Tailoring communication to the public’s intuitive understanding of CCS

Insights from experimental research in Switzerland

Lasse Wallquist, Selma L’ Orange, Simone Dohle, Michael Siegrist, ETH Zurich, Switzerland
The Swiss case

- Swiss electricity supply is based on 60% hydro, 40% nuclear
- Older nuclear power plants need to be replaced
- Gas fired power plants with CCS may be one option
- Considerable theoretical storage potential for CO2
- Switzerland is a direct democracy (only 50’000 signatures needed for a referendum)
- More than 10 national public votes a year (frequently about energy issues in the last decade)
- Large-scale CCS project would be subject to a national vote
- Important for CCS in Switzerland: Understand lay people’s mental models of CCS and develop efficient communication materials for the lay audience.

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Study 1: Lay Model

Aim
Identify concepts, beliefs and initial attitudes of laypeople (N=16)

>> Qualitative inventory

Method
Semi-structured interviews with laypeople

Int. J. Greenhouse Gas Control, 2009

Study 2: Survey

Aim
Check for the prevalence of the concepts. What are their influences on perceived risk and benefit of CCS? (N=654)

>> Quantification

Method
Survey based on Study 1. Regression analysis

Env. Sci. & Tech., 2010

Study 3: Experiments

Aim
Examine the influence of specific concepts in a communication context on perceived risk and benefit.

>> Causal relations

Method
Various within- and between-subject designs

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Experiment 1: Comprehensive information

- Within-subject design with two levels
  - Basic introduction
  - Basic introduction + comprehensive information aimed at correcting prevalent lay concepts on CCS found in previous research.
- N=64 (in CH, paper & pencil, via postal mail)
- Dependent measures:
  - Risk perception
  - Benefit perception
- Hypotheses
  - Comprehensive information about CCS:
    - decreases risk perception
    - increases benefit perception
Experiment 1: Results

**Risk Perception**

\[ t(63) = 3.06, \ p < 0.01 \]

**Benefit Perception**

\[ t(63) = 2.69, \ p < 0.01 \]
Experiment 2: Information on specific concepts

- Within-subject design with four levels
  - Basic introduction
  - + a) Pressure in the reservoir
  - + b) Liquid form of CO2 in the reservoir
  - + c) Role of CCS as a bridging technology in a portfolio of climate change mitigation measures.
- N=22 (Convenient sample in CH, paper & pencil, lab experiment)
- Dependent measures:
  - Risk perception
  - Benefit perception
a) CO\(_2\) is pumped under high pressure into the subsurface

The deeper one drills into the earth, the higher the pressure gets. The reason for this is the weight of the material which lies above. Therefore the CO\(_2\) needs to be pumped under pressure into the reservoir to be stored in the porous rock.

b) The CO\(_2\) is stored in liquid form

Natural pressure and temperature conditions that are present at a depth of 800m keep the CO\(_2\) in a liquid form. Therefore, the liquid CO\(_2\) stored in the porous rock has a lower buoyancy than if it were stored in gaseous form.

c) The subsurface storage of CO\(_2\) is a bridging solution in a set of climate change mitigation measures

The potential of one single measure or technology to protect the climate is limited. Therefore, as many measures as possible are needed to get the problem of high CO\(_2\) concentration in the atmosphere under control. Storage of CO\(_2\) is, therefore, only a part of an interim solution on the way to an energy system that requires no fossil resources.
Experiment 2: Results

Types of information:

a) Pressure in the reservoir,  
   b) Liquid form of CO₂ in the reservoir,  
   c) Role of CCS as a bridging technology in a portfolio of climate change mitigation measures.

Level of perceived risk & benefit

- Perceived Risk: $F(1, 21)= 2.52$, $p< 0.1$, $\eta^2= 0.11$
- Perceived Benefit: $F(1, 21)= 2.84$, $p< 0.05$, $\eta^2= 0.12$
Experiment 3: Information about monitoring

- Information on precautionary measures increased risk perception of mobile communication (Wiedemann & Schütz, 2006)
- 2 conditions:
  - Basic introduction
  - Basic introduction + info on monitoring
- N=200 (in CH, recruited via online panel)
- Dependent measures:
  - Risk perception, Benefit perception
  - Acceptance
  - Affect
- Hypotheses
  - Information on monitoring activities: Increase of risk perception and affect, and decrease of benefit perception and acceptance.

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Precautionary measures / monitoring of storage sites

There are several precautionary and monitoring measures to monitor the storage of CO2. After careful selection of the storage site, an individual monitoring program is developed for each site. During piping CO2 into the storage formation, the pressure and the injected amount are monitored. When the CO2 is in the subsurface, its spreading in the reservoir can be tracked with special methods. To ensure that the CO2 remains in the storage formation, measurements are also performed on the surface. In particular, boreholes are checked for tightness. Additionally, the ground is monitored for non perceptible earthquakes.
Experiment 3: overall results

- Affect: $t(148)=-2.15$, $p<.05$ (1-tailed)
- Acceptance: $t(146)=1.79$, $p<.05$ (1-tailed)
- Risk: $t(148)=-1.19$, n.s.
- Benefit: $t(148)=1.29$, n.s.
Experiment 3: gender difference

Acceptance

$t(73)=1.79, p<.05$

<table>
<thead>
<tr>
<th></th>
<th>Men</th>
<th>Women</th>
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</thead>
<tbody>
<tr>
<td>basic</td>
<td>4.0</td>
<td>3.5</td>
</tr>
<tr>
<td>basic + monitoring</td>
<td>4.5</td>
<td>4.0</td>
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</tbody>
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Experiment 3: results for men

- **Affect**
  - $t(73) = -2.93, p < .01$ (1-tailed)

- **Acceptance**
  - $t(73) = 2.45, p < .01$ (1-tailed)

- **Risk**
  - $t(73) = -2.17, p < .05$ (1-tailed)

- **Benefit**
  - $t(73) = 1.51, n.s.$
Conclusions from experimental studies

- Comprehensive information aimed at correcting lay people’s intuitive concepts of CCS can significantly decrease perceived risks and increase perceived benefits.
- Information in specific knowledge domains (e.g. knowledge about reservoir pressurization) can play an ambiguous role for the perception of risks and benefits.
- Information on protective measures does not lead to lower risk perception and higher acceptance.
- Men’s perceptions of CCS may be more susceptible to information (e.g. on monitoring procedures).
- Testing communication materials in experimental setups helps to tailor them to lay people’s intuitive understanding of CCS.
Thank you!

Lasse Wallquist  
ETH Zurich  
Institute for Environmental Decisions / Consumer Behavior  
Universitätstrasse 22  
CH- 8092 Zurich  
Phone: +41 44 632 3207  
E-mail: lwallquist@ethz.ch  
www.cb.ethz.ch