



Carbon Capture at Petra Nova

July 2017

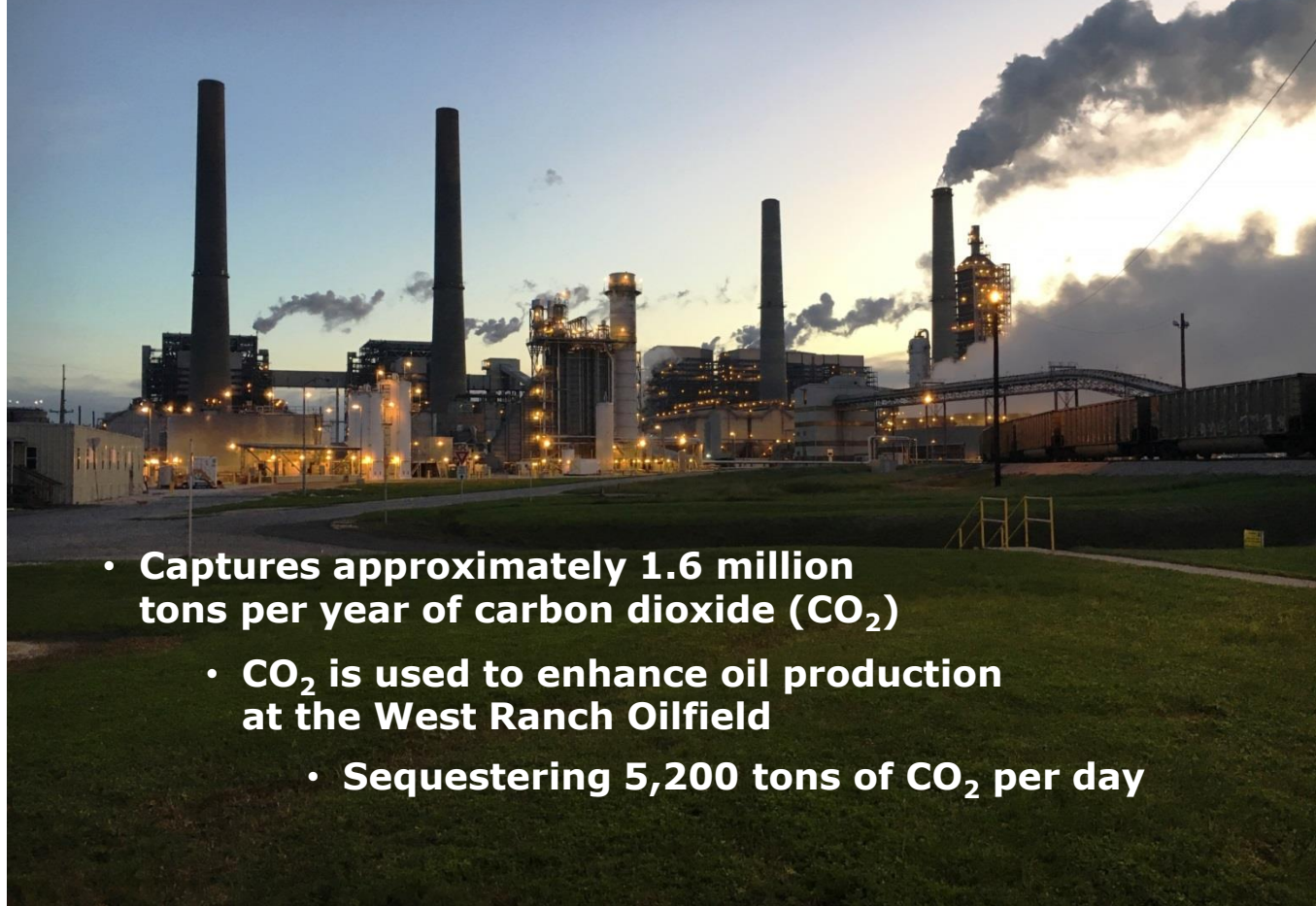


Petra Nova – so far so good

Achieved COD on Dec. 29, 2016

DELIVERED

 **n spec**
 **n time**
 **n budget**



- Captures approximately 1.6 million tons per year of carbon dioxide (CO₂)
 - CO₂ is used to enhance oil production at the West Ranch Oilfield
 - Sequestering 5,200 tons of CO₂ per day



Over 700,000 tons of CO₂ captured as of July 17th



Producing more than 4,000 barrels of oil per day

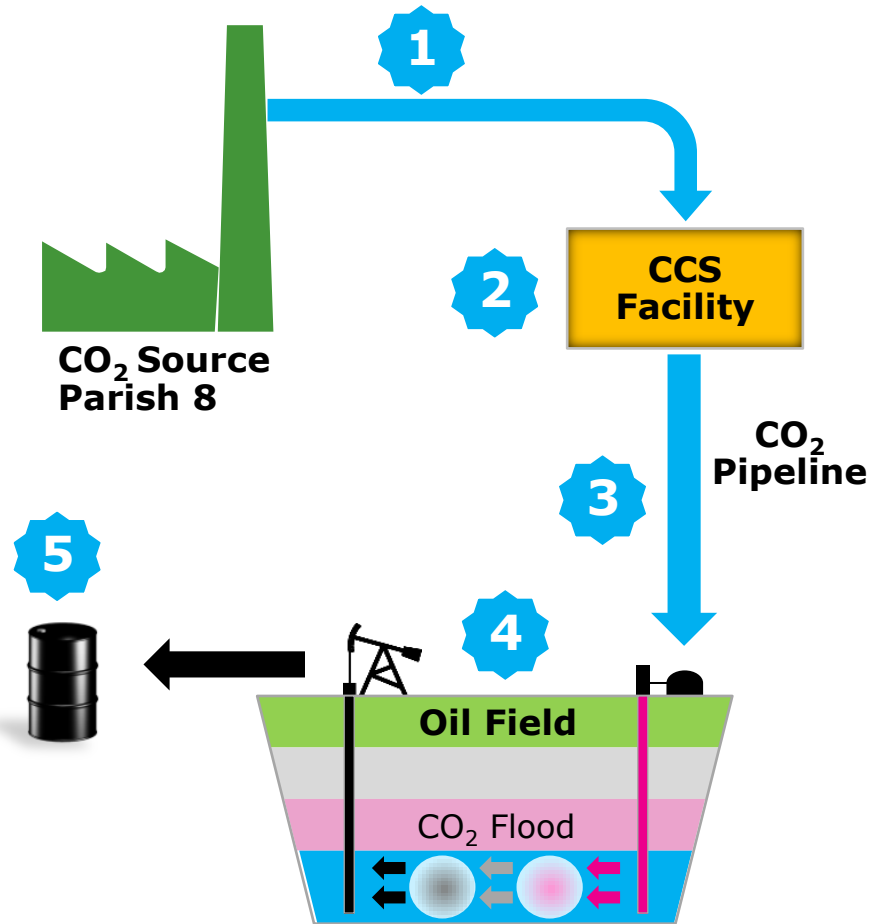
Petra Nova Project Overview

Five Projects in One

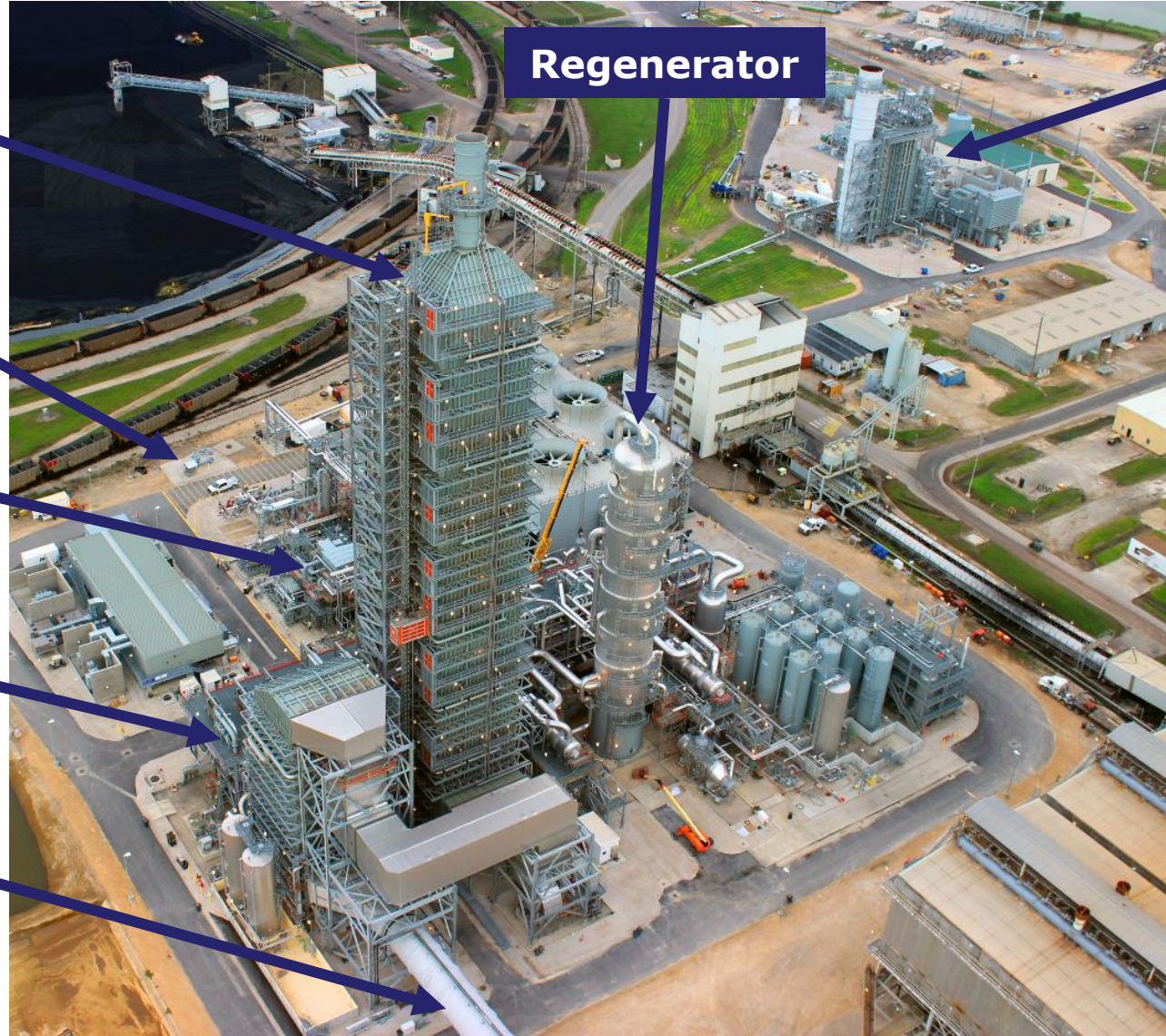
1. **Diverting the flue gas** from an existing facility (Parish Unit 8)
2. **Processing flue gas** in a carbon capture system to strip out the CO₂
3. **Transport CO₂** to a nearby oil field.
4. **CO₂-EOR** operation to produce otherwise unrecoverable oil
5. **Transport and sell oil** – marketing, selling, and transporting the oil

Oil revenues pay for the entire project

No impact on power plant or its costs



Carbon Capture System Site Layout



Absorber

CO₂ Pipeline

Compressor

Quencher

Flue Duct

Regenerator

Cogeneration
(steam & power)

Petra Nova
Carbon Capture
Site

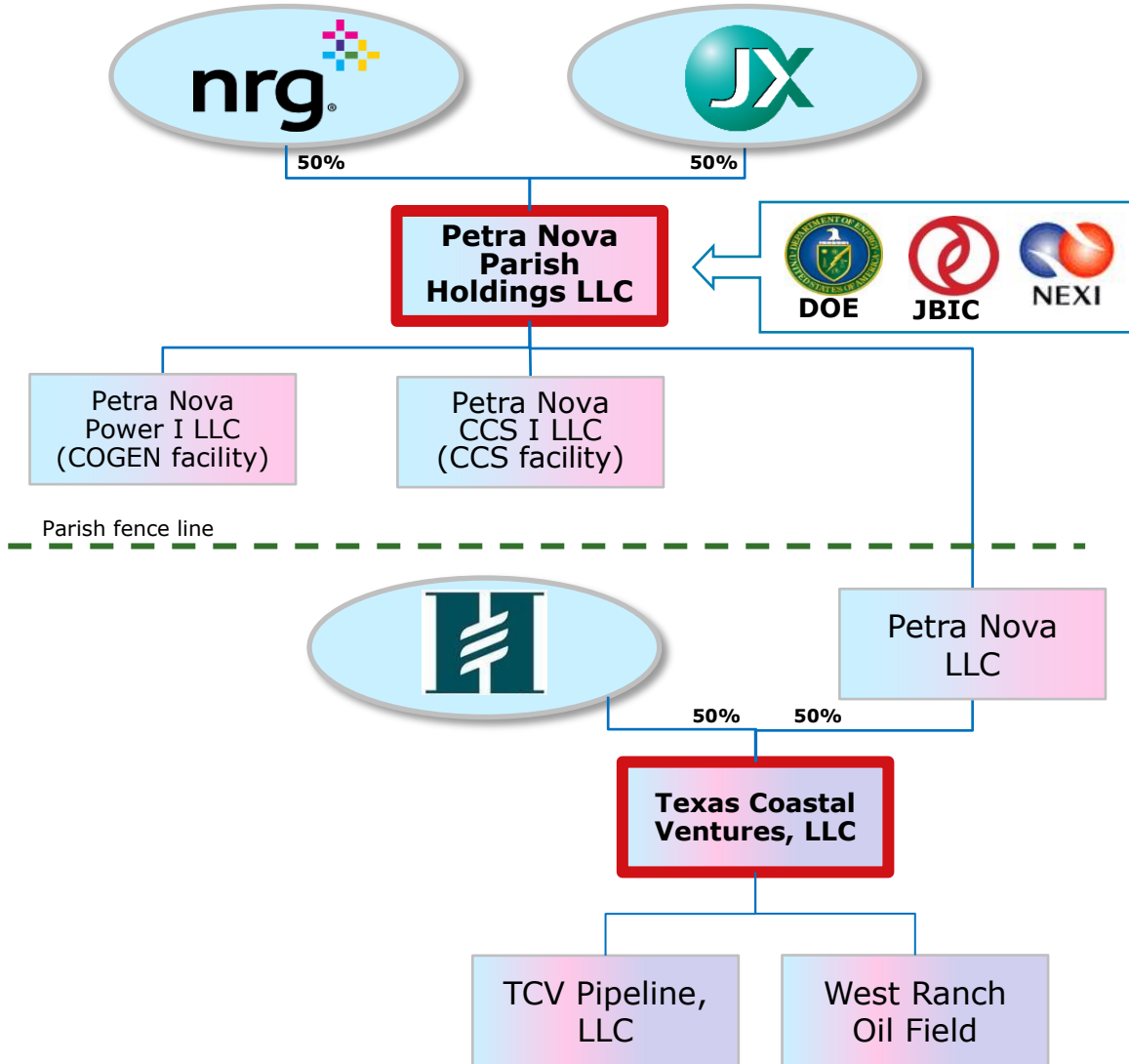
Oilfield Facilities Recapture and Inject CO₂

West Ranch Field Central Facilities

- **200 new wells to be drilled (over 100 now complete)**
- **2 central processing facilities to separate oil-CO₂-water**
- **All produced CO₂ and water is reinjected into the formation**
- **University of Texas managing monitoring**



Commercial Structure



Our Partners



JX 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

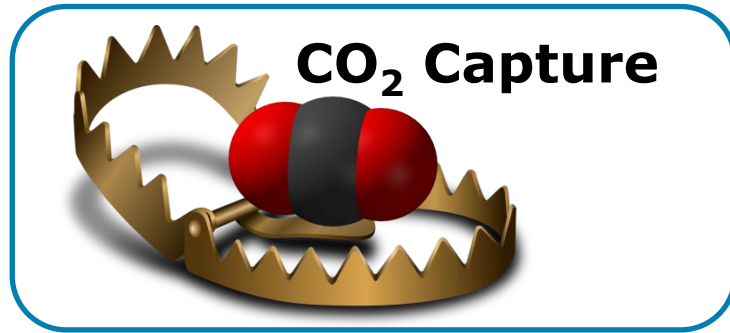


JBIC and NEXI combined on a \$250 million project loan.



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

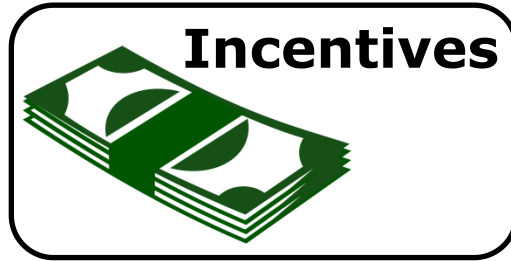
CCS industry is progressing



**Amine technology progressing.
Next unit must be cheaper**

Membrane technologies seem to be the best hope for natural gas capture.

Solid adsorbents may not be far behind and will work on coal and natural gas.



Continue to be refined

**EOR
Well-understood and mature technology**

**Bulk materials (cement or plastics)
Markets are relatively small.
First movers only**

**Liquid fuels (methanol or diesel)
New oil finds depresses prices**

CCUS is beginning to emerge commercially

Some headwinds moving forward



1. Cost



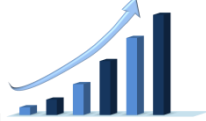
Commercially available technologies are capital intensive

2. Competition



More options and technologies are needed

3. Scale



Technologies need to be proven at a sufficient scale

4. Development



Approaches and incentives need to be re-evaluated

5. Reputation



Confidence in this space has eroded

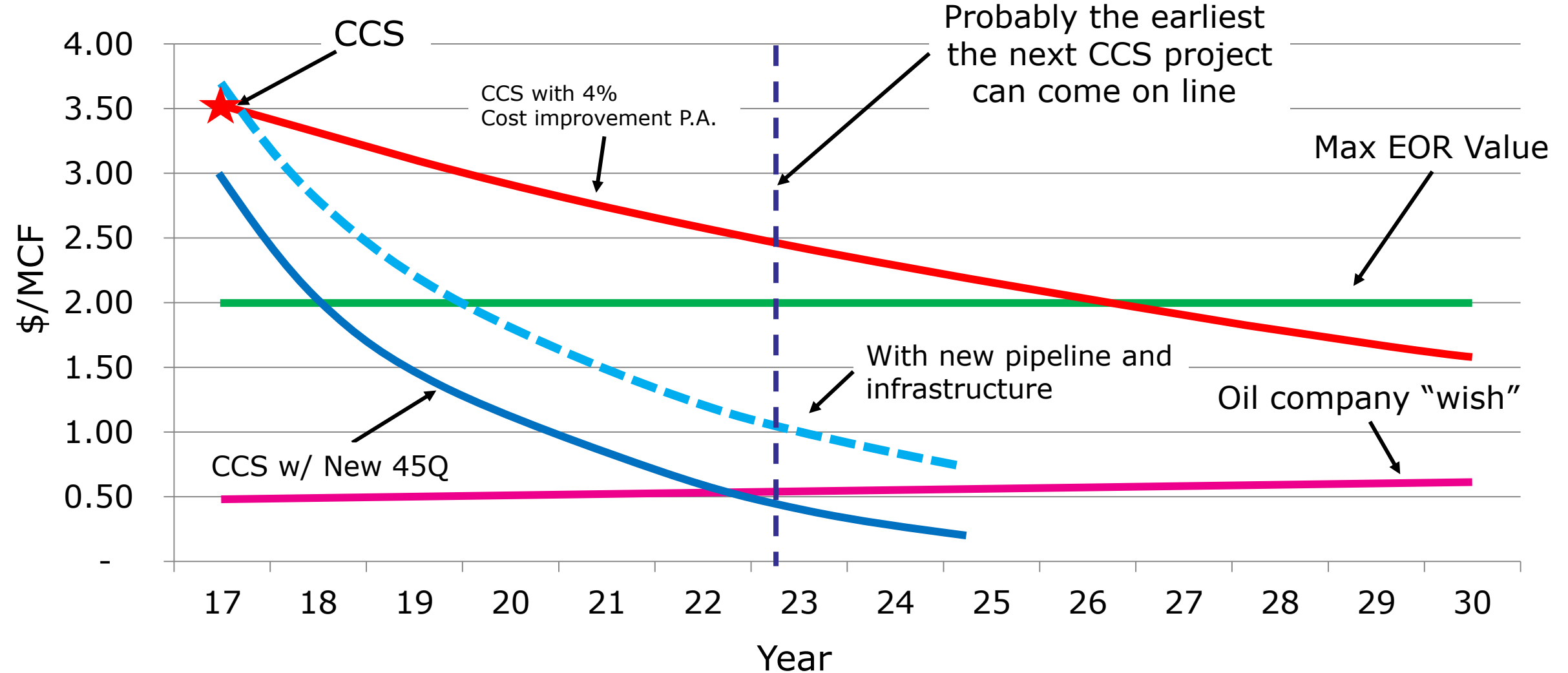
6. Time



Need to start now. Projects can take years to develop and build



Path to success – improving economics



Interest is high right now

International Interest:

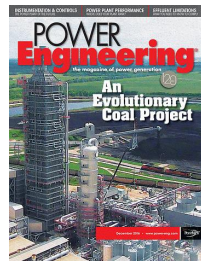
2017



30+ tours



8 speaking engagements



30+ articles written

When Petra Nova is operating, the coal-fired Parish Unit 8 has the same carbon intensity as a gas-fired power plant.

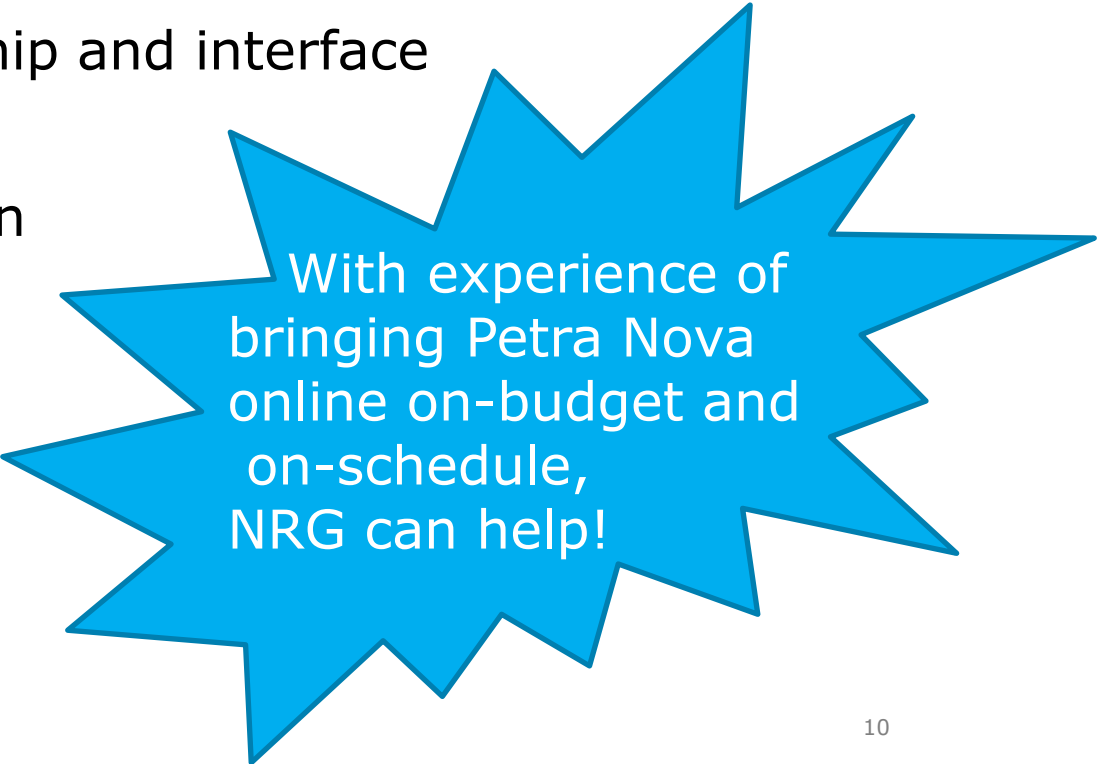
-  Australia*
-  Canada*
-  Chile
-  China
-  Colombia
-  India*
-  Korea*
-  Kuwait
-  Mexico
-  Norway*
-  Pakistan*
-  Singapore*
-  Thailand*
-  U.K.*

* Have sent delegations to visit the project.

Near Term – How to repeat?

Requirements for successful CCS projects:

- + Technology evaluation
- + Engineering and design management
- + Pipeline development
- + Commercial structuring and CO₂ sales
- + Acquisition and management of oil field ownership and interface
- + Project finance
- + Government grant application and administration
- + Environmental study management
- + Permitting and licensing
- + Construction management
- + Communications and messaging
- + Operational experience

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With experience of bringing Petra Nova online on-budget and on-schedule, NRG can help!

Celebrate Success!

