Summit's Proposed Project	No Action Alternative*
	because 1) large, cross-country transmission lines are presently visible in the ROI; 2) constructing another transmission line would be consistent with the level of development in the ROI; and 3) the lines would be visible to the casual viewer, but because of existing power lines, they would not attract attention or become a focus of viewer attention. **Pipeline structures**: Minor adverse impacts would occur during construction because equipment would be visible in the middle ground and background during ROW vegetation and soil removal, trenching, pipeline laying, and pipeline burial. Although pipelines would be buried, negligible long-term impacts to aesthetics could occur because ROWs would be maintained. **Technology options:** Of the three concentrated brine disposal options, solar evaporation ponds would noticeably add to the aesthetic impacts of the polygen plant. Given the presence of oil and gas wells in the vicinity, deep injection wells would minimally affect aesthetics.	
Cultural Resources	<u>Polygen Plant Site</u> Direct impacts could occur to one historical site (consisting of historic-era pump jack foundations and associated debris scatter) that is not eligible for the National Register of Historic Places (NRHP). One historical complex or set of buildings, the Rhodes Welding Complex, is considered eligible for the NRHP. Changes to the setting would not affect NRHP eligibility. <u>Linear Facilities</u> There is one previously recorded archaeological site in the WL1 ROW. No evidence of that site was found during ground surveys. No other cultural resources have been documented in the linear facilities corridors. A full cultural resources study would be conducted after the alignments have been finalized and before construction and installation of the facilities. At this time, there appears to be a low probability of impacts to cultural resources. <u>Native American Resources</u> There are no known Native American resources documented in the cultural resources ROI. Impacts associated with increased access (e.g., WL3 and WL4) to areas previously not accessible by roads could occur; however, impacts associated with the project would not occur. Coordination with the Texas Historical Commission occurred in the fall of 2010 and provided concurrence with DOE's findings.	There would be no effect on known or undocumented historic or cultural resources. The ground disturbance associated with construction would not occur, and in situ resources would remain in place. No structures would be built, and therefore no NRHP-eligible properties would be affected.
Land Use	<u>Polygen Plant Site</u> Existing land uses on the 600-ac (243-ha) polygen plant site would be displaced by the TCEP industrial use. Existing subsurface rights would continue to be available for exploration and production. Operation of the polygen plant would not be incompatible with surrounding land uses. Construction and operation of the TCEP would have no notable effect on airspace; however, signal lights would be required atop the towers. <u>Linear Facilities</u> Existing land uses would be briefly and temporarily affected by construction. During operations, impacts to land use would be limited to the ROW corridor use and maintenance. The amount of ROW land requirements vary by facility option, and the associated impacts would last for the life of the project. The linear facilities would be consistent with the intent of the zoning districts through which they pass. WL1 would temporarily impact 2.4 ac (1.0 ha) of prime farmland, which could	There would be no impacts to land use beyond a continuation of existing upward trends in residential, commercial, and industrial uses. The area in the polygen plant site would remain undeveloped, and no new land uses would be imposed

Table S3-1. Summary of Impacts from Summit's Proposed Project and the No Action Alternative

Resource	Summit's Proposed Project	No Action Alternative*
	be put back to use after construction completion. Construction of NG1, WL1, or both could temporarily impact access to Penwell Knights Raceway Park located south of the polygen plant site; however, impacts could be reduced by coordination with raceway operations.	on the landscape.
Socioeconomics	Demographics Impacts to population numbers during construction would be minor because most workers would commute from nearby communities. Impacts to population numbers during operations would be negligible because most of the 150 permanent workers would come from the local population, although some would come from outside the area. Housing Existing housing and hotel/motel supply would be adequate for anticipated employment during construction. There would be no new housing needs as a result of operations. Economics During most of the construction, gross domestic product in the ROI would increase 0.5 percent; during the final year of construction, it would increase 0.7 percent. During operations, gross domestic product in the ROI would increase by 0.2 percent, representing a long-term and beneficial impact for the region. Tax revenue from the TCEP would have a beneficial and long-term impact to the region as revenue would be redistributed to counties, which in turn would allocate and redistributed to local communities.	Existing socioeconomic trends, including population growth and increase in residential, commercial, and industrial development would continue as they are.
Environmental Justice	Construction Activities Construction activities would have neither disproportionately high nor adverse effects on minority or low-income communities. Short-term beneficial impacts could include an increase in employment opportunities with potentially higher wages or supplemental income through jobs created during plant construction. Operations Activities Operations activities would have neither disproportionately high nor adverse effects on minority or low-income communities.	There would be no disproportionately high or adverse effects on minority or low-income communities in the ROI.
Community Services	Law Enforcement, Emergency Response Services, and Health Services Because TCEP workers would come primarily from the existing workforce in the ROI, no impacts to the demand for local law enforcement, emergency response, or health services would occur. Schools Because TCEP workers would come primarily from the existing workforce in the ROI, no increase in school enrollment and no increased burden on the school systems would occur. Recreation Because TCEP workers would come primarily from the existing workforce in the ROI, population-related impacts to recreation (including nearby city, county, and state parks) would not occur. Likewise, no project-induced impacts to the regional recreational experiences would occur.	There would be no impacts to community services in the ROI.

Table S3-1. Summary of Impacts from Summit's Proposed Project and the No Action Alternative

Resource	Summit's Proposed Project	No Action Alternative*
Utility Systems	<u>Polygen Plant Site</u> Existing utilities would not be adversely impacted by construction or operation activities at the polygen plant site. <u>Linear Facilities</u> **Construction activities**: Existing utilities infrastructure could inadvertently be damaged or have service disrupted during construction of the linear facilities. Risk of construction-related impacts would be greatest during trenching activities. **Operations activities**: *TL1–TL6*: There is a potential for system upgrades associated with the interconnection to either the ERCOT or Southwestern Power Pool grid. *WL1:* WL1 could impact the Midland Wastewater Treatment Plant. WL1 would divert all or some portion of the water currently being used to irrigate city-owned cropland adjacent to the Midland Wastewater Treatment Plant. Current agricultural activities would be reduced by the amount of Midland's waste water diverted under the WL1 option. *WL2 and WL3:* No impacts to water treatment utility systems would occur as a result of WL2 or WL3. *WL4:* The GCA Odessa South Facility would make use of more of its full treatment capacity with the use of WL4. **Technology options:** Among the cooling tower options, the use of a wet cooling tower, instead of a dry cooling tower, for the chemical process part of the TCEP plant may require a larger water supply pipeline than currently proposed under the various waterline options. However, the wet cooling tower option would have a lower electricity demand than the dry cooling tower option. Of the three concentrated brine disposal options, the brine concentrator and filter press option may require the greatest parasitic electricity demand, depending on the choice of equipment. Alternatively, the solar evaporation ponds, if this option were chosen, would require the least parasitic electricity demand.	There would be no impacts to utility systems beyond existing trends, which generally include an increase in electricity, CO_2, and water demand.
Transportation	<u>Roadways</u> **Construction activities**: Annual average daily traffic (AADT) would increase in four primary locations (listed below). Increases would vary depending on the construction year. *I-20 at Penwell:* 15,580 current AADT; would increase to 15,660, 15,685, and 15,730 projected AADT (1 percent increase) in construction years 1, 2, and 3, respectively. *I-20, east of FM 866 exit:* 16,700 current AADT; would increase to 17,350, 18,840, and 19,750 projected AADT (4 percent, 13 percent, and 18 percent) in construction years 1, 2, and 3, respectively. *FM 866:* 1,500 current AADT; would increase to 2,120, 3,535, and 4,400 projected AADT (41 percent, 136 percent, and 193 percent) in construction years 1, 2, and 3, respectively. *FM 1601:* 20 current AADT; would increase to 50, 125, and 170 projected AADT (150 percent, 525 percent, and 750 percent) in construction years 1, 2, and 3, respectively. Delays associated with merging traffic and increased percent of time spent following slow vehicles would affect the level of service (LOS) of each road. Construction of a 3.7-mi (6.0-km) access road between the polygen plant site and FM 866 would result in temporary, localized traffic delays. Use of FM 1601 for	There would be no additional roadway traffic imposed on the federal or TxDOT road system, or railroad traffic on the UPRR rail system.

Table S3-1. Summary of Impacts from Summit's Proposed Project and the No Action Alternative

Resource	Summit's Proposed Project	No Action Alternative*
	emergency and secondary access to the polygen plant site would require construction of an at-rail grade pass or a below-rail underpass for crossing the UPRR rail line. Construction activities would result in temporary localized traffic delays and a potential rerouting of CR 1216 (Avenue G) traffic during construction. **Operations activities**: AADT would increase in four primary locations during operations (listed below). *I-20 at Penwell:* 15,580 current AADT; would increase to 15,595 projected AADT (<1 percent increase). *I-20, east of FM 866 exit:* 16,700 current AADT; would increase to 17,400 projected AADT (2 percent increase). *FM 866:* 1,500 current AADT; would increase to 1,835 projected AADT (22 percent increase). *FM 1601:* 20 current AADT; would increase to 35 projected AADT (75 percent increase). **LOS changes**: *I-20:* No changes are forecast for LOS as a result of the TCEP. *FM 1601:* FM 1601 would remain at an acceptable LOS (A–C) during construction and operations. *FM 866:* FM 866 could degrade to LOS D or lower (unacceptable) during construction years 2 and 3 and would remain at an acceptable LOS (A–C) during operations. Impacts would mostly occur during shift changes. **Impacts from linear facilities**: Construction of the natural gas, CO_2, and transmission lines would cause temporary and localized congestion; impacts would be minor. <u>Railways</u> Increases in rail traffic would occur due to transportation of supplies and products in and out of the polygen plant site. **Construction activities**: Temporary and minor adverse impacts to the existing rail lines would occur as the polygen plant railroad spur (RR1) is connected to the existing system and if an overpass, underpass, or at-grade intersection is constructed for AR1. Once constructed, there would be no delays or congestion along the UPRR line due to unloading of construction materials. **Operations activities**: During operations, there would be an average of six additional 135-car-unit trains per week along the UPRR line, a 5 percent increase over the existing rail traffic. This would not represent an increase that would exceed system capacity nor cause delay to existing railway operations. Because the loading and unloading of TCEP-related materials would occur on the railroad spur, no impacts to the UPRR rail line would occur.	
Materials and Waste Management	<u>Materials Management</u> Construction materials would vary widely, including concrete, crushed stone and aggregate, asphalt, steel, lumber, sand, insulation, wire and cables, joining and welding materials, and other materials. No impacts would occur from the management of these materials. No impacts would occur to the supply of materials as a result of the demand from the project. Operations materials would include coal, natural gas, process water, process chemicals, and commercially marketable products. No impacts from the management of these materials would occur. Plans for delivery, handling, and	There would be no change to the amounts of materials and wastes currently generated, stored, or transported on or near the project area.

Table S3-1. Summary of Impacts from Summit's Proposed Project and the No Action Alternative

Resource	Summit's Proposed Project	No Action Alternative*
	storage of operations materials would be in place before operation of the project. Waste Management All wastes would be disposed of, treated, or recycled at or through properly licensed facilities. Impacts to the environment as a result of waste management would be minimized. Technology options: Of the three concentrated brine disposal options, the brine concentrator and filter press option and the solar evaporation ponds option would produce crystallized salt to be sent to a landfill; the deep injection well would not. Of the cooling tower options, wet cooling tower operations would have a greater demand for biocides in the cooling water.	
Human Health, Safety, and Accidents	Occupational Health and Safety **Construction activities**: The TCEP construction management would develop manuals with OSHA procedures to assure compliance with OSHA and EPA regulations and to serve as a guide for providing a safe and healthy environment for workers, contractors, visitors, and the community. Based on industry workplace hazard statistics, the TCEP construction workforce could experience 91.65 nonfatal, recordable incidents and 48.75 lost workdays. Statistics imply that fatalities are unlikely (0.19 fatality) during the three-year construction period. **Operations activities**: Polygen plant design features and management programs would be established to address hazards. Based on industry workplace hazard statistics, over the life of the project the TCEP operations workforce could experience 158 recordable incidents, 122 lost workdays, and fewer than one fatality. Transportation Safety **Motor vehicles**: Based on TxDOT 2012–2014 forecasts, approximately 0.35 fatality could occur due to the movement of workers and supplies from trucks and personal vehicles during construction (TxDOT 2010). During the 30-year operations period, approximately 0.61 fatality could occur as a result of worker travel during operations. **Railroads**: Risk of a hazardous materials spill during rail transport of TCEP products would be low. Construction of an at-grade rail crossing would result in an increased risk to those accessing the TCEP from FM 1601. Each additional train added to the UPRR system could delay emergency vehicles attempting an at-grade rail crossing by approximately three to five minutes. CO_2 and Natural Gas Pipeline Safety The project would require the installation of approximately 2.7 mi (4.3 km) of new natural gas transmission lines and 1.0 mi (1.6 km) of CO_2 pipeline. The probability of an accidental release associated with these lengths of new pipeline would be negligible. Exposure to Contaminated Sites The risk of discovering soils contamination during construction of the polygen plant would be low. Risk to residents or TCEP personnel during linear facility construction could be eliminated through proper due diligence, including conducting a Phase 1 environmental site assessment where needed along ROW sections prior to construction (If necessary) or Phase II environmental site assessments. If necessary, Phase III remedial actions would be performed.	There would be no impacts to human health and safety related to occupational safety, traffic fatalities, risks related to the construction of the at-grade rail crossing at FM 1601 or increases in rail traffic, or risks from accidents or intentional acts of destruction at the polygen plant site or its supporting linear facilities.

Table S3-1. Summary of Impacts from Summit's Proposed Project and the No Action Alternative

Resource	Summit's Proposed Project	No Action Alternative*
	<u>Risk Analyses</u> **Polygen plant site**: Toxic hazards would be dominated by the potential releases of NH_3 gas from the pipeline leading from the NH_3 synthesis unit to the urea synthesis plant, or through NH_3 production or storage processes. Risks would be greatest to those workers closest to the NH_3 synthesis unit. The highest level of fire risk in the polygen plant would result from processes involving the production and transfer of syngas. Fire hazards at the polygen plant site would not extend beyond the plant itself. The risk of a person being fatally affected by exposure to a toxic hazard in the event of a release would vary depending on their location relative to the release. The risk per year would range from one in 1,000 to one in 100,000,000 of being killed in the project area. The risk levels posed by potential releases of flammable, toxic, and asphyxiant fluids from the proposed TCEP and associated pipelines would be considered acceptable by several international standards. **TCEP CO_2 injection-related activities**: The potential for accidents considered in the analysis were expressed on a per annum basis: likely (frequency $\geq 1 \times 10^{-2}$ per year); unlikely (frequency from 1×10^{-2} per year to 1×10^{-4} per year), and extremely unlikely (frequency from 1×10^{-4} per year to 1×10^{-6} per year). The following scenarios were analyzed as part of a study for a project similar to the TCEP: • Ruptures in the pipeline transporting CO_2 and H_2S from the plant to the sequestration site (considered unlikely) • Punctures in the CO_2 pipeline (considered unlikely to likely depending on the site) • Wellhead failures at the injection well (considered extremely unlikely) • Slow upward leakage of CO_2 from the injection well (considered extremely unlikely) • Slow upward leakage of CO_2 from other existing wells (considered extremely unlikely to unlikely) Site-specific risk for oil fields that purchase and use TCEP's CO_2 cannot be estimated until after the specific fields are identified. However, for those operators that currently implement CO_2 injection, the CO_2 is a valuable resource that is monitored and recycled back into the oil-bearing formation to minimize future purchases of the gas. The numbers of residents or sensitive receptors that could be exposed to CO_2 cannot be estimated until a more exact area for EOR is identified. However, it can be inferred from the study that if residential receptors are present, assumed downwind distances of concern and exposures to potentially released CO_2 would be unlikely to pose a risk because assumed exposures to CO_2 from EOR activities do not exceed either the acute (for short-term) or chronic (for long-term) toxicity criteria.	
Noise and Vibration	<u>Construction Activities</u> **Stationary source analysis:** *Polygen plant site:* Construction-related equipment noise would be perceptible outdoors during the busiest periods of activity at the Penwell receptor locations north of I-20; however, receptors south of I-20 would likely not hear a substantial noise level increase owing to the existing ambient noise levels from vehicular traffic on I-20. Intermittent increases in noise would result from steam venting prior to and during polygen plant startup and commissioning. Although this venting would briefly exceed acceptable Federal Transit Administration levels for	There would be no additional noise impacts beyond the existing trends of noise from traffic and oil and gas development.

Table S3-1. Summary of Impacts from Summit's Proposed Project and the No Action Alternative

Resource	Summit's Proposed Project	No Action Alternative*
	residential areas (series of short blasts over a two-week period), Federal Transit Administration commercial and industrial-area construction threshold levels would bet met. *Linear facilities:* The construction of WL3, TL5, TL6, NG1, and AR1 would likely create temporary, adverse noise impacts to sensitive receptors because the proposed lines would be constructed close to residential receptors near these facilities. **Mobile source analysis**: Use of I-20 and FM 866 for construction-related activities would not result in substantial noise impacts on noise-sensitive receptors (<1 dBA); however, there would be a substantial temporary increase (8.8 dBA) in noise intensity along FM 1601 for the two noise-sensitive receptors located north of I-20 in Penwell. The increase in nose along these access roads would meet Federal Transit Administration noise threshold levels. Operations Activities **Stationary source analysis**: Several plant components (e.g., generators, pumps, fans, vents, relief valves, coal delivery/handling system) would generate noise during operations. This operational noise would attenuate to levels at the two closest noise-sensitive receptors in Penwell that slightly exceed the EPA 55 dBA Ldn outdoor noise threshold (exceeding the threshold by 6 and 4 dBA). Long-term indoor noise levels would be in compliance with the EPA health and safety guidelines. Temporary and brief adverse noise impacts from unscheduled restarts or emergency-pressure safety-valve discharges could occur within approximately 3,000 ft (914 m) of the polygen plant. **Mobile Source Analysis**: Use of I-20 and FM 866 for project operations and commuting would not produce substantial noise impacts on noise-sensitive receptors located along either roadway. There would be an increase in noise activity on FM 1601 (a 2.4 dBA increase) that could impact noise-sensitive receptors in Penwell. There would also be an adverse, minor increase in noise impacts to receptors located near the railroad in the ROI caused by the approximately 3 percent increase in rail traffic.	

Note: PM_{10} = PM with aerodynamic diameters equal to or less than 0.00039 in (10 micrometers);
$PM_{2.5}$ = PM with aerodynamic diameters equal to or less than (0.000098 in (2.5 micrometers).

* Summit has stated that, should the TCEP not go forward, the 600-ac (243-ha) polygen plant site would be sold. It is probable that the purchaser of the site would develop that tract for industrial, commercial, or residential uses that could impose impacts to the respective resources shown in this table. The specific impacts would be dependent upon the type of development pursued.

4 POTENTIAL CUMULATIVE EFFECTS

DOE analyzed the extent to which the proposed TCEP and other past, present, and reasonably foreseeable future projects in the ROI could impose cumulative effects on environmental resources. Humans have been altering the area in which the TCEP would be constructed and operated since people began settling the region. In combination with natural processes, these past and present actions and activities have produced the affected environment.

DOE identified the following future actions that could have environmental impacts in the region:

- A new rail trade corridor is proposed as part of the existing La Entrada al Pacifico trade corridor between the U.S. and Mexico. This proposed rail corridor would connect the cities of Midland and Odessa in Midland and Ector Counties, Texas, to the South Orient rail line in the city of San Angelo, Tom Green County, Texas. This corridor would improve freight travel from north West Texas and the Panhandle to the Mexican border at Presidio. Should this project go forward, it may expand the availability of freight routes in the area around the proposed polygen site, allowing for greater flexibility and lower cost of deliveries to and from the polygen plant site. This project would introduce new air emissions sources, rail traffic, and noise that may degrade the environment.

- A new 14-mi (32-km) transmission line and switching station project is proposed in West Odessa to address transmission constraints that limit the delivery of electricity within competitive renewal energy zones. Should this project go forward, it would increase the efficiency in the delivery of electricity produced by wind-powered-generating facilities in the competitive renewal energy zones to the electric market. This project would introduce new noise sources that may degrade the environment and would contribute to wildlife hazards and habitat loss, soil disturbance, and temporary employment opportunities.

- Because West Texas has favorable conditions for wind energy, future construction of additional wind farms near the polygen plant site is highly likely. Although no wind farms are currently proposed, such projects would provide clean, renewable energy that could replace the energy provided by aging fossil fuel power plants in the future.

- Numerous opportunities exist for EOR in the region. Over time, it is possible that new EOR projects could emerge as a result of new CO_2 streams in the region. The potential cumulative effects resulting from any EOR undertakings would principally be related to construction of the necessary infrastructure to transport the CO_2 to the injection locations and the activities that would occur at injection and recovery sites.

- Geologic sequestration research and projects would also continue in the region, including those under DOE's Carbon Sequestration Program. Because of the abundant land area and suitable geologic conditions in the Odessa area, the TCEP would not limit future sequestration activities in the region.

After examining the potential for cumulative environmental impacts as a result of the proposed TCEP and other past, present, and reasonably foreseeable future actions, DOE determined that potential cumulative effects could occur as a result of greenhouse gas emissions and water use.

The effects of greenhouse gases on climate change are an increasing concern at a cumulative effects level. Greenhouse gas emissions, which have been shown to contribute to climate change, do not remain localized but become mixed with the general composition of the Earth's atmosphere and therefore are addressed on a global scale. Although the TCEP would capture approximately 90 percent of the carbon entering the plant, the plant would contribute 0.3 million tn (0.27 million t) of CO_2 annually to the 2.64 billion tn (2.40 billion t) of energy-related CO_2 emissions released annually by the electric power sector in the U.S. (EPA 2010). Emissions of greenhouse gases from the TCEP would not have a direct impact to the environment in and near the project area; neither would these emissions cause appreciable global warming that would lead to climate changes. However, these emissions would increase the atmosphere's concentration of greenhouse gases, and in combination with past and future emissions from all other sources, they would contribute incrementally to the global warming that produces the adverse effects of climate change.

Because the TCEP is designed for 90 percent carbon capture, it represents a step toward reducing greenhouse gas emissions from producing electric power from both coal and natural gas. Should the TCEP demonstrate the feasibility of utility-scale electric power generation with CO_2 capture, it could result in the incorporation of CO_2 capture in future power plant construction, with resulting reduction in CO_2 emissions from new electricity generating capacity built in the future.

Water availability in West Texas is a concern. The proposed TCEP is located in Water Planning Region F, where projected water demand between 2010 and 2050 is expected to increase by 2 percent. Approximately 75 percent of current water demand is associated with agricultural irrigation, and 78 percent of the region's existing water supply consists of ground water from the Ogallala, Edwards-Trinity (Plateau), Edwards-Trinity (High Plains), and Pecos Valley Aquifers. Water conservation strategies for the region include advanced irrigation methods and reuse of treated municipal waste water. The region is also looking to desalinate brackish ground water and add new well fields for Midland and San Angelo. Based on existing ground water supplies in the region (all aquifers), the TCEP would use approximately 0.7 percent of the annual ground water supply if Summit selected WL Options 2, 3, or 4.

Although the Texas Water Development Board has indicated that a number of existing well fields could provide sufficient water for the TCEP, the withdrawal of a maximum of 5.5 million gal (20.8 million L) of water per day or 6,165 ac-ft per year for the TCEP could affect future ground water supplies. In addition, regional population and industry growth over time may strain water supplies in the future.

5 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES AND LOCAL SHORT-TERM USES AND LONG-TERM PRODUCTIVITY OF THE ENVIRONMENT

5.1 Irreversible and Irretrievable Commitments of Resources

A resource commitment is considered irreversible when impacts from its use would limit future use options and the change could not be reversed, reclaimed, or repaired. Irreversible commitments generally occur to nonrenewable resources such as minerals or cultural resources, and to those resources that are renewable only over long time spans, such as soil productivity.

A resource commitment is considered irretrievable when the use or consumption of the resource is neither renewable nor recoverable for use by future generations until reclamation is successfully applied. Irretrievable commitments generally apply to the loss of production, harvest, or natural resources and are not necessarily irreversible.

The land that would be committed to develop the proposed TCEP would include land used for construction staging areas for the polygen plant and linear facilities, the footprint of the polygen plant, and the footprint of associated linear facilities. Although not all of the 600 ac (243 ha) at the polygen plant site would actually be developed, it is likely that the entire site would be unavailable for other uses. Similarly, the land required for the linear facilities could be restricted from some other uses. However, after the operational life of the polygen plant is over and the plant and linear facilities have been decommissioned and reclamation implemented, the land would again be available for other uses. Therefore, during the lifespan of the project, land use would experience an irretrievable impact.

The land areas required for the polygen plant and linear facilities would be cleared, graded, and filled, as needed, to suit construction of the project. These actions would result in additional impacts that are irreversible and/or irretrievable. Existing vegetation and soils would be removed, causing mortality of some wildlife, such as burrow-dwelling species and slow-moving species that are unable to relocate when ground disturbance activities begin. In addition, the vegetation and soil habitats would be lost for future use by wildlife until reclamation could be successfully implemented. The direct mortality of wildlife would be an irreversible impact and the loss of habitat would be an irretrievable impact. It can be argued that the loss of soil (which requires a very long time to generate) would constitute an irreversible and irretrievable resource commitment. However, reclamation would likely include replacing any lost topsoil and not relying on natural soil-producing processes. Therefore, it is likely that the soil removal would ultimately be an irretrievable impact but not irreversible.

The clearing and grading actions also pose a risk to cultural resources that may exist at the polygen plant and linear facilities. If cultural resources were discovered during construction, they would be documented and likely moved from the site. Disturbances to these resources would be considered irreversible.

Process water would be used primarily in the cooling towers, which would convert the water to vapor. Potable water used during construction and operations would be discharged through a septic system. Because the project would not directly discharge any of the process or potable water directly back to ground water or surface water, much of this water may be lost to the local area and downstream users. This would result in an irretrievable commitment of water resources. In the event the ground water option is used, due to the amount of time required for ground water recharge through the hydrologic cycle, this use could also result in an irreversible commitment of ground water resources.

Aesthetics would experience irretrievable, but not irreversible, commitments during the life of the polygen plant operation. The viewshed would be altered as long as the polygen plant was present.

Although air emissions would be greatly reduced compared to typical coal-fueled electricity generation facilities, there would be some emissions that would contribute to reduced air quality.

Material and energy resources committed for the TCEP would include construction materials (e.g., steel, concrete) and fuels (e.g., coal, diesel, gasoline). All energy used during construction and operation would be irreversible and irretrievable. During operation, the project would use up to 2.1 million tn (1.9 million t) of coal annually. The sub-bituminous coal resources would be irreversibly and irretrievably committed. Based on 2009 U.S. coal production statistics, the TCEP would use approximately 0.42 percent of the sub-bituminous coal produced annually in the U.S. (U.S. Energy Information Administration 2010). The polygen plant would also use natural gas during startup and as a backup fuel. Although the amount of natural gas used would be negligible in relation to local capacity, it would be irreversibly and irretrievably committed.

5.2 Relationship between Short-term Uses of the Environment and Long-term Productivity

Short-term uses of the environment would be associated with construction activities. They would include use of the aesthetic, air, wetlands, and transportation environments. Aesthetic impacts affecting nearby residents would include the effects to viewsheds from land-clearing activities and increased noise levels. Aesthetics and air quality would both experience short-term impacts from fugitive dust emissions. Although there are no surface waters that would be affected by the TCEP, there are wetlands along some of the linear facilities that would be affected by land clearing activities. The impacts to these wetlands, as well as general vegetation and wildlife habitat losses along the linear facilities, would be considered short-term impacts because those resources would likely re-establish after the facilities are constructed. Short-term impacts would also include traffic diversions and disruptions.

In the long term, the project would support the DOE objective of demonstrating and promoting innovative coal power technologies that can provide the U.S. with clean, reliable, and affordable energy using domestic sources of coal. The project would contribute approximately 213 MW (net) of electricity per year to the electric grid system. The proposed project would minimize sulfur dioxide, nitrogen oxides, Hg, CO_2, and PM emissions compared to other coal-fueled power plants.

The successful development of low-emissions electricity production from sub-bituminous coal, an abundant energy source, would further the goal of reducing anthropogenic emissions of CO_2. If the project is approved and developed, the use or consumption of land, materials, water, energy, and labor to construct and operate the project would have long-term positive impacts on reducing CO_2 emissions per unit of electricity generated.

REFERENCES

California Integrated Waste Management Board. 2006. Estimated Solid Waste Generation Rates for Industrial Establishments. Available at http://www.ciwmb.ca.gov/WasteChar/WasteGenRates/Industrial.htm Accessed November 9, 2006

Federal Register. 2010. Notice of Intent To Prepare an Environmental Impact Statement for Texas Clean Energy Project, Ector County, TX. *Federal Register* 75-30800

EPA**.** 2010. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2008. Available at: http://www.epa.gov/climatechange/emissions/usinventoryreport.html. Accessed January 11, 2011.

———. 2010a. State and Prevention of Significant Deterioration Air Permit Nos. 92350 and PSDTX1218. Approved December 28, 2010 by the TCEQ. Austin, Texas.

———. 2010b. *Texas Clean Energy Project Initial Conceptual Design Report*. Prepared by CH2MHill, September 2010 (draft).

TxDOT. 2010. Texas motor vehicle crash rate. Available at: http://apps.dot.state.tx.us/txdot_tracker/enhance_safety/fatalities.asp. Accessed October 2, 2010.

Texas Water Development Board. 2010. 2011 State Water Plan: Summary of Region F. Available at: http://www.regionfwater.org/index.aspx?id=2011Plan. Finalized December 2010. Accessed January 7, 2011.

U.S. Energy Information Administration. 2010. Coal Production and Number of Mines by State and Coal Rank. Available at: http://www.eia.doe.gov/cneaf/coal/page/acr/table6.html. Accessed November 11, 2010.

INDEX

-I-

-J-

-K-

-L-

-M-

-N-

-O-

-P-

-R-

-S-

-T-

-U-

-W-

-Z-

This page intentionally blank