Subject: Re: EGR of Antrim gas in Michigan
From: "Anthony R. Ingraffea" <ari1@cornell.edu>
Date: 6/2/2021, 2:44 PM
To: Ellis Boal <ellisboal@voyager.net>
CC: LuAnne Kozma <luannekozma@gmail.com>

Hi Ellis

Correct, I read the papers cited and now see that that there is no attempt to frac with liquified CO2.

You might use this as amended:

"Question: If the project succeeds and is then applied successfully to 10,000 wells which were otherwise about to play out -- such that US methane production were multiplied exponentially to leak from pipelines or burn at power plants around the world -- would that offset the climate benefit of CO2 sequestration?"

There is NO climate benefit from the proposed process. Yes, CO2 sequestration is of climate benefit if there is a NET-DECREASE in the volume of CO2 in the atmosphere over the life cycle of the project, e.g. grow a tree. But this proposed project intends to:

1. first capture the gaseous CO2 that accompanies methane production from wells
2. dehumidify and compress the CO2
3. Reinject the CO2 to stimulate increased production of methane, AND CO2, from the wells.
4. Repeat steps 1 through 3.

If this process were 100% efficient--that is, were it a closed-loop, no leakage usage of CO2--there is no climate benefit because there is no NET-DECREASE in CO2 in the atmosphere because of it. The process can't be 100% efficient: there will be some leakage of CO2 during steps 1-3, so a NET-INCREASE in CO2 in the atmosphere because of the process. Moreover, during step 2, there will be energy needed, and if it comes from burning fossil fuels, there is a further INCREASE in CO2 emission into the atmosphere. In other words, a formal, quantitative LIFE-CYCLE analysis of the process would conclude that any assertion that this proposal is climate beneficial is asinine."

best

tony

A. R. Ingraffea, Ph.D., P.E., Dist. Member ASCE
Dwight C. Baum Professor of Engineering Emeritus and Weiss Presidential Teaching Fellow at Cornell University
607-351-0043

Subject Editor for Geomaterials for ENGINEERING FRACTURE MECHANICS
https://www.journals.elsevier.com/engineering-fracture-mechanics/

As a concerned scientist/engineer, I engage beyond the academy to further inform and educate the public on critical scientific issues that involve public health and safety, and am also Founding and Past President and now Senior Fellow:

PSE Healthy Energy, Inc.
www.psehealthyenergy.org

From: Ellis Boal <ellisboal@voyager.net>
Sent: Monday, May 31, 2021 12:02 AM
To: Anthony R. Ingraffea <ari1@cornell.edu>
Cc: LuAnne Kozma <luannekozma@gmail.com>
Subject: Re: EGR of Antrim gas in Michigan

Tony,

I am about to write about the Riverside project and would like to use your quote below starting with "There is no climate benefit..." and ending with "...is asinine."

First I want to call your attention to one point you make which may be mistaken. In ¶¶ 2-3 you refer to processing CO2 "to a liquid."

But see the last sentence in ¶ 20 of the affidavit of Riverside engineer Phillip Koro that I previously sent where he says, referring to Exhibit E: "We plan to add infrastructure to capture the CO2 instead of venting it, compress and dehydrate the CO2 and send it back to injection wells depicted in red."

Are you sure Riverside plans to inject CO2 in liquid form?

(I also attach an April 2020 permit application to upgrade Riverside's amine CO2 processing unit by adding gen sets for power generation. Not sure it's important)

Before quoting you I will send a draft of the whole piece so you can see it in context. Thanks very much.

Ellis

On 9/29/2020 7:16 AM, Anthony R. Ingraffea wrote:

> Hi LuAnne and Ellis:
>
> Nice to hear from you, that you are well, and still fighting the fight.
>
> You ask:
>
> "Question: If the project succeeds and is then applied successfully to 10,000 wells which were otherwise about to play out -- such that US methane production were multiplied exponentially to leak from pipelines or burn at power plants around the world -- would that offset the climate benefit of CO2 sequestration?"
>
> There is NO climate benefit from the proposed process. Yes, CO2 sequestration is of climate benefit if there is a NET-DECREASE in the volume of CO2 in the atmosphere, e.g. grow a tree. But this proposed project intends to:

1. first capture the gaseous CO2 that accompanies methane production from wells
2. process that CO2 to a liquid
3. Reinject the liquid CO2 to stimulate increased production of methane, AND CO2, from the wells.
4. Repeat steps 1 through 3.

If this process is 100% efficient--that is, it is a closed-loop, no leakage usage of CO2--there is no climate benefit because there is no NET-DECREASE in CO2 in the atmosphere because of it. The process can't be 100% efficient: there will be some leakage of CO2 during steps 1-3, so a NET-INCREASE in CO2 in the atmosphere because of the process. Moreover, during step 2, there will be energy needed, and if it comes from burning fossil fuels, there is a further INCREASE in CO2 emission into the atmosphere. In other words, a formal, quantitative LIFE-CYCLE analysis of the process would conclude that any assertion that this proposal is climate beneficial is asinine.

Of course, if they just stopped all well activity now, there would be no CO2 to sequester, and climate would benefit from decreased methane burning, a net decrease in potential CO2 emission, and decreased methane leakage.

This reminds me of another asinine process used in a couple of places, like Texas, where CO2 captured at coal-fired power plants is captured-liquified-injected to stimulate increased oil production from dying wells. Same story: NO climate benefit.

hope this helps,

best

tony

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Co-Editor-In-Chief of ENGINEERING FRACTURE MECHANICS
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PSE Healthy Energy, Inc.
www.psehealthyenergy.org

From: Ellis Boal <ellisboal@voyager.net>
Sent: Saturday, September 26, 2020 9:55 PM
To: Anthony R. Ingraffea <ari1@cornell.edu>; Robert Warren Howarth <howarth@cornell.edu>
Cc: LuAnne Kozma <luannekozma@gmail.com>
Subject: EGR of Antrim gas in Michigan

Tony, Robert,
Hope you are both well in these perilous times.
You may recall my wife LuAnne Kozma and I corresponded with you in 2016 and

previous regarding frack activities in Michigan.
LuAnne leads a statewide ballot initiative here which collected 271,000 voter signatures for a ban of horizontal fracking and waste, reversal of the state's 1930s-era policy requiring our oil-gas regulators to "foster" the oil-gas industry "favorably" and "maximize" oil-gas production, and replacement with a requirement that regulators protect "climate," which they now have no obligation to even try to protect.
We turned in the signatures two years ago. We have sued five times, with interim success at one point, and still are litigating whether the initiative will actually go on the ballot in 2022.
Tony helped us with the wording of the initiative, finalized in 2015. The ballot language is here: *https://www.letsbanfracking.org/ballot_language*
I wrote a piece two years ago exhaustively detailing the history of oil-gas regulation in Michigan and the climate implications of the initiative: *http://banmichiganfracking.org/?p=4875* .
Anyway we thought you might be able to help with the following, or if not, direct us to someone more knowledgeable.
Riverside Energy, a Texas company with offices in Michigan, got state approval the other day for a pilot CO2-injection enhanced gas recovery operation in the Antrim shale of northern lower Michigan not far where we live.
The Antrim was one of the first economic shale-gas plays in the US and has been actively developed since the 1980s. The shale is biogenic. After decades of production, Antrim wells are far down the decline curve. Over that time, the CO2 percentage in produced gas has increased.
Injection would start at two wells, for which I could get and send you detailed descriptions.
Because a significant amount of CO2 currently accompanies the methane coming out of Antrim wells, Riverside has a processing plant nearby which separates them, pipes the methane away to market, and vents the CO2 to the atmosphere. It plans to re-engineer that plant so as to capture, compress, dehydrate, and recycle the CO2 for injection. Below, the rock will adsorb and sequester it, and release methane in its place.
I attach Riverside's petition, verified statement, and the order. The verified statement is by an engineer, and includes two articles from reliable institutions on which the approval order relied.
Riverside has also applied for an EPA permit. I have a request in for those documents.
Riverside has been the largest gas producer in the state for two years now. It owns 4300+ Antrim wells. Publicity materials say this project "will provide proof of concept for a technical and commercial success ultimately paving the way for

application to potentially all 10,000+ Antrim Shale wells."
Because the Antrim is naturally highly fractured, fracking there has tended to be vertical or low-volume horizontal, so even if successful our initiative's "ban" language might not stop this project.
But we wonder if the climate-protection language might. True, injection of CO2 would seem to benefit climate. But Riverside forecasts this small "proof-of-concept" project will will result in incremental recovery of 3.1 to 7.7 billion cubic feet of gas (and add gross revenue of about $5.5 million).
I would think that at least some -- and maybe a significant fraction -- of the recycled CO2 would end up being leaked to the atmosphere despite Riverside's best efforts. But suppose not.
Question: If the project succeeds and is then applied successfully to 10,000 wells which were otherwise about to play out -- such that US methane production were multiplied exponentially to leak from pipelines or burn at power plants around the world -- would that offset the climate benefit of CO2 sequestration?
After all, as your writings have shown, in the 20-year short term methane is far more destructive to climate than CO2.
The other day our governor issued a directive calling for a "carbon neutral" state by 2050. *https://www.michigan.gov/whitmer/0,9309,7-387-90499_90704-540278--,00.html* .
Does this sound like part of a carbon neutrality plan? Is "carbon neutrality" even the right approach? Thanks for your thoughts.
Ellis Boal, 231-547-2626
LuAnne Kozma, 231-547-2828