

Preliminary Study on the Public's Perceptions of CO₂ Sequestration

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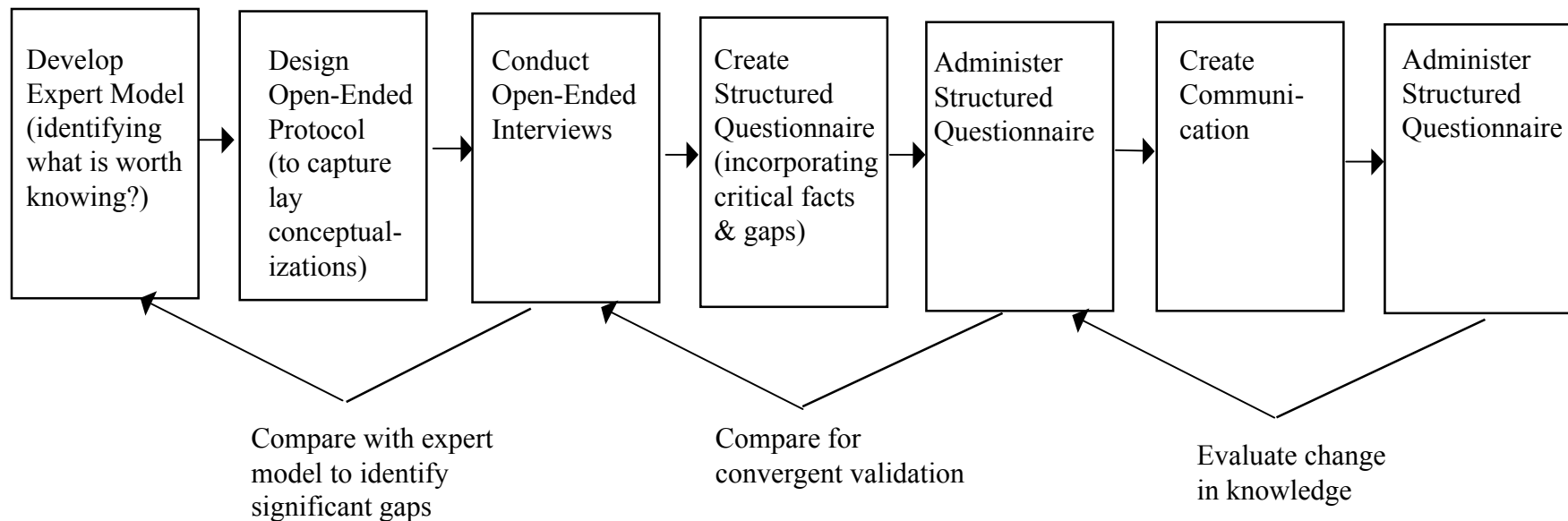
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Goals of Study

With a small sample, quickly:

- Elicit initial reactions of public towards CO₂ separation and sequestration.**
- Assess understanding, perceptions and attitudes.**
- Identify gaps, misperceptions, and concerns.**

“Mental Models” Strategy for Risk-Communication Development



From: Fischhoff, B., D. Riley, D. Kovacs, M. Small. 1998a. “What Information Belongs in a Warning?,” *Psychology and Marketing* 15,663-686.

Modified MM Method

- **Create communication**
- **Pretest interviews**
- **Revise communication**
- **Collect data**

Structure of Study

- **Individual Open-Ended Interviews: 45-Minutes**
 - **“Read aloud” protocol**
 - **Non-judgmental probing**
- **Focus Group: 1 Hour**
 - **Facilitate group dialogue**
 - **Non-judgmental guidance**

Study Materials

- **Part 1: Neutral background info**
- **Part 2: Implementation issues**
 - Technology practical & cheap enough
 - Will CO₂ stay where put
 - Energy industry diffusion
- **Part 3: Concerns of critics**
 - CO₂ pipeline issues
 - Slow leaks over long time
 - Fast “burps” in short time
 - Ocean ecology
 - Hydrogen safety

Study Materials in Detail

Subject Materials:

**A Technology that
Might Be Used to
Help Address the
Problem of Global
Warming and
Climate Change**

Part 1

Part 2

Part 3

Interviewer Materials:

Notes to Interviewer

Study Sample

- **Convenience sample of 11 CMU staff without engineering or science degrees**
- **No active environmentalists**
- **Age: Range 21 - 63 years**
Mean 37.1 years, +/-13.3
- **Gender: 4 Men**
7 Women

Part 1: Interview Results

Initial Reactions to Separation and Sequestration

Subjects (n=11)

Positive	4
Negative	3
Ambiguous	2
Too little info	2

Part 1: Interview Results

Initial Reaction to S and S: Sample Comments

• Positive

- Well, it's the beginning, somebody has to start somewhere. And so this sounds like a good beginning. [S5]
- I think it's a good idea because of the problems that we attribute to the CO₂, the global warming. [S10]

• Negative

- It makes me feel uncomfortable, the thought of putting the CO₂ either deep in the ground or deep in the ocean. [S3]
- It's just polluting it in a different place or putting it somewhere else. [S4]
- Because, sometimes things are done to fix a problem and then you find out the fix was worse than the original thing. And again, I'm still, I'm not sure that the carbon dioxide is a problem in the atmosphere yet. [S8]

Part 1: Interview Results

Overall Acceptance of Premises

Subjects (n=11)

	<u>Accept</u>	<u>Implied</u>	<u>Reject</u>	<u>Unclear</u>
Global Warming	6	1	3	1
Climate Change	4	0	0	7
Effects of CO ₂	5	3	2	1

Part 1: Interview Results

Initial Preference for Geological or Ocean Sequestration

- Only 2 out of 11 subjects explicitly preferred geological**
- However, number of comments on oceans outnumbered comments on geological by 2.5:1**

Part 1: Interview Results

Ocean Sequestration Comments

- I think the concern that really strikes me the most would have to be pumping it under very high pressure into the deep ocean . . . I know the ocean is very big and is very deep but I'm wondering what kind of effect it would have on our oceans. [S1]**
- That, if this extra CO₂ is absorbed into the ocean, would it disrupt whatever balance is in the ocean. That it might be harmful to things that live in the ocean. [S3]**
- Well, where are they going to build these? Are they have to be near the ocean? Or are they going to build big pipelines into the ocean to flush the stuff away? In the process of doing this, is there going to be pollution occurring, from this process?[S5]**
- So, I don't necessarily like the fact that it's being pumped down deep in the ocean, kind of like out of sight, out of mind. [S7]**
- So if we were to put it, like, in the ocean, we could be messing with some form of life that's on the bottom. I don't think we have much knowledge of what's down there. Because we really can't explore that deep. So we'd be messing with something we have no knowledge of. [S8]**

Part 1: Interview Results

Potential Problems Mentioned

Subjects (n=11)

Negative impacts	8
Substituting one problem for another	7
Don't know enough before we do it	4

Part 1: Interview Results

Potential Problems: Sample Comments

- Negative impacts:**

I'm not sure the ecological—we're talking about ecology—what possible damage putting this down into the ocean and some of the different, the deep geological formations. . . [S9]

- Substituting problem for another:**

But it's almost kind of like the old analogy, robbing Peter to pay Paul. You're doing one thing to improve something, but you're creating a problem elsewhere. [S7]

- Don't know enough before we do it:**

And I don't think they know what's going to happen when they stick it somewhere. [S4]

Part 1: Interview Results

Alternate Actions Mentioned

Subjects (n=11)

Work on alternate energy production methods	5
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Develop more alternatives for sequestration	4
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(3 people mentioned both)

Part 1: Interview Results

Alternate Energy Production Systems

Biomass Comments

- I'm just trying to understand, since a tree takes several years to grow, how they could maintain a constant supply without deforesting areas. I guess that's what they mean by a very large amount of land, for growing the trees. But that does seem—I can't quite picture it. [S3]**
- I mean, that whole idea, just off the top of my head, just seems a little bit like a catch 22. I mean we are so involved in renewable resources for trees just for its lumber. I mean like the raw material, not even converting it. But it would be great to think that if we could just grow the trees enough to help another type of resource, it would be great. But, I guess, I'm wondering how successful you could create that much tree growth. I guess, I question the success of the whole process there. Sounds great if it is obtainable. [S6]**
- So if you burn trees to make power, you don't produce CO₂? You must produce something horrible, though. So burning trees is called biomass energy (A lot of trees. We've got that, though. [S11])**

Part 1: Interview Results

Alternatives for Sequestration: Comments

- I guess, even trying to come up with ways to even use the CO₂. That would be great. [S6]**
- But, heck, with all of these space or exploration, why can't they ship it off the planet. As opposed to keeping it on the planet. [S7]**
- I think CO₂, if I remember, I think that's dry ice, I believe, in a solid state. And I didn't see that mentioned. I don't know if that's a possibility to turn it into a solid state. [S8]**

Part 2: Interview Results

Implementation Issues

- Technology practical & cheap enough**
- Will CO₂ stay where put**
- Energy industry diffusion**
- People were happy to read the information**

Part 2: Interview Results

Implementation Issues, Sample comments

- **I don't know how they would pump it into rocks without it escaping somehow. But that's technology that's way over my head. And yes if it can be made cheap and reliable it would be wonderful. [S5]**
- **I would be concerned in terms of the fact that they're trying to save money by getting rid of it as cheaply as possible, as opposed to doing something that would be more environmentally safe. As opposed to economically safe. [S7]**

Part 3: Interview Results

Concerns of Critics: CO₂ Pipeline Issues

- Moderate concern**
- Arguments that not dramatically different from other technologies**
- Identification of a likely NIMBY response**

Part 3: Interview Results

Concerns of Critics:

CO₂ Pipeline Issues, Sample Comments

- Well, these same critics should be worried about the pipelines for gas then. Because gas could explode; and it has. But if these pipelines are constructed properly, they should run efficiently. Of course, there's always the chance that inefficient work people might do something wrong. But hopefully it will be inspected and these pipelines will work well. These pipelines are not going to go under schools, hopefully, or in big communities. They'll probably be out in the country somewhere. [S5]**
- But it seems like it's definitely of a lesser concern or severity in comparison of what is already out there. [S6]**

Part 3: Interview Results

Concerns of Critics: Slow leaks of CO₂ over a long time

- Low concern**
- Sense that if most of it stays down there, that's progress**
- Doesn't have to be 100%**
- Some concern about drinking water**

Part 3: Interview Results

Concerns of Critics:

Slow leaks of CO₂ over a long time, Sample Comments

- Well, if they weren't directly a threat to people or animals, so what? They were going to go into the atmosphere anyway. So, monitor them and fix them when you find them, but it doesn't really seem like this would be much of an issue. [S2]**
- I don't really—I think that's kind of presumptuous to think that anyone knows that much about the forces on earth that control deep ocean and deep land formations. [S4]**
- And if you're able to capture this and create a good idea to trap it, this slow leak just seems like it's, you know, instead of a hundred percent of the CO₂ being released into the air, you're letting one percent or two percent released. I think you've still created a much better benefit. [S6]**

Part 3: Interview Results

Concerns of Critics: Fast “burps” of CO₂ in a short time

- High level of concern**
- African lake highly salient**
- Major event could be a show-stopper**

Part 3: Interview Results

Concerns of Critics:

Fast “burps” of CO₂ in a short time, Sample Comments

- **Just thinking about it scares me . . . [S1]**
- **It could happen if – I mean, the Titanic sunk; the experts aren’t always right. [S3]**
- **You’re not talking about sticking it into a small man-made storage tank that’s going to be kept in a large building in remote area that’s never experienced...It’s just too unpredictable. [S4]**
- **Well, we had Three-Mile Island. That was a large burp. We had a place in Africa where they blinded –I don’t know what that was. I forget what that was, it was a chemical that was burped into the air and a lot of people went blind. [S5]**

Part 3: Interview Results

Concerns of Critics: Ocean ecology

- **Great concern about affecting both biological and physical systems**
- **Almost all opposed going further without much greater understanding**

Part 3: Interview Results

Concerns of Critics:

Ocean ecology, Sample Comments

- **If it makes the ocean water acidic that sounds like a very major concern. . . I'd really like to know how localized these effects are. [S1]**
- **But that doesn't really help the locale in question if the waters are turned acidic. And the ecology of that area of the ocean or watershed was destroyed; that's not going to help that area. [S2]**
- **Messing with the ecosystem, which I don't think we know enough about to really mess with. [S4]**
- **So, they're now planning to put more in and will the oceans be able to absorb it without something really drastically happening to all the stuff that lives under the ocean. [S5]**

Part 3: Interview Results

Concerns of Critics: Hydrogen safety

- Mixed reactions**
- Some viewed risk manageable**
- High volatility source of concern**
- Hindenburg remains salient**

Part 3: Interview Results

Concerns of Critics:

Hydrogen safety, Sample Comments

- **. . . considering it's a potential explosive. I've also—I'm a little prejudiced against that because of a lot of stuff I've read about just how flammable and destructive hydrogen can be. [S2]**
- **I think it's a valid concern, and just because it's been OK with natural gas and gasoline all the time, doesn't mean that we should be blasé and just say "We do this all the time." [S3]**
- **But my same argument about it being shipped, if there's something –it has to be monitored. It really has to be monitored. Very, very carefully. For leaks. [S5]**

Overview: Interview Results

Initial and Final Attitudes towards Separation and Sequestration

Subjects (n=11)

	<u>Initial</u>	<u>Final</u>
Positive	4	4
Negative	3	3
Ambiguous	2	3
No Preference	2	1

Overview: Interview Results

Initial and Final Attitudes towards Separation and Sequestration

- **3 remained in the Negative category, of which:**
 - **2 rejected Global Warming premise**
 - **Remaining one's "vote would still be to pursue solar power or something where you don't need to have all these concerns." [S3]**
- **5 of 11 Subjects changed category:**
 - **Positive to Ambiguous - 2 Subjects**
 - **Ambiguous to Positive - 2 Subjects**
 - **No Preference to Ambiguous - 1 Subject**

Overview: Interview Results

Final Attitude towards S & S: Sample Comments

- **Positive to Ambiguous:**
 - I think I couldn't give a flat out good or bad. I think they could be a good idea if they were proven --all the things I mentioned – cost effective and as safe as can be made. It's a judgment call being made, whether they are safe enough to implement. It would have to be the government that would decide that. [S2]
- **Ambiguous to Positive**
 - I think overall, I think the technologies definitely sound like a good idea. And it just needs to be, you need to take these ideas and proceed with the right amount of caution to hopefully really create a better solution down the road. To just not address the problem that's been presented, or say, wow this is just too much opposition and walk away from it, obviously that doesn't make sense. I just think that –yes I think there's a lot of benefit to move forward with these ideas and technology. [S9]

Overview: Interview Results

Subjects Overlay CO₂ Sequestration Concepts onto Existing Environmental Risk Frameworks

- **Pollution Framework**
- **Garbage/Trash Framework**
- **Nuclear Waste Framework**
 - We're talking about putting something down in there. This almost sounds like nuclear waste, putting it down, storing it somewhere. Gee, it will be safe for ever and ever and ever. [S9]
- **Chemical Waste Framework**
 - Nuclear waste being stored here, garbage being put there, to store it to other places—it's going to storage as an unwanted product. So then there's going to be arguments over where to put it. [S8]

Overview: Interview Results

Issues Important to Subjects

- **Quality of Scientific Knowledge**
 - Possible and anticipated outcomes
 - Likelihood of outcomes
 - Natural vs. man-made
- **Trust-Building**
 - Previous experience
 - Suspicious of business interests
 - Government accepting dangerous technology
- **Economics and Stakeholders**
 - Who's doing the research
 - Who will profit if implemented
- **Location of Sequestration Facilities**

Overview: Interview Results

Issues Important to Subjects

- **Quality of Scientific Knowledge**

- I think if anything on the ocean floor, they should look at more of what's down there. If they need to know more of what's there and how the life forms are behaving down there, because we might be dependent on what's going on in a deep ocean, just as much as we are the trees and the plants. So. I'd want to know what they know more about the physical systems in the oceans before they mess with that. [S8]

- **Trust-Building**

- Does the general public have any say in it. Or is it just going to be, like I said, big business doing what big business is going to do anyway. And just doing it and saying, well, you know, it may affect you, it may not; you're just going to have to live with it. [S7]

Overview: Interview Results

Issues Important to Subjects

- **Economics and Stakeholders**
 - Who's doing the research
 - Who will profit if implemented
- **Location of Sequestration Facilities**
 - Well, in my mind I wouldn't want to see pipelines running behind my house. [S8]

Overview: Interview Results

Aquifer Issues

- **In the deep formations, how are they going to –we're already having problems with our water table. Are they sure that they're dissolving it in salty water or how will they make sure it doesn't contaminate or taint what's left of the Artesian Wells and things like that.
[S4]**

Next Steps

- **Revise procedure in light of lessons learned at this meeting.**
- **Apply to larger sample.**
- **Use results as a basis for a closed-form survey to get statistical power.**
- **Explore development of alternative procedures.**