

Power Generation and CO₂ Storage in Southern Tier, NY

Methane extraction and carbon dioxide sequestration in Marcellus and Utica shales

By Brian Brock

Overview

This proposal combines two things that could be done with CO₂: increase fuel production and sequester it underground. Southern Tier Solutions wants to do both by swapping CO₂ for CH₄ in the black shales. In addition, the company is looking to use much of the CH₄ to generate electricity where it is produced. STS projects a buildout of thousands of horizontal wells to source CH₄ for a dozen or so zero-emission electric generating stations and to sink the resulting CO₂ for over 35 years.

Well Drilling and Completion

STS plans to use [supercritical CO₂](#) (ScCO₂) to drill and produce natural gas wells. (Supercritical fluids have properties of both liquids and gasses.) The company claims that this is an alternative method to High-Volume Hydraulic Fracturing (HVHF) for getting the CH₄ out of the black shales in the Marcellus and Utica formations. (The use of HVHF has been banned in New York since 2014.) Supposedly, the low viscosity of ScCO₂ would allow penetration into natural fractures and its corrosiveness would open-up pores. As with conventional gas wells, water-based mud would be used to drill the vertical and transitional segments of well, and water-based cement would be used to case them. However, ScCO₂ would be used to drill the horizontal segment.

At depth, the flow of ScCO₂ would be dense enough to turn the drill bit at the end of the drill stem. While CO₂ is supercritical at depth, it returns to a gas near the surface. The debris from horizontal drilling would be blown out of the well bore by high-pressure CO₂ gas, similar to air drilling of shallow wells. Unclear how this dirty gas would be captured, cleaned, and recycled down the well, similar to what happens with drilling mud.

In 2008, Governor Paterson imposed a moratorium on HVHF to allow investigations. The NYSDEC [Final SGEIS](#) of 2015 only evaluated using water-based fracs above 300K gallons. Company claims that their process of drilling and completing would use no additives, either chemicals or sand. I haven't found any background literature on using CO₂ as the drilling fluids, but a 2021 [review article](#) in the Journal of Petroleum Science and Engineering on CO₂ fracing discusses some of the issues of using CO₂ underground. STS does not cite any full-scale well in this country that used supercritical CO₂ as a drilling fluid.

Without HVHF completions of wells, STS would not need huge volumes of water. Therefore, the company claims that they would be able to drill wells under existing regulations. STS wants to spud test wells in the summer of 2024 or at worst of 2025. (Its primary leases run three years.) The company estimates the cost of exploratory drilling at \$60 million.

STS plans to tap into the black shales by horizontal drilling from multi-well pads as is SOP. Presumably, the existing spacing for wells on multiwell pads in Marcellus and Utica fms. would apply. This permits spacing units of no more than a square mile (640 ac) with a setback of at least 330' of horizontal wellbores from unit boundaries.

What sort of approval will NYS Department of Environmental Conservation require? Would the department be satisfied with a simple drilling permit; or would it require that the first test well submit a site-specific environmental impact statement; or would governor Hochul impose another statewide moratorium until a supplemental generic environmental impact statement (SGEIS) was written for this novel process.

In November, Assemblywoman Lupardo (D, 123rd district of Binghamton, Union, and Vestal) and State Senator Webb (D, 52nd district of Broome, Cortland, and Tompkins) sent a [letter](#) to Commissioner Seggos asking what information DEC had. In [response](#), he assured them that should STS apply for a drilling permit, then the department would conduct a “thorough and transparent review process” and consult any states with relevant experience with ScCO₂. The project would have to comply with the NYS Climate Leadership and Community Protection Act including “addressing whether the project is inconsistent with or interfere with the statewide greenhouse gas emission limits.”

Also dozens of environmental groups have [written](#) to Commissioner Seggos to express their concerns of the possible return fracking. This despite STS stating that they will not use fracking to complete wells.

Methane Production

While not clear, likely that CO₂ would be used continuously during production to flush CH₄ out of the black shale by pumping CO₂ down one well and collecting the mixed gases that come up out of others. STS cryptically refers to “reservoir pressure management operations.” A similar technique has long been used for secondary recovery of oil, but DEC confirms that this flooding of the producing formation with CO₂ has never been used in New York. After leasing, STS would allot at least two years to evaluate the geology, drilling, and production.

Initially, the CO₂ that is required for the drilling and production would have to be purchased and imported. At first, it would be delivered by railroad and then truck tankers from sources along the Gulf Coast but later, possibly by pipelines from Pennsylvania. Unclear if this CO₂ would be captured and recycled during testing. Eventually, the CO₂ would be captured from the air on site or come from industries in New York.

Any CH₄ produced would have to be separated from the admixed CO₂, which would then be recycled to produce more CH₄.

STS has said nothing about flaring.

If tests of drilling, completion, and production are successful, then the company plans a density of drilling similar to that envisioned for HVHF a decade ago, with thousands of wells across the fairway, although the boundaries of their fairway are not specified. STS would organize the drilling around a dozen or so hubs. They have not located these hubs, which would in part depend on where they can lease enough land, roads & rails, pipelines, powerlines, etc.

Carbon Capture and Sequestration (CCS)

STS plans are more grandiose than the mere extraction of CH₄. They plan on building Direct Air Capture (DAC) facilities to provide some of the CO₂ that they will use to produce the CH₄ and be sequestered underground. Eventually the company anticipates drawing additional CO₂ from New York industries via pipelines, although there is not a hint where these would be.

Because there is not much empty space underground, pumping it full of CO₂ would raise the surface. However, STS claims that the CO₂ would get bound to the shale minerals. That review article cited sequestration of 9.4 cubic meters of CO₂ per metric ton of shale, although that may be theoretical. By this odd measure, that is roughly one eighth of a cubic foot of CO₂ (a cube 6" on a side) stored in a pound of shale, which is a piece the size of your fist. A more useful measure is that STS estimates that the shale formations could hold 2,000 tons of CO₂ per acre.

Government money for CCS could be used to subsidize gas drilling, which is currently unprofitable in New York. [New York State Oil, Gas and Mineral Resources 2020 Annual Report](#) is the most recent. There have been few if any gas wells drilled since 2015, and therefore gas production is declining for more than a decade.

The company envisions building DAC units that could capturing 400,000 to 1 million metric tons of CO₂ annually. Currently, the cost for DAC to remove one ton of CO₂ out of the air is typically hundreds of dollars, which is far from economic.

STS provides no details on how it would capture CO₂. A popular method involves blowing air through an alkaline solution, desolving the atmospheric CO₂. In solution, it reacts with NaOH to form Na₂CO₃. Then in the next stage, that reacts with Ca(OH)₂ to form CaCO₃, which precipitates. Finally, CaCO₃ is dried and roasted to release the CO₂, which is captured. The residual CaO is recycled into the process.

The company expects that a third of the sequestered CO₂ would be a byproduct of their power generation, third from their DAC units, and a third gathered from surrounding industries.

Worldwide, billions of dollars have been poured into CCS projects by governments and industries, but these commercial-scale projects have consistently failed to reach its promised rates of sequestration. Only 27 commercial CCS facilities are operating worldwide, of which almost half are in the United States. Of these dozen U.S. facilities, only the Illinois Industrial Carbon Capture and Storage Project run by Archer Daniels Midland in Decatur stores the captured CO₂ underground but in a saline formation. Annually, it has failed to reach its goals

CCS has been a Crazy Carbon Scheme for decades. It is expensive to capture and liquify the CO₂, and the scale of capture that would be necessary to measurably reduce atmospheric carbon is mind-boggling. What is more, there is the question if the carbon sequestration would be only temporary because the ground leaks. Is the residence time years or centuries? STS argues that because the black shales contain methane now, they have been sealed for millions of years. However, that assumes that there was not more that had since leaked. Traces of methane and oil show up in waters throughout the Southern Tier, and most of the region is dry land where methane can escape without a trace.

In the most recent NYS Oil, Gas, and Mineral Resources Report, there is nothing on supercritical CO₂ or using wells for CCS. In the past few years, the Division of Mineral Resources (DMN) which has been belatedly working on supplemental findings concerning the plugging of abandoned wells, finished that report March 2023.

In the accounting of the carbon balance for their operation, STS neglects CH₄. Methane can leak from wells and pipelines. In addition, the company plans to sell CH₄ when there is space in pipelines. Before the gas turbines are built, CH₄ can only be exported.

Project Fairway

There are thousands of gas wells in the Medina Formation in western New York. Why does not the company want to try to sequester carbon there? Possibly because many of those wells are used for underground gas storage, and STS does not want CO₂ leaking into the stored fuel. From Erie to Chemung, there are 27 methane and 3 propane storage fields using almost a thousand wells. Also, there are tens of thousands of abandoned wells in that region, most of which are unmapped and many of which are not properly sealed. Ground must leak like a sieve. And the Medina Fm. is not a shale, so it would not sequester carbon in the same way.

Where CH₄ could be economically recovered from black shales depends on depth, thickness, and thermal maturity of the formations, among other features.

Southern limit. Much of the land south of the border of New York is already leased. This drilling using ScCO₂ might not work at depths greater than 5,000', such as where you find the Marcellus in the Northern Tier of Pennsylvania.

Northern limit. CO₂ is only supercritical at pressures greater than 7.4 MPa (1,100 psi or 73 atm), so this process could work only at depths greater than about 2,500'. While the Marcellus outcrops north of the Finger Lakes and along the Mohawk Valley, likely STS would only drill where it is at least 2,500' deep, which is south of the Finger Lakes.

Western limit. Marcellus is over 100' thick from Chemung County eastward towards Broome County.

Eastern limit. There is little or no economically-recoverable gas below Delaware County and points east, except maybe in the Deposit area. The Marcellus is cooked, having been heated so that most of the CH₄ is oxidized to H₂O and CO₂.

The target region for STS is along the border with Pennsylvania: Chemung, Tioga, and Broome counties. This fairway confirms the estimates that we made for the Marcellus years ago. Operations could be extended farther to the west into Steuben County if they drilled the deeper Utica Fm.

The fairway is west of the Catskill region and south of the Finger Lakes region, thereby excluding these popular tourist destinations. Pushback from populations in those regions was instrumental in banning HVHF.

If STS manages to get these novel drilling and production techniques working, then it is possible that it could expand the fairway somewhat.

Power Plants and Pipelines

Exporting for sale all the CH₄ is not practical. It has become virtually impossible to build transmission pipelines for CH₄ in New York, and existing pipelines are near capacity. However, the company would utilize existing pipelines such as the Dominion and Millenium as capacity is available.

STS plans to build generating plants to power an all-electric operation and to export any excess electricity, although that would require building transmission lines. Thereby, they would take advantage of the sky-high prices of electricity in New York. Also, selling CH₄ is plagued by the cycle of boom-and-bust prices.

In the [Allam-Fetvedt cycle](#) (aka Allam cycle), instead of hot air, hot ScCO₂ is used to spin the turbine. A mixture of CH₄ and O₂ is burned to heat the CO₂, resulting in a mixture of 97% CO₂ and 3% H₂O flowing

through the turbine. Then this exhaust is captured and cooled, the H₂O extracted, and the CO₂ recycled through the system.

Burying CH₄ in pure oxygen prevents NO_x pollutants. Unfortunately, the cryogenic separators that produces O₂ requires considerable electrical power, which reduces plant output.

An experimental 50 MW_{th} turbine (25-MW_{el}) using the Allam cycle was built in 2018 at La Porte TX by Net Power Electric in partnership with Toshiba Corporation, Exelon Corporation, and CB&I using a design developed by 8 Rivers Capital LLC and Palmer Labs LLC. This power plant has been successfully synched to the grid.

In Odessa TX, a 300 MW generating plant using the same design is scheduled to spin up in third quarter 2024. NET Power Electric plans on commissioning it in the third quarter of 2026. This power station has seven 50 MW turbines.

STS plans to build 200 to 300 MW power plants. A standard issue gas-powered turbine generating station would take a few years to design, build, test, and commission. How much longer for one of a novel design? Until then, they would be selling the gas into pipelines — hardly net-zero

Hub and Spoke

STS is planning to build at least ten hubs which could require as much as a million acres, see diagram on page 7. Each hub could sprawl over 150 sq miles. At the center would be an industrial core of direct air capture units, electric-powered drilling rigs, an EV well-service fleet, CO₂/CH₄ separation equipment, bulk CO₂ working storage, electrical generation plants, and transmission lines. This would be connected by the spokes of a subsurface network of CO₂ and CH₄ distribution/collection pipelines to/from dozens of multi-well pads, which could stretch-out 5 to 10 miles.

In a letter to President Biden dated October 2023, eleven Democratic members of Congress asked for a moratorium on the construction of CO₂ pipelines until safety regulations can be updated. STS claims that every pipeline will have a fiber optic sensor system to detect leaks.

Primary target is the Marcellus Fm in the three counties of Chemung, Tioga, and Broome stretching about 150 miles along the southern border of New York. Additionally targeting the Utica Fm would extend drilling to Steuben County. STS has projected leasing of a half million to a million acres. Chemung has 411 sq mi, Tioga has 523 sq mi, and Broome has 716 sq mi for a total of 1,650 sq mi or about 1,056,000 acres. The company has plans for drilling under much if not most of the landscape.

STS expects that the build-out of one industrial hub, pipeline spokes, and scores of well pads would take seven to nine years, progressing from the center outward. It plans to operate this network for 35 years, maybe as much as 50 years.

Full buildout of the ten hubs and spoke networks could cost \$12 to 16 billion. The president of STS, Bryce Phillips, said “There are some big banks and private equity on the sidelines that like what we’re thinking.”

With all the required infrastructure, how could the methane be recoverable so that the project would turn a profit? The most recent report from NYS Division of Mineral Resources has no gas wells were started or completed in 2020. STS claims that their process could be more productive than HVHF, although evidence is lacking. This scheme depends heavily on federal grants and tax credits that are available for CCS. Also, recently there is been a shift to greenwashing of O&G production. Both government and

industry are trying to market fossil fuels as net-zero with the potential for liquifying the CO₂ and pumping it underground, aka carbon capture and sequestration.

Company

Southern Tier CO₂ to Clean Energy Solutions was incorporated as a New York LLC in April 2023, NYSDOS ID: 6802221. It is commonly referred to as Southern Tier Solutions or STS. Also, company is registered in Texas as a foreign LLC, Texas File Number: 0805275551

STS has a polished and informative [website](#).

As of yet, it has no offices in the Southern Tier. Principal address of STS is listed as the Houston TX office of Incfile, which is a full-service, online legal document preparation and filing service. Incfile offers a virtual address and mail forwarding service, which can be useful for those lacking a physical office and needing a professional address.

Bryce P. Phillips of Fort Worth TX is president, managing member, or governing person of Phillips Land Associates, Inc. (2003), Inland Scout, LLC (2003), Tsavoil LLC (2019), and Southern Tier Co2 to Clean Energy Solutions, LLC (2023) as well as half a dozen now-defunct companies. [Phillips Land Associates](#) owns O&G leases in Texas. Phillips says that he has been in the O&G industry since the 90s, starting as a landman and then moving to production as a geologist, geophysicist, and then operations manager across various western states.

He claims that STS is owned by CO₂ To Clean Energy Solutions LLC of Wyoming – but I can't find anything on that company. According to Phillips, this parent company will cover the estimated costs of \$60 million for the pilot project. "We're not out looking for partners."

In an interview on Capitol Pressroom, Mr. Phillips assured that STS had begun talking to the US EPA and NYS DEC in November. Commissioner Seggos contradicted him, stating that the company had not as of December 8th. Phillips clarified that STS had not received a response from DEC.

Leasing

This project came to light only when STS began mailing [letters](#) to landowners in October.

STS has mailed letters to over 6,000 owners of 30 or more acres in the fairway, inviting them to lease their land for \$10 an acre for the primary lease. (Would be interesting to see if the letter were sent to largest landowners closest to the border.) In addition, it hosted two public meetings in each of the targeted counties.

These leases are unlike ones typically used in New York because they lease land for both extracting CH₄ and storing CO₂.

Since being incorporated, STS's activities New York have concentrated on leasing. Those backers from Wyoming are willing to spend a year or so and a few million dollars to see if it can lease enough land to make the first commercial installation feasible, a minimum of 40 to 60,000 ac but as much as 100,00 ac.

If it can lease the necessary 10,000s of acres by spring, then STS will proceed with applying for permits for the pilot wells. To date, at least 1,000 landowners have expressed an interest in the lease, and several dozen have signed agreements. Phillips said, "I haven't heard anyone say no."

In the company's FAQ, it is misleading to say that landowners will not be forced to lease: "22) What happens if I don't sign a lease? You have absolutely no obligation to sign a lease. This is your land and your decision, and if you do not feel that our plan is in your best interest, the best interest of your family, the best interest of the environment, or the best interest of your community, then we will respect your decision." New York has compulsory integration whereby once the driller has leased at least 60 percent of the spacing unit, he can integrate the rest of the land. (As a practical matter, it would be hard to draw a unit if he was required to lease 100 percent of the land within.) Even if the owners do not lease their land, it could become part of a drilling unit, although they would be compensated.

Questions

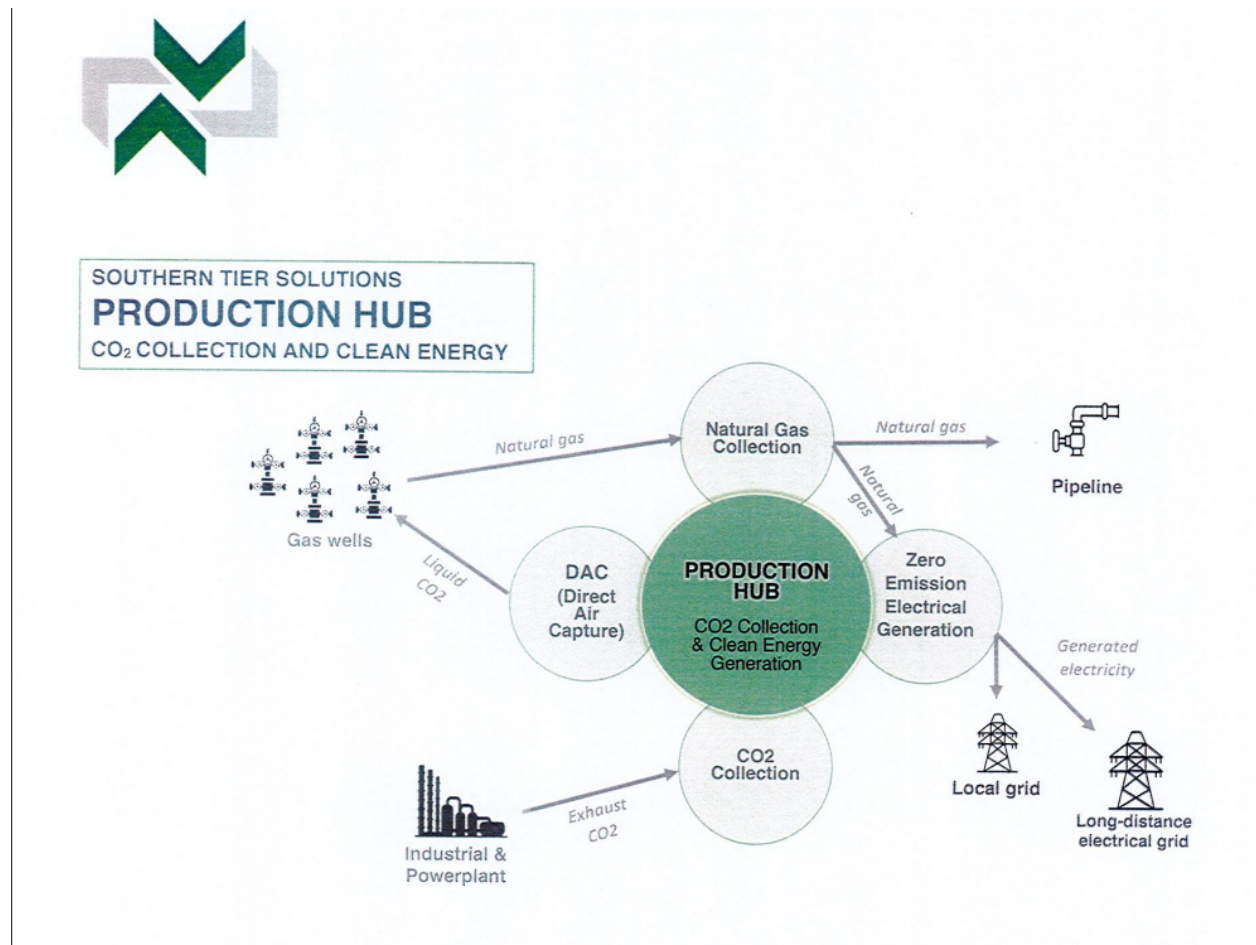
How will NYSDEC regulate these novel methods of drilling and production that use supercritical CO₂?

Would this horizontal drilling and flooding using ScCO₂ produce CH₄ economically?

Would flooding black shales with CO₂ retain significant volumes?

Would an infrastructure of wells, DAC plants, and electrical generators sequester more carbon than escapes?

Would the Marcellus and Utica plays in New York sustain 35 to 50 years of production?



Resources

November 11, 2023

[Massive Southern Tier Gas Drilling Spree Proposed; 6,500 Land Leases Sought for Plan to Extract Methane and Store CO₂](#)

By Peter Mantius, Water Watch

November 17, 2023

[Plan for Gas Drilling Spree in Southern Tier Draws Muted Response from DEC, State Reps; But Green Groups Outraged](#)

By Peter Mantius, Water Watch

December 5, 2023

[Southern Tier's natural gas eyed for extraction \(again\)](#)

By David Lombardo, Capitol Pressroom

December 6, 2023

[Is Proposal to Store CO₂ in Southern Tier Gas Wells New York State's Clean Energy Future ... or Just Another Gas Bubble?](#)

By Peter Mantius, Water Watch