



Texas Clean Energy Project

Final Environmental Impact Statement

DOE/EIS-0444

Summary



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COVER SHEET

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Abstract:

This *final* environmental impact statement (EIS) provides information about the potential environmental impacts associated with the U.S. Department of Energy's (DOE) proposal to provide limited financial assistance (approximately \$450 million), through a cooperative agreement, to Summit Texas Clean Energy, LLC (Summit) for the proposed Texas Clean Energy Project (TCEP). The TCEP would use coal-based integrated gasification combined-cycle technology to generate electric power and would capture carbon dioxide (CO₂) for use in enhanced oil recovery (EOR) and eventual sequestration. The plant would generate 400 megawatts (gross) of electricity, of which **130–213** megawatts would be provided to the power grid. It would also produce urea, argon, and sulfuric acid for sale in commercial markets. Because of its multiple production capabilities, the plant is referred to as a polygeneration (polygen) plant. DOE would provide approximately 26 percent of the project's total capital cost of at least \$1.73 billion (2009 dollars).

The polygen plant would be built on a 600-acre (243-hectare) oil field site in Ector County, Texas, north of the oil community of Penwell. Summit would design and construct the plant to capture approximately 90 percent of its CO₂. During the demonstration phase of the plant's operations, the project would sequester approximately **2.5–3.0 million tons (2.3–2.7 million metric tonnes)** of CO₂ per year by transporting it in pipelines to existing oil fields in the Permian Basin of West Texas for use in EOR operations by third-party buyers of the CO₂. Following the demonstration phase, the polygen plant would continue in commercial operation for 30–50 years.

DOE determined that the proposed TCEP constitutes a major federal action within the meaning of the National Environmental Policy Act of 1969, as amended. The *Federal Register* "Notice of Intent

To Prepare an Environmental Impact Statement for Texas Clean Energy Project, Ector County, Texas” was published on June 2, 2010 (75 *Federal Register* 30800). DOE held a public scoping meeting at Odessa College in Odessa, Texas, on June 17, 2010. ***The Federal Register “Notice of Availability for the Draft Environmental Impact Statement for Texas Clean Energy Project, Ector County, Texas” was published on March 18, 2011 (76 Federal Register 14969). DOE published a second Notice of Availability in the Federal Register on March 22, 2011, to announce the date and location of the public hearing, which was held on April 5, 2011, in the city of Odessa, Ector County, Texas (76 Federal Register 15968). The public comment period began March 18, 2011, and ended May 2, 2011.***

This ***final*** EIS provides an evaluation of the environmental consequences that may result from Summit’s proposed project, including potential impacts on air quality and greenhouse gas emissions; climate; soils, geology, and mineral resources; ground water resources; surface water resources; biological resources; aesthetics; cultural resources; land use; socioeconomics; environmental justice; community services; utility systems; transportation; materials and waste management; human health, safety, and accidents; and noise and vibration. The ***final*** EIS also provides an analysis of the No Action Alternative, under which DOE would not provide financial assistance to the TCEP, with the assumption that without federal financial assistance, the project would not be constructed. ***DOE’s preferred alternative—to provide financial assistance to Summit’s proposed project—is identified in the final EIS.***

In addition, the final EIS provides the comments received on the draft EIS, DOE’s prepared responses to those comments, revisions that were made in response to the comments, and changes that were made to the Proposed Action between the preparation of the draft EIS and final EIS. Vertical lines in the left margin of a page indicate where text in the draft EIS has been deleted, revised, or supplemented for this final EIS, except for Volume II, which contains the public comments on the draft EIS and DOE’s responses. This revised text in the Summary and Volume I is shown in boldface italics font (as in this paragraph).

CONTENTS

1 PURPOSE AND NEED.....	S-1
1.1 Introduction.....	S-1
1.2 DOE’s Purpose and Need	S-3
1.3 Industrial Participant’s (Summit’s) Purpose and Need	S-3
1.4 DOE Scoping Process.....	S-3
1.5 Comments on the Draft Environmental Impact Statement	S-4
1.6 Consultation and Coordination.....	S-6
1.6.1 Coordination with Federal and State Agencies	S-6
1.6.2 Consultation with Native American Tribes.....	S-7
1.7 Summary of Changes in the Environmental Impact Statement	S-7
2 PROPOSED ACTION AND ALTERNATIVES.....	S-8
2.1 DOE’s Proposed Action.....	S-8
2.1.1 Alternatives Determined to be Reasonable by DOE.....	S-9
2.2 Summit’s Proposed Project	S-9
2.2.1 Process Description.....	S-9
2.2.2 Process Components and Major Equipment	S-10
2.2.3 Utility Systems	S-15
2.2.4 Marketable Products	S-17
2.2.5 Resource Requirements.....	S-18
2.2.6 Materials, Discharges, and Wastes	S-23
2.2.7 Construction Plans	S-27
2.2.8 Operation Plans.....	S-28
2.3 Avoidance and Mitigation Measures	S-29
2.4 DOE’s No Action Alternative.....	S-33
3 AFFECTED ENVIRONMENT AND ENVIRONMENTAL IMPACTS.....	S-33
4 POTENTIAL CUMULATIVE EFFECTS.....	S-62
5 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES AND LOCAL SHORT-TERM USES AND LONG-TERM PRODUCTIVITY OF THE ENVIRONMENT.....	S-64
6.1 Irreversible and Irretrievable Commitments of Resources	S-64
6.2 Relationship between Short-term Uses of the Environment and Long-term Productivity.....	S-65
6 CONCLUSIONS.....	S-66
7 REFERENCES	S-68
8 INDEX.....	S-69

FIGURES

Figure S1-1. General location map	S-2
Figure S2-1. Polygen plant site and associated linear facility options.....	S-11
Figure S2-2. Illustration (simplified) of the TCEP’s gasification, power generation, and urea production.....	S-12

TABLES

Table S1-1. General Comments Received During the Draft EIS Public Comment Period	S-5
Table S2-1. TCEP Process Components and Major Equipment	S-13
Table S2-2. TCEP Utility Systems	S-15
Table S2-3. TCEP Resource Requirements.....	S-18
Table S2-4. Toxic and Hazardous Materials and Estimated Storage at the Polygen Plant Site	S-24
Table S2-5. TCEP Permitted Air Pollutant Emissions	S-25
Table S2-6. Solid Wastes from the Polygen Plant.....	S-27
Table S2-7. The TCEP’s Incorporated Mitigation Measures.....	S-29
Table S3-1. Summary of Impacts from Summit’s Proposed TCEP and the No Action Alternative.....	S-35
Table S3-2. Summary Comparison of Impacts from Summit’s Proposed Waterline Options for the TCEP.....	S-48
Table S3-3. Summary Comparison of Impacts from Summit’s Proposed Transmission Line Options for the TCEP	S-53
Table S3-4. Summary Comparison of Impacts from Summit’s Proposed Access Road Options for the TCEP.....	S-56
Table S3-5. Summary Comparison of Impacts from Summit’s Proposed Natural Gas Pipeline Options for the TCEP	S-59

ABBREVIATIONS

AADT - annual average daily traffic	n/a - not available
ac - acre	N ₂ - nitrogen gas
ac-ft - acre-feet	NAAQS - National Ambient Air Quality Standards
AR - access road option (e.g., AR1)	NEPA - National Environmental Policy Act
C.F.R. - Code of Federal Regulations	NG - natural gas pipeline option (e.g., NG1)
CCPI - Clean Coal Power Initiative	NH ₃ - ammonia
cm - centimeter	NRHP - National Register of Historic Places
CO - carbon monoxide	OEPP - Odessa-Ector Power Partners LP
CO ₂ - carbon dioxide	OSHA - Occupational Safety and Health Administration
dBA - A-weighted decibels	Oxy Permian - Oxy USA-W Texas Water Supply
DOE - U.S. Department of Energy	pH - measure of acidity or basicity
EIS - environmental impact statement	PM - particulate matter
EOR - enhanced oil recovery	PM ₁₀ - particulate matter with aerodynamic diameter equal to or less than 0.00039 inch (10 micrometers)
EPA - U.S. Environmental Protection Agency	PM _{2.5} - particulate matter with aerodynamic diameter equal to or less than 0.000098 inch (2.5 micrometers)
ERCOT - Electric Reliability Council of Texas	polygen - polygeneration
FM - Farm-to-Market Road (e.g., FM 866)	ROI - region of influence
FSH - Fort Stockton Holdings	ROW - right-of-way
FTA - Federal Transit Administration	RR - railroad option (e.g., RR1)
ft - foot	SPCC - spill prevention, control, and countermeasures
ft ³ - cubic foot	Summit - Summit Texas Clean Energy, LLC
gal - gallon	SWPPP - storm water pollution prevention plan
GCA - Gulf Coast Waste Disposal Authority	t - metric tonnes
GHG - greenhouse gas	TCEP - Texas Clean Energy Project
H ₂ - hydrogen gas	TCEQ - Texas Commission on Environmental Quality
H ₂ S - hydrogen sulfide	Texland - Texland Great Plains Water Company
H ₂ SO ₄ - sulfuric acid	TL - transmission line option (e.g., TL1)
ha - hectare	tn - ton
HAP - hazardous air pollutants	TxDOT - Texas Department of Transportation
Hg - mercury	U.S. - United States
I - Interstate (e.g., I-20)	UPRR - Union Pacific Railroad
in - inch	U.S. - United States (e.g., waters of the U.S.)
IGCC -integrated gasification combined-cycle	WL - waterline option (e.g., WL1)
km - kilometer	WWTP - waste water treatment plant
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	

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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 (CO₂) capture with an integrated gasification combined-cycle (IGCC) power production system, and captured CO₂ would be sold on the regional market for enhanced oil recovery (EOR), resulting in permanent sequestration of the CO₂.

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 CO₂ 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 CO₂ 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.

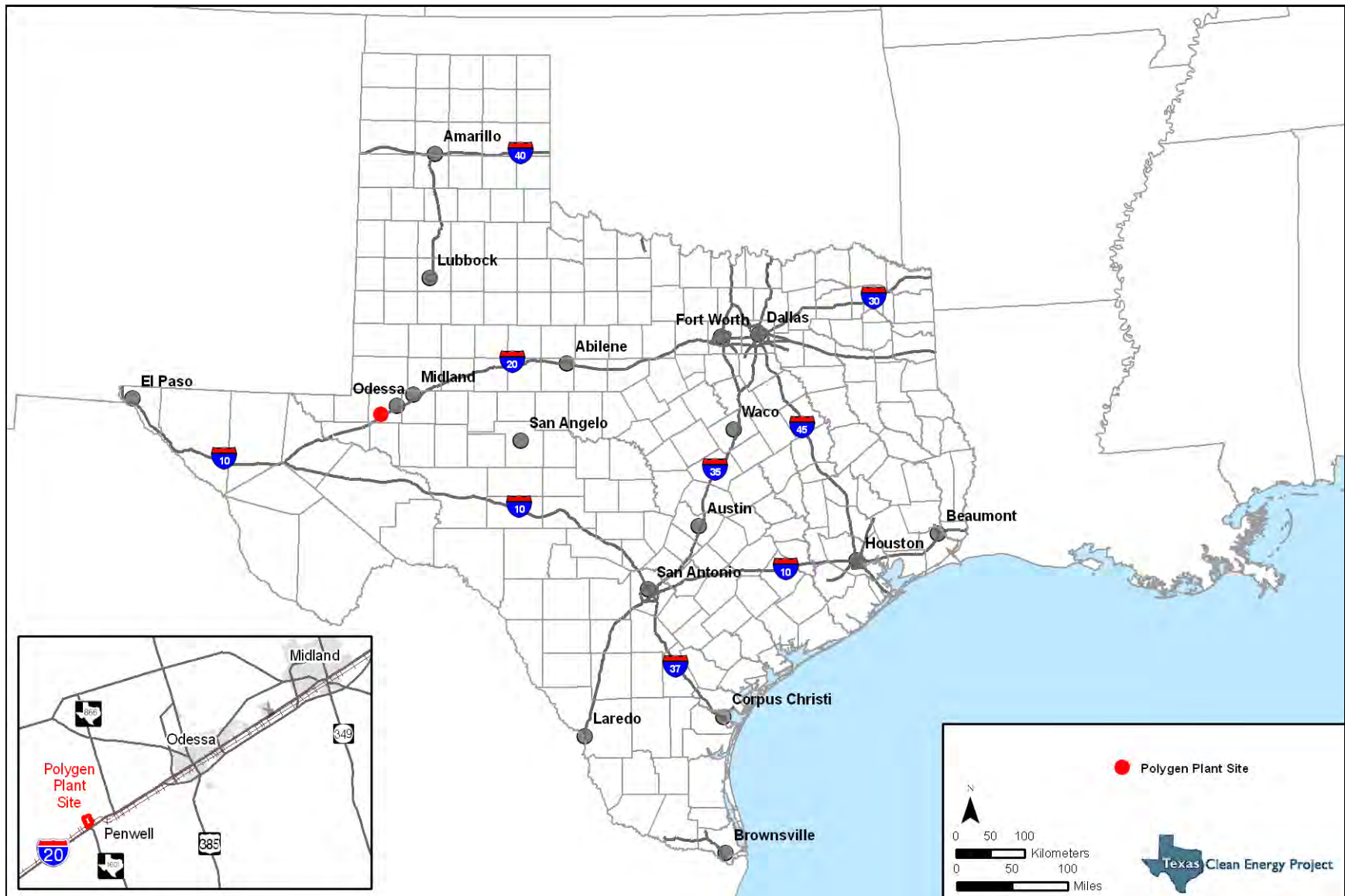


Figure S1-1. General location map.

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 CO₂ 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 CO₂ 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 CO₂ 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 CO₂ to support the ongoing EOR operations within the Permian Basin. The TCEP would capture **up to** approximately 3 million tons (tn) (2.7 million metric tonnes [t]) of CO₂ per year, **of which approximately 2.5–3.0 million tn (2.3–2.7 million t)** would be transported by pipeline to EOR industry buyers. Should the TCEP demonstrate the feasibility of utility-scale electric power generation with CO₂ capture, it could result in the incorporation of CO₂ capture in future power plant construction, with the resulting reduction in CO₂ 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 verbal 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, CO₂ monitoring systems for EOR, labor mix, and utility and resource requirements.
- Consideration of alternative technologies for various chemical processes, including ammonia (NH₃) 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 CO₂ sequestration through EOR efforts would be offset by full life-cycle CO₂ impacts associated with the recovered oil.
- Petroleum issues including the EOR process and CO₂ monitoring methods, as well as clarification on the liability and guarantees associated with the CO₂ monitoring system.

1.5 Comments on the Draft Environmental Impact Statement

DOE issued the draft EIS on March 18, 2011, and distributed copies to the elected officials, agencies, Native American tribes, organizations, and members of the public identified in the TCEP distribution list (Chapter 9). DOE filed the draft EIS with EPA on March 11, 2011, and EPA's Notice of Availability was published in the Federal Register on March 18, 2011 (76 Federal Register 14968). EPA's notice started the 45-day comment period on the draft EIS, which ran from March 18 to May 2, 2011.

On March 22, DOE published its own notice of the availability of the draft EIS and announced the date and location of a public hearing on the draft EIS (76 Federal Register 15968). The public hearing was held on April 5, 2011, in the city of Odessa, Ector County, Texas. Collectively, 27 individuals attended the public hearing, including members of the public and representatives from state agencies, media, and Summit Energy and its associated business entities. DOE received verbal comments on the TCEP draft EIS at the hearing and through comment form, by letter, and by email. After reviewing the comment documents, a list of issues was developed (Table S1-1).

Table S1-1. General Comments Received During the Draft EIS Public Comment Period

Issues	
Economy, Employment, and Income	Commenters expressed concern regarding the market for carbon dioxide (CO ₂).
DOE's Proposed Action	Commenters requested consideration of other energy sources in the EIS beyond fossil fuels.
Summit's Proposed Project and Project Options	<p>Commenters expressed concern with the use of wet cooling technology and requested consideration of an alternative using only dry cooling technology.</p> <p>Commenters also provided suggestions regarding other alternative sources of water that should be analyzed in the final EIS: Pecos Alluvium Aquifer, Capitan Reef Complex Aquifer, construction of pipelines from East Texas, and use of produced water from oil fields.</p> <p>Commenters expressed a preference for the zero liquid discharge system technology option.</p> <p>Commenters questioned the rationale for the elimination of other locations for the TCEP from detailed analysis in the draft EIS.</p>
DOE's Purpose and Need	<p>Commenters expressed concerns about practicality of producing and using synthesis gas when natural gas is already available in the area.</p> <p>Commenters expressed concern about the likely success of the reported DOE programmatic goal of a net decrease in greenhouse gas (GHG) emissions that could be triggered if the proposed technologies are successfully and widely deployed by industry.</p>
Summit's Purpose and Need	Commenters expressed concerns about a market for the energy to be produced by the project and the economic viability of the project.
Air Quality	Commenters expressed concern about impacts from coal dust from trains.
CO₂ Sequestration	Concerns were expressed regarding the sequestration of CO ₂ , specifically the manner in which CO ₂ stays underground, and the overall net decrease in CO ₂ emissions though use in EOR.
Waters of the U.S.	Commenters requested clarification regarding impacts on waters of the U.S.
Water Use/Utilities	<p>Commenters expressed concern regarding the impact of the project on water supply and demand, particularly the potential use of potable water to meet process water needs.</p> <p>Commenters expressed concern about the availability of some of the process water options, due to over-commitment of water rights, potential for litigation, or other issues.</p>
Ground Water	<p>Commenters expressed concern regarding impacts to ground water, including</p> <ul style="list-style-type: none"> • depletion of aquifers and ground water supplies, • increased salinity from discharge of waste water and its impact on local wells, and • impacts to aquifer recharge from reallocation of water from current uses to accommodate the TCEP.
Surface Water	<p>Commenters expressed concern regarding impacts to surface waters. Concerns included</p> <ul style="list-style-type: none"> • impacts from runoff from the polygen plant site, • increased flooding due to project-related discharges to local surface waters, • impacts from the discharge of saline waters into local surface waters, • impacts from the potential dewatering of local surface waters, • changes in surface water quality, • impacts to jurisdictional waters of U.S., and • impacts to playas from proposed waste water discharges and from direct surface disturbance.
Traffic	Commenters expressed concern regarding the proposed increase in railroad traffic.

Table S1-1. General Comments Received During the Draft EIS Public Comment Period

Issues	
Vegetation	<p><i>Commenters expressed concern regarding impacts to riparian vegetation and wetlands from effluent discharge and/or direct surface disturbance.</i></p> <p><i>Commenters suggested the use of reclamation measures and best management practices to prevent growth of noxious weeds.</i></p>
Terrestrial Wildlife	<p><i>Commenters expressed concern regarding impacts to migratory birds, as well as impacts to wildlife from placement of certain linear facility options near playas.</i></p> <p><i>Commenters expressed concern about impacts to wildlife habitat as a result of changes in surface water quality.</i></p>
Cumulative Effects	<p><i>Commenters requested an update of reasonably foreseeable projects that would occur near the polygen plant site to include proposed TxDOT projects.</i></p> <p><i>Commenters expressed concern about impacts of climate change on future water availability, and consideration of those impacts in DOE project and funding plans.</i></p> <p><i>Commenters expressed concern about the likely success of the reported DOE programmatic goal of a net decrease in GHG emissions that could be triggered if the proposed technologies are successfully and widely deployed by industry.</i></p>
Coordination and Consultation	<p><i>Commenters requested that the EIS include all consultation request letters.</i></p>

1.6 Consultation and Coordination

1.6.1 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.

1.6.2 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 are unearthed during the construction of the TCEP.

1.7 Summary of Changes in the Environmental Impact Statement

The final EIS reflects the revisions made to the draft EIS. Revisions were based on either comments received during the draft EIS comment period, changes in project plans, or changes based on events that took place or actions that occurred between the publication of the draft EIS and the preparation of the final EIS. The changes in plans are considered in the impacts analysis for all resources. A summary of these changes is provided below:

- *Summit has included an option to increase the flexibility in the production of urea by up to 40 percent. Under this option, net electrical output would be decreased due to the use of additional syngas for the production of NH₃, and 40 percent more CO₂ could be used in the additional production of urea.*
- *Summit has revised the right-of-way (ROW) widths for the linear facilities. A 200-foot (ft) (61-meter [m]) construction ROW and a 150-ft (46-m) permanent ROW are now considered for the transmission line options. A 150-ft (46-m) construction ROW and a 50-ft (15-m) footprint are now considered for the waterline, natural gas pipeline, CO₂ pipeline connector, access road, and railroad options.*
- *Summit has included six new linear facility options that were either not finalized by the time the draft EIS was published or were the result of refinements made to the linear facilities identified in the draft EIS. The new linear facility options are as follows:*
 - *One additional linear facility option for the Gulf Coast Waste Disposal Authority (GCA) primary water source (WL5), which is now Summit's preferred process waterline option*
 - *One additional linear facility option for TCEP's backup water supply (WL6)*
 - *Two new options for natural gas interconnection pipelines (NG2 and NG3)*
 - *Two new options to provide access into the polygen plant site (AR3 and AR4)*

- *Concerns were raised regarding the potential for cumulative effects to water supply resources. The final EIS more fully explains the water supply sources and the potential demand on these sources.*
- *Summit has included on-site water treatment under all water source options. Source water, which would be delivered to the polygen plant site from one of the various water source options under consideration, would be treated on-site in the source water treatment system, which uses reverse osmosis membranes to remove dissolved solids and other constituents prior to use in the various facility processes. Dry cooling is also an alternative Summit is considering that would reduce the amount of process water required for cooling.*
- *Summit has modified the proposed project to include two waste disposal systems for on-site disposal of the waste water streams from the various processes at the polygen plant site. There would be no surface discharge of industrial waste water from the polygen plant site. The revised systems for disposal of waste water are considered in the impacts analysis under all resources. A summary of the disposal systems is below:*
 - *Reverse osmosis reject water disposal system (Disposal System 1), which would dispose of reject water through a combination of evaporation ponds and deep well injection;*
 - *Residual industrial waste water disposal system (Disposal System 2), which would dispose of all residual industrial waste water that could not be cleaned and recycled back into the plant for use as process water. This system would use a mechanical crystallizer and filter press system or solar evaporation ponds, with an option to deep well inject the industrial waste water, depending on its quality.*
- *There is a change from two totally enclosed ground flares (each 200 ft [61 m] high) to four flares (each approximately 200 ft [61 m] high and co-located on one structure).*
- *Additional information regarding the specifications of the pipelines used for CO₂ transport is provided.*
- *Concerns were raised about impacts to ground and surface waters, as well as cumulative effects to water supply resources. As a result, the final EIS and Volume II (Responses to Comments) more fully explain impacts to respective ground water and surface water resources from the project.*
- *Revisions to the cumulative effects analysis were made to identify additional reasonably foreseeable transportation and renewable energy projects identified through the public comment period.*
- *Volume II (Responses to Comments) of the final EIS provides a description of the public hearing, DOE's methodology for responding to public comments, a copy of the transcript from the public hearing and original comment documents in their entirety, and DOE's response to each comment.*

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 CO₂. 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 1–6), a natural gas pipeline (Natural Gas [NG] Options 1–3), a CO₂ pipeline connector (CO₂ Option 1), access roads (Access Road [AR] Options 1–4), and a rail spur (Railroad [RR] Option 1). These linear facilities would connect the plant to existing utilities, a CO₂ 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 CO₂, the hydrogen (H₂)-rich syngas would be used in the power island to generate **up to** 400 megawatts (MW) (gross) of electrical power. Under **minimum and** maximum power output conditions, approximately **130–213 MW (net) (1.0–1.7 billion net kilowatt-hours)** 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.

The captured CO₂ would be further cleaned and compressed. It would then be transported through a short connector pipeline to an existing, regional CO₂ pipeline for dispersal to oil fields in the Permian Basin. Captured sulfur compounds would be converted into sulfuric acid (H₂SO₄), 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 [N₂] production),
- syngas cleanup systems (including water-gas shift reactors, sulfur recovery, Hg removal, and CO₂ capture),
- CO₂ compression,
- an H₂SO₄ 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 **Final Conceptual Design Report**, dated **June 2011** (Summit **2011**).*

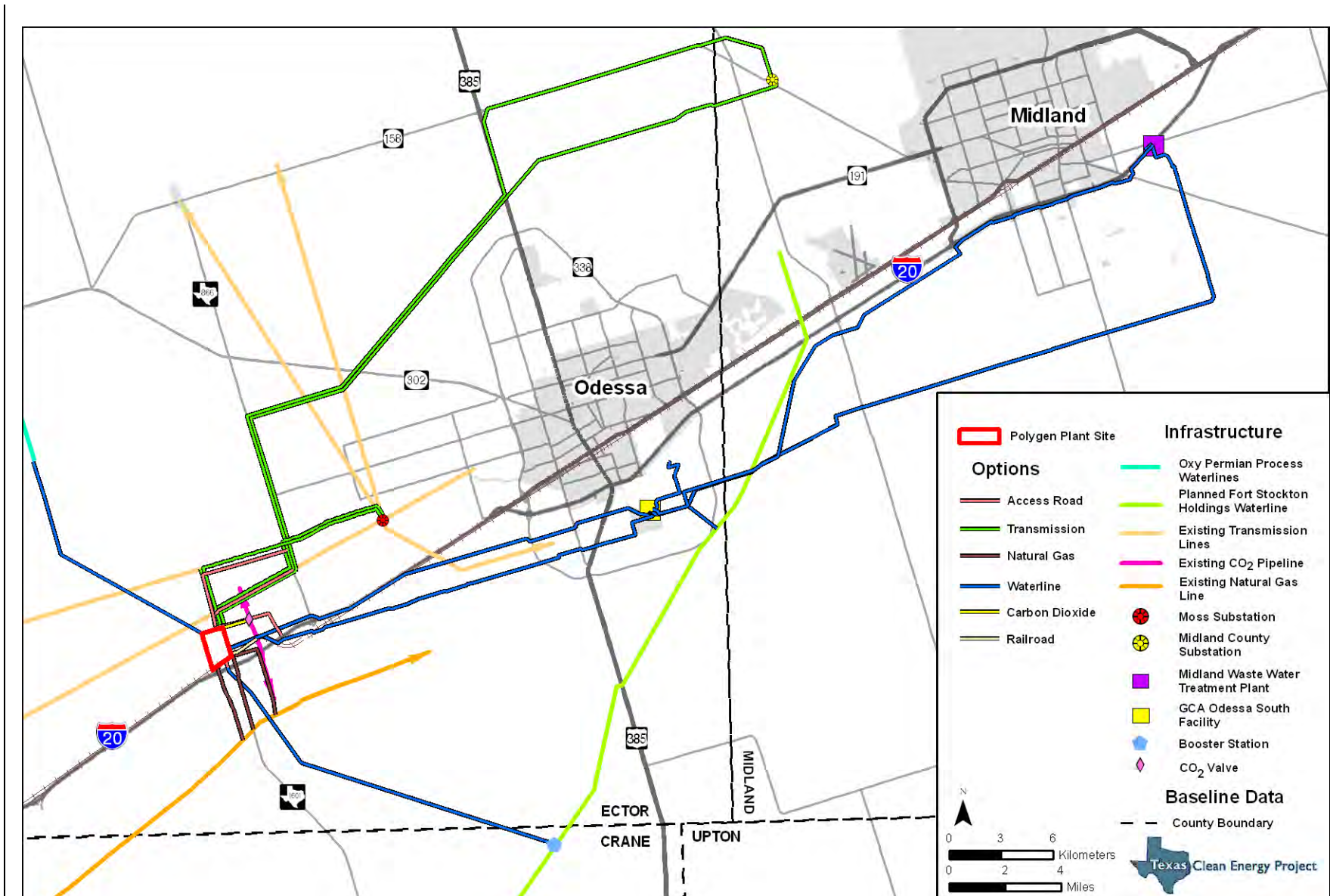


Figure S2-1. Polygen plant site and associated linear facility options.

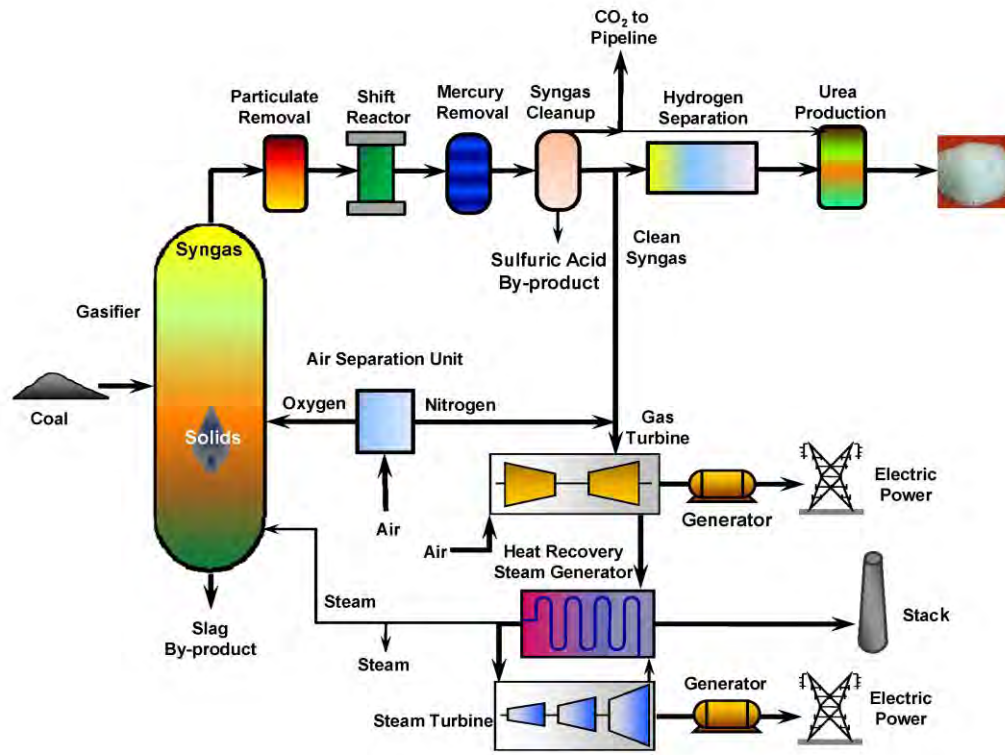


Figure S2-2. Illustration (simplified) of the TCEP's gasification, power generation, and urea production.

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. Reclaim 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. Feed 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 gas 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 residual industrial waste water disposal system for disposal .
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 ₂ S), 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 ₂ S 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 ₂ S 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 process water treatment system for cleaning.
H₂SO₄ 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 ₂ SO ₄ . Once cooled, the concentrated H ₂ SO ₄ product would be stored in a carbon steel tank coated with a fluorinated polymer and transported off-site by rail.
CO₂ 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.
NH₃ 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. <i>Summit is considering an option to increase the urea production, which would allow the TCEP the flexibility to accommodate fluctuation in urea and electricity sales. As a result, urea, electricity, and CO₂ outputs could vary at any given time.</i>
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 gas turbine generator for primary power generation. The gas turbine would also be configured to use natural gas as a startup and backup fuel. Waste heat from the gas 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
Water Treatment Systems	
Source Water Treatment System	<i>Source water would be delivered to the polygen plant site from one or more of the various waterline options under consideration. If source water from the GCA water option (either WL1 or WL5) were chosen, municipal waste water piped from the city of Midland would receive secondary biological treatment followed by low pressure membrane filtration (microfiltration or ultrafiltration) to remove particulate matter at the GCA Odessa South Facility. The source water would then be piped to the polygen plant site where the water would receive additional treatment using a reverse osmosis system to remove dissolved solids and other constituents prior to use in the various facility processes. For all other water sources under consideration (Oxy Permian and FSH), low pressure membrane filtration and additional treatment using reverse osmosis membranes would both occur at the polygen plant site. After the source water was treated by source water treatment system, it would be used as process water in the various plant processes.</i>
Process Water Treatment System	<i>Once the process water had been used in the various processes, it would be industrial waste water, which would go through the process water treatment system for cleanup and reuse in the polygen plant. The industrial waste water would be processed through one or more initial treatment systems depending upon the specific power block and chemical block process waste stream characteristics. Initial treatment processes could include biological treatment using activated sludge to treat high levels of ammonium and formate compounds in the waste stream, electro-deionization for removal of ions and cold lime softening to treat all of the cooling tower blowdown in order to remove calcium, magnesium, alkalinity, and silica. After initial treatment, the industrial waste water would be further treated using a smaller reverse osmosis system, separate from the source water treatment system, which would recycle much of the industrial waste water back to the polygen plant for use as process water.</i>
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 back to the process water treatment system for reuse in the various plant processes . 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	Four gasification island flares, each approximately 200 ft (61 m) high and co-located on one structure , 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 either natural gas or syngas 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.

Table S2-2. TCEP Utility Systems

System	Description
Waste Disposal Systems	
Reverse Osmosis Reject Water Disposal System	<i>The source water treatment system, consisting of reverse osmosis filtration, would be designed to remove dissolved solids and other constituents in the source water. The volume of reverse osmosis reject water produced by the source water treatment system would be dependent on the water source that was selected for the TCEP. Reverse osmosis brine wastes from the source water treatment system would be disposed of using a combination of solar evaporation ponds and deep injection wells. Once a Class V test injection well was permitted, drilled on the polygen plant site, and tested for the injection zone (or zones) characteristics, an evaluation of the amount of waste water that could be disposed of through the injection wells would be determined, although Summit anticipates no more than eight Class I injection wells would be required and permitted through a Class I Underground Injection Control General Permit. Based on this information, the precise number and size of the evaporation ponds would be determined to optimize the overall waste disposal system for the polygen plant.</i>
Residual Industrial Waste Water Disposal System	<i>The primary industrial waste water sources for the TCEP would be the oil water separator, urea condensate, gasification gray water purge, sulfuric acid plant tail gas scrubber effluent, shift stripper purge, Rectisol® waste water, cooling tower blowdown, contact and noncontact storm water, and miscellaneous IGCC plant washdown wastes. The largest volume of waste water would be generated by the wet cooling tower blowdown. The industrial waste water would be processed through one or more initial treatment systems depending upon the specific power block and chemical block process waste stream characteristics. Industrial waste water would then be filtered with a reverse osmosis (using a separate, smaller unit than the source water treatment system) to recycle most of the water for reuse at the polygen plant. Residual industrial waste water from these treatment systems would likely be disposed of via solar evaporation ponds. Other options for disposal of this residual industrial waste water would include a mechanical crystallizer and filter press system or deep well injection. The mechanical crystallizer and filter press system would produce a filter cake, which would be transported to a licensed landfill for disposal. The filter cake would be nonhazardous but would be tested to confirm its characteristics. Clean condensate water could also be produced by the mechanical crystallizer and filter press system for recycle back to the polygen plant. If Summit chose to inject the residual industrial waste water deep underground, the water would be analyzed to confirm its characteristics (e.g., as nonhazardous or hazardous) and an Individual Class 1 Underground Injection Control Permit would be obtained accordingly.</i>
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 **up to** 400 MW (gross) of electric power, with approximately **130–213** MW (net) transported either to the Electric Reliability Council of Texas (ERCOT) or Southwestern Power Pool power grid **based on minimum and maximum** power output conditions. **Fluctuations in the urea and electricity markets could encourage Summit to increase its production of urea by up to 40 percent, which could result in a corresponding decrease in net electrical output due to the use of additional syngas for the production of NH₃, a precursor for the production of urea.** 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 **would** capture approximately 3 million tn (2.7 million t) **of CO₂** per year, **of which between 2.5 and 3.0 million tn (2.3–2.7 million t)** would be **sold for use in EOR, depending on electricity and urea demand. The CO₂ 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. **For the maximum urea production case, approximately 1,512 tn (1,372 t) per day of CO₂ would be sent to the urea synthesis plant, with approximately 8,633 tn (7,832 t) per day of CO₂ being compressed and sent to the CO₂ pipeline for use in EOR. For the maximum power case, approximately 600 tn (544 t) per day of CO₂ would be sent to the urea synthesis plant, with approximately 9,100 tn (8,255 t) per day of CO₂ being compressed and sent to the CO₂ pipeline for use in EOR.**

In the Kinder Morgan pipeline, TCEP's CO₂ would comingle with CO₂ from other sources and would be transported throughout the Permian Basin oil fields. Buyers would take a purchased quantity of CO₂ from the Kinder Morgan pipeline. In the Permian Basin, CO₂ is a commodity sold on a regional market. EOR using CO₂ 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 CO₂ would be sold to buyers that already use CO₂ 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 CO₂ and a high level of confidence that the CO₂ 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 CO₂ offtake agreement (or agreements).

2.2.4.3 UREA

To optimize the operational flexibility of the polygen plant, Summit is considering increasing urea production by up to 40 percent, with a resulting decrease in the production of electricity and CO₂ available for EOR. With this flexibility, the TCEP would produce **between 1,485 and**

2,079 tn (1,347–1,886 t) of granulated urea per day (**542,025–758,835 tn [491,716–688,404 t] annually**) at **minimum and** 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 H₂SO₄ 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 two 150 -car-unit trains per day could come on-site, with an average of two to three 150 -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. H₂SO₄: Up to one-half railcar per day would be filled and sold. Urea: Up to 21 railcars per day would be required for the transportation of urea to buyers.

Table S2-3. TCEP Resource Requirements

Type	Description
Linear facility requirements	<p>CO₂: A 1.0-mi (1.6-km) CO₂ pipeline measuring 12 in (30 centimeters [cm]) in diameter would be constructed to connect plant facilities to the existing Kinder Morgan Central Basin CO₂ pipeline east of the polygen plant site. A maximum of 18.7 ac (7.6 ha) could be temporarily affected during construction, and 18.7 ac (7.6 ha) could be permanently affected by ROW maintenance.</p> <p>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 209.9 ac (84.9 ha) could be temporarily affected, and 157.5 ac (63.7 ha) could be permanently affected by ROW maintenance.</p> <p>TL2: An 8.7-mi (13.9-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 209.9 ac (84.9 ha) could be temporarily affected, and 157.5 ac (63.7 ha) could be permanently affected by ROW maintenance.</p> <p>TL3: A 2.2-mi (3.6-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 54.3 ac (22.0 ha) could be temporarily affected, and 40.7 ac (16.5 ha) could be permanently affected by ROW maintenance.</p> <p>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 15.2 ac (6.2 ha) could be temporarily affected, and 11.4 ac (4.6 ha) could be permanently affected by ROW maintenance. This is Summit's preferred transmission line option.</p> <p>TL5: A 36.8-mi (59.3-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 893.1 ac (361.4 ha) could be temporarily affected, and 669.8 ac (271.1 ha) could be permanently affected by ROW maintenance.</p> <p>TL6: A 32.8-mi (52.9-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 796.3 ac (322.3 ha) could be temporarily affected, and 597.3 ac (241.7 ha) could be permanently affected by ROW maintenance.</p>
Land Area	
Plant requirements	The polygen plant site would be constructed on 600 ac (243 ha). It is assumed that up to a maximum of 600 ac (243 ha) of the site would be permanently developed.
Linear facility requirements	Temporary impacts during construction could range from 378 to 1,982 ac (153–802 ha) , whereas permanent impacts from operations could range from 132 to 1,033 ac (53–418 ha) , based on the smallest combination (NG3, WL2, WL4, TL4, AR1, AR4, RR1, CO₂) and largest combination (NG2, WL5, WL6, TL5, AR1, AR3, RR1, CO₂) of the linear facility options. Linear facility alignments could vary slightly depending on land acquisition issues, environmental conditions, and engineering considerations. Impact area details can be found in each linear facility description, as provided in this table.

Table S2-3. TCEP Resource Requirements

Type	Description
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.
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	
<i>Plant</i> 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	<p>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 2.8-mi (4.6-km), 12-in-diameter (30-cm-diameter) connector pipeline would be constructed along FM 1601 to connect to the Oneok WesTex pipeline. Approximately 51.7 ac (20.9 ha) could be temporarily affected during construction, and 17.2 ac (7.0 ha) could be permanently affected by ROW maintenance.</p> <p>NG2: Oneok WesTex would provide natural gas to the polygen plant from an existing 20-in-diameter (51-cm-diameter) pipeline southeast of the polygen plant site. A 3.5-mi (5.6-km), 12-in-diameter (30-cm-diameter) connector pipeline would be constructed approximately 1.0 mi (1.6 km) east of FM 1601 to connect to the Oneok WesTex pipeline. Approximately 63.6 ac (25.7 ha) could be temporarily affected during construction, and 21.2 ac (8.6 ha) could be permanently affected by ROW maintenance.</p> <p>NG3: Oneok WesTex would provide natural gas to the polygen plant from an existing 20-in-diameter (51-cm-diameter) pipeline south of the polygen plant site. A 2.8-mi (4.5-km), 12-in-diameter (30-cm-diameter) connector pipeline would be constructed approximately 0.5 mi (0.8 km) west of FM 1601 to connect to the Oneok WesTex pipeline. Approximately 49.9 ac (20.2 ha) could be temporarily affected during construction, and 16.6 ac (6.7 ha) could be permanently affected by ROW maintenance.</p>
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. Potable water options consist of transporting water by truck, installing an on-site water well with additional treatment, or providing additional treatment to the water source to bring it up to potable water standards.
Transportation requirements	If delivered by truck, 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.

Table S2-3. TCEP Resource Requirements

Type	Description
Primary Process Water Supply	
Plant requirements	The TCEP would require <i>an average of 4.2 million gal (15.9 million L)</i> per day (<i>4,705 ac-ft per year</i>) and a maximum of <i>4.5 million gal (17.0 million L)</i> per day (<i>5,030 ac-ft per year</i>) of water for all polygen plant uses.
Linear facility requirements	<p>WL1/WL5: GCA would provide source water to the TCEP from treated effluent at the GCA Odessa South Facility, a waste water treatment plant (WWTP) in the city of Odessa. The source 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, <i>unless Summit chooses to use GCA as a backup water supply, in which case all flow could be diverted for up to one day.</i> WL5 is Summit's preferred water option for the TCEP.</p> <p><i>If WL1 is chosen, a 41.3-mi (66.4-km), 20- to 30-in-diameter (51- to 76-cm-diameter) pipeline would be constructed south of I-20 from the Midland WWTP to the GCA Odessa South Facility and from there to the polygen plant site. A maximum of 539.1 ac (218.2 ha) could be temporarily affected during construction, and 179.6 ac (72.7 ha) could be permanently affected by ROW maintenance.</i></p> <p><i>If WL5 is chosen, a 44.5-mi (71.6-km), 20- to 30-in-diameter (51- to 76-cm-diameter) pipeline would be constructed south of I-20 from the Midland WWTP to the GCA Odessa South Facility and from there to the polygen plant site. A maximum of 834.1 ac (338.0 ha) could be temporarily affected during construction, and 278 ac (112.5 ha) could be permanently affected by ROW maintenance.</i></p> <p>WL2: Oxy USA-W Texas Water Supply (Oxy Permian) would provide source 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.</p> <p>A 9.3-mi (15.0-km), up to 24-in-diameter (61-cm-diameter) pipeline would be constructed to connect to an existing Oxy Permian pipeline northwest of the polygen plant site. A maximum of 169.1 ac (68.4 ha) could be temporarily affected during construction, and 56.3 ac (22.8 ha) could be permanently affected by ROW maintenance.</p> <p>WL3: Fort Stockton Holdings (FSH) would provide source 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.</p> <p>A 14.2-mi (22.8-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 257.7 ac (104.3 ha) could be temporarily affected during construction, and 85.9 ac (34.7 ha) could be permanently affected by ROW maintenance.</p>

Table S2-3. TCEP Resource Requirements

Type	Description
<i>Backup Water Supply</i>	<p><i>WL4: FSH would provide source water from their proposed main waterline project to the GCA Odessa South Facility to be used as a backup to WL1 or WL5. 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.</i></p> <p><i>A 2.6-mi (4.2-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 48.4 ac (19.6 ha) could be temporarily affected during construction, and 16.0 ac (6.5 ha) could be permanently affected by ROW maintenance.</i></p> <hr/> <p><i>WL6: Texland Great Plains Water Company (Texland) would provide backup water supply using their existing firm service capacity reserved for the Odessa-Ector Power Partners LP (OEPP). Texland would only provide water to the polygen plant as a backup when TCEP calls upon the service and when it is not being used by OEPP.</i></p> <p><i>If WL1 or WL5 is chosen, a 3.0-mi (4.8-km), 16-in-diameter (41-cm-diameter) pipeline would be constructed between the existing OEPP facility to the GCA Odessa South Facility. A maximum of 54.8 ac (22.2 ha) could be temporarily affected during construction, and 18.2 ac (7.4 ha) could be permanently affected by ROW maintenance. If WL2 is chosen, a new 16-in-diameter (41-cm-diameter) pipeline would be constructed between the OEPP facility and the polygen plant, a distance of 17 mi (27 km), following either the WL1 or WL5 alignment from the GCA Odessa South Facility to the polygen plant site.</i></p>
Transmission	
Plant requirements	<p>Between 187 and 270 MW would be used to operate the plant, compress CO₂, and produce urea fertilizer, depending on electricity and urea demand. Prior to operations, the TCEP would require power during construction and would connect to an ERCOT distribution line.</p>
Transportation	
Plant requirements	<p>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, H₂SO₄, urea, and slag.</p> <p>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, H₂SO₄, urea, and slag.</p>

Table S2-3. TCEP Resource Requirements

Type	Description
Linear facility requirements	<p>AR1: 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 0.3 mi (0.5 km). A maximum of 6.4 ac (2.6 ha) could be temporarily affected during construction, and 2.1 ac (0.8 ha) could be permanently affected by ROW maintenance.</p> <p>AR2: Access to the polygen plant site <i>using AR2</i> 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 3.8 mi (6.1 km). A maximum of 69.3 ac (28.0 ha) could be temporarily affected during construction, and 23.1 ac (9.3 ha) could be permanently affected by ROW maintenance.</p> <p>AR3: <i>Access to the polygen plant site using AR3 would be primarily from FM 866 (95 percent use expected). AR3 would be constructed from FM 866 along existing roads and rangeland to the northeast corner of the polygen plant site, totaling 5.0 mi (8.0 km). A maximum of 91.2 ac (146.8 ha) could be temporarily affected during construction, and 30.4 ac (48.9 ha) could be permanently affected by ROW maintenance.</i></p> <p>AR4: <i>Access to the polygen plant site using AR4 would be primarily from the I-20 frontage road (95 percent use expected). AR4 would be constructed from the I-20 frontage road along an existing, unnamed well access road to the northeast corner of the polygen plant site, totaling 2.8 mi (4.5 km). A maximum of 50.1 ac (80.6 ha) could be temporarily affected during construction, and 16.7 ac (6.8 ha) could be permanently affected by ROW maintenance.</i></p> <hr/> <p>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 H₂SO₄, 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.</p> <p>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 20.5 ac (8.3 ha) could be temporarily affected during construction, and 6.8 ac (2.8 ha) could be permanently affected by ROW maintenance.</p>

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 **2.8–3.5 mi (4.5–5.6 km)** south *to southeast* of the polygen plant site, **depending on which option is chosen**. Natural gas would not be stored on-site. H₂-rich syngas would be used on-site (as generated) with no on-site storage. Bulk quantities of liquid oxygen gas and N₂ 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 ₂ SO ₄ (<i>process</i> water treatment use)	54,062 (204,647)	815,176 (369,759)
H₂SO₄ Plant		
Hydrogen peroxide	9,725 (36,813)	89,700 (40,687)
Gasification		
Hydrochloric acid	13,981 (52,924)	131,637 (59,710)
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)

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])
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)
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, **gas** turbines, heat recovery steam generator, and associated equipment.

The TCEP would feature IGCC technology with comprehensive gas cleanup, including CO₂ capture that would allow the conversion of coal to a H₂-rich syngas. H₂-rich syngas would burn with substantially less air pollution as compared to other fuels. Because H₂ constitutes most of the fuel, much of the exhaust from the **gas** 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	385.00 (349.30)

Table S2-5. TCEP Permitted Air Pollutant Emissions

Type	Emissions (tn [t]/year)
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)
Other Air Pollutants	
NH ₃	363.00 (329.30)
H ₂ S	3.20 (2.90)
H ₂ SO ₄	14.60 (13.20)

Source: Summit (2010b).

Note: PM₁₀ = PM 0.00039 in (10 micrometers) in diameter and PM_{2.5} = PM 0.000098 in (2.5 micrometers) in diameter.

Primary **industrial** 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 **plant processes** would be treated and disposed of through **the residual industrial waste water disposal system. This system's disposal options include** a mechanical crystallizer **and filter press system or** solar evaporation ponds, **with an option to use deep well injection, depending on the quality of water.** 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 **residual industrial waste water disposal system.** Sanitary wastes would be collected and discharged directly to an on-site, underground septic disposal field.

The **mechanical crystallizer and filter press system** would result in a solid filter cake material, which would be transported off-site to appropriate facilities for disposal. Based on preliminary design information, Summit estimates that up to 23,360 tn (21,191 t) of clarifier sludge and solids (filter cake) would be generated by the **mechanical crystallizer and filter press** system annually. The filter cake is expected to be nonhazardous, but **it** 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:

- **January–March 2012:** Site mobilization and preparation
- **June 2012–July 2013:** Construction of main foundations
- **March 2013–October 2013:** 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

Summit expects the TCEP to be operational in **the fourth quarter of 2014.**

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 CO₂ 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	<u>Construction</u> During construction, Summit would implement the following practices: <ul style="list-style-type: none"> • 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
	<u>Operation</u> Summit would implement the following process modifications and improved work practices to mitigate emissions: <ul style="list-style-type: none"> • To reduce nitrogen oxides: Using diluent injection in the gas 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 gas 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 gas 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 H₂SO₄: Using clean syngas in the gas turbine

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

Resource	Mitigation Measure
	<ul style="list-style-type: none"> • To reduce PM: Implementing good combustion practices in the <i>gas</i> 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 CO₂: Capturing as CO₂ 90 percent of the carbon entering the plant with compression and pipeline transportation of the CO₂ for use in EOR; limiting use of the CO₂ bypass vent to 5 percent of the year • To reduce Hg: Using clean syngas in the <i>gas</i> turbine
Geology and Soils	<p><u>Construction</u></p> <p>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.</p> <p>Summit would stockpile and cover excavated topsoil until reuse, install wind and silt fences, and reseed disturbed areas.</p> <p><u>Operation</u></p> <p>Summit would continue to implement relevant parts of its approved SWPPP.</p> <p>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).</p>
Ground and Surface Water Resources	<p><u>Construction</u></p> <p>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.</p> <p>Summit would implement dust suppression and sedimentation control measures.</p> <p>For construction of linear facilities, Summit would apply for appropriate permits for all stream and water crossings and would implement required mitigation measures.</p> <p><u>Operation</u></p> <p>Summit would continue to implement relevant parts of its approved SWPPP.</p> <p>Summit would develop and implement effective measures, in accordance with an SPCC plan, to mitigate potential impacts caused by the release of petroleum products.</p> <p>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.</p>
Floodplains	<p><u>Construction</u></p> <p>Summit would develop and implement an approved SWPPP to minimize sedimentation and the filling of any downstream floodplains.</p> <p><u>Operation</u></p> <p>Summit would develop and implement an approved SWPPP to minimize sedimentation and the filling of any downstream floodplains.</p>

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

Resource	Mitigation Measure
Wetlands	<p data-bbox="396 352 521 378"><u>Construction</u></p> <p data-bbox="435 390 1341 445">Summit would develop and implement an approved SWPPP to minimize potential impacts on wetlands.</p> <p data-bbox="435 457 1406 655">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.</p> <p data-bbox="396 667 496 693"><u>Operation</u></p> <p data-bbox="435 705 1432 760">Summit would continue to implement relevant parts of its approved SWPPP to minimize potential impacts on wetlands.</p> <p data-bbox="435 772 1422 827">Summit would develop and implement effective measures, in accordance with a SPCC plan, to reduce the risk of contamination of wetlands.</p> <p data-bbox="435 840 1432 953">Summit would use a <i>mechanical crystallizer and filter press</i> system, <i>solar evaporation ponds</i>, or <i>deep well injection</i> for 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.</p>
Biological Resources	<p data-bbox="396 974 521 999"><u>Construction</u></p> <p data-bbox="435 1012 1432 1066">Summit would develop and implement an approved SWPPP that would minimize potential impacts on wildlife using downstream water resources, wetlands, and floodplains.</p> <p data-bbox="435 1079 1153 1104">Summit would use dust suppression and sedimentation control measures.</p> <p data-bbox="435 1117 1360 1171">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.</p> <p data-bbox="435 1184 1416 1348">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 protection of known habitats elsewhere that contain the resource to be affected) or more aggressive measures (e.g., complete avoidance of impact).</p> <p data-bbox="396 1360 496 1386"><u>Operation</u></p> <p data-bbox="435 1398 1409 1453">Summit would continue to implement relevant parts of its approved SWPPP to help minimize impacts to certain biological resources.</p> <p data-bbox="435 1465 1360 1520">Summit would develop and implement effective measures, in accordance with an SPCC plan, to mitigate potential impacts caused by the release of petroleum products.</p> <p data-bbox="435 1533 1357 1587">Summit would ensure evaporative ponds are covered with netting to prevent wildlife access, <i>if required by the State of Texas</i>.</p>
Aesthetics	<p data-bbox="396 1604 521 1629"><u>Construction</u></p> <p data-bbox="435 1642 1422 1667">Summit would develop and implement an SWPPP to reduce erosion and minimize landscape scarring.</p> <p data-bbox="435 1680 945 1705">Summit would employ dust-suppression techniques.</p> <p data-bbox="396 1717 496 1743"><u>Operation</u></p> <p data-bbox="435 1755 1416 1810">Summit would plan and install an outdoor lighting system that would minimize TCEP's nighttime, off-site illumination and glare.</p>

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

Resource	Mitigation Measure
Cultural Resources	<p data-bbox="396 352 521 373"><u>Construction</u></p> <p data-bbox="435 390 1419 499">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.</p> <p data-bbox="435 516 1419 596">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.</p>
Traffic and Transportation	<p data-bbox="396 621 521 642"><u>Construction</u></p> <p data-bbox="435 659 1403 739">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.</p> <p data-bbox="435 756 1403 835">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.</p> <p data-bbox="396 852 521 873"><u>Operation</u></p> <p data-bbox="435 890 1403 936">Summit would make road improvements, where necessary, to minimize traffic congestion and road hazards. Improvements may include adding lanes for turning and acceleration.</p>
Safety and Health	<p data-bbox="396 961 634 982"><u>Construction/Operation</u></p> <p data-bbox="435 999 1409 1050">Summit would comply with OSHA requirements as they apply to the project during construction and operations activities.</p>
Noise	<p data-bbox="396 1075 521 1096"><u>Construction</u></p> <p data-bbox="435 1113 1419 1163">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.</p> <p data-bbox="396 1180 500 1201"><u>Operation</u></p> <p data-bbox="435 1218 922 1239">Summit would equip silencers on the relief valves.</p> <p data-bbox="435 1255 1390 1306">Summit would perform a noise survey to ensure that operations are in compliance with applicable noise standards.</p> <p data-bbox="435 1323 1419 1398">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 <i>gas</i> turbine; and include silencers on plant vents and relief valves.</p>

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 proceeds 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 is canceled, the proposed technologies of the TCEP (demonstration of commercial-scale IGCC integrated with CO₂ capture and geologic storage of CO₂ 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, CO₂ 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 **and** November 2 and 3, 2010. **A fourth field investigation was conducted on April 19 and 20, 2011.** 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 CO₂, urea, and H₂SO₄. 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. **Tables S3-2-S3-5 provide a detailed comparison of each of the waterline, transmission line, access road, and natural gas pipeline options, respectively.**

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

Resource	Summit’s Proposed Project	No Action Alternative*
Air Quality	<p><u>Project Emissions during Construction</u></p> <p>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 (PM₁₀ and PM_{2.5}). Impacts resulting from dust emissions would be localized and short term.</p> <p><u>Project Emissions during Operations</u></p> <p>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:</p> <p style="padding-left: 40px;">NO₂: 225 tn (204 t) per year (2 percent increase over existing sources in Ector County)</p> <p style="padding-left: 40px;">CO: 1,173 tn (1,064 t) per year (4 percent increase over the same)</p> <p style="padding-left: 40px;">SO₂: 251.1 tn (228 t) per year (20 percent increase over the same)</p> <p style="padding-left: 40px;">PM₁₀: 380 tn (345 t) per year (6 percent increase over the same)</p> <p style="padding-left: 40px;">PM_{2.5}: 367 tn (333 t) per year (20 percent increase over the same)</p> <p style="padding-left: 40px;">H₂SO₄: 15 tn (14 t) per year</p> <p>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 NO₂, SO₂, CO, PM₁₀, 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).</p> <p>Incremental contributions to 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 PM₁₀ to 200 percent for NO₂ at the points of maximum impact.</p> <p>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.</p> <p>Hg: TCEP operations would produce approximately 0.02 tn (0.018 t) of Hg emissions per year.</p> <p>GHGs: Annual noncaptured CO₂ emissions from TCEP operations would be approximately 300,000 tn (272,155 t) per year.</p> <p>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.</p> <p><u>Local Plume Visibility, Shadowing, Fogging, and Water Deposition</u></p> <p>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</p>	<p>Rural land uses, including residential development, grazing, dispersed recreation, and light commercial and industrial development, would continue in the air quality 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.</p>

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

Resource	Summit's Proposed Project	No Action Alternative*
	<p>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 stack emissions.</p> <p><u>Odor</u></p> <p>Two odorous compounds that are regulated by the TCEQ would be emitted from the TCEP in small quantities: H₂S and NH₃. The wind may carry small volumes and may create a nuisance for residents within 1.0 mi (1.6 km) of the polygen plant.</p>	
Climate	<p><u>Severe Weather</u></p> <p>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 occurs 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.</p> <p>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 PM₁₀ and PM_{2.5}.</p> <p>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.</p> <p>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. Among the waste disposal options, solar evaporation ponds could cause ground-level fogging under certain weather conditions.</p>	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 tornados.
Soils, Geology, and Mineral Resources	<p><u>Soils</u></p> <p>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</p>	Soil and geological resources would remain unchanged, mineral

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

Resource	Summit’s Proposed Project	No Action Alternative*
	<p>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.</p> <p>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. Among the waste disposal options, there would be a potential for local soil contamination at the solar evaporation pond sites if the pond liner were to leak.</p> <p><u>Geology</u></p> <p>Polygen plant site: No impacts to or from geologic features would occur.</p> <p>Linear facilities: No impacts to or from geologic features would occur.</p> <p>Technology options: Of the waste 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.</p> <p>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.</p> <p><u>Mineral Resources</u></p> <p>Polygen plant site: No impacts to or from mineral resources would occur.</p> <p>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.</p> <p>Technology options: Of the waste 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.</p> <p>EOR sequestration site (or sites): CO₂ from the TCEP would be used by the ongoing EOR industry in the Permian Basin. This use of CO₂ is a well-developed and documented industrial process that would serve as final sequestration for the captured CO₂ 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 CO₂ from the TCEP. Concentrations and pH of dissolved mineral matter could change and potentially hinder access as a result of injected CO₂; however, negligible impacts would occur if suitable drilling practices, well casing materials, and well casing cements are used on wells that penetrate through the CO₂ floods to reach deep petroleum resources.</p>	<p>development would continue, and EOR would continue throughout the Permian Basin using natural sources of CO₂.</p>
Ground Water Resources	<p><u>Ground Water Quantity</u></p> <p>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</p>	<p>Existing activities, such as oil and gas production and land development, would continue in the region with a continuation of the</p>

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

Resource	Summit’s Proposed Project	No Action Alternative*
	<p>the region and would represent a small fraction (0.7 percent) of the total water demand in the region (based on the <i>2011 State Water Plan: Summary of Region F</i> [TWDB 2010c]). The city of Midland WWTP’s land application of waste water, as a means of waste disposal, may be reduced or terminated altogether if WL1 or WL5 are chosen.</p> <p>Linear facilities: Minor impacts to ground water quantity could occur as a result of impervious areas associated with access roads.</p> <p>Technology options: Among the cooling tower options, wet cooling towers would have a higher water demand than dry cooling towers. Of the waste disposal options, the mechanical crystallizer and filter press option may minimize the plant’s demand for water.</p> <p><u>Ground Water Quality</u></p> <p>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 RRC and TCEQ standards.</p> <p>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.</p> <p>Technology options: <i>One of the waste disposal options, mechanical crystallizer and filter press system, presents a small possibility that salt from the concentrated solids, which would be transported to landfills, could eventually leach into the ground water.</i> Furthermore, there would be a potential for local, shallow ground water contamination at the solar evaporation pond sites should a liner leak. Deep well injection would have a remote possibility for injected brine to displace native fluids to shallow aquifers or for injected brine to migrate into shallow aquifers.</p> <p>Sequestration sites: There would be a risk for potential ground water quality impacts associated with 1) the limited potential for upward migration of CO₂, 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.</p>	<p>existing trend of impacts. EOR activities would continue on a regional scale, with CO₂ for EOR from natural geological sources rather than from industrial sources.</p>
<p>Surface Water Resources</p>	<p><u>Wetlands, Waterways, Water Bodies, and Surface Water Quality</u></p> <p>Polygen plant site: No surface water resources are present at the proposed polygen plant site, and therefore, no impacts to surface waters would occur.</p> <p>Linear facilities: Five water bodies are present within the proposed WL1, WL3, and WL5 corridors, with a combined area of 4.68 ac (1.89 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 from most of the linear facilities. If WL1 or WL5 is chosen, the resulting increase in effluent discharge from the GCA outfall 1) would not contribute significantly to anticipated future flooding events in downstream low-lying areas, and 2) would have a minor contribution to the already existing salt loading occurring in Monahans Draw.</p>	<p>Oil and gas exploration, land development, ranching, and other existing activities and uses would continue to affect surface water resources in the ROI.</p>

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

Resource	Summit's Proposed Project	No Action Alternative*
	<p>Technology options: <i>One of the waste disposal options (mechanical crystallizer and filter press system) presents a remote possibility that salt from the concentrated solids, which would be transported to landfills, could eventually leach into the ground water.</i></p> <p>Flooding Impacts: <i>The average 0.75-million-gal (2.8-million-L) increase in discharge to Monahans Draw would represent a 27 percent increase over the current average discharge from the GCA outfall and would have negligible impacts to the conditions along Monahans Draw during dry periods. Neither the average per day increase in GCA's effluent discharge, nor the infrequent (if ever) full release would represent a significant impact to flood flow volume, flood elevations, or flooding frequency in the low-elevation downstream areas of Monahans Draw, because they would contribute 0.04 and 0.3 percent of the total flood flow during a two-year natural storm event, respectively.</i></p> <p>Salt Loading Impacts: <i>Although there would not be an increased concentration of total dissolved solids as a result of the increase in effluent being discharged from the GCA outfall, there would be a minor contribution to the existing salt loading in the draw because the increase in the quantity of effluent would allow for additional salt loading in Monahans Draw after evapotranspiration occurs.</i></p> <p><u>Floodplains</u></p> <p>Impacts to floodplains <i>from linear facilities</i> would be minor and temporary.</p>	
Biological Resources	<p>Polygen plant site: Construction and operations could result in the permanent loss of up to a maximum of 600 ac (243 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.</p> <p>Linear facilities: Construction of the linear facilities would result in the permanent removal of 132–1,032 ac (53–418 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 246–949 ac (100–384 ha) of habitat could be temporarily removed or disturbed during construction. Impacts to terrestrial species would be similar to those described above.</p> <p><u>Aquatic Species</u></p> <p>Polygen plant site: No impacts to aquatic species from construction or operation of the polygen plant site would occur.</p> <p>Linear facilities: Impacts to aquatic species from construction of WL1, WL3, and WL5 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.</p> <p><u>Migratory Birds</u></p> <p>Polygen plant site: a maximum of 600 ac (243 ha) of suitable habitat for scrubland-nesting migratory birds and their nesting sites would be permanently removed. Introduced species (European starlings and house sparrows) 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</p>	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 TCEP and the No Action Alternative

Resource	Summit’s Proposed Project	No Action Alternative*
	<p>those described for terrestrial species.</p> <p>Linear facilities: Habitat loss could occur from the construction and operation of some of the linear facility options. Disturbance from construction and operation 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.</p> <p>Technology options: <i>Among the waste</i> disposal options, solar evaporation ponds could affect waterfowl 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.</p> <p><u>Bats</u></p> <p>Bat mortalities due to collision with man-made structures associated with the TCEP could occur during operation.</p> <p><u>Rare, Threatened, and Endangered Species</u></p> <p>Polygen plant site: Construction and operation of the polygen plant would result in the loss of 600 ac (243 ha) of Texas horned lizard (<i>Phrynosoma cornutum</i>) (state listed, threatened) habitat as well as suitable habitat for 11 state-listed rare species.</p> <p>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.</p>	
<p>Aesthetics</p>	<p><u>Polygen Plant Site</u></p> <p>Daylight conditions: The impacts to KOPs 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.</p> <p>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.</p> <p>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.</p>	<p>No impacts to aesthetics beyond existing trends (which have stagnated since the 1960s and 1970s when Penwell became largely abandoned) and conditions would occur.</p>

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

Resource	Summit’s Proposed Project	No Action Alternative*
	<p><u>Linear Facilities</u></p> <p>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 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.</p> <p>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.</p> <p>Technology options: <i>Among the waste</i> 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.</p>	
Cultural Resources	<p><u>Polygen Plant Site</u></p> <p>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 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.</p> <p><u>Linear Facilities</u></p> <p>There is one previously recorded archaeological site in the WL1 ROW and one in the WL5 ROW. No evidence of <i>either</i> 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.</p> <p><u>Native American Resources</u></p> <p>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.</p>	<p>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.</p>
Land Use	<p><u>Polygen Plant Site</u></p> <p>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 stacks.</p> <p><u>Linear Facilities</u></p> <p>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,</p>	<p>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</p>

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

Resource	Summit's Proposed Project	No Action Alternative*
	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 be put back to use after construction completion. Construction of NG1, WL1, or WL5 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.	undeveloped, and no new land uses would be imposed on the landscape.
Socioeconomics	<p><u>Demographics</u></p> <p>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.</p> <p><u>Housing</u></p> <p>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.</p> <p><u>Economics</u></p> <p>During most of the construction, GDP in the ROI would increase 0.5 percent; during the final year of construction, it would increase 0.7 percent. During operations, GDP 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.</p>	Existing socioeconomic trends, including population growth and increase in residential, commercial, and industrial development would continue as they are.
Environmental Justice	<p><u>Construction Activities</u></p> <p>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.</p> <p><u>Operations Activities</u></p> <p>Operations activities would have neither disproportionately high nor adverse effects on minority or low-income communities.</p>	There would be no disproportionately high or adverse effects on minority or low-income communities in the ROI.
Community Services	<p><u>Law Enforcement, Emergency Response Services, and Health Services</u></p> <p>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.</p> <p><u>Schools</u></p> <p>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.</p> <p><u>Recreation</u></p> <p>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.</p>	There would be no impacts to community services in the ROI.

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

Resource	Summit’s Proposed Project	No Action Alternative*
<p>Utility Systems</p>	<p><u>Polygen Plant Site</u> Existing utilities would not be adversely impacted by construction or operation activities at the polygen plant site.</p> <p><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.</p> <p>Operations activities: <i>TL1–TL6:</i> There is a potential for system upgrades associated with the interconnection to either the ERCOT or Southwestern Power Pool grid.</p> <p><i>WL1 and WL5:</i> WL1 or WL5 could impact the <i>city</i> of Midland WWTP. Either option would divert all or some portion of the water currently being used to irrigate city-owned cropland near the city of Midland WWTP. Current agricultural activities would be reduced by the amount of Midland’s waste water diverted under the WL1 option.</p> <p><i>WL2 and WL3:</i> No impacts to water treatment utility systems would occur as a result of WL2 or WL3.</p> <p><i>WL4:</i> The GCA Odessa South Facility would make use of more of its full treatment capacity with the use of WL4 as a backup water supply option.</p> <p>WL6 and other backup water supply options: No impacts to water treatment utility systems would occur because backup water would only be provided if it is available.</p> <p>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. Out of the options for waste disposal, the mechanical crystallizer and filter press system may require the greatest parasitic electricity demand, depending on the choice of equipment. Alternatively, the solar evaporation ponds would require the least parasitic electricity demand.</p>	<p>There would be no impacts to utility systems beyond existing trends, which generally include an increase in electricity, CO₂, and water demand.</p>
<p>Transportation</p>	<p><u>Roadways</u> Construction activities: AADT would increase in four primary locations (listed below). Increases would vary depending on the construction year.</p> <p><i>I-20 at Penwell (AR1):</i> 15,580 current AADT; would increase to 15,660, 15,685, and 15,730 projected AADT (1 percent increase) in construction years one, two, and three, respectively.</p> <p><i>I-20, east of FM 866 exit (AR2–AR4):</i> 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 one, two, and three, respectively.</p> <p>FM 1601 (AR1): 20 current AADT; would increase to 50, 125, and 170 projected AADT (150 percent, 525 percent, and 750 percent) in construction years one, two, and three, respectively.</p> <p><i>FM 866 (AR2 and AR3):</i> 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 one, two, and three, respectively.</p>	<p>There would be no additional roadway traffic imposed on the federal or TxDOT road system, or railroad traffic on the UPRR rail system.</p>

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

Resource	Summit’s Proposed Project	No Action Alternative*
	<p>Existing, unnamed well access road (AR4): 90 current AADT; would increase to 710, 2,125, and 2,990 projected AADT (690 percent, 2,260 percent, and 3,220 percent) in construction years one, two, and three, respectively.</p> <p>Delays associated with merging traffic and increased percent of time spent following slow vehicles would affect LOS of each road. Construction of an access road (either AR2 or AR3) between the polygen plant site and FM 866 would result in temporary, localized traffic delays. Construction of an access road from the I-20 frontage road (AR4) would result in temporary, localized, and significant delays. Use of FM 1601 (AR1) for emergency and secondary access to the polygen plant site would require construction of a TxDOT-supported, below-rail underpass for crossing the UPRR rail line. Construction activities would result in temporary localized traffic delays.</p> <p>Operations activities: AADT would increase in four primary locations during operations (listed below).</p> <p>I-20 at Penwell (AR1): 15,580 current AADT; would increase to 15,595 projected AADT (<1 percent increase).</p> <p>I-20, east of FM 866 exit (AR2–AR4): 16,700 current AADT; would increase to 17,400 projected AADT (2 percent increase).</p> <p>FM 1601 (AR1): 20 current AADT; would increase to 35 projected AADT (75 percent increase).</p> <p>FM 866 (AR2, AR3): 1,500 current AADT; would increase to 1,835 projected AADT (22 percent increase).</p> <p>Existing, unnamed well access road (AR4): 90 current AADT; would increase to 417 projected AADT (363 percent increase).</p> <p>LOS changes:</p> <p>I-20: No changes are forecast for LOS as a result of the TCEP.</p> <p>FM 1601: FM 1601 would remain at an acceptable LOS (A–C) during construction and operations.</p> <p>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.</p> <p>Existing, unnamed well access road: No identified LOS for either the unnamed well access road or the I-20 frontage road that it connects to.</p> <p>Impacts from linear facilities: Construction of the waterline, natural gas, CO₂, and transmission lines would cause temporary and localized congestion at road crossings; impacts would be minor.</p> <p><u>Railways</u></p> <p>Increases in rail traffic would occur due to transportation of supplies and products in and out of the polygen plant site.</p> <p>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.</p> <p>Operations activities: During operations, there would be an average of four additional 150-car-unit trains per week along the UPRR line, a 3 percent increase over the existing rail traffic. Under the peak urea production option, there would be an average of approximately six 150-car unit trains per week along the UPRR</p>	

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

Resource	Summit’s Proposed Project	No Action Alternative*
	<p><i>line, a five percent increase in rail traffic. Neither option</i> would 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.</p>	
<p>Materials and Waste Management</p>	<p><u>Materials Management</u></p> <p>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.</p> <p>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 storage of operations materials would be in place before operation of the project.</p> <p><u>Waste Management</u></p> <p>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.</p> <p>Technology options: One waste disposal option, the mechanical crystallizer and filter press system, presents a small possibility that salt from the concentrated solids, which would be transported to landfills, could eventually leach into the ground water. Of the cooling tower options, wet cooling tower operations would have a greater demand for biocides in the cooling water.</p>	<p>There would be no change to the amounts of materials and wastes currently generated, stored, or transported on or near the project area.</p>
<p>Human Health, Safety, and Accidents</p>	<p><u>Occupational Health and Safety</u></p> <p>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.</p> <p>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.</p> <p><u>Transportation Safety</u></p> <p>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 2010a). During the 30-year operations period, approximately 0.61 fatality could occur as a result of worker travel during operations.</p> <p>Railroads: Risk of a hazardous materials spill during rail transport of TCEP products would be low. <i>If selected</i>, construction of an at-grade rail crossing at the polygen plant site would result in an increased risk to those accessing the TCEP from FM 1601; <i>however, TxDOT has begun to develop plans for a below-grade rail crossing.</i> Each additional train added to the UPRR system could delay emergency vehicles attempting an at-grade rail crossing by approximately three to five minutes.</p>	<p>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.</p>

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

Resource	Summit’s Proposed Project	No Action Alternative*
	<p><u>CO₂ and Natural Gas Pipeline Safety</u></p> <p>The project would require the installation of a new natural gas pipeline ranging from 2.8 to 3.5 mi (4.5–5.6 km) in length and 1.0 mi (1.6 km) of CO₂ pipeline. The probability of an accidental release associated with these lengths of new pipeline would be negligible (less than one chance in 10 million of a fatality per year).</p> <p><u>Exposure to Contaminated Sites</u></p> <p>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.</p> <p><u>Risk Analyses</u></p> <p>Polygen plant site: Toxic hazards would be dominated by the potential releases of NH₃ gas from the pipeline leading from the NH₃ synthesis unit to the urea synthesis plant, or through NH₃ production or storage processes. Risks would be greatest to those workers closest to the NH₃ 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.</p> <p>TCEP CO₂ 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:</p> <ul style="list-style-type: none"> • Ruptures in the pipeline transporting CO₂ and H₂S from the plant to the sequestration site (considered unlikely) • Punctures in the CO₂ pipeline (considered unlikely to likely depending on the site) • Wellhead failures at the injection well (considered extremely unlikely) • Slow upward leakage of CO₂ from the injection well (considered extremely unlikely) • Slow upward leakage of CO₂ from other existing wells (considered extremely unlikely to unlikely) <p>Site-specific risk for oil fields that purchase and use TCEP’s CO₂ cannot be estimated until after the specific fields are identified. However, for those operators that currently implement CO₂ injection, the CO₂ is a valuable resource that is monitored and recycled back into the oil-bearing formation to minimize future purchases of the gas.</p> <p>The numbers of residents or sensitive receptors that could be exposed to CO₂ 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 CO₂ would be unlikely to pose a risk because assumed exposures to CO₂ from EOR activities do not exceed either the acute (for short-term) or chronic (for long-term) toxicity criteria.</p>	

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

Resource	Summit's Proposed Project	No Action Alternative*
Noise and Vibration	<p><u>Construction Activities</u></p> <p>Stationary source analysis:</p> <p><i>Polygen plant site:</i> 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 (FTA) levels for residential areas (series of short blasts over a two-week period), FTA commercial and industrial-area construction threshold levels would be met.</p> <p><i>Linear facilities:</i> The construction of WL3, TL5, TL6, NG1–NG3, 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.</p> <p>Mobile source analysis: Use of I-20 and FM 866 (AR2 and AR3) 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 (AR1) for the two noise-sensitive receptors located north of I-20 in Penwell. The increase in noise along these access roads (AR1–AR3) would meet FTA noise threshold levels. A significant increase (15.2 dBA) along the unnamed well access road proposed for AR4 would exceed FTA noise threshold levels, but AR4 is in an industrial use area only (road leads to limestone quarry) and would be temporary.</p> <p><u>Operations Activities</u></p> <p>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.</p> <p>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. An increase in noise activity on the unnamed well access road proposed for AR4 (a 6.7-dBA increase) would occur, but this increase would not exceed FTA noise threshold levels. 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.</p>	There would be no additional noise impacts beyond the existing trends of noise from traffic and oil and gas development.

Note: PM₁₀ = 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 on the type of development pursued.

Table S3-2. Summary Comparison of Impacts from Summit’s Proposed Waterline Options for the TCEP

Resource		WL1	WL2	WL3	WL4	WL5	WL6
Linear Footprint	Length (mi [km])	41.3 (66.4)	9.3 (15.0)	14.2 (22.8)	2.6 (4.2)	45.9 (73.9)	3.0 (4.8)
	Temporary Disturbance (ac [ha])	539.1 (218.2)	169.1 (68.4)	257.7 (104.3)	48.4 (19.6)	834.1 (337.5)	54.8 (22.2)
	Permanent Impact (ac [ha])	179.6 (72.7)	56.3 (22.8)	85.9 (34.7)	16.0 (6.5)	278.1 (112.5)	18.2 (7.4)
Air Quality and GHG Emissions		Direct impacts from vehicle exhaust and dust-generating activities would occur during construction of the process waterline(s).					
Climate		No climate impacts to or from construction or operation of the process waterline(s) would occur.					
Soils, Geology, and Mineral Resources		<p><u>Soils</u>: Temporary impacts such as soil disturbance would occur during construction of the process waterline(s). See linear footprint areas listed above.</p> <p><u>Geology</u>: No impacts to geologic resources or from events such as earthquakes, landslides, or subsidence would occur during construction or operation phases.</p> <p><u>Mineral Resources</u>: Minor obstructions to mineral resource access along the process waterline alignment(s) could occur during construction and operation phases.</p>					
Ground Water Resources		No impacts to ground water quantity or quality would occur as a result of construction or operation of the process waterline linear facilities.					
Surface Water Resources	Temporary Impacts (ac [ha])	1.71 (0.69)	0	0.56 (0.23)	0	0.81 (0.33)	0
		Temporary, short-term impacts during construction activities would be as follows: increased turbidity, sedimentation, streambed disturbance, and streambank vegetation removal.					
Surface Water Resources	Permanent Impacts (ac [ha])	0.82 (0.33)	0	0.30 (0.12)	0	0.48 (0.19)	0
		Either traditional open-cut trenching methods or horizontal directional drilling would be used during construction to minimize impacts.	n/a	Ephemeral playa is isolated and nonjurisdictional and would not require a permit.	n/a	Either traditional open-cut trenching methods or horizontal directional drilling would be used during construction to minimize impacts.	n/a

Table S3-2. Summary Comparison of Impacts from Summit’s Proposed Waterline Options for the TCEP

Resource		WL1	WL2	WL3	WL4	WL5	WL6	
		<i>Increase in effluent discharge from the GCA would 1) not contribute significantly to anticipated future flooding events in downstream low-lying areas, and 2) have a minor contribution to the existing salt loading occurring in Monahans Draw.</i>				<i>Increase in effluent discharge from the GCA would 1) not contribute significantly to anticipated future flooding events in downstream low-lying areas, and 2) have a minor contribution to the existing salt loading occurring in Monahans Draw.</i>		
<i>Biological Resources (habitat impacts [ac (ha)])</i>	<u>Terrestrial Species</u>	<i>Temporary Impacts</i>	539.1 (218.2)	169.1 (68.4)	257.7 (104.3)	48.4 (19.6)	834.1 (337.5)	54.8 (22.2)
		<i>Permanent Impacts</i>	179.6 (72.7)	56.3 (22.8)	85.9 (34.7)	16.0 (6.5)	278.1 (112.5)	18.2 (7.4)
	<u>Aquatic Species</u>	<i>Temporary Impacts</i>	1.71 (0.69)	0	0.56 (0.23)	0	0.81 (0.33)	0
		<i>Permanent Impacts</i>	0.82 (0.33)	0	0.30 (0.12)	0	0.48 (0.19)	0
	<u>Migratory Birds*</u>	<i>Temporary Impacts</i>	539.1 (218.2)	169.1 (68.4)	257.7 (104.3)	48.4 (19.6)	834.1 (337.5)	54.8 (22.2)
		<i>Permanent Impacts</i>	179.6 (72.7)	56.3 (22.8)	85.9 (34.7)	16.0 (6.5)	278.1 (112.5)	18.2 (7.4)

Table S3-2. Summary Comparison of Impacts from Summit’s Proposed Waterline Options for the TCEP

Resource		WL1	WL2	WL3	WL4	WL5	WL6
<u>State-listed Species (Texas horned lizard) *</u>	Temporary Impacts	539.1 (218.2)	169.1 (68.4)	257.7 (104.3)	48.4 (19.6)	834.1 (337.5)	54.8 (22.2)
	Permanent Impacts	179.6 (72.7)	56.3 (22.8)	85.9 (34.7)	16.0 (6.5)	278.1 (112.5)	18.2 (7.4)
Aesthetics		<i>Minor, short-term, temporary, adverse impacts during construction activities would occur due to visibility of construction equipment.</i>					
Cultural Resources		<i>No known cultural resources are within the linear facility corridor; four ineligible archaeological sites were identified.</i>	<i>No known cultural resources are within these linear facility corridors.</i>		<i>No known cultural resources are within the linear facility corridor; one ineligible archaeological site was identified.</i>	<i>No known cultural resources are within this linear facility corridor.</i>	
Land Use	ROW Area (ac [ha]) Requirements	179.6 (72.7)	56.3 (22.8)	85.9 (34.7)	16.0 (6.5)	278.1 (112.5)	18.2 (7.4)
	Land Use Impacts	<i>Permits and ROW would be required in zoning districts. Temporary impact to 2.4 ac (1.0 ha) of prime farmland would occur, which could be put back to use after construction.</i>	n/a	<i>Temporary impacts would occur to Penwell Knights Raceway Park access during construction.</i>	<i>Land use zoning permit would be required.</i>	n/a	<i>Land use zoning permit would be required.</i>
Socioeconomics		<i>No socioeconomic impacts would occur as a result of the construction or operation of the process waterline(s).</i>					
Environmental Justice		<i>No disproportionately high and adverse impacts to low-income or minority populations would occur as a result of the construction or operation of the process waterline(s).</i>					

Table S3-2. Summary Comparison of Impacts from Summit’s Proposed Waterline Options for the TCEP

Resource		WL1	WL2	WL3	WL4	WL5	WL6
Community Services		<i>No impacts to community services would occur as a result of the construction or operation of the process waterline(s).</i>					
Utility Systems	Number of Known Pipeline ROW crossings	40	11	13	2	57	6
	Number of Transportation ROW crossings	9	9	2	2	14	2
	Utility Impacts	<i>Potential impacts to city of Midland WWTP agricultural activities would occur due to diversion to GCA Odessa South Facility for TCEP.</i>	<i>No impacts to water treatment utility systems would occur.</i>		<i>There would be a potential for GCA Odessa South Facility to make better use of its capacity.</i>	<i>Potential impacts to city of Midland WWTP agricultural activities would occur due to diversion to GCA Odessa South Facility for TCEP.</i>	<i>No impacts to water treatment utility systems would occur.</i>
Transportation		<i>Construction of the process waterline(s) would cause minor, temporary, and localized congestion at road crossings.</i>					
Materials and Waste Management		<p><i>No impacts would occur to supply/demand of materials to construct the process waterline(s).</i></p> <p><i>Minor impacts to waste collection services and regional disposal capacity would occur during construction of the process waterline(s).</i></p> <p><i>Negligible impacts to waste collection services and regional disposal capacity would occur during operations of the process waterline(s).</i></p>					
Human Health, Safety, and Accidents		<p><u>Occupational Health and Safety:</u> <i>Risks and hazards associated with construction of process waterline(s) would be addressed through a worker protection program currently under development by Summit for the TCEP.</i></p> <p><u>Transportation Safety:</u> <i>No specific impacts would occur as a result of the construction or operation of the process waterline linear facilities.</i></p> <p><u>Exposure to Contaminated Sites:</u> <i>Risk during construction of the process waterline(s) 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.</i></p>					

Table S3-2. Summary Comparison of Impacts from Summit’s Proposed Waterline Options for the TCEP

Resource	WL1	WL2	WL3	WL4	WL5	WL6
Noise and Vibration	<i>n/a</i>	<i>n/a</i>	<i>Temporary, adverse impacts to sensitive noise receptors would occur during construction.</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>

**Impacts to migratory bird and state-listed species habitats are generalized as the same footprint of impacts to terrestrial species habitat. These areas do not represent a duplication of the area, but rather, an identical impact as the terrestrial species’ area of impacts.*

Table S3-3. Summary Comparison of Impacts from Summit’s Proposed Transmission Line Options for the TCEP

Resource		TL1	TL2	TL3	TL4	TL5	TL6	
Linear Footprint	Length (mi [km])	9.3 (14.9)	8.7 (13.9)	2.2 (3.6)	0.6 (1.0)	36.8 (59.3)	32.8 (52.9)	
	Temporary Disturbance (ac [ha])	224.6 (90.9)	209.9 (84.9)	54.3 (22.0)	15.2 (6.2)	893.1 (361.4)	796.3 (322.3)	
	Permanent Impact (ac [ha])	168.5 (68.2)	157.5 (63.7)	40.7 (16.5)	11.4 (4.6)	669.8 (271.1)	597.3 (241.7)	
Air Quality and GHG Emissions		Direct impacts from vehicle exhaust and dust-generating activities would occur during construction of the transmission line.						
Climate		No climate impacts to or from construction or operation of transmission line would occur.						
Soils, Geology, and Mineral Resources		<p><u>Soils</u>: Temporary impacts such as soil disturbance would occur during construction of the transmission line. See linear footprint areas listed above.</p> <p><u>Geology</u>: No impacts to geologic resources or from events such as earthquakes, landslides, or subsidence would occur during construction or operation phases.</p> <p><u>Mineral Resources</u>: No obstructions to mineral resource access would occur during construction and operation phases along the transmission line.</p>						
Ground Water Resources		No impacts to ground water quantity or quality would occur as a result of construction or operation of the transmission line.						
Surface Water Resources		No impacts to surface waters would occur from the construction or operation of the transmission line.						
Biological Resources (habitat impacts [ac (ha)])	<u>Terrestrial Species</u>	Temporary Impacts	224.6 (90.9)	209.9 (84.9)	54.3 (22.0)	15.2 (6.2)	893.1 (361.4)	796.3 (322.3)
		Permanent Impacts	168.5 (68.2)	157.5 (63.7)	40.7 (16.5)	11.4 (4.6)	669.8 (271.1)	597.3 (241.7)
	<u>Aquatic Species</u>	Temporary Impacts	0	0	0	0	0	0
		Permanent Impacts	0	0	0	0	0	0
	<u>Migratory Birds*</u>	Temporary Impacts	224.6 (90.9)	209.9 (84.9)	54.3 (22.0)	15.2 (6.2)	893.1 (361.4)	796.3 (322.3)
		Permanent Impacts	168.5 (68.2)	157.5 (63.7)	40.7 (16.5)	11.4 (4.6)	669.8 (271.1)	597.3 (241.7)

Table S3-3. Summary Comparison of Impacts from Summit’s Proposed Transmission Line Options for the TCEP

Resource		TL1	TL2	TL3	TL4	TL5	TL6
	Permanent Impacts	168.5 (68.2)	157.5 (63.7)	40.7 (16.5)	11.4 (4.6)	669.8 (271.1)	597.3 (241.7)
	<u>State-listed Species (Texas horned lizard) *</u> Temporary Impacts	224.6 (90.9)	209.9 (84.9)	54.3 (22.0)	15.2 (6.2)	893.1 (361.4)	796.3 (322.3)
	<u>State-listed Species (Texas horned lizard) *</u> Permanent Impacts	168.5 (68.2)	157.5 (63.7)	40.7 (16.5)	11.4 (4.6)	669.8 (271.1)	597.3 (241.7)
Aesthetics		<i>Minor, permanent adverse impacts from the construction and operation of the transmission line would occur due to new vertical form contrasts on the landscape.</i>					
Cultural Resources		<i>No known cultural resources are within these linear facility corridors.</i>					
Land Use	ROW Area (ac [ha]) Requirements	168.5 (68.2)	157.5 (63.7)	40.7 (16.5)	11.4 (4.6)	669.8 (271.1)	597.3 (241.7)
Socioeconomics		<i>No socioeconomic impacts would occur as a result of construction or operation of the transmission line.</i>					
Environmental Justice		<i>No disproportionately high and adverse impacts to low-income or minority populations would occur as a result of the construction or operation of the transmission line.</i>					
Community Services		<i>No impacts to community services would occur as a result of the construction or operation of the transmission line.</i>					
Utility Systems	Number of Known Pipeline ROW Crossings	15	13	4	2	44	41
	Number of Transportation ROW Crossings	3	3	0	0	12	14
	Utility Impacts	<i>There would be a potential for system upgrades associated with interconnections.</i>			<i>Oncor identified upgrades: constructing a switching station, rebuilding existing 138-kV transmission line, and various other improvements</i>		<i>There would be a potential for system upgrades associated with interconnections.</i>

Table S3-3. Summary Comparison of Impacts from Summit’s Proposed Transmission Line Options for the TCEP

Resource	TL1	TL2	TL3	TL4	TL5	TL6
Transportation	<i>Construction of the transmission line would cause minor, temporary, and localized congestion where it crosses roads.</i>					
Materials and Waste Management	<p><i>No impacts would occur to supply/demand of materials to construct the transmission line.</i></p> <p><i>Minor impacts would occur to waste collection services and regional disposal capacity during construction of the transmission line.</i></p> <p><i>Negligible impacts would occur to waste collection services and regional disposal capacity during operations of the transmission line.</i></p>					
Human Health, Safety, and Accidents	<p><u>Occupational Health and Safety:</u> <i>Risks and hazards associated with construction of the transmission line would be addressed through a worker protection program currently under development by Summit for the TCEP.</i></p> <p><u>Transportation Safety:</u> <i>No specific impacts would occur as a result of the construction or operation of the transmission linear facilities.</i></p> <p><u>Exposure to Contaminated Sites:</u> <i>Risk 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.</i></p> <p><u>Electromagnetic Fields:</u> <i>Any exposure-related health risk to an individual from electromagnetic field of transmission line would likely be small.</i></p>					
Noise and Vibration	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>Temporary, adverse impacts would occur to sensitive noise receptors.</i>	

**Impacts to migratory bird and state-listed species habitats are generalized as the same footprint of impacts to terrestrial species habitat. These areas do not represent a duplication of the area, but rather, an identical impact as the terrestrial species’ area of impacts.*

Table S3-4. Summary Comparison of Impacts from Summit's Proposed Access Road Options for the TCEP

Resource			AR1	AR2	AR3	AR4
Linear Footprint	Length (mi [km])		0.3 (0.5)	3.8 (6.1)	5.0 (8.1)	2.8 (4.5)
	Temporary Disturbance (ac [ha])		5.5 (2.2)	69.3 (28.0)	91.2 (36.9)	50.1 (20.3)
	Permanent Impact (ac [ha])		1.8 (0.7)	23.1 (9.3)	30.4 (12.3)	16.7 (6.7)
Air Quality and GHG Emissions		Direct impacts from vehicle exhaust and dust-generating activities would occur during construction of the access roads.				
Climate		No climate impacts to or from construction or operation of the access roads would occur.				
Soils, Geology, and Mineral Resources		<p><u>Soils</u>: Temporary impacts such as soil disturbance would occur during construction of the access roads. See linear footprint areas listed above.</p> <p><u>Geology</u>: No impacts to geologic resources or from events such as earthquakes, landslides, or subsidence would occur during construction or operation phases.</p> <p><u>Mineral Resources</u>: Minor obstructions to mineral resource access along access roads could occur during construction and operation phases.</p>				
Ground Water Resources		<p>Minor, permanent impacts would occur to ground water quantity from development of new impervious surface in aquifer recharge area. See footprint areas listed above.</p> <p>No impacts to ground water quality would occur as a result of access road development.</p>				
Surface Water Resources		No impacts to surface waters would occur from the construction or operation of the access roads.				
Biological Resources (habitat impacts [ac (ha)])	<u>Terrestrial Species</u>	Temporary Impacts	5.5 (2.2)	69.3 (28.0)	91.2 (36.9)	50.1 (20.3)
		Permanent Impacts	1.8 (0.7)	23.1 (9.3)	30.4 (12.3)	16.7 (6.7)
	<u>Aquatic Species</u>	Temporary Impacts	0	0	0	0
		Permanent Impacts	0	0	0	0
	<u>Migratory Birds*</u>	Temporary Impacts	5.5 (2.2)	69.3 (28.0)	91.2 (36.9)	50.1 (20.3)
		Permanent Impacts	1.8 (0.7)	23.1 (9.3)	30.4 (12.3)	16.7 (6.7)

Table S3-4. Summary Comparison of Impacts from Summit’s Proposed Access Road Options for the TCEP

Resource		AR1	AR2	AR3	AR4	
	<u>State-listed Species (Texas horned lizard)</u> *	Temporary Impacts	5.5 (2.2)	69.3 (28.0)	91.2 (36.9)	50.1 (20.3)
		Permanent Impacts	1.8 (0.7)	23.1 (9.3)	30.4 (12.3)	16.7 (6.7)
Aesthetics		Minor, short-term, temporary, adverse impacts during construction activities would occur due to visibility of construction equipment.				
Cultural Resources		No known cultural resources are within these linear facility corridors.				
Land Use	ROW Area (ac [ha]) Requirements	1.8 (0.7)	23.1 (9.3)	30.4 (12.3)	16.7 (6.7)	
Socioeconomics		No socioeconomic impacts would occur as a result of the construction or operation of the access roads.				
Environmental Justice		No disproportionately high and adverse impacts to low-income or minority populations would occur as a result of the construction or operation of the access roads.				
Community Services		No impacts to community services would occur as a result of the construction or operation of the access roads.				
Utility Systems	Number of Known Pipeline ROW Crossings	3	7	14	8	
	Number of Transportation ROW Crossings	0	0	0	0	
Transportation	Current AADT	I-20 at Penwell = 15,580 FM 1601 = 20	I-20, east of FM 866 = 16,700 FM 866 = 1,500	I-20, east of FM 866 = 16,700 FM 866 = 1,500	I-20, east of FM 866 = 16,700 Existing, unnamed well access road = 90	
	AADT Percentage Increase During Peak Construction (LOS)	I-20 at Penwell = 1 (acceptable) FM 1601 = 750 (acceptable)	I-20, east of FM 866 = 18 (acceptable) FM 866 = 193 (unacceptable)	I-20, east of FM 866 = 18 (acceptable) FM 866 = 193 (unacceptable)	I-20, east of FM 866 = 18 (acceptable) Existing, unnamed well access road = 3,220 (not available)	
	AADT Percentage Increase During Operation (LOS)	I-20 at Penwell = <1 (acceptable) FM 1601 = 75 (acceptable)	I-20, east of FM 866 = 2 (acceptable) FM 866 = 22 (acceptable)	I-20, east of FM 866 = 2 (acceptable) FM 866 = 22 (acceptable)	I-20, east of FM 866 = 2 (acceptable) Existing, unnamed well access road = 363 (not available)	

Table S3-4. Summary Comparison of Impacts from Summit’s Proposed Access Road Options for the TCEP

Resource		AR1	AR2	AR3	AR4
Materials and Waste Management		<p>No impacts would occur to supply/demand of materials to construct the access roads.</p> <p>Minor impacts would occur to waste collection services and regional disposal capacity during construction of the access roads.</p> <p>Negligible impacts would occur to waste collection services and regional disposal capacity during operations of the access roads.</p>			
Human Health, Safety, and Accidents		<p>Occupational Health and Safety: Risks and hazards associated with construction of access roads would be addressed through a worker protection program currently under development by Summit for the TCEP.</p> <p>Transportation Safety: Fewer than 1 fatality would be expected to occur due to the travel of workers during TCEP operations.</p> <p>Exposure to Contaminated Sites: Risk during linear facility construction could be eliminated through proper due diligence, including conducting a Phase I 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.</p>			
Noise and Vibration	Projected Change in Noise Levels During Peak Construction (dBA)	I-20 at Penwell = 0.2 FM 1601 = 8.8	I-20, east of FM 866 = 0.2 FM 866 = 1.6	I-20, east of FM 866 = 0.2 FM 866 = 1.6	I-20, east of FM 866 = 0.2 Existing, unnamed well access road = 15.2
	Projected Change in Noise Levels During Operation (dBA)	I-20 at Penwell = 0.1 FM 1601 = 2.4	I-20, east of FM 866 = 0.1 FM 866 = 0.6	I-20, east of FM 866 = 0.1 FM 866 = 0.6	I-20, east of FM 866 = 0.1 Existing, unnamed well access road = 6.7

**Impacts to migratory bird and state-listed species habitats are generalized as the same footprint of impacts to terrestrial species habitat. These areas do not represent a duplication of the area, but rather, an identical impact as the terrestrial species area’ of impacts.*

Table S3-5. Summary Comparison of Impacts from Summit's Proposed Natural Gas Pipeline Options for the TCEP

Resources			NG1	NG2	NG3
Linear Footprint	Length (mi [km])		2.8 (4.6)	3.5 (5.6)	2.8 (4.5)
	Temporary Disturbance (ac [ha])		51.7 (20.9)	63.6 (25.7)	49.9 (20.2)
	Permanent Impact (ac [ha])		17.2 (7.0)	21.2 (8.6)	16.6 (6.7)
Air Quality and GHG Emissions		Direct impacts from vehicle exhaust and dust-generating activities would occur during construction of the natural gas pipeline.			
Climate		No climate impacts to or from construction or operation of the natural gas pipeline would occur.			
Soils, Geology, and Mineral Resources		<p><u>Soils</u>: Temporary impacts such as soil disturbance would occur during construction of the natural gas pipeline. See linear footprint areas listed above.</p> <p><u>Geology</u>: No impacts to geologic resources or from events such as earthquakes, landslides, or subsidence would occur during construction or operation phases.</p> <p><u>Mineral Resources</u>: Minor obstructions to mineral resource access along the natural gas pipeline alignment could occur during construction and operation phases.</p>			
Ground Water Resources		No impacts to ground water quantity or quality would occur as a result of construction or operation of the natural gas pipeline linear facility.			
Surface Water Resources		No impacts to surface waters would occur from the construction or operation of the natural gas pipeline.			
Biological Resources (habitat impacts [ac (ha)])	<u>Terrestrial Species</u>	Temporary Impacts	51.7 (20.9)	63.6 (25.7)	49.9 (20.2)
		Permanent Impacts	17.2 (7.0)	21.2 (8.6)	16.6 (6.7)
	<u>Aquatic Species</u>	Temporary Impacts	0	0	0
		Permanent Impacts	0	0	0
	<u>Migratory Birds*</u>	Temporary Impacts	51.7 (20.9)	63.6 (25.7)	49.9 (20.2)
		Permanent Impacts	17.2 (7.0)	21.2 (8.6)	16.6 (6.7)

Table S3-5. Summary Comparison of Impacts from Summit's Proposed Natural Gas Pipeline Options for the TCEP

Resources		NG1	NG2	NG3
	<u>State-listed Species (Texas horned lizard) *</u>	51.7 (20.9)	63.6 (25.7)	49.9 (20.2)
	Temporary Impacts			
	Permanent Impacts	17.2 (7.0)	21.2 (8.6)	16.6 (6.7)
Aesthetics		<i>Minor, short-term, temporary, adverse impacts during construction activities would occur due to visibility of construction equipment.</i>		
Cultural Resources		<i>No known cultural resources are within these linear facility corridors.</i>		
Land Use	ROW Area (ac [ha]) Requirements	17.2 (7.0)	21.2 (8.6)	16.6 (6.7)
	Land Use Impacts	<i>Temporary impacts would occur to Penwell Knights Raceway Park access during construction.</i>	<i>n/a</i>	<i>n/a</i>
Socioeconomics		<i>No socioeconomic impacts would occur as a result of the construction or operation of the natural gas pipeline.</i>		
Environmental Justice		<i>No disproportionately high and adverse impacts to low-income or minority populations would occur as a result of the construction or operation of the natural gas pipeline.</i>		
Community Services		<i>No impacts to community services would occur as a result of the construction or operation of the natural gas pipeline.</i>		
Utility Systems	Number of Known Pipeline ROW Crossings	5	6	7
	Number of Transportation ROW Crossings	1	1	1
Transportation		<i>Construction of the natural gas pipeline would cause minor, temporary, and localized congestion at road crossings.</i>		
Materials and Waste Management		<i>No impacts would occur to supply/demand of materials to construct the natural gas pipeline. Minor impacts would occur to waste collection services and regional disposal capacity during construction of the natural gas pipeline. Negligible impacts would occur to waste collection services and regional disposal capacity during operations of the natural gas pipeline.</i>		

Table S3-5. Summary Comparison of Impacts from Summit’s Proposed Natural Gas Pipeline Options for the TCEP

Resources	NG1	NG2	NG3
Human Health, Safety, and Accidents	<p><u>Occupational Health and Safety:</u> Risks and hazards associated with construction of natural gas pipeline would be addressed through a worker protection program currently under development by Summit for the TCEP.</p> <p><u>Transportation Safety:</u> No specific impacts would occur as a result of the construction or operation of the natural gas pipeline linear facility.</p> <p><u>Pipeline Safety:</u> The probability of an accidental release associated with the new length of natural gas pipeline would be negligible.</p> <p><u>Exposure to Contaminated Sites:</u> Risk 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.</p>		
Noise and Vibration	Temporary, adverse impacts to sensitive noise receptors would occur during construction.	n/a	n/a

**Impacts to migratory bird and state-listed species habitats are generalized as the same footprint of impacts to terrestrial species habitat. These areas do not represent a duplication of the area, but rather, an identical impact as the terrestrial species area’ of impacts.*

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.
- ***Three new TxDOT roadway projects are proposed in Ector, Midland, and Ward Counties to repair existing roads and improve driving conditions. The 2.5-mi (4-km) roadway project in Ector County would repair Loop 338 from SH 302 to Yukon Road. The 5.4-mi (8.7-km) roadway project in Midland County would repair I-20 from SH 349 to FM 1788. The 11.2-mi (18.0-km) roadway project in Ward County would resurface I-20 from Pyote to Monahans. Although no roadway surface area expansion is expected as a result of these projects, construction activities could occur concurrently with polygen plant site construction activities, which would cumulatively introduce new air emissions sources and noise that may degrade the environment.***
- 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, ***DOE recently announced funding for a power storage project on an existing 153-MW Notrees Wind Farm in Ector County. Up to 36 MW of power would balance the delivery of power over time or store electricity for times of peak demand as a result. This proposed project and other wind development projects would help*** 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 CO₂ 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 CO₂ 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 GHG emissions and water use.

The effects of GHGs on climate change are an increasing concern at a cumulative effects level. GHG 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 CO₂ annually to the 2.64 billion tn (2.40 billion t) of energy-related CO₂ emissions released annually by the electric power sector in the U.S. (EPA 2010). Emissions of GHGs 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 GHGs, 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 GHG emissions from producing electric power from both coal and natural gas. Should the TCEP demonstrate the feasibility of utility-scale electric power generation with CO₂ capture, it could result in the incorporation of CO₂ capture in future power plant construction, with resulting reduction in CO₂ 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 0.9 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 4.5 million gal (17.0 million L) of water per day or 5,041 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 **130–213 MW** (net) of electricity per year to the electric grid system. The proposed project would minimize sulfur dioxide, nitrogen oxides, Hg, CO₂, 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 CO₂. 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 CO₂ emissions per unit of electricity generated.

6 CONCLUSIONS

As shown in Tables S3-1-S3-5, the proposed TCEP would result in generally minor environmental impacts. The potential impact to water resources is the dominant environmental concern for the Odessa-Midland area with regard to the siting and operation of a new power plant. The proposed reuse of waste water and use of highly brackish ground water are the most promising strategies to minimize the impacts on the local and regional water supply while limiting project costs. Although the reuse of waste water is Summit's preferred source water option, the TCEP has the potential to use approximately 0.9 percent of the annual ground water supply in the region if Summit chooses one of the options that originates from a ground water source. This amount, in combination with water needed for the expected regional population and industry growth over time, could strain future ground water supplies.

The proposed TCEP would capture approximately 90 percent of the carbon entering the plant. Construction and operation of the plant would be an important step toward reducing GHG emissions from both coal- and natural gas-fueled electric generating plants. Should the TCEP demonstrate the feasibility of utility-scale electric power generation with CO₂ capture, it could result in the incorporation of CO₂ capture in future power plant construction, with resulting reduction in CO₂ emissions from new electricity generating capacity built in the future.

Because not all CO₂ emissions would be captured, the plant would contribute 0.3 million tn (0.27 million t) of CO₂ to the 2.64 billion tn (2.40 billion t) of energy-related CO₂ emissions released annually by the electric power sector in the United States (EPA 2010). Although not a direct impact, these emissions would increase the atmosphere's concentration of GHGs, 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.

In addition to the potential impacts summarized previously, there are areas of controversy or uncertainty regarding the Proposed Action. These areas were identified during the public involvement process and in consultation with Native American tribes and other federal, state, and local agencies. Many of these issues are not reconcilable, because they reflect differing points of view or uncertainties in predicting the future. The key areas of controversy are the range of alternatives considered reasonable by DOE, siting of the plant in a region that has scarce supplies of water, and the net reduction in CO₂ emissions that can be expected with use of CO₂ for EOR.

Some members of the public would have preferred that the alternatives analysis be expanded to include alternative technologies (e.g., natural-gas fired electric generation, renewable energy generation technologies). However, as explained in Chapter 1, the agency's goal is not to address the need for power or other products generated by TCEP but rather to demonstrate the technology selected during a competitive solicitation. The solicitation in turn was issued to meet a congressional mandate to select and fund promising clean coal technologies that advance efficiency, environmental performance, and cost competitiveness well beyond the level of technologies that are currently in service. Therefore, the technologies suggested by these comments do not "accomplish the goals of the agency's action."

Questions were raised during the public involvement process regarding the site selection process. Commenters noted that the region currently has ample supplies of natural gas to produce electricity but scarce supplies of water. DOE recognizes that the use of water supplies in the area for the TCEP is controversial. Summit selected a site in the Permian Basin because the region has an existing market for CO₂, which is used in EOR. Sales and use of the CO₂ are important for demonstrating the commercial feasibility of a power plant to capture and sequester CO₂. Thus, Summit decided to locate the plant near existing oil fields that could use CO₂ for EOR, rather than to build a power plant near a fuel source that would require the construction of a long CO₂ pipeline or near a large electricity demand center where there was no established market (and price) for CO₂. DOE believes that Summit has developed options for water sources that minimize the impacts on water availability.

Concerns have been raised over the use of CO₂ for EOR as a sequestration option. Public comments questioned whether there would be any substantial net reduction in emissions, because the subsequent consumption of oil produced by EOR would produce GHGs. DOE does acknowledge that the oil produced by the EOR (CO₂ floods) would ultimately lead to the emissions of CO₂ to the atmosphere when the oil-derived products are produced and consumed. However, DOE does not expect that this project would result in increased GHG emissions from consumption of oil-derived fuels domestically or globally because the potential increase in domestic supply of crude oil (about 0.45 percent) would not be enough to change the market price. With no price signal, the project would not affect the crude oil consumption rate, and therefore there would be no change in CO₂ emissions from the combustion of oil-derived fuels. A detailed life cycle analysis would be needed to quantify the net reduction in emissions based on a range of assumptions. However, a detailed life-cycle analysis is beyond the scope of this EIS, and DOE has determined that such an analysis is not essential to a reasoned choice among alternatives. Data obtained through the monitoring, verification, and accounting activities of this project and other projects in DOE's programs would allow for such a detailed life-cycle analysis to be performed in the future to support DOE's programmatic goals.

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8 INDEX

-A-

access road option (AR1-AR2), S-23, S-43, S-47, S-56
 acid gas, S-13, S-14
 aesthetics, S-31, S-40, S-50, S-54, S-57, S-60, S-65
 air quality, S-4, S-5, S-29, S-34, S-35, S-48, S-53, S-56, S-59, S-65
 ammonia, S-4, S-7, S-14, S-17, S-24, S-26, S-35, S-45
 aquifer, S-4, S-7, S-14, S-17, S-24, S-26, S-35, S-45
 argon, S-10, S-18, S-22

-B-

best management practices, S-6
 biological resources, S-4, S-31, S-39, S-49, S-53, S-56, S-59
 blowdown, S-15, S-16, S-26, S-31
 brackish water, S-21, S-37
 Bureau of Economic Geology, S-17

-C-

Capitan Reef Complex Aquifer, S-5, S-21
 carbon dioxide (CO₂), S-1, S-3, S-4, S-5, S-7, S-8, S-9, S-10, S-13, S-14, S-17, S-19, S-20, S-22, S-25, S-28, S-29, S-33, S-34, S-35, S-36, S-37, S-43, S-45, S-63, S-65, S-66, S-67
 carbon sequestration, S-63
 chemicals, S-1, S-3, S-13, S-14, S-18, S-20, S-22, S-23, S-34, S-45
 Class I area, S-35
 Clean Air Act, S-35
 Clean Coal Power Initiative, S-1, S-3, S-9, S-33
 Clean Water Act, S-30
 climate, S-1, S-6, S-29, S-36, S-48, S-53, S-56, S-59, S-63, S-66
 CO₂ pipeline, S-1, S-7, S-9, S-10, S-17, S-19, S-28, S-45, S-67
 community service, S-42, S-51, S-54, S-57, S-60
 cooling tower, S-15, S-16, S-24, S-26, S-29, S-31, S-35, S-36, S-37, S-40, S-43, S-45, S-64
 cooling water, S-45

Council on Environmental Quality, S-1, S-6
 cultural resources, S-32, S-41, S-50, S-54, S-57, S-60, S-64
 cumulative effects, S-4, S-6, S-8, S-62, S-63

-D-

deep well injection, S-8, S-26, S-31, S-36, S-37

-E-

Ector County, S-1, S-4, S-35, S-62, S-68
 Electric Reliability Council of Texas (ERCOT), S-17, S-19, S-22, S-43
 electricity, S-3, S-10, S-14, S-17, S-22, S-33, S-43, S-62, S-63, S-65, S-66, S-67
 emergency response, S-28, S-42
 employment, S-5, S-42, S-62
 endangered species, S-39
 enhanced oil recovery, S-1, S-3, S-4, S-5, S-14, S-17, S-21, S-29, S-33, S-36, S-37, S-45, S-63, S-66, S-67
 environmental justice, S-42, S-50, S-54, S-57, S-60

-F-

Federal Aviation Administration, S-40
 fire, S-16, S-27, S-28, S-29, S-45
 flood, S-21, S-38
 floodplain, S-30, S-31, S-36, S-38
 Fort Stockton Holdings (FSH), S-15, S-21, S-22, S-37

-G-

geologic reservoir, S-36
 geologic sequestration, S-3, S-63
 geology, S-17, S-30, S-36, S-48, S-53, S-56, S-59
 greenhouse gases, S-5, S-6, S-48, S-53, S-56, S-59, S-63, S-66, S-67
 ground water, S-5, S-37, S-48, S-53, S-56, S-59
 Gulf Coast Waste Disposal Authority (GCA), S-7, S-15, S-21, S-22, S-38, S-43, S-48, S-51

-H-

hazardous air pollutants, S-26, S-35
 hazardous material, S-20, S-24, S-28, S-36, S-45
 housing, S-42
 human health, safety, accidents, S-45
 hydrogen (H₂), S-10, S-13, S-14, S-18, S-22, S-23, S-24, S-25, S-26, S-29, S-34, S-35

-I-

integrates gasification combined-cycle (IGCC), S-1, S-3, S-16, S-25, S-33

-J-

jobs, S-42

-K-

Kinder Morgan, S-17, S-19

-L-

land use, S-4, S-34, S-35, S-41, S-50, S-54, S-57, S-60, S-64
 law enforcement, S-42
 level of service (LOS), S-43, S-57
 linear facilities, S-7, S-9, S-17, S-18, S-20, S-27, S-30, S-32, S-34, S-36, S-37, S-38, S-39, S-40, S-41, S-43, S-45, S-47, S-48, S-51, S-55, S-64, S-65
 low income, S-42, S-50, S-54, S-57, S-60

-M-

materials and waste management, S-45, S-51, S-55, S-58, S-60
 meteorology, S-36
 Midland County, S-19, S-62
 Midland, city of, S-15, S-21, S-37, S-43, S-51
 mineral resources, S-36, S-48, S-53, S-56, S-59
 minority, S-42, S-50, S-54, S-57, S-60
 mitigation, S-9, S-29, S-30, S-31, S-34
 monitoring, verification, and accounting, S-17

-N-

national ambient air quality standard, S-35
 National Environmental Policy Act (NEPA), S-1, S-9, S-31
 National Historic Preservation Act, S-32

natural gas pipeline option (NG1), S-20, S-34, S-41, S-47, S-59
 NEPA Process, S-31
 nitrogen dioxide (NO₂), S-35
 nitrogen oxides (NO_x), S-25, S-29, S-35, S-65
 No Action Alternative, S-33, S-34, S-35
 noise, S-32, S-39, S-47, S-52, S-55, S-58, S-61, S-62, S-65
 noise and vibration, S-47, S-52, S-55, S-58, S-61
 Notice of Intent (NOI), S-3, S-68

-O-

Occupational Safety and Health Administration (OSHA), S-28, S-32, S-45
 Odessa, city of, S-1, S-4, S-21
 ONEOK, S-20
 Oxy Permian, S-15, S-21, S-37
 oxygen (O₂), S-10, S-13, S-20, S-23

-P-

particulate matter (PM), S-4, S-15, S-25, S-26, S-29, S-35, S-36, S-47, S-65
 Pecos Valley Aquifer, S-63
 Penwell, community of, S-1, S-34, S-40, S-41, S-43, S-47, S-50, S-57, S-58, S-60
 permits, S-30, S-33, S-50
 plume, S-17, S-35, S-40
 police, S-28
 polygen plant, S-1, S-3, S-5, S-6, S-7, S-8, S-9, S-10, S-11, S-13, S-15, S-16, S-17, S-18, S-19, S-20, S-21, S-22, S-23, S-24, S-26, S-27, S-28, S-30, S-32, S-33, S-34, S-35, S-36, S-37, S-38, S-39, S-40, S-41, S-43, S-45, S-47, S-62, S-64, S-65
 population, S-34, S-42, S-63, S-66
 Prevention of Significant Deterioration (PSD)-of Air Quality, S-35, S-68
 Proposed Action, S-1, S-3, S-5, S-9, S-66
 Proposed Project, S-3, S-4, S-5, S-8, S-9, S-21, S-33, S-35, S-62, S-65
 public scoping, S-3

-R-

rail spur, S-9, S-23
 rail spur (RR1), S-19, S-23, S-43
 railroad, S-5, S-7, S-43, S-47
 rainfall, S-36

region of influence (ROI), S-35, S-38, S-39, S-40, S-41, S-42, S-47, S-62

renewable energy, S-3, S-8, S-62, S-66

Resource Conservation and Recovery Act, S-34

-S-

safety, S-28, S-32, S-45, S-47, S-51, S-55, S-58, S-61, S-68

saline, S-5, S-21, S-37

school, S-42

seismic event, S-36

slag, S-10, S-13, S-18, S-22, S-23, S-27

socioeconomic, S-4, S-42, S-50, S-54, S-57, S-60

soils, S-29, S-30, S-33, S-34, S-36, S-45, S-48, S-53, S-56, S-59, S-64

sub-bituminous coal, S-10, S-18, S-65

sulfur, S-10, S-13, S-14, S-20, S-26, S-29, S-65

sulfuric acid, S-10, S-14, S-18, S-22, S-23, S-24, S-26, S-29, S-34, S-35

surface water, S-5, S-6, S-8, S-30, S-38, S-39, S-48, S-53, S-56, S-59, S-65

synthesis gas (syngas), S-5, S-7, S-10, S-13, S-14, S-15, S-17, S-23, S-25, S-29, S-45

-T-

Texas Commission on Environmental Quality (TCEQ), S-6, S-30, S-31, S-35, S-37, S-68

Texas Department of Transportation (TxDOT), S-6, S-43, S-45, S-62, S-68

Texas Historical Commission, S-6, S-32, S-41

Texas Parks and Wildlife Department (TPWD), S-6, S-31

Texas Water Development Board (TWDB), S-37, S-63, S-68

transmission line option (i.e., TL1–TL6), S-7, S-17, S-19, S-43, S-47, S-53

transportation, S-6, S-8, S-9, S-18, S-20, S-22, S-28, S-29, S-32, S-43, S-45, S-51, S-54, S-55, S-57, S-58, S-60, S-61, S-65

-U-

U.S. Department of Energy (DOE), S-1, S-3, S-4, S-5, S-6, S-7, S-8, S-9, S-17, S-32, S-33, S-34, S-41, S-62, S-63, S-65, S-66, S-67

U.S. Fish and Wildlife Service (USFWS), S-6

Union Pacific Railroad, S-1, S-23, S-34, S-43, S-45

urea, S-7, S-10, S-12, S-13, S-14, S-16, S-17, S-18, S-22, S-23, S-25, S-26, S-33, S-34, S-43, S-45

utility systems, S-15, S-43, S-51, S-54, S-57, S-60

-V-

vibration, S-47, S-52, S-55, S-58, S-61

-W-

waste management, S-26, S-27, S-28, S-45, S-51, S-55, S-58, S-60, S-68

water quality, S-5, S-6, S-31, S-37, S-38, S-39, S-56

water rights, S-5

waterline option (i.e., WL1–WL4), S-7, S-15, S-21, S-22, S-37, S-38, S-39, S-41, S-43, S-47, S-48

weather, S-36

wetland, S-6, S-31, S-38, S-65

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