



PETRA NOVA Carbon Capture

December 1, 2017

Clean Coal Industry Forum

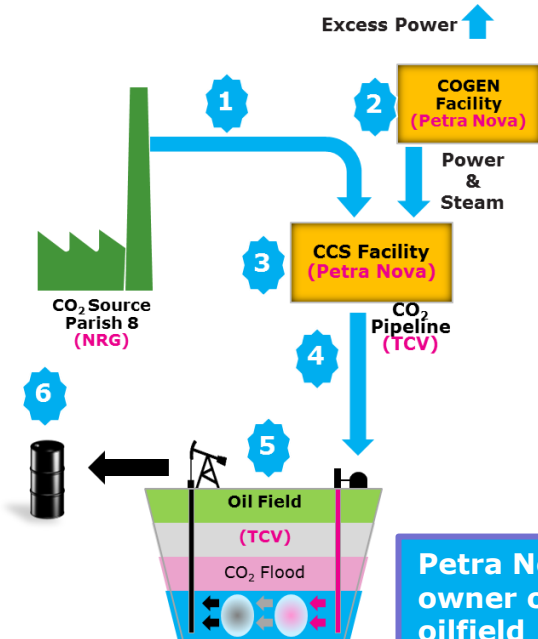
Petra Nova Parish Holdings LLC

Petra Nova Overview



- Petra Nova uses a 240MW equivalent slipstream of flue gas from the 640MW coal-fired power WAP unit 8
- CO₂ accounts for ~13% of the flue gas
- Petra Nova captures >90% of the CO₂ from the processed flue gas
- When operating at 100%, Petra Nova captures 5,200 tons of CO₂ per day
- At this rate, we expect full year operations capturing ~1.6 million tons of CO₂

Project Systems



How it Works

1. **Divert the flue gas** from NRG's WA Parish Unit 8
2. **Provide power and steam** via dedicated COGEN facility, sell surplus power to grid
3. **Process flue gas** in a carbon capture system to strip out the CO₂
4. **Transport CO₂** to West Ranch Oil Field through 81 mile long CO₂ pipeline
5. **CO₂ Enhanced Oil Recovery** operation to produce otherwise unrecoverable oil
6. **Transport and sell crude oil** - marketing, selling, and transporting the recovered oil

Petra Nova is part owner of the oilfield

No impact on power plant or its costs

Carbon Capture System Site Layout



Absorber

Regenerator

Cogeneration
(steam & power)

CO₂ Pipeline

Compressor

Quencher

Flue Duct

Petra Nova
Carbon Capture
Site

CCS Facility – Flue Gas Duct and Blower



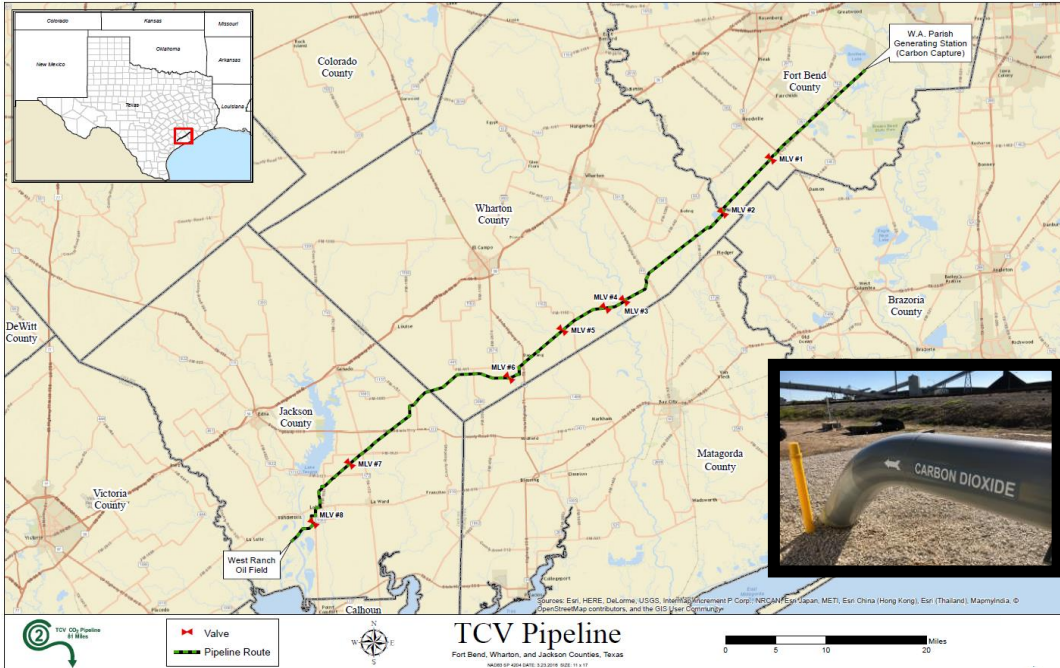
CCS Facility – CO₂ Pipeline Delivery



CCS Facility



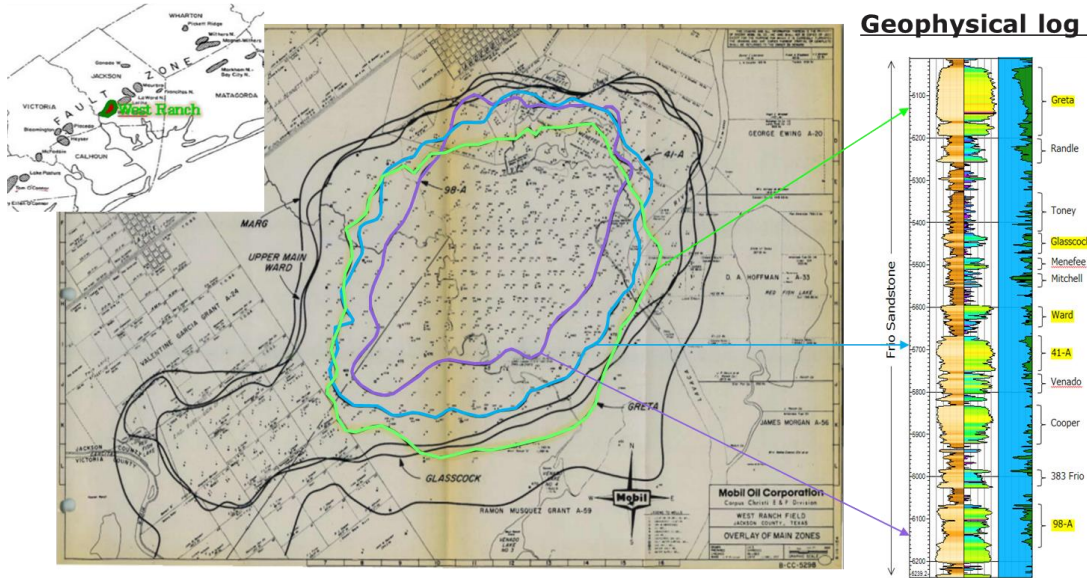
CO₂ Pipeline



- 81 Miles
- ~160 landowners; no condemnation authority
- 12" diameter
- .330 wall pipe (.406 on HDDs)
- 8 Mainline Valves (MLVs)
- 1,900 psi at inlet; ~1,650 psi at delivery
- No intermediate compression

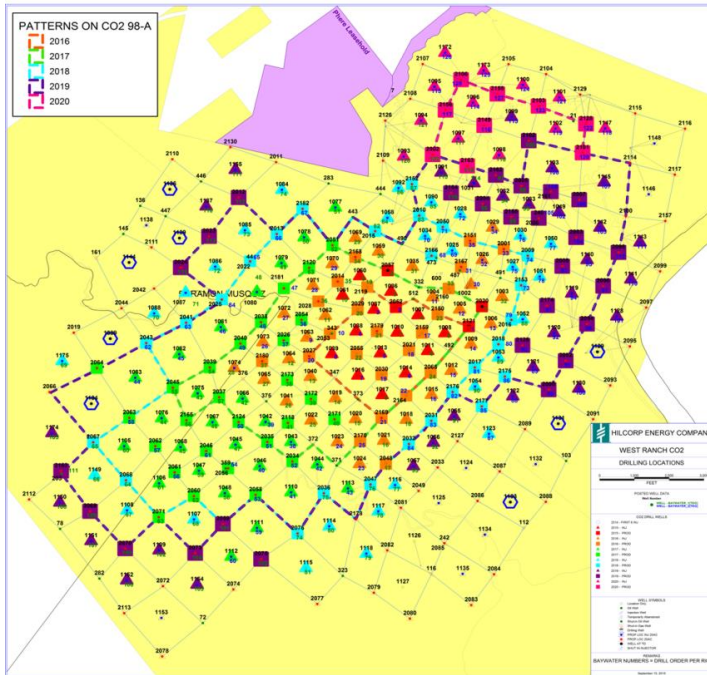
Flat, rural, and co-located with existing utilities

West Ranch Oil Field



Discovered in 1938, West Ranch is a “legacy oil field” in Gulf coast region.

Enhanced Oil Recovery Project



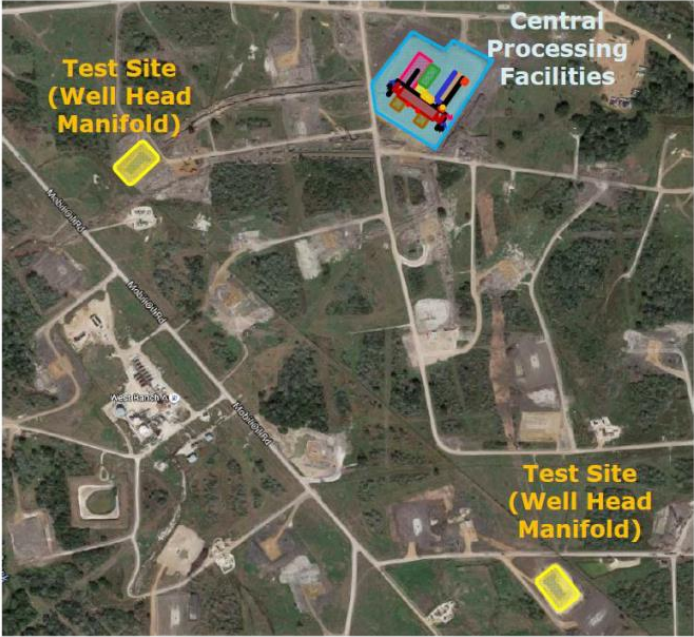
West Ranch Field Development

- Field is being flooded using a “5-spot” pattern (each injector surrounded by 4 producers)
- A comprehensive monitoring, verification, and accounting (MVA) plan is in place to track the flow of CO2 and to insure that it is sequestered in the reservoir
- University of Texas Bureau of Economic Geology (BEG) developed the plan to sync with oilfield operations and manages the plan during the DOE 3-year demonstration period

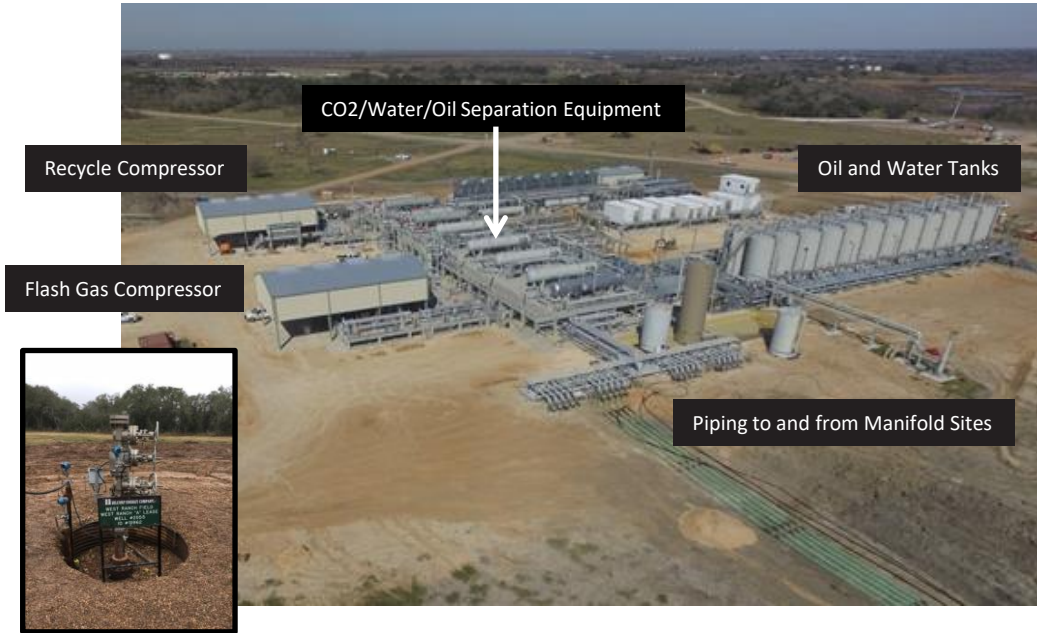
Key Components of the MVA Program

- 1. Modeling** – development of a fluid flow simulation model using actual logging and production data
- 2. Mass Balance Accounting** – accounting for injected CO₂
- 3. Pressure Monitoring** – monitoring pressure in 10 dedicated AZMI (above zone monitoring intervals) wells (5 each in two zones)
- 4. Fluid Sampling** – collection of pre-injection fluids (brine, gas, oil) in the injection and AZMI zones
- 5. Groundwater Monitoring** – one year of baseline and periodic ongoing sampling of groundwater at several ground water wells
- 6. Soil Gas Monitoring** – characterization of soil gases at several sites
- 7. Additional Monitoring** – in addition to the BEG program, the oilfield operator has also installed numerous surface level pressure monitors and 2 down hole monitors

Oilfield Facilities – EOR Facility Layout



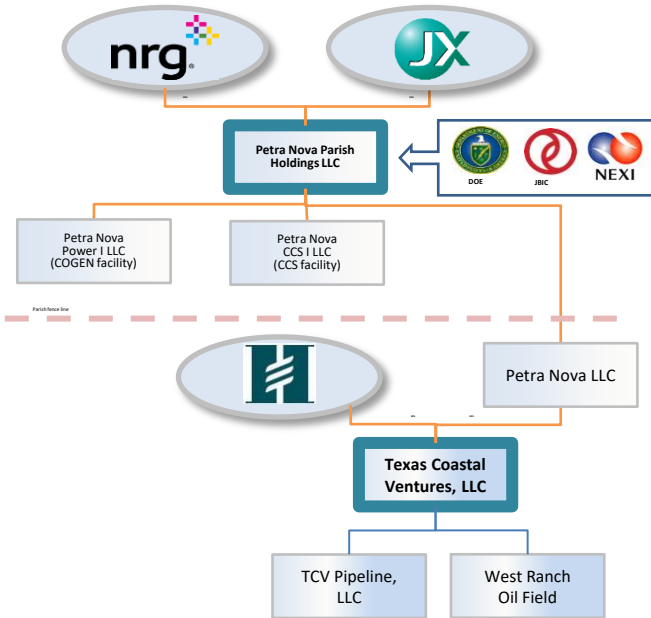
West Ranch Central Facility #1



West Ranch Field Central Facilities

- Over 300 new wells to be drilled
- 2 central processing facilities to separate oil-CO₂-water
- All produced CO₂ and water is re-injected into the formation

Commercial Structure



Our Partners



JXTG Holdings is a leading integrated energy, resources, and materials company



NRG Energy, Inc. is the largest independent power company in the US



Hilcorp Energy is one of the largest privately-held oil and natural gas E&P companies in the US



JBIC and NEXI are wholly-owned by the Japanese government.



US DOE awarded \$190 MM grant funded through Clean Coal Power Initiative

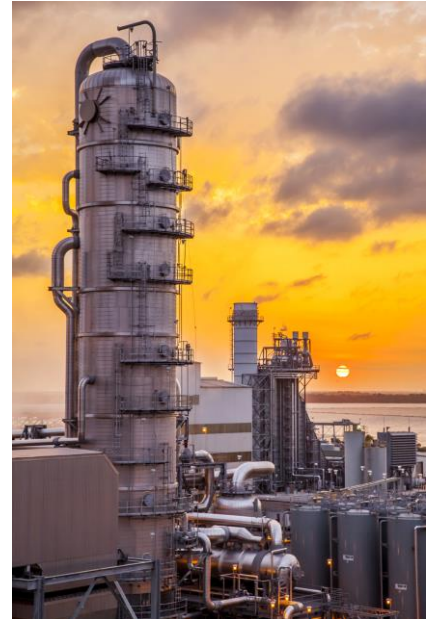


PETRA NOVA Carbon Capture

Lesson Learned – How to repeat?

Requirements for successful CCS projects:

- ✦ Technology evaluation
- ✦ Engineering and design management
- ✦ Location and pipeline development
- ✦ Commercial structuring and CO₂ sales
- ✦ Acquisition and management of oil field ownership and interface
- ✦ Project finance
- ✦ Government grant application and administration, if available
- ✦ Environmental study management
- ✦ Permitting and licensing
- ✦ EPC Selection, Contract Structure and Construction management
- ✦ Integrated Project Team – communications and messaging
- ✦ Aligned Partners
- ✦ Operational experience – engage early



Interest is high right now



2017

Numerous tours



Several speaking
engagements



30+ articles
written

Thank You!

