CMTC-554157-MS

CO_2 Sequestration - Enhanced Oil Recovery - CO_2/EOR "Huff-n-Puff" in the 21st Century

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Abstract

During the past 47 years, CO_2 flood technology for Enhanced Oil Recovery projects evolved from a partially understood process filled with uncertainties to a process based on proven technology and experience. Many questions involved with CO_2 flooding have been thoroughly analyzed and answered. This knowledge is currently being used by a limited number of companies that actually know how to **design**, **implement**, and **manage** a CO_2 flood for long term **profit**. The purpose of this report is to help disseminate this knowledge to operating companies interested in EOR flooding or to CO_2 Sequestration Communities interested in storing CO_2 in EOR projects.

Carbon Sequestration Options for CO_2/EOR from the 20th Century:
In 2015 and 2017, Merchant Consulting published two papers: **CMTC-440075-MS "Life beyond 80 – A look at Conventional WAG Recovery beyond 80% HCPV Injection in CO_2 Tertiary Floods"** and **CMTC-502866-MS "Enhanced Oil Recovery – The History of CO_2 Conventional WAG Injection Techniques developed from Lab in the 1950's to 2017"**. The objective of these reports were to target all **"10 CO_2 Recovery Methods"** used to date including **"Conventional WAG Techniques"** Results show Tertiary Oil Recovery can be as high as 26% OOIP with 190% HCPV Injected.

Carbon Sequestration Options for CO_2/EOR in the 21st Century:
From 2005 to 2019, the **Shale Oil Revolution** killed CO_2/EOR Sequestration by driving oil prices down to the \$50-\$60 dollar range along with the inability to lower CO_2 Capture costs. The purpose of this report is to provide the CO_2 Sequestration Community an update of **combining two existing Conventional CO_2/EOR Recovery Techniques** that will compete economically with today's **Shale Oil Revolution (Primary Recovery - Single Cycle)**. This includes:

"Shale Oil CO_2/EOR Huff-n-Puff" Oil Recovery to recover 2X to 3X times todays 1X Recovery.

New methods also target: Zero Emissions (No Flare) and incorporates Q45 Tax Credits

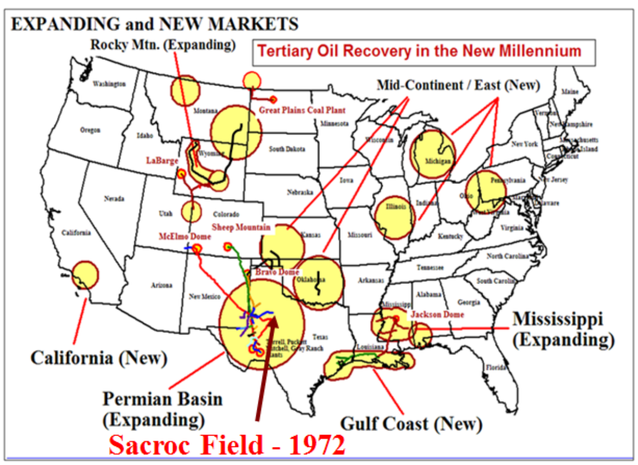
Introduction – CO_2 Flooding

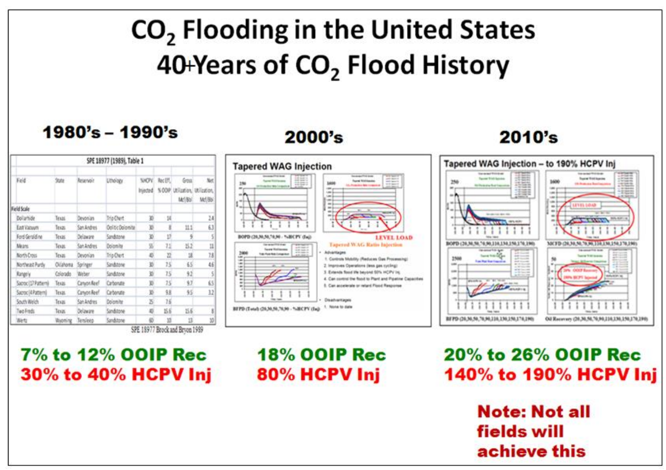
CO_2 Flood History

The Permian Basin has had over 95+ years of oil production history (1923-2019) and produced over 35 BBO (Billion Barrels of Oil), 80 TCF (Trillion Cubic Feet) of gas, and represents the largest petroleum producing area in the United States. The Permian Basin covers 75,000 square miles in West Texas and Southeastern New Mexico. Its first gusher was drilled in 1923. In 1972, CO_2 injection was first introduced commercially in the Sacroc Field. Today, over 1.3 billion barrels have been produced with CO_2 and accounts for over 350,000 BOPD from over 17,000 production wells and 14,000 CO_2 injection wells, through 4,500 miles of pipeline.

Carbon Sequestration Options for CO_2/EOR from the 20th Century (Lessons Learned)

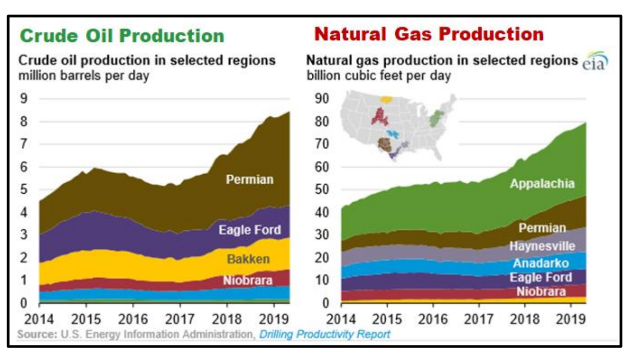
In 2015 and 2017, Merchant Consulting published two papers: **CMTC-440075-MS "Life beyond 80 – A look at Conventional WAG Recovery beyond 80% HCPV Injection in CO_2 Tertiary Floods"** and **CMTC-502866-MS "Enhanced Oil Recovery – The History of CO_2 Conventional WAG Injection Techniques developed from Lab in the 1950's to 2017"**. The objective of these reports were to target all **"10 CO_2 Recovery Methods"** used to date including **"Conventional WAG Techniques"** which have been used in over 90% of all the EOR projects conducted to date. Results show Tertiary Oil Recovery can be as high as 26% OOIP with 190% HCPV Injection of CO_2.





Unconventional Shale Oil Recovery in the 21st Century (United States Today)

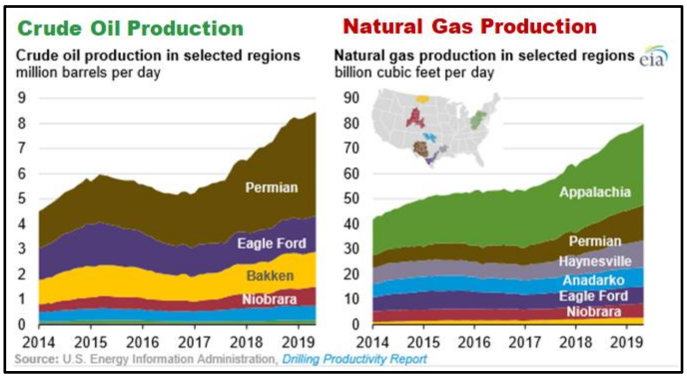
The introduction and economic impact of **Unconventional Shale Oil Recovery** into the Permian Basin, Eagleford, and Bakken regions of the United States has been a game changer for many regions around the World. According to the American Petroleum Institute, the U.S. Crude Oil Production reached an all time high of 12.2 MMBOPD (million barrels per day) in May, 2019, with Texas Crude Oil output exceeding 5 MMBOPD for the first time. In addition, U.S. exports reached 8.1 MMBOPD, an increase of 10.5% over May, 2018.

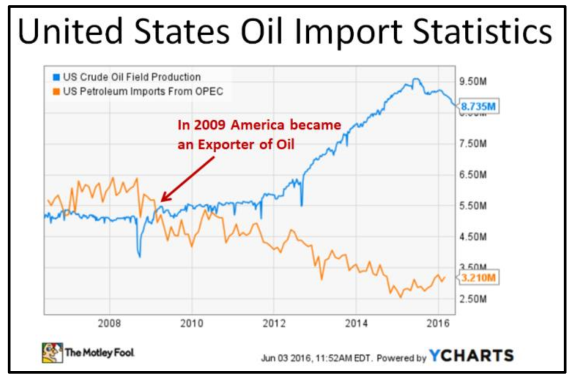


Shale Oil Revolution (The Good ….)

From a **United States** perspective, the U.S. currently holds the title of **Global leader in Recoverable Oil Resources**, according to the latest annual report of world recoverable oil by energy research firm Rystad Energy, a 20 percent increase from previous stated official reserves. With 293 billion barrels of recoverable oil resources, the U.S. beats out both Saudi Arabia and Russia by 20 billion barrels and 100 billion barrels, respectively. According to Rystad analysis, the Permian's tight oil plays hold 100 billion barrels of recoverable oil resources and the resources there remain largely flat from the previous year. It was also noted that production was not fully replaced by increased reserves in some U.S. shale plays, including Eagle Ford in Texas and Utica in Ohio. With the stabilization in oil prices, oil companies have been focusing more on core development and cash flows rather than new exploration.

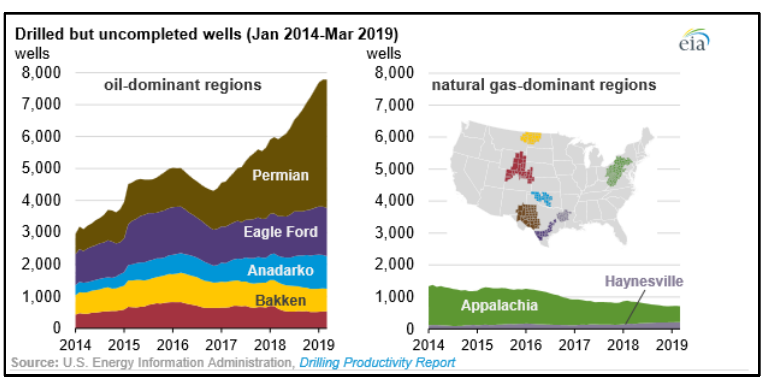
In addition to the small players (EOG, Pioneer Resources, etc.), Major Oil Companies have also entered into the game. Chevron said it had plans to double its production to the equivalent of 900,000 BOPD by 2023, and Exxon sait it planned to produce 1 MMBOPD (one million barrels per day) by 2024, an 80% increase over its current level.

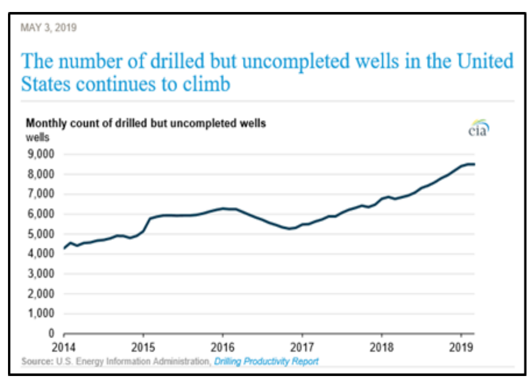




Drilled but Un-Completed Wells (DUC's)

In addition to reaching record breaking levels, the Permian Basin along with the remaining six regions contains a record number of DUC's (Drilled but Uncompleted Completions). These wells provide a "Nest" full of locations already drilled, but waiting to be completed, providing that safety net to fall back into when oil prices fall. Since this technology provides a quick entrance back into the Oil Market, the response time utilizing DUC's is much better and quicker to fill the Energy Gap between Supply and Demand when compared to other recovery methods.



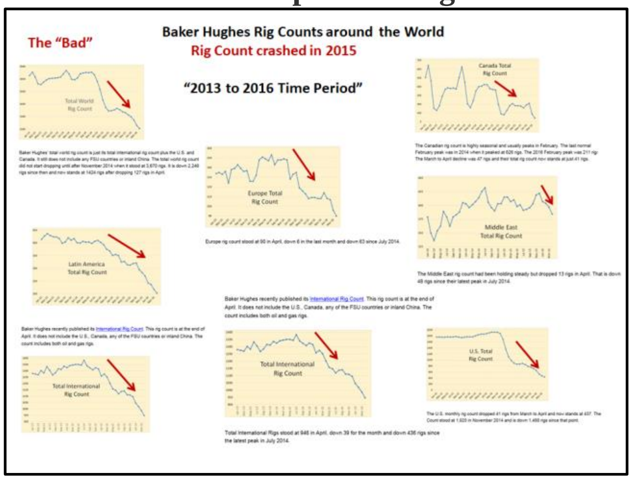


The number of drilled but uncompleted wells in seven key oil and natural gas production regions of the United States has increased over the past two years, reaching a high of 8,504 wells in February, 2019, according to the EIA's Drilling Productinvity Report (DPR). The most recent count, at 8,500 wells in March 2019, was 26% higher than the previous March in 2018.

Shale Oil Revolution (The Bad ….)

From a **Total World perspective**, this impact of the **Shale Oil Revolution** has been felt all over the World. This is shown below by Baker Hughes Well Rig Count reports over the period 2013 to 2016. In 2015, Total Rig Count dropped on a Global Basis, impacting the total Global Market. In 2019, WTI oil price settled in between $50 to $60 dollars per barrel. This impact also had an effect on North Sea Carbon Capture efforts to recover oil not recoverable under Primary Recovery. As of 2019, North Sea Primary Oil Recovery has recovered 80% of its ultimate Primary Oil Potential. Tertiary CO_2 Recovery would have saved the Oil Industry in the North Sea. Today, decommissioning will plug 4,000 wells, along with the removal of 300 platforms, and 20,000 Km of pipelines at a cost of 35 Billion Pounds.

Total Globe Perspective- Rig Count

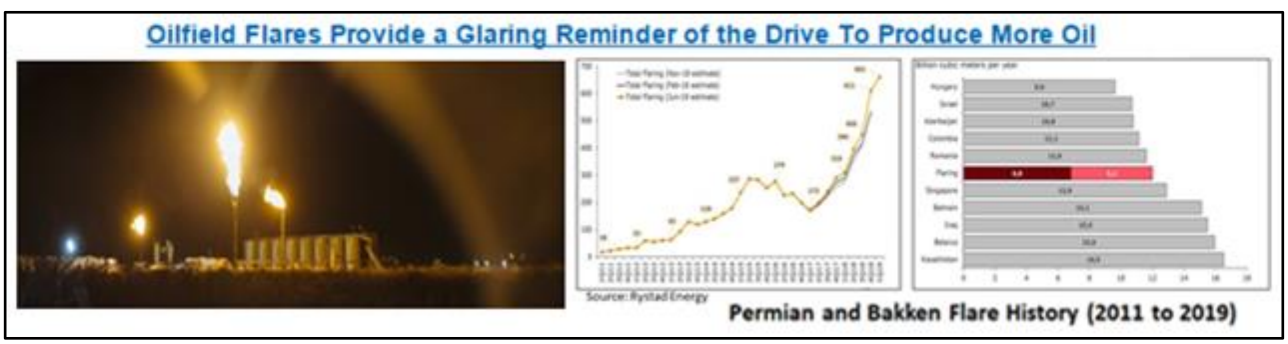


North Sea Abandonment

Shale Oil Revolution (The Ugly ….)

Flare History across America

In every new basin of the World, the amount of associated gas not available for market is flared. This has been true across the globe including: Middle East, North Africa, North Sea, Alaska, Gulf Coast, Africa, and South America. As shown below, the prolific waste from the Permian Basin and Bakken is no exception. This occurs when rising oil production outstrips processing plant and pipeline production capacity, thus the associated hydrocarbon gas produced with the oil is flared.



The volume of natural gas flared in the Permian basin MMCF/day (million ft3/day) has raised sharply since early 2017. When you compare the total amount of Gas Flared from the Permian and Bakken, Basins, more than half of the total comes from the Permian, which has surpassed the Bakken by more than tripling the volume of gas burned per day since early 2017. The severity of the problem, though, is more acute in the Bakken. While Rystad said about 5% of the Permian gas is flared, in the Bakken, 19% of the gas is flared. The Permian produces far more gas but has the advantage of being close to growing markets for it—chemical plants, export pipelines to Mexico, and natural gas liquefaction facilities—while North Dakota is a distant option for Midwestern markets well supplied by other plays.

21st Century Un-Conventional CO_2 Tertiary Recovery Methods

CO_2 Storage Solutions

Permian Basin Goal – Zero Gas Emissions

CO_2 Plant Capture

CO_2 Pipeline Infrastructure

CO_2 Reservoir Storage and Sequestration

CO_2 Storage Solutions – CO_2 Plant Capture

Electrical Power across the Permian Basin **(A Solution to the Flare Gas Problem)**

In addition to Flaring natural gas, ensuring adequate power for Permian oil field operations has been increasingly challenging. Operators are seeing longer lead times to get power, higher cost of infrastucture and power outage issues. The Electric Reliability Coucil of Texas (EPCOT) reported in July, 2018 that West Texas power use increased by nearly 250 meagawatts over the previous year due to increased oil and gas activity and is trending upward. On May 10, 2018, power use in West Texas exceeded 3,400 megawatts (3.4gigawatts) for the first time. (One megawatt powers 200 homes, and one gigawatt = one nuclear power plant or 680,000 homes.

The **Solution** to this problem is to build more Power Plant Capacity. The question becomes **Which Type**?

Century Plant Solution

Gulf Coast Pipeline Solution

Shovel Ready Coal Projects

Petra Nova Coal Solution

NetPower Gas Solution

Hydrogen Solution

1. The Century Plant currently provides CO_2 to the Permian Basin capable of receiving Q45 credits.
2. The Permian pursued two Coal Powered Power plants (Odessa and East Permian) but both failed economically.
3. The Petra Nova Plant (Southwest of Houston) is Coal Powered and was built "On Budget and On Time"
4. The **NetPower** **Hc-gas Powered Power Plant** utilizes both "Produced and Flare Gas" to make CO_2 and Water.
5. In the future, the Energy Gap between Consumption and Supply will be moving towards the "Hydrogen Era"
6. In the future, Direct Air Capture (DAC) solutions will also aid reduction of CO_2 from the atmosphere.

Comparison Results:

Currently the Oil Industry is moving towards eliminating the flare by moving Hc-Gas, LNG, and Oil out of the Eagleford and Permian Basins through a massive pipeline investment to the Gulf Coast and Over Seas. The overall impact is good when considering we are helping mitigate Climate Change by closing down Coal Powered Coal Plants abroad. When comparing **Coal Capture projects** identified above for the Permian Basin, they all create CO_2; but, do not do anything to eleiminating the flare problem. The **NetPower** option utilizes Hc-gas and Oxygen to create CO_2 and water, plus electricity and provides the **best option** in today's market to solve the flare problem and make CO_2/EOR Unconventional oil recovery in the Permian with "Zero CO_2 Emissions."

Permian Basin Unconventional (Oxy Permian Lab and Well Simulation Results)

Oxy Permian - Unconventional CO_2 Learnings

What is Huff-n-Puff?

The Huff-n-Puff Recovery process is a single-well process that has been successfully implemented in conventional reservoirs for several decades. Since the recovery process is a miscible process, the injecting fluid can be Methane (CH_4), Ethane (C2), Propane (C3), CO_2, H_2S, or a combination (C2+C3) of components. For example: Oxy Permian included in its modelling efforts a comparison between pure CO_2, Methane (CH_4) only, and Separator Gas (C2and C3+) injection in its model predictions.

CO_2 Huff-n-Puff for an individual well is a three-step process

Step 1: CO_2 is injected in the production well.

Step 2: The well is shut in for a predetermined time called the “soak period.”

Step 3: The well is returned to production, and oil flows toward the wellbore because of a pressure sink.

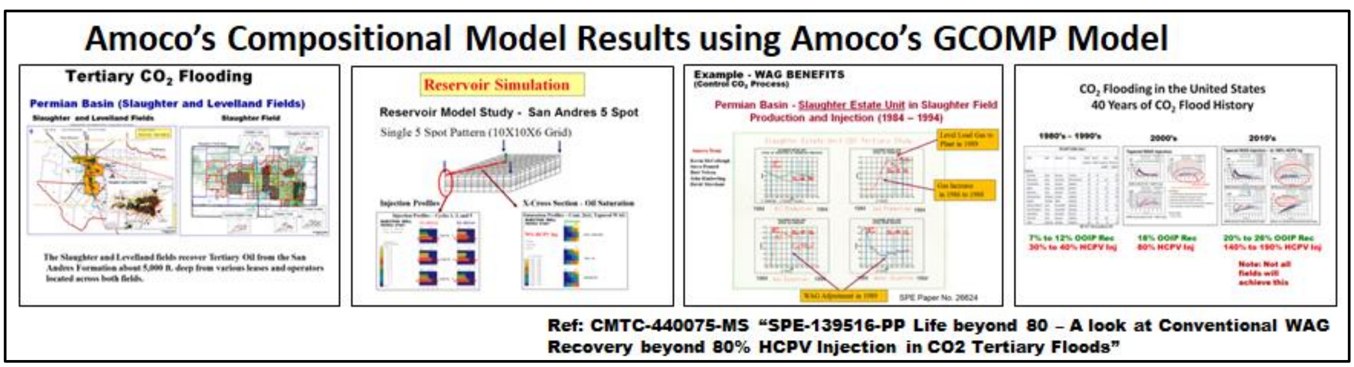
The reason why CO_2 Huff-n-Puff works is simple “The presence of hydraulic and natural fractures provides a large **contact surface area** for injected gas to penetrate into the ultra-low permeability matrix. The main recovery mechanisms are: 1) vaporization of lighter oil components, and 2) interfacial tension (IFT) reduction at pressures above the minimum miscibility pressure (MMP). Below the minimum miscibility pressure (MMP), CO_2 improves oil recovery through the mechanisms of oil phase swelling, viscosity reduction, and gas-oil displacement. At pressures above the MMP, miscibility results in high displacement efficiency due to ultra-low capillary forces.

Oxy Permian in a recent publication stated “our study indicates carbon dioxide (CO_2) Huff-and-Puff **may** be a technically feasible EOR method for unconventional reservoirs.” They make their claims based on the following:

Miscible Enhanced Oil Recovery (EOR) mechanisms in unconventional, tight reservoirs may be substantially different than those associated with miscible gas flooding in conventional reservoirs. Due to potentially low cross-well throughput in ultra-low permeability rock, the **Single-well Huff-n-Puff** process is being considered within the industry for application in unconventional reservoirs.

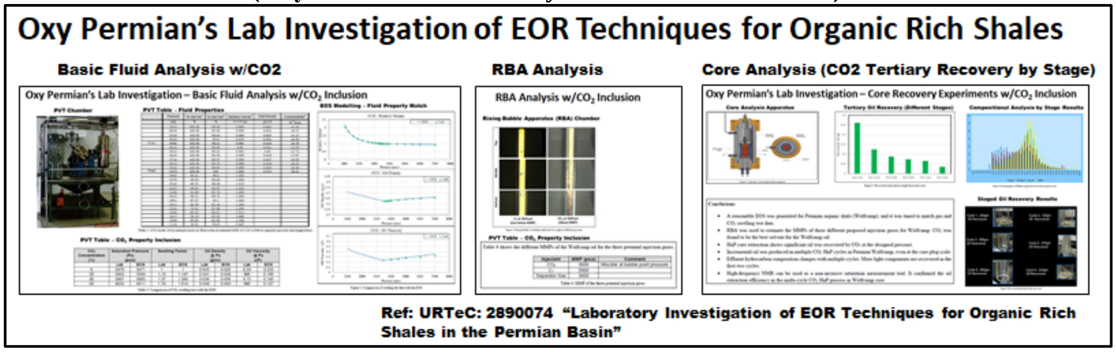
Reservoir Simulation (Simple Mechanistic Reservoir Modelling)

Compositional Reservoir Modelling provides the ability make future predictions under various operating scenarios beyond Lab and Core data. For example: Amoco Production in 1986, modelled the Conventional WAG process with a single 5-spot model under various scenarios to understand the CO_2/EOR process better. The result was Tapered WAG Injection.

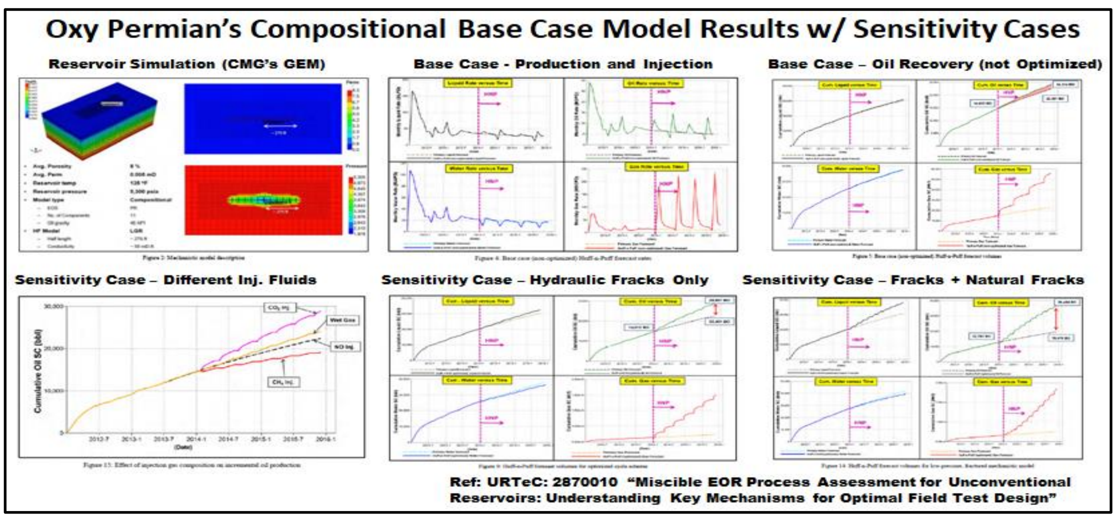


In a similar fashion, Oxy Permian collected fluid and rock samples from the Permian Basin Wolfcamp formation and tuned their EOS models. The results of both the lab fluid and rock data as stated by Oxy Permian demonstrated the Huff-n-Puff process could recover significant additional oil with additional cycles for Permian organic rich shales. The multi-cycle incremental recovery – even at the small core plug scale- suggests the significant potential for multiple huff-n-puff cycles for a future Unconventional EOR project design. In addition, for the Wolfcamp formation, CO_2 was found to be the best solvent for Tertiary Oil Recovery when compared with other injection gases. In addition, since CO_2 is a Multiple Contact Miscible process with the oil, the fluid composition of the produced oil changes with time.

Reservoir Simulation (Oxy Permian's Lab Analysis: Fluid and Core data)



Reservoir Simulation (Oxy Permian's Single Well Model Predictions)
Compositional Reservoir Modelling is predicated on the ability to properly match field historical performance and lab data. The compositional model developed by Oxy Permian utilized an 11 component description based on the Peng-Robinson Equation of State (PR EOS). The primary recovery history match (Base Case) was calibrated to match Wolfcamp primary performance using assisted history matching techniques. The cycle scheme for the non-optimized (base case) Huff-n-Puff forecast assumed a schedule of 10 days of injection at 1.0 MMSCFD, 7 days of soaking, and 180 days of production. **The incremental oil realized under the un-optimized base case was around 23% over a period of 2 years with a gross utilization of around 22 MSCF/Bbl.**



Cycle Scheme Optimization (Sensitivity Case Runs)
Optimizing the injection-soak-production design greatly influences CO_2 Huff-n-Puff performance. **The Optimized Huff-n-Puff oil recovery wedge was 81% higher than primary production (compared with 23% for the non-optimized case.** In addition, gross utilization calculated was 25 MMSCF/BBL).

Effect of Natural Fractures on Process Performance
The presence of hydraulic and natural fractures provides a large contact area for injected gas to penetrate into the low-permeability matrix to improve recovery. **The Huff-n-Puff wedge was 250% higher than primary production for the naturally fractured reservoir, compared to 81% higher for the optimized Huff-n-Puff hydraulically fractured case.** In addition, gross utilization was 18 MMSCF/Bbl for the naturally fractured case, compared to 25 MMSCF/Bbl for the base.

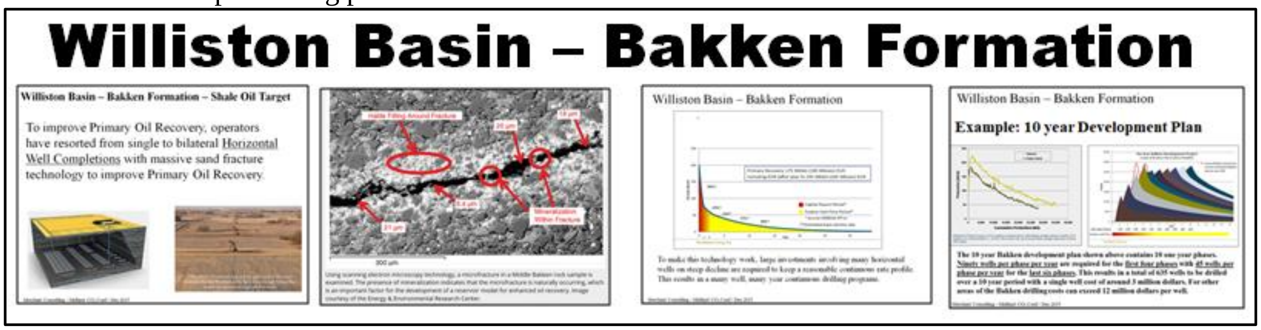
Effect of Injection Gas Composition on Process Performance
The effect of injection gas composition on incremental oil production was also evaluated. The injectants evaluated included CO_2, wet gas (CH_4 ~ 65 mole %, C2 ~ 15 mole %, C3+ ~ 20 mole %), and methane (CH_4). CO_2 had the highest recovery.

Conclusion

Oxy Permian <u>demonstrated</u> through lab and Reservoir Simulation, the Huff-n-Puff CO_2/EOR process could recover significant additional oil beyond Primary Unconventional Recovery in Permian organic rich shales.

Bakken Unconventional Shale Oil

As one of the largest unconventional resources in the World (200,000-square-mile-area in North America) with over 10,000 wells drilled in the past 10 years), the **Bakken Petroleum Basin** contains approximately 3.6 billion barrels of recoverable oil as estimated by the U.S. Geological Survey in 2008. The economic impact was seen when oil production grew significantly from 2009 to 2014 from 0.2 MMBOPD to 1.1 MMBOPD. In addition to the oil, a large volume of associated gas (1.6 BCF per day) was also produced. A substantial part (>10%) was flared off because of the low natural gas price and limited infrastructure for gathering and transporting the gas from well sites to processing plants.



The Energy & Environmental Research Center (EERC) is currently focused on solving the Bakken formation's energy and environmental challenges. Through its Center for Climate Change & Carbon Capture and Storage, the EERC is engaged in research activities in direct support of carbon management. One significant carbon management effort led by the EERC is the Plains CO_2 Reduction (PCOR) Partnership. The PCOR Partnership is one of seven regional partnerships established by the U.S. Department of Energy National Energy Technology Laboratory to assess and develop carbon storage opportunities.

The main target of this drilling has been two of the non-shale low-permeability units, the Middle Bakken Member and the Three Forks Formation. Over the last 7-8 years, there have been a number of pilot tests for both water and gas injection. Results showed CO_2 and produced Bakken gas to be miscible with the oil at reservoir conditions (>5000 psi, 230°F), and measured MMPs for pure CO_2 and ethane were 2528 psi and 1344 psi, respectively. Injectivity of gas or water does not appear to be an issue in the Bakken; however, the projects, in general, show early breakthrough times and poor reservoir sweep efficiencies. Although the production rate is encouraging, the recovery factor (averaging 7% per well) is small compared to the huge amount of oil in place. How to improve oil recovery becomes a critical step toward future development of the basin.

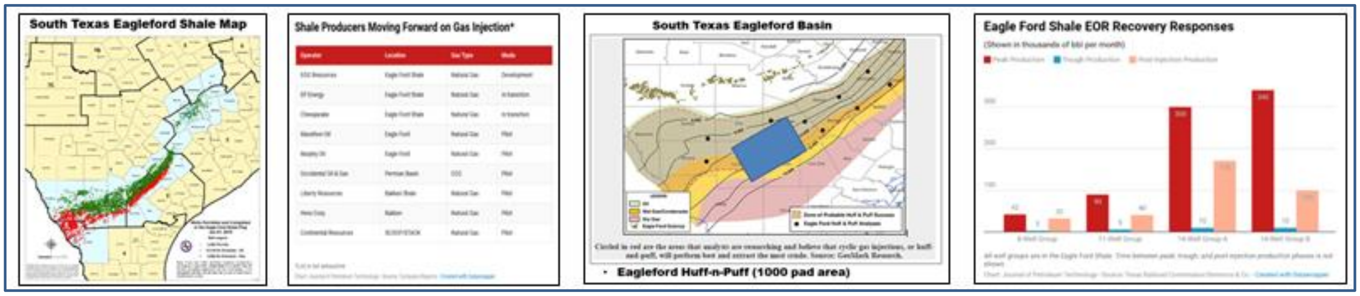
Lessons Learned -Confinement and "Frac Hits"

Vertically, confinement in the Bakken, and elsewhere, has so far not been a big concern to operators, but **Horizontally** with **"Frac Hits",** we have a bigger problem. While a large surface area for the gas to interact with is critical to achieving success, there are cases where the tensile fracture networks created during fracturing, along with natural fracture networks, could be overly extensive, allowing the gas to spread quickly into adjacent wellbores, thus lowering ultimate oil recovery.

Horizontal Confinement is not a new issue. These issues have been a part of Conventional CO_2 flooding since its conception. One of the best examples involves the Central Mallet Unit in Slaughter field. (Ref: SPE 26624 "Reservoir Management in Tertiary CO_2 Floods', published in1993). In fields with multiple operators and leases, **"Water Curtain Technology"** was first introduced to **contain** the CO_2/EOR flood within unit boundaries by incorporating water injectors at lease boundaries. But in the Central Mallet Unit and Slaughter Estate Units, Chichenleg pattern producers were converted to water injection, thus increasing reservoir pressure above MMP across the reservoir, allowing the WAG injectors freedom to do what they were designed for; that is, managing conformance across the injection interval with water, rather than the injectors doing both conformance control and maintaining pressure above Minimum Miscibility Pressure (MMP). For the Bakken, water could work, but other alternative approaches and (Containment Area Solutons) need to be investigated.

Eagleford Unconventional (Proven Hydrocarbon Gas Huff-n-Puff Projects)

CO_2 Injection is not the only injectant to recover additional Tertiary Oil. In the spring of 2016, Houston-based EOG Resources let it be known that its shale EOR program was boosting production from vintage horizontal wells in its Eagle Ford Shale asset in south Texas. It is commonly accepted today all of these projects rely on the **Huff-n-Puff** Injection process using **Natural Gas** as the injectant mobilizing tertiary oil. In a recent quarterly earnings statement, EOG said it continues to see "strong results" from around 150 EOR wells, more than a third of which were converted in 2018. Analysts and engineering consultants have found about 100 other wells in the Eagle Ford that several other operators have converted into huff-and-puff injectors as well.



John Watson, a senior research analyst who put together a report late last year that highlighted production details of shale EOR projects, found dozens of pad wells that saw a combined 10-fold rise in production above their trough. Watson's report covers more than two dozen other shale EOR projects, though most lacked production results, revealing only project cost estimates. Among the standouts, a group of 11 wells that reached a combined peak production rate in December, 2011 of about 90,000 bbl a month. By August 2017, these wells were pumping out only 5,000 bbl a month. After gas injections began, the group produced 40,000 bbl a month—an average increase from about 15 BOPD to 117 BOPD per well. Another case involved 14 wells that peaked at 330,000 bbl a month in 2013, and then dropped to 10,000 bbl per month. Post injection, output increased to 170,000 bbl a month.

Pilot Response Proof:
A comparison of Oil Recovery for the different pattern areas is shown above, proving the Huff-n-Puff process works with actual proven results.

Confinement: Vertically, confinement in the Eagle Ford, and elsewhere, has so far not been a big concern to practitioners. "Horizontally, we have a bigger problem," said Chet Ozgen, a Reservoir Engineering Consultant with NITEC LLC, who explained that the worry here is over the long, tensile fractures that operators created via their early-generation stimulations. While a large surface area for the gas to interact with is critical to achieving success, there are cases where the tensile fracture networks could be overly extensive, allowing the gas to spread quickly into adjacent wellbores. In addition, Chet Ozgen has found that newer generations of hydraulic fracturing designs, ones aimed at generating near-wellbore complexity, are making for the best EOR candidates.

Sequencing and communication: The order in which gas injections take place between groups of wells is the key to optimizing the approach. And a big deciding factor here is how the pad wells communicate, which the shale sector has learned is almost always the case. Ozgen and others are using reservoir models to derisk the sequencing options. Based on his experience, Ozgen estimates that 50% of the scenarios where wells are highly communicative, which could be indicated by a history of intense frac hits during the completions phase, may turn out to be noneconomic. He compared this to converting isolated, individual wells to EOR, in which case the sequencing will have almost no impact on the economics.

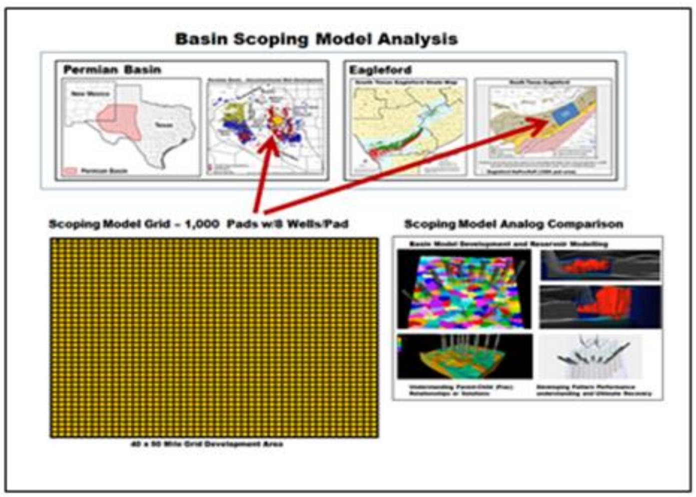
In the worst cases, the big risk might be that the wells end up recycling the injected gas from one to the next without improving production. To sum up how critical sequencing is, Ozgen concluded: "If you do not find the correct order, you can lose money and your [incremental] recovery is horrible."

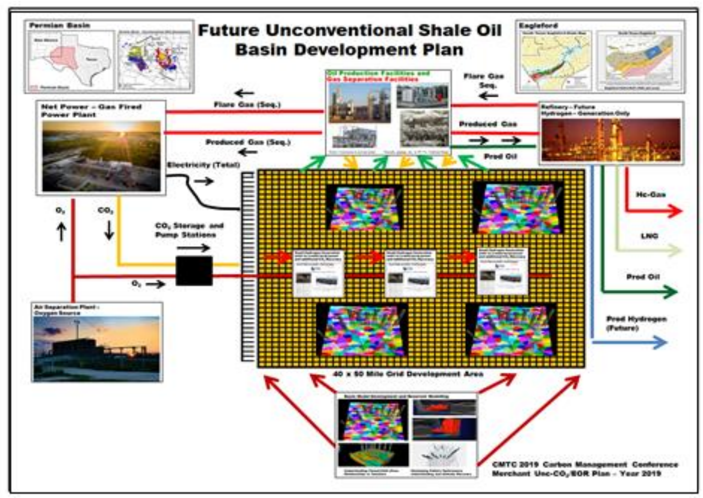
<u>Permian Basin and Eagleford:</u> What is the CO_2 Storage Capacity of a 1,000 Pad region (40 by 50 square mile area) located within either the Midland or Eagle Ford Basins Look Like?

Historically, **Scoping Study Model Analysis** has been used to make **Tertiary CO_2/EOR Predictions** in **Conventional CO_2 floods** for over three decades without having to conduct extensive Reservoir Modelling. Reservoir Modelling and analysis in the Unconventional Shale Oil Reservoirs has been primarily focused on understanding **Single Well Performance** or **Parent/Child Relationships** to better improve **Single Stage Primary Oil Recovery**. The question becomes?

What will the <u>Permian Basin</u> or <u>Eagleford</u> look like with the inclusion of CO_2/EOR Huff-n-Puff in the future by the year 2050?

The example below depicts a 1,000 PAD example (50 mile X 40 mile) grid or (area covering 2,000 square miles), that was used to compute CO_2 Storage and Capture values.





The Basin Area Scoping Model Prediction of CO_2 Storage and Sequestration was built on the following:

<u>Assumptions</u>

1. Assume that 1000 drilling PADS in the Eagle Ford would be available for future CO_2 sequestration <u>or</u> 1,000 PADS would be located within the Permian Wolfcamp zones A and B, which have similar CO_2 sequestering potential and CO_2/EOR Recovey characteristics, but over a much larger area in the Midland Basin.
2. Assume that each Drill Pad (PAD) was 1 mile by 2 miles in drainage area with 8 horizontal Eagle Ford wells per PAD
3. Assume that 5% of the active Huff-and-Puff (HnP) EOR gas injectant (in this case CO_2, not Rich gas) would be retained during 5 gas injection cycles per well
4. Assume that that 80% of the removed reservoir bbls could be refilled with sequestered CO_2 gas and the wells on each PAD would be abandon (with monitoring) to sequester about 4.5 Bcf per well PAD
5. Assume a conservative 1000 PADs (8000 wells) would be used for CO_2 sequestering at final abandonment (Fifth Cycle wth Huff, but no Puff (Storing CO_2 in Reservoir)

Results

The Scoping Model estimates 4.5 Tcf of CO_2 could be stored or sequestered in the ground permanently over a 50x40 square mile area (80 km x 64 km) of the Bakken or Midland Wolfcamp A and B reservoirs.

Conclusions

Technical Success Is Not Enough

No matter how inspiring or representative the early results appear to be, they have not proven to be enough to warrant major investments by most of the shale sector. Experts believe there are thousands of potential shale EOR locations in the Eagle Ford alone, yet only a relative small of projects have been piloted. Further, less than a dozen shale producers are known to be testing injection operations of various scales in south Texas. Some will rely on CO_2, such as Occidental Petroleum's Permian plans call for, but it appears the most popular approach will rely on natural gas.

The Question becomes "At what point will Unconventional Shale Oil CO_2/EOR make its mark in the 21st Century?"

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