The Partners

- JXTG Holdings is a leading integrated energy, resources, and materials company
- NRG Energy, Inc. is a large 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 the Clean Coal Power Initiative
Key Project Dates

- **May 2010**: DOE Grant Awarded
- **October 2011**: TCV Partnership Formed
- **May 2013**: Petra Nova Partnership Formed
- **July 2014**: Financing Completed
- **July 2014**: Carbon Capture Facility Construction Started
- **December 2016**: Plant Operations Commences
- **2017 – 2019**: 3-Year DOE Demonstration Period
- **October 2017**: 1,000,000 tons of CO2 captured
- **January 2017**: First EOR Oil Production Well is turned on

**Significant planning required from start to finish!**
Petra Nova Overview

- Petra Nova uses a 240MW equivalent slipstream of flue gas from NRG’s 640MW coal-fired power plant - W. A. Parish 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
- To date, over 2.8 million tons of CO₂ have been captured
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
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.
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 Petra Nova 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 groundwater wells

6. **Soil Gas Monitoring** – characterization of soil gases at several sites

7. **Additional Monitoring** – in addition to the BEG program, the oilfield operator is also monitoring surface level and down hole pressures
West Ranch Central Facility #1

**West Ranch Field Central Facilities**

- Up to 300 new wells to be drilled
- 2 central processing facilities to separate oil-CO$_2$-water
- All produced CO$_2$ and water is re-injected into the formation
Lessons Learned

Requirements for a successful CCS project:

- Technology evaluation and evolution
- Engineering and design management
- Location and pipeline development
- Commercial structuring and CO₂ sales
- Interface/relationship with the oil field
- Financing structure, including tax incentives, if available
- 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
Current Focus for NRG

- Optimization of the technology that we have in place with the Petra Nova project
  - “First-of-a-kind” project creates challenges not seen with conventional projects.
- Optimization of project economics
  - Project economics impacted by commodity prices of oil, gas, coal, and power
- Continue to develop operational expertise
  - Limited industry-wide operations expertise
- Evaluating and optimizing on tax incentives for the current project, where possible
  - Regarding 45Q, NRG supports/applauds Congress action to continue advancing the development of CCS projects across the nation
Interest in Petra Nova Remains High

Numerous tours – international, domestic, and government

Ongoing requests for speaking engagements

Referenced in numerous articles
Thank You!