U.S. Department of Energy

W.A. Parish Post-Combustion CO_2 Capture and Sequestration Project

Draft Environmental Impact Statement Summary

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COVER SHEET

Responsible Federal Agency: U.S. Department of Energy (DOE)
Title: W.A. Parish Post-Combustion CO_2 Capture and Sequestration Project, Draft Environmental Impact Statement (DOE/EIS-0473D)
Location: Southeastern Texas, including Fort Bend, Wharton, and Jackson Counties
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Abstract:
This Environmental Impact Statement (EIS) evaluates the potential impacts associated with DOE's Proposed Action to provide financial assistance to NRG Energy, Inc. (NRG) and with NRG's proposed W.A. Parish Post-Combustion CO_2 Capture and Sequestration Project (Parish PCCS Project). DOE's Proposed Action would provide $167 million in cost-shared financial assistance to NRG under the Clean Coal Power Initiative (CCPI) Program to support construction and operation of NRG's Parish PCCS Project. The funding would be used for project design and development, procurement of capital equipment, construction, and CO_2 monitoring during the 35-month demonstration period of the integrated CO_2 capture and compression system.

NRG's proposed Parish PCCS Project would construct a CO_2 capture facility at its 4,880-acre W.A. Parish Plant in rural Fort Bend County near the small town of Thompsons, Texas. The capture facility would use an advanced amine-based carbon dioxide (CO_2) absorption technology to capture at least 90% of the CO_2 from a 250-megawatt equivalent (MWe) portion of the flue gas exhaust from Unit 8 at the W.A. Parish Plant. The project would be designed to capture approximately 1.6 million tons of CO_2 per year from the plant exhaust, which would otherwise be emitted to the atmosphere. The captured CO_2 would be compressed and transported via a new approximately 80-mile-long, 12-inch-diameter underground pipeline to the existing West Ranch oil field in Jackson County, Texas. The CO_2 would be used for enhanced oil recovery (EOR) and ultimately sequestered in geologic formations approximately 5,000 to 6,300 feet below ground surface (bgs).

DOE is the lead federal agency responsible for preparation of this EIS. DOE prepared the EIS pursuant to the National Environmental Policy Act (NEPA) and in compliance with the Council on Environmental Quality (CEQ) implementing regulations for NEPA (40 Code of Federal Regulations [CFR] 1500 through 1508) and DOE NEPA procedures (10 CFR 1021). The EIS evaluates the potential environmental impacts of the Parish PCCS Project as part of DOE's decision-making process to determine whether to provide NRG with financial assistance for its proposed project. The EIS also analyzes the No-Action Alternative, under which DOE would not provide financial assistance for the proposed project.

Comment Period:
DOE encourages public participation in the NEPA process. Comments postmarked by November 5, 2012 will be addressed in the Final EIS. DOE will consider late comments to the extent practicable.

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ACRONYMS

Acronym	Definition
%	percent
°F	degrees Fahrenheit
AF	acre-feet
aka	also known as
Approx.	Approximately
Ar	argon
BEG	Texas Bureau of Economic Geology
bgs	below ground surface
BMPs	best management practices
ca.	circa
CCPI	Clean Coal Power Initiative
CCS	carbon capture and sequestration
CCTP	Climate Change Technology Program
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CO_2	carbon dioxide
COE	cost of electricity
CT	combustion turbine
dBA	decibel, A-weighted
DOE	U.S. Department of Energy
e.g.	for example (Latin: exempli gratia)
EIS	Environmental Impact Statement
EMT	emergency medical technician
EOR	enhanced oil recovery
EPA	U.S. Environmental Protection Agency
EPAct05	Energy Policy Act of 2005
ERC	emission reduction credit
ES&H	environmental safety and health
ETP	Energy Transfer Partners
FEMA	Federal Emergency Management Agency
FM	Farm-to-Market Road
FOA	funding opportunity announcement
FR	Federal Register
GHG	greenhouse gas
gpd	gallons per day

Acronym	Definition
H_2O	water
HAZMAT	hazardous material
HCl	hydrochloric acid
HDD	horizontal directional drilling
HEC	Hilcorp Energy Company
HF	hydrofluoric acid
HGB MSA	Houston Galveston Brazoria Metropolitan Statistical Area
HRSG	heat recovery steam generator
HVTL	high-voltage transmission line
i.e.	that is (to say); in other words (Latin: id est)
lb/hr	pounds per hour
lbs	pounds
mD	millidarcies
MECT	Mass Emission Cap & Trade
mgd	million gallons per day
MLV	main line valve
MMTA	million metric tons per annum
MP	milepost
msl	mean sea level
MSA	Metropolitan Statistical Area
MTA	metric tons per annum
MW	megawatt
MWe	megawatt equivalent
N_2	nitrogen
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NETL	National Energy Technology Laboratory
NGL	natural gas liquid
NH_3	ammonia
NNSR	Nonattainment New Source Review
NO	nitrogen oxide
NO_2	nitrogen dioxide
NOI	Notice of Intent
NOx	nitrogen oxides
NRG	NRG Energy, Inc.
NRHP	National Register of Historic Places
NWI	National Wetland Inventory

Acronym	Definition
O_2	oxygen
O_3	ozone
Parish PCCS Project	W.A. Parish Post-Combustion CO_2 Capture and Sequestration Project
PCCS	Post-Combustion CO_2 Capture and Sequestration
PM_{10}	particulate matter with a diameter of 10 microns or less
ppmv	parts per million by volume (1 ppmv = 0.0001%)
psia	pounds per square inch absolute
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
ROI	region of influence
ROW	right-of-way
RRC	Railroad Commission of Texas
SO_2	sulfur dioxide
SO_3	sulfur trioxide
STEC	South Texas Electric Cooperative
SWPPP	stormwater pollution prevention plan
TCEQ	Texas Commission on Environmental Quality
TCV	Texas Coastal Ventures LLC
THC	Texas Historical Commission
TPWD	Texas Parks and Wildlife Department
tpy	tons per year
TSDF	treatment, storage, and disposal facility
TXDOT	Texas Department of Transportation
U.S.	United States
UIC	Underground Injection Control
USACE	U.S. Army Corps of Engineers
USDW	underground source of drinking water
VOC	volatile organic compound
WWTP	wastewater treatment plant

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GLOSSARY

Term	Definition
"A-weighted" Scale	Assigns weight to sound frequencies that are related to how sensitive the human ear is to each sound frequency. Frequencies that are less sensitive to the human ear are weighted less than those for which the ear is more sensitive. A-weighted measurements indicate the potential damage a noise might cause to hearing.
100-year floodplain	Land that becomes or will become submerged by a flood that has a chance to occur every 100 years (1% annual chance of flooding).
500-year floodplain	Land that becomes or will become submerged by a flood that has a chance to occur every 500 years (0.2% annual chance of flooding).
Ambient noise level	Background noise associated with a given environment. Ambient noise is typically formed as a composite of sounds from many near and far sources, with no particular dominant sound.
Amines	A group of organic compounds of nitrogen, typically derived from ammonia, with one or more of the hydrogen atoms in ammonia replaced by one or more organic functional groups. Amines include amino acids and a wide range of primary, secondary, and tertiary amines used for dyes, pharmaceuticals, and gas treatment.
Aquifer	Underground geologic formation composed of permeable layers of rock or sediment that holds and/or transmits water.
Best Management Practice (BMP)	Method for preventing or reducing pollution impacts resulting from an activity. BMPs include non-regulatory methods designed to minimize harm to the environment.
Carbon dioxide (CO_2)	A common chemical compound, abbreviated as CO_2, composed of two oxygen atoms covalently bonded to a single carbon atom. CO_2 is a colorless, odorless, nonpoisonous, GHG created by combustion and emitted from natural and human activities, including the burning of fossil fuels to generate electricity and operate motor vehicles.
Cultural resources	Archaeological sites, historical sites (e.g., standing structures), Native American resources, and paleontological resources.
Cumulative effects	The impact to the environment that results from the incremental effect of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time.
Decibel (dB)	Unit used to express the intensity of sound.
Dissolution	Process of dissolving a substance into a liquid.
Effluent	Waste stream flowing into the atmosphere, surface water, groundwater, or soil.
Emergent	Erect, rooted herbaceous plants, such as cattails and bulrush, which dominate wetlands.

Term	Definition
Endangered Species	Plants or animals that are in danger of extinction. A federal list of endangered species can be found in 50 CFR 17.11 (wildlife), 50 CFR 17.12 (plants), and 50 CFR 222.23(a) (marine organisms). Texas maintains its list of endangered species with the TPWD.
Environmental justice	The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic groups, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies. Executive Order 12898 directs federal agencies to make achieving environmental justice part of their missions by identifying and addressing disproportionately high and adverse effects of agency programs, policies, and activities on minority and low-income populations.
Erosion	The process by which particles of soils or other material are removed and transported by water, wind, and/or gravity to some other area.
Fault	A subsurface fracture or discontinuity in geologic strata, across which there is observable displacement as a result of earth movement.
Floodplain	Flat or nearly flat land adjacent to a stream or river that experiences occasional or periodic flooding.
Flue gas	Residual gases after combustion that are vented to the atmosphere through a flue or chimney.
Formation	The primary unit associated with formal geological mapping of an area. Formations possess distinctive geological features and can be combined into "groups" or subdivided into "members" or "units".
Fossil fuel	Coal, oil, or natural gas, formed from vegetation and animals under high pressure and temperatures during a past geological age.
Fresh water	Water with bacteriological, physical, and chemical properties that make it suitable for beneficial use. (e.g., with TDS concentrations less than 1,000 mg/L).
Fugitive dust	Airborne particulate matter, typically associated with disturbance of unpaved haul roads, wind erosion of exposed surfaces, and other activities in which soil is removed and redistributed.
Greenhouse gas	Gas that contributes to the greenhouse effect by absorbing infrared radiation and ultimately warming the atmosphere. GHGs include water vapor, nitrous oxide, methane, CO_2, O_3, halogenated fluorocarbons, hydrofluorocarbons, and perfluorinated carbons.
Groundwater	Water obtained from an underground source (i.e., from an aquifer); may supply wells and/or springs.
Growth faults	Faults caused when sediment layers slump or subside at different rates. Growth faults are common along the Gulf of Mexico.

Term	Definition
Hazardous waste	Waste that exhibits at least one of four characteristics (ignitability, corrosivity, reactivity, or toxicity), or that is specifically listed by the EPA as a hazardous waste. Hazardous waste is regulated under RCRA Subtitle C.
Historic Property	Prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places.
Laydown area	Material and equipment storage area during the construction phase of a project.
Lithic scatter	Concentration of waste flakes resulting from the manufacture of stone tools.
Low income population	A community that has a proportion of low-income population greater than the respective average.
Major aquifers	Aquifers that produce large amounts of water over large areas.
Megawatt (MW)	Unit of power equal to 1 million watts. A power plant with 1 MW of capacity operating continuously for one year could supply electricity to approximately 750 households.
Minor aquifers	Aquifers that produce minor amounts of water over large areas or large amounts of water over small areas.
Minority	Individual(s) who are members of the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic.
Minority population	Identified where either more than 50 percent of the population of the affected area is minority, or the affected area's minority population percentage is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis.
Mitigation	Efforts to lessen the severity or to reduce adverse impacts, including: avoiding the impact altogether by not taking a certain action or parts of an action; minimizing impacts by limiting the degree or magnitude of the action; repairing, rehabilitating, or restoring the affected environment; reducing or eliminating the impact over time by preservation; and compensating for the impact by replacing or providing substitute resources or environments.
National Ambient Air Quality Standards (NAAQS)	Uniform, national air quality standards established by EPA that restrict ambient levels of certain pollutants to protect public health (primary standards) or public welfare (secondary standards). Standards have been set for CO, lead, NO_2, O_3, particulate matter, and SO_2.
National Environmental Policy Act (NEPA)	Signed into law on January 1, 1970, the National Environmental Policy Act (NEPA) declared a national policy to protect the environment and created the Council on Environmental Quality (CEQ) in the Executive Office of the President. To implement the national policy, NEPA requires that environmental factors be considered when federal agencies make decisions, and that a detailed statement of environmental impacts be prepared for all major federal actions significantly affecting the human environment.
Nitrogen oxides (NO_x)	A product of combustion by mobile and stationary sources and a major contributor to the formation of O_3 in the troposphere.

Term	Definition
Nonattainment	An area that does not meet air quality standards set by the Clean Air Act for specified localities and time periods; locations where pollutant concentrations are greater than the NAAQS.
Notice of Intent (NOI)	Notice that an EIS will be prepared and considered. It is published in the *Federal Register* as soon as practicable after an agency knows that an EIS is required for a proposed action.
Ozone, (O_3)	A form of O_2 found naturally in the stratosphere and that provides a protective layer for shielding the Earth from ultraviolet radiation. O_3 occurring in the lower atmosphere is harmful and is classified as a criteria pollutant.
Palustrine	Living or thriving in a marshy environment.
Particulate matter (PM)	Small particles of solid or liquid materials that, when suspended in the atmosphere, constitute an atmospheric pollutant.
Permeability	Rate at which fluids flow through the subsurface; reflects the degree to which pore space is connected.
Potable water	Water that is safe and satisfactory for drinking and cooking.
Prime farmland	Land that has the best combination of physical and chemical characteristics for producing food, feed, fiber, forage, oilseed, and other agricultural crops with minimum inputs of fuel, fertilizer, pesticides, and labor, and without intolerable soil erosion.
Produced water	Brine separated from produced oil or gas at an oil field. Produced water may also be called brine, salt water, or process water.
Proposed Action	The activity proposed to accomplish a federal agency's purpose and need, often requiring an analysis of potential environmental impacts. A proposed action includes the project and its related support activities (pre-construction, construction, and operation, along with post-operational requirements).
Pulverized coal	Crushed coal used to fuel a coal power plant. Currently the principal electric generation technology in the U.S.
Region of influence (ROI)	The physical area that bounds the environmental, sociologic, economic, or cultural features of interest for the purpose of analysis.
Riparian	Pertaining to, situated, or dwelling on the bank of a river or other body of water.
Scoping meeting	An early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action.
Scrubber	A device that removes noxious gases (such as SO_2) from flue gases by using absorbents suspended in liquid solution.
Scrub-shrub	Woody vegetation less than 20 feet (6 meters) tall. Species include true shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions.
Sediment	Material that has been eroded, transported, and deposited by erosional processes, typically wind, water, and/or glaciers.

Term	Definition
Sedimentation	The process or action of depositing sediment.
Seismic	Pertaining to, characteristic of, or produced by earthquakes or Earth vibrations.
Sensitive receptor	As used in this analysis, any specific resource (i.e., population or facility) that would be more susceptible to the effects of the impact of implementing the proposed action than would otherwise be.
Sequestration	Process of injecting the CO_2 captured from an industrial or energy-related source into deep subsurface geologic formations for long-term storage.
Slipstream	The portion or percentage of the flue gas exhaust that is diverted to another location for alternative uses, including monitoring, research, or separate testing.
Stream	A continually, frequently, or infrequently flowing body of water that follows a defined course. The three classes of streams are: ephemeral—a channel that carries water only during and immediately following rainstorms; intermittent—a watercourse that flows in a well-defined channel during the wet seasons of the year, but not the entire year; and perennial—a watercourse that flows throughout the year or more than 90 percent of the time in a well-defined channel.
Sulfur dioxide (SO_2)	A heavy, pungent, colorless, gaseous air pollutant formed primarily by the combustion of fossil fuels.
Supercritical CO_2	CO_2 usually behaves as a gas in air or as a solid known as dry ice. If the temperature and pressure are both increased (above its supercritical temperature of 88ºF [31.1ºC] and 73 atmospheres [1073 psi]), it can adopt properties midway between a gas and a liquid, such that it expands to fill its container like a gas, but has a density like that of a liquid.
Surface water	All bodies of water on the surface and open to the atmosphere, such as rivers, lakes, reservoirs, ponds, seas, or estuaries.
Topography	The configuration of a surface including its relief and position of the natural and manmade features.
Topsoil	The upper native soil layer; generally the layer that supports plant growth.
Turbidity	Capacity of material suspended in water to scatter light. Highly turbid water is often called muddy, although all manner of suspended particles contribute to turbidity.
Underground Source of Drinking Water (USDW)	Any aquifer or part of an aquifer that (1) supplies any public water system; or (2) contains a sufficient quantity of groundwater to supply a public water system, and currently supplies drinking water for human consumption or contains fewer than 10,000 milligrams per liter of total dissolved solids; and (3) is not an exempted aquifer.
Vibration	Force that oscillates about a specified reference point. Vibration is commonly expressed in terms of frequency, such as cycles per second, Hertz, cycles per minute, or strokes per minute.
Viscosity	Measure of a fluid's resistance to flow.

Term	Definition
Volatile organic compound (VOC)	A VOC is one of a group of carbon-containing compounds that evaporate readily at room temperature. As defined in 40 CFR 51.100(s), a VOC is any compound of carbon that participates in atmospheric photochemical reactions, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, and other organic compounds designated by EPA as having negligible reactivity.
Wastewater	A combination of liquid and water-carried wastes from residences, commercial buildings, and/or industrial facilities.
Wetland	An area that is inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas and have the following general characteristics: (1) Vegetation typically adapted to inundated or saturated soil conditions; (2) Hydric soils or soils associated with low oxygen conditions; and (3) The area is inundated either permanently or periodically at mean water depths less than 6.6 feet, or the soil is saturated to the surface at some time during the growing season of the prevalent vegetation.

INTRODUCTION

The United States (U.S.) Department of Energy (DOE) prepared this Environmental Impact Statement (EIS) to evaluate the potential impacts associated with its Proposed Action to provide financial assistance to NRG Energy, Inc. (NRG) and with NRG's proposed W.A. Parish Post-Combustion CO_2 Capture and Sequestration Project (Parish PCCS Project). DOE's Proposed Action is to provide $167 million in cost-shared funding to support construction and operation of NRG's proposed Parish PCCS Project under the Clean Coal Power Initiative (CCPI) Program. Congress established the CCPI Program to enable and accelerate the deployment of advanced technologies to promote clean, reliable, and affordable electricity for the U.S. The CCPI operates as a cost-shared partnership between government and industry to develop and demonstrate advanced coal-based power generation technology at the commercial scale. DOE selected NRG's Parish PCCS Project and four other projects during the CCPI Round 3 solicitation.

NRG's proposed Parish PCCS Project would construct a CO_2 capture facility at NRG's 4,880-acre W.A. Parish Plant in rural Fort Bend County near the small town of Thompsons, Texas. The CO_2 capture facility would use an advanced amine-based carbon dioxide (CO_2) absorption technology to capture at least 90% of the CO_2 from a 250- megawatt equivalent (MWe) portion of the flue gas exhaust from Unit 8 at the W.A. Parish Plant. The project would be designed to capture approximately 1.6 million tons of CO_2 per year from the plant exhaust that the facility would otherwise emit to the atmosphere. The captured CO_2 would be compressed and transported via a new approximately 80-mile-long, 12-inch-diameter underground pipeline to the existing West Ranch oil field in Jackson County, Texas, near the town of Vanderbilt. The CO_2 would be used for enhanced oil recovery (EOR) and ultimately sequestered in geologic formations approximately 5,000 to 6,300 feet below ground surface (bgs).

DOE is the lead federal agency responsible for preparation of this EIS. DOE prepared the EIS pursuant to the National Environmental Policy Act (NEPA) and in compliance with the Council on Environmental Quality (CEQ) implementing regulations for NEPA (40 Code of Federal Regulations [CFR] 1500 through 1508) and DOE NEPA procedures (10 CFR 1021). The EIS also evaluates the potential environmental impacts of the Parish PCCS Project as part of DOE's decision-making process to determine whether to provide NRG with financial assistance for the project.

DOE'S PURPOSE AND NEED

The *purpose* of DOE's Proposed Action under the CCPI Program is to demonstrate advanced coal-based technologies at a commercial scale that capture and geologically sequester CO_2 emissions. The principal *need* addressed by DOE's Proposed Action is to satisfy the responsibility Congress imposed on DOE to demonstrate advanced coal-based technologies that can generate clean, reliable, and affordable electricity in the U.S. The CCPI Program selects projects with the best chance of achieving the program's objectives as established by Congress: commercialization of clean coal technologies that advance efficiency, environmental performance, and cost competitiveness well beyond the level of technologies currently in commercial service.

The proposed project would help DOE, through the CCPI Program, meet its congressionally mandated mission to support advanced clean-coal technology projects. This specifically includes those projects that have progressed beyond the research and development stage to a point of readiness for operation at a scale that, once demonstrated, can be readily implemented across the commercial sector. Post-combustion CO_2 capture offers the greatest near-term potential for reducing power sector CO_2 emissions because it can be used to retrofit existing coal-based power plants and can also be tuned for various levels of CO_2 capture, which may accelerate market acceptance (NETL 2010a). A successful commercial-scale demonstration of amine-based carbon capture technology at NRG's W.A. Parish Plant with beneficial use of the CO_2 at an existing oil field would also generate technical, environmental, and financial data from the design, construction, and operation of the CO_2 capture facility, pipeline, and EOR/ CO_2 monitoring facilities at the oil field. These data would be used to evaluate whether the deployed technologies could be effectively and economically implemented at a commercial scale.

NRG'S PROJECT OBJECTIVES

Consistent with DOE's requirements under CCPI Round 3, NRG identified the following objectives for the Parish PCCS Project:

- Demonstration of an advanced amine-based CO_2 absorption technology;
- Integration of a custom-built cogeneration plant into the project to meet the specific power and steam requirements of the CO_2 capture system;
- Demonstration of EOR with CO_2 sequestration in a nearby oil field; and
- Demonstration of a CO_2 monitoring program.

ALTERNATIVES CONSIDERED BY DOE

Section 102 of NEPA requires that agencies discuss the reasonable alternatives to the Proposed Action in an EIS. The term "reasonable alternatives" is not self-defining, but rather must be determined in the context of the purpose expressed by the underlying legislation. The purpose and need for a federal action determines the reasonable alternatives for the NEPA process. Any reasonable alternative to the Proposed Action must be capable of satisfying the purpose and need of the CCPI Program.

The alternatives considered by DOE were limited to the applications submitted to DOE in response to requirements specified in the CCPI Round 3 solicitation. DOE considered all the applications that met the mandatory eligibility requirements as expressed in the funding opportunity announcement. In a competitive process, DOE can only consider site or technology combinations included in the applications received. The applicant must provide at least a 50–50 cost share and bears the responsibility for designing and executing the project. DOE's action concerning these applications was to decide which projects would receive DOE financial assistance from among the eligible applications submitted. Unlike a project owned by DOE, when projects are selected in a competitive process in response to a funding opportunity

announcement, DOE does not make decisions concerning the location, layout, design, or other features of the project. In other words, DOE must select among the eligible projects submitted to DOE by the applicants. DOE cannot re-write an applicant's proposal and thereby compromise an open, fair, and competitive funding opportunity. DOE's initial decision is to select projects to receive federal financial assistance for a project definition phase, prior to DOE's final decision.

After DOE selects a project for an award, the range of reasonable alternatives becomes the project as proposed by the applicant, any alternatives still under consideration by the applicant, and the no action alternative. DOE's final decision, documented in a Record of Decision (ROD), is to either accept or reject the project as proposed by the proponent, including its proposed technology and selected sites. However, DOE may specify mitigation measures that would be required as part of the proposed project.

No-Action Alternative

Under the No-Action Alternative, DOE would not provide cost-shared funding for the proposed Parish PCCS Project. In the absence of DOE cost-shared funding, NRG could still elect to construct and operate the proposed project; therefore, the DOE No-Action Alternative could result in one of two potential scenarios:

- The proposed Parish PCCS Project would not be built; or
- The proposed Parish PCCS Project would be built by NRG without benefit of DOE cost-shared funding.

DOE assumes that if NRG proceeded with project development in the absence of DOE cost-shared funding, the project would include the features, attributes, and impacts as described for the proposed project. However, without DOE participation, it is possible that the project would be canceled. Therefore, for the purposes of analysis in this EIS, the DOE No-Action Alternative is defined as the No-Build Alternative. This means that the project would not be built and environmental conditions would not change from the current baseline (i.e., no new construction, resource use, or CO_2 capture and storage would occur).

Therefore, under the No-Action Alternative, the project technologies (i.e., large-scale CO_2 capture and geologic sequestration) may not be implemented in the near term. Consequently, commercialization of these technologies for large-scale, coal-fired electric generation facilities would be postponed and may not be realized. This scenario would not contribute to the CCPI goals to invest in the demonstration of advanced coal-based power generation technologies that capture and sequester, or put to beneficial use, CO_2 emissions. While the No-Action Alternative would not satisfy the purpose and need for the Proposed Action, this alternative was retained for comparison to the effects of the proposed project, as required under CEQ Regulations (40 CFR 15012.14). The No-Action Alternative reflects the current baseline condition and serves as a benchmark against which the effects of the Proposed Action can be evaluated.

Alternative Project Applications Considered During the CCPI Procurement Process

DOE's alternatives for CCPI – Round 3 consisted of the other eligible applications received in response to FOA DE-FOA-0000042, *Clean Coal Power Initiative - Round 3, Amendments 005 and 006*. DOE received 36 applications that met the minimum eligibility requirements listed in the FOA under Round 3 of the CCPI. These applications provided DOE with a range of options for meeting the objectives of Round 3 of the CCPI. DOE reviewed each of the 36 applications that met minimum eligibility requirements to evaluate potential environmental consequences and made preliminary determinations

regarding the level of NEPA review required. DOE documented the potential environmental consequences for each application in an environmental critique that was considered by the selection official. The environmental critique was summarized in a publicly available environmental synopsis, prepared in accordance with DOE's NEPA implementing regulations (10 CFR 1021.216). DOE also reviewed each eligible application for technical and financial merit. Through this review process, DOE considered both potential environmental consequences and the ability of each application to meet DOE's purpose and need.

Considering technical and financial merit along with the potential environmental impacts associated with each application's proposal, DOE ultimately determined that the proposed Parish PCCS Project and four other proposals would best meet the goals and objectives of the CCPI Program. After selection, DOE must complete a project-specific NEPA analysis for each selected project before making a final decision. Although each of these projects is eligible for cost-shared funding under CCPI, no other relationship exists among them. The selection and potential execution of each standalone project has no effect or bearing on the other projects.

NEPA PROCESS

DOE published a Notice of Intent (NOI) to prepare an EIS in the *Federal Register* (FR) on November 14, 2011, under Docket ID No. FR Doc. 2011–29333; (76 FR 70429). The NOI identified potential issues and areas of impact that would be addressed in the EIS. DOE also published notices in local newspapers announcing the public scoping meeting locations and times. DOE held public scoping meetings on November 30, 2011, at the Needville High School in Needville, Texas, and December 1, 2011, at the Jackson County Services Building in Edna, Texas. These two meetings were attended by a total of ten members of the public, including two elected officials, along with project staff from DOE, NRG, and other project partners.

The 30-day public scoping period ended on December 15, 2011. DOE received four scoping comments at the Public Scoping Meetings. These comments, which were delivered verbally at the November 30, 2011 meeting, involved questions about ownership of the pipeline and use of eminent domain to obtain property for the pipeline; availability for inspection of a certified payroll (i.e., to report prevailing wages according to the requirements of the Davis-Bacon Act); how much DOE funding would be provided for the project; water requirements for the CO_2 capture system; and any potential impact on consumers' electricity bills.

This EIS addresses potential impacts to the areas identified during both internal planning and public scoping for the proposed project. DOE encourages public participation in the NEPA process. Public comments on the draft EIS will be solicited for 45 days from the Notice of Availability published in the *Federal Register*. Public hearings will also be held in the project area.

DESCRIPTION OF NRG'S PROPOSED PROJECT

NRG's proposed project consists of four components: a CO_2 capture facility and supporting infrastructure at the W.A. Parish Plant, a CO_2 pipeline, EOR operations at the West Ranch oil field, and a CO_2 monitoring program at the oil field. The design, construction, and operation of the CO_2 capture facility and the design and implementation of the CO_2 monitoring program are the primary focus of the DOE's Proposed Action. The CO_2 pipeline and EOR components of NRG's proposed project are connected actions that would not be conducted if not for the proposed action. Each of the four components of the Parish PCCS Project is summarized below and in Table S-1. Figure S-1 shows the general location of the proposed project components. Figure S-2 presents an overall schematic of the PCCS concept.

1. ***CO_2 Capture Facility:*** The proposed project would retrofit one of the W.A. Parish Plant's existing coal-fueled units (Unit 8) with a post-combustion CO_2 capture system constructed within the existing W.A. Parish Plant site. A new natural gas-fired cogeneration plant, estimated to be 80 MW in size, would also be constructed on the plant property to produce the auxiliary power and steam needed by the proposed CO_2 capture system. The captured CO_2 would be compressed to the pipeline pressure (i.e., 2,115 pounds per square inch absolute [psia]) and dehydrated within the CO_2 capture facility before delivery to the CO_2 pipeline. The compressed CO_2 would be a supercritical fluid (i.e., resembling a liquid but expanding to fill space like a gas) with a density heavier than air and a very low viscosity (i.e., flows readily).
2. ***CO_2 Pipeline:*** Captured CO_2 would be transported via a new, approximately 80-mile-long, 12-inch-diameter underground pipeline to the West Ranch oil field, located near the city of Vanderbilt in Jackson County, Texas. The anticipated pipeline route includes mostly rural and sparsely-developed agricultural lands in Fort Bend, Wharton, and Jackson Counties. NRG plans to use existing mowed and maintained utility rights-of-way (ROWs) to the extent practicable to minimize environmental impacts and avoid sensitive resources. As proposed, NRG's pipeline would be collocated along or within existing mowed and maintained utility ROWs (i.e., high-voltage transmission line [HVTL] and pipeline ROWs) for approximately 85% of the route. A joint venture between NRG and Hilcorp Energy Company (HEC), known as Texas Coastal Ventures LLC (TCV), would operate the pipeline.
3. ***EOR Operations:*** The Parish PCCS Project would deliver up to 1.6 million tons of CO_2 per year to the West Ranch oil field, where the CO_2 would be injected into the 98-A, 41-A, Glasscock, and Greta sand units of the Frio Formation, which lie approximately 5,000 to 6,300 feet bgs. The portions of the West Ranch oil field in which EOR operations would be conducted are currently owned or leased by TCV. HEC has been contracted to conduct the EOR operations.
4. ***CO_2 Monitoring Program:*** TCV would implement a program to monitor the injection and migration of CO_2 within the geologic formations at the EOR site based on a CO_2 Monitoring Plan developed in cooperation with the Texas Bureau of Economic Geology (BEG). In addition to satisfying the CO_2 monitoring requirements of the CCPI Program, the CO_2 monitoring program that would be conducted at the West Ranch oil field would be designed to satisfy the monitoring, sampling, and testing requirements of the Railroad Commission of Texas (RRC) certification program for tax exemptions related to use of CO_2 for EOR and use of CO_2 from anthropogenic sources.

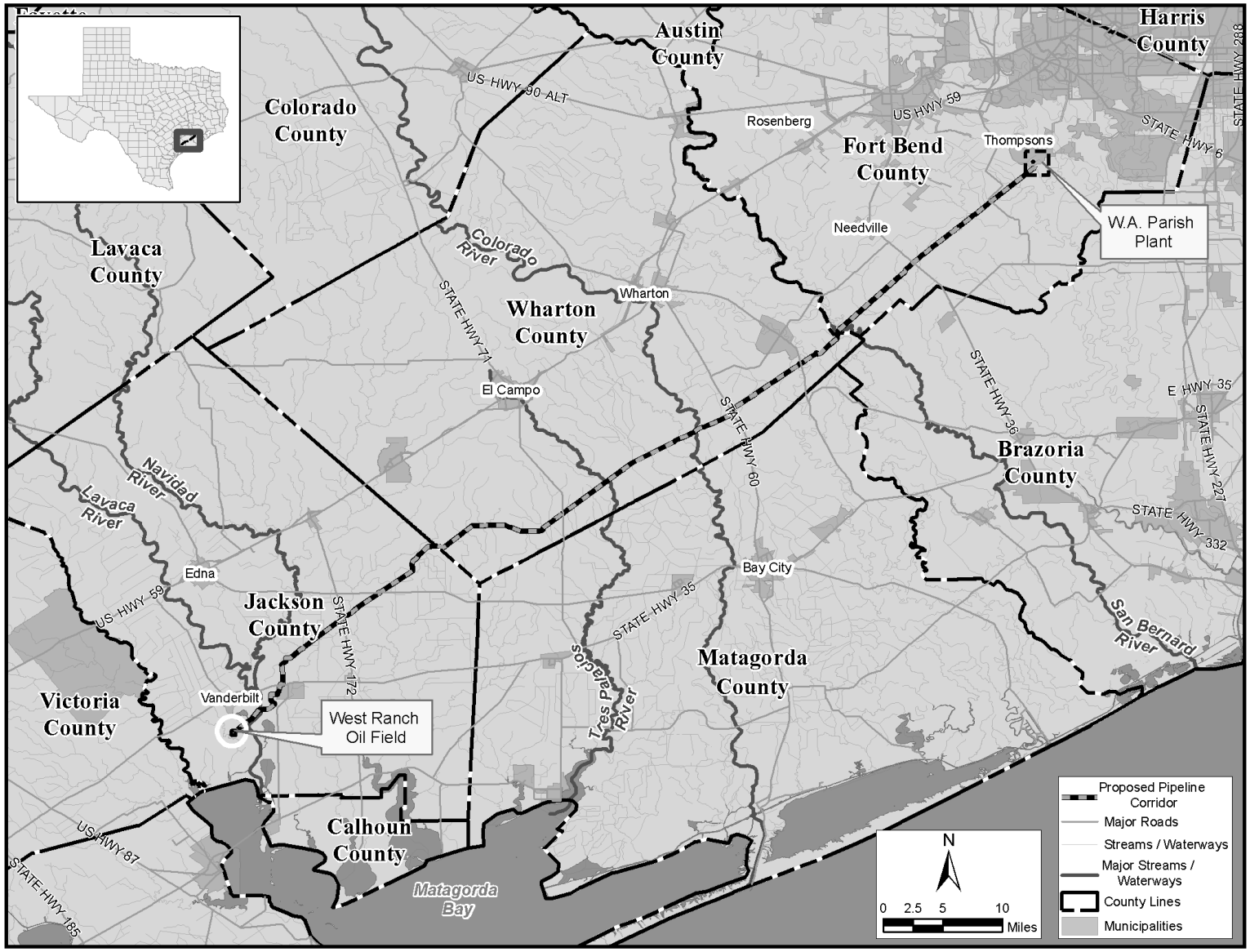

Figure S-1. Map of Project Area

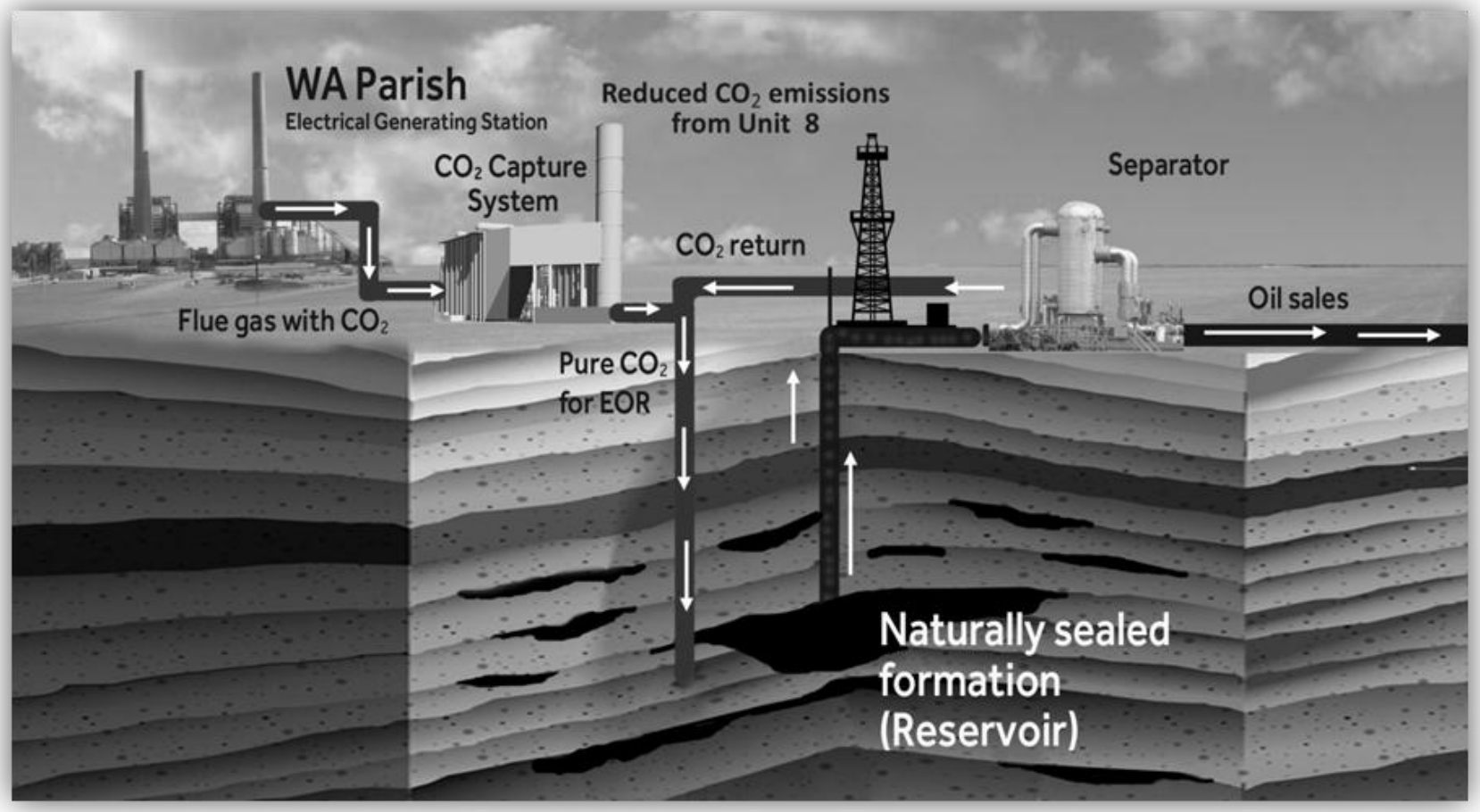

Figure S-2. Schematic of the PCCS Concept

Table S-1. Proposed Parish PCCS Project Features

Project Component	Description	Characteristics (Approximate Dimensions)
CO_2 Capture Facility	**Location:** A CO_2 capture facility would be constructed at NRG's W.A. Parish Plant. The facility would use an advanced amine-based absorption technology to capture CO_2 from a 250-MWe flue gas slipstream at the plant's 650-MW Unit 8 pulverized coal-fired electric generating unit. **Capacity:** Approximately 1.6 million tons of CO_2 per year.	**Facility Footprint:** 29 acres, as shown in Figure S-3
CO_2 Pipeline	**Route:** A new, approximately 80-mile-long, 12-inch-diameter underground pipeline would be collocated along or within existing mowed and maintained utility ROWs for approximately 85% of its length. Aboveground facilities would include approximately 12 main line valves (MLVs) and two meter stations. One meter station would be located within the W.A. Parish Plant. The second meter station would be located near milepost (MP) 76.5. **Operator:** TCV would own, operate, and maintain the pipeline.	**Construction ROW Width:** Generally 100 feet, reduced to 75 feet in some areas to minimize impacts to wetlands **Permanent ROW Width:** 30 feet **MLV Area:** 100 square feet **Meter Station Area:** 0.25 acres
EOR Operations	**Location:** The approximately 5,500-acre EOR area would be located within the portion of the West Ranch oil field currently owned/leased by TCV. A central CO_2 recycle facility would be constructed near the center of the EOR area in a disturbed area previously occupied by a gas processing facility. **Quantity:** TCV estimates that approximately 9 injection wells and 16 production wells would be used initially for EOR operations. As many as 130 injection wells and 130 production wells would be used over the 20-year span of the project. Existing wells at the West Ranch oil field would be used (i.e., refurbished or deepened as needed) to the extent practicable for the proposed project. New injection wells would be drilled if the existing wells cannot be reworked for injection. New wells would be installed on existing well pads to the extent practicable. As shown in Figure S-4, injection and production wells would be arranged in overlapping 5-spot patterns. Each 5-spot pattern would consist of four injection wells surrounding one production well. Each injection well would be installed to a sufficient depth that it could be used for injection into the 98-A, 41-A, Glasscock, and Greta sand units. A schematic illustrating the EOR process is provided in Figure S-5.	**Facility Footprint:** 5,500 acres **Well Configuration:** Overlapping, 5-spot patterns, 40 acres each pattern **Well Depths:** 5,000 to 6,300 feet bgs **Well Construction Areas:** 0.5 to 2.0 acres per well site **Well Operational Areas:** 0.01 to 0.5 acres per well site **CO_2 Recycle Facility Area:** 250 feet by 250 feet (1.5 acres)
CO_2 Monitoring Program	**Location:** Each monitoring well would be located within approximately 1,500 to 3,000 feet of an injection well. Existing wells would be used to the extent practicable to minimize the number of new wells needed. **Quantity:** Approximately 10 to 13 monitoring wells (i.e., one monitoring well for each 10 to 15 injection wells), including some wells monitoring above the injection zones and some monitoring within the injection zones.	**Well Depths:** 1,500 to 6,300 feet bgs **Well Construction Areas:** 0.5 to 2.0 acres per well site **Well Operational Areas:** 0.01 to 0.5 acres per well site
Access Roads	**W.A. Parish Plant:** As shown in Figure S-3, one road (approximately 1,000 feet long, included in 29-acre area discussed above) would be relocated. **CO_2 Pipeline:** Approximately 40 miles of existing roads would be used to access the construction ROW. Some roads may be upgraded (i.e., resurfaced and/or widened) to make them suitable for use by construction equipment. **West Ranch oil field:** Existing roads would be used to the extent practicable to access EOR and CO_2 monitoring areas. No new road construction is anticipated.	**Construction Width:** 30 feet **Permanent Width:** 20 feet

bgs = below ground surface; CO_2= carbon dioxide; EOR = enhanced oil recovery; MLV = main line valve; MP = milepost; MW = megawatt; MWe = megawatt equivalent; ROW = right-of-way; tpy = tons per year; TCV = Texas Coastal Ventures LLC; UIC = Underground Injection Control

Figure S-3. Aerial Photo of W.A. Parish Plant Showing Areas Related to CO_2 Capture Facility Construction and Operations

CO_2 = carbon dioxide; HDD = horizontal directional drill; kV = kilovolt

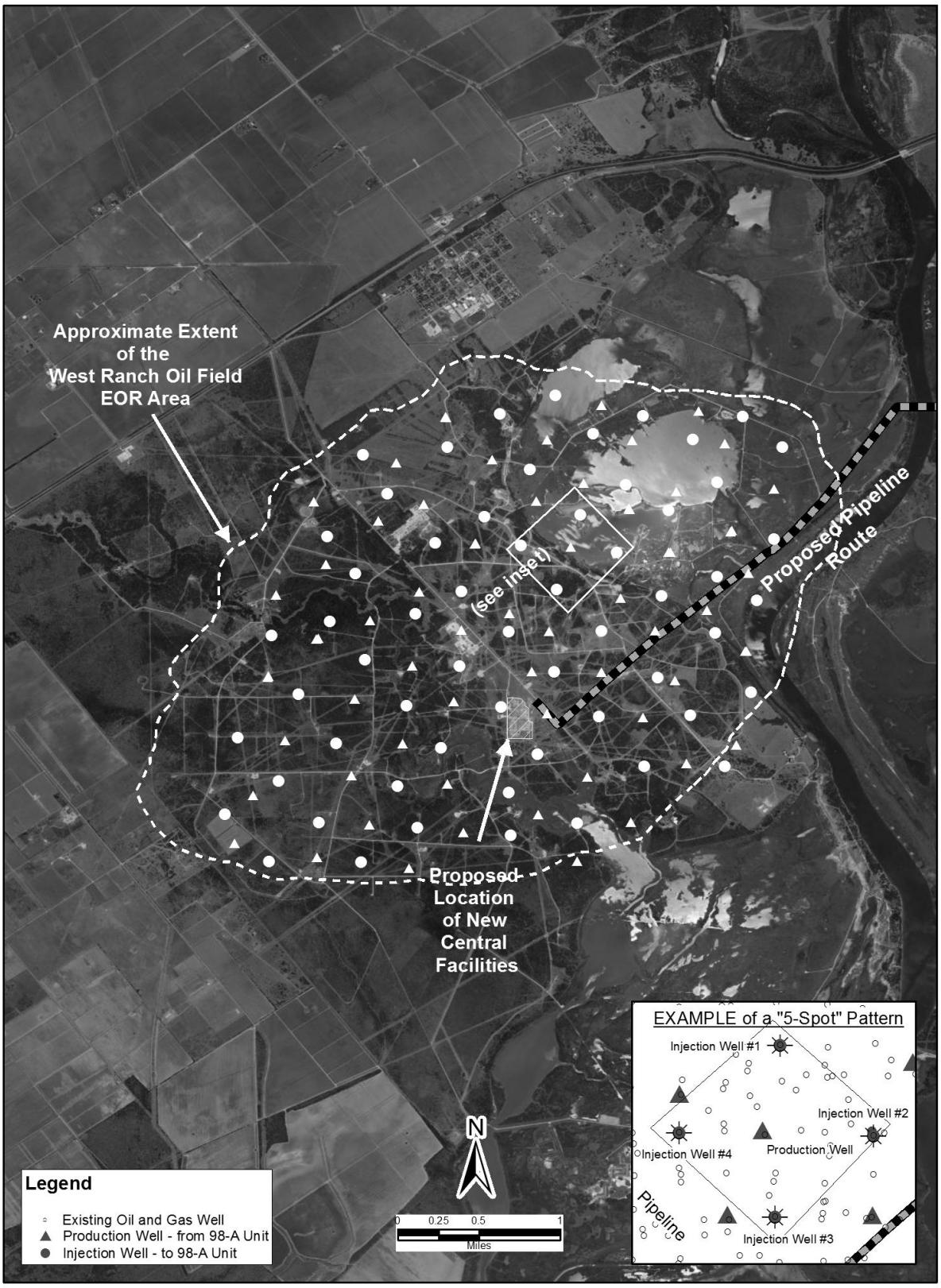

Figure S-4. Map of West Ranch Oil Field Showing Conceptual Arrangement of Injection and Production Wells for Proposed CO_2 Flood

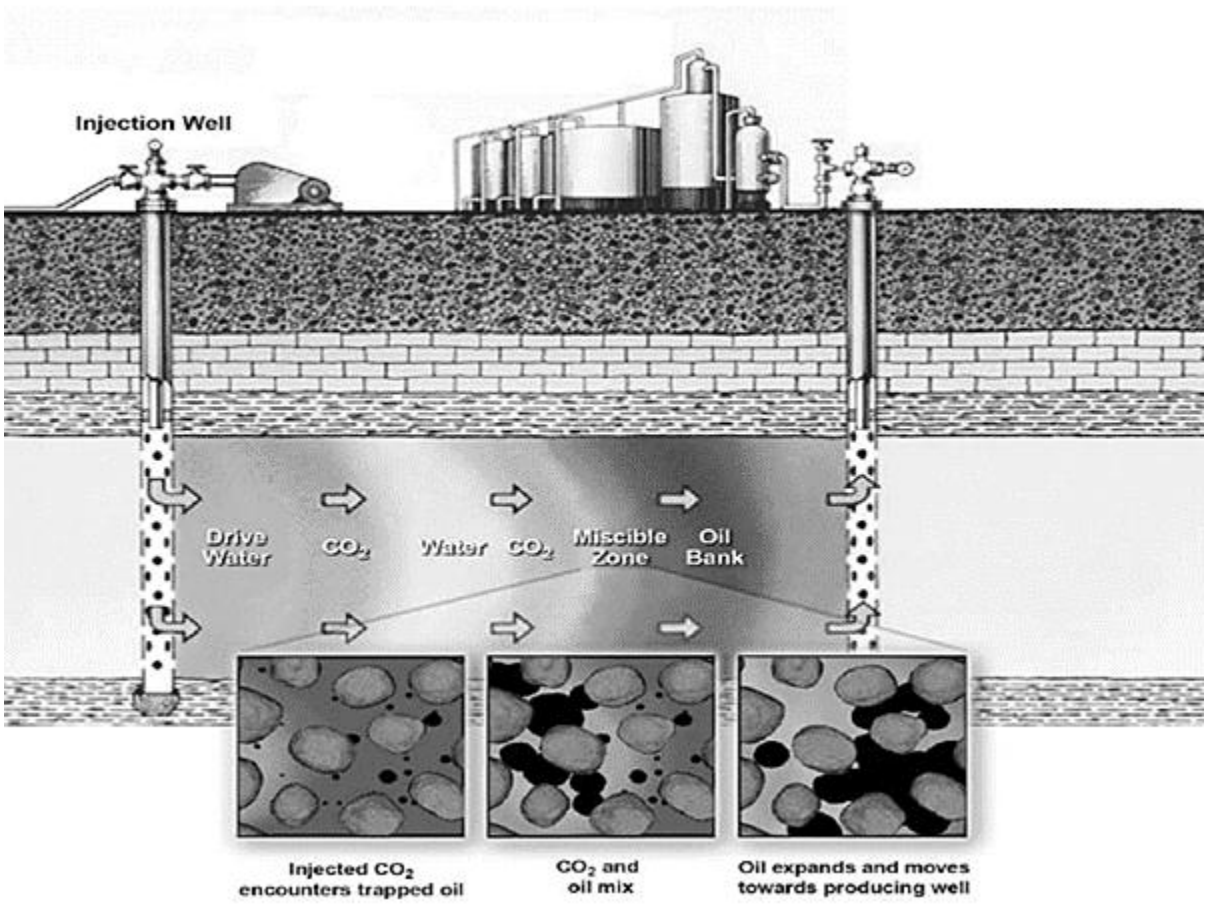

Figure S-5. Enhanced Oil Recovery Schematic

Source: NETL 2010.

The demonstration phase of the proposed project is currently scheduled to last for 35 months, according to the terms and conditions of the cooperative agreement between DOE and NRG. NRG would ultimately determine how long to continue running the CO_2 capture system following the demonstration phase based on a variety of factors, including potential future CO_2 legislation and regulations, process performance, and overall economics. For the purposes of this EIS, DOE assumes the CO_2 capture system would continue to operate for 20 years.

CO_2 capture facility construction is planned to start in late 2012, at the earliest, and take approximately 24 months to complete. Construction would be followed by a three- to six-month commissioning and start-up period to verify that all process systems function properly and achieve project requirements. The phases of construction would include site grading and preparation, the erection of administrative facilities, installation of piles and foundations, assembly of structural steel and building enclosures, and installation of mechanical and electrical systems. The number of construction workers would vary during the two-year construction period, ranging from 250 to 600 persons during the various phases of construction and averaging approximately 360 personnel. The largest demand for construction workers would likely occur approximately six months after the start of construction, when approximately 600 construction workers would be on site to construct the mechanical and electrical systems. Construction materials and equipment would be delivered by trucks and rail; however, construction-related rail traffic would be minimized to reduce the potential for disruption of coal deliveries. To operate the systems installed as part

of the Parish PCCS Project, the W.A. Parish Plant would require approximately 15 additional full-time personnel.

Construction of the proposed CO_2 pipeline would take place over approximately six months beginning in April 2014. Construction techniques may include excavated trenching, boring, tunneling, and horizontal directional drilling (HDD). During pipeline construction, materials would be staged adjacent to the pipeline ROW or trucked in as necessary. The phases of construction would include clearing the ROW of trees and brush; grading the ROW; trenching or drilling, as applicable; pipe welding; pipe inspection; application of coating to welded areas; placing pipe; hydrostatic testing; backfilling; and site restoration. The pipeline would be covered by a minimum of three feet of compacted soil, but would be buried deeper (e.g., minimum of four feet in cultivated areas) or would be encased in reinforced concrete when needed to accommodate planned surface activities. During trenching in agricultural areas and wetlands, topsoil would be temporarily stored separately from other excavated material and would be replaced as the upper-most soil layer following pipeline construction. NRG's current project design would use HDD construction techniques in seven sections of the proposed pipeline corridor, including five large water body crossings (i.e., Big Creek, San Bernard River, Colorado River, Jones Creek, and Lavaca River). NRG's current design also includes conventional bores for most road crossings to minimize traffic disruption. The pipeline construction workforce would average 300 workers and reach a peak of 500 workers over the six-month construction period. Construction activities would generally be conducted 10 hours per day and six days per week. Approximately two full-time personnel would be required for pipeline operations.

The proposed pipeline would deliver CO_2 to the West Ranch oil field at a central CO_2 recycle facility, which would be constructed in an area previously occupied by an oil field gas processing facility. The CO_2 recycle facility would likely be constructed using skid-mounted equipment on gravel pads and would require a work force of approximately 12 workers during the three-month construction period. TCV estimates that approximately 9 injection wells and 16 production wells would be used initially. The number of injection and production wells would increase over the duration of the project to as many as 130 injection wells and 130 production wells. TCV plans to use existing wells (i.e., refurbished or deepened as needed) to the extent practicable for the proposed project. New injection wells would be drilled if the existing wells cannot be reworked for injection. All new injection wells would require UIC permits and TCV would install the new injection wells in accordance with the design standards specified by the RRC UIC Program. New wells would be installed on existing well pads to the extent practicable. Because some EOR operations would be automated, TCV anticipates that no additional operations personnel would be required for the EOR operations. TCV and the BEG are in the process of developing a CO_2 Monitoring Plan, scheduled for completion in early 2013, to define the particular activities that would be conducted as part of the CO_2 monitoring program for the West Ranch oil field. TCV and the BEG would conduct a variety of monitoring and modeling activities as part of this program to monitor the injection and migration of CO_2 within the geologic formations at the EOR site. As discussed in Chapter 2 of this EIS (Proposed Action and Alternatives), these monitoring and modeling activities may include preparing static and dynamic reservoir models of the proposed EOR area; conducting well integrity reviews and inspections; performing borehole seismic surveys and/or gravity surveys; performing gas tracer tests; and conducting groundwater and soil gas monitoring around the proposed EOR area. Approximately three full-time personnel would be required to implement the CO_2 monitoring program.

Table S-2 summarizes some of the key requirements and characteristics of the Parish PCCS Project.

Table S-2. Project Requirements and Characteristics Summary

Requirement/ Characteristic	Description	Source/Provider
Potable Water	**W.A. Parish Plant:** *Construction*: Approx. 10,800 gpd; *Operations*: Approx. 450 gpd **Pipeline:** *Construction*: Approx. 12,750 gpd **West Ranch:** Negligible additional water	**W.A. Parish Plant:** *Construction*: W.A. Parish Plant and other local sources; *Operations*: Existing W.A. Parish Plant groundwater wells **Pipeline:** *Construction*: local sources **West Ranch:** On-site groundwater wells
Industrial Water	**W.A. Parish Plant:** *Construction*: Approx. 12,000 gpd over 24-month construction phase for dust control and general washdown and Approx. 3.5 million gallons for hydrotesting and system startup; *Operations*: Approx. 4 to 5 mgd (approx. 3.6 to 4.9 mgd for cooling tower make-up water, 0.1 mgd for the CT/HRSG, and 0.1 mgd for CO_2 capture system) **Pipeline:** *Construction*: Approx. 1.75 million gallons **West Ranch:** Negligible additional water needed; produced water would be used for anticipated industrial purposes	**W.A. Parish Plant:** Smithers Lake (new intake point) and existing W.A. Parish Plant groundwater wells **Pipeline:** *Construction*: trucked in or obtained from surface water **West Ranch:** On-site groundwater wells
Electricity Required during Operations	**W.A. Parish Plant:** *Operations*: Approx. 50 MW (full-load) **Pipeline:** *Operations:* To be determined during detailed design (for meter station) **West Ranch:** *Operations*: Approx. 36 MW for CO_2 compressor.	**W.A. Parish Plant:** proposed 80-MW cogeneration plant **Pipeline:** Drop line from existing retail power provider **West Ranch:** Purchase from existing retail power supplier
Sanitary Wastewater	**W.A. Parish Plant:** *Construction*: Approx. 5,625 to 11,250 gpd; *Operations*: Approx. 225 to 450 gpd **Pipeline:** *Construction*: Approx. 4,500 to 9,000 gpd; *Operations*: Negligible **West Ranch:** Negligible additional wastewater	**W.A. Parish Plant:** *Construction*: portable restroom trailers and local WWTP(s); *Operations*: W.A. Parish Plant WWTP **Pipeline:** *Construction*: portable restroom trailers and local WWTP(s); **West Ranch:** On-site septic system
Industrial Wastewater	**W.A. Parish Plant:** *Construction*: Approx. 3.5 million gallons (from hydrotesting and system startup); *Operations*: Approx. 7,200 to 36,000 gpd **Pipeline:** *Construction*: Approx. 1.75 million gallons **West Ranch:** Negligible additional water	**W.A. Parish Plant:** W.A. Parish Plant WWTP **Pipeline:** Disposed to ground or surface waterbodies per RRC and EPA regulations **West Ranch:** On-site injection well
Hazardous Waste Generation	**W.A. Parish Plant:** Reclaimer effluent would be generated by the CO_2 capture system at a rate of approx. 2,712 lbs per day; Approx. 24 truck shipments per year of reclaimer effluent would be removed from the W.A. Parish Plant. **Pipeline:** None **West Ranch:** None	**W.A. Parish Plant:** Licensed and approved off-site TSDF
Solid Waste Generation	**W.A. Parish Plant:** Rate of waste generation and number of shipments to be determined during detailed design **Pipeline:** Rate of waste generation and number of shipments to be determined during detailed design **West Ranch:** Rate of waste generation and number of shipments to be determined during detailed design	**W.A. Parish Plant:** WMI Coastal Plains or WMI Conroe **Pipeline:** Organic debris to be burned under controlled conditions within ROW; other waste to nearby landfill **West Ranch:** Recycled or landfarmed on-site or disposed of at VI Wolf, Inland Environmental, or other nearby landfill

Table S-2. Project Requirements and Characteristics Summary

<table>
<tr><th>Requirement/ Characteristic</th><th>Description</th><th>Source/Provider</th></tr>
<tr><td>Material Transport during Operations</td><td>W.A. Parish Plant: Approx. number of truck shipments per year for process materials required for CO_2 capture facility operation:
<table><tr><th>Materials</th><th>Truck Shipments</th></tr><tr><td>Amine-Based Solvent</td><td>24 per year</td></tr><tr><td>10% carbohydrazide</td><td>2 per year</td></tr><tr><td>Ferric chloride coagulant</td><td>20 per year</td></tr><tr><td>Polymer</td><td>2 per year</td></tr><tr><td>Caustic</td><td>2 per year</td></tr><tr><td>Sulfuric Acid</td><td>50 per year</td></tr><tr><td>Hypochlorite</td><td>50 per year</td></tr><tr><td>Sodium bisulfate</td><td>2 per year</td></tr></table>Pipeline: None
West Ranch: To be determined during detailed design</td><td>W.A. Parish Plant: Commercial vendors, shipped by commercial carriers</td></tr>
<tr><td>Construction and Operational Emissions</td><td>Construction Emissions (tons):<table><tr><th>Com-pound Emitted</th><th>Pipeline (2013)</th><th>CO_2 Capture Facility (2013)</th><th>CO_2 Capture Facility (2014)</th><th>Total</th></tr><tr><td>CO</td><td>8.73</td><td>5.59</td><td>5.27</td><td>19.6</td></tr><tr><td>NO_x</td><td>22.2</td><td>17.4</td><td>13.3</td><td>53.0</td></tr><tr><td>PM_{10}</td><td>1.60</td><td>1.37</td><td>1.15</td><td>4.12</td></tr><tr><td>SO_2</td><td>124.1</td><td>119.4</td><td>92.8</td><td>336.3</td></tr><tr><td>VOC</td><td>1.62</td><td>1.44</td><td>1.27</td><td>4.33</td></tr></table>Operational Emissions (tpy):<table><tr><th>Com-pound Emitted</th><th>CO_2 Capture Facility</th><th>CO_2 Recycle Facility</th><th>Total</th></tr><tr><td>CO</td><td>102.1</td><td>9.6</td><td>111.7</td></tr><tr><td>NO_x</td><td>37.6</td><td>10.3</td><td>47.9</td></tr><tr><td>PM_{10}</td><td>75.1</td><td>0.7</td><td>75.8</td></tr><tr><td>$PM_{2.5}$</td><td>71.7</td><td>0.7</td><td>72.4</td></tr><tr><td>SO_2</td><td>6.9</td><td>0.1</td><td>7.0</td></tr><tr><td>VOC</td><td>65.1</td><td>14.6</td><td>79.7</td></tr></table>VOC and NO_x emissions from the CO_2 capture facility exceed major source thresholds; therefore, NRG must obtain and retire VOC emission reduction credits (ERCs) and NO_x Mass Emission Cap & Trade (MECT) allowances to reduce the total net project increases of these ozone precursors (i.e., NO_x and VOC) within the Houston Galveston Brazoria Metropolitan Statistical Area (HGB MSA). NRG would be required to purchase and retire 1.3 tons of credits or allowances, as applicable, for each ton of emission increase related to the Parish PCCS project.</td><td>Construction emissions are from material handling (e.g. dirt moving) and emissions from combustion of fuel (i.e., gasoline and diesel) in mobile sources, which are mainly non-road construction equipment.
Operational emissions related to the CO_2 capture facility are from the CO_2 capture system, the CT/HRSG, the cooling tower, the emergency generator, and fugitive sources. Operational emissions from the CO_2 recycle facility are estimated based on reported emissions for the CO_2 recycle facility located at the West Hastings oil field in Alvin, Texas.</td></tr>
</table>

Table S-2. Project Requirements and Characteristics Summary

Requirement/ Characteristic	Description	Source/Provider
Flue Gas Inlet and Outlet Characteristics	**W.A. Parish Plant:** General characteristics of the flue gas feed to CO_2 capture system, the treated flue gas vent to atmosphere, and the compressed CO_2 product stream are as follows (NRG 2012g):	Flue gas obtained from 250-MWe flue gas slipstream of combustion exhaust gases from existing 650-MW coal-fired Unit 8 Treated flue gas vented from a new stack (i.e., the CO_2 scrubber vent).in the CO_2 capture facility; CO_2 product is pumped to the CO_2 pipeline

Stream Description	Flue Gas Feed	Treated Flue Gas	CO_2 Product
Component Concentrations			
H_2O	18.0%	9.8%	100 ppmv
CO_2	11.5%	1.4%	>99.96%
N_2	65.4%	82.3%	226 ppmv
Ar	0.8%	1.0%	5 ppmv
O_2	4.3%	5.5%	<10 ppmv
SO_2	60.6 ppmv	0.0 ppmv	0.0%
SO_3	1.2 ppmv	1.5 ppmv	0.0%
NO	26.0 ppmv	32.7 ppmv	0.0%
NO_2	1.4 ppmv	0.1 ppmv	0.0%
HCl	2.2 ppmv	0.0 ppmv	0.0%
HF	0.6 ppmv	0.0 ppmv	0.0%
NH_3	1.3 ppmv	<1 ppmv	0.0%
Amine-Based Solvent	0.0 ppmv	<1 ppmv	0.0%
Acetaldehyde	0.0 ppmv	2.1 ppmv	0.0%
Other Characteristics			
Temperature, ºF	165	114	102
Pressure, psia	14.6	14.7	2,115
Total Flow, lb/hr	2,723,940	2,108,470	438,780

% = percent; °F = degrees Fahrenheit; Approx. = Approximately; Ar = argon; CO = carbon monoxide; CO_2 = carbon dioxide; CT/HRSG = combustion turbine/heat recovery steam generator; ERC = emission reduction credit; gpd = gallons per day; H_2O = water; HCl = hydrochloric acid; HF = hydrofluoric acid; lbs = pounds; lb/hr = pounds per hour; MECT = Mass Emission Cap & Trade; mgd = million gallons per day; MW = megawatt; MWe = megawatt equivalent; N_2 = nitrogen; NH_3 = ammonia; NO = nitrogen oxide; NO_2 = nitrogen dioxide; NOx = nitrogen oxides; O_2 = oxygen; ppmv = parts per million by volume (1 ppmv = 0.0001%); $PM_{2.5}$ = particulate matter with a diameter of 2.5 microns or less; PM_{10} = particulate matter with a diameter of 10 microns or less; psia = pounds per square inch absolute; SO_2 = sulfur dioxide; SO_3 = sulfur trioxide; tpy = tons per year; TSDF = treatment, storage, and disposal facility; WWTP = wastewater treatment plant; VOC = volatile organic compounds

ALTERNATIVES CONSIDERED BY NRG

NRG considered a number of design alternatives for the various components of the Parish PCCS Project while preparing its response to the FOA and during the preliminary design phase that followed DOE selection. As discussed below, these alternatives included locations for the CO_2 capture facility, methods of CO_2 capture, locations for the EOR field, and pipeline routes to the selected EOR site.

During preparation of its proposal, NRG reviewed the many power plants that it owns or operates as candidates for a large, integrated PCCS project. The primary criteria for selection were for a plant to have a sufficiently large coal-fired unit and for the plant to be located in proximity to oil fields suitable for tertiary recovery. NRG's W.A. Parish, Big Cajun II, and Limestone Plants met these criteria. NRG selected the W.A. Parish Plant because more oil fields that are suitable for tertiary recovery occur in the area.

NRG's project and technology selection process for the CO_2 capture facility focused on the set of commercially available post-combustion CO_2 capture technologies. Among the technologies currently available, only a few chemical absorption processes using ammonia or aqueous amines were determined to be sufficiently proven for a commercial-scale application. For this reason, and because an ammonia absorption project had already been selected as a demonstration project by the DOE CCPI program, NRG elected to scale up a comparatively proven advanced amine technology.

Prior to selection of the EOR site for this project, NRG approached the owners of several oil fields in the vicinity of the W.A. Parish Plant that NRG believed would be suitable for tertiary recovery using EOR. During this selection process, NRG determined that, of the prospective teaming partners who own or operate fields suitable for EOR along the Texas Gulf Coast, HEC was the candidate most aligned with the proposed project objectives. As a result, affiliates of NRG and HEC entered into a joint venture (i.e. TCV) and collectively determined that the West Ranch oil field was the most suitable candidate for the CO_2 injection and EOR component of this project.

After selecting the West Ranch oil field as the EOR site for this project, NRG considered several potential pipeline routes to convey CO_2 from the W.A. Parish Plant to the West Ranch oil field. The seven primary route alternatives considered by NRG, as described in the EIS, included:

- alternatives for routing the CO_2 pipeline through the W.A. Parish Plant from the compressor station at the CO_2 capture facility to the adjacent CenterPoint ROW;
- five alternate routes collocated with other utility or railroad ROWs from the W.A. Parish Plant to the West Ranch oil field; and
- two options for the approach to the West Ranch oil field from the adjacent South Texas Electric Cooperative (STEC) ROW.

NRG selected the pipeline route shown in Figure S-1 because it would minimize the length of the pipeline to approximately 80 miles and would be collocated along or within existing mowed and maintained utility ROWs for approximately 85% of its length, which would minimize potential environmental impacts by allowing NRG to use existing maintained ROW during construction. Additionally, this route avoids several riparian corridors and population centers that would have been crossed by more southerly routes, but it is not so far north as to impact development around the U.S. Highway 59 corridor.

CHARACTERISTICS OF THE AFFECTED ENVIRONMENT

The affected environment, also referred to as the region of influence (ROI), for the project was defined for each of 18 environmental resource areas depending on the extent of potential impacts resulting from plant and infrastructure construction and operation. The ROI includes, at a minimum, the proposed CO_2 capture facility areas at the W.A. Parish Plant, the proposed CO_2 pipeline corridor, and the proposed EOR area at the West Ranch oil field. However, the size of the ROI varies by resource depending on the extent of potential impacts on respective resources. Table S-3 summarizes the affected environment for each of the 18 resource areas. The affected environment for each of these resources is described in greater detail in Chapter 3 of the EIS.

Table S-3. Affected Environment of the Parish PCCS Project

Resource	Existing Conditions
Air Quality and Climate	With the exception of ozone in Fort Bend County, the National Ambient Air Quality Standards (NAAQS) promulgated by the EPA are being attained in the three counties in which components of the proposed project would be located (i.e., Fort Bend, Wharton, and Jackson Counties). Fort Bend County, in which the CO_2 capture facility and related infrastructure, along with a portion of the pipeline corridor, would be constructed and operated, has been classified as a severe nonattainment area for ozone.
Greenhouse Gases	In 2009, estimated U.S. CO_2 emissions totaled 5,426 million metric tons, including 2,160 million metric tons of CO_2 from generation of electricity. Emissions of CO_2 in Texas accounted for approximately 11% of total U.S. CO_2 emissions (i.e., 605.5 million metric tons) in 2009. Currently, there are no Texas regulations limiting greenhouse gas (GHG) emissions, including emissions of CO_2.
Geology	The Frio Formation is made up of several massive sand units that have created a number of highly prolific oil and gas reservoirs, including the West Ranch oil field. At the West Ranch oil field, the Frio Formation is approximately 5,000 to 7,200 feet below ground surface (bgs) and is capped by the Anahuac Formation, consisting of over 400 feet of low permeability calcareous shale with some occasional interlaminated sand lenses. A study near Beaumont, Texas, estimated the average permeability (to liquid) of the Anahuac Formation is approximately $5.2x10^{-6}$ millidarcies (mD). At the West Ranch oil field, the Frio Formation has held large quantities of buoyant fluids (i.e., oil and gas) over geologic time, indicating that very little migration occurs, if any, through the overlying Anahuac Formation. The Catahoula Sandstone is a very coarse-grained, homogenous sandstone unit found at a depth of approximately 4,250 to 4,500 feet bgs into which excess produced water is currently reinjected at the West Ranch oil field. The Burkeville confining system, which overlies the Catahoula Sandstone, consists primarily of silt and clay with a typical thickness ranging from approximately 300 to 500 feet. Southeastern Texas exhibits low seismicity and there are no major mapped faults within or near the proposed project areas. The risk of seismic events (i.e., earthquakes) occurring within the proposed project area is therefore very low. The BEG conducted a geophysical-log-based evaluation of regional structural features in the vicinity of the West Ranch oil field, which identified two growth faults in the deep subsurface to the northwest and southeast of the West Ranch oil field. The shallowest expression of the two faults is approximately 2,500 feet below mean sea level (msl) and both faults extend through the Greta, Glasscock, 41-A, and 98-A sand units of the Frio Formation. An approximately 200-foot offset of geologic strata on either side of the fault to the northwest of the oilfield reveals the simple domal structure that is responsible for hydrocarbon trapping in the West Ranch oil field. Neither of these faults extends upward to land surface nor do they lie within the boundaries of the West Ranch oil field (Appendix I, Figures 4 through 8). There are no obvious or large-scale faults within the West Ranch oil field itself.
Physiography and Soils	The project area is located in the Gulf Coastal plain, which is a low-lying area that has a gradual rise from sea level (at the Gulf of Mexico) in the south and east up to an elevation of about 900 feet above msl to the north and the west. The physiography originated from the deposition of sediments around the margins of the Gulf of Mexico in fluvial-deltaic to shallow-marine environments. In the vicinity of the project, most of the land is nearly flat (< 1 percent slope) with very small areas of slightly sloping land (< 8 percent, mostly < 3 percent). Approximately 600 acres in the construction ROW is classified as Prime Farmland and less than 20 acres classified as more than slightly erodible (i.e., moderately to severely erodible).
Groundwater	The major aquifer beneath the proposed project area is the Gulf Coast Aquifer, which is divided into four hydrostratigraphic units: the Chicot Aquifer, Evangeline Aquifer, Jasper Aquifer, and the Catahoula Confining System (aka, the Catahoula Restricted Aquifer). The Catahoula Confining System is composed of (in descending order) the Catahoula Sandstone, the Anahuac Formation, and the Frio Formation. The Chicot and Evangeline Aquifers are the primary underground sources of drinking water (USDWs) in the area. The only minor aquifer in the proposed project area is the Brazos River Alluvium Aquifer, which terminates north of the project area, but is hydraulically connected to the Brazos River, which supplies water to Smithers Lake for use by the W.A. Parish Plant.

Table S-3. Affected Environment of the Parish PCCS Project

Resource	Existing Conditions
Surface Water	The W.A. Parish Plant is located within the Brazos River Basin, immediately south of Smithers Lake, which is a 2,430-acre man-made lake with a capacity of about 18,000 acre-feet (AF) of water. The W.A. Parish Plant uses approximately 34 to 50 mgd (38,000 to 56,000 AF per year) of surface water from Smithers Lake, which receives water from the Brazos River, and discharges storm water and treated wastewater to the lake through permitted outfalls. The pipeline corridor would traverse several Texas coastal river basins. Surface water bodies drain these basins from the northwest to the southeast across the generally low topographic relief of coastal Texas towards the Gulf of Mexico. The pipeline would cross 210 waterbodies (23 perennial streams/rivers, 32 intermittent or ephemeral streams/rivers, 3 ponds, and 152 canals/ditches), including three major rivers (i.e., the San Bernard, Colorado, and Lavaca Rivers). The proposed pipeline would cross six waterbodies designated as Ecologically Significant Stream Segments (i.e., Big Creek, the San Bernard River, Cedar Lake Creek [aka Caney Creek], the Colorado River, West Carancahua Creek, and the Lavaca River) and two waterbodies designated by the State of Texas as impaired (i.e., the San Bernard River, which is listed for bacteria, and Caney Creek, which is listed for bacteria and low dissolved oxygen). The West Ranch oil field is located near the juncture of the Lavaca, Lavaca-Guadalupe, and Colorado-Lavaca River Basins. Waterbodies within the oil field ROI include the Lavaca River, the Navidad River, Venado Creek, Garcitas Creek, the Menefee Lakes, Redfish Lake, and the Venado Lakes. The Lavaca Bay/Chocolate Bay Estuary and associated tributaries, including Garcitas Creek are designated by the State of Texas as impaired for low dissolved oxygen. Additionally, the nearby oyster waters of Lavaca Bay and Chocolate Bay are designated as impaired because of bacteria.
Wetlands and Floodplains	There are no wetlands located within the area proposed for the CO_2 capture facility, but some project infrastructure may be located within approximately 50 to 200 feet of a wetland (i.e., Smithers Lake and associated canals). Approximately 117 acres of wetlands are located within the proposed pipeline construction ROW, including the following types: 99 acres of palustrine emergent, 2 acres of palustrine scrub-shrub, 1 acre of palustrine forested, 9 acres of riverine, and 6 acres of drainage ditches. These 117 acres of wetlands include several large fallow rice fields, which are categorized as palustrine emergent wetland areas, and a large gulf cordgrass (*Spartina spartinae*) marsh between the Lavaca River and the West Ranch oil field. The northern portion of the EOR area at the West Ranch oil field includes a wetland near Menefee Lake, classified as estuarine and marine wetland/deepwater by the National Wetland Inventory (NWI). Venado Creek, which crosses the EOR area at the West Ranch oil field, is classified by the NWI as estuarine and marine wetland and fresh water emergent wetland. The NWI also identifies several small fresh water ponds and a small estuarine and marine deepwater habitat within the area. There are no wetlands located within the area proposed for the CO_2 recycle facility. The area proposed for the CO_2 capture facility is located outside of the 100-year and 500-year floodplains identified by FEMA, but some project infrastructure may be located within approximately 50 to 200 feet of a floodplain (i.e., Smithers Lake and associated canals). The proposed pipeline corridor crosses FEMA 100-year and 500-year floodplains in 32 locations including areas adjacent to the following waterbodies: Colorado River, Lavaca River, Blue Creek, Juanita Creek, San Bernard River, and Tres Palacios River. The EOR area at the West Ranch oil field includes the FEMA 100-year and 500-year floodplains of Venado Creek, the Lavaca River, Menefee Lake, and Menefee Bayou. The land area proposed for the CO_2 recycle facility is located outside of the FEMA 100-year and 500-year floodplains.
Biological Resources	The CO_2 capture facility ROI has been previously disturbed (i.e., cleared and graded) and provides poor habitat quality for most wildlife species. Most of the proposed pipeline corridor consists of previously cleared utility ROW, which is maintained a minimum of once every four years, and agricultural land. Approximately 10% of the proposed pipeline construction ROW is classified as natural systems. The dominant land cover types in the West Ranch oil field EOR area, which is currently used for oil and gas production and cattle pasture, are pasture/hay/grassland/herbaceous, shrub/scrub, developed (open space/low density), emergent herbaceous wetlands, and woody wetlands. Three federally listed endangered species (Whooping crane, West Indian manatee, and Texas prairie dawn-flower) potentially occur in the three-county ROI (i.e., Fort Bend, Jackson, or Wharton Counties), which is located within the Western Gulf Coastal Plain EPA Level III

Table S-3. Affected Environment of the Parish PCCS Project

Resource	Existing Conditions
	Ecoregion. The West Indian manatee is a marine species and its occurrence in the ROI is very unlikely. The Lavaca River may provide suitable habitat, but there are no documented sightings of a West Indian manatee in the ROI and none were observed during field surveys. The ROI includes no suitable habitat (i.e., pimple mounds) for the Texas prairie dawn and no designated critical habitat for the whooping crane. A large wetland habitat is present within the proposed pipeline route between the West Ranch oil field and the Lavaca River which has the potential to provide habitat for the whooping crane. However, this area is adjacent to an active oil field, which would make it less attractive for use by whooping cranes than other wetland habitats in the vicinity. There are no documented sightings of whooping cranes within the ROI and none were observed during field surveys. The State of Texas has identified five previously used nesting areas within the ROI that are no longer in use, including a previously used colonial waterbird rookery near the W.A. Parish Plant, two previously used bald eagle nest near the W.A. Parish Plant in Fort Bend County, a previously used bald eagle nest along the boundary of Fort Bend and Wharton Counties, and a previously used bald eagle nests in Jackson County. An active bald eagle nest was observed adjacent to the proposed pipeline corridor in Wharton County near Jones Creek. The bald eagle is afforded federal protection under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act and is a protected species in the State of Texas. Other than the single active bald eagle nest, no state-listed species were identified during field surveys.
Cultural Resources	No State Archeological Landmarks, Texas Historic Landmarks, National Register historic buildings, or historic structures are located within the ROI. Three previously identified prehistoric lithic artifact scatters are situated within the ROI of the W.A. Parish Plant (along the southern shore of Smithers Lake and/or Dry Creek/Rabbs Bayou), but none were considered eligible by the Texas Historical Commission (THC) for listing in the National Register of Historic Places (NRHP). No known historic buildings, features, or above-ground properties listed, or eligible for listing, on the NRHP are recorded within the ROI for the proposed pipeline. Only one previously identified archaeological site is located within the ROI. This site is a prehistoric period lithic site located along the Lavaca River in Jackson County that has not been assessed for its eligibility to be listed in the NRHP. During the Phase I inventory study of the proposed pipeline construction ROW, six archaeological sites (2 prehistoric and 4 from historic periods) were identified within the pipeline construction ROW and a total of 12 buildings (6 in Fort Bend County, 5 in Wharton County, and 1 in Jackson County) greater than 45 years of age were identified within 164 feet (50 meters) of the pipeline construction ROW or associated access roads. The 12 buildings were predominantly National-style structures (6 structures), but also included two structures of undetermined design (due to inaccessibility) and single examples of a barn, a Spanish Eclectic structure, a railroad bridge, and an I-house. Most of the structures (i.e., 10 of 12) were built between ca. 1930 and the 1950s, with single examples noted from the 1890s to 1900s and 1920s to 1930s. No State Archeological Landmarks, Texas Historic Landmarks, National Register historic buildings or historic structures have been identified within the ROI of the West Ranch oil field. Nine previously identified archaeological sites have been identified within the ROI. Most of these sites are located along the boundaries of Venado Creek, with a single site by Menefee Lake. All of these sites are identified as prehistoric lithic scatters, except for one site which also contained prehistoric ceramics. Information regarding eligibility for listing on the NRHP is not available. The THC identified the following Native American Tribes that may have an interest in activities in the proposed project area: the Alabama-Coushatta Tribe of Texas, the Apache Tribe of Oklahoma, the Comanche Nation of Oklahoma, the Coushatta Tribe of Louisiana, the Kiowa Indian Tribe of Oklahoma, the Mescalero Apache Tribe of the Mescalero Reservation, the Tonkawa Tribe of Indians of Oklahoma, and the Tunica-Biloxi Indian Tribe of Louisiana. DOE sent letters to these tribes but has received no responses to date.

Table S-3. Affected Environment of the Parish PCCS Project

Resource	Existing Conditions
Land Use and Aesthetics	The proposed CO_2 capture facility would be constructed in Fort Bend County in areas within the existing W.A. Parish Plant that are currently in industrial use. The proposed CO_2 pipeline would cross lands used for utility (HVTL and pipeline) ROWs, livestock grazing, cultivated agriculture, and open space in Fort Bend, Wharton, and Jackson Counties. Approximately 85% of the pipeline corridor would be collocated with existing utility ROWs. The proposed EOR area would be constructed within the West Ranch oil field in an area used for oil and gas production and cattle pasture. Fort Bend, Wharton, and Jackson Counties have no land use plans, zoning, or development standards that would apply to the proposed project.
Traffic and Transportation	Access from Highway 59 to the W.A. Parish Plant is via Farm-to-Market Road (FM) 762 and Smithers Lake Road to the west side of the plant and via FM 2759, North Thompson Road, and Y U Jones Road to the east side of the plant. The proposed pipeline crosses several public roadways, all of which have two lanes and operate in a free-flowing manner with little congestion. Highway access to the West Ranch oil field is via State Highway 87 to FM 616 from the west or via FM 234 South to FM 616 from the east. The W.A. Parish Plant uses its rail facilities primarily for coal delivery. On average, the plant unloads two to three trainloads of coal each day, with each train averaging approximately 128 rail cars.
Noise	Dominant noise sources in the vicinity of the proposed CO_2 capture facility include power plant operation, coal train traffic and unloading, and use of heavy industrial vehicles. The nearest sensitive receptors to the proposed CO_2 capture facility are the rural residential communities near the perimeter of the W.A. Parish property (i.e., approximately 0.5 miles east, 1.5 miles to the southwest of the project site, 3 miles to the east, and 3 miles to the northwest) and a church located approximately 2.5 miles northeast of the proposed project site. The proposed pipeline would traverse primarily agricultural and rural residential areas, in which typical ambient noise levels are estimated to range between 28 and 38 dBA in calm weather conditions. Average noise levels are expected to be higher near roadways due to vehicle traffic. The existing noise at the West Ranch oil field comes from a number of sources, including truck traffic, drilling and associated activities, and well pumps and compressors. The nearest residential community is the town of Vanderbilt, located approximately 0.5 miles north of the northern perimeter of the West Ranch oil field and 2.3 miles north of the proposed location of the central CO_2 recycle facility. The nearest non-residential sensitive receptors include the Industrial Independent School District Junior and Senior High Schools, the Vanderbilt Baptist Church, and the St. John Bosco Catholic Church in the town of Vanderbilt.
Materials and Waste Management	The W.A. Parish Plant and the West Ranch oil field have current suppliers for the types of construction and operational materials that would be needed for the proposed project, including preferred providers for management of solid and hazardous wastes. The West Ranch oil field also operates injection wells permitted for the disposal of excess produced water. The W.A. Parish Plant is currently a conditionally exempt small quantity generator, but conforms to the requirements of a large quantity generator for consistency with other NRG facilities.
Human Health and Safety	Of the three counties in the ROI, Fort Bend County has the best overall health ranking (i.e., #9 of 221 Texas counties). Health rankings for Wharton and Jackson Counties are generally not as good as Fort Bend County for most indicators but neither county is consistently better than the other. Wharton County is ranked #61 of 221 Texas counties in overall health and Jackson County is ranked #57. All three counties in the ROI have better overall health rankings than over half of the counties in the state of Texas. Wharton and Jackson Counties had higher incidences of cancer deaths when compared to the average cancer rate for Texas, while Fort Bend County had a lower incidence of cancer deaths. Occupational injury data from 2008 for industries related to the proposed project (i.e., utility, pipeline, and non-residential construction; oil and gas extraction; and electric power generation) reflect total recordable incident rates of between 1.4 and 4.4 cases per 100 workers per year, including between 0.4 and 1.5 lost work day cases per 100 workers per year and between 0.7 and 2.3 days away from work, job transfer, or restriction cases per 100 workers per year. The fatality rate for the utility; construction; oil & gas extraction; and installation, repair, and maintenance industries in 2008 were between 3.9 and 23.9 fatalities

Table S-3. Affected Environment of the Parish PCCS Project

Resource	Existing Conditions
	per 100,000 workers. The population density in a small area east of the W.A. Parish Plant and a larger area southwest of the plant is 100 to 500 people per square mile. The population density west of the plant is 26 to 50 people per square mile and the areas north and south of the plant are mostly unpopulated. The majority of the pipeline traverses areas with population densities of five or less people per square mile, with certain segments that have a population density as high as 100 to 500 people per square mile. The population densities are higher within 15 miles of the W.A. Parish Plant than along the remainder of the pipeline corridor. The areas surrounding the West Ranch oil field are primarily unoccupied, except for the town of Vanderbilt, north of the oil field, which has a population density of 25 to 50 people per square mile. Areas to the southwest and northeast of the oil field have population densities of 5 to 25 people per square mile. The winds in the ROI are predominately from the direction of the Gulf of Mexico (i.e., from the south and southeast).
Utilities	The W.A. Parish Plant generates its own electricity (3,865 MW total); operates its own WWTP, treating approximately 4,000 gpd of sanitary wastewater; obtains potable water from existing groundwater wells; and obtains water for industrial use from Smithers Lake and existing groundwater wells. The combined units at the W.A. Parish Plant use a maximum of approximately 27,500 million cubic feet of natural gas per hour. The West Ranch oil field has utility service in place for potable water, produced water management, electricity, and natural gas. Crude oil produced at the West Ranch oil field is currently transported off site by truck. Existing pipelines are in place to receive crude oil shipments from the West Ranch oil field. Wastewater produced at the West Ranch oil field is primarily disposed of by underground injection along with excess produced water.
Community Services	The combined number of law enforcement officers in the project area (Fort Bend, Wharton, and Jackson Counties) is between 1.6 and 2.35 officers per 1,000 residents, as compared to the State of Texas average of 2.2 officers per 1,000 residents. The average crime rate in the three-county area is 1,680 crimes per 100,000 residents as compared to the State of Texas average of 4,239 crimes per 100,000 residents. The W.A. Parish Plant's Emergency Response Team includes Environmental, Safety, and Health (ES&H) professionals; firefighters, emergency medical technicians (EMTs); and hazardous material (HAZMAT) response personnel. Emergency response services (i.e., fire, ambulance, and HAZMAT response) within the project area are also provided by the Richmond Fire Department and several volunteer fire departments (i.e., Thompsons, Wharton County, Edna, and Vanderbilt). There are 12 hospitals in the three-county area with a total of 1,139 hospital beds (i.e., 5.62 beds per 1,000 people). The schools in the three-county area have an average of 14.28 students per teacher, as compared to the maximum of 20 students per teacher specified in the Texas Education Code.
Socioeconomics	Of the five counties in the ROI, Fort Bend County was the most populous at 585,375 persons and Jackson County was the least populous at 14,075 persons, according to the 2010 Census. Fort Bend County also had the highest population density (679.5 persons per square mile), while Jackson County had the lowest population density (17.0 persons per square mile). Fort Bend County is expected to more than triple its population to 1,917,470 persons by 2040, while Matagorda County is anticipated to shrink in population by 9% (i.e., a reduction of nearly 3,300 persons) by 2040. Brazoria County is expected to more than double its population to 664,503 persons by 2040. Jackson and Wharton Counties are anticipated to experience modest growth (6.9% and 3.7%, respectively). There are 357,884 housing units in the ROI of which 14.5% are vacant. Additionally, there are 150 hotel/motel facilities within the five county ROI. Within the ROI, the residents of Brazoria, Fort Bend, and Jackson Counties had higher average per capita incomes than the State of Texas, which was $23,863 in 2010, while Matagorda and Wharton County residents had slightly lower average per capita incomes than the State of Texas. The county with the highest unemployment rate in 2010 was Matagorda County at 6.4%. The unemployment rates for the other four counties were between 3.4% and 4.0% unemployed, all of which were lower than the unemployment rate for Texas, which was 5.7% in 2010.

Table S-3. Affected Environment of the Parish PCCS Project

Resource	Existing Conditions
Environmental Justice	Members of minority populations accounted for approximately 29.6% of the population of Texas and 27.6% for the U.S. in 2010. The percentage of minority populations in Fort Bend, Wharton, and Jackson Counties was 49.5%, 27.9%, and 18.8%, respectively, in 2010. These three counties did not exhibit minority populations that are meaningfully greater than the state or U.S. minority population percentages. Of the nine census tracts within the ROI, the largest percentage of minority populations was 42.9%. None of the nine census tracts exhibited minority populations that were meaningfully greater than the corresponding county minority population percentage. Therefore, there are no minority environmental justice areas of concern within the ROI. The median household income was $48,615 for Texas and $51,914 for the U.S. in 2010. Of the three counties analyzed, Fort Bend County had the highest median household annual income ($79,845) with 9.1% of residents below the poverty line, while Wharton County had the lowest annual income ($41,148) with 17.2% of residents below the poverty line in 2010. For the nine census tracts within the ROI, the highest median household income in 2010 was $70,321 and the lowest was $26,818. The lowest percentage below the poverty line was 6.0% and the highest percentage was 23.3%, as compared to 17.9% for the State of Texas and 15.3% for the U.S. in 2010. Neither the three counties nor the nine census tracts in the ROI exhibited a median household income below the 2010 Health and Human Services Poverty Guidelines. Also, the three counties in the ROI did not exhibit low-income populations that are meaningfully greater than the state or U.S. low-income population percentages. Additionally, none of the nine census tracts exhibited low-income populations that were meaningfully greater than the corresponding county low-income population percentage. Therefore, there are no low-income environmental justice areas of concern within the ROI.

AF = acre-feet; BEG = Texas Bureau of Economic Geology; bgs=below ground surface; ca. = circa; CO_2 = carbon dioxide; dBA = decibel, A-weighted; EMT = emergency medical technician; EOR = enhanced oil recovery; EPA = U.S. Environmental Protection Agency; ES&H = environmental safety and health; FEMA = Federal Emergency Management Agency; FM = Farm-to-Market Road; GHG=greenhouse gas; gpd = gallons per day; HAZMAT = hazardous material; HVTL = high-voltage transmission line; mD = millidarcies; mgd = million gallons per day; msl = mean sea level; NAAQS = National Ambient Air Quality Standards; NRHP = National Register of Historic Places; NWI = National Wetland Inventory; ROI = region of influence; ROW = right of way; USDWs = underground sources of drinking water

ENVIRONMENTAL IMPACTS

DOE evaluated the potential impacts of the Proposed Action and the No-Action Alternative in relation to the baseline conditions described in Chapter 3 and summarized above. More detailed discussions of potential impacts are provided in Chapter 3. Table S-4 summarizes the potential impacts for each of the 18 resource areas for the No-Action Alternative and the Proposed Action.

The EIS uses the following descriptors to qualitatively characterize impacts on respective resources:

- ***Beneficial*** – Impacts would improve or enhance the resource.
- ***Negligible*** – No apparent or measurable impacts would be expected; may also be described as "no impact" if appropriate.
- ***Minor*** – Barely noticeable but measurable adverse impacts on the resource. Mitigation measures may be considered for these impacts.
- ***Moderate*** – Noticeable and measurable adverse impacts on the resource. Mitigation measures would usually be considered for these impacts.
- ***Substantial*** – Obvious and extensive adverse effects, and potentially significant impacts on a resource. Mitigation measures would be sought to reduce these impacts.

Table S-4. Summary of Environmental Impacts

No-Action Alternative	Proposed Action
Air Quality and Climate	
No impacts. The W.A. Parish Plant, pipeline corridor, and EOR area at the West Ranch oil field would remain in their current conditions. No changes to air quality would occur.	**Negligible to minor adverse impacts with some beneficial impacts.** Construction of the CO_2 capture facility, CO_2 pipeline, and EOR/CO_2 monitoring infrastructure would result in short-term, localized increased tailpipe and fugitive dust emissions. Emission rates for criteria pollutants would be less than 1% of the total emissions in the ROI, except PM_{10} emissions during 2013, which would account for 3.1% of total ROI emissions. Emission rates for ozone precursors (i.e., volatile organic compounds [VOC] and nitrogen oxides [NO_x]) during the construction phase of the project would be lower than thresholds documented in the EPA rules for General Conformity (40 CFR 94.153). Operational emissions from the pipeline corridor would be negligible. Operational emissions of criteria pollutants from the CO_2 capture facility and related infrastructure (e.g., CT/HSRG) and the CO_2 recycle facility would be less than 1% of the total emissions in the ROI. Operational emissions of NO_x and VOC would exceed the thresholds documented in the Conformity Rules. However, as part of the NNSR permitting process, NRG would be required to provide offsets (i.e., ERCs or allowances) to reduce the total net project increases of ozone precursors (i.e., NO_x and VOC) within the HGB MSA. VOC ERCs are generated when the holder of an existing air permit reduces existing emissions and registers the emissions reduction with the TCEQ. MECT allowances were granted by the TCEQ to regulate the emissions of NO_x in the HGB MSA. Credits and allowances can either be obtained from a broker maintaining a "bank" of emissions credits and allowances generated by previously completed emissions reduction projects, or can be obtained directly from another company. In either case, the credits and allowances must be registered with the TCEQ to qualify as offsets for a new project, such as the proposed Parish PCCS Project. Also, NRG would be required to purchase and retire 1.3 tons of credits or allowances, as applicable, for each ton of emission increase related to the proposed project. Due to the 1.3 to 1 retirement ratio of ERCs and allowances, the proposed project would result in no net adverse impact on air quality in the HGB MSA with regard to ozone. Therefore, adverse impacts to air quality in the ROI due to operational emissions from the proposed project would be considered negligible to minor with some beneficial impacts in the form of elimination of SO_2 emissions from the Unit 8 flue gas slipstream, as well as reduced emissions of HCl, HF, and NH_3. As part of the state air permit application process, NRG would be required to finalize a detailed air quality analysis that includes dispersion modeling to compare predicted ambient air quality concentrations to the National Ambient Air Quality Standards (NAAQS). The detailed air quality analysis is not yet available. However, the Texas Commission on Environmental Quality (TCEQ) would not be able to issue the permit unless the modeling shows that NAAQS are met.
Greenhouse Gases	
Loss of potential beneficial impact. The W.A. Parish Plant, pipeline corridor, and EOR area at the West Ranch oil field would remain in their current conditions. However, without the project, there would be no reduction in GHG emissions from the W.A. Parish Plant and no commercial-scale demonstration of advanced coal-based power generation technologies to capture CO_2 for EOR and ultimate sequestration.	***Beneficial impacts.*** Construction of the CO_2 capture facility, CO_2 pipeline, and EOR/CO_2 monitoring infrastructure would generate up to approximately 4,900 tpy (4,400 metric tons per annum [MTA]) of CO_2 emissions over the two-year construction period. Operation of the CO_2 capture facility and CO_2 recycle facility would result in approximately 785,000 tpy (0.71 MMTA) of new CO_2 emissions. However, the proposed project would result in the capture approximately 1.6 million tpy (1.5 MMTA) of existing CO_2 emissions, resulting in a net reduction of approximately 815,000 tpy (0.74 MMTA) of CO_2 emissions during operations. The capture and geological storage of existing GHG emissions by the project would produce a minor beneficial cumulative effect on a national and global scale. The reduction in CO_2 emissions resulting from the Parish PCCS Project would incrementally reduce the rate of GHG accumulation in the atmosphere and help to incrementally mitigate climate change related to atmospheric concentrations of GHGs.

Table S-4. Summary of Environmental Impacts

No-Action Alternative	Proposed Action
Geology	
No impacts. The W.A. Parish Plant, pipeline corridor, and EOR area at the West Ranch oil field would remain in their current conditions. No changes to geologic resources would occur.	**Negligible to minor adverse impacts with some beneficial impacts.** Construction of the CO_2 capture facility, pipeline, and CO_2 recycle facility would result in negligible impacts to geologic resources. New well construction in the EOR area would result in removal of geologic media through the drilling process. This process would not be unique to the area and would not affect the availability of local geologic resources. Existing wells used by the project would be reworked, resulting in a potential beneficial impact to geologic resources by reducing the risk of leakage. Operation of the CO_2 capture facility and pipeline would not affect geologic resources. In the EOR area, the potential for CO_2 migration upward through the caprock seal is considered unlikely; however, leakage from one or more previously plugged and abandoned wells, oil-producing wells, injection wells, or observation wells might occur if any casing and/or cement placed in or around a well were to leak. To mitigate the potential for impacts related to casing or annular seal issues associated with wells in the proposed injection area, TCV and BEG would conduct a well integrity testing program prior to EOR operations and TCV would correct deficiencies prior to the use of such wells. These improvements to existing wells would result in a potential beneficial impact to geological resources by reducing the chance of leakage due to improperly sealed wells. Preliminary reservoir modeling indicates that injected CO_2 and associated zones of increased pressure would not be expected to migrate laterally outside the area at the West Ranch oil field that is leased and operated by TCV. As part of the proposed CO_2 monitoring program, TCV and BEG would conduct studies to detect migration of injected or displaced fluids, should migration occur, so that potential long term impacts to geologic resources may be minimized or avoided. No known major faults exist within the West Ranch oil field or within the area of maximum predicted EOR-induced impacts to geologic formations. Therefore, the potential for the proposed project to increase seismic activity or for seismic activity to impact proposed project activities or facilities is low. The addition of CO_2 to a geologic unit (i.e., a target geologic unit or an overlying unit, if leakage were to occur) could make the fluids within the unit more acidic. The creation of potentially more corrosive conditions could result in increased costs for later oil and gas development. However, DOE expects the injection of CO_2 to beneficially impact oil and gas resources at the West Ranch oil field by increasing production from the target geologic units. Furthermore, the presence of infrastructure for CO_2 floods may make oil production from other geologic units at the West Ranch oil field more feasible, which could result in an indirect beneficial impact.
Physiography and Soils	
No impacts. The W.A. Parish Plant, pipeline corridor, and EOR area at the West Ranch oil field would remain in their current conditions. No changes to physiography and soils would occur.	**Negligible to minor adverse impacts.** In general, potential minor impacts to physiography and soils during construction would include disturbance of soils from grading, soil excavation activities, earthwork compaction, installation of impermeable surfaces over soils at some locations, and increased soil erosion. At the CO_2 capture facility, up to 29 acres of soil within the W.A. Parish Plant boundary would be disturbed or lost. Soil in these areas is classified as Prime Farmland, but they have been previously impacted and would not be utilized for agricultural purposes. For the proposed pipeline development, up to 1,028 acres of soils would be disturbed; however, the disturbed land areas would be restored following construction and overall land use impacts would be minimized through use of existing ROW for most of its length. Approximately 600 acres in the construction ROW is classified as Prime Farmland and less than 20 acres classified as more than slightly erodible (i.e., moderately to severely erodible). In agricultural areas, impacts to soil would be minimized by segregating topsoil from underlying soil and placing the topsoil back as the top layer when trench is filled. For the EOR area, construction and operational activities would be conducted in existing operational areas; therefore, impacts to soils would be similar to existing impacts. Potential soil impacts in all construction areas would be avoided or mitigated as described in a

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No-Action Alternative	Proposed Action
	project-specific stormwater pollution prevention plan (SWPPP). Operational activities associated with the CO_2 capture facility, CO_2 pipeline, and EOR/CO_2 monitoring infrastructure would be anticipated to result in negligible impacts to soil resources, primarily due to disturbance of soils from vehicle traffic and an increased potential for erosion.
Groundwater	
No impacts. The W.A. Parish Plant, pipeline corridor, and EOR area at the West Ranch oil field would remain in their current conditions. No changes to groundwater resources would occur.	**Negligible to minor adverse impacts with some beneficial impacts.** The potential for groundwater contamination during construction is considered low as potential spills and unintentional releases of wastes or petroleum-based materials to groundwater would be avoided or mitigated as described in a project-specific SWPPP. Operation of the CO_2 capture facility would require an additional 0.2 to 0.3 mgd of groundwater from existing onsite wells (an approximately 13% increase as compared to current groundwater usage rates). The existing wells at the W.A. Parish Plant have capacity to supply the CO_2 capture facility with potential minor impacts to on-site groundwater supplies, such as a reduction in groundwater volumes in underlying aquifers, water level declines, and potential subsidence. There are currently no plans to withdraw groundwater or to discharge directly to groundwater during construction of the proposed pipeline. Water supply wells near the West Ranch oil field are not anticipated to be affected by injected or displaced fluids due to the relatively shallow depths of existing groundwater supply wells as compared to the depths of the proposed CO_2 injection wells in the Frio Formation (approximately 5,000 to 6,200 feet bgs) and the existing produced water injection wells in the Catahoula Sandstone (approximately 4,250 to 4,500 feet bgs); the presence of the approximately 400-foot-thick, low-permeability confining caprock formation (i.e., the Anahuac Formation) and the approximately 2,000-foot-thick low-permeability Burkeville confining system; and the absence of known faults in the EOR area. Although it is considered unlikely that CO_2 would leak from the injection zone, the possibility exists, in theory, for impacts to occur to shallower geologic units if leakage of CO_2 from the injection reservoir units were to occur. Increased groundwater acidity could result under such a hypothetical leakage scenario, potentially resulting in leaching of minerals and development of preferential flow pathways for migration of injected or displaced fluids. However, based on preliminary reservoir modeling results (Appendix H to this EIS), the probability of injected or displaced fluids migrating from the target injection zone into overlying aquifers is considered to be low. As part of the proposed CO_2 monitoring program, TCV and BEG would conduct studies to detect migration of injected or displaced fluids, should migration occur, so that potential long term impacts to groundwater resources may be minimized or avoided. In the EOR area, the potential for CO_2 to migrate upward through fractures in the caprock seal is considered unlikely; however, leakage from one or more wells (e.g., plugged and abandoned, oil-producing, injection, or observation wells) might occur if any casing and/or cement placed in or around a well were to leak. To mitigate the potential for impacts related to casing or annular seal issues associated with wells in the proposed EOR area, TCV and BEG would conduct well integrity testing prior to EOR operations and TCV would correct deficiencies prior to use of such wells. Additionally, existing wells used by the project would be reworked. Improvements to existing wells would result in a potential beneficial impact to groundwater resources by reducing the chance of leakage due to improperly sealed wells.
Surface Water	
No impacts. The W.A. Parish Plant, pipeline corridor, and EOR area at the West Ranch oil field would remain in their current conditions. No changes to surface waters would occur.	**Negligible to moderate adverse impacts.** Construction of project-related facilities has the potential to cause increased sedimentation and turbidity in adjacent waterbodies and increase the potential for surface water contamination from material spills. A SWPPP would be developed and implemented to avoid or minimize potential impacts to surface waters during construction activities. Negligible impacts to the surface water supply at W.A. Parish Plant would be

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No-Action Alternative	Proposed Action
	expected due to the approximately 12,000 gpd required during construction for dust suppression, vehicle wash down, and other construction-related uses. Operation of the CO_2 capture facility (including supporting infrastructure and facilities, such as the CT/HRSG and cooling water tower), would require approximately 3.5 to 4.9 mgd more surface water from Smithers Lake than is currently used by the W.A. Parish Plant. Including this approximately 10% increase in surface water usage, the W.A. Parish Plant would use a total of 38 to 55 mgd of surface water. This usage rate would be approximately 3% to 6% of the average Brazos River flow rate and approximately 8% to 13% of the Brazos River's critical low-flow rate. The portion of this water that would be related to the proposed project would account for approximately 0.5% of the average Brazos River flow rate and approximately 1% of the Brazos River's critical low-flow rate. Therefore, minor impacts on surface water supplies would be expected. NRG's projected surface water usage would also be well below NRG's current 99 mgd of surface water rights (i.e., 74 mgd from a surface water contract with the Brazos River Authority and 25 mgd of diverted Brazos River water that may be stored in Smithers Lake). During construction of the proposed pipeline, approximately 1.75 million gallons of water would be trucked in from outside sources or obtained from nearby surface water. NRG plans to discharge spent hydrotest water to upland areas according to RRC and EPA discharge permits and guidelines, as applicable. Construction would require 210 waterbody crossings. Three major rivers (i.e., the San Bernard River, the Colorado River, and the Lavaca River) and three other waterbodies (i.e., the man-made pond by FM 1994, Big Creek and Jones Creek) would be crossed by HDD. Additional mitigation measures (i.e., best management practices [BMPs], which would be specified in the project-specific SWPPP) would be employed for Ecologically Significant Stream Segments that are not crossed using HDD construction techniques (i.e., Cedar Lake Creek and West Carancahua Creek). Crossings of the San Bernard River and Caney Creek are not expected to exacerbate existing water quality impairments for these waterbodies. Construction-related impacts are expected to be negligible (i.e., for HDDs) to moderate (i.e., for open cuts) and temporary. Normal pipeline operations are not expected to impact surface waters. Negligible to minor impacts to surface water features in the West Ranch oil field ROI would be expected to occur as a result of construction activities within the proposed EOR area. During operations, the potential exists for a CO_2 well blow-out to occur, with some injected material being ejected and deposited into nearby surface waters. If that were to occur, such effects would be highly localized, minor, and readily remediated.
Wetlands and Floodplains	
No impacts. The W.A. Parish Plant, pipeline corridor, and EOR area at the West Ranch oil field would remain in their current conditions. No changes to wetlands and floodplains would occur.	**Negligible to minor adverse impacts.** There are no wetlands of floodplains located within the area proposed for the CO_2 capture facility at the W.A. Parish Plant or within the area proposed for the CO_2 recycle facility at the West Ranch oil field. However, construction of project-related facilities has the potential to cause increased sedimentation and turbidity in adjacent wetlands and increase the potential for contamination from materials spills. A SWPPP and SPCC would be developed and implemented to avoid or minimize potential impacts to wetland and floodplain areas during construction activities, resulting in negligible to minor impacts. Approximately 105 acres of wetlands would be temporarily impacted during pipeline construction and approximately 7 acres of wetlands may be permanently impacted. Topsoil in wetland areas would be segregated from other excavated material during trenching and returned to the surface to promote revegetation of disturbed areas and to restore preexisting soil conditions. NRG would reduce the width of the construction ROW in wetland areas from 100 feet to 75 feet and/or use of timber mats or low ground pressure equipment to minimize wetland impacts, as appropriate. Impacts to large riverine features and any adjacent wetlands would be avoided through the use of HDDs. Overall, the proposed project would result in minor, direct short-term

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No-Action Alternative	Proposed Action
	impacts to wetlands. Based on the current project design and field survey data collected to date, compensatory mitigation would not be required for NRG's proposed project by the U.S. Army Corps of Engineers (USACE) or the state of Texas. The pipeline route would cross FEMA 100-year and 500-year floodplains in 32 locations. The temporary presence of construction equipment and spoil piles would cause a minor temporary impact within the floodplain that could redirect flood flows in the event a flood occurred during construction in a floodplain. It is not expected that this impact would reach a level of endangering human health or property or conflict with any state, local, or federal floodplain ordinances as equipment and soil piles would be contained within the construction ROW and would represent relatively small, short-term obstructions as compared to the overall area of the floodplain. Following pipeline installation, the construction ROW would be returned to the original topography to the extent practicable. Three main line valves would be constructed within the FEMA 100-year floodplain in Wharton County. Changes to the flood elevation or the flow of water in the floodplain as a result of these valves would be negligible. No other aboveground facilities are planned within floodplain areas. BMPs (as specified in the site-specific SWPPP) would be implemented to avoid or minimize potential impacts to wetland and floodplain areas during construction activities, resulting in negligible to minor impacts. During operations, a 30-foot permanent ROW would be mowed and maintained along the pipeline route for pipeline inspection and maintenance activities, which could result in minor long-term impacts due to changed wetland functions in the approximately 36.6 and 42 acres of wetlands located within the proposed permanent ROW. Impacts to floodplains would be minor during pipeline operations.
Biological Resources	
No impacts. The W.A. Parish Plant, pipeline corridor, and EOR area at the West Ranch oil field would remain in their current conditions. No changes to biological resources would occur.	**Negligible to moderate adverse impacts.** The CO_2 capture facility and EOR area would be expected to have negligible impacts to biological resources as affected habitats have been previously disturbed for industrial and oil production uses. Impacts to wildlife from construction of the pipeline corridor would be negligible to minor. Approximately 85% of the proposed pipeline corridor would be constructed within or immediately adjacent to existing mowed and maintained utility corridors. Also, approximately 60% of the pipeline corridor is currently in agricultural use, which is of limited use to wildlife. The pipeline route was chosen to minimize the overall effect to wildlife and fragmentation of wildlife habitat. Construction activities, including land clearing, would cause a negligible loss of wildlife habitat. The potential would exist for invasive species to colonize newly disturbed areas following construction, which could result in long-term moderate adverse impacts to biological resources. Except in cultivated fields, unless requested by the landowner, NRG would plant areas of disturbed soil along the pipeline construction ROW following construction with an appropriate mix of seeds for perennial grasses and forbs native to the area or with a seed mixture requested by the landowner to reduce the potential for establishment of invasive plant species. Depending on the season in which construction is completed, NRG may also seed with a cold-weather annual grass species, such as Gulf Coast ryegrass (*Lolium multiflorum*), to establish a temporary vegetative cover until conditions become favorable for growth of perennial grasses and forbs. With the exception of one active bald eagle nest, no state-listed or federally listed species were identified during field surveys in the ROI. NRG would install the pipeline using HDD in the vicinity of the one observed active bald eagle nest such that construction activities would be separated by a distance of approximately 750 feet from the nest site. Therefore, no impacts to protected species would be expected. NRG would limit land-clearing activities in previously undisturbed areas to periods outside of the nesting season, to the extent practicable, to minimize the potential for impacts to migratory birds. If clearing vegetation during the nesting season is unavoidable, previously undisturbed areas within the construction area would be surveyed prior to construction to verify that nests with eggs or young would not be disturbed by construction activities.

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No-Action Alternative	Proposed Action
	In the process of finalizing the pipeline route and detailed design, NRG would coordinate with TPWD to identify potential waterbodies in which state-listed mussels or rare mussel habitat may be located. If suitable habitat is present in a waterbody that NRG plans to cross using open cut construction techniques, NRG would work with TPWD to determine whether a change in route or construction method (e.g., use of HDD construction techniques) would be warranted or whether surveys and other measures to avoid or minimize potential impacts to state-listed mussel species, as recommended by the TPWD, would be more appropriate.
Cultural Resources	
No impacts. The W.A. Parish Plant, pipeline corridor, and EOR area at the West Ranch oil field would remain in their current conditions. No changes to cultural resources would occur.	**Negligible adverse impacts.** DOE determined, and the THC has concurred, that no impacts to historic properties listed, or eligible for listing, in the NRHP would be expected from construction or operational activities for the CO_2 capture facility or EOR/CO_2 monitoring areas. Additionally, based on cultural resources survey data collected to date, the DOE has determined that no historic properties listed, or eligible for listing, in the NRHP would be impacted by the construction and operation of the proposed pipeline. Additional investigation activities (i.e., mechanized trenching) are pending to verify that no deeply buried archaeological deposits are present near several river crossings. DOE has submitted its findings regarding pipeline corridor surveys to the THC for review and consultation with the THC is ongoing.
Land Use and Aesthetics	
No impacts. The W.A. Parish Plant, pipeline corridor, and EOR area at the West Ranch oil field would remain in their current conditions. No changes to land use and aesthetic resources would occur.	**Negligible to moderate adverse impacts.** The proposed construction and operation of the CO_2 capture facility at the W.A. Parish Plant and EOR and CO_2 monitoring infrastructure at the West Ranch oil field is consistent with existing land use and would result in negligible to minor impacts. Construction of the proposed CO_2 pipeline would temporarily impact approximately 371 acres of agricultural lands, but no permanent loss of agricultural lands would occur. Less than 0.3 acres would be converted for aboveground pipeline facilities (one meter station and 12 main line valves). Impacts to aesthetic values would be negligible at the CO_2 capture facility and EOR field as the existing aesthetic character would generally remain unchanged. Along the proposed CO_2 pipeline route, minor to moderate aesthetic impacts to adjacent property owners would occur in some locations due to construction noise, truck traffic, fugitive dust emissions, and vegetation clearing. Operational aesthetic impacts would be negligible to minor and would be related to placement of pipeline markers, periodic vegetation clearing, and other maintenance activities. The impact of lighting during construction would be temporary and minor. The impact of lighting for operations at the proposed CO_2 capture facility, the EOR/CO_2 monitoring facilities, and the pipeline meter station would be negligible to minor as lighting would be consistent with existing operations. Lighting along the pipeline would be limited to the meter station. Meter station lighting would be down shielded to avoid interference with wildlife, which would result in minor impacts.
Traffic and Transportation	
No impacts. The W.A. Parish Plant, pipeline corridor, and EOR area at the West Ranch oil field would remain in their current conditions. Transportation resources would remain unchanged when compared to existing conditions.	**Negligible to minor adverse impacts.** The introduction of a temporary increase in traffic during construction (up to 1,100 workers) would be easily accommodated by the existing road systems with only minor temporary disruptions. Continuing operation of the W.A. Parish Plant, the pipeline, and the West Ranch oil field would have negligible effects as a relatively small number of commuting employees (20) would be added as well as a relatively small amount of additional material deliveries.

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No-Action Alternative	Proposed Action
Noise	
No impacts. The W.A. Parish Plant, pipeline corridor, and EOR area at the West Ranch oil field would remain in their current conditions. No changes to the noise environment would occur.	**Negligible to moderate adverse impacts.** Construction of the CO_2 capture facility would result an estimated 0.3 dB increase over existing noise levels for nearby receptors (i.e., nearby residential areas), which is below the threshold of human perception. Increased truck traffic during daytime hours may result in minor, short-term noise impacts along transportation corridors. Residences within 500 to 1,000 feet of pipeline construction would experience a short-term increase in ambient noise and vibrations from construction activity. Receptors near HDD locations could experience elevated temporary ambient noise levels as high as 78 dBA. Overall, noise and vibrations would result in minor to moderate impacts to receptors, depending on the distance from the receptor to the construction area. Construction and operations at the West Ranch oil field would result in an estimated 0.8 dB increase over existing noise levels for nearby receptors (i.e., in Vanderbilt), which is below the threshold of human perception, resulting in negligible to minor impacts to receptors.
Materials and Waste Management	
No impacts. The W.A. Parish Plant, pipeline corridor, and EOR area at the West Ranch oil field would remain in their current conditions. Conditions related to material use and waste generation would remain unchanged.	**Negligible to moderate adverse impacts.** The W.A. Parish Plant is currently a conditionally exempt small quantity generator and generates approximately 200 pounds of hazardous waste per year. Due to the generation of approximately 2,712 pounds per day of reclaimer effluent, a hazardous material, the W.A. Parish Plant would become a large quantity generator of hazardous waste. Approximately 24 shipments of reclaimer effluent would be sent to a permitted TSDF per year. The amounts sent for disposal would not substantially affect the capacities of the TSDF. Adequate waste disposal capacity exists within the ROI. Based on over 20 million tons of capacity available in waste disposal facilities that have been identified to date and the relatively low volumes of solid waste that would be generated by the proposed project (e.g., up to approximately 60 tons per year from the CO_2 capture facility), adequate capacity exists along the Texas Gulf Coast for solid waste disposal with negligible impacts to waste management service providers. Construction materials, equipment and supplies are readily available within the ROI and quantities required to support the proposed action are expected to be well within the capacity of material suppliers. Some specialized equipment may be required from outside the ROI; however, it is expected that this equipment would also be within existing supplier capacities. As a result, impacts to regional and national construction material resources and special equipment suppliers would be negligible.
Human Health and Safety	
No impacts. The W.A. Parish Plant, pipeline corridor, and EOR area at the West Ranch oil field would remain in their current conditions. Conditions related to human health and safety would remain unchanged.	**Minor adverse impacts.** The potential for worker injuries and fatalities would be present during the construction of the proposed CO_2 capture facility, CO_2 pipeline, and EOR/CO_2 monitoring infrastructure. Based on historical records for related industries, no worker fatalities would be expected. During facility operation, workers could be subject to physical and chemical hazards, which would be typical of those associated with similar power plant, pipeline, and oil field operations. An estimated nine to 12 OSHA recordable incidents would be anticipated during project construction based on national incidence rates for comparable industries. The potential for CO_2 pipeline ruptures or punctures is considered to be unlikely (i.e., the potential to occur between once in 100 years and once in 10,000 years). The upper bound impact from a pipeline release of CO_2 would be transient and reversible effects for up to 12 people. More severe impacts would affect less than one person for all other pipeline release scenarios. If a release were to occur with workers present, the workers would likely experience the physical effects of an accident (physical trauma, asphyxiation [i.e., displacement of oxygen in a small confined place], or frostbite from the rapid expansion of CO_2) or a higher concentration

Table S-4. Summary of Environmental Impacts

No-Action Alternative	Proposed Action
	exposure to CO_2 than the surrounding population. Potential exposure would be limited because the pipeline would be buried underground. Additionally, NRG plans to install 12 main line valves to stop the release of CO_2 should a puncture or rupture occur. These valves, along with pipeline pressure monitoring equipment, would be linked to the CO_2 capture system operations control room, which would be staffed at all times when the CO_2 capture system is in operation. In the event of a pressure drop indicating a pipeline rupture, the control room operator would shut down the CO_2 capture system and remotely activate the main line valves to prevent further damage to the pipeline and minimize impacts to people in the surrounding area and the environment. The potential for release of CO_2 from the EOR area is considered to range from unlikely (i.e., the potential to occur between once in 100 years and once in 10,000 years) to Incredible: (i.e., the potential to occur less than one time in 1 million years) with less than one person affected for all release scenarios. In the extremely unlikely occurrence of an injection well blowout (i.e., a sudden loss of CO_2 from failure of an injection well during operation), the main adverse outcome would be the potential for ejection of CO_2, possibly as dry ice particles, and formation fluids from the wellhead. Effects would be expected to be localized to the area around the affected wellhead and events of this type would be avoided or minimized by incorporating high pressure piping, overpressure protection (i.e., relief) valves, and blowout preventers into the design of the injection wells. A leak of amine-based solvent from a storage tank was evaluated. Such a release would be unlikely (i.e., with the potential to occur between once in 100 years and once in 10,000 years) and effects would be confined to the W.A. Parish Plant property. In this scenario, no nearby residents or the general public in the vicinity of the plant would be affected; however, plant workers would need to take appropriate response actions, since life-threatening concentrations of the solvent in air could occur within the plant site to a distance of 0.3 miles from the release. No nearby residents or general public in the vicinity of the plant would be affected beyond mild irritation if an amine-based solvent tank release occurred, although an odor may be detectable depending on the wind conditions.
Utilities	
No impacts. The W.A. Parish Plant, pipeline corridor, and EOR area at the West Ranch oil field would remain in their current conditions. No changes to utilities would occur.	**Negligible to minor adverse impacts with some beneficial impacts.** The construction and operations phases of the proposed project would increase demand for potable and industrial water; and wastewater treatment services. Construction-related impacts to water supplies would be short term and negligible to minor. Construction-related impacts to wastewater treatment would be negligible. Operations impacts to water supplies would be negligible. Operations of the CO_2 capture facility would result in negligible impacts to the natural gas supply as compared to existing use (i.e., much less than 1% of the current maximum usage). EOR operations may require additional natural gas supply and electricity, which may result in minor impacts to the local utility infrastructure. Beneficial impacts to oil supplies would be provided in the long term as a result of increased production of oil in the ROI as a result of EOR operations.
Community Services	
No impacts. The W.A. Parish Plant, pipeline corridor, and EOR area at the West Ranch oil field would remain in their current conditions. No changes to community services would occur.	**Negligible adverse impacts.** A temporary workforce of up to 1,100 workers would be required for construction of the proposed project. Long-term operation of the project would require up to 20 new employees. Many of these workers are expected to be employed from within the ROI. Negligible impacts on community services would be expected due to a relatively small population increase that would be related to the construction and operations phases of the Parish PCCS Project. Existing community services (i.e., law enforcement, emergency response, hospitals, and education) are expected to be adequate to address the needs of the population in the ROI, including project personnel.

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No-Action Alternative	Proposed Action
Socioeconomics	
Loss of potential benefit. The W.A. Parish Plant, pipeline corridor, and EOR area at the West Ranch oil field would remain in their current conditions. The region would lose the potential for employment, economic stimulus, and tax revenue.	***Beneficial impacts.*** The project (with approximately 1,100 construction-related jobs and up to 20 new jobs for operations) would be expected to contribute minor, long-term, beneficial impacts on the local economy and employment activities, as well as taxes and revenue through increased employment opportunities and expenditures in the local economy. Housing demand may increase slightly during construction if a portion of the 1,100 construction workers temporarily relocate to the area; however, this would be a negligible, short-term effect. The State of Texas offers many legislatively enacted production tax structures. Under the State's tax code, oil produced using methods involving the injection of CO_2 into an oil-bearing formation falls into two categories of tax rate - using CO_2 for EOR and using anthropogenic CO_2 for EOR. The Parish PCCS project would fall into both categories, which would result in an effective oil production tax rate of 1.15% (Texas Comptroller 2012c). The legislative record indicates the intent of these tax structures is to increase oil production in a manner that likewise increases tax revenue to the State. Consistent with the legislative intent, and as Section 2.3.4 of this EIS indicates, the Parish PCCS project is expected to increase the rate of oil production from the West Ranch oil. TCV's portion of the West Ranch oil field currently has approximately two million barrels of conventional proven oil reserves. TCV estimates that using CO_2 floods (i.e., EOR), the West Ranch oil field could produce an additional 55 to 75 million barrels of oil. This projected increase in oil production is expected to translate directly into additional revenues for the State of Texas, even after taking into account the tax exemptions related to use of CO_2 for EOR and use of CO_2 from anthropogenic sources.
Environmental Justice	
No impacts. The W.A. Parish Plant, pipeline corridor, and EOR area at the West Ranch oil field would remain in their current conditions. No environmental justice impacts would occur.	***No impacts.*** The project would not be expected to cause disproportionate adverse impacts on minority or low-income populations as they these populations do not occur in the ROI.

BEG = Texas Bureau of Economic Geology; BMPs = best management practices; CFR = Code of Federal Regulations; CO_2 = carbon dioxide; CT/HRSG = combustion turbine/heat recovery steam generator; EOR = enhanced oil recovery; EPA = U.S. Environmental Protection Agency; ERC = emission reduction credit; FEMA = Federal Emergency Management Agency; FM = Farm-to-Market Road; GHG=greenhouse gas; gpd = gallons per day; HCl = hydrochloric acid; HDD = horizontal directional drilling; HF = hydrofluoric acid; HGB MSA = Houston Galveston Brazoria Metropolitan Statistical Area; MECT = Mass Emission Cap & Trade; mgd = million gallons per day; MLV = main line valve; MMTA = million metric tons per annum; MTA = metric tons per annum; MW = megawatts; NAAQS = National Ambient Air Quality Standards; NH_3 = ammonia; NNSR = Nonattainment New Source Review; NOx = nitrogen oxides; NRHP = National Register of Historic Places; PCCS = Post-Combustion CO_2 Capture and Sequestration; PM_{10} = particulate matter with a diameter of 10 microns or less; ROI = region of influence; ROW = right of way; RRC = Railroad Commission of Texas; SWPPP = stormwater pollution prevention plan; TCEQ = Texas Commission on Environmental Quality; TCV = Texas Coastal Ventures LLC; tpy = tons per year; TSDF = treatment, storage, and disposal facility; UIC = Underground Injection Control; VOC = volatile organic compounds

POTENTIAL CUMULATIVE IMPACTS

DOE addressed the impacts of the Parish PCCS Project incrementally when added to the reasonably foreseeable impacts of other significant known or proposed projects within the geographic area in accordance with the cumulative impact requirements of NEPA (40 CFR 1508.7). As a result of the cumulative impacts analysis, DOE concluded that the Parish PCCS Project, in combination with other reasonably foreseeable future actions may result in cumulative impacts on the following resource areas:

- **Air Quality and Climate:** Emissions from the proposed project and other power or oil and gas projects in the same airsheds as the proposed project (e.g., the Colorado Bend Energy Center,

Deer Park Energy Center Expansion, King Power Station, White Stallion Energy Center, and the Flag City Natural Gas Processing Plant) may have a cumulative impact on air quality. Due to emission limits imposed by the TCEQ as part of the Texas air permitting process, in conformity with the Texas SIP, significant adverse cumulative effects on air quality are not expected.

- **Greenhouse Gases:** The proposed project would be expected to contribute minor beneficial impacts by reducing CO_2 emissions. Other projects in the ROI that would include combustion of additional fossil fuels or other GHG emissions (e.g., Colorado Bend Energy Center, Deer Park Energy Center Expansion, King Power Station, White Stallion Energy Center, and the Flag City Natural Gas Processing Plant) would be expected to cumulatively emit additional amounts of GHGs within the ROI.
- **Physiography and Soils:** Each of the reasonably foreseeable future actions would cause some degree of soil disturbance, loss, and/or erosion, which may result in minor cumulative impacts.
- **Groundwater and Surface Water:** Each of the reasonably foreseeable future actions may require some amount of water for construction and/or operation. Minor cumulative impacts in terms of increased demand on groundwater and/or surface water, and the potential for contamination of water resources may occur in the ROI.
- **Wetlands and Floodplains:** The ETP NGL pipeline could interact with construction of the proposed CO_2 pipeline and cumulatively reduce wetland acreage by expanding the width of the mowed and maintained ROW in the existing utility corridor and/or increase the duration of temporary impacts (i.e., for wetland restoration). Cumulative impacts associated with these projects would be minor, however, as both projects would be required to avoid, minimize, and mitigate wetland impacts according to USACE permit requirements.
- **Biological Resources:** Each of the reasonably foreseeable future projects may result in some degree of wildlife habitat losses. The impacts to wildlife habitat resulting from the proposed project combined with other reasonably foreseeable future projects would be minor because comparable habitat is available throughout the region.
- **Cultural Resources:** Each of the reasonably foreseeable future actions may cause some degree of cultural resource disturbance. Thus, minor cumulative impacts would be expected on cultural resources.
- **Land Use and Aesthetics:** The ETP NGL pipeline could interact with construction of the proposed CO_2 pipeline and cumulatively make land unavailable for other uses temporarily, resulting in minor cumulative impacts on land use.
- **Transportation and Traffic, and Noise and Vibration:** Should construction of the proposed CO_2 pipeline coincide with construction of the ETP NGL pipeline and/or the bridge replacement in Fairchilds, construction-related, temporary cumulative impacts of increased traffic may occur. Additionally, minor to moderate, short-term cumulative effects of increased sound levels and perceptible vibrations may occur during project construction. However, current information suggests that the construction timeframes would be unlikely to overlap.
- **Materials and Waste Management:** Each of the foreseeable future actions would require construction materials and/or operational materials, which may result in minor cumulative adverse impacts on availability of materials and waste disposal facility capacity.
- **Utilities:** Minor beneficial cumulative impacts would be expected in terms of oil supplies. Minor cumulative adverse impacts on utility providers' supply and distribution capacities would be expected; however, the existing utility capacities within the ROI would be adequate to support the increased demand.
- **Community Services:** The planned new subdivision in Greatwood would contribute to population growth near the W.A. Parish Plant. Overall, minor impacts on community services in the Greatwood area may occur, though the contribution of the proposed project would be negligible.

- **Socioeconomics:** Construction projects could compete for skilled and unskilled labor and lodging in the short-term. However, beneficial short-term and long-term impacts result from increased employment opportunities, local spending, and related tax revenue.

The Parish PCCS Project would not contribute to adverse GHG impacts in the ROI. The estimated GHG reduction attributable to the proposed project would result in overall beneficial impacts. Cumulative impacts are also not expected for the geology, human health and safety, or environmental justice resources areas because the Parish PCCS Project is not expected to interact with other reasonably foreseeable future actions with regard to these resource areas.

CONCLUSIONS

As with the development of any large industrial project, the construction and operation of the proposed Parish PCCS Project, including the CO_2 capture facility and related infrastructure, the approximately 80-mile CO_2 pipeline, and EOR and related CO_2 monitoring activities at the West Ranch oil field, would impact the surrounding environment. Analyses included in this EIS indicate that the project could result in:

- potential beneficial impacts, primarily related to regional socioeconomics and the reduction of greenhouse gas emissions, but also related to some aspects of air quality, geology, groundwater, and utilities;
- potential moderate adverse impacts to surface water, biological resources, land use and aesthetics, noise, and materials and waste management;
- potential negligible to minor adverse impacts to air quality, geology, physiography and soils, groundwater, surface water, wetlands and floodplains, cultural resources, traffic and transportation, human health and safety, utilities, and community services; and
- no environmental justice impacts.

DOE's Proposed Action would support the CCPI Program in demonstrating an advanced coal-based technology at a commercial scale that would capture, put to beneficial use, and geologically sequester CO_2 emissions. The proposed action would satisfy the responsibility Congress imposed on DOE to demonstrate advanced coal-based technologies that can generate clean, reliable, and affordable electricity in the U.S. The CCPI Program selects projects with the best chance of achieving the program's objectives as established by Congress: commercialization of clean coal technologies that advance efficiency, environmental performance, and cost competitiveness well beyond the level of technologies currently in commercial service. Accelerated commercial use of these new or improved technologies will help to sustain economic growth, yield environmental benefits, and produce a more stable and secure energy supply.

DOE also recognizes the controversies surrounding the continued dependence on coal by the power industry and the need to address the associated environmental and climate change challenges related to the continued use of coal. However, as the most abundant fossil fuel resource in the U.S., coal will continue to play an important role in the nation's energy supply. The proposed Parish PCCS Project would capture for EOR and ultimately sequester approximately 1.6 million tons per year of CO_2 that is currently emitted by the W.A. Parish Plant to the atmosphere. DOE considers the technological advancement and commercialization of carbon capture and storage, and beneficial use of CO_2, as important components of maintaining energy supplies while minimizing environmental impacts associated with using fossil fuel resources.

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