Pseudo-opinions on CCS technologies

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Abstract
Public opinions on six specific CCS technologies were assessed with two traditional questionnaires (TQ). In both TQ's, high percentages of the respondents first stated that they had never heard of a specific technology but then, despite this, gave their overall evaluation of this technology (expressed as a grade) in the next question instead of using the possibility to refrain from evaluation. After twelve minutes respondents were asked to grade the six technologies again. The grades showed to be highly unstable (correlations between the first and the second grade ranged around a mere 0.35). In the first TQ, the grades became on average slightly more positive if the respondents received a bit of information on the usefulness of CO_2 sequestration between the first time they graded the CCS technologies and the second time. In the second TQ, the respondents received no information between the first and the second time grading, but they performed an unrelated, slightly annoying task. Due to this task their second grades were on average a bit more negative. It is concluded that these uninformed opinions are in effect 'pseudo opinions', which say nothing about the public acceptance of the CCS technologies. It is argued that an Information-Choice Questionnaire is more appropriate than a traditional questionnaire when assessing public opinions on new technologies

Keywords: public opinion, pseudo-opinions, CCS, Information-Choice Questionnaire

Introduction

If one wants to know opinions of the general public regarding a specific policy issue, it is often a fruitful approach to "just ask them". That is, to design a questionnaire on the issue and administer it to a sample representative for the population. However, such conventional mass opinion surveys may fall short if the issue concerns a complex policy problem (e.g., to supply the nation with enough energy and decrease the emission of greenhouse gasses) for which the options for solution are new to the public (e.g., the use of hydrogen as a fuel for cars). When options are new with relatively unknown consequences, respondents may simply lack the knowledge to have opinions. Part of them may refrain from answering but a significant part of the respondents may respond with "pseudo-opinions" or "non-attitudes" [cf.1]. An early demonstration of this phenomenon was presented in a survey in the US on attitudes towards a *non-existing* act: A substantial part of the sample expressed (strong) views regarding this fictitious act [2]. Thus, respondents are inclined to give an opinion even on topics they know nothing about [3, 4]. Other research showed that such pseudo-opinions are unstable and easily changed by contextual information [e.g. 5].

As the risk of pseudo-opinions holds especially for new and complicated issues, the issue of CCS technologies, global warming and their relationship might well be the kind of issue that is at risk for pseudo-opinions.

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Methodology and results

We tested the knowledge of the Dutch public on these issues and asked them for opinions. Specifically, we administered a traditional questionnaire (TQ1) to a sample of the Dutch population (n=327) in December 2004. A second traditional questionnaire (TQ2) was administered to a sample of 300 respondents in November 2005. These questionnaires were completed on the home computers of the respondents and contained knowledge questions and opinion questions about global warming, about CCS in general and about six specific technologies which use fossil fuels for energy production combined with CCS.

The data of TQ1 show that a substantial part of the respondents lacks even the most basic knowledge that is needed to have (or construct) a well considered opinion on these issues. For instance 38% of the respondents did not know what carbon dioxide is (faced with a multiple choice question only 62% chose the correct answer "a greenhouse gas", whereas 23% chose incorrect and 15 percent admitted to not knowing). Another example, 43% of the respondents did not know that CO_2 is emitted into the atmosphere when natural gas is used for energy production. And the majority of respondents (76%) admitted they had no clue what was meant by "CO_2 capture, transport and storage".
We asked respondents whether they had ever heard about six specific CCS technologies and whether they had an opinion on these technologies. These CCS options were (first the label for lay people we used in the TQ, next –in italics- the expert label, and finally –between quotation marks- the brief expert label for the option, which we will use in this paper):

1. Large modern coal fired power stations (for private and commercial use) with CO_2 capture and storage. *Integrated Gasification Gas Combined Cycles with CCS for all kinds of end use* "IGCC with CCS"
2. Conversion of natural gas into electricity (for private and commercial use) with CO_2 capture and storage. *Solid Oxide Fuel Cells with CCS for private and commercial use* "SOFC with CCS"
3. Large coal fired hydrogen stations (for industrial use and for bus and freight transport) with CO_2 capture and storage. *Hydrogen production via coal gasification with CCS for industrial use* "Hydrogen production via coal gasification with CCS"
4. Conversion of natural gas into hydrogen in large plants (for private and industrial use and bus and freight transport) with CO_2 capture and storage. *Hydrogen production via steam reforming with CCS for private and industrial use "*Hydrogen production via steam reforming with CCS"
5. Retrieval of methane gas by storing captured CO_2 in coal beds. *Enhanced Coal Bed Methane for similar use as natural gas* "ECBM"
6. Conversion of natural gas into hydrogen (for motor vehicles) with CO_2 capture and storage. *Small Scale reforming based on membrane technology with CCS for motor vehicles* "Small Scale reforming based on membrane technology with CCS"

Not surprisingly, high percentages of the respondents stated that they had never heard of these specific technologies (between 65% and 91% depending on the technology, see Table 2, first column). However, it is surprising that high percentages of the respondents who first stated that they had never heard of a specific technology nevertheless gave their overall evaluation of this technology (expressed as a grade) in the next question instead of using the possibility to refrain from evaluation (i.e., answer "no opinion"). For instance, 56% of all respondents admitted to have never heard of ECBM but were nevertheless willing to evaluate ECBM in the next question by providing a grade (Table 1). This means that (at least) 56% of the respondents gave "pseudo opinions" on ECBM.

Table 1: Percentages for self-reported awareness of "ECBM" crossed with evaluation willingness in TQ1

	Have you heard of retrieval of methane gas by storing captured CO_2 in coal beds? ("ECBM")		
	No	A bit	Yes
Gave their overall evaluation (graded ECBM)	56.0%	6.7%	1.2%
Refrained from evaluation (answered: "no opinion"*)	35.5%	0.6%	0%

**This is the percentage "no opinion" at the first overall evaluation.*

It will be clear from Table 2 that the percentages of the respondents who stated to have never heard of a specific technology are much higher than the percentages who refrained from evaluation. In fact, the percentages of respondents who were totally unaware of a technology but, despite this, still graded this technology ranged between 40% and 56%.

Table 2: Percentages of respondents in TQ1 who state to have never heard of technologies and percentages of respondents who refrained from evaluation of these technologies in the next question in TQ1

Expert labels for technology*	Have you heard of… No	Refrained from evaluation in the next question (answered: "no opinion")
IGCC with CCS	67.6%	26.9%
SOFC with CCS	64.5%	26.0%
Hydrogen production via coal gasification with CCS	82.0%	27.5%
Hydrogen production via steam reforming with CCS	70.6%	27.8%
ECBM	91.4%	36.1%
Small scale reforming based on membrane technology with CCS	72.2%	27.5%

** These expert labels for the technologies were translated for lay people*

Within twelve minutes, we asked respondents again to express their overall evaluation of each of the six CCS technologies into a grade between 1 and 10. Between the first and the second time respondents graded the technologies, they got some information about the nature of CO_2, about how our current manner of energy use leads to global warming and that many countries in the world want to reduce CO_2 emissions. It was also stated that the six technologies in the questionnaire aim to reduce CO_2 emissions via CCS, literally stated as "because the CO_2 is stored, it is not released in the atmosphere and can therefore no longer contribute to the greenhouse effect". Respondents were told that when the six CCS technologies were implemented on a large scale in the Netherlands each was able to reduce 20 % of CO_2 emissions by 2030. On the whole, this information probably led respondents to believe that CO_2 emission reduction is worth aiming for and that the six CCS technologies are viable options to attain this goal.
Not surprisingly, the grades became on average slightly more positive after respondents received this information on the usefulness of CO_2 sequestration (see Table 3). The second time the technologies were rated the grades were significantly higher than the first time for five of the six technologies ($p<.001$, the difference for "Small scale reforming based on membrane technology with CCS" was not significant). More importantly, the grades showed to be highly unstable (correlations between the first and the second grade ranged around a mere 0.35). This implies that the overall evaluations (i.e. grades) of most respondents changed within 12 minutes (merely around 12 percent of the variance in the second grades can be predicted from the first grades). As

these overall evaluations can hardly predict the exact same overall evaluations after twelve minutes, they are totally worthless for predicting future evaluations of the CCS technologies by the Dutch public.

Table 3: Means for first and second overall evaluations of technologies (expressed as grades between 1 and 10) and correlations between these evaluations in TQ1

Technology*	First grade**	Second grade**	Correlation between 1st and 2nd grade
IGCC with CCS	5.72	6.22	.36
SOFC with CCS	6.08	6.38	.35
Hydrogen production via coal gasification with CCS	5.83	6.37	.48
Hydrogen production via steam reforming with CCS	6.23	6.50	.34
ECBM	5.61	6.45	.39
Small scale reforming based on membrane technology with CCS	6.11	6.22	.32

**The expert labels for the technologies were translated for lay people*
***Time between 1st and 2nd grade was on average 12 minutes*

The second traditional questionnaire (TQ2) was very similar to TQ1: TQ2 also contained knowledge questions and opinion questions about global warming, about CCS in general and about the six specific CCS technologies. The results were also quite similar. Again high percentages (between 60% and 86%) stated they had never heard of the specific CCS technologies. Averaged over the six CCS technologies, 50% of the respondents in TQ2 expressed pseudo-opinions: these respondents first stated that they had never heard of a specific technology and then gave their overall evaluation of this technology (expressed as a grade) instead of using the possibility to refrain from evaluation. Different from TQ1, the respondents in TQ2 received no information between the first and the second time they graded the six technologies, but instead performed an unrelated, slightly annoying filler task. Due to this task the mood of respondents probably deteriorated and even this influenced their overall evaluations: for four of the six CCS technologies the second grades were on average slightly (but significantly) lower than the first grades.

Discussion and conclusions

Using traditional surveys, we established that a huge part of the Dutch public lacks the most basic knowledge needed to have (or construct) a well considered opinion on (the causes of) the greenhouse effect and on CO_2 mitigation techniques. On average half of the respondents gave "pseudo-opinions" regarding six CCS technologies. Overall evaluations of CCS technologies were very unstable (correlations between the first and the second grade ranged around a mere 0.35). And these overall evaluations are easily influenced by limited information and even by mood changes of the respondents.

Not all pollsters consider the possibility of a lack of knowledge as a possible compromising factor when collecting public opinions on these issues. For instance, a recent national opinion poll on CO_2 mitigation techniques in the Netherlands [6] got a lot of media coverage and its results were used by policy makers. In this survey it was assumed that all respondents knew that emission of CO_2 adds to the greenhouse effect. Based on our own research we know this is not the case. A recent study on the public awareness of carbon capture and storage in the US also showed that part of the public lacked the most basic knowledge [7].

These results all suggest a necessity for more informed opinions than can be obtained with traditional surveys when it comes to new and complicated issues. There are several techniques known that aim for more deliberated and better informed opinions [for a review, see 8]. One of these techniques is the Information-Choice Questionnaire [9, 10]. In an Information-Choice Questionnaire (ICQ), respondents are provided with well-balanced expert information on the most important consequences of each option before they are asked for their opinions and preferences. This information is translated for lay people and the processing of this information is facilitated. We developed an Information-Choice Questionnaire on global warming and on six CCS technologies. So, the topics in this Information-Choice Questionnaire (ICQ) were identical to those in the traditional questionnaires (TQ) we described in this paper. Contrary to the TQ' though, the respondents in the ICQ were provided with information (e.g., on attributes and consequences of the six technologies). For a description of the content of this information as well as the procedure to gather this information see [11]. This ICQ was administered to a representative sample of the Dutch population (n= 995). In another paper [12] we submitted to this conference we will present the results of the ICQ.

Note
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