The Effect of Monitoring Complexity on Stakeholder Acceptance of CO_2 Storage Projects in the GoM

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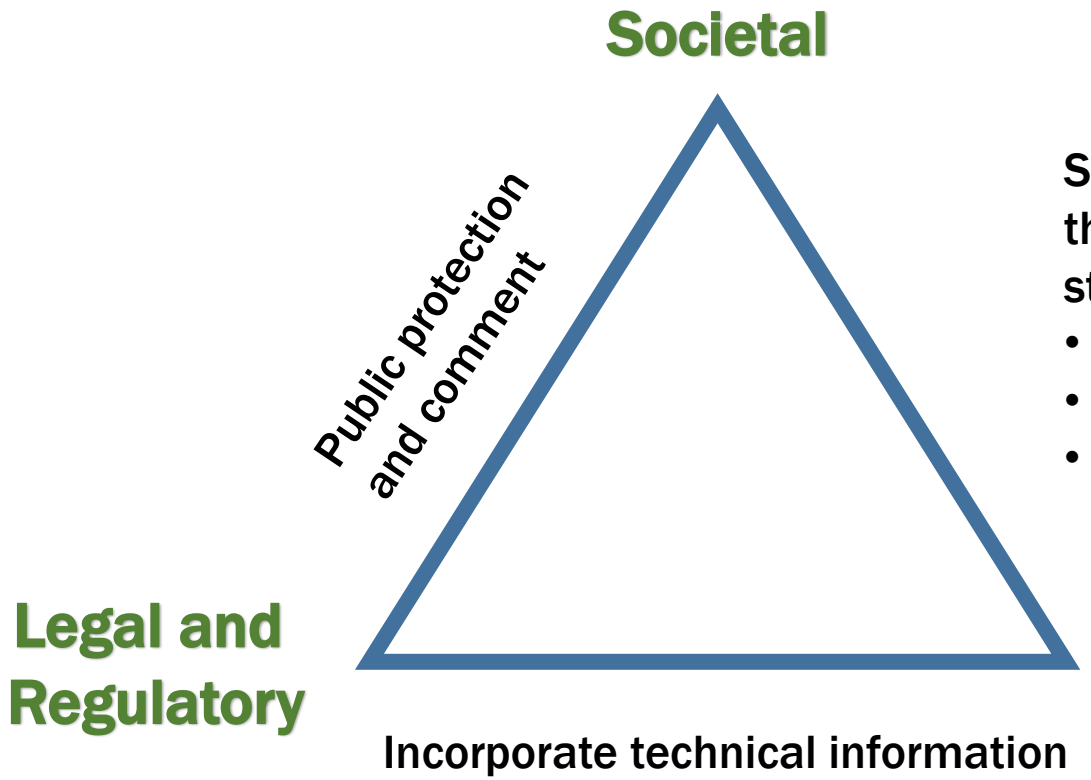
Interplay Among the Components



Stakeholder interactions with the technical aspects of storage

- Assurance
- Understanding
- Acceptance

Stakeholder Perception Challenges

Technical Issues

- **Putting geologic scales into perspective**
  - **Time**
  - **Mass**
  - **Volume**
- **Understanding geologic mechanisms**
  - **Injection, Trapping Mechanisms**

Socio-emotional issues

- ***"Hollywood" view of risk***
- ***Lack of trust in industry***

Stakeholder Analysis -The Problem

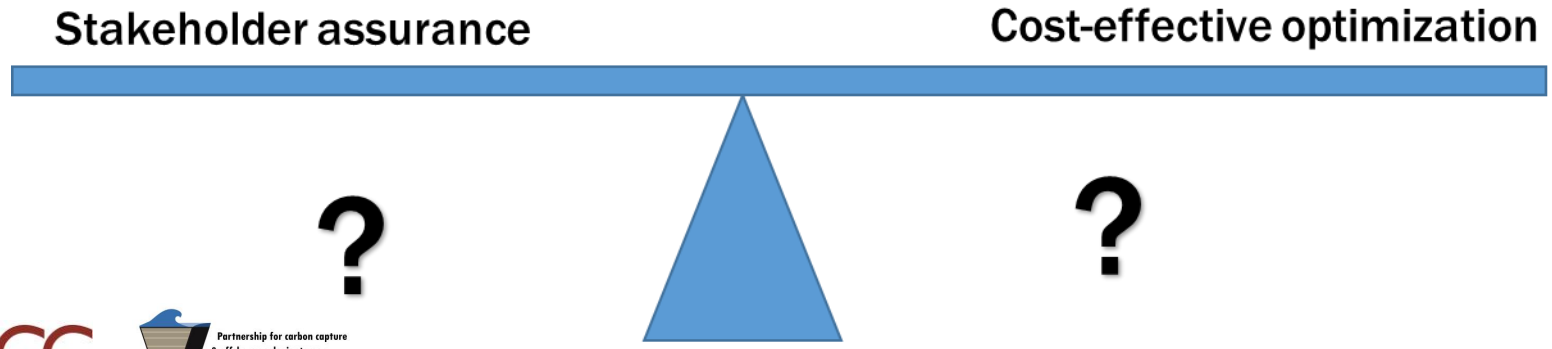
- Stakeholder acceptance is critical for project success
- CCS is growing and more projects are being developed
- More people are dealing with the potential for projects near their homes, especially in the GoM Region
- For many, this is the first they have heard of CCS
- Environmental justice and Responsible Research and Innovation concepts are also gaining traction
- How to shape our outreach in the GoM region so that we learn from important societal conditions (Responsible Research and Innovation).
- greater insight on how to create successful outreach for projects.

Research Questions

What are the roles of technology and society in reassuring the public?

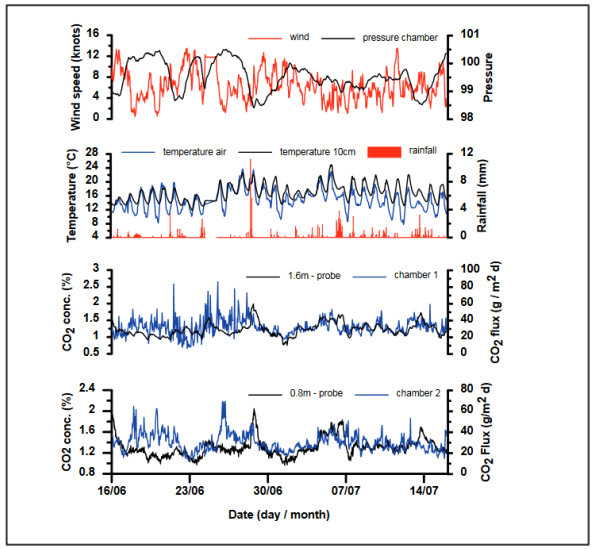
If environmental monitoring is for assurance, how are complex monitoring approaches viewed by the public compared to simple approaches?

- Which ones are more likely to garner public support for CCS?
- Which ones are more likely to assure the public
- Would stakeholders go as far as participating in monitoring?



Baseline vs Stoichiometric Approaches

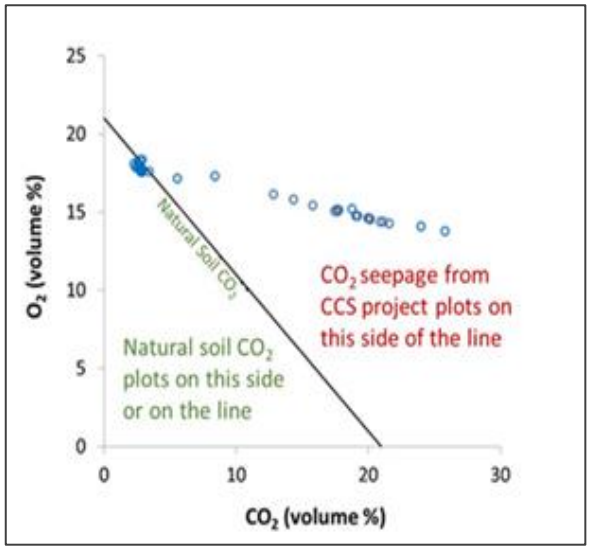
Complex



Jones et al., 2014, Energy Procedia, Volume 63, Pages 4155-4162

- 1-3 years of CO_2 soil gas and weather data
- Complex algorithms to determine thresholds
- Need time to determine leakage
- Methods inaccessible to lay stakeholders

Simple



- One-time characterization of soil gas
- Simple data reduction with clear graphical threshold
- Real time answer
- Methods easily understood by lay stakeholders

Survey Sample

- American adults aged 18 and older
- Data collection by global market research firm YouGov.
- Living in Texas and Louisiana (west GoM, O&G prevalent). Florida (east GoM, O&G not prevalent)
- States were chosen because they are close to existing or proposed CCS facilities- both onshore and offshore.
- An attention check was included to screen out inattentive subjects. Midway through the survey, one question asked them to select “somewhat agree” as their response.
- Only those who responded correctly were included in the final sample of 997 subjects (Texas = 328; Louisiana = 336; Florida = 333).
- Our sample was 44% male and 56% female.
- The average age was 47
- High school graduate (40.3%).
- 56.7% white, 18.6% Black or African American, 20.3% Hispanic, remainder were Asian, Native American or a combination of two or more races.

Novel Segmentation Approach

- We did not approach our public as uniform or singular.
- Used audience segmentation approaches to understand how different audiences process and respond to different messages

T test Variable	Higher Science Orientation n=471 (47.2%)	Lower Science Orientation n=526 (52.8%)
Science Values (1.00)	M = 4.44	M = 3.29
Need for Cognition (0.37)	M = 3.63	M = 2.94
Science Media Consumption (0.81)	M = 3.17	M = 2.03
Climate Change Beliefs (0.46)	M = 4.53	M = 3.24

Note: all $p<0.001$

T-tests and chi-square tests confirmed the experimental groups did not differ according to age, gender, ethnicity, education, income or political ideology.

Clustered Variables

- Attitudes toward science.
  - Sample items include “Science and research play an important role in my life”, “In general, I trust science”, and “Science should have no limits to what it is able to investigate.”
- Climate change Beliefs.
  - “Climate change is a serious problem” and “CO_2 that is emitted from power plants and industrial sources has been scientifically linked to climate change”
- Need for cognition.
  - Sample items include “I would prefer complex to simple problems” and “Learning new ways to think doesn’t excite me very much”
- Science media consumption.
  - Frequency with which subjects consumed science-oriented media content (science documentaries, science-themed entertainment shows, or science blogs)

Stakeholder Population Hypothesis

High Science Orientation

- Prefers complex messages and effortful cognition
- Consumes science media

- Trust more rigorous complex approaches?
- Feel safer with complex monitoring because it seems more rigorous?
- Trusts the scientist?
- Self assurance to participate in monitoring?

Low Science Orientation

- Trouble with complex messages
- Little science media consumption

- Prefers simple approaches?
- Feels safer with approaches they can understand?
- Trusts the scientist?
- No self assurance to participate?

Cluster Solution

Random Assignment. Assuming random assignment to condition was successful, subjects in each group should not differ significantly in terms of demographic characteristics. We ran T-tests and chi-square tests to confirm the experimental groups did not differ according to age, gender, ethnicity, education, income or political ideology. Random assignment was successful.

Variable	Higher Science Orientation n=471 (47.2%)	Lower Science Orientation n=526 (52.8%)
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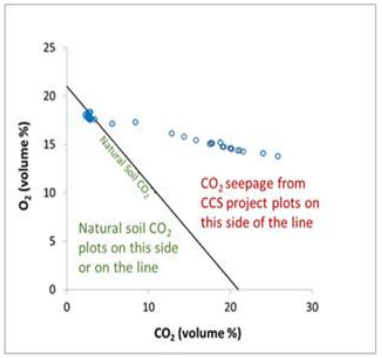
Key Variables

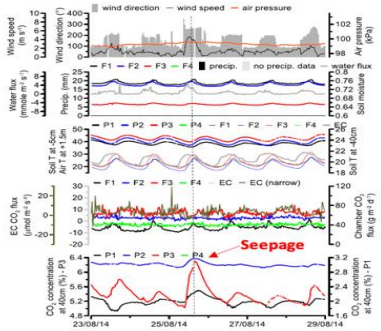
- ***Message elaboration***. Sample items: paid attention to message – did not pay attention to the message; was very involved – very uninvolved) to rate their engagement with the message about the monitoring system
- ***Attitude toward the monitoring approach*.** This scale used three items adapted from Taylor and Todd [18] and Chen, Fan and Farn [19]. Sample items include "Using this CO_2 monitoring approach would be a fun experience" and "Using this CO_2 monitoring approach is a smart idea"
- ***Perceived ease of use***. This scale used three items adapted from the literature [18, 19]. Sample items include "I think the CO_2 monitoring approach would be easy to use" and "Learning how to use the CO_2 monitoring approach would not be a problem" ($M = 3.16$, $SD = .97$; $\alpha = .88$).
- ***Perceived usefulness***. Also adapted from previous literature [20, 19], sample items include "Using the CO_2 monitoring approach would improve my understanding of CCS" and "The CO_2 monitoring approach would make CCS less confusing" ($M = 3.37$, $SD = .98$; $\alpha = .89$)
- ***Self-efficacy***. This was measured with three items drawn from Cheon, Lee, Crooks & Song [21]. Sample items include: "I would be confident about using this CO_2 monitoring approach" and "Using this CO_2 monitoring approach would not challenge me" ($M = 3.21$, $SD = 1.04$; $\alpha = .87$).
- ***Behavioural control*.** We used three items adapted previous scales [18], [21]. Sample items include "I have sufficient knowledge to use this CO_2 monitoring approach" and "I am capable of using this CO_2 monitoring approach" ($M = 2.87$, $SD = 1.13$; $\alpha = .90$).
- ***Intention to use***. This was measured with three items adapted from previous literature [18, 21, 22]. Sample items include "I would like to see the real-time data as it comes in" and "I would be interested in having the CO_2 monitor on my property" ($M = 3.35$, $SD = 1.08$; $\alpha = .82$).
- ***Support for CCS*.** This was measured with a single item asking subjects how strongly they would support or oppose a carbon capture and storage project being constructed within 15 miles of their home with the CO_2 monitoring approach they read about ($M = 2.76$, $SD = 1.17$).

2x2 Experiment

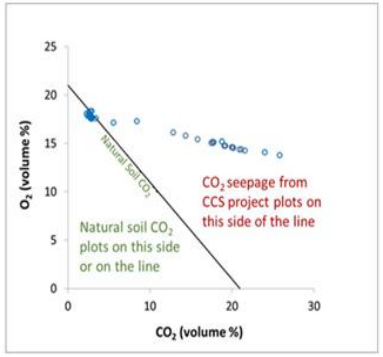
Simple Monitoring Academic Social Norm



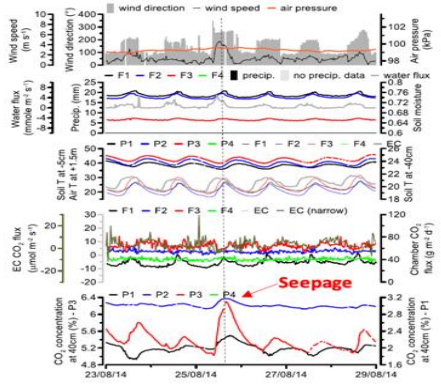
Complex Monitoring Academic Social Norm



Simple Monitoring Community Social Norm



Complex Monitoring Community Social Norm



Results

High Science Orientation

- Social norms had no influence (academic vs community)
- Simple monitoring influenced outcomes positively

Low Science Orientation

- Social norms were the primary influential factor
- Simple monitoring was favoured over complex.

Simple monitoring approaches were preferred in both populations- the ability to understand an approach was favorable over a rigorous complex approach.

Conclusions and Recommendations

- Beliefs about monitoring and CCS are statistically different among people with high science values and those with low science values within the sample population.
- Focus on simple approaches because it speaks to both groups
- Important to engage community leaders in stakeholder outreach.
- Find a community leader with HSO
- Can place messaging in science media to reach HSO
- The public should not be treated as a single entity, the public is diverse so we must account for this in communication so segmentation is important.
- Society must act and social science collaboration can help! Penetration of technical into political and social sphere.
- Analysis of multiple variables is ongoing
- Sister survey will be given in Norway and results compared

Thank You

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