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Pitfalls in the communication about CO2 capture and storage

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Citation

Vries, G. de. (2014, June 18). *Pitfalls in the communication about CO2 capture and storage*. Ridderprint B.V., Ridderkerk. Retrieved from <https://hdl.handle.net/1887/26923>

Version: Corrected Publisher's Version

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Issue Date: 2014-06-18

Appendix A

A survey among a representative sample of the Dutch population was conducted to provide external validity to the experimental research. The main aim of the survey was to get insight in public perceptions about oil and gas companies in relation to CCS. Furthermore, the survey assessed general environmental beliefs, perceptions about CCS, and perceptions about corporate social responsibility (CSR).

Method

Sample. The survey was administered to a sample of 845 respondents representative of the adult population of the Netherlands (51% female, mean age 49.7 years). Of this sample, 328 individuals (39%) indicated to have never heard about CCS before. Respondents were invited to complete the questionnaire based on their registration in a large database of the professional research agency that executed the survey (TNS NIPO).

Procedure. The 10-minute survey was conducted online from September 24 until October 1, 2013 after it had been pre-tested among a student sample at Leiden University. Perceptions about CSR and environmental beliefs were assessed first. Then, after a brief introduction of CCS, items followed to measure perceptions about CCS, and perceptions about oil and gas companies in relation to CCS.

Results

Measures, items, and coefficients of internal consistency are provided in Table A.1. Means, standard deviations, and correlations are shown in Table A.2.

Table A.1

Measures, items and coefficients of internal consistency.

Motive to invest in CCS:	<i>To what extent do you think that oil and gas companies are involved in the development of CCS... (1 = not at all; 7 = completely)</i>
1. Economic Motive	... because they can make a profit from it in the long run
2. Legal Motive	... because of legal obligations
3. Ethical Motive	... out of ethical considerations
4. CSR Motive	... out of corporate social responsibility
5. Environmental Motive	... because it is beneficial for the natural environment
6. Greening Motive	... to get an environmentally friendly image
7. Fit with CCS ($\alpha = .86$)	<i>To what extent do you think it is logical that oil and gas companies are involved in the development of CCS? (1 = not at all; 7 = completely)</i> <i>To what extent do you think that CCS suits the activities of oil and gas companies? (1 = not at all; 7 = completely)</i>
8. Expected Manipulation ($\alpha = .89$)	<i>To what extent do you expect that oil and gas companies will try to ... (1 = not at all; 7 = completely)</i> ... manipulate people's opinion about CCS? ... convince people of their own ideas about CCS? ... influence public opinion about CCS?
9. Expected Honesty ($\alpha = .88$)	<i>To what extent do you expect that information from oil and gas companies about CCS will be honest? (1 = not at all; 7 = completely)</i> <i>To what extent do you expect that information from oil and gas companies about CCS will be objective? (1 = not at all; 7 = completely)</i>
10. Environmental Concern ($\alpha = .87$) (based on Dunlap, Van Liere, Mertig, & Jones, 2000)	<i>Indicate for each of the following environmental issues to what extent you think it is a problem for our society (1 = no problem at all; 7 = a big problem)</i> Air pollution and smog Pollution of rivers, lakes, and oceans Loss of the rain forests and jungles Climate change, global warming, also known as the greenhouse effect Ozone depletion

11. Dominant Social Worldview $(\alpha = .80)$	<i>Indicate the extent to which you disagree or agree with each of the statements below (1 = completely disagree; 7 = completely agree)</i>
(based on Dunlap et al., 2000)	<p>Humans have the right to modify the natural environment to suit their needs</p> <p>Human ingenuity will ensure that we do not make the earth unlivable</p> <p>The earth has plenty of natural resources if we just learn how to develop them</p> <p>The balance of nature is strong enough to cope with the impacts of modern industrial nations</p> <p>The so-called 'ecological crisis' facing humankind has been greatly exaggerated</p> <p>Humans were meant to rule over the rest of nature</p> <p>Humans will eventually learn enough about how nature works to be able to control it</p>
12. Attitude towards CCS	<i>Indicate below what you think about CCS.</i>
$(\alpha = .95)$	<i>"I find CCS..." (1 = bad; 7 = good)</i>
(based on Petty & Cacioppo, 1984)	<i>"I find CCS..." (1 = harmful; 7 = beneficial)</i>
	<i>"I find CCS..." (1 = foolish; 7 = wise)</i>
	<i>"I find CCS..." (1 = unfavorable; 7 = favorable)</i>
13. CCS Tampering with Nature $(\alpha = .91)$	<i>Indicate the extent to which you disagree or agree with each of the statements below (1 = completely disagree; 7 = completely agree)</i>
(based on Sjöberg, 2000)	<p>The implementation of CCS goes against nature</p> <p>The implementation of CCS can turn into a catastrophe because humans try to influence the basic processes and structures of nature</p> <p>CCS is an 'unnatural' activity</p> <p>The implementation of CCS is an expression of human arrogance</p> <p>Any negative effects of CCS for the environment will probably increase over time</p> <p>CCS has risks because nature will be disturbed</p> <p>CCS is unfair and immoral</p>
14. Importance of CSR $(\alpha = .82)$	<i>Indicate the extent to which you disagree or agree with each of the statements below (1 = completely disagree; 7 = completely agree)</i>
(based on Maignan, 2001)	<p>I would pay more to buy products from a socially responsible company</p> <p>When I buy things, I consider the ethical reputation of businesses</p> <p>I avoid buying products from companies that have behaved immorally</p> <p>I would pay more to buy products from a company that shows to care about the wellbeing of our society</p> <p>If the price and quality of two products are the same, I would buy the product from the firm that has a good reputation concerning CSR</p>

<p>15. Economic CSR ($\alpha = .66$)</p> <p>(based on Maignan, 2001)</p>	<p><i>Indicate the extent to which you disagree or agree with each of the statements below (1 = completely disagree; 7 = completely agree)</i></p> <p>Oil and gas companies try to maximize their profits</p> <p>Oil and gas companies control their production costs strictly</p> <p>Oil and gas companies plan for their long-term success</p> <p>Oil and gas companies always try to improve economic performance</p>
<p>16. Legal CSR ($\alpha = .87$)</p> <p>(based on Maignan, 2001)</p>	<p>Oil and gas companies always submit to the principles defined by the regulatory system</p> <p>Oil and gas companies will always fulfill their contractual obligations</p> <p>Oil and gas companies do not break the law, not even if this helps improve performance</p> <p>Oil and gas companies ensure that their employees act within the standards defined by the law</p>
<p>17. Ethical CSR ($\alpha = .84$)</p> <p>(based on Maignan, 2001)</p>	<p>Oil and gas companies ensure that the respect of ethical principles ('doing good') has priority over economic performance</p> <p>Oil and gas companies permit that economic performance can be negatively affected by ethical concerns</p> <p>Oil and gas companies be committed to well-defined ethics principles</p> <p>Oil and gas companies avoid achieving corporate goals that compromise ethical standards</p>
<p>18. Philanthropic CSR ($\alpha = .85$)</p> <p>(based on Maignan, 2001)</p>	<p>Oil and gas companies allocate some of their resources to philanthropic activities</p> <p>Oil and gas companies participate in the management of public affairs</p> <p>Oil and gas companies help solve social problems</p> <p>Oil and gas companies play a role in our society that goes beyond the mere generation of profits</p>
<p>19. Environmental CSR ($\alpha = .89$)</p> <p>(based on Chow & Chen, 2012; Turker, 2009)</p>	<p>Oil and gas companies do anything in their power to reduce the negative impact of their activities on the natural environment</p> <p>Oil and gas companies inform the public about their environmental impact and the risks involved</p> <p>Oil and gas companies participate in activities which aim to protect and improve the quality of the natural environment</p> <p>Oil and gas companies implement special programs to minimize their negative impact on the natural environment</p>
<p>20. General Image</p>	<p>The general impression I have of oil and gas companies is... (1 = very negative; 7 = very positive)</p>

Table A.2

Means, standard deviations and correlations.

	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
1. Economic Motive	5.00	1.26																				
2. Legal Motive	4.83	1.23	.16																			
3. Ethical Motive	3.39	1.39	-.24	.03																		
4. CSR Motive	3.65	1.36	-.23	.05	.65																	
5. Environmental Motive	3.40	1.41	-.28	.01	.60	.68																
6. Greening Motive	4.62	1.46	.08	.30	.07	.14	.22															
7. Fit with CCS	4.91	1.28	.04	.29	.09	.27	.23	.26														
8. Expected Manipulation	5.21	1.15	.39	.28	-.29	-.31	.19	.20														
9. Expected Honesty	3.14	1.23	-.32	-.05	.45	.48	.54	.06	.13	-.47												
10. Environm. Concern	5.69	0.98	.12	.12	-.02	-.01	-.00	.10	.13	.24	-.09											
11. Dom. Social Worldview	3.49	1.03	-.13	-.00	.26	.23	.29	-.03	.04	-.24	.34	-.35										
12. Attitude CCS	4.49	1.45	-.09	.14	.20	.30	.37	.11	.35	-.06	.26	.09	.16									
13. CCS Tamp. with nature	4.47	1.17	.23	.06	-.04	-.16	-.28	-.03	-.21	.24	-.28	.19	-.18	-.55								
14. Support for CSR	4.40	1.14	.06	.13	.00	.04	.01	.18	.18	.20	-.05	.33	-.14	.14	-.00							
15. Economic CSR	5.33	1.00	.19	.22	-.07	-.04	-.07	.08	.14	.24	-.04	.08	.02	.06	.04	.18						
16. Legal CSR	3.55	1.13	-.19	.01	.35	.38	.38	.03	.13	-.25	.46	-.10	.33	.19	-.16	.04	.15					
17. Ethical CSR	3.07	1.12	-.23	-.14	.43	.42	.43	-.02	-.02	-.37	.50	-.09	.34	.10	-.07	-.01	-.05	.58				
18. Philantropic CSR	3.48	1.18	-.19	-.01	.32	.39	.39	.16	.16	-.19	.43	-.07	.26	.16	-.15	.09	.09	.47	.52			
19. Environmental CSR	3.45	1.26	-.19	-.01	.43	.48	.48	.11	.16	-.28	.52	-.09	.37	.22	-.14	.02	.06	.62	.64	.65		
20. General Image	3.36	1.24	-.25	-.04	.39	.46	.46	.08	.16	-.34	.52	-.16	.35	.20	-.21	.01	.10	.64	.60	.62	.73	

Note: bold faces indicate significance at $p < .01$

Appendix B

One-sided pro CCS condition

CO₂ Capture and Storage has Positive Consequences for Climate

In the Netherlands, a lot of energy is used. This energy is mainly produced by fossil fuels such as oil, natural gas, and coal. During the production of energy from fossil fuels carbon dioxide (CO₂) is released. International agreements have been made to reduce CO₂ emissions. Reduction of CO₂ can be achieved in several ways. One of these ways is the implementation of CO₂ capture and storage technology. The capture and deep underground storage of CO₂ is also considered in the Netherlands.

The increase of CO₂ in the air can contribute to the rise of the average temperature on earth. Recent research shows that considerably less CO₂ will be released into the air when CO₂ capture and storage is implemented. This helps to combat global warming. Thus, CO₂ capture and storage has benefits for the climate.

One-sided con CCS condition

CO₂ Capture and Storage has Negative Consequences for Ground Water

In the Netherlands, a lot of energy is used. This energy is mainly produced by fossil fuels such as oil, natural gas, and coal. During the production of energy from fossil fuels carbon dioxide (CO₂) is released. International agreements have been made to reduce CO₂ emissions. Reduction of CO₂ can be achieved in several ways. One of these ways is the implementation of CO₂ capture and storage technology. The capture and deep underground storage of CO₂ is also considered in the Netherlands.

Recent research shows that there is a possibility that stored CO₂ leaks from the underground reservoirs. If this happens, this could have negative consequences such as acidification of the ground water.

Two-sided pro CCS condition

CO₂ Capture and Storage has Positive Consequences for Climate

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Recent research shows that the implementation of CO₂ capture and storage has advantages as well as disadvantages. The increase of CO₂ in the air can contribute to the rise of the average temperature on earth. Considerably less CO₂ will be released into the air when CO₂ capture and storage is implemented. This helps to combat global warming. Thus, CO₂ capture and storage has benefits for the climate. However, if stored CO₂ leaks from the underground reservoirs, negative consequences could occur such as acidification of the ground water.

Many people support the implementation of CO₂ capture and storage because of the positive consequences for the climate. One of them remarked: "The quality of our ground water is important, but so is combating global warming. I am convinced that this technology helps to keep the climate on earth livable. Although CO₂ capture and storage can have negative consequences, the advantages for the climate outweigh the disadvantages for the ground water."

Two-sided con CCS condition

CO₂ Capture and Storage has Negative Consequences for Ground Water

In the Netherlands, a lot of energy is used. This energy is mainly produced by fossil fuels such as oil, natural gas, and coal. During the production of energy from fossil fuels carbon dioxide (CO₂) is released. International agreements have been made to reduce CO₂ emissions. Reduction of CO₂ can be achieved in several ways. One of these ways is the implementation of CO₂ capture and storage technology. The capture and deep underground storage of CO₂ is also considered in the Netherlands.

Recent research shows that the implementation of CO₂ capture and storage has advantages as well as disadvantages. The increase of CO₂ in the air can contribute to the rise of the average temperature on earth. Considerably less CO₂ will be released into the air when CO₂ capture and storage is implemented. This helps to combat global warming. Thus, CO₂ capture and storage has benefits for the climate. However, if stored CO₂ leaks from the underground reservoirs, negative consequences could occur such as acidification of the ground water.

Many people oppose the implementation of CO₂ capture and storage because of the negative consequences for the climate. One of them remarked: "Combating global warming is important, but so is the quality of our ground water. We cannot allow that CO₂ is being dumped underground. Although CO₂ capture and storage also has positive consequences, the possible disadvantages for the ground water outweigh the advantages for the climate."

Balanced condition

CO₂ Capture and Storage

In the Netherlands, a lot of energy is used. This energy is mainly produced by fossil fuels such as oil, natural gas, and coal. During the production of energy from fossil fuels carbon dioxide (CO₂) is released. International agreements have been made to reduce CO₂ emissions. Reduction of CO₂ can be achieved in several ways. One of these ways is the implementation of CO₂ capture and storage technology. The capture and deep underground storage of CO₂ is also considered in the Netherlands.

Recent research shows that the implementation of CO₂ capture and storage has advantages as well as disadvantages. The increase of CO₂ in the air can contribute to the rise of the average temperature on earth. Considerably less CO₂ will be released into the air when CO₂ capture and storage is implemented. This helps to combat global warming. Thus, CO₂ capture and storage has benefits for the climate. However, if stored CO₂ leaks from the underground reservoirs, negative consequences could occur such as acidification of the ground water.

In short, the implementation of CO₂ capture and storage has both advantages and disadvantages.