Informed public opinions on CO_2 mitigation options in the Netherlands: deliberating expert information and lay beliefs

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Executive Summary (restricted)

The current report discusses the Information-Choice Questionnaire study done within the CATO2 program for Work Package 5.3, “Trends in public opinion”. When Carbon Capture and Storage (CCS) emerged as a possible technological solution to the excessive emission of CO_2 the logical next step seemed to investigate public perception of this option. Investigating public perception of a new and mostly unknown technology is not straightforward though. Earlier studies show that few people are aware of CCS or have some understanding of this option. They also show that uninformed opinions are unstable and easily changed, and therefore not predictive of actual future opinions. Moreover, they are not useful for a serious discussion on the place of CCS in society. Another way to study public perception in such situations is to use instruments that inform people while questioning them. A proven method for this is the so-called Information-Choice Questionnaire method (ICQ). An ICQ is essentially a decision-aid that includes information. In an ICQ several experts decide on the most relevant policy problem as well as the most relevant options to solve it. The experts gather information on the background of the problem, the options and the consequences of implementation of the options. After translation to lay language, this information is offered to people to evaluate in a highly structured way. The method of the ICQ is designed to support people in their decision making process and never to manipulate; it is therefore crucial that the information in the ICQ is accurate, reliable and balanced.

Until now, several ICQ’s on the topic of CCS have been developed and administered in the Netherlands. A large percentage of the respondents is positive about the methodology of the ICQ and evaluates the ICQ as a good decision aid. Results also show that people base their opinion of the options in the ICQ for a large part on the information provided by the experts, which most indeed evaluate as reliable. Part of the opinion regarding the options, such as CCS, is however not based on the given information from experts. That means that people base their opinion on other factors as well, such as other arguments, beliefs and possibly misconceptions. The ICQ developed in this study therefore also included an experimental design to investigate methods for debunking misconceptions regarding CO_2 and CCS, based on explorative qualitative and quantitative studies of current lay Dutch public beliefs and perceptions. It was also revised to include the latest insights into energy transition possibilities and consequences, leading to several significant changes in the emission reduction policy problem and the emission reduction options in the questionnaire.

The results of the current study point out several important finds. For one, this study again shows that it is possible for experts of different backgrounds and affiliations to agree on what is valid, accurate and balanced information regarding the consequences of CO_2 mitigation options. Moreover, after processing this information, people from the general public base their evaluation of an option for a substantial part on this information. These evaluations are also influenced by people’s values, but very little. They are not based on misconceptions of CO_2. The methods used in this study to debunk misconceptions proved to be effective in improving knowledge. However, more knowledge did not mean people used the information from experts more to base their opinion on. No specific consequences of CCS stood out as a critical influence on the evaluation or acceptance of CCS. Together with results from earlier studies though, it is evident that opinions are influenced by specifics in the whole chain. For instance, people are much more negative about technologies that use coal. The combination of CCS with biomass seems to be evaluated somewhat positive, though not as positive as the option of electricity and fuel from biomass without CCS, the option of electricity from windturbines at sea, the option of CO_2 emission reduction in households or the option of CO_2 emission reduction in the industry. These options were preferred by the vast majority of people and hardly anyone found these options unacceptable. CCS combined with coal and gasfired powerplants was mostly evaluated as not good enough though, with only few people choosing this option and 10.7% of people finding this option unacceptable. The most controversial option was nuclear energy, which was chosen as one of the four preferred options by more than a quarter of people, but was also found unacceptable by just as many people.

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2014.06.15	229	Small clarification in executive summary as requested by stakeholder of WP5.3. Some grammatical and spelling errors have been corrected.	

Table of Content

Applicable/Reference documents and Abbreviations

Applicable Documents

(Applicable Documents, including their version, are the "legal" basis to the work performed)

	Title	Doc nr	Version
AD-01d	Toezegging CATO2b	FES10036GXDU	2010.08.05
AD-01f	Besluit wijziging project CATO2b	FES1003AQ1FU	2010.09.21
AD-02a	Consortium Agreement	CATO-2-CA	2009.09.07
AD-02b	CATO-2 Consortium Agreement	CATO-2-CA	2009.09.09
AD-03h	Program Plan 2014	CATO2-WP0.A-D03	2013.12.29
AD-01d	Toezegging CATO2b	FES10036GXDU	2010.08.05
AD-01f	Besluit wijziging project CATO2b	FES1003AQ1FU	2010.09.21

Reference Documents

(Reference Documents are referred to in the document)

	Title	Doc nr	Version
RD-01			

Abbreviations

(this refers to abbreviations used in this document)

ICQ	Information Choice Questionnaire

1 Introduction

What is technically possible, is not always wanted by society. When new technologies emerge, the question always remains if and how a new technology fits into that society. Some new technologies are rejected locally or even nationally after much time and effort has been spent on development. When Carbon Capture and Storage (CCS) emerged as a possible technological solution to the excessive emission of CO_2 the logical next step therefore was to investigate public perception of this option. Recent events in the Netherlands with carbon capture and storage (CCS) demonstration projects show that public opinion can be a very crucial factor of influence for actual implementation. For instance, a project that was planned to store CO_2 in the vicinity of the Dutch city of Barendrecht, was cancelled after two years due to protests from the local public and politicians (Brunsting et al., 2011; Feenstra et al., 2010). As these events illustrate, public opposition can have severe consequences, as it can even lead to cancellation of projects. This shows how important it is to involve the public early in the process and make an accurate assessment of their perceptions and opinion.

Investigating public perception of a new and mostly unknown technology is not straightforward though. Obviously, one can just ask about people's opinion of this technology. But the first studies done about ten years ago showed that very little people had heard of CCS, let alone knew something about it. These studies also showed that a substantial percentage of people were inclined to give an opinion about CCS even if they had just stated to have never heard of it. Not surprisingly, these uninformed opinions turned out to be easily changed, after providing relevant or even irrelevant information (de Best-Waldhober et al., 2006).

For a serious discussion on the place of CCS in society, uninformed opinions are therefore not very useful. Another way to study public perception in such situations is to use instruments that inform people while questioning them. A proven method for this is the so-called Information-Choice Questionnaire method (ICQ). An ICQ is essentially a decision-aid that includes information. In an ICQ several experts decide on the most relevant policy problem as well as the most relevant options to solve it. The experts gather information on the background of the problem, the options and the consequences of implementation of the options. After translation to lay language, this information is offered to people to evaluate in a highly structured way. The method of the ICQ is designed to support people in their decision making process; it is therefore crucial that the information in the ICQ is accurate, reliable and balanced.

Until now, several ICQ's on the topic of CCS have been developed and administered in the Netherlands. A large percentage of the respondents is positive about the methodology of the ICQ and evaluates the ICQ as a good decision aid. Results also show that people base their opinion of the options in the ICQ for a large part on the information provided by the experts, which most indeed evaluate as reliable. However, a substantial part of the opinion regarding the options, such as CCS, cannot be explained by the given information from experts on the consequences of options. That means that people base their opinion on other factors as well, such as other arguments, ideas, feelings and possibly misconceptions. The ICQ apparently does not include all the information people use to form their opinion. Still, to be able to have a meaningful discussion on the use of CCS as a mitigation option it is essential that all arguments are known. Moreover, for the effectiveness of communication it is necessary to know the knowledge level and possible misconceptions of the groups with whom communication is intended.

The current report discusses the Information-Choice Questionnaire study done within the CATO2 program for Work Package 5.3, “Trends in public opinion”. The ICQ developed in this study went further than previous ICQ’s as it incorporates methods for debunking of prevalent beliefs and misconceptions regarding CO_2 and CCS. The latter are based on explorative qualitative and quantitative studies of current lay public beliefs and perceptions (Paukovic et al., 2011; 2012). Same as in our previous research, the aim is not to find out how to influence people’s opinions of CCS in order to “create acceptance”. The aim is to aid opinion formation and decision making and thus enhance the quality (i.e. stability and consistency) of opinions and decisions, regardless of the effect on the value of opinions (i.e. evaluations becoming more positive or negative). The current ICQ was furthermore revised to include the latest insights into energy transition possibilities and consequences, leading to several significant changes in the emission reduction policy problem and the emission reduction options in the questionnaire.

1.1 Earlier research

An accurate assessment of the publics’ perceptions and opinions on new technologies comes with some challenges. Research performed in the Dutch program for CO_2 Capture and Storage research, CATO, has so far revealed that public interest in energy and climate change issues is low and serious knowledge gaps exist (De Best-Waldhober et al. 2009; Paukovic et al., 2011). Few people know how much fossil fuels we use and understand how their use affects the climate. The public has limited understanding of what carbon is, what its sources are and what the relation is between carbon and climate change (Paukovic et al., 2011; Whitmarsh et al., 2011). Moreover, these studies and others show that the climate change problem and CO_2 emissions are often confused with other environmental problems such as ozone depletion and local air pollution such as NO_x and SO_2 (Ashworth et al., 2011).

Such low levels of awareness and knowledge can pose problems when the aim is to accurately assess public opinion on related technology. First of all, uninformed opinions can be unstable, because people are inclined to give an answer even if they have not heard about a topic before (Bishop et al., 1980). Such uninformed opinions are easily changed with any new information about the topic (De Best-Waldhober et al., 2006; 2009; Bishop et al., 1980) and as such hold little value for understanding or predicting public’s future reactions to any decision made. Secondly, without accurate assessment of the public’s knowledge levels communication about these topics might not match the information needs of the public and therefore fail to provide them with the necessary building blocks for decision making.

This problem has to be taken into account when it comes to opinion research of a relatively new and unknown technology such as carbon capture and storage. In most countries the general public still knows very little, if anything, about CCS. In their 2006 study, Reiner and colleagues (Reiner et al, 2006) investigated CCS awareness levels in the United States, the United Kingdom, Sweden, and Japan. The highest awareness levels were found in Japan where 22% stated to have heard of CCS while as little as 4% stated this in the USA. In France, 27% indicated to have heard of CCS in 2007, making CCS the second to last known climate change mitigation technology among the public (Ha-Duong et al., 2009). More recently, a study in six European countries Pietzner and colleagues (2011) showed higher levels of awareness. While in Greece 18.7% stated to have heard ‘a little bit’ about CCS, in

Norway this percentage was as high as 45.2%. Percentages of people indicating to have heard ‘quite a bit’ are, however, much lower. Although in Norway this is 17.4%, in all other countries the levels fall below 10% of the public.

In The Netherlands public awareness of CCS increased slowly until 2007, but increased quite fast after that, when the controversies surrounding the Barendrecht project were almost constantly in the media. When asked if they have heard about CCS, the percentage of people from the general public answering ‘a little bit’ rose from 20.2% in 2004 to 46.7% in 2008; the percentage of those who answered ‘Yes’ rose from 3.6% to 10.4% in the same period (De Best-Waldhober & Daamen, 2011). In 2010 Paukovic et al. (2011) found considerably higher percentages, with respectively 26.9% (‘a little bit’) and 37.7% (‘Yes’). This study also showed the relation between awareness and the events in Barendrecht; 95% of the people who stated that they had heard about CCS in general also confirmed to have heard of specific plans for the deployment of CCS in Barendrecht. In 2011, percentages were comparable to 2010 (Paukovic et al., 2012).

Although awareness levels are rising, there is evidence that awareness of the topic does not directly translate into knowledge. Despite the fact that respondents indicated to have heard of CCS, they have trouble indicating some basic aspects of CCS such as the problem it addresses (Sharp et al., 2006; Pietzner et al., 2011; de Best-Waldhober & Daamen, 2011). In a recent European study less than 3% of respondents could identify climate change mitigation as the sole goal of CCS (Pietzner et al., 2011). Two studies regarding knowledge and awareness of CCS in 2010 and 2011 in the Netherlands showed similar results (Paukovic et al., 2011; 2012). Poor knowledge of CCS, its aims and its aspects, therefore, continues to pose a challenge to opinion research.

1.2 Why the Information-Choice Questionnaire is an appropriate instrument when assessing public opinion on CO_2 emission reduction options[1].

Traditional public opinion surveys present a representative sample of the population with questions about the topic at hand, which can be policy measures. Traditional surveys are often a useful instrument to assess the public acceptance of a specific policy. However, for some purposes the traditional questionnaire is not sufficient. As stated above, the main drawback that can be held against traditional questionnaires, especially when it comes to problems involving technologies that are new to the public, is that a substantial part of the general public lacks the knowledge to have a well-considered opinion. Part of them may refrain from answering but a significant part of the respondents may respond with “pseudo-opinions” or “non-attitudes” (cf. Converse, 1964). 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 (Bishop et al., 1980). Thus, respondents are inclined to give an opinion even on topics they know nothing about (Bishop et al., 1986, Schuman and Presser, 1981). Other research has shown that such pseudo-opinions are unstable and easily changed by contextual information (e.g., Strack et al., 1991; Daamen et al., 2006) or slight changes in mood (De Best-Waldhober et al., 2006).

Another drawback of traditional surveys is that respondents are not encouraged to compare policy options. Policy making usually involves choosing one option over other policy options.

[1] Parts of this section are taken from our earlier reports on different ICQ studies, de Best-Waldhober et al., (2006) and de Best-Waldhober et al., (2009).

But where policymakers have to make a choice between several policy options, respondents are seldom presented with a choice problem in opinion research. Usually, respondents are asked to evaluate options rather than choose between them. As a consequence, responses are often isolated and not seen within their relevant context (Neuman, 1986). Especially if a policy problem is complex with a number of options to solve the problem, such isolated instead of comparative responses may be less useful because they are ephemeral and not really diagnostic for societal support or opposition. First of all, the isolated evaluation is without frame of reference and therefore its quantification is rather meaningless. But second and more importantly, isolated instead of comparative evaluations of options do not lead to the solution of the policy problem and can even lead to the wrong conclusions concerning societal support of or opposition to an option. For instance, if a respondent is asked to evaluate a number of options without instructions or implication to compare these options, all options could be evaluated as very negative. This would imply that none of the options is preferred. This might lead to the wrongful conclusion that the public is ready to oppose all options. For example, when evaluating options for energy production, all options could be evaluated as negative by the public, while it is not possible to do none as that would mean no energy would be produced.

1.3 Information-Choice Questionnaire: Potential

Originally, the ICQ was developed by Saris et al., 1983a (see e.g. Neijens, 1987; Neijens et al., 1992) in order to assess preferences for different ways of generating electricity in the Netherlands. Since then it has also been used to assess preferences in other areas as well; see Price and Neijens (1998) for a review. The ICQ has multiple aims. First, its aim is to provide respondents with the necessary information to reach an informed opinion. Second, its aim is to help them make use of this information to form opinions about different policy options: the ICQ is designed to guide respondents' information processing. Before respondents in the ICQ choose between policy options, they receive information to make a more informed choice. The choice is explicitly framed as a decision problem and respondents are informed about the background of the decision problem, e.g. they are told why these specific options are included in the decision problem. Then respondents are provided with information about the consequences of the different policy options and are requested to give a quantitative evaluation of each consequence. This is done by giving a rating on a scale ranging from -9 "a very big disadvantage" via 0 "totally irrelevant" to + 9 "a very big advantage". Such evaluation methodology helps the processing of information and helps respondents reach a decision. Based on these quantitative evaluations, the respondent is aided in assessing the subjective utility of each option. If respondents base their choices on their evaluations of consequences, they will choose the alternative(s) with the highest subjective utility (Neijens, 1987; Neijens et al., 1992). The ICQ procedure, however, neither requires nor requests that respondents (solely) base their choices on their evaluations of consequences.

The effects and usefulness of the ICQ has been studied in extensive evaluation research (Neijens, 1987). Neijens shows that non-response in the ICQ is not substantially different from non-response in traditional opinion surveys (non-response is low and the group of non-respondents has the same profile as the group that does respond) and concludes that the ICQ may be used to collect opinions of representative samples of the general public. In addition, Neijens found that preferences of respondents in an ICQ survey differ from those in a traditional survey, i.e. ICQ respondents make different choices than respondents in a survey in which no information about the policy options is provided. Van der Salm, van

Knippenberg and Daamen (1995) provide experimental evidence for the fact that ICQ respondents' preferences are affected by the information provided in the ICQ. Neijens' examination of the correspondence between evaluations of consequences of the options and choices suggests that ICQ respondents tend to base their choices – at least in part – on their evaluations of the consequences of the options. Moreover, comparison of evaluation-choice correspondence in the ICQ with evaluation-choice correspondence in a survey in which respondents first make their choice and then evaluate the consequences of the options shows that respondents' choices correspond more to their evaluations in the ICQ (Neijens et al., 1992). This suggests that the ICQ's effect on respondents' preferences is probably due to both the information provided – which may wholly or in part contain new information relevant to the decision problem – and to better integration of the available information into people's existing mental model (due to the ICQ's structuring of information processing). The fact that ICQ respondents may report different preferences than respondents in a more traditional survey shows that it may indeed be worth the effort to use the ICQ in public opinion research. At the same time it implies that the results of an ICQ do not necessarily reflect *present* public support for a policy. Rather, the ICQ is especially suited to assess how public opinion may be *after* the public is informed about an issue or to assess the *potential* (i.e. after extra information is provided to the public) support for alternative policies.

1.3.1 Information-Choice Questionnaire: Additions to the original method

The ICQ described in this report is the sixth ICQ addressing CCS in the Netherlands. The first ICQ that included CCS was done two decades ago and included one option where storage of CO_2 was mentioned (van Knippenberg and Daamen, 1996). An ICQ that was aimed fully at the choice problem of which CCS technology to use was done in 2004, including six CCS technologies (de Best-Waldhober et al, 2006). In 2007, an ICQ was developed that was very similar to the current ICQ, with the basic choice problem of what CO_2 emission reduction options to choose in the Netherlands (de Best-Waldhober et al., 2009). Then two ICQs were done that were based on the structure of the 2007 ICQ for methodological reasons. Ter Mors cum sui (2013) tested the methodological differences between deliberation via an ICQ and deliberation in a focus group, using a reduced ICQ with less options. Paukovic cum sui (2011) tested information-need after the ICQ by interviewing 126 people right after a slightly updated version of the 2007 ICQ. The 2007 ICQ was further used in two experiments testing the long term stability of opinion after the ICQ as well, but these experiments have not been published yet.

Overall, these studies added quite some knowledge on the usefulness and effects of the ICQ, but also brought a knowledge gap to light; the information presented in the ICQ is not the only factor on which people base their opinion of the options. First we explain here the knowledge that has been gained, the next paragraph will explain the knowledge gap. The gained knowledge here concerns mostly knowledge from ICQ's on CCS, not studies of the ICQ methodology on other topics. The unpublished experiments mentioned showed that informed opinions after the ICQ are stable after one week and resistant to dramatic information regarding a CO_2 disaster (websites explaining and showing events at lake Nyos), contrary to uninformed opinions. The study by ter Mors et al. (2013) was an extensive experimental study to systematically examine and compare the quality of opinions created by either the ICQ or focus groups. Participants received either in a focus group or via the ICQ the same factual information about two specific CCS options. The quality of opinions after this information was assessed using three indicators of opinion quality: consistency, stability and confidence. The opinions after the ICQ were more consistent, stable and confident after the ICQ, but the focus groups did not perform poor on these three indicators either.

The reason for the study using interviews after the ICQ (Paukovic et al., 2011) was one of the results of the 2007 ICQ. The 2007 ICQ used the bookkeeping system that Neijens (1987) studied, a bookkeeping system aimed at a higher opinion quality. Neijens studied how several possible steps in this system could contribute to the consistency of opinion, i.e. how much the choice for a certain option is consistent with the evaluation of the option. In Neijens' study a choice was deemed consistent if it agreed with a respondents' summed positive and negative evaluations of consequences across options. When no information was provided, 37% made a consistent choice. When information was presented in the form of an article, 48% made a consistent choice. When the information was evaluated, by evaluating each consequence, 57% made a consistent choice. Most consistent were choices after both information, evaluation and use of a bookkeeping system; 68% choose consistently after they had calculated the overall evaluation by subtracting the sum of the negative evaluations from the sum of the positive evaluations. This last system was used in the 2007 ICQ as well. As this ICQ had a policy problem that required three options to solve the policy problem, consistency was calculated differently, by calculating the variance of the overall evaluation of each option (i.e. the grade given by the respondents to the options overall, not the sum of evaluations) explained by the evaluations of the consequences of that option. Although the bookkeeping system had a positive effect on the consistency (for a more elaborate explanation see de Best-Waldhober et al., 2009), this also brought a knowledge gap to light. The consequence evaluations did not fully explain the overall evaluations of options. This means that although people did base their opinion of the options largely on the information about the options consequences in the 2007 ICQ, part of their opinion was based on something else. It is possible that people use information they already had but was not in the expert information in the questionnaire. The study with interviews after the ICQ, in 2010, was aimed at assessing possible information gaps in the expert information in the ICQ. Unfortunately, probably because they knew an interview was waiting after the ICQ, most people took a lot of time with the ICQ, much more than with similar ICQ's, and were very tired during the interview. The interviews showed little result about possible missing information, or other beliefs or arguments used in forming opinions about the options.

Concluding, the gap that was brought to light with the aforementioned studies, and which has not been studied elsewhere either, is what people use to form their opinion of options in the ICQ other than the information provided.

1.3.2 Information-Choice Questionnaire: Adding information based on lay beliefs

Within Work Package 5.3 in the CATO2 program several studies have been done to try and answer inter alia the question what other beliefs or perceptions people base their opinion on, besides the information from experts given in the ICQ. The first was the study described above adding interviews after the ICQ in 2010. Another line of studies investigated lay people's beliefs and perceptions on CO_2 and CCS and the prevalence of these beliefs and perceptions in the general population. Although knowing public lay beliefs and perceptions is informative in itself for communication and participation purposes, another aim of this line of studies was to find out which possible knowledge gaps and misconceptions could be addressed in the current ICQ. Paukovic and colleagues (2011) developed a questionnaire, named the Knowledge and Beliefs Test. This questionnaire was based on 15 interviews using the mental model approach. The questionnaire was administered twice, first in 2010 on a random sample of the Dutch population of over 402 people, then in 2011 on a representative sample of the Dutch population of over 936 people.

The questionnaire measured lay people's awareness and knowledge of, and beliefs about CCS and related topics such as energy production, climate change and CO_2. The results showed that large numbers of respondents are unsure about all of the topics. Many were unfamiliar with the characteristics, effects and sources of CO_2. For example, many of the respondents were unsure about whether CO_2 causes cancer, and many about whether CO_2 is flammable, explosive or emits radiation. A substantial percentage of people was also in doubt of the effects of CO_2: whether it causes acid rain or smog. Furthermore, there was much doubt about the sources of CO_2 emissions. A substantial percentage of respondents did not know whether CO_2 is released when electricity is produced using natural gas, or coal, or oil, or using nuclear power. Most striking though is that there was quite a bit of confusion among the Dutch public as to our current energy use and its' relation to climate change. Although a majority of people stated to have some idea of global warming and understand that CO_2 emissions influence climate, much less people can give a reasonable estimate of the percentage the Dutch energy consumption that is produced using fossil fuels, or can answer correctly that the use of gas, oil or coal for electricity production emits CO_2.

With these results, several beliefs and misconceptions could be distilled that might have an effect on opinion formation. We define a misconception as a belief that can be objectively evaluated as wrong, more specifically a belief that goes against the laws of nature. It is possible that some of the information from experts is not taken into account by people, or processed differently, due to present contradicting beliefs or misconceptions. It is important to reiterate here that the aim of this research, both the described Knowledge and Beliefs Tests as well as the ICQ's, is not to find out how to influence people's opinions of CCS in order to "create acceptance". The aim is to aid opinion formation and decision making and thus enhance the quality of opinions and decisions, regardless of the effect on the value of opinions.

Debunking misconceptions that lay-people have about concepts relevant for the ICQ is difficult and there are several aspects to consider. Cook & Lewandowsky (2011) provided an overview of ways in which correcting misconceptions may backfire. The first difficulty is that people are more familiar with the misconception than with the facts, making it more likely that people accept the misconception to be true. When communicating about a misconception, it is therefore essential to put most emphasis on the facts rather than on the misconception as this increases familiarity with the facts rather than the misconception. Second, it is important not to provide people with too much information. The content of the message should still be easily processed. When providing a lot of information, people tend to disregard the information altogether and stick to the misconception instead. Recent research of De Vries and colleagues (2014) showed that providing people with more (but less relevant) information regarding CCS reduces the effectiveness of this information. Third, when correcting misconceptions it is not sufficient to say that something is not true. The "information gap" should be filled with correct information. It is most effective when not only an alternative explanation is provided, but also an explicit warning is given that information is incorrect. Finally, when correcting misconceptions care should be taken that no norms are set. For example, stating that "a lot of people incorrectly belief that …" might lead to the inference that since a lot of people believe it, it must be true.

In the present ICQ, we will use the misconceptions regarding CO_2 that were distilled from the Knowledge and Beliefs Test (Paukovic et al., 2011). Misconceptions of CO_2 capture and storage will not be corrected. Doing so would only influence the perceptions of two options (CCS and biomass CCS) within the ICQ, while misconceptions would remain for other options (e.g. wind or nuclear energy). It is not possible to correct misconceptions of other options, as that would require extensive research (similar to the Knowledge and Beliefs Test) on which misconceptions people hold about these options. Misconceptions will be corrected in the introduction of the ICQ. Three different versions of the introduction will be created, one without extra information regarding misconceptions, one in which misconceptions were implicitly corrected by adding the correct information and one in which misconceptions were explicitly corrected. More information regarding the way in which misconceptions are corrected can be found in section 2.3.

1.4 Development of the current Information-Choice Questionnaire

The current study focuses on a complex environmental problem (climate change) and on future technologies that may contribute to solving this problem. When informing lay people about such complex matters via an ICQ, several precautions are needed to guarantee that the public is presented with a relevant policy problem and with valid and balanced information regarding a restricted set of viable options to solve this problem. These precautionary procedures are crucial when preparing an ICQ and will be discussed here. An overview of the procedures used in the current study for the development of the ICQ is given here:

1. Five experts define a relevant policy problem, consulting colleagues too
2. Five experts define seven options to solve the problem
3. Literature review and internal consultation to draft information on the seven options and their consequences
4. First review of >15 experts of draft information packages for the seven options
5. Second review of these experts of improved information packages options
6. Selection and translation of information to lay language packages by researchers based on expert review
7. First review of resonance committee (7 other experts), review of whole questionnaire, including background information, explanation questionnaire, climate change information, policy problem information, and information about the seven options and their consequences
8. Test of improved draft whole questionnaire on VMBO students, improvement ICQ based on test
9. Final review of whole Information-Choice Questionnaire by resonance committee

1.5 Defining the policy problem and options to solve it

First, it is essential to define a clearly specified and policy relevant choice problem that is not overly demanding for respondents. The policy problem should be *clear* regarding what, when, where and to what end. To ensure this was correctly done, the researchers took much care in the process of developing the policy problem. Three experts on energy transition and energy roadmaps were consulted as were two leading experts from the CATO2 project (Ecofys and Utrecht University-Copernicus Institute). Several extensive meetings were held to define a concrete policy problem that was realistic and usable for an ICQ. In consultation with the experts and the researchers on this project the assumptions of the policy problem and the most likely options to solve this policy problem were defined. The policy problem was defined as:

“How can the Dutch demand for energy be fulfilled in 2030 in such a way that emissions of CO_2 will be reduced by 40%?”.

Further, only *policy relevant* options to solve the problem should be presented, that is, options which are according to experts viable and not unlikely to be implemented (for a description of such options in the current ICQ, see section 1.5). This restriction to policy relevant options also reduces the number of options, which helps to keep the choice problem manageable for lay people. However, to fully attain the latter goal (i.e., a choice problem tuned to the capabilities of lay people) a further reduction of options as well as some simplification of options is needed. For instance, while preparing the current ICQ, the experts identified many energy options which could reduce CO_2 emissions. There are many new energy technologies that emit (much) less CO_2 than current technologies. There are also many ways to reduce the use of energy (efficiency improvements as well as change of behavior). These options may all be implemented to different degrees. There are a huge number of combinations of these options and each combination may solve the policy problem, so we had to reduce the number of combinations. To further reduce complexity, it was decided to confine choice to options that led to a substantial and equal emission reduction (25 Mt CO_2 per year) and to options where the energy conversion was situated in the Netherlands (in the current ICQ, respondents should choose four options out of seven to solve the policy problem). Furthermore, to be able to compare and draw conclusions regarding the change in opinions over time, options have been kept similar as much as possible with the 2007 ICQ.

Seven reduction options were defined:

1. Reduction of CO_2 emissions in the built environment;
2. Decreasing CO_2 emissions in the industrial sector;
3. Electricity production from wind turbines at sea;
4. Converting biomass to electricity and fuel;
5. Converting coal or gas to electricity with underground CO_2 storage;
6. Converting biomass to electricity and fuel with underground CO_2 storage
7. Electricity production from nuclear powerplants

The following assumptions, criteria and points of attention were defined and taken into account by the experts:

1. The Netherlands strives for a reduction of the CO_2 emissions of 40% in 2030 compared to 2010. This ambition level should proportionally contribute to limit global temperature increase to a maximum of 2ºC.
2. Other countries in the world also put optimal efforts in reducing emissions. It is taken into account that Western countries could and should achieve higher emissions reduction figures than non-western countries.

3. Assuming current growth rates, the emission reduction goal of 40% corresponds to about 100 Million tonnes CO_2.
4. Each option should contribute with a CO_2 emission reduction of 25 Million tonnes in 2030; the deployment of four options should be enough to achieve the 40% reduction target in 2030.
5. The geographical area where conversion takes place is the Netherlands.

1.6 Expert information on seven options for CO_2 emission reduction

Second, when informing people about the choice problem and about the consequences of the options that can solve this problem, it is essential that this information is valid and balanced. The information should be extensive and detailed. However, another demand for the information in the questionnaire is that it needs to be understandable for nearly all groups in Dutch society. To avoid dropout of groups like the elderly, who are usually slower completing questionnaires, the more difficult groups should not need more than two hours to complete. In that case the average sample will take 1 hour to complete. Half of this hour is needed for the instructions, the presentation of the problem and the information about current situation and climate change. This means that half an hour is left for seven options. This time limit reduces the possible amount of information that can be given on one option to *a single page*.

In the case of complex topics this means that in order to keep the amount of information manageable for all respondents, one must make a selection of the available expert information. With relatively complex and controversial topics any selection could arouse debate. It is therefore recommended that the information for an ICQ is compiled by experts from different backgrounds and different organizations and checked by another, similarly differentiated group of experts. This method also results in the avoidance of another possible problem that arises with controversial issues, namely the (lack of) credibility of the source of the information. When the responsibility for the definition of the choice problem and the given information is not carried by a differentiated group of experts, an ICQ runs the risk of losing accuracy, balance and credibility in the eyes of the respondents.

For all seven options, information was therefore gathered and reviewed by experts. This compilation of information started with drafting the first draft descriptions of each option through literature review and expert consultation. These drafts were then reviewed several times by over 15 experts from all kinds of institutes and companies, not only to assure that all relevant arguments were described and that the information was accurate and balanced, but also for selecting the most relevant information.

The first (external) review was made in written form by providing the experts with (i) a letter containing a detailed account of what it was required from them, (ii) the policy problem, assumptions and points of attention, and (iii) a questionnaire. The questionnaire provided the expert with a systematic way of evaluating each individual part of the description: Firstly, the expert was asked to read the whole description for the option. Secondly, he (or she) was asked to evaluate each individual part by answering several questions regarding the quality and completeness of the information (see Appendix A) and asked to explain how to improve this. The final expert information packages for each option can be found in Appendix B.

1.7 Selection and translation of the expert information[2]

There were several requirements for the information on the consequences of the policy options. The information on consequences had to apply to the specific options. The information aims to describe the most important consequences of the implementation of each option, given the assumptions of the policy problem.

After the experts had evaluated the importance of all the pieces of expert information, the following step was to establish which information is essential to the public. For this, input from the experts was used, keeping in mind that the information has to be valid, balanced, and does not exceed the ability and willingness of respondents to process this information. Several extra steps were taken to make sure that the information was limited enough and understandable for all respondents to process properly. First, the information on consequences was formulated per consequence, so that respondents are able to evaluate each consequence separately. In this way, respondents are able to evaluate one by one how much of an advantage or disadvantage they think a relevant consequence is. This method of giving respondents little “blocks” of information and asking them to evaluate this information supports respondents to process the information (Neijens, 1987). Second, the information on the consequences is preferably given relative to the status quo. For instance: “When this technology is implemented, the costs of power for households will be 10% higher compared to current costs”. Relative information is preferable over absolute information because the latter is more difficult to process and results in extended processing (Chestnut, 1976; Van Raaij, 1977).

Information on consequences was omitted from the questionnaire when it was either non-discriminatory or a so-called null-effect. These two points will be explained in the next paragraphs.

1.7.1 Non-discriminatory information

When a consequence results from all options equally, the information on this consequence is not informative to the decision making process, because the information does not discriminate between options. For instance, an important consequence of all the options in the questionnaire is that they provide enough energy or that the options will decrease 25 Mt CO_2. This information does not help in making a choice, as it is true for all options in the ICQ.

1.7.2 Null-effects

With information on null-effects we mean information on the lack of occurrence of a certain consequence. For instance “Studies so far show that movements of mammals and fish are not affected by wind turbines at sea”. The information that was gathered by the experts contains several of such null-effects. Most null-effects concern information on consequences that do not differ from the status quo. A null-effect can be a consequence that lacks absolutely, it can also be a consequence that does not differentiate from the current consequences of energy production. There are several reasons to omit these kinds of information from the information on consequences that will be given to respondents. First,

[2] As the method of the current study is very similar to our earlier ICQ studies, several descriptions in this section are similar to the 2006 and 2009 reports (de Best-Waldhober et al., 2006; de Best-Waldhober et al., 2009)

omitting this kind of information leads to less information to read and to process by respondents, but does not lead to much relevant information being lost. Even when null-effects are not added to the information within a certain option, they are still implicitly assumed when options are compared. Take for example the consequence of bird deaths from wind turbines. For the option wind energy, this consequence is mentioned. Within the other options, this consequence is not mentioned as it is a null-effect. Not mentioning this consequence in the other options will not lead to information loss as it can be implicitly assumed that these options have no impact on bird deaths. (See also Neijens, de Ridder and Saris, 1988).

The second reason to omit null-effects is that if they are not omitted they are evaluated twice in the ICQ. For instance, when it is mentioned that the use of coal for generating power does contribute to more deaths in coalmines and that the use of wind turbines does not, this information is counted twice, namely as an advantage of wind turbines and as a disadvantage of coal. In this case, for reasons of equality, it would be fair to mention that the use of power from coal or gas does not contribute to the need for new vehicles that run on hydrogen or the production of radioactive waste. This would lead to the addition of great amounts of trivial information and it is also likely to annoy the respondents. Given all these negative results of null-effects, this kind of information has been omitted from the questionnaire.

1.8 Translation into lay language

To make the information understandable for lay people, we have translated the text from expert language to lay language. We have used several methods to adapt the text in such a way that lay people were able to understand it. First, we replaced expert terms with terms that were more understandable for lay people. We also added extra explanation of processes or installations if we thought this might be unclear for respondents. These explanations could be redundant for experts and therefore not mentioned in the information, but necessary for lay people to understand and evaluate consequences.

Second, we converted the information, if necessary, from expert standard measures to measures that are understandable for lay people. For instance, instead of framing the costs of energy in terms of euros per kWh or euros per gallon of fuel, it is framed as the percentage people would have to pay more (or less) compared to what they pay now for the same amount of energy. Sometimes a frame of reference can be given to clarify quantification. For instance, when stating how many birds might die by flying into wind turbines, it could help people to evaluate this better if it is also stated how many birds die in general each year.

Third, a real effort was made to specify to what extend a consequence might occur, as well as to specify the probability of occurrence. For instance, how high the chance was of something occurring and how much more this would happen compared to the current situation. Of course, sometimes expert knowledge is simply not yet available which makes it impossible to get an exact number or even a quantitative estimate.

It is essential to realize that although many details that experts have given were not mentioned literally in the translation for lay people, these details were the basis for the consequences that were described in the translation for lay people. For instance, efficiency of a technology is an aspect that is frequently specified by experts. However, efficiency figures were not mentioned in the translation. It was taken into account for the specification of the price of energy, which was mentioned in the translation, mostly stated as the percentage customers have to pay extra for energy or fuel. This is something that is clearer and more important to lay people. Therefore, although it might seem that a lot of expert information has been omitted, much of this information has in fact been taken into account for the statements in the translation for lay people.

1.9 Adjustments following tests and reviews of the resonance committee

1.9.1 The resonance committee (“klankbordgroep”)

Several translation checks were done. This translation process will be described in more detail in the paragraphs below. During this process of improving the translation of the expert information into lay language, we were advised by a resonance committee. This group consisted of six experts from different backgrounds most of whom had not participated during the gathering of information. The purpose of the resonance committee was to independently check the quality of the research that was being done. An important check was on the selection and translation of the expert information. Before the information was tested, the resonance committee checked the information on accuracy and balance. With their help, the text on all options was improved, as was the text regarding the consequences of climate change. The main reason for adjustments was the balance of the consequences, the resonance committee indicated that several options were out of balance in relation to the others because some consequences were either stated too positive/negative. The final version of the information was approved by the resonance committee as being valid, impartial, and even-handed.

1.9.2 Test on VMBO students

After selecting and translating the information in the questionnaire to the level and proportion suitable for almost all respondents and the first review round of the resonance committee, we tested the information on 19 VMBO students. These students were between 15 and 16 years old. VMBO is the lowest level of secondary vocational training in the Netherlands except for the level with students with serious learning problems. We recorded the time students used to finish the questionnaire. Questions about the comprehensibility of the information were inserted multiple times after every few sentences of information that could be misunderstood. Students were asked to underline words or sentences that they did not understand, and were asked to rewrite parts they did not understand in their own words.

Although the text was found comprehensible for the most part, the students mentioned several sentences more than once as being difficult to understand. These sentences, or paragraphs containing these sentences, were rewritten to become more comprehensible. When rewriting, we also took into account what information had been misunderstood as apparent from frequent wrong answers on the knowledge test. We were not able to avoid all difficult terms though, for instance “uranium” was mentioned a lot as being a difficult “word”, but this term was well-explained and furthermore unavoidable in this questionnaire. The time it took students to finish the questionnaire gave no reason to shorten the questionnaire.

The final lay information for each option can be found in Appendix C.

2 Method

The ICQ was distributed from the end of December 2013 until the second week of January 2014. The distribution was done by TNS-NIPO, a Dutch research firm. Respondents received a link per email to the questionnaire, which they could fill in on their computer or tablet. They were randomly assigned to receive one of three different introductions (see section 2.3). Due to an error in the distribution the amount of respondents is not entirely equally divided across conditions, however, sufficient cases remain in each condition to be able to compare results reliably. The sample of respondents is described in detail in the results section. For the full questionnaire (in Dutch) see Appendix D. To be able to compare the results of the present ICQ with previous questionnaires, the methodology and information was kept similar where possible. Descriptions of different elements of the ICQ in this method section are therefore partly the same as the description in the 2009 report (De Best-Waldhober et al., 2009).

2.1 Introduction

To start the survey, respondents received an elaborate introduction about the subject, methodology and construction of the survey. First, they were provided with an overview of the policy problem at hand. Then the methodology was explained based on a non-energy related example (medicine side-effects).

Before receiving information about the options, respondents were asked to provide their uninformed opinion on the options. Respondents were told that each time, they would first receive a question on whether they had heard about something, and would then be asked to state their overall evaluation of it. For all seven energy options, the title of an option would be given (same title as later in the ICQ), with the question "have you heard of…", which they could answer with "No, I have never heard of that", "I have heard of it, but I don't know what it is" "Yes, and I know a little bit about it", or "Yes, and I know quite a few things about that". After each awareness question, respondents would be asked to grade the option on a scale of 1 to 10 (i.e. give a "rapportcijfer"). This evaluation was given without receiving any information and was used to measure pre-existing opinions on the options in the ICQ.

2.2 Explanation of the ICQ procedure (start of the ICQ)

2.2.1 Calibration and calibration of probability

After a quick introduction of the purpose of the ICQ and the kind of task respondents could expect, respondents were given several example questions and exercises to practice the ICQ procedure with. These examples and exercises were used to explain how to evaluate consequences. Respondents were given four negative consequences to evaluate on a scale of one to nine, one being a very small disadvantage, nine being a very big disadvantage. These four consequences differed on two dimensions; the negativity of the consequence and the chance the consequence would occur. The purpose of this was to explain to respondents that it would be logical to rate a certain more negative consequence as more negative, and that it would be logical to rate a chance of less than 100% on something negative (e.g. 50% chance on 100 casualties) as less negative than a certainty (100%) of the same event occurring (see Appendix D).

2.2.2 Evaluation of consequences

Respondents were then given an exemplary ICQ about painkillers. With this exemplary ICQ, respondents were explained how to fully evaluate consequences. For each consequence respondents were asked to state if they thought this consequence was an advantage, a disadvantage or not important. If the consequence was evaluated as an advantage or a disadvantage, respondents stated to what extent they saw it as an advantage or disadvantage on a scale of one to nine (1= "a very small disadvantage" or "very small advantage", and 9= "a very large disadvantage" or "a very large advantage"). After respondents had received 4 consequences of medicine "X", the computer checked whether the respondent had evaluated all disadvantages as disadvantages. If this was not the case, the respondent received the following text: "You have evaluated one or more of the consequences of medicine "X" as an advantage. Although you are of course free to think so, something could be said for considering the possible side-effects of a painkiller to be a disadvantage."

2.2.3 Value and consistency

As one of the consequences in the exemplary ICQ about medicine "X" was the same as in the first four negative consequences, respondents who gave equal evaluations of this consequence were explained that this was the logical thing to do. Respondents who gave different evaluations to the same consequence were suggested to consider that equal consequences should receive equal evaluations.

2.3 Presentation of the choice problem and background information

After familiarizing respondents with some elements of the ICQ procedure, respondents were explained in detail what the questionnaire was about. They were told that the questionnaire had been made with the help of a diverse group of energy experts and that the information in the questionnaire was acknowledged by these experts as both a trustworthy account of energy dilemmas as well as of the consequences of seven options to diminish CO_2 emissions. The respondents were given information on the current use of energy in the Netherlands and on the current ways in which energy is produced in the Netherlands. Next, they were explained what the frequent use of oil, gas and coal mean for our climate, by explaining the role of carbon dioxide in climate change. They were then given 8 consequences to evaluate that are expected to occur when the earth's temperature rises as much as expected by scientists. They were also asked to state their overall evaluation on climate change. This overall evaluation was asked twice to rule out scale effects; the respondents were asked to give their overall evaluation on a scale of 1 to 7, 1 being very bad and 7 being very good. They were furthermore asked to grade climate change on a scale of 1 to 10.

Respondents were randomly assigned to receive one of three different introductions. These introductions were very similar on the whole, but version two and three contained additional information about aspects of CO_2 (see Appendix D). The information in the first version was kept similar to the ICQ that was administered in 2007 (but updated to the current situation). In the second version of the introduction, two sections of the introduction contained extra information about what CO_2 is. For example, it stated that "CO_2 is released when people exhale". This manner of debunking misconceptions is called implicit, because it is not explicitly stated that this is commonly misconceived. In the third version of the introduction, the same two sections contained the same extra information, but in this version the misconceptions were explicitly debunked. This was done by telling participants that the information is sometimes misconceived. To avoid norm setting, which may lead people to agree with the majority, we avoided using quantification of the misconceptions. For example, it was stated that "*Some people do not know that* CO_2 is released when people exhale". By using these three different versions of the introduction we could measure whether the way in which information is presented influences the amount of information that is still known after some time. Furthermore, it was reasoned that if knowledge is increased about what CO_2 is, explained variance of the options will increase (especially for the CCS options, as for these options knowledge of CO_2 is more relevant).

2.3.1 Knowledge test

Following the information on climate change, respondents were given information on different ways to reduce emissions of carbon dioxide. It was explained that this questionnaire focuses on seven options that can help to reduce CO_2 emissions. Respondents were made clear that four of these seven options are necessary to reduce CO_2 emissions by 40%. Respondents received a summary of all the information they had to process up to this point. As respondents have had a lot of information to take in so far, it was questionable if they remembered all of it. To test respondents' knowledge at this point and to fill in any omissions, respondents received 12 multiple-choice questions on information they had just been given to read. After respondents gave their answer, the right answer would always be displayed on screen once more (for exact wording see Appendix D).

2.3.2 More evaluation aid; explanation of accounting system

It was announced at this point that they would not only be asked to evaluate the options and their consequences, as they had done in an example before, but that they would also be asked to make a choice for four of the seven options. We used an exemplary choice procedure to explain what the real choice procedure would be like. Respondents were shown in a table, what evaluations they had given before in the earlier example of the ICQ procedure of "medicine X". Not only their evaluations were given, but also an explanation on how adding these numbers gave respondents their overall scores of disadvantage and advantage of "medicine X". They were shown how the computer calculated these scores, and how these scores can be used to further evaluate the option (medicine X) overall.

2.4 Evaluating consequences of seven options

At this point, respondents would receive the information on each of the seven options in general as well as information on the consequences of each option. 14 different orders of options were used to avoid any order effects. In this report we consistently use the same order of options for clarity, but only a small percentage of respondents actually received the options in that order, others received one of the other 13 possible orders. Per option, respondents would first get a description. This description contained information on, for instance, the essence of the technologies, the amount and location of plants, conditions for implementation, or the kind of end use. After the general description, respondents were asked to evaluate the consequences of the option one by one (See Appendix D).

The criteria for the information about the options was explained to respondents. First it was explained that the respondent would receive information on consequences that experts found important, but we added the comment that experts obviously could not decide for the respondent whether they thought a consequence was important or not. The second criterion for the information on consequences was the relevance of a kind of consequence for a policy option. If one option has an influence on sea life whereas the other option does not, this is only mentioned as a consequence when it has an influence. The third criterion was a difference from the status quo. For instance, if the consequences for air quality of an option do not differ from the consequences of the currently used option, these air quality consequences were not mentioned. Only if it was well known or expected that lay people expect a consequence that experts know will not occur, this was explicitly mentioned. Another criterion was the level of knowledge of a certain consequence of all options. It was explained to respondents that certain consequences were studied or well known for some options, but not for others. These kinds of consequences are likely to occur in several options, not just the ones experts studied. However, as it was impossible to give information about these consequences for some options, information about these consequences was not given for any of the options.

A last remark about the information on consequences that respondents received was that although the prices of all options seem to be higher in comparison with the current energy prices, experts expect energy prices to rise over time, regardless the energy source.

The information about a consequence was given to respondents in such a way that it was possible for them to evaluate this consequence. As in the exemplary ICQ, respondents were asked to state for every consequence if they thought this consequence was an advantage, a disadvantage or not important. If the consequence was evaluated as an advantage or a disadvantage, respondents could state how much of an advantage of disadvantage on a scale of one to nine, with one being a very small disadvantage or very small advantage, and nine being a very large disadvantage or advantage. This way, respondents could evaluate all the relevant consequences of an option, one by one, as they had been practicing with the exemplary ICQ. At this point, respondents were asked to accumulate all the evaluations of an option, and were asked to base their overall evaluation of the option on the resulting total. They could do so by pressing a button (‘calculate’) below the table on screen with all the consequences and their evaluations. If a consequence had been evaluated as unimportant, this would presented as a “0” in blue, if it had been evaluated as a disadvantage the evaluation would be presented in red, and if it had been evaluated as an advantage the evaluation would be presented in green. Respondents were now asked how they thought about the option as a whole, and were suggested to base this on their evaluations of the consequences and the total disadvantage and advantage score they calculated. They were asked to give an overall evaluation of the option on two different scales. First they were asked to state on a scale of one to seven what they thought all in all of an option, with one meaning “very bad” and seven meaning “very good”. They were also asked to grade the options on a scale of one to ten.

2.5 Choice of four out of seven options

When respondents had evaluated all seven options, a table would appear on screen with all options, their overall evaluations and total disadvantage and advantage scores. Respondents were told they could now change the overall evaluations if they wanted, having now read all information on the seven options. Following this, respondents were asked which four options they preferred to be implemented on a large scale. They had to choose four options. It was suggested that they could base their choice on their overall evaluations of the options and/or on the total disadvantage and advantage scores. In the previous ICQ in 2007 respondents were informed that not all combinations of options were possible. This was however not the case with the options used in the current ICQ; respondents were free to choose all combinations of options. Respondents were subsequently asked if there were any options in the questionnaire for which they thought implementation on a large scale was absolutely unacceptable, to a level that they considered taking action if Dutch society considered implementing this option on a large scale.

2.6 Closing questions

After the respondent had made a choice, the actual Information Choice Questionnaire was over. However, several additional measures were taken.

2.6.1 Perception of information

First, fourteen questions were asked to evaluate whether –subjectively– the goal of the ICQ had been reached. These questions concerned the amount, the impartiality, the clarity, and the completeness of the information. The questions furthermore concerned how the procedure of the ICQ had aided respondents' decision, how comprehensible it was and how complicated. All questions were asked to be evaluated on a scale from 1 to 7 (See Appendix D).

2.6.2 Climate change perceptions

To study the perceptions respondents might have of climate change as a topic of scientific debate, five questions were asked regarding a warmer climate, cause of warming and protection against consequences of a warmer climate. All questions were asked on a scale from 1 to 7, with an additional answer option of "no opinion" (See Appendix D).

2.6.3 Design effect checks CO_2 attributes and sources

Respondents received one of three different introductions of the ICQ, with varying degrees of information on attributes of CO_2. Respondents received four statements on attributes of CO_2 (e.g., "CO_2 is a natural gas", and seven statements about sources of CO_2 (e.g., "CO_2 is released when people exhale"). All questions could be evaluated on a scale of 1 to 7, from "I'm certain this is not true" to "I'm certain this is true" (See Appendix D). These questions were the same as measured in the Knowledge and Beliefs test (Paukovic et al., 2010, 2011).

2.6.4 Value scale

To be able to see whether personal values of respondents influenced their opinion on the options to reduce CO_2 emissions, we added a scale that is often used to measure pro-environmental behavior (De Groot & Steg, 2008; adjusted from Schwartz, 1992). This scale consists of 16 items within four subscales: hedonic values (3 items), egoistic values (5 items), altruistic values (4 items), and biospheric values (4 items). Respondents rated these values as "guiding principles in their lives" on a 9-point scale ranging from -1 "opposing my principles", 0 "not important", to 7 "extremely important" (See Appendix D).

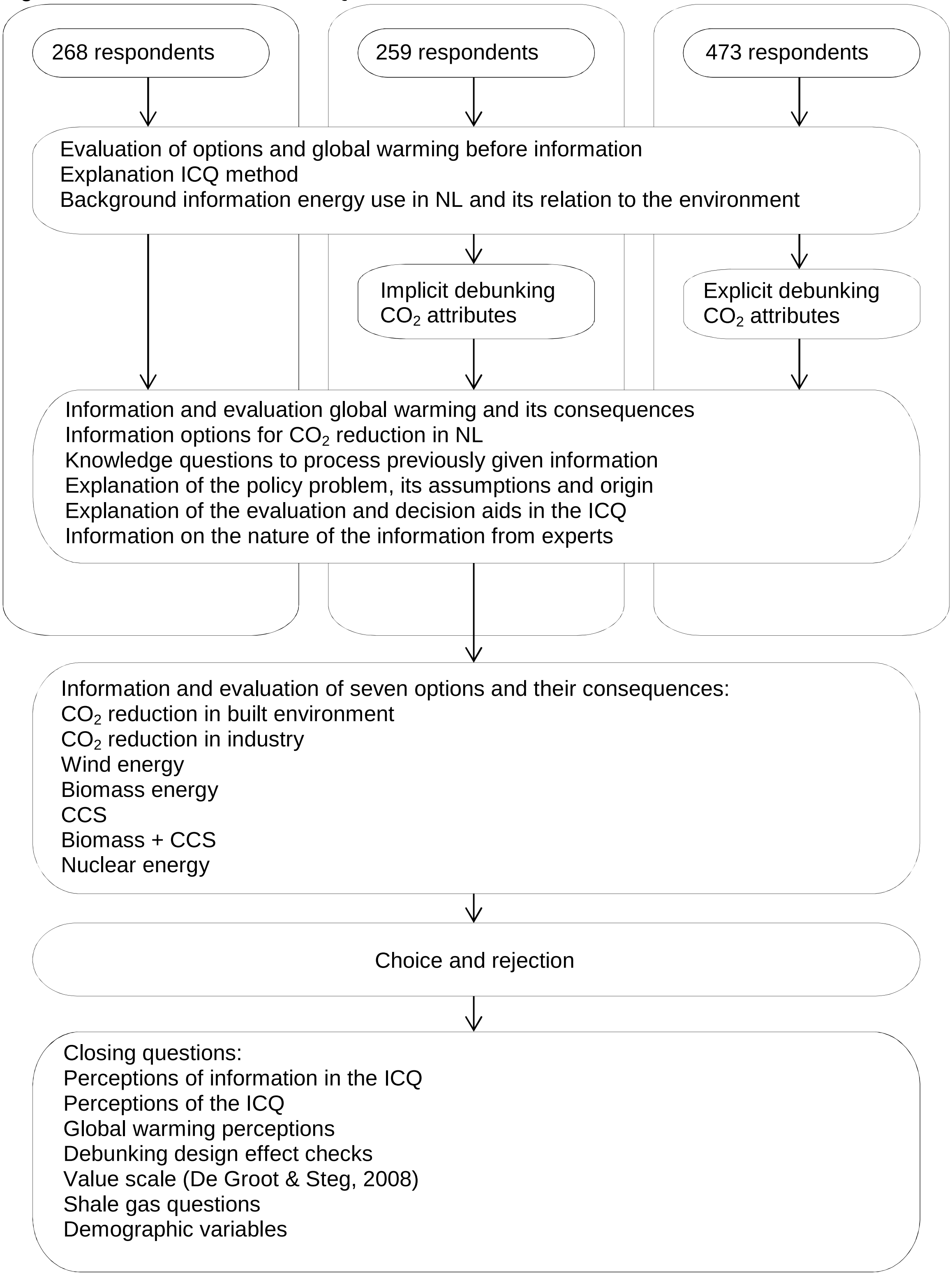
2.6.5 Shale gas

An issue that is currently receiving a lot of media attention in The Netherlands is shale gas. There has been debate whether The Netherlands should explore this as a possibility to increase the gas stock. This idea has, however, received a lot of negative public response (e.g. “Protest tegen schaliegas in Den Bosch”, 2013). As shale gas is new for The Netherlands and many elements are still not known or uncertain, it was not possible to integrate it as one of the options within the ICQ. We were however interested in the uniformed opinions of respondents on the subject. As we were uncertain what the effects would be of mentioning this topic on the evaluation of the ICQ options, we decided to ask these questions after all other questions. Respondents were asked whether they had heard of shale gas. When they answered to at least have heard of it, they received 5 questions about possible consequences and (dis)advantages. Finally, all respondents received 2 questions to rate what they think of shale gas. The first on a scale from 1 “very bad” to 7 “very good”, the second was a grade on a scale from 1 to 10 (See Appendix D).

2.6.6 Background questions

Measures of background variables were not asked in the present questionnaire. These variables were already known as respondents were part of a panel who participate in research more often for TNS-NIPO (the institute that has done the fieldwork of programming and administering the questionnaire to the respondents). The background variables were sex, age, family size, education, and region. As a final question, respondents received the opportunity to provide any comments on the entire questionnaire and were thanked for their participation.

Figure 2.1. Flow chart of the ICQ.



3 Results

3.1 Sample

The ICQ was administered from the end of December 2013 until the second week of January 2014. The sample consisted of 1417 respondents[3]. Of these, 1034 respondents (527 men, 51%) completed the survey. Mean age was 50.33, with a range of 18 to 90 years old. This was a representative sample of the Dutch population in terms of gender, age, education and geographical location (see Table 3.1 for comparison with the Dutch population in 2013). Respondents completed the ICQ individually on the computer, using a web tool for questionnaires, developed by TNS-NIPO. Respondents completed the questionnaire on average in 4544 seconds (75.73 minutes). In total there were 34 respondents (3.3%) who completed the entire questionnaire within 20 minutes and/or completed one or more options within 40 seconds. As it can be concluded that it is highly unlikely that these respondents took enough time to read through all the information presented, these respondents were not included in further analyses leading the final sample to be 1000 respondents (M_{age} = 50.85, range 18 to 90, 50.7% men). The respondents who were excluded from analyses were equally distributed across conditions.

Table 3.1. Demographic variables in the ICQ sample compared to the Dutch population in 2013

	Dutch population 2013	ICQ sample
Sex		
Male	49.5%	51%
Female	50.5%	49%
Age		
< 20	23.1%	3.7% (18+)
20-40	24.6%	25.4%
40-65	35.5%	49.2%
65-80	12.6%	19.1%
80+	4.2%	2.6%
Region		
3 biggest municipalities + neighbouring municipalities	15.6%	15.7%
West (UT, NH, ZH, excl. 3 biggest municipalities)	29.4%	29.3%
North (GR, FR, DR)	10.3%	9.2%
East (OV, GL, FL)	20.6%	19.2%
South (ZL, NB,LB)	23.9%	26.6%

Source: CBS Kerncijfers 2013 www.cbs.nl
Note: the ICQ was distributed to respondents older than 18, therefore, the group <20 is underrepresented.

[3] 383 respondents (54.6% female) did not complete the survey. Most of these respondents already stopped while reading the introduction, before receiving the information on the first option.

3.2 Evaluation and choice in the ICQ 2013

3.2.1 Ruling out scale effects

To measure respondents' evaluations of climate change and the seven options, two different scales were used. First, people answered on a 7-point scale how good they thought the option was (1= "very bad" to 7 = "very good"). Then, they gave the option a grade ranging from one to ten (Dutch school grade). The correlations between the two scales ranged between .52 [Wind energy] and .81 [Nuclear energy] (before the adjustments people could make at a later stage in the ICQ). As the correlations were mostly high, we chose to only report the results from the one to ten scale.

3.2.2 Overall opinion options

3.2.2.1 Overall evaluations: grades of the seven options

After receiving all the information and consequences of an option, respondents were asked to give their overall evaluation of the option. After giving their overall evaluations of all options, respondents received an overview of their evaluations of the consequences and their grade per option. They then received the possibility to adjust their overall grades of the options now that they had full overview of all the options. Only 87 respondents (8.7%) chose to change one or more grades. The following calculations are based on respondents' final overall evaluations. Table 3.2 contains the distribution of the overall evaluations per option and the mean overall evaluation given by respondents in the ICQ. The results show that while most options score above 6 (which is considered as an acceptable (adequate) score within the Dutch school grade system), two options were scored negatively by respondents. The use of coal and gas in combination with CO_2 storage, and Nuclear energy were scored below acceptable (4.55 and 4.80 respectively). Although the coal and gas in combination with CO_2 storage option was thus evaluated negatively, the biomass with CO_2 storage option was graded acceptable. None of the options were graded above 7, which means that in general respondents were rather negative about all the options.

Table 3.2: overall evaluations of seven options in the ICQ: percentage for grades and means and standard deviations

Option	1-3	4-5	6-7	8-10	Mean	SD
CO_2 reduction built environment	1.3%	12.1%	48.3%	38.3%	6.98	1.39
CO_2 reduction industry	1.1%	16%	56.5%	26.4%	6.68	1.32
Wind energy	3.8%	15.5%	50.3%	30.4%	6.65	1.58
Biomass energy	3.1%	14%	50.6%	32.3%	6.75	1.47
CCS	26.2%	45.3%	25.5%	3%	4.55	1.66
Biomass + CCS	5.4%	25.2%	53.5%	15.9%	6.08	1.52
Nuclear energy	29.2%	29.4%	31.1%	10.3%	4.80	2.15

3.2.2.2 Relation between overall evaluation options

To test whether respondents were likely to grade certain options similarly, several analyses were conducted. First, it was tested whether overall evaluations of the options were correlated. Correlation between options ranged from -.02 to .56 (see Table 3.3). The highest correlation was found between the biomass and the biomass with CCS option. The CCS and

the biomass with CCS option were also moderately correlated (0.35). The options to decrease CO_2 emissions by being more energy efficient in the built environment and industry were also highly correlated (0.51). The nuclear energy option correlated moderately with the CCS option and with the CCS with biomass option, while it did not correlate with any of the other options. Besides the correlations with nuclear energy and the biomass CCS option, the coal and gas CCS option had low correlations with the other options.
Furthermore, it was tested whether clusters of options which were rated similarly could be identified. Results from the factor analysis showed that the options could be divided into three factors. Eigenvalues of the factors were 2.44 and 1.41 and 1.02, with 69.0% variance explained. The first factor consisted of the built environment option (.81), industry (.75), and wind energy (.74). The second cluster consisted of the biomass (.86) and biomass with CCS option (.86). The third cluster consisted of the coal and gas CCS option and the nuclear energy option (.80 and .84 respectively). These results imply that when, for example, people are positive about wind energy, they will likely also be positive about CO_2 reduction in the industry or in the built environment. Similarly, people who are positive about CCS are likely to also be positive about nuclear energy.

Table 3.3 Correlations between the options.

	CO_2 reduction built environment	CO_2 reduction industry	Wind energy	Biomass energy	CCS	Biomass + CCS	Nuclear energy
CO_2 reduction built environment	–						
CO_2 reduction industry	**.51***	–					
Wind energy	.37*	.34*	–				
Biomass energy	.27*	.35*	.20*	–	.		
CCS	.08*	.08	.12*	11*	–		
Biomass + CCS	.21*	.28*	.17*	**.56***	.35*	–	
Nuclear energy	.00	.04	-.02	.03	.38*	.11*	–

Note: *p <.01 level. Bold correlations are correlations above .50, which is considered acceptable (Cohen, 1988).

3.2.2.3 Seven options: Choice and rejection

After evaluations of all the options and the possibility to adjust the overall grades, respondents could choose four out of the seven options provided to solve the policy problem. As can be seen in Table 3.4, the CO_2 reduction in the built environment and industry options were the most often chosen (80.2 and 82.6%), as well as the wind energy option (77.6%) and biomass energy (74.6%). We also examined which options were chosen as first, second, and third. The option that respondents most often chose as the first option was wind energy. Even though the grade of wind energy was not the highest of all options, when choosing from a suit of options this was the most preferred. As second and third choice respondents most often picked the CO_2 reduction in industry and in the built environment. The fourth and final choice was most often filled by the biomass energy option.

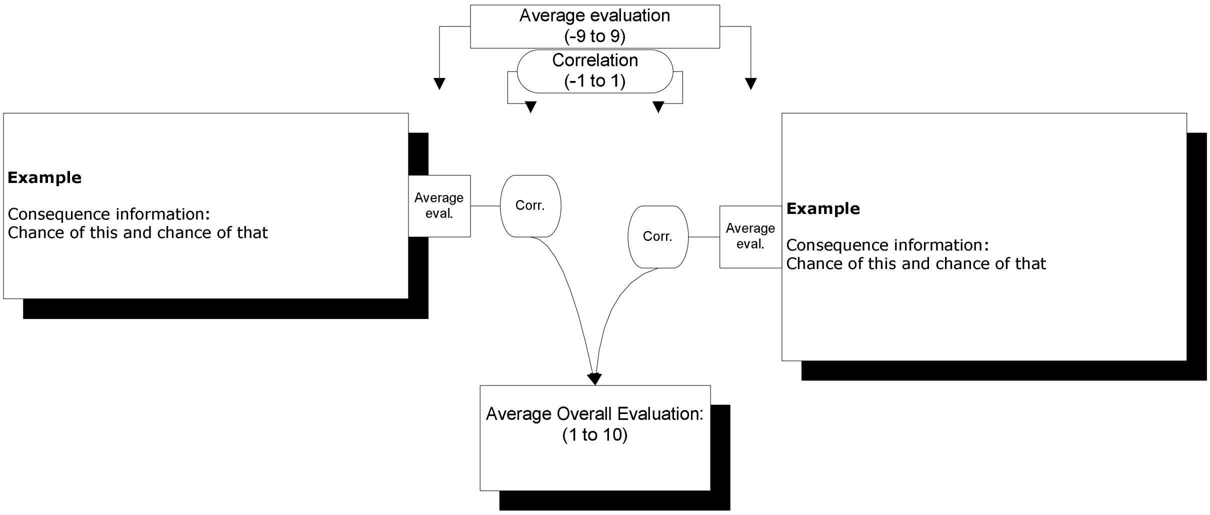
After choosing four options, respondents were asked whether there were any options which they thought to be unacceptable. Respondents were asked if large scale implementation of any of the seven options is so unacceptable to them that they would consider taking action if this was planned.
Of all respondents, 33.1% indicate that they think at least one option is unacceptable to them. The option of nuclear energy was rejected by almost a quarter of all respondents. CCS was rejected by 10.7% of the respondents. The biomass CCS option was rejected less frequently (6.7%) than the CCS option, but more frequently than the biomass energy without CCS (1.3%). Wind energy and the emission reduction in the built environment and industry are only rejected by a very small percentage of respondents (2.4%, 0.6%, and 0.3% respectively).

Table 3.4: overall evaluations of seven options in the ICQ: percentage for grades, mean grades, percentages for choice and rejection

Option	Mean	Choice %	Reject %	1st choice	2nd choice	3rd choice	4th choice
CO_2 reduction built environment	6.98	80.2%	0.6%	22.0	23.4	18.9	15.9
CO_2 reduction industry	6.68	82.6%	0.3%	16.3	24.2	24.4	17.7
Wind energy	6.65	77.6%	2.4%	28.8	18.0	17.7	13.1
Biomass energy	6.75	74.6%	1.3%	15.8	17.2	17.8	23.8
CCS	4.55	12.1%	10.7%	1.2	2.0	3.4	5.5
Biomass + CCS	6.08	45.3%	6.7%	7.5	9.4	12.4	16.0
Nuclear energy	4.80	27.6%	24.0%	8.4	5.8	5.4	8.0

3.3 Evaluation of consequences in relation to overall evaluations

Before respondents evaluate an option overall, they evaluated, one by one, all of the consequences of the seven options. Respondents stated whether they thought the consequence was an advantage, a disadvantage, or not important. When the consequence was thought to be an advantage or disadvantage they evaluated how much of an advantage or disadvantage the consequence was on a scale of one to nine. An overview of the evaluations of each consequence in each option is provided. In the current section the average evaluations of consequences and their relation to the overall evaluation of an option are provided. The evaluations of the consequences are measured on a scale of -9 to 9, -9 meaning a very big disadvantage, 0 meaning unimportant, and 9 meaning a very big advantage. The outer right and outer left columns of each figure of an option contains the information regarding the consequences of an option. This information is an English translation of the Dutch information for lay people that respondents received. Right and left of the information columns, in the square box, the average evaluation of the specific consequence is provided. Connected to this is the correlation between the evaluation of the consequence and the overall evaluation of the option (round box). These correlations are all single correlations between evaluation of one consequence and the overall evaluation of the option it concerns.



These correlations give some insight into the relative influence of the different consequences. A correlation can vary between -1 and 1, with 0 meaning no relationship between two variables. A correlation of 1 means a perfect linear relation between two variables. A correlation of -1 also means a perfect linear relation between two variables, however, a negative correlation means that as one variable increases, the other decreases, and vice versa. A positive correlation means that as one variable increases, the other also increases, and if one variable decreases so does the other. As the correlation between the overall evaluation and the evaluation of the consequence rises, the consequence is likely to play a more important role in the determination of the overall evaluation. A correlation of .50 or higher was considered as a high correlation, a correlation of .30 – .50 is considered medium, and .30 or lower as a low correlation (Cohen, 1988). If a correlation is significant at the $p < .01$ level, this is indicated in the figure as a *.

In the middle column of the figure, the average overall evaluation of the option is given. The multiple correlation between the evaluations of the consequences of an option and the overall evaluation of that option is stated in the discussion of the figure. The multiple correlation (R) represents how much the evaluations of the consequences of an option together are connected to the overall evaluation of an option. A multiple correlation can vary between 0 and 1. Although a multiple correlation of for example .60 is considered high, this means that .40 (40%) of the evaluation is not explained by the information in the option. The squared multiple correlation (R^2) represents the proportion of variance that can be explained. This gives an indication of the degree to which the overall evaluation of an option can be explained or predicted from the evaluations of the consequences of that option. Linear regression analyses were done to investigate this.

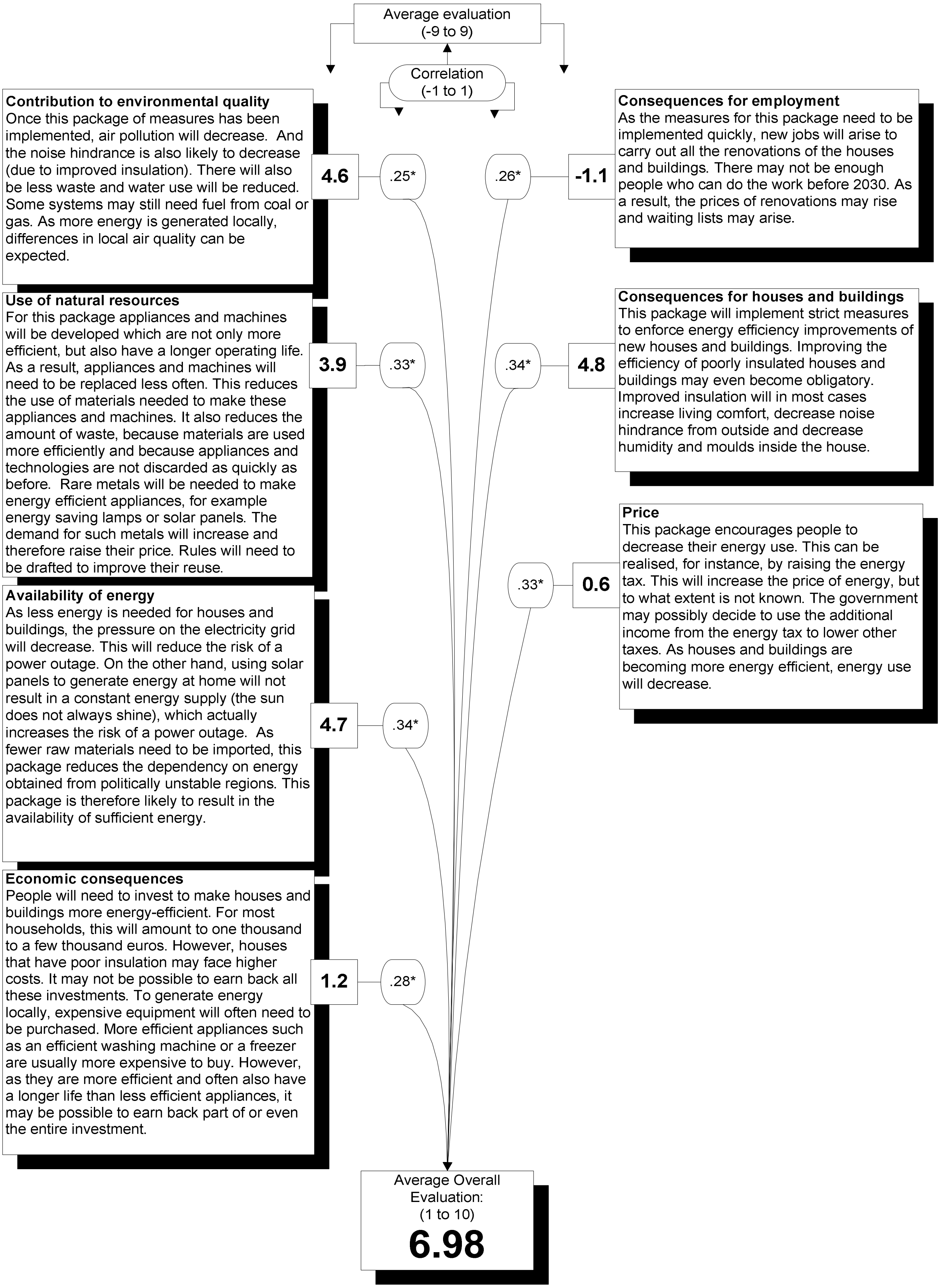
3.3.1 From consequence evaluations to overall evaluation: Option “Reducing CO_2 emissions in the built environment”.

After receiving some general information regarding the option, respondents evaluated seven consequences. Table 3.5 and Figure 3.1 show the information respondents evaluated, the mean evaluations of consequences, the mean overall evaluation of the option and correlations between consequence evaluations and overall option evaluation. The multiple correlation between the evaluations of the consequences and the overall evaluation of this option is high, R = .57. This means that although the information that is given about the consequences influences the overall evaluation, the overall evaluation is based on more than this information. This could mean that not all arguments that respondents find important were stated in the provided information. The single correlations between the evaluations of the consequences and the overall evaluation of the option are moderate to low. The highest correlation is for both the “Availability of energy” consequence as well as the “Consequences for houses and buildings”. Respondents tend to evaluate these consequences as moderately advantageous. The consequence regarding “Environmental quality” had a somewhat lower correlation with the overall grade. Respondents also rated this as a moderate advantage, but it has a lower correlation with the overall grade.

Table 3.5. Percentages of respondents choosing response categories, mean evaluations, standard deviations and correlation with overall opinion of the option “Reducing CO_2 emissions in the built environment”.

	Disadvantage			Unimportant	Advantage		
	Big -9 to -7	Moderate -6 to -4	Small -3 to -1	0	Small 1 to 3	Moderate 4 to 6	Big 7 to 9
Environmental quality	1.6	4.1	1.7	18.3	4.1	22.4	47.8
Natural resources	2.9	7.6	3.5	16.4	4.1	23.4	42.1
Availability of energy	2.8	3.8	1.4	14.7	4.2	26.7	46.4
Economic consequences	9.4	15.2	8.7	22.9	2.9	14.1	26.8
Consequences for employment	14.6	25.7	10.5	24.1	3.4	8.0	13.7
Consequences for houses and buildings	3.2	4.9	1.7	9.2	5.7	24.9	50.4
Price	15.2	15.2	4.6	21.5	5.5	14.8	23.2

Figure 3.1: Reducing CO_2 emissions in the built environment



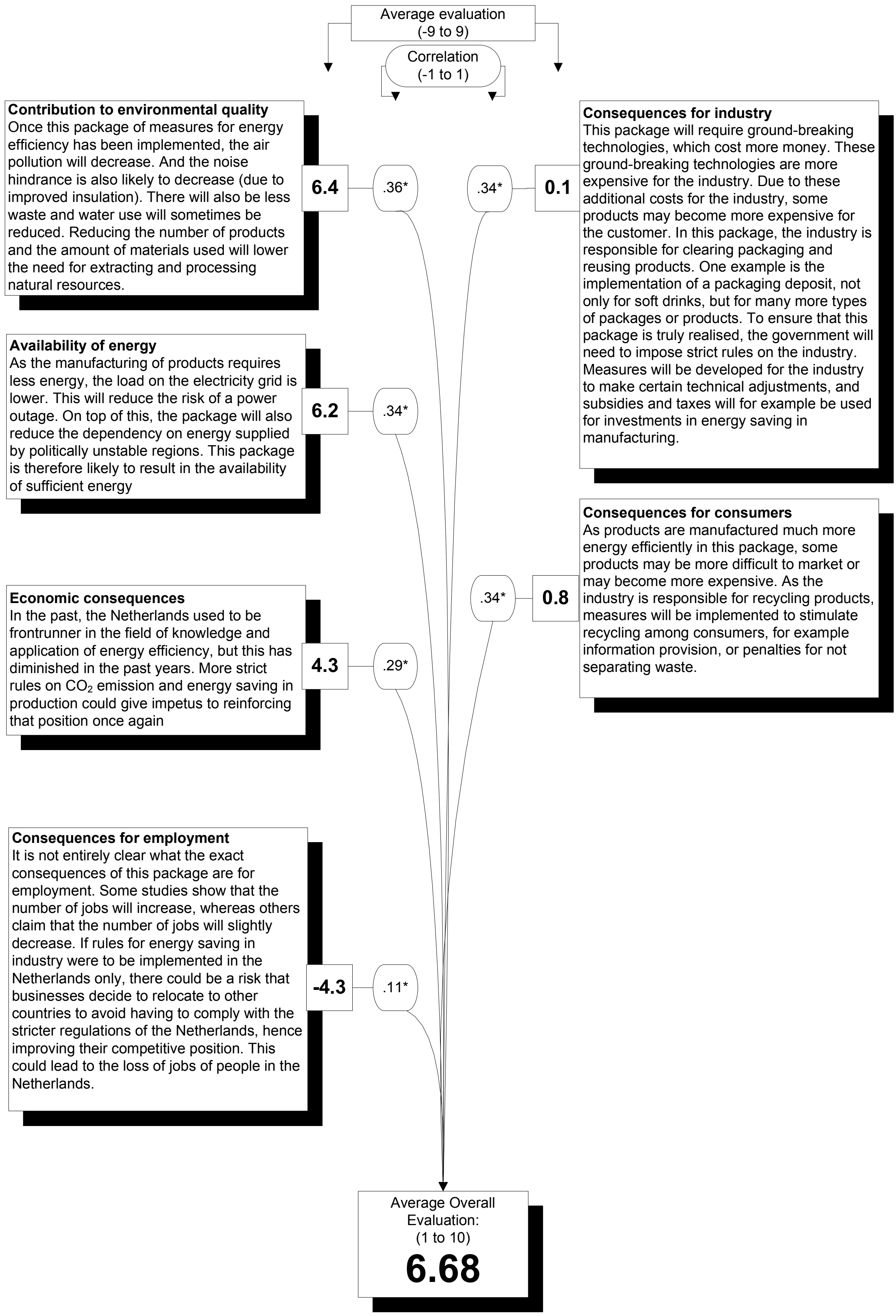
3.3.2 From consequence evaluations to overall evaluation: Option "Reducing CO_2 emissions in the industry".

Table 3.6 and Figure 3.2 show the information respondents evaluated, the mean evaluations of consequences, the mean overall evaluation of the option and correlations between consequence evaluations and overall option evaluation of the option "Reducing CO_2 emissions in the industry". The multiple correlation between the evaluations of the consequences and the overall evaluation of this option is high, R = .53. This means that although the information that is given about the consequences influences the overall evaluation, the overall evaluation is based on more than this information. This could mean that not all arguments that respondents find important are stated in the provided information. The single correlations between the evaluations of the consequences and the overall evaluation of the option vary from moderate to low. The highest correlation is for the "environmental quality" consequence. Respondents tend to evaluate this consequence as highly advantageous, which has a moderate relation with the overall grade. The consequence regarding employment has a lower correlation with the overall grade. Respondents rated this as a moderate disadvantage, but it has a low correlation with the overall grade.

Table 3.6. Percentages of respondents choosing response categories, mean evaluations, standard deviations and correlation with overall opinion of the option "Reducing CO_2 emissions in the industry".

	Disadvantage			Unimportant	Advantage		
	Big -9 to -7	Moderate -6 to -4	Small -3 to -1	0	Small 1 to 3	Moderate 4 to 6	Big 7 to 9
Environmental quality	0.6	1.6	0.1	4.8	2.9	23.2	66.8
Availability of energy	0.8	1.1	0.2	6.3	3.3	25.1	63.2
Economic consequences	1.2	2.6	1.4	25.1	6.4	23.5	41.0
Consequences for employment	35.7	29.5	12.9	16.1	0.5	1.8	3.5
Consequences for industry	9.7	20.9	8.1	27.2	2.8	15.2	16.1
Consequences for consumers	11.2	14.4	7.7	26.2	4.4	15.7	20.4

Figure 3.2: Reducing CO_2 emissions in the industry



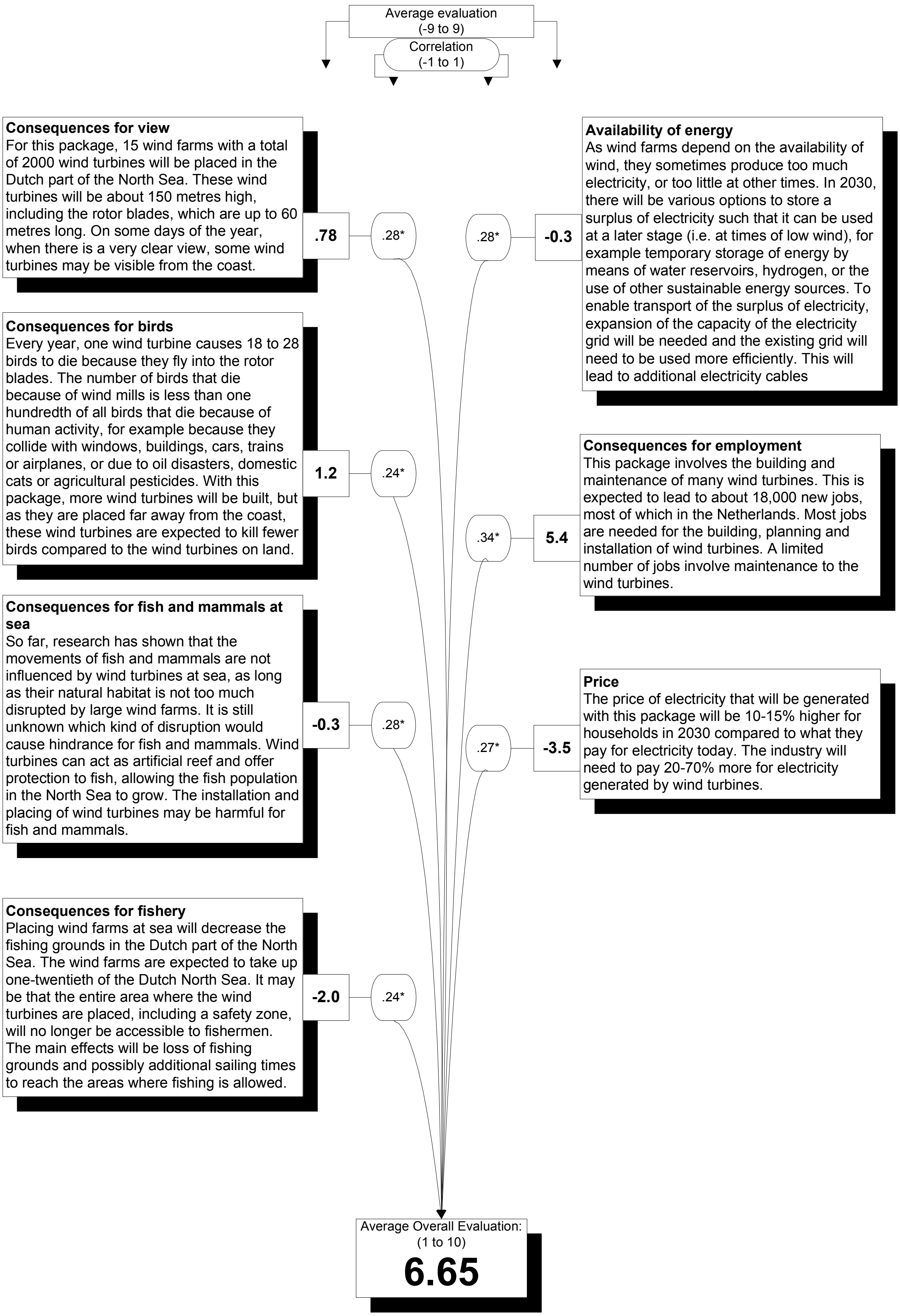
3.3.3 From consequence evaluations to overall evaluation: Option “Electricity from wind turbines at sea”.

Table 3.7 and Figure 3.3 show the information respondents evaluated, the mean evaluations of consequences, the mean overall evaluation of the option and correlations between consequence evaluations and overall option evaluation of the option “Electricity from wind turbines at sea”. The multiple correlation between the evaluations of the consequences and the overall evaluation of this option is high, R = .53. This means that although the information that is given about the consequences influences the overall evaluation, the overall evaluation is based on more than this information. This could mean that not all arguments that respondents find important are stated in the provided information. The single correlations between the evaluations of the consequences and the overall evaluation of the option are moderate to low. The highest correlation is for the “consequences for employment”. Respondents tend to evaluate this consequence as moderately advantageous, which has a moderate relation with the overall grade. The consequence regarding the effects on birdlife has a lower correlation with the overall grade. Most respondents rated this as unimportant. This had a low correlation with the overall grade. Interestingly, consequences for the view and availability of energy were evaluated as unimportant by more than half of the respondents (67.9% and 55.4% respectively). These consequences both had a low impact on the overall grade. This leads to the conclusion that changes in the view and a slightly lower availability of energy is not so important to respondents and has a small positive relation with the overall evaluation of wind energy.

Table 3.7 Percentages of respondents choosing response categories, mean evaluations, standard deviations and correlation with overall opinion of the option “Electricity from wind turbines at sea”.

	Disadvantage			Unimportant	Advantage		
	Big -9 to -7	Moderate -6 to -4	Small -3 to -1	0	Small 1 to 3	Moderate 4 to 6	Big 7 to 9
Consequences for view	4.2	3.8	5.1	67.9	0.5	3.5	15.0
Consequences for birds	5.1	6.9	7.9	45.7	4.9	9.7	19.8
Consequences for fish and mammals at sea	9.3	15.0	12.3	38.9	4.1	9.4	11.0
Consequences for fishery	14.0	21.4	17.6	37.4	1.4	3.6	4.6
Availability of energy	5.6	12.9	10.3	55.4	1.1	6.7	8.0
Consequences for employment	1.2	2.0	0.8	10.3	7.3	24.0	54.4
Price	28.3	24.7	18.0	22.1	0.5	3.2	3.2

Figure 3.3: Electricity from wind turbines at sea



3.3.4 From consequence evaluations to overall evaluation: Option "Converting biomass to electricity and fuel".

Table 3.8 and Figure 3.4 show the information respondents evaluated, the mean evaluations of consequences, the mean overall evaluation of the option and correlations between consequence evaluations and overall option evaluation of the option "Converting biomass to electricity and fuel". The multiple correlation between the evaluations of the consequences and the overall evaluation of this option is high, R = .62. This means that although the information that is given about the consequences influences the overall evaluation, the overall evaluation is based on more than this information. This could mean that not all arguments that respondents find important are stated in the provided information. The single correlations between the evaluations of the consequences and the overall evaluation of the option vary from moderate to low. The highest correlation is for the consequence about "land use of biomass with certificate". Respondents tend to evaluate this consequence as a small to moderate advantage, which has a moderate relation with the overall grade. The consequence about "land use of biomass without certificate" had no correlation with the overall evaluation. While respondents think this is a moderate disadvantage, this has no relation with the overall grade respondents gave the option.

Table 3.8. Percentages of respondents choosing response categories, mean evaluations, standard deviations and correlation with overall opinion of the option "Converting biomass to electricity and fuel".

	Disadvantage			Unimportant	Advantage		
	Big -9 to -7	Moderate -6 to -4	Small -3 to -1	0	Small 1 to 3	Moderate 4 to 6	Big 7 to 9
Environmental quality	0.7	1.7	0.3	10.3	9.2	32.5	45.3
Land use of biomass with certificate	6.5	8.4	2.0	8.4	4.8	27.3	42.6
Land use of biomass without certificate	47.6	34.7	7.4	7.4	0.4	1.2	1.3
Influence on food production	14.3	12.6	4.9	13.5	7.2	23.9	23.6
Availability of energy	3.9	3.7	0.9	12.2	6.8	29.4	43.1
Consequences for employment	1.8	2.2	0.4	17.2	8.2	28.6	41.6
Economic consequences	3.1	10.3	6.0	46.0	4.0	14.1	16.5
Price	1.4	1.9	1.1	23.0	4.5	19.3	48.8

Figure 3.4: Converting biomass to electricity and fuel

Average evaluation (-9 to 9)

Correlation (-1 to 1)

Contribution to environmental quality
Deployment of this package in 2030 will slightly reduce air pollution and improve air quality in the Netherlands.
5.3 | .39*

Land use for biomass with certificate
Land is needed to obtain biomass. To obtain enough biomass for this package, a land area the size of once or twice the surface of the Netherlands will be required. That is why most of the biomass will be imported from regions such as Latin America, Southern and Eastern Africa, Eastern Europe/Russia and Southeast Asia. Biomass that is thus produced in a responsible manner (for example from grass or trees) will be given a certificate (comparable to for example the certificate for hardwood). Responsible biomass can generate more income and more employment as well as reduce poverty in the above-mentioned regions. Moreover, the cultivation of this type of crop can improve the land quality and lead to more sustainable agriculture.
3.8 | .47*

Land use for biomass without certificate
Some experts think that the Netherlands will be able to import enough certified biomass for this package. Other experts, however, think that this may not be possible, for example when other countries also start importing large quantities of biomass. Biomass without certificate is not always produced responsibly, which may have serious consequences for the areas where the biomass is cultivated. In the worst case, water reserves may become exhausted in these areas, and other types of agriculture and woods may be destroyed and small farmers chased away.
-5.5 | -.04

Influence on food production
When many countries start using biomass, this may require so much agricultural land that less land is available for growing food crops. By improving agriculture in areas with low yields, the same amount of food crops can be grown with less land use, thus leaving more land for the cultivation of biomass. Biomass can also be planted in soil that is unsuitable for other types of agriculture. Biomass cultivation may in some cases lead to more agricultural land. Land that was previously unsuitable for growing food crops may become suitable for food crops as a result of biomass cultivation. Agricultural or forestry waste, which otherwise would not have been used (e.g. waste wood, saw dust or straw) can be used as biomass.
Biomass cultivation can lead to competition with food crop cultivation, but at the same time also improve soil management, stimulating better and more efficient food crop cultivation.
1.3 | .37*

Availability of energy
The feedstocks that are needed to generate energy need to be partly imported from other countries. We aim to reduce our dependency on the political decisions of only a few countries (cf. our strong dependency on oil from the Middle East). Biomass can be obtained from many more countries compared to for example petroleum. As a result, the package will reduce the dependency on energy supplied by politically unstable regions. This package is therefore likely to result in the availability of sufficient energy.
4.5 | .43*

Consequences for employment
The sectors of industry and transport may benefit from large-scale import of biomass and the establishment of new industry. This package will probably not create more jobs in the agricultural sector, but is likely to create more jobs in technical functions, in trade and in the ports. People that are currently employed in the oil and gas sector will probably switch to the biomass industry. This is likely to increase employment in the areas from which biomass is imported.
4.6 | .42*

Economic consequences
In this package, fossil fuels are replaced by biomass. To this end, one tenth of the existing production based on fossil fuel will need to be replaced by biomass. Existing infrastructure can be used for transport of biomass, hence there is no need for additional investments. Some investments are needed though for the conversion of existing power plants or the construction of new ones.
1.2 | .25*

Price
This package will lead to a biofuel price in 2030 which is comparable to the price of petrol or diesel produced from oil. The price of electricity is expected to stay at today's level, both for consumers and for the industry.
4.7 | .39*

Average Overall Evaluation: (1 to 10)
6.75

3.3.5 From consequence evaluations to overall evaluation: Option "Converting coal or gas to electricity with underground CO_2 storage".

Table 3.9 and Figure 3.5 show the information respondents evaluated, the mean evaluations of consequences, the mean overall evaluation of the option and correlations between consequence evaluations and overall option evaluation of the option "Converting coal or gas to electricity with underground CO_2 storage". The multiple correlation between the evaluations of the consequences and the overall evaluation of this option is high, R = .51. This means that although the information that is given about the consequences influences the overall evaluation, the overall evaluation is based on more than this information. This could mean that not all arguments that respondents find important are stated in the provided information. The single correlations between the evaluations of the consequences and the overall evaluation of the option vary from moderate to low. The highest correlations are for the consequences about "safety of CO_2 storage" and "safety of CO_2 transportation pipelines". Respondents tend to evaluate these consequences as a moderate disadvantages, which has moderate relations with the overall grade. The consequence about "price" had the lowest correlation with the overall evaluation. Respondents evaluate this as a moderate disadvantage, which has a low correlation with the overall grade respondents give the option.

Table 3.9. Percentages of respondents choosing response categories, mean evaluations, standard deviations and correlation with overall opinion of the option "Converting coal or gas to electricity with underground CO_2 storage".

	Disadvantage			Unimportant	Advantage		
	Big -9 to -7	Moderate -6 to -4	Small -3 to -1	0	Small 1 to 3	Moderate 4 to 6	Big 7 to 9
Coal mining and pollution	49.8	29.8	7.9	9.9	0.4	0.4	1.4
Environmental quality	27.7	30.7	8.8	10.8	3.7	10.5	7.8
Safety of CO_2 transportation pipelines	22.7	21.7	16.4	25.2	1.5	6.8	5.7
Safety of CO_2 storage	36.0	30.2	12.8	12.9	0.4	3.5	4.2
Availability of energy	6.4	12.3	4.4	23.7	7.1	24.8	23.3
Price	36.7	29.4	12.5	17.2	0.8	1.2	2.2

Figure 3.5: Converting coal or gas to electricity with underground CO_2 storage

Average evaluation (-9 to 9)

Correlation (-1 to 1)

Contribution of coal mining to pollution
The coal that is needed for the power plants is mined abroad. In some countries, the immediate surroundings of coal mines are often heavily polluted, and to a lesser extent in other countries. Strongly depending on the countries from which the Netherlands imports its coal for this package, the country, the water and the air in the vicinity of the mine may get slightly to very heavily polluted. The miners' working conditions differ strongly per country

-5.5 | .20*

Safety of underground storage of CO_2
Similar to gas extraction, CO_2 injection into the ground may cause minor earth quakes. It may lead to cracks in buildings in the area. Once CO_2 has been stored underground, leakage may occur as a result of poorly sealed wells and through the cracks and tears in the sealing layer of the underground space. If an underground space continues to leak for years, this will partly undo the emission reduction of the package. Although experts are not sure how much CO_2 would be released into the air, this will probably involve very small amounts. Moreover, there is a very small risk that leaked CO_2 accumulates in low-lying, confined spaces such as basements. This could be harmful, even lethal, for humans, animals and plants that occupy such kind of space.
There is a small risk that leaked CO_2 acidifies the groundwater in the area. If this is drinking water, it renders the water unsuitable for consumption unless an additional treatment step is conducted.
Careful monitoring will expectedly reduce the risk of CO_2 leakage from underground spaces to practically zero.

-4.2 | .39*

Contribution to environmental quality
Next to reducing the CO_2 emission, the technique also reduces other hazardous substances that are emitted by the power plants. Implementation of this package in 2030 will reduce air pollution and improve the environmental quality. In some cases, the deployment of CO_2 storage may lead to increased emission of other gases that are harmful for the environment, because certain chemical substances need to be used to capture the CO_2.

-2.7 | .30*

Availability of energy
The raw materials needed to generate energy need to be partly imported from other countries. Our aim is to limit our dependency on the political decisions of only a few countries (cf. our currently high dependency on the Middle East for oil). Coal can be imported from numerous countries. Gas, however, can be imported from fewer countries. This package is likely to result in the availability of sufficient energy.

2.1 | .28*

Safety of CO_2 transportation in pipelines
Air that contains too much CO_2 is hazardous and even lethal in case of very high concentrations. During CO_2 transportation, a pipeline may spring a leak, causing CO_2 to be emitted into the air. There is a small risk that the amount of CO_2 that lingers in the air is so large that it is hazardous for humans, animals and plants. The risk of such leakage is comparable to the current risk of gas leakages in underground natural gas pipelines in the Netherlands. This package will require up to 600 to 1000 kilometres of pipeline, part of which subsea. With this quantity of pipelines, accidents may be expected to occur once every two years, but this need not always lead to CO_2 escaping into the air. Expectedly, careful monitoring may reduce the risk of leakage in a CO_2 pipeline to practically zero.

-2.4 | .37*

Price
The price of electricity that will be generated with this package will be 10-15% higher for households in 2030 compared to what they pay for electricity today. The industry will need to pay an additional 40-100% for electricity from biomass with CO_2 storage.

-4.4 | .14*

Average Overall Evaluation: (1 to 10)
4.55

3.3.6 From consequence evaluations to overall evaluation: Option "Converting biomass to electricity and fuel with underground CO_2 storage".

Table 3.10 and Figure 3.6 show the information respondents evaluated, the mean evaluations of consequences, the mean overall evaluation of the option and correlations between consequence evaluations and overall option evaluation of the option "Converting biomass to electricity and fuel with underground CO_2 storage". The multiple correlation between the evaluations of the consequences and the overall evaluation of this option is high, R = .55. This means that although the information that is given about the consequences influences the overall evaluation, the overall evaluation is based on more than this information. This could mean that not all arguments that respondents find important are stated in the provided information. The single correlations between the evaluations of the consequences and the overall evaluation of the option vary from moderate to low. The highest correlation is for the consequence "land use of biomass with certificate". Respondents tend to evaluate this consequence as a small to moderate advantage, which has a moderate relation with the overall grade. The consequence about "land use of biomass without certificate" had the lowest correlation with the overall evaluation. While respondents think this is a moderate disadvantage, this has no relation with the overall grade respondents give the option. Interesting to highlight is that environmental quality is perceived as a big advantage by a majority of the respondents (67.7%). It is likely that this is caused by the fact that this option has negative emissions, which is explained to respondents in the introduction of this option.

Table 3.10. Percentages of respondents choosing response categories, mean evaluations, standard deviations and correlation with overall opinion of the option "Converting biomass to electricity and fuel with underground CO_2 storage".

	Disadvantage			Unimportant	Advantage		
	Big -9 to -7	Moderate -6 to -4	Small -3 to -1	0	Small 1 to 3	Moderate 4 to 6	Big 7 to 9
Environmental quality	1.5	0.6	0.3	4.3	3.3	22.3	67.7
Land use of biomass with certificate	5.9	6.2	2.4	10.3	5.3	27.9	42.0
Land use of biomass without certificate	47.9	31.7	9.3	7.9	0.0	1.2	2.0
Influence on food production	13.8	16.6	2.4	14.7	5.7	25.2	21.6
Availability of energy	4.2	3.8	0.9	13.2	7.1	28.9	41.9
Consequences for employment	1.9	2.7	0.9	16.6	8.2	28.0	41.7
Economic consequences	6.3	18.3	11.9	46.0	1.5	8	8
Price	36.4	30.2	12.7	17.8	0.4	1.1	1.4

Figure 3.6: Converting biomass to electricity and fuel with underground CO_2 storage

Average evaluation (-9 to 9)
Correlation (-1 to 1)

Contribution to environmental quality — 6.4 — .33*
Implementation of this package in 2030 will reduce air pollution.

Land use for biomass with certificate — 4.0 — .41*
Land is needed to obtain biomass. To obtain sufficient biomass for this package, the largest share of biomass will be imported from regions such as Latin America, Southern and Eastern Africa, Eastern Europe/Russia and Southeast Asia. Without CO_2 storage, the amount of land needed for biomass production will amount to once or twice the total surface area of the Netherlands. However, as less biomass production is needed to reduce the same amount of CO_2 if CO_2 storage is deployed, this will also reduce the amount of land needed. Biomass that is produced responsibly (for example from grass or trees) will be given a certificate (comparable to for example the certificate for hardwood). Responsible biomass can generate more income and more employment as well as reduce poverty in the above-mentioned regions. Moreover, the cultivation of this type of crop can improve the land quality and lead to more sustainable agriculture.

Land use for biomass without certificate — -5.4 — .05
Some experts think that the Netherlands will be able to import sufficient biomass with certificate for this package. However, other countries think that this may not be feasible, for example when other countries also start importing large amounts of biomass. Biomass without certificate is not always produced responsibly, which may have serious consequences for the areas where the biomass is cultivated. In the worst case, water reserves may become exhausted in these areas, while other types of agriculture and woods may be destroyed and small farmers chased away

Influence on food production — 1.2 — .38*
When many countries start using biomass, this may require so much agricultural land that less land is available for growing food crops. By improving agriculture in areas with low yields, the same amount of food crops can be grown with less land use, thus leaving more land for the cultivation of biomass. Biomass can also be planted in soil that is unsuitable for other types of agriculture. Biomass cultivation may in some cases lead to more agricultural land. Land that was previously unsuitable for growing food crops may become suitable for food crops as a result of biomass cultivation. Agricultural or forestry waste, which otherwise would not have been used (e.g. waste wood, saw dust or straw) can be used as biomass. Biomass cultivation can lead to competition with food crop cultivation, but at the same time also improve soil management, stimulating better and more efficient food crop cultivation.

Availability of energy — 4.4 — .35*
The raw materials needed to generate energy need to be partly imported from other countries. Our aim is to limit our dependency on the political decisions of only a few countries (cf. our currently high dependency on the Middle East for oil). Biomass can be obtained from many more different countries compared to for example petroleum. Therefore, this package will reduce the dependency on energy supplied by politically unstable regions. This package is therefore likely to result in the availability of sufficient energy

Consequences for employment — 4.5 — .37*
Industry and transport may benefit from large-scale biomass import and the establishment of new industry. This package will probably not create more jobs in the Dutch agricultural sector, but it will create more jobs in technical functions, in trade and in the ports. People that are currently employed in the oil and gas sector will probably switch to the biomass industry. This is likely to increase employment in areas from which biomass is imported.

Economic consequences — -0.6 — .26*
In this package, fossil fuels are replaced by biomass. To this end, one tenth of the existing production based on coal, oil and gas will need to be replaced by biomass. Existing infrastructure can be used for transportation of biomass, hence there is no need for additional investments. When the combination of biomass and CO_2 storage is used in smaller biomass installations, this will require additional investments in an infrastructure that is suited for this purpose. Investments are needed to convert existing power plants or to build new ones. Smaller installations will face higher costs.

Price — -4.6 — .14*
The price of electricity that will be generated with this package will be 10-30% higher for households in 2030 compared to what they pay for electricity today. The industry will need to pay an additional 40% to 100% more.

Average Overall Evaluation: (1 to 10)
6.08

3.3.7 From consequence evaluations to overall evaluation: Option “Electricity from nuclear plants”.

Table 3.11 and Figure 3.7 show the information respondents evaluated, the mean evaluations of consequences, the mean overall evaluation of the option and correlations between consequence evaluations and overall option evaluation of the option “Electricity of nuclear power plants”. The multiple correlation between the evaluations of the consequences and the overall evaluation of this option is high, R = .73. This means that the information that is given about the consequences to a large extent influences the overall evaluation. The overall evaluation is mostly based on the information in this option and only to a small degree on other sources of information. The single correlations between the evaluations of the consequences and the overall evaluation of the option are all moderate to high. The highest correlation was for the consequences “safety of nuclear plants” and “nuclear waste”. Respondents tend to evaluate these consequences as moderately disadvantageous, which has a high correlation with the overall grade. The lowest correlation with the overall grade was for the consequence about “price”, however, with a correlation of .36, this was still a moderate relation.

Table 3.11. Percentages of respondents choosing response categories, mean evaluations, standard deviations and correlation with overall opinion of the option “Electricity from nuclear plants”.

	Disadvantage			Unimportant	Advantage		
	Big -9 to -7	Moderate -6 to -4	Small -3 to -1	0	Small 1 to 3	Moderate 4 to 6	Big 7 to 9
Radioactive radiation	49.0	21.5	12.2	12.7	0.1	1.6	2.9
Nuclear waste	49.0	21.1	9.7	10.1	0.8	4.1	5.2
Safety of nuclear plants	42.1	22.1	10.7	14.3	1.1	4.3	5.4
Protecting plants against attacks	30.2	19.5	11.5	20.4	2.0	6.5	9.9
Nuclear plants and nuclear weapons	44.2	21.2	12.0	20.0	0.2	1.1	1.3
Availability of energy	8.1	4.4	0.8	18.4	8.2	25.1	35.0
Consequences for employment	2.5	1.4	0.1	20.4	8.9	24.8	41.9
Price	19.1	15.8	4.8	28.5	5.9	9.4	16.5

Figure 3.7: Electricity from nuclear plants

Average evaluation (-9 to 9)

Correlation (-1 to 1)

Radioactive radiation under normal operating conditions
Under normal operating conditions, nuclear plants produce very small particles that emit very small quantities of radioactive radiation, which is lower than the radiation that is present in the environment by nature. This amount does not cause any health problems in the short term. Some experts think that there will not be any consequences in the long term for mankind and nature of very low quantities of radioactive waste, while other experts feel that there is not enough knowledge on this topic to make such statements. Miners who extract the substances from the mines, which are needed for this package, are exposed to substances that may be carcinogenic.

-5.0 | .46*

Nuclear waste
The preparation of uranium for use in nuclear plants, but especially the deployment in the nuclear plant itself, leads to nuclear waste. A small part of this nuclear waste is highly radio-active for thousands of years; it emits very much radiation, which is limited by packaging the waste. In this package, nuclear waste will probably be stored deeply underground. Experts think that this storage method will be safe for the first centuries to come and that leakage will not occur. Experts think that the risk of leakage after this period is extremely small, but they acknowledge the existence of uncertainties, because it is hard to predict what will happen underground. Some experts think that by 2030 nuclear waste can be treated such that it will only be highly radioactive for 500 to 1000 years. Other experts doubt whether this nuclear waste treatment technique will be advanced enough to be ready for use in 2030. Leakage can be hazardous for the health of plants, animals and humans, for example when this leakage occurs near ground water. This can be prevented by not storing the nuclear waste near ground water, but there is no full certainty that after thousands of years the groundwater will not have come any nearer the storage facility. All in all, the best prediction that experts can make is that the risk of danger to the health of plants, animals and humans caused by leakage is extremely small.

-4.7 | .51*

Safety of nuclear plants
The nuclear plants in this package have been built such that human intervention is not needed to check the system for failures or to solve them. A protective dome will be built around the nuclear plants. The new nuclear plants will be safer than the current generation of nuclear plants, as for example the nuclear plant in Fukushima. The nuclear plants in this package are as safe as, for example, the current chemical industry in the Netherlands. The risk of a serious accident is very small. An example of a very serious accident with the nuclear plants in this package is when there is an accident involving the reactor. People who are within a 1500 metre distance from the plant will need to be evacuated and never be allowed to return there. The area of about 20 by 40 kilometres around the plant will also need to be evacuated. This area will be entirely unusable for at least one year, but this may be much longer. As the new plants are even safer than the current ones, the risk of a very drastic accident is very small (one in a million). However, some experts say that these risks cannot be estimated and that the risks are in fact underestimated. The largest risk for the plant in Borssele is flooding. If new plants are built at similar locations, the dikes will need to be raised there.

-4.1 | .52*

Protecting plants against attacks
Some people are concerned about the risk of terrorist attacks against nuclear plants, which will have devastating results. The plants in this package are very well-protected. Accidents with the reactor are difficult to accomplish with bombs or by means of plane crashes on top of or near the plants. Sabotage by employees is not impossible yet very difficult.

.47* | -2.5

Nuclear plants and nuclear weapons
Proliferation of nuclear weapons means that countries that do not have such weapons are able to develop them or that they may fall in the hands of terrorists. According to some experts, this proliferation of nuclear weapons becomes more likely due to the development and use of nuclear plants. Some experts think that the risk of collecting knowledge about nuclear technology for nuclear plants is that it also raises knowledge about nuclear weapons. Moreover, some experts think that the development of materials for nuclear plants may also increase the materials that can be used for nuclear weapons. Other experts say that there is no link between the development and use of nuclear plants and the proliferation of nuclear weapons.

.42* | -4.8

Availability of energy
The raw materials needed to generate energy need to be partly imported from other countries. Our aim is to limit our dependency on the political decisions of only a few countries (cf. our currently high dependency on the Middle East for oil). Uranium can be obtained from many more different countries compared to for example petroleum. Therefore, this package will reduce the dependency on energy supplied by politically unstable regions. Moreover, uranium reserves can easily be realised, as uranium takes up relatively little space. This package is therefore likely to result in the availability of sufficient energy.

.40* | 3.3

Consequences for employment
The construction of new nuclear plants yields new jobs. Approximately 1500 jobs will be involved in the building and set-up of one plant. Another 500 jobs will need to be filled to keep the plant in operation.

.46* | 4.4

Price
The electricity generated with this package will be about 10-30% lower compared to electricity from coal- or gas-fired electricity plants. The costs involved in building a nuclear plant are very high. These costs will be higher if more safety measures are taken, or if waste from the plant is processed to reduce the duration of the radioactivity. It is unknown if and how much this will raise the price of electricity from nuclear energy.

.36* | -0.5

Average Overall Evaluation: (1 to 10)
4.80

3.4 Effects of correcting misconceptions

Before respondents received the information on the options to reduce CO_2 emissions, they read an elaborate introduction with background information, including information regarding what CO_2 is. Previous research has shown that people tend to have many misconceptions regarding CO_2 (Paukovic et al., 2011; 2012, Wallquist et al., 2009). In the current ICQ, respondents were divided in three experimental conditions. The only difference between these groups was that misconceptions were not corrected, corrected in an implicit manner, or corrected explicitly. For example, people either received an additional sentence stating that "CO_2 is released when people exhale" (implicit correction), "Some people do not know that CO_2 is released when people exhale" (explicit correction) or did not receive this information (no correction). After receiving this information and after completing all the options for reducing CO_2 emissions, including the final choice, respondents received several questions regarding their knowledge of CO_2. Respondents received eleven statements and answered to what degree they agreed with the statement on a 5 point scale. Their answers where coded as "correct" when they correctly agreed (score of 4 or 5) or disagreed (score of 1 or 2) with the statement, and vice versa when incorrectly agreed or disagreed with the statement. An answer of 3 (scale median) was coded as "I don't know". Misconceptions that were corrected were chosen based on earlier research showing that these are commonly mentioned misconceptions by lay people (Paukovic et al., 2011; 2012). Chi-square tests were done to compare the amount of correct and incorrect answers given between the different experimental conditions. It was hypothesized that when misconceptions are corrected in the introduction of the ICQ, more correct answers are given. This effect will be the strongest when explicitly correcting the misconceptions, rather than implicitly doing so.
Results showed that implicit and explicitly correcting misconceptions lead to more knowledge of CO_2 attributes, such as whether it is explosive, or released when exhaling, even after a significant amount of time and receiving much more information in the meantime (see Table 3.12). There were no significant differences between experimental conditions for the misconceptions regarding CO_2 emissions when producing energy. This is probably caused by the fact that respondents have received much more information about the effects these technologies have on CO_2 emissions within the options. This leads to a relatively large amount of correct knowledge in all conditions.

Table 3.12. Percentages of respondents who correctly or incorrectly answered the manipulation checks, Chi-square and p-value.

		No correction N=268	Implicit correction N=259	Explicit correction N=473	Chi^2	p
CO_2 is a natural gas	Correct	70.1	78.0	78.2	7.65	.105
	Incorrect	9.3	6.2	7.6		
	Don't know	20.5	15.8	14.2		
CO_2 is explosive	Correct	50.4	60.2	67.2	21.10	.000
	Incorrect	17.2	12.0	10.6		
	Don't know	32.5	27.8	22.2		
CO_2 is harmful in contact with skin.	Correct	52.6	55.6	64.9	13.05	.011
	Incorrect	15.3	13.5	12.1		
	Don't know	32.1	30.9	23.0		
CO_2 makes a liveable climate possible	Correct	51.1	54.1	61.1	8.96	.062
	Incorrect	17.2	18.5	15.6		
	Don't know	31.7	27.4	23.3		

CO_2 is released when exhaling	Correct	58.2	68.0	73.4	18.14	.001
	Incorrect	19.0	15.1	12.7		
	Don't know	22.8	17.0	14.0		
CO_2 is emitted when using spray cans	Correct	24.3	43.2	51.2	53.33	.000
	Incorrect	57.1	39.4	34.5		
	Don't know	18.7	17.4	14.4		
CO_2 leaks from old batteries	Correct	39.2	44.4	43.6	9.37	.052
	Incorrect	26.5	30.5	31.9		
	Don't know	34.3	25.1	24.5		
CO_2 is emitted when energy is generated from gas	Correct	77.2	80.3	77.6	1.11	.893
	Incorrect	5.6	5.4	6.1		
	Don't know	17.2	14.3	16.3		
CO_2 is emitted when energy is generated from coal	Correct	86.2	87.6	84.8	1.28	.865
	Incorrect	2.2	1.9	2.7		
	Don't know	11.6	10.4	12.5		
CO_2 is emitted when energy is generated from biomass	Correct	70.9	73.0	73.2	0.54	.969
	Incorrect	11.2	10.4	9.9		
	Don't know	17.9	16.6	16.9		
CO_2 is emitted when nuclear energy is generated	Correct	60.4	62.2	60.5	1.15	.887
	Incorrect	20.9	22.0	20.7		
	Don't know	18.7	15.8	18.8		

Note: The N of respondents on which the Chi^2 test is based was converted to percentages in this table for means of comparison.

3.4.1 Effects of correcting misconceptions on explained variance of the options

As stated in the introduction, correcting misconceptions may lead to a decrease in the knowledge gap that is observed within the ICQ; respondents have less misconceptions which may influence their perception, and therefore the information within the ICQ better explains their opinion. We therefore examined whether correcting misconceptions in the introduction would lead to a higher explained variance of the options. As can be seen in Table 3.13 results showed only small differences between the multiple correlation coefficients between the different introductions, therefore it can be assumed that the misconceptions that were corrected did not lead to a larger part of respondents' opinion being based on the information of the options. It might be concluded from this result that the other information that people base their opinions on is not likely to be based on these specific misconceptions of CO_2, but rather on other information such as values or emotions. Finally, it was also examined whether there was a difference between the three introductions in overall evaluations, choices and rejection of options. However, these analyses showed no significant differences.

Table 3.13. Multiple correlation coefficients as a function of introduction.

	No correction	Implicit correction	Explicit correction	Overall R
CO_2 reduction built environment	.60	.62	.54	.57
CO_2 reduction industry	.57	.50	.55	.53
Wind energy	.53	.56	.53	.53
Biomass energy	.67	.59	.64	.62
CCS	.56	.59	.45	.51
Biomass + CCS	.60	.56	.55	.55
Nuclear energy	.74	.72	.74	.73

3.5 Evaluations of climate change

3.5.1 Evaluations of climate change consequences

Before respondents received the information regarding the options of reducing CO_2 emissions, they first received an elaborate introduction into the subject and methodology of the questionnaire. In this introduction, several questions were asked regarding their perceptions of climate change in general. When asked whether they had heard of climate change, a large majority (83.7%) answered that they had heard and know a little about climate change. A small group of respondents (8.8%) indicated they know a lot about climate change, 7,2% say they had heard of it but don't know what it is, and only 0.3% say they had never heard of it. Without having received any information, respondents were asked to grade climate change on a ten-point scale. On average, *uninformed opinion* of climate change was negative with a mean grade of 4.02.

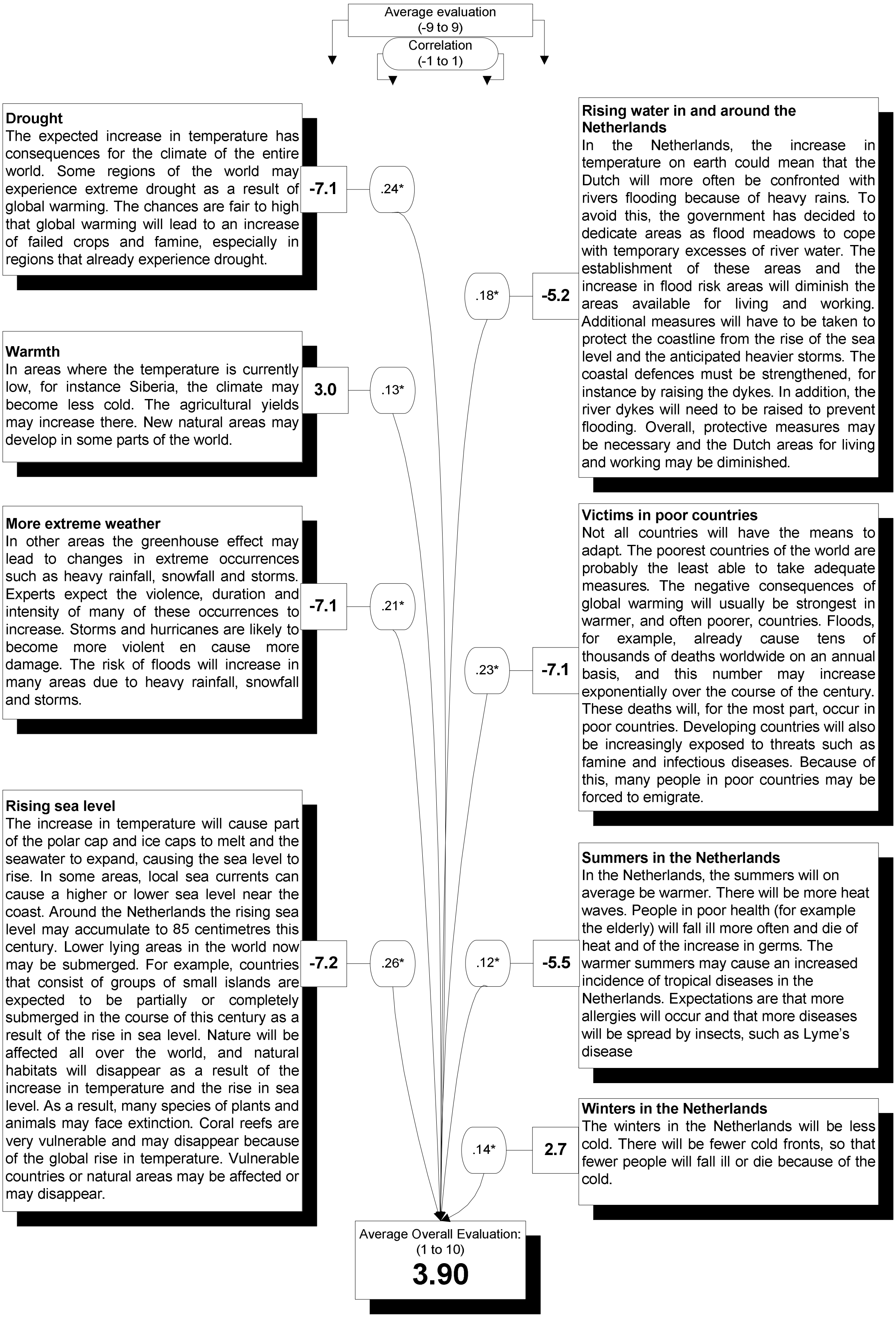
After respondents gave their opinion of climate change, they received information regarding climate change and its consequences. Similar to the method in which respondents evaluated the options, they also evaluated climate change. Table 3.14 and Figure 3.8 show the information respondents evaluated, the mean evaluations of consequences, the mean overall evaluation of climate change and correlations between consequence evaluations and overall evaluation. The overall evaluation of climate change after receiving more information was 3.90, which was slightly below the average opinion before information. The correlation between before and after evaluations was moderate, r = .49. The multiple correlation between the evaluations of the consequences and the overall evaluation is quite low in comparison to the options in the ICQ, R = .35. This means that respondents based their overall evaluation of climate change only in part on the consequences that experts deemed important. The single correlations between the evaluations of the consequences and the overall evaluation of the option were low. The highest correlation was for the consequences "sea level rise" and "drought". These consequences were perceived as big disadvantages. Interestingly, these are both issues that were relevant in the media around the time that people filled in the questionnaire. In the Netherlands a severe storm had just passed, in England there were floods due to storms and in Australia record high temperatures were reached and there were a number of forest fires. Other consequences that were evaluated as big disadvantages were "more extreme weather" and "victims in poorer countries".

Consequences regarding The Netherlands specifically (rising water, summers, and winters in The Netherlands) all seem to have a lower correlation with the overall evaluation.

Table 3.14. Percentages of respondents choosing response categories, mean evaluations, standard deviations and correlation with overall opinion of "Climate change".

	Disadvantage			Unimportant	Advantage		
	Big -9 to -7	Moderate -6 to -4	Small -3 to -1	0	Small 1 to 3	Moderate 4 to 6	Big 7 to 9
Drought	78.6	15.7	2.5	2.6	0.1	0.2	0.3
Warmth	11.4	8.6	1.3	8.9	6.2	29.2	34.4
More extreme weather	76.0	17.3	2.9	3.2	0.2	0.1	0.3
Sea level rise	78.9	13.8	2.7	4.2	0.2	0.1	0.1
Rising water in and around The Netherlands	57.9	19.7	5.3	9.9	0.5	3.1	4.4
Victims in poorer countries	77.8	14.7	2.2	4.1	0.2	0.3	0.7
Summers in The Netherlands	55.3	24.2	5.6	10.2	1.0	2.6	1.1
Winters in The Netherlands	7.9	8.0	3.0	18.6	8.3	23.7	30.5

Figure 3.8: Consequences of the increase in temperature caused by the greenhouse effect



3.5.1.1 Relation between different climate change perceptions

At the end of the questionnaire, after the seven options on CO_2 emission reduction, respondents were asked to indicate how they think about climate change as a topic of scientific debate. Results are presented in Table 3.15. Most respondents tend to agree with the statements.

It was examined whether perceptions of anthropogenic climate change (i.e. that climate change is caused by mankind) are correlated to perceptions of climate change and the need for action. Correlations with past climate change (r = .55), future climate change (r = .59) the need to decrease CO_2 emissions (r = .61) and the need to protect against the consequences of climate change (r = .42) were all moderate to high. This means that most respondents who are convinced that climate change is caused by mankind, are also convinced that the climate has become warmer, will become warmer in the future and that actions should be taken to decease emissions and protect against a changing climate. Correlations of anthropogenic climate change with climate change grades before receiving information (r = -.19) and after receiving the information (r = -.15) were rather low, which seems to indicate that these perceptions are not related to perceptions of whether climate change is caused by mankind. The correlations between evaluations and past climate change, future climate change, need to decrease CO_2 emissions, and the need to protect against the consequences of climate change were all low as well (ranging between -.14 to -.26).

Table 3.15. Perceptions of climate change, percentages of respondents choosing response categories on a scale ranging from 1 "not at all" to 7 "very"

	1-3	4	5-7	Mean	SD
To what extent are you convinced that the climate on earth has become warmer on average in the past century?	9.2	13.5	73.9	5.35	1.39
To what extent are you convinced that the climate on earth will become warmer on average in the coming century?	8.6	12.6	75.2	6.00	1.39
To what extent are you convinced that climate change is a consequence of CO_2 emissions by mankind?	12.8	13.9	67.8	5.29	1.55
To what extent do you think something must be done to reduce CO_2 emissions?	3.8	8.2	84.2	5.92	1.23
To what extent do you think it is necessary for the Netherlands to protect themselves against possible consequences of a warmer climate, such as floods, by for instance raising the dikes or strengthening the sea wall?	2.8	6.8	86.6	5.91	1.13

Note: Percentages do not add up to 100% because up to 5.5% of respondents indicated they do not have an opinion on the matter.

3.5.1.2 Relation between climate change perceptions and evaluation options

Some previous studies show a relation between public perceptions of CCS and awareness of the necessity to reduce CO_2 emissions (Itaoka et al, 2006; Tokushige et al., 2009). To see whether overall evaluations of the options were also positively correlated to climate change perceptions, the correlations were examined. As can be seen in Table 3.16 all correlations were low to non-existent. How respondents perceived climate change has a minor influence on the overall evaluations of the options. Informed opinion on climate change was moderately correlated with the coal and gas CCS option and the nuclear energy option. This indicated that respondents who were more negative about climate change, also tended to be more negative about CCS and nuclear energy. Furthermore, when looking at the correlations of the overall evaluations with the statement about the need to reduce CO_2 emissions, the correlation with the options CO_2 reduction in the built environment, wind energy and biomass energy were near to moderate. Respondents who think it is necessary to reduce emissions also gave higher evaluations to these options.

Table 3.16. Relation between climate change perceptions and evaluations of options.

	Uninformed evaluation climate change	Informed evaluation climate change	Climate change up to now	Climate change in the future	Climate change manmade	Necessity to reduce CO_2 emissions	Necessity to protect against climate change
CO_2 reduction built environment	-.13*	-.10*	.17*	.13*	.11*	**.20***	.14*
CO_2 reduction industry	-.08	-.08*	.11*	.09*	.07	.17*	.12*
Wind energy	-.07	-.08	.15*	.13*	.17*	**.21***	.15*
Biomass energy	-.08	-.03	.10*	.06	.11*	**.20***	.11*
CCS	.15*	**.23***	-.02	-.02	.03	-.01	-.06
Biomass + CCS	.01	.06	.08*	.07	.13*	.16*	.06
Nuclear energy	.16*	**.21***	-.13*	-.15*	-.14*	-.16*	-.12*

Note: * p significant at <.01 level.

3.6 Uninformed opinions

3.6.1 Self-reported awareness options

Before receiving any information regarding the options, respondents were asked about their awareness of climate change and of the seven options. They were furthermore asked to evaluate climate change and each of the seven options, with the option to refrain from evaluation. For the opinions of climate change see section 3.5.

As can be seen in Table 3.17 The options "CO_2 reduction in industry", "wind energy", "biomass energy" and "nuclear energy" are options that most people tend to know a little about. While it can be assumed that CO_2 reduction in the built environment may be the option that is most relevant to respondents, almost 20% indicated to have never heard of this option. CCS as an option to reduce CO_2 emissions is relatively unknown to respondents, as well as the combination of CCS and biomass.

Table 3.17. Mean and SD scores of uninformed report grades and stated knowledge of options.

	Mean	SD	Have you ever heard of… No, never heard of it	I have heard of it, but don't know what it is	Yes and I know a little about it	Yes and I know a lot about it
CO_2 reduction built environment	6.75	1.60	19%	27.1%	50.5%	3.4%
CO_2 reduction industry	7.29	1.81	7.1%	21.7%	65.7%	5.5%
Wind energy	7.50	1.61	3.1%	11.4%	76.9%	8.6%
Biomass energy	7.16	1.42	13.3%	26.0%	56.3%	4.4%
CCS	5.13	1.83	35.3%	26.9%	34.9%	2.9%
Biomass + CCS	5.35	1.78	48.8%	24.9%	24.4%	1.9%
Nuclear energy	5.27	2.12	3.2%	17.4%	70.2%	9.2%

3.6.2 Relationship between uninformed and informed opinions

To assess whether respondents changed their evaluations of options after receiving information, the results of evaluations before receiving information are compared with the informed evaluations at the end of the ICQ. Results are shown in Table 3.18. While the difference is not very high for most options, most options are evaluated slightly more negatively after receiving information. Only "CO_2 reduction in the built environment" and "Biomass + CCS" is slightly more positively after receiving information about these options.

Correlations between the before and after information evaluations range from moderate to high. For wind energy and nuclear energy correlations are relatively high, which might indicate that respondents already had some understanding of what the technology entails before information was provided. This also corresponds with respondents self-reported knowledge of the options.

Table 3.18. Mean evaluations of the options before and after receiving information, difference scores and correlations.

	Mean evaluation before information	Mean evaluation after information	Difference	r
CO_2 reduction built environment	6.75	6.98	0.23	.19
CO_2 reduction industry	7.29	6.68	-0.61	.31
Wind energy	7.50	6.65	**-0.85**	**.51**
Biomass energy	7.16	6.75	-0.41	.27
CCS	5.13	4.55	-0.58	.36
Biomass + CCS	5.35	6.08	**0.73**	.37
Nuclear energy	5.27	4.80	-0.47	**.63**

3.6.3 Uninformed opinions of shale gas at the end of the ICQ

At the end of the questionnaire, respondents were asked to indicate their opinion on shale gas, a matter that is currently discussed in The Netherlands as a possible technology to increase the gas supply. We were interested in the degree to which a representative sample of the Dutch population has heard of this development and how they evaluate this option, without receiving any information on this option.
Before discussing these results, it is important to emphasize that respondents already completed the entire ICQ. Respondents may therefore be tired and less concentrated than they were at the beginning of the questionnaire. Furthermore, respondents already received a lot of information about energy and climate change in general. It is not unlikely that this information also influenced respondents' perceptions of shale gas. Care should therefore be taken into account when interpreting the results.

First of all, it is interesting to see that while this is a relatively new technology to be discussed in The Netherlands, it seems that a relatively large percentage of participants had heard of shale gas. Awareness percentages were roughly comparable to biomass, and even higher than CCS. The large amount of media attention that shale gas had is probably the cause of this awareness. To respondents who answered that they at least had heard of shale gas, four questions were asked concerning their perceived interest, necessity, and consequences (on a scale from 1 to 7). Overall, respondents were rather negative about shale gas in The Netherlands. Respondents thought that shale gas will not be economically interesting, nor necessary for the Dutch supply. Furthermore, they expected that shale gas will have little positive consequences and some negative consequences. There were several differences in evaluations of shale gas between different knowledge levels (see Table 3.19). Respondents who indicated knowing a lot about shale gas were less convinced that shale gas is necessary than respondents with lower knowledge levels. Higher levels of indicated knowledge furthermore lead to less perceived positive consequences and more perceived negative consequences.

Table 3.19. Mean evaluations of shale gas for each knowledge level.

	Never heard of shale gas N = 138 13.8%	Heard of shale gas, but don't know what it is N = 310 31.0%	Know a little about shale gas N = 494 49.4%	Know a lot about shale gas N = 58 5.8%	Overall N = 1000 100%
To what degree do you think that:					
Shale gas is economically interesting in The Netherlands	-	3.24	3.20	2.78	3.18
Shale gas is necessary for the Dutch energy supply	-	3.15_a	2.93_a	2.33_b	2.97*
Shale gas will have positive consequences	-	3.08_a	2.88_{ab}	2.47_b	2.93*
Shale gas will have negative consequences	-	4.83_a	5.25_b	5.76_c	5.13*

Note: When respondents indicated that they had never heard of shale gas, the subsequent questions were skipped. * ANOVA was significant on the p <.05 level. Per row different subscripts mean that the post-hoc Tukey HSD test showed a significant difference on the p<.05 level.

The overall grade that respondents give to shale gas is, in accordance with their perceptions, also rather low (M = 4.29). The overall grade is even lower than the grades that respondents gave to all the other options in the ICQ before receiving information, such as CCS (M = 4.55) and nuclear energy (M = 4.80). Respondents who indicated to know a lot about shale gas were even more negative (M = 3.50).

Table 3.20. Percentage of respondents evaluating shale gas (as percentage of total respondents), and the overall evaluation of shale gas.

	Evaluation	No opinion	Total	Mean grade
Never heard of shale gas	6.7%	7.1%	13.8%	3.54_a
Heard of shale gas, but don't know what it is	22.3%	8.7%	31.0%	4.52_b
Know a little about shale gas	47.4%	2.0%	49.4%	4.38_b
Know a lot about shale gas	5.8%	0%	5.8%	3.50_a
Overall evaluation	82.2%	17.8%	100%	4.29

Note: different subscripts mean that the post-hoc Tukey HSD test showed a significant difference on the p<.01 level.

3.7 Subjective evaluations concerning the quality of the information and the method of the ICQ

In the ICQ a number of questions was asked to gain insight into the evaluations of respondents concerning the quality of the information, the method of the ICQ, and the amount of information. These questions were all answered on a 7 point scale. To be able to clearly discuss the outcome of these questions the results were re-coded in three categories; a neutral statement (the original midpoint of the scale, 4), statements on the low end of the scale (score 1, 2, and 3), and statements on the high end of the scale (score 5, 6, and 7). The percentages of respondents in these three categories will be discussed below. Note that the percentages do not always add up to 100% as respondents also received the opportunity to select the answer “no opinion”.

3.7.1 Evaluations concerning the quality of information

Concerning the partiality of the information in the ICQ, 36.6% of the respondents stated they thought the information was unbiased. Approximately the same amount of respondents answered neutral to this question (37.9%) and 19.5% of respondents thought it was biased. The question whether information was one-sided received similar evaluations. 40.1% of respondents thought it was not one-sided. A large majority thought the information was clear (73.9%) and complete (62.1%). When asked whether the information that was provided was new and unknown, 27% answered that it was mostly new, while 44.7% answered it was mostly already known (see Table 3.21).

3.7.2 Evaluations concerning the method of the ICQ

Respondents answered four questions about the method of the ICQ. All respondents answered that the survey was clear and there was no moment at which it was unclear what to do. Most respondents also stated the method is understandable (82.9%). While most respondents thought the method was simple (45.5%), 21.4% thought it was complicated. A majority of respondents (68.1%) also stated that the ICQ methodology was helpful in making a choice. Based on these reports by respondents, it seems justified to conclude that the method of the ICQ is well understood, although not all respondents think it is simple. When compared to a traditional questionnaire, the ICQ involves more complex decision making from respondents. Therefore, it is to be expected that respondents also indicate this (see Table 3.21).

3.7.3 Evaluations concerning the amount of information in the ICQ

Respondents were asked with five questions concerning the amount of information they received in the ICQ. Most respondents indicated they had sufficient information to base their choice of options on (84.9%). A majority did not report a desire for more or less information about the consequences before evaluating the option (67.9%), and 22.7% would have liked some more information. On the other hand, half of the respondents (50.6%) said the amount of information was just right, while 40.3% thought it was too much. These results might be interpreted as respondents would have liked more information about the consequences and less other information. A majority (52.5%) did, however, like that information was sometimes repeated. It seems that preferences of the amount of information differ somewhat across respondents, some prefer more information while others would have liked less. In general, if can be concluded that the amount of information was sufficient for most respondents.

Respondents were also asked how limited they felt concerning their choice options. Approximately half of the respondents (48%) stated not to feel limited (see Table 3.21).

Table 3.21. Subjective evaluations of the quality of information, method of the ICQ, and the amount of information in percentages of respondents.

	Low 1 to 3	Neutral 4	High 5 to 7
Quality of information			
To what degree do you think the information about consequences was biased or unbiased?	36.6	37.9	19.5
To what degree do you think the information about consequences was one-sided?	40.1	38.8	15.1
How clear did you think the information about the consequences was?	7.1	16.3	73.9
To what degree do you think the information about consequences was complete?	12.2	20.9	62.1
To what degree was the information about consequences new and unknown to you?	27.0	25.3	44.7
Method of ICQ			
Was there a moment during the survey that something was unclear or that you did not understand what to do?	100	-	-
To what degree did the method of the ICQ help you to make a choice?	7.5	21.3	68.1
To what degree do you think the method is understandable?	3.0	12.0	82.9
To what degree do you think the method is simple or complicated?	45.5	30.6	21.4
Amount of information			
To what degree did you have sufficient information to make a choice between the options?	4.3	9.1	84.9
To what degree would you have liked more or less information about the consequences before evaluating the consequences?	6.0	67.9	22.7
To what degree did you think the amount of information was appropriate?	5.9	50.6	40.3
To what degree was it pleasant that information and ICQ method was sometimes repeated?	24.6	19.9	52.5
The choice possibilities were limited. To what degree did you feel restricted by this?	48.0	26.4	22.7

Note: percentages do not add up to 100% as some participants selected the option "no opinion".

3.8 Influence of personal characteristics

Several demographic and personal background variables were assessed. We will not discuss the effects of all characteristics of respondents that were assessed or known, as this would generate a lot of information that is far from enlightening. This also has the negative side-effect of false hits: When testing if groups differ on certain variables, there is a chance that the test will suggest that groups differ, when in fact they do not. How small this chance is depends on the parameters of the test. It is customary to use a confidence interval of 95%, which means that there is a 5% chance that you are wrongfully rejecting the hypothesis that there is no effect. However, if more tests are done, the chance becomes greater that one of these tests shows an effect that is coincidental. Testing all the effects of all personal characteristics on all major dependent variables – overall evaluations, choice, acceptance – would result in hundreds of tests and a very great chance of false hits. To avoid this, we will only test the personal characteristics that can reasonably be expected to have some relation with opinion about climate change and the seven options. We will discuss the relations of these opinions with gender, education, demographic region, and values. To further avoid reporting small and trivial effects, we will only consider effects of a certain effect size as actual effects. After establishing that there is very likely an effect, it becomes important to know how large this effect is. For instance, if two groups differ in their evaluation of a technology by 0.09 on a scale of one to ten, this might be a statistically significant difference, but it hardly has any practical impact. Therefore, we only considered effect sizes that were at least "small"- partial eta square above .01 by definition of Cohen (1973, 1988) and only report Chi-square results with a significance level of <.01. To analyse the influence of personal characteristics on overall evaluations we used analyses of variance (ANOVA). To analyse this influence on the percentage of rejection of technologies, we used Pearson Chi-square tests.

3.8.1 Influence of gender

Men gave somewhat higher report grades for the CCS option, M_{men} = 4.71 SD = 1.66, M_{women} = 4.38 SD = 1.65, p = .001, η^2 =.01. Men also gave higher report grades for the nuclear energy option, M_{men} = 5.11 SD = 2.13, M_{women} = 4.47 SD = 2.13, p = .000, η^2 =.02. Chi-square analyses of the choices of options showed that the option "biomass" was chosen more often by women than by men (78.7% and 70.6% respectively), p = .003. The option "nuclear energy" was chosen more often by men than by women (34.3% and 20.7% respectively), p = .000. Acceptability of options did not differ between men and women.

3.8.2 Influence of age

Age was recoded into two categories, split on the median (< 52 years vs. > 52 years). With regard to grades, there were no significant differences with a partial eta square above .01. With regard to choices there was a significant difference for choice of the option "CO_2 reduction in the built environment", p = .009 and "nuclear energy", p = .000. Younger respondents chose the built environment option more frequently than older respondents (83.4% vs. 76.8%). Younger respondents chose the nuclear energy option less frequently than older respondents (22.2% vs. 33.3%). Finally, there was a difference in the amount of respondents rejecting the biomass option, p = .004. Although differences are small, older respondents seemed to rejected this option more frequently than younger respondents (0.4% vs. 2.3%).

3.8.3 Influence of education

For these analyses, respondents were divided in three groups: low education (lo, lbo, mavo), medium education (mbo) and higher education (havo, vwo, hbo, wo). With regard to the report grades, there were differences for the options "CO_2 reduction in the built environment" (p = .001, η^2 =.01), "CO_2 reduction in the industry" (p = .000, η^2 =.03), and "CCS" (p = .008, η^2 =.01). Tukey HSD post hoc tests showed that CO_2 reduction in the built environment received a higher report grade from higher educated respondents than medium and lower educated respondents (M_{high} = 7.21 vs. M_{mbo} = 6.85 & M_{low} = 6.87). Similarly, post hoc tests showed that CO_2 reduction in the industry received a higher report grade from higher educated respondents than medium and lower educated respondents (M_{high} = 6.99 vs. M_{mbo} = 6.52 & M_{low} = 6.54). For the CCS option, post hoc tests showed that a higher report grade was given by lower educated respondents than medium and higher educated respondents (M_{low} = 4.77 vs. M_{mbo} = 4.42 & M_{high} = 4.43). With regard to choices and rejections there were no significant differences found between different education levels.

3.8.4 Differences between regions

For these analyses, we compared 5 groups: the "Randstad" (the three biggest cities in The Netherlands including surrounding municipalities), region West, North, East, and South. With regard to the report grades, the ANOVA showed no significant differences between regions. With regard to choices there was a difference between regions on "biomass combined with CCS" (p = .009) options. In the North-Netherlands biomass with CCS was chosen more frequently in the North (62% vs. 40 to 47%).

3.8.5 Influence of values

To see whether personal values of respondents influences their opinion on the options to reduce CO_2 emissions, we added a scale that is often used to measure pro-environmental behavior (De Groot & Steg, 2008; adjusted from Schwartz, 1992; Steg, Perlaviciute, van der Werff, Lurvunk, 2012). This scale consists of 16 items within four subscales: hedonic values (3 items), egoistic values (5 items), altruistic values (4 items), and biospheric values (4 items). Respondents rated these values as "guiding principles in their lives" on a 9-point scale ranging from -1 "opposing my principles", 0 "not important", to 7 "extremely important". Reliability of subscales was high (α =.75 to .86).

Correlations between the report grades of the ICQ options and value-scales were all low. The correlations that were mostly in the direction of moderate were on the biospheric and altruistic values with the options CO_2 reduction in the built environment, CO_2 reduction in the industry, wind energy and biomass energy (see Table 3.22).

Table 3.22. Correlations between values and overall evaluations of the options.

	Hedonic values	Egoistic values	Altruistic values	Biospheric values
CO_2 reduction in built environment	.03	-.04	.20*	.28*
CO_2 reduction industry	.05	-.09*	.25*	.28*
Wind energy	.07	-.10*	.14*	.21*
Biomass energy	.13*	-.02	.24*	.17*
CCS	-.02	.12*	-.08	-.07
Biomass + CCS	.06	.03	.12*	.10*
Nuclear energy	.05	.16*	-.12*	-.14*

Note: *P is significant at the <.01 level.

We also examined whether the multiple correlations between the consequences of options and overall evaluations of options increased when values were included. Multiple correlation coefficients showed very small to no increase as compared to the multiple correlations without the value scales added (see Table 3.23). This means that the values people have seem to have a very small effect on the overall evaluations that respondents gave the options. This is somewhat surprising as in the introduction it was theorized that the part of opinion that was not based on information in previous ICQs is possibly caused by other factors influencing opinions, such as values. The values measured seem to have a limited effect on the evaluations though.

Table 3.23. Multiple correlation of the regression model of the options with and without values.

	R without values	R with values
CO_2 reduction in built environment	.57	.60
CO_2 reduction industry	.53	.55
Wind energy	.53	.55
Biomass energy	.62	.63
CCS	.51	.51
Biomass + CCS	.55	.56
Nuclear energy	.73	.74

Finally, the relation between values and choices were examined using logistic regression analyses to predict the choice for an option using the four value-scales as predictors.
A test of the full model against a constant only model was statistically significant for all options except the biomass with CCS option, indicating that the values combined reliably distinguished between choosing or not choosing the option except for the biomass with CCS option. This option is therefore not further examined. Nagelkerke's R^2 was low for all options, indicating a small relationship between values and choices.
For the option "CO_2 reduction in the built environment" prediction success overall was 80.3% (100% chosen, 0.5% not chosen). The Wald criterion demonstrated that only biospheric values made a significant contribution to the prediction (p = .012). EXP(B) value indicates that when biospheric value increases with 1 the odds ratio is 1.22, which means that respondents are 1.22 times more likely to choose this option.
For the option "CO_2 reduction in the industry", prediction success overall was 82.6% (100% chosen, 0% not chosen). The Wald criterion demonstrated that only biospheric values made a significant contribution to the prediction (p = .043). EXP(B) value indicates that when biospheric value increases with 1 the odds ratio is 1.18, which means that respondents are 1.18 times more likely to choose this option.

For the option “Wind energy”, prediction success overall was 77.6% (100% chosen, 0% not chosen). The Wald criterion demonstrated that biospheric values made a significant contribution to the prediction (p = .031) as well as altruistic values (p = .001). EXP(B) value indicates that when biospheric value increases with 1, the odds ratio is 1.18 which means that respondents are 1.18 times more likely to choose this option. The odds ratio for altruistic value is 0.76, which means that respondents are less likely to choose this option when altruistic value is higher.

For the option “Converting biomass to electricity and fuel” prediction success overall was 74.6% (100% chosen, 0% not chosen). The Wald criterion demonstrated that only altruistic values made a significant contribution to the prediction (p = .002). EXP(B) value indicates that when altruistic value increases with 1, the odds ratio is 1.29 which means that respondents are 1.29 times more likely to choose this option.

For the option “Converting coal or gas to electricity with underground CO_2 storage” prediction success overall was 87.9% (0% chosen, 100% not chosen). The Wald criterion demonstrated that only egoistic values made a significant contribution to the prediction (p = .042). EXP(B) value indicates that when egoistic value increases with 1, the odds ratio is 1.18 which means that respondents are 1.18 times more likely to choose this option.

For the option “Electricity from nuclear plants” prediction success overall was 72.6% (1.4% chosen, 99.7% not chosen). The Wald criterion demonstrated that egoistic values made a significant contribution to the prediction (p = .038) as well as biospheric values (p = .041). EXP(B) value indicates that when egoistic value increases with 1, the odds ratio is 1.13 which means that respondents are 1.13 times more likely to choose this option. The odds ratio for biospheric value is 0.86, which means that respondents are less likely to choose this option when biospheric value is higher.

In short, these results show that choices for the options “CO_2 reduction in the built environment”, “CO_2 reduction in the industry”, and “wind energy” were positively related to biospheric values, while the option “nuclear energy” was negatively related to biospheric values. Choice for the option “wind energy” was negatively related to altruistic values and “biomass” was positively related to altruistic values. Finally, choices for the options “CCS and “nuclear energy” were positively related to egoistic values. No relation with hedonic values was found.

4 Summary and discussion

What is technically possible, is not always wanted by society. When new technologies emerge, the question always remains if and how a new technology fits into that society. Some new technologies are rejected locally or even nationally after much time and effort has been spent on development. When CCS started emerging as a possible technological solution to the excessive emission of CO_2 the logical next step therefore was to investigate public perception of this option. The current study is part of a larger research program on public perception of CCS in the Netherlands, itself part of the national research program on CCS in the Netherlands, CATO2.

The study discussed in this report has investigated the choices the Dutch general public would make after having received and evaluated expert information on the consequences pertaining to these choices. Here, we summarize our reasoning for the design of this study, discuss the results, and suggest implications.

An accurate assessment of the publics' perceptions and opinions comes with some challenges. Research performed in the first Dutch program for CO_2 Capture and Storage research, CATO, has revealed that public interest in energy and climate change issues is low and serious knowledge gaps exist (De Best-Waldhober et al. 2009; Paukovic et al., 2011). The percentage of people from the general Dutch public stating to have heard a little bit about CCS or a lot rose from 20.2% and 3.6% respectively in 2004 to 46.7% and 10.4% in 2008 (De Best-Waldhober & Daamen, 2011). In 2010 Paukovic et al. (2011) found considerably higher percentages, with 26.9% that had heard 'a little bit', and 37.7% that indicated to indeed have heard of CCS. Despite the fact that respondents indicated to have heard of CCS, they have trouble indicating some basic aspects of CCS such as the problem it addresses (Sharp et al., 2006; Pietzner et al., 2011; de Best-Waldhober & Daamen, 2011). Less than 3% of respondents could identify climate change mitigation as the sole goal of CCS in a recent European study (Pietzner et al., 2011). Two studies regarding knowledge and awareness of CCS in 2010 and 2011 in the Netherlands showed similar results (Paukovic et al, 2011; 2012).

Such low levels of awareness and knowledge can pose problems when the aim is to accurately assess public opinion. Uninformed opinions can be unstable, because people are inclined to give an answer even if they have not heard about a topic before (Bishop, 1980). Such uninformed opinions are easily changed with any new information about the topic (De Best-Waldhober, 2006; Bishop et al., 1980) and as such hold little value for understanding or predicting the public's future reactions to any decision made. For a serious discussion on the place of CCS in society, uninformed opinions are therefore not very useful. Another way to study public perception in such situations is to use instruments that inform people. In earlier projects in the Netherlands the Information-Choice Questionnaire (ICQ) method has been used for that. The Information-Choice Questionnaire is essentially a decision help that includes information. It aims to provide respondents with the necessary information and helps them make use of this information to form opinions about different policy options: the ICQ is designed to guide respondents' information processing. Before respondents in the ICQ choose between policy options, they receive information. The choice is explicitly framed as a decision problem and respondents are informed about the background of the decision problem (e.g., they are told why these specific options are included in the decision problem). Then respondents are provided with information about the consequences of the different policy options and are requested to give a quantitative evaluation of each consequence (a rating on a scale with nineteen response categories ranging from -9 “a very big disadvantage” via 0 “totally irrelevant” to + 9 “a very big advantage”). These evaluations help stimulate information processing and help respondents reach a decision.

Thus far, several ICQ’s with CCS as a mitigation option have been developed and administrated to large samples representative of the Dutch general public. A large percentage of the respondents is positive about the methodology of the ICQ and evaluates the ICQ as a good decision aid. Results also show that people base their opinion of the options in the ICQ for a large part on the given information from experts, which most indeed evaluate as reliable. But a substantial part of the opinion regarding the options, such as CCS, cannot be explained by the given information from experts on the consequences of options. That means that people base their opinion on other factors as well, such as other arguments, ideas, feelings and possibly misconceptions.

The ICQ developed for this study went further than previous ICQ’s as it incorporates prevalent beliefs and misconceptions regarding CO_2 and CCS based on explorative qualitative and quantitative studies of current lay public beliefs and perceptions (Paukovic et al, 2011; 2012). The effectiveness of debunking methods were investigated with an experimental design, with three different versions of the introduction. One without extra information regarding misconceptions, one in which misconceptions were implicitly corrected by adding the correct information and one in which misconceptions were explicitly corrected by adding the information and the phrase “some people do not know, that”. The current ICQ was also revised to include the latest insights in energy transition possibilities and consequences, leading to several significant changes in the emission reduction policy problem and the emission reduction options in the questionnaire.

The ICQ is developed by having several experts decide on the most relevant policy problem as well as the most relevant options to solve it. Together with other experts they gather information on the background of the problem, the options and the consequences of implementation of the options. After translation to lay language, this information is offered to people to evaluate in a highly structured way to aid people in their decision making process. Because of this it is crucial that the information is accurate, reliable and balanced. In the current study, much care was taken to ensure accurate, reliable and balanced information based on a relevant policy problem. Many experts were consulted in several phases of the project, during the definition of the policy problem, the assessment of the expert information, and the translation of the expert information to lay language. The policy problem was defined as:

“*How can the Dutch demand for energy be fulfilled in 2030 in such a way that emissions of carbon dioxide will be reduced by 40%?”*

The options chosen were:

1. Reducing CO_2 emissions in the built environment;
2. Reducing CO_2 emission in the industry;
3. Electricity from wind turbines at sea;
4. Converting biomass to electricity and fuel;
5. Converting coal or gas to electricity with underground CO_2 storage;
6. Converting biomass to electricity and fuel with underground CO_2 storage;
7. Electricity from nuclear plants.

As each option is set up to reduce 25 million tons CO_2, the respondents should select four of these options in order to (almost) achieve the goal of reducing 100 Mt CO_2.

During late December 2013 and early January 2014 the current ICQ was filled in completely by a sample of 1000 people, representative of the Dutch population.

4.1 Evaluation of the options

Respondents were asked to grade the options on a scale of 1 to 10 right after they had processed all information regarding the consequences of that option. Grades are on a scale of 1 to 10 in the Dutch school system, with 1 meaning the lowest possible score and 10 meaning the highest possible score. A "6"(i.e. 5.51) is considered a just acceptable score ("adequate"). This means in the Dutch grading system you did just good enough to pass but not any better. 5 or lower means you have failed the test. The option that received the highest grade (6.98 on average) is CO_2 reduction in the built environment. CO_2 reduction in the industry, wind energy, biomass energy and biomass in combination with CCS all received adequate grades as well, although the average grade for biomass with CCS (6.08) was significantly lower than the average grade for biomass without CCS (6.75). The other CCS option and the nuclear energy option were evaluated lower on average with a 4.55 and 4.80 respectively. Noteworthy is that people were much more divided over the nuclear energy option than over other options. 29.2% of people gave this option a very low grade, whereas 10.3% gave a very high grade.

4.2 Choice and rejection

After people had processed all the information on the consequences of the options and evaluated all the options, they had to choose four options (out of seven) to solve the policy problem. The two options for reducing emissions, in the built environment and in industry, together with wind energy and biomass were the most preferred options. Wind energy was the most popular as a first choice, but CO_2 reduction in the built environment and industry were the most frequently chosen options. A little over a quarter of the respondents chose the nuclear energy option, while only 12% chose the CCS option. Interestingly, 45% of the respondents also included biomass with CCS in their selection of options to pursue.
When asked whether people would actively oppose to one or more of the options, the nuclear energy option was most often mentioned. Almost a quarter of the respondents stated to oppose to the use of nuclear energy as a strategy to reduce CO_2 emissions. Interestingly, while CCS was chosen less often by respondents it also received lower rejection rates. The gas and coal powered electricity option with CCS was rejected by 10.7% of people, the option with biomass and CCS was rejected by 6.7%. It might be the case that people tend to have a stronger opinion about nuclear energy than about CCS, which leads to more pronounced opinions on being pro- or anti-nuclear energy. As CCS is less known to respondents before the ICQ, their opinion might be less developed than their opinion about nuclear energy.

The evaluation of certain options were related. People who were positive about energy efficiency in the built environment were mostly also positive about energy efficiency in industry, about wind energy and about energy from biomass. Likewise, people who are positive about the option electricity from gas and coal with CCS tend to be positive about the nuclear energy option. The option energy from biomass with CCS however was just a bit related to all other options. This option was evaluated significantly more positive than the other CCS option, but significantly less positive than the biomass option without CCS. It seems many people are able to see the benefits of this option, but for different reasons. Less than half of people choose this option as one of their preferred options though, so other options are still more preferred. The combination of energy from biomass with CCS was definitely the newest to people, with almost half of people stating they had never heard of it, and another quarter stating that they had heard of it, but do not know what it is. This is reflected in the relation between the evaluations of this technology before and after information, which isn't nearly as high as with technologies like nuclear energy or wind energy. People changed their opinion of energy from biomass combined with CCS significantly after information, mostly becoming more positive, but also becoming more negative.

Another factor anticipated to have an effect on people's opinion of the options is the kind of values people have. When measuring the guiding principles people state to have, four groups of values can be distinguished: Hedonic values, egoistic values, altruistic values and biospheric values. Although some influence was found of altruistic values and biospheric values on the opinion of options, this influence was very minor. People with more altruistic values and more biospheric values tended to be more positive about efficiency, wind energy and energy from biomass, and tended to choose these options more often. That means that people who value the welfare of other people more are more positive about these options, and people who value the environment and biosphere more are also more positive about these options. However, values were only a very small predictor of opinion when compared to evaluations of consequences. Evaluations of the options could for the most part be explained by these consequence evaluations, and values only added one or two percent. The effect of values on the choices for options was a bit stronger, though not much. This might indicate that values have more impact on behavior than on opinion, which is in line with previous research looking at actual behavior that shows much stronger effects of values than found in this study (de Groot and Steg, 2008).

4.3 Debunking misconceptions

This study explored the possibility of integrating both top down and bottom up knowledge in a decision aid; not only where people given information that experts deemed important, but factual information regarding the most common lay beliefs were given as well. Integrating beliefs that lay-people have about concepts relevant for the ICQ is difficult and there are several aspects to consider. Cook & Lewandowsky (2011) provided an overview of factors to take into account when it comes to misconceptions. In the current study, we define misconceptions as beliefs that are factually incorrect, more specifically beliefs that are not in line with the laws of nature. The first difficulty is that people are more familiar with the misconception than with the facts, making it more likely that people accept the misconception to be true. When communicating about a misconception, it is therefore essential to put most emphasis on the facts rather than on the misconception as this increases familiarity with the facts rather than the misconception. Second, it is important not to provide people with too much information. The content of the message should still be easily processed. When provided with a lot of information, people tend to disregard the information altogether and stick to the misconception instead. Third, when correcting misconceptions it is not sufficient to say that something is not true. The "information gap" should be filled with correct information. It is most effective when not only an alternative explanation is provided, but also an explicit warning is given that information is incorrect. Finally, when correcting misconceptions care should be taken that no norms are set. For example, stating that "a lot of people incorrectly belief that …" might lead to the inference that since a lot of people believe it, it must be true. In this study, these aspects were taken into account when designing the ICQ, in order to test several possible ways to debunk possible misconceptions. A third of the respondents had an introduction to the current ICQ that was comparable to the introduction of the 2007 ICQ (De Best-Waldhober et al, 2009). Another third had an introduction containing implicit debunking of misconception of CO_2 that were distilled from earlier research (Paukovic et al., 2011). In this version, factual information was given negating the misconception, without mentioning the misconception. The third group of respondents had an introduction containing explicit debunking. The same factual information was given, but it was added that some people do not know about that fact.

The effects of adding additional information in the introduction led to a higher percentage of correct knowledge directly after the ICQ. Especially when misconceptions were explicitly debunked, knowledge improved. However, correcting the misconceptions did not affect the multiple correlations between the evaluations of the consequences and the overall evaluation of the option. That means that even though the misconceptions were corrected, this did not change the way people formed their opinion of the options. Apparently, misconceptions regarding CO_2 do not affect the way the information about consequences is processed or taken into account when evaluating the option overall. These results also mean that misconceptions about CO_2 are not part of the unexplained part of opinion regarding the options. As the results from the value scales used in this study also did not explain more variance of the evaluation of options, the values measured – hedonistic, egoistic, altruistic and biospheric- do not seem to influence opinions of the options either. People's evaluation of the options are still explained for the most part by people's evaluation of the information on consequences of the options.

4.4 Climate change perceptions.

At several point in the questionnaire, people were asked about different aspects of climate change. Before information was given, respondents were asked to evaluate climate change. On average climate change was evaluated rather negatively, 4.02 on a ten point scale. After information regarding the consequences of climate change, it was still evaluated rather negatively, 3.90 on the same scale. The evaluations before and after information were related moderately high, with a correlation of .49. Simultaneously, the relation between evaluations of the consequences of climate change and the overall evaluation was quite low, meaning the evaluation of the consequences hardly predicts opinion of climate change. This means that most people's opinion of climate change is based on other arguments, before and after information is given on the consequences. Other perceptions of climate change, the perception of anthropogenic climate change, past global warming, future global warming, the need to decrease CO_2 emissions and the need to protect against the consequences of climate change hardly related to the overall evaluation of climate change either, ranging from -.14 to -.26. The analysis did show a rather strong consensus on most of these perceptions; a large majority is convinced that the climate on earth has become warmer on average, will become warmer, is a consequence of CO_2 emission by mankind and should be addressed by reducing CO_2 emissions and by protecting ourselves from the consequences.

As some research in other countries (Itaoka et al, 2006; Shackley et al, 2006; Tokushige et al., 2007) finds a relation between perceptions of CCS and awareness of the necessity to reduce CO_2 emissions, we also analysed the relation between all the climate change perceptions and the evaluations of the options. Very little relation was found however. There was a small relation between the evaluation of climate change after information and the evaluations of CCS and of nuclear energy, but not as expected. People who are more positive about climate change are also more positive about these options. In other words, the more negative people are about climate change, the more negative they are about these options. Similarly unexpected, the awareness of the necessity to reduce CO_2 emissions relates positively to the more sustainable options, efficiency, wind, and biomass, but not to CCS. It seems that people base their opinion of the options much more on their consequences than on their opinion of climate change. However, we should mention that the options did not differentiate on their contribution to CO_2 emission reduction, which might explain the low correlations, as all options contribute equally to avoiding climate change.

4.5 Future research

Altogether, the results from the current ICQ show that most people are not very enthusiastic, but that most people also do not reject CCS options either. This ICQ contained a different CCS option than earlier ICQ studies, the option of using biomass for electricity and fuel combined with CCS. People were more positive and more accepting of this option than they were of the other CCS option in this ICQ, using coal and gas fuelled power plants. This difference in evaluation of CCS depending on what other technology it is combined with, has been shown in earlier research as well, where people were more positive about carbon capture and storage itself, than they were about energy options combined with CCS (De Best-Waldhober et al, 2009). Options with CCS combined with electricity or hydrogen from gas were also evaluated much more positive than options with CCS combined with electricity or hydrogen from coal (De Best-Waldhober, Daamen and Faaij, 2006). It seems that because people are more positive about biomass, they are also more positive about biomass with CCS, though not as positive as the use of biomass without CCS. This disproves the theory that people will be more positive about the combination of biomass and CCS than they are about the separate technologies because the combination leads to negative emissions. It does however not disprove that people might be more willing to accept the disadvantages of CCS when combined with biomass due to the big advantage of negative emissions. In this respect, it would be interesting to find out how people evaluated the application of CCS to CO_2 intense industry. This option could not be included in the current study. As there is no other way to mitigate the CO_2 emissions of CO_2 intense industry other than CCS, future studies should include this option as well.

Another possible avenue of future research is a follow up on methods for debunking misconceptions. This seems to become more and more important in a society that is increasingly getting unreliable information from many channels. This study investigated just a few ways to debunk misconceptions, and in a very specific situation, the Information Choice Questionnaire. Given that there are currently few empirical studies on this topic, more research on this topic seems essential.

5 Conclusion

All together, the results of the current study point out several important finds. For one, this study again shows that it is possible for experts of different backgrounds and affiliations to agree on what is valid, accurate and balanced information regarding the consequences of CO_2 mitigation options. Moreover, after processing this information, people from the general public base their evaluation of an option for a substantial part on this information. These evaluations are influenced by people's values, but very little. They are also not based on misconceptions of CO_2. The methods used in this study to debunk misconceptions proved to be effective in improving knowledge, but did not improve how much of the basis for evaluation could be explained. No specific consequences of CCS stood out as a critical influence on the evaluation or acceptance of CCS, but together with results from earlier research on this topic, it can be concluded that there is an influence of the association with aspects of specific technologies, such as a negative influence of the combination with coal. The combination with biomass seems to be evaluated somewhat positively, though not as positively as the option of electricity and fuel from biomass without CCS, the option of electricity from wind turbines at sea, the option of CO_2 emission reduction in the built environment or the option of CO_2 emission reduction in the industry. These options were preferred by the vast majority of people and hardly anyone found these options unacceptable. CCS combined with coal and gasfired powerplants was evaluated as inadequate though, with only few people choosing this option and 10.7% of people finding this option unacceptable. The most controversial option was nuclear energy, which was chosen as one of the four preferred options by more than a quarter of people, but was also found unacceptable by just as many people.

6 References

References of expert information per option are in the Appendices.

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Appendix A. Questionnaire for experts to evaluate the expert information

1. Do you think this information is accurate?

0 YES

0 NO

If your answer was NO, can you underline the inaccurate and improve?

………………………………………………………………………………………

2. Do you think this information is complete?

0 YES

0 NO

Can you add or remove the information that you think is lacking or is unnecessary?

…………………………………………………………………………………………

3. Do you think this information is essential, that is, to what extend do you think a layperson needs this information to make a well-informed decision?

Not at all necessary 1 2 3 4 5 Essential

4. Is there anything else you would like to comment on concerning this information?

…………………………………………………………………………………………

These four questions were repeated for every part of the information given in each description. Finally, the experts were asked to evaluate the whole option by answering the following questions:

Do you think there are arguments missing from the description of this technology?

…………………………………………………………………………………………

Do you think there is information in this description that is unnecessary or redundant?

…………………………………………………………………………………………

Is there anything else you would like to comment on concerning this option?

…………………………………………………………………………………………….

Appendix B. Expert information

B.1. Option 1: Reduction of CO_2 emissions in the building sector.

Introduction
The goal of this option is to reduce 25 million tonnes of CO_2 in 2030 in the building sector (that is residential plus non-residential such as hospitals, offices, and schools).

Description of the option
CO_2 emissions in the building sector mainly derive from the combustion of natural gas for heating and cooking purposes and from the consumption of electricity which is (partly) originated from combustion of fossil fuels in power plants. In this option measures are included that *decrease the energy demand of the building sector* as well as technologies that *locally produce electricity and heat*.

Decreasing the energy demand of the building sector can be achieved by technical measures such as improving insulation, double/high efficiency glazing, more efficient appliances. Energy demand can also be decreased by behavioral changes, for instance by setting the thermostat one degree lower, switching off the light when leaving a room, turning down the heat at night time and washing at lower temperature. The technical potential reported in the literature for 2030 is large:

- 9 Mt CO_2 as a consequence of increasing buildings insulation to label B (e.g., by replacing ventilation system, window insulation and cavity wall insulation which will lower the heat demand by 40 to 50%). It this package it is also assumed that from 2020 new buildings will have a label A^{++} (passive households), which is in agreement with current EU targets.
- 5.5 Mt CO_2 can be saved by increasing insulation in the non-residential sector (schools, hospitals, banks, etc)
- 9 Mt CO_2 from the use of more efficient appliances and changes in behaviour. It is assumed that from 2020 onwards all appliances will have at least an A^{++} label.

Local production of heat and electricity can be done by installing solar water heaters, solar panels to produce electricity, micro and mini cogeneration units, and heat pumps. *Solar water heaters and solar panel electricity* (also known as solar photovoltaic (PV)), use the sun's energy to heat water or to produce electricity respectively. Solar systems work only when the sun is shining and therefore they almost always require a backup system for cloudy days and times of increased demand. *Micro and mini CHPs* are units which generate both heat and electricity. Most buildings in the Netherlands have a natural gas fired boiler or use district heating. Technically it is possible to install CHPs in any building that is connected to the gas and electricity infrastructure. *Heat pumps* provide space heating and cooling, and hot water in buildings. They use energy from their surroundings (ambient air, water or ground) and electricity or gas, to raise the temperature for heating or to lower it for cooling. The technical CO_2 saving potentials reported for 2030 are:

- 0.7 to 2.1 Mt CO_2 per year due to deployment of micro and mini CHPs. The range is caused by assumptions on market penetration (between 2 and 3.8 million units deployed by 2030). It is assumed that the CHPs replace electricity produced by centralized natural gas fired power plants
- 1.6 to 3.4 Mt CO_2 if heat pumps with cold and heat storage are deployed. The range is also due to assumptions on market penetration (between 2 and 4 million units deployed by 2030). It is assumed that the heat pumps replace heat produced by

natural gas fired boiler and use electricity generated by centralized natural gas fired power plants.

- 1.5 Mt CO_2 is reported as the potential contribution of PV (assuming it replaces electricity generated by centralized natural gas fired power plants). In this case PV account for 3% of the electricity demand in 2030. To reach this amount about 15.000 roofs will need to install PV panels each year from now until 2030.
- Mt CO_2 savings from solar water heaters, assuming that by 2030 20% of the buildings will be equipped with solar water heaters. This corresponds to a collector surface of about 10 km^2.

Required technology development

All technologies and measures in this package are already available in the market. There is however room for improvement in both efficiency and costs. For instance, it is expected that PV cells will improve their efficiency by a factor two to three and that they are integrated into the roof or facades of the buildings; CHPs can work with new technologies such as fuel cells which will increase their efficiency. Since in this package, PV technologies are deployed in large scale, cost-efficiency energy storage will need to be developed. Furthermore, the installation of solar systems at large scale requires a large mate of standardization in construction and installation techniques. This will require concrete commitments within Europe and in thermal technology that would make such standardization possible.

Environmental impacts of the technology

Implementation of measures that reduce the energy demand of a dwelling or that avoid the use of fossil fuels for the generation of heat and or electricity (solar based systems) will reduce air pollution (particulate matter, NOx, volatile organic compounds, etc.) and CO_2 emissions. In many cases, the measures can also reduce noise, increase water savings and minimize waste. Many energy efficient appliances, devices and technologies also have a longer life span than inefficient equivalents. However, potential trade-offs between positive and negative impacts is not easy to estimate since they are technology dependent. For example, compact fluorescent lightening (CFL) is more efficiency than traditional globes and has on average a life span of some 5.000 hours, compared to about 1.000 for traditional globes. It, however, contains mercury, which complicates their disposal and if not done properly cause environmental damage.

Contrary to solar based systems, *heat pumps and mini and micro CHPs* run on fossil fuels but are more efficient than current heating systems so overall they decrease the amount of emissions, although the location where the emission are generated can change. In the case of an electric heat pump, less natural gas will be consumed at the household level but more electricity will be bought from the grid. In the case of a micro CHP more natural gas will be needed to heat the house but less electricity is bought from the net.

The production of construction and insulation material that are used to renovate houses requires energy. Studies indicate that the amount of energy is relatively small compared to the savings that are achieved if a house is insulated to level B. Studies also indicate that production processes of construction and insulation material will improve in energy efficiency in the coming years. Also other materials with better environmental performance will become available, e.g. wood. There are, however, some concerns that a large switch towards wood would demand that larger land areas are dedicated to wood plantations and thus may impact biodiversity.

Other impacts

PV cells, solar heathers and low energy light bulbs are made from a variety of natural resources, including some rare earth metals. There are concerns that large worldwide increase in demand for green technologies could lead within a few years to the point where it might exceed its supply. The expected supply shortages may then lead to a significant increase in rare earth prices. Some argue that low prices in the past has led to a significant waste of resources (until now, there has been almost no recycling of rare earths) and, therefore, an increase on prices will induce recycling. Others indicate that while this happens, resources will keep being exploited and that a reliance on these products will increase dependency in foreign resources, such as China which has about 40% of the worldwide reserves.

Energy security and energy reliability

Improvements in *energy performance of buildings, energy efficiency and changes in consumer behavior* can enhance energy reliability by reducing system loads and stresses (for instance, by reducing consumer peak demand) and therefore decreasing the likelihood of blackouts and power shortages. It will also reduce the need for investments in energy infrastructure (plants and power lines). However, the reliability of a decentralized system, based on micro and mini CHPs, heat pumps, PV, solar heaters, etc., will strongly depend on the reliability of the specific technologies and the existence of buffer capacity. The intermittent character of sun based energy can lead to problems since, for instance, six times more electricity can be produced in the summer than in winter (so there is excess electricity in the summer and shortage of electricity in the winter). The increasing complexity of a decentralized system could reduce the reliability of the energy supply (increase possibility of blackouts and power shortages). However, the failure on few small units will have lower consequences than failure in large power plants.

Studies for the Netherlands have also indicated that if the amount of PV is higher than 2 GWp (such as in this package), problems can arise in the power grid and therefore changes in the way the electricity network is managed will be needed.

The use of efficient production of heat and electricity technologies and of renewables can reduce the dependency of fossil fuel imports. To which extend will depend on the mix of measures used. *Sun based system* (such as solar heaters and PVs) do not require any fossil fuel while deploying of *micro and mini CHPs,* for instance, will result in an increase demand on gas (and a decrease in demand for coal and/or natural gas from large power plants).

Direct impact on living conditions other than environmental impacts

Improving the energy performance of buildings, especially old ones, will require strong renovation efforts. In most cases, insulation of floors, walls, roofs and windows have to be performed. During the renovation period nuisance from the construction work will occur for the household and direct neighbors. Furthermore, construction work will also be needed on the top of a large number of roofs for the large scale deployment of PV and solar heaters.

A well-insulated home will provide year-round comfort. Insulation also helps to reduce noise levels and condensation. It will therefore have less mould and be a less appealing environment for allergy-aggravating dust mites

Micro economic impacts

The cost of transforming the building sector will be substantial. The cost to *increase the energy performance* of a private household to label B was estimated in 2010 in the range of 1250€ (for a row house built after 1995) to 17500€ (for a single house build between 1960-

1970). For a large amount of households the amount will be in the lower range but particularly for old(er) detached houses (vrijstaande woningen) the investment needed will be significantly high. The cost effectiveness will depend on characteristics of the households such as type, size, degree of insulation, year of construction, the price of natural gas and the level of investment. For the non-residential sector, it is estimated that for 50% of the buildings it is profitable to invest and change to label B.

Additional investments are also required for the alternative heat and electricity installations. For comparison purposes, a HR boiler costs about 2000€ while a *micro-CHP* cost about 10700€ and a *water-to-water heat pump* cost between 18000€ per household (collective system for 5 households) to 31000€ (one household). In the case of *PV*, the current electricity cost for average rooftop systems in the Netherlands is in the rage 0.15 to 0.23 €/kWh, which is about the same price or lower than the current electricity produced in large power plants (0.23 €/kWh). The range is due to differences in energy yields and interest rates. *Sun heaters* cost 400 to 1250€ per m^2 collector. The low number is for large scale heater such as those needed by a swimming pool. Pay back periods of 8 to 20 years are found in the literature.

Usually, more efficient appliances will cost more to purchase upfront (what makes an appliance more efficient is additional materials, parts, or research and development all of which costs money), but the extra cost will be made up within a few years through lower operating costs. Analyses for the European Union show that an average EU household could save between 200€ and 1000€ per year in a cost-effective manner, depending on its energy consumption.

Policy requirements (to implement the option)

This package requires strong governmental intervention. In this package, measures such as energy saving standards with regard to roofs, facades or installation will be imposed by the government. This means that in some cases households will be forced to take measures that are unprofitable. Furthermore, additional policy measures may also be needed. These will be a mixed of regulatory (e.g., building codes, labeling and certification programs, energy efficiency obligations); economic (e.g., white certificates, energy savings performance contracting); Fiscal (e.g., taxes on CO_2 or fuels; tax exemptions, subsidies) and information (e.g., education and information programs). Furthermore, since cheaper or falling energy prices do not encourage either careful consumption or investments in energy efficient technologies, an increase of energy efficiency will most likely be accompanied by an increase in energy prices. The effect of higher energy prices, either through taxes or producer-induced shortages, initially reduces demand but in the longer term it will encourage energy efficiency improvements.

Other

The rate at which measures need to be implemented will put stress in the construction sector. To reach this demand, new jobs will be created. However, if the stress is too large, it could become a bottleneck, resulting in a decrease in the amount of households that can be renovated per year, long(er) waiting lists and an increase in the prices of renovation.

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B.2. Option 2: Decreasing CO_2 emissions in the industrial sector

Introduction

This option aims to reduce 25 million tonnes of CO_2 emissions in 2030 in the Dutch industrial sector. According to the Dutch Central Bureau of Statistics, in 2010 the Dutch industry emitted about 43 Million tonnes CO_2, corresponding to about one-quarter of the total CO_2 emissions in the Netherlands. The industrial sector is the largest energy consumer in the Netherlands with three quarters of the energy demand been used by four sectors: chemicals, petroleum products by refining, food and iron and steel. Given the large number of processes involved, in this option the potential saving measures and their consequences will be discussed at a general level.

Description of the option

Reducing 25Mt of CO_2 will require a portfolio of measures including energy management; retrofitting existing industries with energy efficient measures that have lower energy demand; switching to low carbon energy sources and increasing the share of cogeneration units which generate heat and electricity in-situ; introducing breakthrough technologies, which are new ways of producing a given product; altering product design to reduce the amount of material use in a product, and via improvements in the material chain (e.g., by implementing material cascading, material substitution, including the use of biomass-derived materials and recycling). In this package, improvements in energy efficiency in power generation plants are not taken into account.

Required technology development (towards 2030)

Between 1993 and 2008, the Dutch industry has annually increased (on average) its energy efficiency between 0.7% and 1.4%, depending on the sector. Energy efficiency is defined as any process improvement which reduces the energy input needed to produce the same amount of product or service. Studies indicate that if current best practice technologies (that is, the best technologies that are currently available in the market) were to be installed in all processes of the Dutch industry, 37% of the energy used could be saved in average and that, if in addition emerging (more efficient) processes or technologies were implemented, savings of about 70% could be obtained. Other studies indicate however lower potentials, in the order of 25 to 50%.

Technically, the potential to decrease CO_2 emissions is large and includes a combination of cross-cutting technologies (such as efficient steam and process heating systems); inter-industry opportunities (such as reusing waste heat or by-products from other industries) and process-specific technologies (including process redesign). For instance, a study aiming to roadmap energy efficiency improvements of 50% in 2030 for the Dutch chemical industry has identified the contribution of the following measures: increasing energy efficiency of the processes, including recycling of by-products (7.7 Million tonnes CO_2 saved); replacing 25% of the fossil based raw materials by biomass (9.3 Million tonnes); buying or producing renewable energy (3.8 million tonnes CO_2); deployment of carbon capture and storage (2 Million tonnes). It also estimates that about 5.8 million tonnes CO_2 can be saved by developing products (e.g. appliances) that require less energy when used (5.8 Million tonnes). Note that in this case CO_2 emissions are not reduced in the industrial sector itself but in the sectors where the products are used (e.g., households). Large technical potentials have also been reported for other industrial sectors, for instance, for the glass industry (20-40%); Paper and pulp (50% in 2020); refineries (20% in 2020) and iron and steel (40 to 60%).

Reaching such targets requires that a large number of barriers are overcome. These barriers can take the form of imperfect information (knowledge about the availability, costs and savings potentials of a given technology); hidden costs (costs that are generally no quantified by firms and difficult to observe by outsiders, e.g., hiring of staff); access to capital (e.g., availability to finance or place in the investment priorities in an industry core business); risk and uncertainty (e.g., future energy prices; impact on product quality); split incentives and bounded rationality (many firms do not show an optimizing behaviour. E.g., rational cost decisions may be overruled by other factors such as the upfront cost as compared to alternatives).

Environmental impacts of the option
Although it is difficult to make a specific assessment of the environmental benefits of efficiency measures, in general most energy efficiency improvements mitigate environmental impacts. For example, reducing air pollution (particulate matter, NOx, volatile organic compounds, etc.) and CO_2 emissions by avoiding burning of fossil fuels. In many cases, the deployment of more (energy) efficient processes or technologies can also result on noise reduction, increasing water savings and minimizing waste. Furthermore, by increasing the use of energy efficient products, decreasing the amount of products manufactured and the amount of raw material used, environmental benefits are obtained in reduced extraction and processing of natural resources required for manufacture, transport and distribution. Note however that the potential environmental impacts of breakthrough technologies, increase use of cogeneration, industrial CCS etc., are not yet clear.

Energy security and reliability
Improvements in energy efficiency can enhance the reliability of energy supplies by reducing system loads and stresses (for instance, by reducing consumer peak demand). It can also reduce the need for investments in energy infrastructure (plants and power lines).Furthermore, large deployment of technologies or processes that demand less energy input can lead to a reduced dependency from fossil fuels from politically instable regions therefore improving energy security in the country.

Macro and micro economic impact (in 2030)
This package requires that existing processes will be replaced by new (more efficient) ones, which could occur before the life span of current stock expires. Changes in the production process, particularly those changes that significantly affect the way a process is carried out (e.g. breakthrough technologies) are costly. Additional investments could reach ten millions to hundred millions euros. An important challenge is to create a financial environment where it is attractive to invest in complete process changes.

Since breakthrough technologies tend to be more expensive than current designs, the implementation of breakthrough technologies will initially increase production costs. These costs, or part of them, can be transferred to the consumer resulting in increasing product prices. Studies examining the potential impact of EU-wide CO_2 mitigation measures in the industrial sector indicate that for some sectors, such as refineries, a substantial share (about 75%) of the additional costs are expected to pass through to the consumers, while for other industries, which are highly exposed to foreign competition such as iron and steel and cement, only a small share (as low as 6%) could be passed due to severe competition with non-EU countries with lower emission targets. If the additional costs cannot be transferred to the consumer without a loss on market share, there is the risk that such companies would decide to reallocate themselves in countries where climate targets are less stringent. However, if the CO_2 targets are implemented worldwide, the risks of reallocation would diminish significantly.

Employment

Evidence on the impact of industrial energy efficiency on employment generation is still limited. The green paper on Energy Efficiency of the European Commission, estimated that energy savings measures (taking into account all sectors of the economy) could create 1 million new jobs in the EU by 2020. Due to the labor-intensive and localized nature of the work, the bulk of these jobs will be created in local installation and manufacturing, but will also benefit the European transport, energy, and service sectors.

Furthermore, there are some concerns that loss in employment levels could result from carbon leakage that is, the relocation of activities, particularly heavy industry, in countries where climate change mitigation policies are less costly for companies. Currently there is no agreement on the studies found in the literature regarding the potential effect of carbon leakage on employment resulting from strategies to reduce greenhouse gases. Some studies find positive impacts under the assumption that climate policies imply a shift of jobs from energy intensive activities to low carbon activities. Other studies report small shares of jobs deemed at risk.

Other

In the past the Netherlands was a front-runner, both in know-how and implementation, in the field of energy efficiency. In the last years this role has been reduced. Stringent CO_2 emission targets and the resulting implementation of (new) technologies can become a driver to increase the innovation position of the industry, e.g., new technology will be developed and tested, which can then be offered to the international market.

Policy requirements (to implement the option)

CO_2 reduction targets aimed in this package may require a large portfolio of policy measures and instrument that addresses both technological and non-technological aspects. Such portfolio can combine regulatory (administrative based), economic (incentives based) and informative based approaches which can be both, obligating and voluntary. Regulatory measures can take the form of for instance, standards, energy savings targets for individual companies and commitments regarding technology implementation or phase out. Economic measures could be in the form of tax rebates for energy efficiency investments, subsidies or tradable permits. Informative based approaches include energy labeling, awareness campaigns, courses and training programs.

Furthermore, to be able to increase material efficiency, regulatory policy that will assign to industries the responsibility for the waste produce after factory-gate (i.e., used products will go back to the industry for recycling) is needed. Consequently, legislation will also be in place that forces the consumer to recycle.

To decrease impact on the competitiveness and position of the EU and Dutch industrial sector due to the emission targets, would require that alternative policies such as border adjustment mechanisms (e.g. a fee in the carbon content of products imported from countries that do not restrict CO_2 emissions) and global sectoral agreements will need to be implemented.

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B.3. Option 3: Electricity Produced By Offshore Wind Turbines.

Introduction

The goal of this option is to reduce the emissions of CO_2 in 2030 by 25 million tons per year by installing *offshore* wind turbines with a total generation capacity of 11,000 MWe. Typical size of the wind farms will be up to 1,000 MW or more by the year 2030 (Ecofys, 2010a). These wind farms will be built on locations further from the coast than the current farms. Assuming an expected average capacity for offshore wind farms of 750 MW operational by 2030, about 15 wind farms need to be installed in the North Sea. This will generate annually about 44 TWh[4], which is about 30% of the total estimated electricity production in the year 2030.[5]

Description of the option

Wind power is renewable, which means that we will not run out of this energy source. Wind turbines are typically grouped together in so-called wind farms at locations where preferably steady and strong winds blow.

Currently, most of the Dutch wind farms are located on land (NWEA, 2012). However, in a relative small country like the Netherlands, land is scarce and densely populated and therefore a limited number of suitable locations with steady, strong winds are available. Therefore, wind at sea is explored. Offshore wind is a relatively new development. Offshore wind farms typically are larger than onshore wind farms, both in number and size of the turbines. Current offshore wind farms have an installed capacity of about 100 to 300 MW. In the UK offshore wind farms are planned up to 1000 MW or more (Renewable UK, 2012). Wind turbines at sea are more efficient, but also more difficult to install and to access for maintenance than turbines on land.

Globally, the market of wind energy is growing fast. The global installed capacity for onshore and offshore wind grew from 17.4 GW in 2000 to 239 GW in 2012. On average, this represents a growth of 25% per year (WWEA, 2012; REN21, 2011). For offshore, Europe is currently market leader with a total installed capacity of 3.8 GW (EWEA 2012).

In the Netherlands, two offshore wind farms have been built in the North Sea. The first Dutch offshore wind farm OWEZ (Offshore Wind farm Egmond aan Zee) was constructed in 2006 at between 9 and 16 km of the coast at Egmond aan Zee. This “near shore” wind farm has an installed capacity of 108 MW, comprising 36 turbines with a capacity of 3 MW. An equivalent of over one hundred thousand households is supplied with electricity from this wind farm. The second offshore wind farm, the Prinses Amalia windpark, is constructed some 23 kilometres off the coast of IJmuiden. This 120 MW wind farm has been operational since summer 2007. The two farms generates in total about 830 GWh per year, equivalent to 0.7% of the Dutch power production.

For the upcoming years there are three offshore wind projects under development. Two of the projects – with a total capacity of 600 MW – are owned by Typhoon Offshore and HVC[6]. The third project, which has a total planned capacity of 129 MW, is owned by Eneco. Expected investment costs for the third farm are about € 400 - € 450 million (Eneco, 2012). Subsidies have been allocated for all three wind farms and they are expected to start

[4] Based on 4000 full load hours per year as of 2012 (Ecofys, 2010)
[5] In 2030 the gross electricity generation in the Netherlands is estimated at 150 TWh (PRIMES, 2010)
[6] HVC is a local utility in the Netherlands

producing electricity in 2014/2015. These three wind farms will generate approximately 2800 GWh annually, equivalent to about 2.5% of the Dutch power production.

Required technology development (towards 2030)
The average size of offshore installed wind turbines will increase in the future. Current commercially available turbines have a capacity of 3 – 5 MW (Renewable UK, 2012). Prototypes for the next generation with a capacity of 6 – 8 MW are being developed. These machines will become commercially available in the coming 5 years. It is expected that 10 MW wind turbines will be available for commercial deployment in 2030 (Ecofys, 2010a).

Offshore wind technology is developing rapidly but it is still facing challenges in order to bring down the costs and being able to adapt to offshore conditions. Research and development efforts are mainly related to the re-design of wind turbines - e.g. developing dedicated offshore wind turbines, new materials, smart electronics and foundation and tower improvements. Research and development by learning by doing is needed on installation technologies, operation and maintenance strategies, and optimisation of the electrical infrastructure. Wind farms will continue to be built into deeper waters and further offshore. This brings additional challenges to the market and a continuous need for R&D and testing of new or improved wind turbines. This should contribute to improving reliability and availability of the turbines. Other trends are the progress in mass production, increasing the turbine size and standardization of wind turbines.

Environmental impacts of the technology (in 2030)
The environmental impact of wind turbines and wind farms can be described on different levels. Here we focus on life-cycle emissions and impacts on the local environment.
In general, renewable energy options have lower life-cycle CO_2 emissions than fossil energy equivalents (IEA, 2011). When compared to coal and natural gas, life-cycle emissions[7] of wind are lower with respectively 95% and 90% (IEA, 2011). In addition, direct emissions such as NOx, SO_2 and particulates are avoided by using wind instead of fossil-fuel power. Impacts on birds, sea mammals and visual effects are the most important concerns with regards to environmental effects of offshore wind. However, effects on birds, fish, mammals and other sea life seem limited (both positive and negative) and need further study.

Bird impacts
Possible bird impacts are very site specific and involve collision with wind turbines, influence on habitat and interruption of migration routes. There are no recent figures on bird mortality caused by wind farms, but in 2005 1,700 Dutch wind turbines caused 50,000 bird deaths per year (ANP, 2005). For comparison, over one million birds were killed in Denmark in traffic in 1995 (IKLIM, 2012). Most of the bird mortality studies are based on onshore wind turbines. For offshore wind turbines there are no such results, although a model to measure bird mortality caused by offshore parks is currently under development (Ecofys, 2012a, personal communication). Naturally, birds will try to avoid wind farms when they come near it, meaning that some birds will have to change their habitat when a wind park is build (Ecofys, 2012a, personal communication).

Wind turbines could disturb the habitat of birds offshore, as birds will choose other areas to feed and live. On the other hand, some species, like the Cormorant, actually lives inside wind parks (Ecofys, 2012a, personal communication). The effects of wind turbines on the habitat of birds are site and species specific. Near the OWEZ (Offshore Wind park Egmond aan Zee)

[7] Life-cycle emissions are expressed in t CO_2 equivalent / MWh (IEA, 2011)

envelopments of birds have been observed of 3-4 kilometres (Ecofys, 2012a, personal communication). Initial research results on impacts of birds from OWEZ do not suggest large effects on many of the bird species studied (Imares, 2010). Long barricades of wind turbines might prolong flying distance both during feeding and migration. Therefore, long uninterrupted wind farms should be avoided.[8] Additional research to the cumulative effects of multiple wind farms and the indirect effect of birds living in Natura 2000 areas is needed.

Fishery and sea mammals. Placing wind turbines in the North Sea reduces the area that is currently available for fishing, since fishing vessels are not allowed to be close to the wind farm. To build 15 wind parks of 750 MW each, a total area of over 1,500 km^2 is needed.[9] It is hard to quantify the effects on the fishing grounds as the size of the fishing area is not known. Besides, in the UK some forms of fishing inside wind parks is sometimes allowed (Ecofys, 2012b, personal communication). Foundations of wind turbines are covered with big stones and current studies show that these structures serve as artificial reefs. These artificial reefs provide the fish with an abundant supply of food and shelter from currents and fishers (DTU 2011).

There is also a lot of discussion on the electromagnetic interference with fish from the submarine cables (Gill & Taylor, 2011), but consequences for marine ecology are not demonstrated at the moment.

Flickering and noise. Other environmental effects are flickering and noise. Rotating wind turbine blades cast moving shadows, which cause a flickering that can affect residents living nearby (EWEA, 2003). This argument might be of less importance for human beings as these wind turbines are far enough from the coast. The effect of flickering on mammals, fish and birds is not known at the moment but seems ignorable.

Noise from wind turbines comes from rotating blades, the gearbox, the generator and hydraulic systems. In modern wind turbines this noise is reduced considerably. Noise during installation of offshore wind turbines may cause a serious impact as hammering may kill or scare away fish and sea mammals. Another unknown factor is the underwater noise propagation; this noise radiates from the underwater structures. The effects of this noise on sea life are not known yet.

Other impacts

Energy produced within the Netherlands makes it less dependent on energy import from abroad.

Changes to the infrastructure (towards 2030)

Wind energy is a variable energy source, which means that the amount of electricity produced varies with the wind speed. In a period with lack of wind, an alternative source of energy is required, whereas during maximum wind production, transport capacity to other regions (or countries) may be a limiting factor. Supply can be secured by applying other forms of renewables, applying fossil fuel or biomass based power plants, improving European grid connections to optimize power exchange, increasing back-up capacity or applying temporal storage, e.g., water reservoirs, compressed air, hydrogen or batteries and

[8] it should be noted that the future generation wind turbines (~8MW) with a rotor diameter of >160m will be built with an inter array distance of over 1 km

[9] For this calculation the rule of thumb of 6 MW per km^2 is used (Ecofys, 2012b, personal communication)

load management. The current electricity grid is able to cope with an extra capacity of a few thousand MWs of offshore wind capacity, but cannot yet fully cope with the proposed expansion of 11 GWe. The integration of higher capacities requires construction of extra and reinforced grids to assure the stability and sufficient transport capacity of the grid. Improved European interconnection will be required to better match the European power demand and supply and balance the extra wind supply from the North Sea especially because similar or bigger plans exist for the neighbouring countries.

Long-term perspective

The large areas of shallow water (less then 20 to 40 m water depth) suitable for the construction of wind turbines and the large wind resources make the Dutch part of the North Sea, with a surface area of about 57,000 km^2, a suitable area for wind energy capacity (Kooijman et al., 2003). A capacity of 11 GW_e offshore wind will require a surface area of somewhat more than 1,500 km^2, which is less than 2% of the surface area of the Netherlands Continental Shelve. Figure B.1 shows a situation of what 11 GW_e of offshore wind capacity in the North Sea could look like. Theoretically, the full North Sea area is available, but other competitive claims, like important shipping routes and military training zones have to be taken into account as well. Other spatial claims in the North Sea consists of platforms, oil- and gas pipes, telecom cables, sand extraction areas, sludge dumping areas and ecological areas (Friese Front, de Klaverbank and Doggersbank). Generally, competition is more eminent near the coast. However, wind power costs increase for farms farther away from the shore.

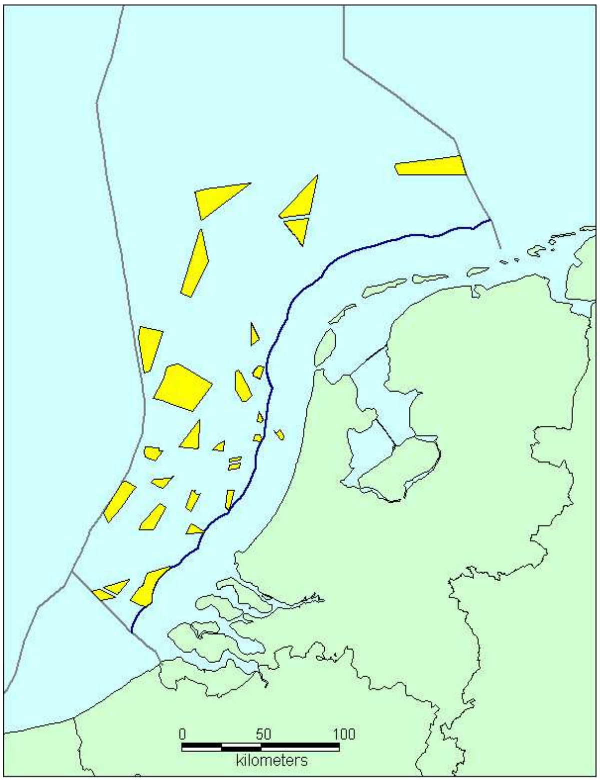

Figure B.1. Overview of potential offshore wind locations providing 11 GW capacity

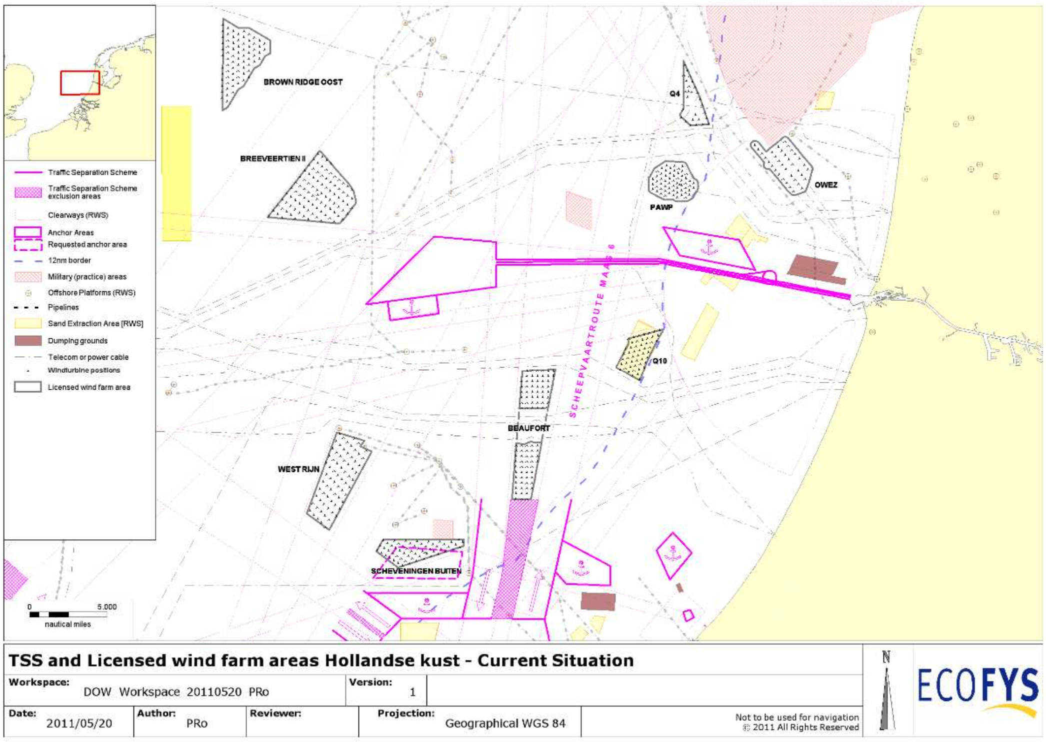

Figure B.2. Planning Map of the North Sea – detail for the coast of IJmuiden.

Figure B.2 illustrates that current activities already claim a large part of the sea. This includes shipping, extraction of oil and gas, fishing, and sand mining, but also the presence of cables, pipelines and nature reserve. Therefore, to install 11 GWe offshore, clear priorities need to be set for the use of the North Sea. It is expected that shipping has the highest priority, followed by platforms for oil and gas, nature reserves and cables and pipelines. Areas for other activities are considered negotiable (Ecofys, 2012b, personal communication). However, by careful siting wind energy should be able to complement other functions. Already a rearrangement of shipping lanes has been agreed to accommodate wind farms and increase shipping safety.

To facilitate offshore wind optimally, EU coordination becomes increasingly important. Currently, such efforts are being done through marine spatial planning (MSP). This approach may provide an appropriate framework for promoting cross-border cooperation. MSP could thus create an enabling environment for the deployment of offshore renewables beyond 2020 (EWEA, 2012).

Macro and micro economic impact (in 2030)

Investment costs.

The investment costs for offshore wind farms are currently 3,000-4,000 €/kW.[10] Electricity production costs for current farms range from 15 to 20 €ct/kWh (estimates from Eneco and Typhoon, 2012). Compared to current production costs of 4.5-6.0 €ct/kWh[11] for fossil fuel-based electricity, electricity from wind tends to be about three times as expensive. It is expected that offshore wind energy becomes competitive to conventional power in the period

[10] Combination of data from Emerging Energy Research, Risø DTU (the Economics of Wind Energy, Part III), 4C offshore, Ecofys

[11] 6.0 – 7.5 €/kWh including 25 euro/tCO2 carbon price

2020 to 2025 if large capacities of wind power are installed, conventional power costs increase and environmental effects of fossil fuels are included in the price (see below).

For the last five years prices have gone up due to a limited competitive market, negative experiences in the first generation of offshore wind farms and due to the fact that wind farms are built further offshore and in deeper waters. This complicates the foundation, installation and maintenance and increases costs for connection lines. However, widespread application of wind power, such as the 11 GWe of this option and even bigger plans in neighbouring countries, reduces the costs. Investment costs are expected to decrease to 1,500 - 2,000 €/kW in 2030.

External costs. The costs of electricity from wind cannot easily be compared to the cost of electricity from conventional sources when external costs are not dealt with. External costs are the costs to human health and environment that are not accounted for in the price of electricity. Compared to fossil-fuel power production, wind energy emits less CO_2, SO_2, NO_x and dust particles. The external costs depend e.g. also on production and installing processes. The external costs of wind energy vary between 0 and 0.25 €ct/kWh. For comparison, the estimated external costs of conventional power plants varies between a few cents to over 10 €ct/kWh (IISD, 2011), depending on the region and methodology of calculation.

Creation of jobs

Jobs created in construction and installation of the offshore wind parks depends on the rate of installation of new wind turbine farms and gradually also by replacing wind turbines. Jobs in operation and maintenance will exist for the time wind farms are operating.

Wind energy companies in the EU currently employ around 110,000 people (Risø´ DTU, 2011). The EWEA scenario indicates an installed offshore capacity of 150 GWe in 2030. According to EWEA this will result in a creation of approximately 300,000 jobs by the year 2030 in Europe. The jobs are created in sectors like project design and development, component supply, assembly, installation and operation and maintenance (EWEA, Pure Power 2011). For the installation of 11 GWe of offshore wind capacity in the Netherlands, this would imply about 18,000 new jobs. By far the largest share of these jobs (95%) is created for production, planning and installing the turbines. The other 5% is for operation and maintenance (Ecofys, 2010b). This share will increase as more wind farms will be realised. Depending on the contracting, these jobs will be created in the Netherlands or elsewhere. Offshore wind development will especially result in additional jobs for the offshore/marine industry in the Netherlands.

Policy requirements and long-term perspective

Offshore wind installation can offer potentially to the Netherlands a large industry and export market, as it has already a strong maritime industry. Strong and consistent policies are required for the start-up phase of this relatively new technology. Stable policies will also reduce the costs: currently financing takes op more than 35% of kWh costs, because of high risk premiums.

Bottlenecks in the integration of larger volumes of wind energy need to be removed and an improved structure plan for power grids has to be developed. On the longer-term, wind energy will be an important source of energy for Europe and contribute to a balanced portfolio of various renewable energy sources.

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B.4. Option 4: Biomass for electricity, liquid transport fuel and green gas

Introduction

The goal of this option is to reduce 25 million tonnes of CO_2 in 2030. This can be done by installing 3300 MWe of biomass-fired power plants capacity and supplying 70 PJ of liquid biofuel and 100 PJ of biomethane (also called green gas) for transportation purpose or to feed into the natural gas grid. The required amount of biomass is 200 PJ for the power production and 350 PJ for liquid fuels and green gas production.

Description of the option

Biomass is organic material such as wood, grass, organic waste, crops and straw. It can be used as fuel for the production of electricity or heat and as a resource to produce ethanol or diesel to replace gasoline and diesel produced from fossil oil. Biomass can also be converted into a gas and then processed to produce biomethane (green gas) to replace conventional natural gas. When biomass is used CO_2 is emitted. It does however – in principle - not add to the atmospheric concentration of CO_2 as an equivalent amount of CO_2 was taken up earlier while the biomass was cultivated. We estimate that in 2010 the use of biomass reduced the CO_2 emissions in the Netherlands by 2.3%.

There is a large variety in the size of biomass fuelled power plants, but they are typically smaller than fossil-fuelled plants. In the Netherlands, the size ranges from small wood combustion facilities of a few MW to several larger power plants of 25 MWe. Outside the Netherlands, considerable larger units of up to several hundreds of MWs are operational. A large plant of 50 MWe[12] is being constructed at the moment in the Delfzijl region.
In 2011, 2.9 PJ of electricity was produced in fully dedicated biomass plants in the Netherlands with a co-production of 2.5 PJ heat. Biomass can also be co-fired in coal power plants, i.e. biomass and coal in combusted in the same installation. In 2010, the total power production from biomass in co-firing installations in the Netherlands amounted to 10.9 PJ. In 2010, 5.4% of the power and 2% of the transport fuel was produced from biomass. Less than 0.1% of the natural gas use in the Netherlands was green gas. In the recent 'green deal' a

[12] Eneco is currently building a new dedicated biomass plant of 49 MWe, the largest in the Netherlands so far. It is aimed to start production mid 2013.

broad coalition of authorities, companies and knowledge institutes agreed to strive to produce around 100 PJ of green gas in 2030, avoiding about 7 million tonnes of CO_2.

Most of the biomass supply will be residues and waste streams like forest residues, agricultural residues or wastes.[13] Only a minor share will come from energy crops. The biomass will predominantly be produced in regions such as Latin America (e.g. Brazil, Argentina and Colombia), SubSaharan Africa (e.g. Mozambique, Tanzania and Zambia), Southeast Asia (e.g. Indonesia, Malaysia) and Eastern Europe (e.g. Ukraine, Rumania and Russia). Production in these regions will be considerable cheaper than production in the Netherlands.

The electricity will be generated in modern (biomass/coal) co-fired power plants or in small dedicated biomass power plants. The locations of the production facilities will most likely be in the vicinity of seaports like Rotterdam, Eemshaven and Terneuzen.

The liquid biofuels and green gas are produced in either the country where the biomass is cultivated or in the Netherlands. The anticipated fuel production in this option equals about one fifth of the current demand for road transport fuels in the Netherlands and about 6% of the current natural gas consumption.[14]

The production of liquid biofuels will take place either using current available production technology like fermentation for ethanol production or esterification for biodiesel production or more advanced technologies like gasification or fermentation of woody biomass. The later technologies will open the way of using a higher diversity of feedstock for the production of biofuels (e.g. lignocellulosic material). Technological developments in the field of advanced biofuels are ongoing.

Green gas is either produced by anaerobic digestion of biomass with high moisture content or through gasification of dry biomass. In the case of digestion the produced gas needs to be upgraded before it can be fed into the natural gas system. The anaerobic digestion of mainly wet biomass, including animal manure, is a commercial technology and applied in the Netherlands and neighbouring countries (Germany and UK). Synthetic gas production solely based on biomass feedstock is not yet at commercial scale, but is being demonstrated in the Netherlands on the short term.

Required technology development (towards 2030)

To increase efficiency and reduce costs in the transportation of biomass, pre-treatment of biomass is of importance. Examples of pre-treatment technologies are torrefaction, pelletisation or conversion to pyrolysis oil. Still substantial improvements in these pre-treatment technologies have to be made. Experts believe that this development will take place in the coming ten to twenty years in the international arena, with a potentially interesting role for the Dutch industry. The expectation is that on the longer-term most of the pre-treatment will take place in the regions where the biomass is produced. During pre-treatment of the biomass, about 10% of the energy content is lost, while a 40% reduction in transportation costs is aimed for.

13 Exact ratio between crops and residues of course depends on application, market fluctuations and logistical chains opening up the potential. As example, in The Energy Report 2011, biomass used consists of about 22% of crops and 78% of residues & waste.

14 The target in 2020 is 10%

The energy conversion ratio from the pre-treated biomass into power is currently about 40%. In 2030 it may have been improved to 45%, which is less than for coal-fired plants, with expected efficiencies of around 50%. The difference in efficiencies between co-fired plants and coal-fired plants will be substantial smaller. When converting biomass into transport fuels, about 35 to 50% of the energy in the biomass can be converted into biofuels. The required technology development for biofuel production is aimed at improving the efficiency of converting ligno-cellulosic (woody) biomass and bringing it towards commercial scale.

For green gas production the conversion efficiency ranges between 40-70% depending on the feedstock and gas production technology. The gasification based conversion of biomass may yield the highest conversion efficiency into green gas (~70%), but this technology requires demonstration and scale-up. The production of green gas based on anaerobic digestion is a proven technology and does not require much technology development. However, development of pre-treatment processes may increase the conversion efficiency for feedstock that is difficult to digest.

Long-term perspective
The potential for the production of biomass for energy purposes on a global scale is very large. Estimations for 2050 are in the range of 20 to 50% of current global energy demand depending on variations in yield, land use and sustainability criteria for the production of biomass (e.g. Campbell 2008, IEA 2009, WBGU 2008, IAASTD 2009, Erb 2009).

To raise sufficient crops for bioenergy at the longer term agricultural productivity would need to grow at a higher pace than current observed. Lower efficiency developments imply that land requirements to fulfil food demand stay high. In turn, however, the introduction of biomass production for energy demands can also accelerate and incentivize this development process. Improving agricultural yields has proven to be difficult in the past decades, particularly in developing countries. Many factors influence productivity, such as stability and security of markets, needed for farmers to safely make investments, access to markets, and dissemination of knowledge and expertise to farmer populations.

Environmental and social impacts of the technology (in 2030)
Greenhouse gas performance of biomass chains: The *cultivation and transport* of biomass will cause CO_2 and other greenhouse gas emissions. The amount of greenhouse gases strongly depends on the type of biomass, production methods and distance to transport the biomass from the location where it is cultivated to where it is used. Compared to fossil fuels, biomass in power production reduces CO_2 emissions by typically 80 to 90% (Ecofys, 2011). The cultivation, pre-treatment and international transport of biomass demands no more than 10% of the total energy produced. This is comparable to coal or gas production chains.

Current default values (RED 2009) for typical greenhouse gas emission savings for biofuels range from 35% (wheat ethanol) to over 80% (biodiesel from waste oils or biogas from waste sources) when replacing fossil fuels. In current EU legislation, only biofuels saving 35% of greenhouse emissions or more are contributing to the EU biofuel targets. This percentage will increase from the 1st of January 2017 to a minimum of 50% savings and from the 1st of January 2018 to minimal 60% (RED 2009). Ligno-cellulose biofuels (as currently in development and expected to reach market volumes before 2020) and biofuels using wastes as feedstock have emission savings averaging round 80-95% of reductions compared to fossil fuels (RED 2009).

Assessments of biofuels indicate that in 2030 about 75-85% (about 65 ktonne per PJ) emission reduction of greenhouse gases can be obtained compared to fossil fuel use (TER, page 191).

Land availability
A substantial amount of the biomass - or the fuel produced from the biomass - will have to be imported. The Netherlands does not have sufficient land available for large-scale cultivation of energy crops nor does it have sufficient residues available for biomass purposes. Biomass production will require large areas of production land. If the total amount of 550 PJ of biomass would be obtained from dedicated energy crops, this would require about 4 to 8 millions of hectare.[15] For comparison, the land area of the Netherlands is 3.4 million hectares.

Sustainability of biomass production
The production of sustainable energy crops should be carefully integrated in the current agriculture of different regions in the world. The introduction of an internationally recognized certification system is therefore a necessary prerequisite.[16]

The ecological and social-economic impacts of energy crops can be positive if biomass is cultivated in a responsible manner within strict criteria. This can be achieved by implementing an internationally accepted certifying system, which should be in place and widely accepted in 2030.[17] This certification, in conjunction with good practice guidelines, must guarantee the principles of sustainable use of land, water management, nature conservation and 'fair trade'. These arrangements could be expanded on longer term to other crop production and agriculture, reducing the overall impacts of agriculture on biodiversity, air, soil and water resources. Some of socio-ecological impacts – like land grabbing, indirect land use change and local food security – are complex and not yet covered in the existing sustainability criteria, but developments are ongoing to incorporate those elements.

At best, biomass production can lead to abatement of poverty in rural regions, regenerate degraded lands and lead to more sustainable agriculture. If this cannot be guaranteed, large-scale biomass production could, in the worst of cases - e.g. by introducing large-scale monocultures - generate serious consequences in relation to water reserves, increasing pressure on agricultural land and forests, as well as the exclusion of small farmers. Currently there is also attention to alternative set up of biomass production through smallholders, combined plantations instead of only large scale plantations with monocultures. Nevertheless, land and water implications of biomass feedstock production will need further research especially at landscape level (TER, WWF/Ecofys).

Land availability deserves sufficient attention, like proper land planning systems, policies and enforcement. If land use is not dealt with in a careful manner, use of land for cultivation of biomass crops could compete with other uses, like biodiversity and food production. Good policies & practices and efficiency improvements in agriculture are needed to reach sufficient sustainable biomass production, especially when global use of biomass is set to the same

15 Mainly depending on the type of biomass, e.g. yields for biomass producing oil and fat are 5 to 10 times lower than lignocellulose biomass (25 – 35 GJ/ha vs 160 – 230 GJ/ha). For the calculation we assume 30/70% to 70/30% mixture of conventional biomass and lignocellulose biomass, respectively.

16 See also http://www.biofuelstp.eu/sustainability.html#enviro

17 Developments are already ongoing (several schemes per crop available, like RSPO, RTRS, FSC and an EU policy based on requirements that need to be met RED 2009

ratio as biomass use in the Netherlands for energy supply. This might not be enough though, meaning that the overall consumption of products that require intensive land-use (like meat) should be lowered. An example is given in The Energy Report 2011 in which for a global renewable energy scenario meat consumption in OECD countries should reduce by half (TER, WWF/Ecofys).

With the use of wastes and residues as biomass feedstock for power production, green gas and advanced biofuels, the risks associated with agricultural impacts are much lower. Here attention should be paid to competition with other uses and sustainable harvesting practices, e.g. leaving sufficient biomass for soil carbon cycles in cases of forestry residues or straw for example.

LAND USE FOR ENERGY PRODUCTION

Biomass production requires land. Relatively conservatively, the productivity for a perennial crop (like Willow, Eucalyptus or Switchgrass) lies between 8 - 20 tonnes dry matter per hectare per year depending on location, climate and soils. The heating value of dry clean wood amounts about 19 GJ/tonne (HHV). This is gross energy yield, and the energy inputs for cultivation, fertilizer, harvest, etc, amounting about 5%, should be deducted). One hectare can therefore produce about 150 – 350 GJ/ha net per year. 1 PJ would require 3,000 - 7,000 ha.
The amount of fuel needed to fire a 600 MWe base load power plant (7000 full load hours) with 40% efficiency is 38 PJ per year. This would require 115,000 - 260,000 ha.
Supplying one quarter of the world's current energy consumption, i.e. about 100 EJ, would require about 300 - 700 million hectares (Mha), which is a quarter to half of the present worldwide land use for agriculture and equals 2% - 5% of the total world land surface. The total land surface of the Netherlands amounts 3.4 Mha, and the present Dutch energy demand is about 3000 PJ. Covering one quarter (750 PJ) of the national energy demand with (imported) biomass would require about 2 – 5 Mha.

Energy security
Increasing the share of biomass in the Dutch primary fuel mix will increase fuel diversity, which is advantageous for the reliability of the energy system. In particular, the dependency on oil will decrease. This is of great strategic importance given the expected shortage in oil production capacity during the first half of this century.

Furthermore, it is possible to produce biomass in different parts of the world. Potentially, important export regions will be Latin America, The South and Sub-Saharan Africa, East Europe/Russia and Oceania. This will decrease the dependency of fossil-fuel producing countries like Middle East and Russia. In general, the Netherlands will still depend on other countries for their energy needs, but might be able to source this from a wider variety of countries in the future.

Changes to the infrastructure (towards 2030)
Import and conversion of (pre-)treated biomass or biofuels can use the existing infrastructure in Rotterdam and other main sea harbours without fundamental changes. Nevertheless, a significant share of the current oil refinery capacity will in due course be replaced with biomass refineries, which require additional investments.

For reference, the current oil refining capacity in the Rotterdam area is about 2.5 EJ per year. The biomass conversion described in this option would require conversion capacity for biomethane and liquid fuels for about 350 PJ of biomass. Capacity equal to about one seventh of current installed fossil based capacity needs thus to be realised. With a gradual introduction over the coming two decades, there should not be fundamental problems.

Economic impact (in 2030)
The power production costs from biomass vary widely depending on size of the plant, availability and type of biomass feedstock (residues, waste, crops), type of biomass plant (co-firing, dedicated, gasification) and transport distance to collect the biomass. With biomass feedstock costs ranging from 4 to 9 euro per GJ, current costs reported range from 0.05 to 0.12 euro/kWh, (Evans, 2010, IEA 2012). Current production costs from fossil-fuel plants amounts to 0.045 0.060 euro/kWh. The biomass price determines 30-50% of the power production costs. For comparison, in Europe the coal prices vary currently from 2 to 4 euro/GJ and natural gas prices from 8 to 12 euro/GJ.

The potential technical developments and experience with (sustainable) production systems can decrease the production costs of biofuels. It is therefore expected that in 2030 the production costs of biofuels will be roughly the same as the cost of gasoline and diesel made from oil. Bio-electricity will also be competitive when logistical chains are properly organized and commodity markets for biomass exist. If this would not be the case, (temporarily) shortage in the market may lead to fluctuating biomass prices.

Expected cost price ranges of biofuels for 2030 are 10 to 20 euro per GJ (Refuel 2008, DECC 2008). Current gasoline production costs are about 18 to 20 euro/GJ. It should be noted that the price of biomass for the longer term is hard to predict and depends both on global demand and supply.[18] Studies indicate generally that production costs will reduce towards 2030. It is unsure how impacts on agricultural markets and commodity markets will influence the costs for bio-electricity and biofuels (e.g. if all feedstock prices will be effected, or that regional variations will not increase/decrease the prices so much). On the longer term it is expected that the wide spread implementation of sustainability criteria will increase costs for biomass significantly.

For countries in Africa and Latin-America and East Europe, the possibility of large-scale export of renewable fuels could represent a source of significant revenues as well as increasing labour opportunities in rural areas. However, when biomass demand competes with food production, also increases in land and subsequently food prices could be observed. This should be avoided and secured by certification, effective and enforced policies, e.g. on land planning. Furthermore improvements in agricultural practices and efficiencies could highly reduce the competition with food production.

The price of imported pre-treated biomass (based on residues) in 2030 is estimated at 60 to 200 euro per tonne (3 – 10 euro/GJ). It implies that the value of the required 550 PJ biomass in this package amounts to over three billion euro. In particular, the chemical industry and the

[18] The costs for feedstock like municipal solid wastes, sewage sludge, and animal manure are very low and in some circumstances even negative – to compensate for waste treatment costs. However, the potential of these types of feedstock is limited. Expansion of biogas production should therefore come from the use of other biomass feedstock, with higher prices most likely determined on the global market.

transport sector in the Netherlands can benefit in economic terms from large-scale imports and the construction of new chemical industries that also produce renewable materials such as biochemicals.

Employment effects of biomass use in the Netherlands will most probably not be noticeable in jobs in the agricultural sector. Employment related to bioenergy is expected more in refinery or power production facilities, trade and harbour locations. Replacement of jobs in current fossil facilities by jobs in biomass facilities will be an expected effect. Employment related to production of biomass will for the larger part take place in regions outside the Netherlands (and also for a considerable part outside the EU).

Policy requirements (to implement the option)
International market: A very important condition for this option is the implementation of an international market for sustainable produced biomass. This requires that various (trade) barriers need to be removed and an international level playing field needs to be created. It requires also a global effort to design policies to provide safeguards for the sustainable way of producing biomass. In addition the implementation of sufficient logistic capacity and an efficient set up of the logistical chain (ships, transfer and storage capacity in harbours) must be available in the important export regions. This is an area where the Netherlands could play a leading and innovative role.

A long term incentive is needed to start a market for biomass conversion into energy carriers. This can be for example be done by a quota system prescribing the share of renewable energy carriers in the energy supply mix and/or by a long term emission trading scheme where the CO_2 price is factored in the price of fossil fuel alternatives. But more policy options are available to achieve a long term incentive.

The conversion technologies required to produce biofuels and bioelectricity are currently mainly developed by companies outside the Netherlands. Technologies related to green gas production are developed within the Netherlands, such as gasification based green gas production and gas upgrading technologies.
Therefore – to successfully introduce the conversion technologies in the Netherlands that are not yet in the commercial phase - more policy support is required for developing the required technology. This will improve the certainty that technology is timely available for large-scale deployment and it improves the (export) market position of the Netherlands for such technologies.

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B.5. Option 5: Carbon Capture and Storage from Power Plants

Introduction

The goal of this option is to reduce 25 million tons of CO_2 in 2030 by capturing, transporting and storing the emissions from coal or gas-fired power plants with a total net capacity of 6,000 MWe. This capacity is about 15-20% of the total installed capacity of power plants in 2030. This technology is to be applied mainly in new power plants, but also existing power plants will be retrofitted.

Description of the option

Carbon dioxide (CO_2) is formed when converting fuels that contain carbon, like gas and coal, into electricity. Today's situation is that this CO_2 is emitted through the stack into the atmosphere. Alternatively, the CO_2 can be captured, transported and subsequently stored in deep saline underground layers.

Capture of CO_2 is common practice in the chemical industry and natural gas industry. Large-scale CO_2 capture from power plants has not yet been demonstrated. Transport of CO_2 is regularly applied and is technically possible. The captured CO_2 is stored in deep underground layers like empty oil or gas fields (hydrocarbon reservoirs) or in water containing layers. CO_2 is also injected in hydrocarbon reservoirs to enhance the recovery of oil, a technology frequently applied in the United States. Desk studies have been carried out to investigate the techno-economic potential of enhancing gas recovery.

CO_2 storage concepts have been proven by several projects. Currently, worldwide there are 73 large-scale integrated identified, of which fifteen are under construction or operational. These projects store annually in total over 35 million tonnes of CO_2 (GCCSI, 2012). Examples of such projects are the storage activities of CO_2 in underground layers beneath the North Sea (since 1996) and the Algerian dessert (since 2004). In the Netherlands, GdF-Suez stores annually 20,000 tonnes in a nearly empty gas field beneath the North Sea. Transportation through pipelines of almost half million tonnes of CO_2 takes already place from Rotterdam to Westland to supply greenhouses in that area with CO_2.

In 2011 the Dutch government cancelled a project to demonstrate CO_2 storage in an empty natural gas field close to Barendrecht. The project in Barendrecht attracted a lot of attention because of concerns of the local community.

Required technology development (towards 2030)

To install and operate CCS there are no major technological bottlenecks expected, although the integration of a large-scale project, i.e. engineering, constructing and operating the full chain project from capture to storage still poses quite some organisational and technical challenges. In addition uncertainties exist regarding costs, energy use and environmental performance of the capturing process.

Transport of the captured CO_2, especially by pipelines, is technically feasible and demonstrated in various countries.

The technical implications of injection large amounts of carbon dioxide in underground reservoirs differ per (type of) storage locations. In most cases it will pose little technical problems, as similar technologies are used in oil and gas exploration and production. Monitoring of the field complemented with computer simulations of storage reservoirs are required to keep track of the stored CO_2. These methods will be based on existing technologies but they need to be refined for CO_2 storage (CO_2ReMove, 2012). There is still some uncertainty on the behaviour of the stored CO_2 on the longer term and substantial research and development efforts are dedicated to this issue. Regulation and guidelines are in place to assure that the storage site is evolving to a stable situation in the long term.

Capture of carbon dioxide from large power plants has not yet been applied. Research and demonstration projects are going on or are planned to improve the technology and economics. Demonstration projects are needed to prove the feasibility, to reduce costs and energy consumption, to improve operational reliability, and to demonstrate safe operations to the public. To substantially reduce costs, breakthrough technologies are required. Technologies that can be applied commercially are not expected to be available before 2020.

Currently, two large projects are being developed in the Netherlands to demonstrate the whole CCS chain of capture, transportation and storage of CO_2, but the final investment decisions are not yet made. The projects should be operational around 2015-2017. In one project over one million tonne of CO_2 will be captured annually from the new coal-fired plant from EON in the Rijnmond area. The CO_2 will be captured from flue gases of the plant. In the second project Air Liquide aims to capture 0.6 million tonne of CO_2 from its new hydrogen plant. The captured CO_2 from both projects is transported by a 20 km pipeline to an empty offshore gas field near the shore of Rotterdam.

Long-term perspective
For the next decades, fossil fuels are expected to remain an important energy source to meet the energy demand. Fossil fuels are abundantly available. Studies show that worldwide the fossil fuel reserves which can be extracted at competitive costs is equal to thousands of gigatonnes of carbon (Shafiee, 2009). At higher fuel prices, this amount will increase. CCS will make it possible to continue using fossil fuels with reduced emissions of CO_2, also after 2030. In the scenarios of the IEA the total contribution of CCS to the emission reduction target in 2050 is about 20% (IEA, 2011)

Studies show that it is likely[19] that there is a global storage capacity of at least 2,000 Gt of CO_2 (IPCC, 2005). This capacity is sufficient to store 80 times the global CO_2 emissions in 2010 from fossil fuel use. Worldwide the largest storage potential is in saline aquifers. The storage capacity might be in the order of hundreds of gigatonne of CO_2, but uncertainties in the estimates – especially for saline aquifers - are large.

In the Netherlands gas fields have by far the largest storage potential in the Netherlands. Up to 2050 the potential of empty gas fields is estimated at 2,750 MtCO_2. Most of this potential will become available in coming two decades or is already available. When after 2050 the gas field in Groningen (Slochteren) is exhausted an additional amount of over 7,000 Mt of CO_2 can possibly be stored (TNO, 2007). The capacity of oil fields is rather limited with 40 Mt of CO_2. Storage capacity could turn out to be somewhat less if alternative uses of potential CO_2 storage reservoirs are planned, e.g. for underground gas storage (UGS).

Environmental impacts of the technology (in 2030)
CO_2 capture technologies generally do not remove all the CO_2 from the flue gases. It is technically possible to construct near-zero CO_2 emission plants, but in most cases 80-90% capture of CO_2 on a per plant basis is more attractive from an economic point of view.

Removing CO_2 from the flue gases of power plants will not only reduce emissions of CO_2 to the atmosphere, but also affects the emission of other pollutants such as SO_2, NO_x and particulate matter. The use of (cooling) water and the formation of liquid and solid by-products (including waste) are also affected by the application of CO_2 capture. The exact effect will depend on the fuel used and on the technologies applied. With some technologies the emissions are strongly reduced compared to generating a kWh with power plants without capture. In some cases it might lead to additional emissions, e.g. due to the use of additional chemicals to capture the CO_2.

Life cycle analyses - with a cradle-to-grave (from mine to kWh) perspective - are important to understand better the life-cycle emissions. By implementing CCS, total greenhouse gas

[19] 'likely' suggests a probability of 66% to 90%

emissions from coal-fired power plants are reduced by 65 to 95% and gas-fired power plants by 45 – 80%. In absolute terms the range for both is between 25 and 275 gCO_2eq/kWh, mainly depending on the fuel supply chain and the applied conversion and capture technologies. It should be noted that both the relative and absolute contribution of emissions outside the power plant increases mainly due to extraction and transport of the fuel. The absolute amount increases because more energy in CCS plants is required to produce one kWh of power.

Safety impacts of the technology (in 2030)

Extraction of fossil fuels. At the start of the chain for fossil fuel use, fossil fuels are extracted from the earth. Health and safety issues are mainly related to coal mining, strongly depending on the origin of the coal. If we assume that the coal comes from the same countries as current imported coal, the mining of the additional required coal to run the capture process will cause yearly about three deaths.

Capture process. In industry the process steps of separating and compressing CO_2 are common practice. CO_2 is used in various applications, like cooling, fire extinguishers, drinking water treatment and foam production. The operational risks associated with capturing carbon dioxide from the production process are generally well known and manageable using standard engineering controls and procedures (IPCC, 2005).

However, risk issues associated with hazardous emissions from amine-based capture technology are a point of attention. Significant R&D efforts have been devoted to this topic and recently a set of measurement and risk assessment methodologies have been developed to measure these emissions and benchmark capture technologies against emissions limits and health and safety standards.

Transport of CO_2. Various quantitative risk assessments (QRA) have been performed for CO_2 pipelines (Kruse and Tekiela 1996; Golomb 1997; National Energy Board 1998; Vendrig et al. 2003; Cameron-Cole 2005; Hooper et al. 2005; Lievense 2005; Molag and Raben 2006; Turner et al. 2006; TetraTech 2007 ; Heijne and Kaman 2008; Eldevik et al. 2009; HSE 2006). Failure rates used in QRAs for CO_2 pipelines range between 0.7 to $6.1*10^{-4}$ incidents per km per year and are often based on experience with natural gas pipelines.[20]. The risks associated with a CO_2 pipeline are different in nature from the risks of natural gas pipelines. The levels of impurities in the CO_2 stream are important from a health, safety and environment point of view in case of CO_2 release, e.g. in case of emergency release. Risk levels will have to take this into account (Buit, 2010). According to the Environmental Impact Assessment for CO_2 pipeline for Barendrecht, the local risk of CO_2 transport is negligible (Haskoning, 2008).

Next to the failure rate the consequence of the failure is of importance when determining risks. The consequence of the failure depends on the amount of CO_2 escaping, the duration of leakage, and the impact of increased CO_2 concentrations on human beings. Carbon dioxide leaking gradually from pipelines will have different consequences than large amounts escaping in a short time, e.g. as possible in the case of a pipeline rupture. The maximum

[20] The causes of failure are predominantly third party interference, corrosion, construction or material defects (e.g. welds), ground movement or operator errors (Gale and Davison 2004; Hooper et al. 2005). Most of the incidents refer to very small pipelines, principally in gas distribution systems. Some scholars believe that empirical data on the operation of CO_2 pipelines is not sufficient to determine the probability of failure of a pipeline section with the same accuracy as for natural gas pipelines.

CO_2 release rate from a failing pipeline is estimated at 22 tonne per second depending mainly on the diameter of the pipeline and the size of the puncture (Koornneef et al. 2010).

When CO_2 escapes from a pipeline it will be dispersed in the atmosphere. The way of dispersion depends on the local conditions and the fact that CO_2 is denser than air. This should be taken into account while selecting a pipeline route. The CO_2 might accumulate to potentially dangerous concentrations in low-lying areas if dispersion of the CO_2 is prevented by a closed environment, by very stable atmospheres and by very low wind speeds. Field-testing and (further) validation of release and dispersion models is necessary for a more accurate risk assessment.

CO_2 leaking from a pipeline is a potential asphyxiate for humans and animals depending on the concentration and the duration of the exposure. Concentrations of 7 to 10% of CO_2 in air can cause lethal effects in human beings (IPCC, 2005). The estimation of the impact of increased CO_2 concentrations on human safety is highly determined by the methodology used. Currently, a variety of concentration thresholds is used worldwide and no formal dose-response function is adopted yet (Turner et al. 2006; Haskoning 2008; Koornneef et al. 2010). Some studies assume a concentration threshold for CO_2 and impurities, while other methodologies include a dose-response function.

Recently, best practice guidelines for the design and operation of CO_2 pipelines have been developed, providing first guidance steps (DNV 2010). And although uncertainties still exist when calculating the risks of CO_2 pipelines, current risk assessment methodologies can take these uncertainties into account by working with conservative assumptions.

Injection of CO_2. The major risk associated with injection is a wellhead failure, which could have different causes like, unsuitable construction, leaking pipe connections, defective materials and collapse of the well. Corrosion of injection equipment is one of the reasons for leakage during injection. Blocking of the wellbore (e.g. by formation of ice or hydrates) represents a different risk. In the majority of failures the amount of CO_2 released would equal the content of the well. Monitoring systems detect the leak and automated safety valve systems prevent the CO_2 from escaping the well. The frequency of blowouts from CO_2 wells is considered equal to those from natural gas. The probability of a blow-out for each well is calculated at in the order of once per 5,000 to 10,000 years (CMPT, 1999; DNV, 2008). Jordan (2008) showed chance of blow-out once per 10,000 years in the period 1991 – 2005 and concluded that blowout rates declined dramatically over the 15-year study period. The potential consequences from a well blow-out are casualties (lethal, injuries) among operators and economic damage caused by temporal disruption of the system.

Storage. The risks related to stored CO_2 can be divided into global and local risks.

Local risks are related to impacts of CO_2 release on people, animals and the local environment, and possibly CH_4 if it is stored in a gas field with CH_4 remnants. Injection of CO_2 could trigger the displacement of fluids, which could influence the quality of potable water in the shallow subsurface. CO_2 injection leads to pressure change in the subsurface, which could result in movement of the earth's surface.

Stored CO_2 in the geological reservoir might migrate out of the reservoir through the subsurface into the atmosphere if not properly characterized and managed. The likelihood of accidental releases of CO_2 from geological storage reservoirs has not been quantified today, especially for the longer term. Effects on the quality of groundwater, soil, energy and mineral sources are less understood compared to health effects on humans. CO_2 leakage may also harm flora and fauna, drinking water reservoirs and the environment. Fresh, potable ground water, located at 100 to 200 metre below the surface, could be contaminated by leakage of CO_2 and brine. Leakage into surface water would increase acidity (pH is lowered) and could therefore affect ecosystems. Leakage from a storage reservoir deep under the seabed could affect marine life in the water column or in the seabed.

On a global level, leakage of CO_2 could become a diffuse source of greenhouse gas, which is difficult to control. The effectiveness of storing CO_2 in the underground is being reduced when CO_2 migrates out of the reservoir. In several countries studies are done, to develop more knowledge on leakage from underground reservoirs. For example, soil gas measurements taken at the Rangely Weber oil field, where CO_2 is injected for enhanced oil recovery, indicates that about 3,800 tonnes of CO_2 per year leak out of the reservoir over an area of 78 km^2, which corresponds to 0.012% of the overall annual CO_2 injection rate. The mechanisms involved are not understood (Klusman 2003). Monitoring of the current major storage locations at Weyburn, Snøhvit, Sleipner and In Salah did observe not or only minor amounts of leakage (Wildenborg, 2012). Claims for leakage by the Kerr family living near the Weyburn site were refuted by international investigations on the site. Large uncertainties still do exist on the long-term consequences of CO_2 storage.

Main targets for CO_2 storage in the Netherlands are the gas fields as they have shown to contain natural gas for very long periods. Also a lot of field information has been collected from measurements during gas production. With a detailed evaluation of the quality of the existing wells these fields could qualify for safe and effective CO_2 storage on the long term (Seeberger & Hugonet, 2011).

The risks of underground CO_2 storage are very site-specific and can not be generalized for all potential storage sites. Experts believe that careful selection of the sites and adequately regulated monitoring will reduce the risk of leakage considerable. After risk identification of selected sites, these risks will be quantified and appropriate monitoring and counter measures will be planned before a storage site can be qualified for injection operations.

Changes to the infrastructure (towards 2030)
No major changes in the energy system are needed for the implementation of CCS to power plants. By applying carbon capture and storage more time is available for the energy system to transfer to fully sustainable system and still reach climate targets.

In principle, CO_2 can be captured from all installations that combust fossil fuels. Logistically and economically seen, the preference is with large-scale sources like power plants or large industrial combustion plants. Capture from small-scale units will become more attractive once the captured CO_2 can be fed into a developed transport infrastructure. Studies have shown that pooling of CO_2 from sources with annual emission of less than 500 ktonne per year seems to be an attractive option. Costs will probably be too high for sources smaller than 50 ktonne per year (Bureau et al., 2012).

The application of carbon capture technology does not affect the transmission of electricity. But next to the power infrastructure, also a CO_2 transport infrastructure will be required to transport the captured CO_2 to the reservoirs. Large-scale application of capturing CO_2 in the Netherlands will require in the order of two to three thousand kilometres of new pipelines. The construction of pipelines could disturb normal life when, for example, roads are blocked during construction of underground pipelines.

Economic impact (in 2030)

According to IEA (2010) power production costs in 2030 are estimated at 0.040 to 0.060 €/kWh. Application of CCS will increase production costs to 0.060 to 0.090 €/kWh. Recently, the ZEP (2011) confirmed these costs ranges. The increase in costs will result in an electricity price increase for small consumers by 10 to 25% and for 40 – 80% for industry. The increase in costs will be less if costs of CO_2 allowances are taken into account. It should be noted that cost estimates are uncertain as current experience is still limited in configuring the various components into an integrated carbon capture and storage system

The capture step bears - typically with a share of 60 to 80% - the largest costs. Transport costs can become more dominant when CO_2 has to be transported over large distances to the storage location, through difficult accessible areas (e.g. highly populated areas and nature reserves) or when only small volumes are transported. The cost for storage is relatively small compared to the other cost components. Sometimes existing infrastructure can be used.

Costs of carbon capture, transport and storage will reduce over time by improvements in performance or finding less expensive ways to build and operate the capture equipment. Improvements in performance refer mainly to the separation and compression step, which are the most important cost factors.

Cost reduction of carbon capture and storage systems is expected to be driven by the experience gained with the technology during demonstration and deployment. One aspect is that due to the gained experience economies of scale that can be achieved. On the long term, economies of scale in plant construction and plant sizes can reduce the costs. Experts expect that carbon capture and storage systems show similar cost reductions compared to other emission control systems in related industries. An average learning rate of 12% is assumed for the expected capital cost decline of carbon capture and storage technologies, which says that with every doubling of installed capacity the investment costs decline with 12% (Rubin, 2004). Largest cost reductions can be obtained by so-called breakthrough technologies by drastically changing the method of capturing. Due to these gradual and abrupt improvements of CCS, some authors expect cost reduction up to 25% towards 2030 and 50% towards 2050 when full-scale application of carbon capture and storage is applied (Hendriks et al., 2004).

Policy requirements (to implement the option)

For successful implementation of CCS a stable and sufficient financial incentive is required, which is currently not the case. This could be established by an effective European Trading Scheme, or other market mechanism, providing CO_2 allowance price of 50 euro per tonne or more. In addition, the following policies are required: (i) supporting research, development and demonstration projects to reduce costs and increase confidence in the technology; and (ii) creating a stable investment climate with long-term certainty in regulation. It is also possible to mandate new and even old coal/gas-fired power plants to use CCS.

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B.6. Option 6: Biomass and CCS for electricity, liquid transport fuels and green gas

Introduction

The goal of this option is to reduce 25 million tons of CO_2 in 2030 by replacing fossil fuels by biomass and by capturing and storing CO_2. This option requires 1000 MWe of biomass-fired power plants capacity and the supply of 80 PJ of liquid biofuel and 50 PJ of biomethane (also called green gas) for transportation purpose or to feed into the natural gas grid. The required amount of biomass is 65 PJ for the power production and 230 PJ for liquid fuels and green gas production.

Description of the option

Biomass is organic material such as wood, grass, organic waste, crops and straw. It can be used as fuel for the production of electricity, heat and as a resource to produce ethanol or diesel to replace gasoline and diesel produced from fossil oil. Biomass can also be converted into a gas and then processed to produce biomethane (green gas) to replace conventional natural gas. When biomass is used CO_2 is emitted. It does however not add to the atmospheric concentration of CO_2 as an equivalent amount of CO_2 was taken up earlier while the biomass was cultivated. We estimate that in 2010 the use of biomass reduced the CO_2 emissions in the Netherlands by 2.3%.

This option combines the use of biomass with storage of the carbon dioxide captured during the production of power, liquid biofuels and green gas. In this way short-cycle carbon (carbon that very recently is fixed from the atmosphere into the biomass during its growth) is effectively removed from the atmosphere and stored underground. This option *Biomass and CCS* can therefore achieve ‘negative emissions’.

Carbon dioxide can be captured from biomass-fired power plants using the same type of technology as from fossil-fuel power plants. Technologies that may combine liquid biofuel production with CO_2 capture and storage are bioethanol production and synthetic biofuel production. Especially the first option, bioethanol production with CO_2 capture, is an economically attractive option for the short term and is currently being demonstrated on a commercial scale.

Capturing CO_2 from liquid biofuels is in general relatively easy compared to capturing CO_2 from power plants. In the case of ethanol production through sugar or starch fermentation a relatively pure stream of CO_2 is already produced during the production process. The CO_2 stream can easily be separated from the ethanol and only needs purification to remove the contaminants. It should be noted that a relatively small fraction of the CO_2 is captured and stored in this way. Depending on the feedstock and technology applied about two-third of the carbon ends up in the ethanol and one-third as CO_2.

The capture of CO_2 from ethanol production is commercially proven technology. Abengoa, an international bioethanol producing company, has a production capacity of approximately 480 million litre bioethanol per year in the Rotterdam harbour, equivalent to more than 2% of the road transport fuel demand in 2010 of 418 PJ. Since early 2012 this facility captures and delivers a part of the pure stream of CO_2 (approximately 100 ktonne of the 300 ktonne annually produced) to a transport pipeline feeding the CO_2 as fertiliser to greenhouses nearby. In the United States the capture of 1 million tonne of CO_2 per year from ethanol production and storage in the underground will be demonstrated. The CO_2 will be stored a saline sandstone formation at depths of approximately 2 km deep. The actual capture and storage of CO_2 is expected to begin in late summer 2013.

Green gas is either produced by anaerobic digestion of biomass or by synthetic gas production based on biomass gasification. In the case of digestion the produced gas needs to be upgraded before it can be fed into the natural gas system. In this process mainly CO_2 is removed. This is a commercial proven technology and widely applied in, for example, Germany. The removed CO_2 is in that cases vented into the atmosphere. When the separated CO_2 stream needs to be stored additional cleaning steps are required depending on the transport and storage quality specifications for the CO_2 stream.

In the case of green gas production the CO_2 removal step is also an intrinsic step of the production process and required before feeding it into the natural gas grid. Green gas production solely based on biomass feedstock is not yet at commercial scale, but is being demonstrated in the Netherlands on the short term. On a global scale there are no demonstration projects storing CO_2 from green gas production facilities.

Required technology development (towards 2030)
The bioenergy technologies all have their individual technology developments needs to increase efficiency, to scale-up and to reduce production cost. This is not new for bio-CCS options. The main challenge when combining bioenergy conversion technologies with CCS is that the complexities of large scale biomass production and use, and the challenges related to CCS are put together. Additionally, specifically for all bio-CCS options more research is needed on how to optimally match biomass supply routes with the current infrastructure for liquid fuels, electricity and natural gas transport and future CO_2 transport networks. Given the relatively smaller scale of bio-CCS facilities a more elaborated CO_2 collection network will be required to transport the CO_2 to storage locations. This is especially the case for green gas facilities using the digestion of biomass which are typically much smaller than power plants. For the production of green gas the facilities may be much larger, but research is required on how to best scale-up this technology. Overall the technological development needed for the deployment of bio-CCS is to match the scale of CO_2 capture and transport options to the typical, often biomass restricted, scale and flexibility of biomass conversion technologies (flexibility in quality and amount of fuel supply). Another point of attention for technology development is the need to deliver clean CO_2 streams into the CO_2 infrastructure. Purification technologies for CO_2 streams are not lynch pin technologies but do need to be optimised in scale and costs for the required scales and gas stream qualities coming from the diverse biomass conversion technologies and their CO_2 capture technologies.

Long-term perspective
Biomass combined with CCS is the only option for large-scale 'negative' emissions. With this group of technologies CO_2 'negative emissions' (removal of CO_2 from the atmosphere) can be obtained and emission elsewhere in the economy, e.g. in some industries where it is difficult or costly to replace fossil fuels, can be compensated for. Scenario studies show that bio-CCS options are especially needed when climate mitigation actions are delayed and CO_2 mitigation efforts later on in the century need to be increased to reach climate goals. Having no bio-CCS options available in the future will most likely result in overall higher cost of meeting long-term climate goals.

Environmental and social impacts of the technology (in 2030)
Greenhouse gas performance of biomass chains: The *cultivation and transport* of biomass will cause CO_2 and other greenhouse gas emissions. The amount of greenhouse gases

strongly depends on the type of biomass, production methods and distance to transport the biomass from the location where it is cultivated to where it is used. Compared to fossil fuels, biomass in power production reduces CO_2 emissions by typically 80 to 90% (Ecofys, 2011). The cultivation, pre-treatment and international transport of biomass demands no more than 10% of the total energy produced. This is comparable to coal or gas production chains.

Biomass in (coal/biomass) co-fired power plants combined with CCS '*captures*' 170 to 330 gram of CO_2 per kWh from the atmosphere (IEAGHG 2011). The exact amount depends on the technology applied and the co-firing share. For 100% biomass fired power plants this figure amounts to 845 gram of CO_2 per kWh. For reference, coal fired power plants in the Netherlands without CCS *emit* about 800 to 900 gram of CO_2 per kWh. Therefore, compared to fossil fuels, biomass in power production combined with CCS reduces 120 to 200% of the emission.[21]

For liquid biofuels production the negative emissions with CCS are about 25 to 120 kg of CO_2 per GJ, with bioethanol having less negative emissions than synthetic diesel. For green gas production the negative emissions are estimated at 40 to 69 kg of CO_2 per GJ. For reference, the CO_2 emission factor for gas and diesel is 56 and 74 kg of CO_2 per GJ, respectively.

Land availability
A substantial amount of the biomass - or the fuel produced from the biomass - will have to be imported since the Netherlands does not have sufficient land available for large-scale cultivation of energy crops nor does it have sufficient residues available for biomass purposes. Biomass production will require large areas of production land. If the total amount of 300 PJ of biomass would be obtained from dedicated energy crops, this would require about 2 to 5 millions of hectare. For comparisons, the land area of the Netherlands is 3.4 million hectares.

The land requirement for bio-CCS per avoided tonne of CO_2 is lower compared to biomass energy conversion without CCS as bio-CCS is able to achieve negative emissions. How much lower depends on the fraction of carbon in the biomass that is captured in the form of CO_2, the biomass to fuel conversion efficiency and the increase in primary energy use due to the CCS processes (mainly capture and compression).

Sustainability of biomass production
The production of sustainable energy crops should be carefully integrated in the current agriculture of different regions in the world. The introduction of an internationally recognized certification system is therefore a necessary prerequisite.[22]

The ecological and social-economic impacts of energy crops can be positive if biomass is cultivated in a responsible manner within strict criteria. This can be achieved by implementing an internationally accepted certifying system, which should be in place and widely accepted in 2030.[23] This certification, in conjunction with good practice guidelines, must guarantee the principles of sustainable use of land, water management, nature

[21] Note that 1 kg of negative emissions is not the same as 1 kg of emission reductions. Generally speaking, the emission reduction potential of bio-CCS options is equal to the amount of negative emissions plus the emissions of the technology or fuel it replaces, in this case coal fired power plants.
[22] See also http://www.biofuelstp.eu/sustainability.html#enviro
[23] Developments are already ongoing (several schemes per crop available, like RSPO, RTRS, FSC and an EU policy based on requirements that need to be met RED 2009

conservation and 'fair trade'. These arrangements could be expanded on longer term to other crop production and agriculture, reducing the overall impacts of agriculture on biodiversity, air, soil and water resources. Some of socio-ecological impacts – like land grabbing, indirect land use change and local food security – are complex and not yet covered in the existing sustainability criteria, but developments are ongoing to incorporate those elements.

At best, biomass production can lead to abatement of poverty in rural regions, regenerate degraded lands and lead to more sustainable agriculture. If this cannot be guaranteed, large-scale biomass production could, in the worst of cases - e.g. by introducing large-scale monocultures - generate serious consequences in relation to water reserves, increasing pressure on agricultural land and forests, as well as the exclusion of small farmers. Currently there is also attention to alternative set up of biomass production through smallholders, combined plantations instead of only large scale plantations with monocultures. Nevertheless, land and water implications of biomass feedstock production will need further research especially at landscape level (TER, WWF/Ecofys).

Land availability deserves sufficient attention, like proper land planning systems, policies and enforcement. If land use is not dealt with in a careful manner, use of land for cultivation of biomass crops could compete with other uses, like biodiversity and food production. Good policies & practices and efficiency improvements in agriculture are needed to reach sufficient sustainable biomass production, especially when global use of biomass is set to the same ratio as biomass use in the Netherlands for energy supply. This might not be enough though, meaning that the overall consumption of products that require intensive land-use (like meat) should be lowered. An example is given in The Energy Report 2011 in which for a global renewable energy scenario meat consumption in OECD countries should reduce by half (TER, WWF/Ecofys).

With the use of wastes and residues as biomass feedstock for power production, green gas and advanced biofuels, the risks associated with agricultural impacts are much lower. Here attention should be paid to competition with other uses and sustainable harvesting practices, e.g. leaving sufficient biomass for soil carbon cycles in cases of forestry residues or straw for example.

Energy security

Increasing the share of biomass in the Dutch primary fuel mix will increase fuel diversity, which is advantageous for the reliability of the energy system. In particular, the dependency on oil will decrease. This is of great strategic importance given the expected shortage in oil production capacity during the first half of this century.

Furthermore, it is possible to produce biomass in different parts of the world. Potentially, important export regions will be Latin America, The South and Sub-Saharan Africa, East Europe/Russia and Oceania. This will decrease the dependency of fossil-fuel producing countries like Middle East and Russia. In general, the Netherlands will still depend on other countries for their energy needs, but might be able to source this from a wider

Changes to the infrastructure (towards 2030)

Import and conversion of (pre-)treated biomass or biofuels can use the existing infrastructure in Rotterdam and other main sea harbours without fundamental changes. Nevertheless, a significant share of the current oil refinery capacity will in due course be replaced with biomass refineries, which require additional investments.

For reference, the current oil refining capacity in the Rotterdam area is about 2.5 EJ per year. The biomass conversion described in this option would require conversion capacity for biomethane and liquid fuels for about 230 PJ (0.23 EJ) of biomass. Capacity equal to about one tenth of current installed fossil based capacity needs thus to be realised. With a gradual introduction over the coming two decades, there should not be fundamental problems.

The implementation of bio-CCS requires careful integration of three main infrastructures: the biomass supply infrastructure, energy transport (electricity, green gas and liquid fuels) and the CO_2 infrastructure. Without careful planning the suitable sites for implementing bio-CCS options in the Netherlands may be lower compared to sites for biomass and CCS separately. The most challenges are expected for implementing small scale bio-CCS options as these require at least a more sophisticated infrastructure for the transport of CO_2 compared to large scale bio-CCS options.

Macro and micro economic impact (in 2030)

The power production costs from biomass with CCS vary widely depending on size of the plant, availability and type of biomass feedstock (residues, waste, and crops), type of biomass plant (co-firing, dedicated, gasification) and transport distance to collect the biomass. The costs depend also on the type of capture installation, CO_2 transport distance and type of storage location. In 2030, the power production costs for large (co-fired) biomass plants including CCS will be in the same order as for fossil-fuelled plants including CCS, i.e. approximately 0.060 to 0.090 €/kWh, strongly depending on the price of biomass. Biomass-dedicated plants, which are typically smaller, may result up to 20-30% higher power production costs. This is mainly due to diseconomy of scale, lower efficiencies and smaller amounts of CO_2 to be transported with higher costs per tonne of CO_2. The increase in costs will result in an electricity price increase for small consumers by 10 to 30% and for 40 – 100% for industry. But it should be noted that the increase in cost will be less or even compensated (i.e. lower cost compared to fossil-CCS) if costs of CO_2 allowances are taken into account. Overall, the production cost of bio-CCS options are more sensitive to changes in biomass prices and the price of CO_2 allowances compared to the biomass options and the fossil-CCS options separately.

Expected cost price ranges of biofuels for 2030 are 10 to 20 euro per GJ (Refuel 2008, DECC 2008; IEAGHG 2011). Adding the costs of CCS the cost will increase with 1 to 2.5 euro/GJ depending on the fuel production technology. Current gasoline production costs are about 18 to 20 euro/GJ. It should be noted that the price of biomass for the longer term is hard to predict and depends both on global demand and supply.[24]

Studies indicate generally that production costs will reduce towards 2030. It is unsure how impacts on agricultural markets and commodity markets will influence the costs for bio-electricity and biofuels (e.g. if all feedstock prices will be effected, or that regional variations will not increase/decrease the prices so much). On the longer term it is expected that the impact of sustainability criteria will increase price for biomass significantly.

[24] The costs for feedstock like municipal solid wastes, sewage sludge, and animal manure are very low and in some circumstances even negative – to compensate for waste treatment costs. However, the potential of these types of feedstock is limited. Expansion of biogas production should therefore come from the use of other biomass feedstock, with higher prices most likely determined on the global market

For countries in Africa and Latin-America and East Europe, the possibility of large-scale export of renewable fuels could represent a source of significant revenues as well as increasing labour opportunities in rural areas. However, when biomass demand competes with food production, also increases in land and subsequently food prices could be observed. This should be avoided and secured by certification, effective and enforced policies, e.g. on land planning. Furthermore improvements in agricultural practices and efficiencies could highly reduce the competition with food production

The price of imported pre-treated biomass (based on residues) in 2030 is estimated at 60 to 200 euro per tonne (3 – 10 euro/GJ). It implies that the value of the required 300 PJ biomass in this package amounts to about 900 million euro or more.

Employment effects of biomass use in the Netherlands will most probably not be noticeable in jobs in the agricultural sector. Employment related to bioenergy is expected more in refinery or power production facilities, trade and harbour locations and other large scale infrastructure related jobs. Replacement of jobs in current fossil facilities by jobs in biomass facilities will be an expected effect. Employment related to production of biomass will for the larger part take place in regions outside the Netherlands (and also for a considerable part outside the EU).

Policy requirements (to implement the option)
Installations within the ETS firing biomass do not have to surrender CO_2 allowances. Captured and stored CO_2 from biomass installation do therefore not receive financial incentive for the CCS part of the operation. Co-fired power plants with CCS do not receive incentives for the CO_2 stored from the biomass part. Modifications to the current set-up of the ETS are therefore required to incentivise CCS from biomass in the same way as CCS from fossil-fuels.

Other economic of financial incentives are needed to enable the commercialisation of bio-CCS technologies. There is a need to provide funding for pilot and demonstration projects specifically for bio-CCS project. This could be in the form of investment support, production support/feed in tariff, tax incentives production quota or bonus incentives (e.g. double counting for biofuel blending targets) for biofuels with negative emissions. Another important aspect is to implement policy measures that enable the development of large scale biomass feedstock collection and supply-chains: in most EU countries there is no or limited experience with the large-scale collection and storage of biomass. Incentives are therefore essential to help establish agriculture and forestry biomass supply-chains and reduce feedstock uncertainty and, with it, the overall risk of advanced biofuel scale-up investments (EBTP/ZEP 2012).

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B.7. Option 7: Electricity Produced By Nuclear Power.

The goal of this packet is to reduce 25 million tonnes CO_2 in 2030 by increasing the amount of electricity produced by nuclear power, from the current 450 MW_e to 5390 MW_e in 2030.

Description of the option

In the Netherlands there is one working nuclear power plant in Borssele. In 2011, the electricity production of Borssele was 3.9 TWh_e (4% of the total electricity produced in the Netherlands). Current plans are to keep the Borssele unit open until the end of 2033.This is under the condition that the operator ensures that the facility, which is a Light Water Reactor, will continue to belong to the 25% safest water-cooled and water moderated nuclear power reactors in the EU, USA and Canada.

Comparison Current Situation-Situation in 2030

A reduction of 25 Million tonnes CO_2 in 2030 would require that new nuclear plants should be installed with a total capacity of 4940 $MW_{e.}$ This could be done by adding 3 to 4 large plants. The most likely technology will be an Advanced Light Water Reactor (ALWR). Trends in the design of ALWR are the long life span of the plants (e.g., 60 years) and the use of passive safety systems, which do not require immediate active operator intervention in case of malfunction, have a lower probability for the core of the reactor to melt (as was the case in the nuclear accident in Fukushima (Japan)) and include measures such as a 'core catcher' that will catch molten core material and prevent it from escaping the containing building. Examples of ALWR are the European Pressurized Water Reactor (currently being built in amongst others Finland and France) and the Advanced Boiling Water Reactor (in operation since 1996 in the United States and Japan).

Long- term potential

Nuclear plants require relatively small amount of fuels, a 1000-MW(e) LWR, for instance, demands about 200 tonnes of natural Uranium per one year (equivalent to roughly 20 tonnes enriched uranium per year. The 450 MW plant in Borssele consumed about 7 tonnes enriched uranium in 2011). For the next century there are no resources constraints concerning uranium foreseen. Identified exploitable reserves of Uranium (reasonable assured and inferred) available at less than 40$/kgU are reported at about 3 million metric tonnes and about 19 million metric tonnes for total uranium reserves and resources available at less than 130$/kgU (current global reactor requirements are about 70 thousand tonnes Uranium per year; natural Uranium prices in 2011 were about 130$/kgU). In the future, new exploitable mines are likely to be discovered and in case of shortages, Uranium could be exploited from seawater (uranium can be found in the world's ocean at a concentration of about 3-4 ppb, that is about 4 billion tonnes of Uranium with an estimate cost of recovery 2 to 10 times higher than land uranium mining). It is also assumed that new reactors will recycle spent nuclear fuel, increasing the electricity production per unit of Uranium by 10 to 15%.

Environmental consequences

Emissions. Nuclear energy emits low amounts of greenhouse gases during operation. If the total chain of activities for nuclear power production is accounted for (mining operations, nuclear fuel conversion, nuclear power plant operation, decommissioning, transportation and waste disposal) values in the order of 3 to 24 gCO_2 per Kwh are reported in the literature, which is significantly lower than emissions reported for fossil fuels (950 to 1250 gCO_{2e}/Kwh for coal power plants and 440 to 780 gCO_{2e}/Kwh in natural gas fired power plants). The values for nuclear plants are at a similar level than those reported for renewable sources (e.g., 8 to 30 gCO_{2e}/ kWh for wind energy; 43-73 gCO_{2e}/ kWh for PV; 1 to 34 gCO_{2e}/ kWh for hydro).

Nuclear energy does not produce local or regional air pollution ($NO_{x,}$ $SO_{x,}$ Particular Matter). It releases, however, small amounts of radioactive materials during normal operation of nuclear power plant operation and fuel cycle facilities. These releases are strictly regulated and resulting radiation doses are below those caused by natural background radiation. The effects of accumulation of radioactive materials in the atmosphere have however received little attention up to now but they may be limited.

The environmental burden of mining and processing uranium depends on the type of mining, mine operation, and management of the residual products of ore processing. Involved miners are exposed to natural radon gas and dust particles, which are considered a risk factor for lung cancer.

Land use. Nuclear energy has low land requirements. An ALWR (1000 MWe) would occupy an area of about 2 to 5 km^2. This amount is in the same order of magnitude than the amount required by fossil fuel plants, but it is significantly lower than for power generation based on renewables (for the generation of 1000 MWe, it is required solar parks between 20-50 km^2 or, in the case of wind, areas between 50-150 km^2).

Nuclear Waste Disposal. The management of high-level radioactive spent fuel is a main problem of nuclear energy. Although it is a relatively small amount (in 2011, Borssele produced about 1.5 m^3 of high-level radioactive spent fuel and 25 m^3 of low-level radioactive waste), high radioactive waste generates heat until years after having been unloaded from the reactor core while remaining highly radioactive for several hundreds of thousand years. No country has yet successfully implemented a system for permanently disposing of this waste. It is possible to reprocess the spent fuel to recover the plutonium, mix it with uranium and feed it back to the nuclear reactor. In this way, the amount of waste is somewhat reduced and less natural uranium is needed. Worldwide only one-third of spent fuel is reprocessed today but some studies indicate that reprocessing may be at the basis of future waste disposal. There is, in any case, need for final disposal options and in the future this will most like happen in deep geological repositories. In the Netherlands, storage in clay formations has been suggested as a viable type of permanent geological storage. There are public concerns about uncertainties on the performance of geological repositories over a time scale of hundreds of thousands of years. The impact of radiation and heat on, for instance, host clay formations is still under research.

In theory, technologies can be used to decrease the time that nuclear waste will remain radioactive (e.g., from 250.000 years to 500-1000 years). These technologies are at an experimental stage and it may take decades before it becomes available on an industrial scale. Some studies estimate that when this technology is available in the market, it may increase the electricity production costs from nuclear plants by about 20%.

Safety risks

Nuclear Reactor Safety. If compared with other fuel cycles, the consequences of a severe nuclear accident can be significantly larger: hundreds to thousands fatalities per accident; hereditary effects; radioactive contamination of areas surrounding the reactor with the consequent loss of land and economic activities, need for massive evacuation of people for many years, and impact on the populations of existing ecosystems. ALWRs are designed with the specification that the consequences of such an accident should be limited to the reactor premises. It is stated that in case of an accident, about 20*40 km^2 of land around the reactor will be unusable for several years (one year being the most optimistic scenario). For comparison purposes, residents within 20 km of Fukushima Dai-ichi (Japan), which used LWRs, were evacuated and those between 20 and 30 km were advised to remain in their homes as shelter or voluntarily evacuate.

Historically, the probability that a severe nuclear accident happens has been estimated as very small. The chance of a core damage accident in a current LWR is reported between 1 per 115,000 per reactor per year. However, statistically if core damage events that have taken place are accounted for, the chance is in the order of 1 per 800 per reactor per year (if all events are taken into account) to 1 per 2000 per reactor per year (if only the 5 serious core melt down are accounted for). Since ALWRs operate with passive safety systems, they are expected to have lower levels of risk to the public than current LWRs. Developers of ALWRs report risk of accidents in the order of 1 per 1.000.000 or less, that is a factor 10 lower than the historical rate. Some experts, however, have indicated that since it is not possible to take into account all possible events, the current methods used to assess risk underestimate the probability of an accident. New nuclear reactors should for instance be designed to stand extreme external events (flood, earthquake, extreme weather, chemical explosions, airplanes crashes).

Due to the low levels of probability of a severe accident, the total mortality of nuclear fuel cycle operation is estimated to be significantly lower than for coal and gas based fuel cycles. A historical analysis for the period 1961-2000 shows that the *immediate* fatalities associated with the full energy chain are 6 fatalities/TWh_e for nuclear, 93 fatalities/TWh_e for gas, and 876 fatalities/TWh_e for coal. The estimated risk for *latent* fatalities, that is deaths resulting from the exposure of radioactivity over long periods after the event, is in the order of 10-1000 fatalities/TWhe (note that other fuel chains also have latent fatalities, for instance, premature deaths resulting from levels of fine particulates in the air was estimated for the year 2000 at 960.000, 30% of which is estimated to be caused by fuel combustion).

Nuclear Weapon Proliferation. Some experts hold that there is no causal relation between civil nuclear power and nuclear weapon proliferation (fission devices based on high enrichment uranium or plutonium) since the risk of proliferation is mainly driven by political decisions and not by the technology itself whereas other experts hold that increasing world civil nuclear power could increase the risk of proliferation. The risk is associated with the development of nuclear knowledge, nuclear installations (including enrichment facilities, research reactors and reprocessing plants), inadequate controls, transfer of technologies and increasing availability of separated plutonium that could be used for nuclear weapons. Note however that eliminating civil nuclear power does not eliminate the possibility of a country embarking on a nuclear weapons program. In Europe, nuclear activities are subjected to inspection activities by international bodies (EURATOM and IEAE) to verify that they are only used for peaceful activities.

Nuclear Plant Security. An additional source of concern has risen since 'September 11, 2001': the possibility of terrorist attacks on nuclear installations (power plants and spent fuel cooling ponds). For new power plants, explicit design requirements are being set with regard to resistance to a terrorist attack, including the threat of a plane crashing.

Macro and micro economic impact (in 2030)

Nuclear plants are characterized by high construction costs and low direct fuel and O&M costs. The construction costs of an ALWR plant are about 1.5-3 times more than an equivalent capacity conventional power plant based on fossil fuels (investments costs for an advance power reactor are about 1600 to 5900 $/kWe with a median value of 4000$/kWe). It is possible that the construction costs will be even larger due to new safety and security criteria and procedures. After its life time (in the case of an ALWR, 60 years) a nuclear plant will need to be decommissioned. The amount of money needed to rehabilitate the site of a nuclear plant (for a current reactor type) is estimated at about 10 to 15% of the initial investment cost. The cost of electricity is in average about 10 to 30% lower for nuclear plants compared to coal and gas power plants. These estimates do not include external costs. A study commissioned by the EC (NewExt) estimated that, if the price of electricity were to include the consequences of health and environmental damage (due to normal operation of the power plant), the price of electricity produced by nuclear power would increase about 0.4 euro cents/kWh (0.2-0.7 cent averages in different European countries), while for coal it would be over 4.0 cents (2-10), gas ranges 1.0-4.0 cents and only wind shows up better than nuclear, at 0.05-0.25 cents/kWh.

Security of supply

New nuclear power plants have no notable effect on integration in and flexibility of the electricity system. Nuclear energy is less subject to supply security issues than fossil fuels both with respect to supply disruptions (uranium supply is geographically and politically diverse) and price volatility. For instance, a doubling of natural gas price would generate a 65-75% increase kWh_e price, while doubling uranium price would only increase the kWh_e price by 5-9% (fuel costs in a nuclear energy account for about 3-5% of the electricity costs while in a natural gas power plant the share is about 80%). In case of sudden failure, the reliability of electricity supply is no more or no less threatened than in case of sudden failure of a coal fire power plant. A main difference with fossil fuel power plants is that in case of an accident (such as Fukushima), nuclear power plants that do not have a failure could also be shut down (as preventive measure) and therefore serious disruptions in the electricity system may occur.

Employment

Expansion of nuclear energy in the Netherlands is expected to stimulate nuclear research, especially at research institutes and universities. A 2009 study indicated that construction and operation of a 1600 MWe nuclear power plant will create an average of 1500 direct jobs on the site itself for a period of five years, with peaks of between 2500 and 3000. In the operational phase there will be 500 jobs.

Others

A study assessing the vulnerability of Borselle in situations comparable to the Fukushima accident, identify flooding as the most important external hazard. If the new reactors are located near the sea (as in the case of Borssele) it will be necessary to reinforce the dikes, so that they can resist a so-called super-storm.

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Appendix C. Information for lay people (English)

C.1. Global warming

Drought

The expected increase in temperature has consequences for the climate of the entire world. Some regions of the world may experience extreme drought as a result of global warming. The chances are fair to high that global warming will lead to an increase of failed crops and famine, especially in regions that already experience drought.

Warmth

In areas where the temperature is currently low, for instance Siberia, the climate may become less cold. The agricultural yields may increase there. New natural areas may develop in some parts of the world.

More extreme weather

In other areas the greenhouse effect may lead to changes in extreme occurrences such as heavy rainfall, snowfall and storms. Experts expect the violence, duration and intensity of many of these occurrences to increase. Storms and hurricanes are likely to become more violent en cause more damage. The risk of floods will increase in many areas due to heavy rainfall, snowfall and storms.

Rising sea level

The increase in temperature will cause part of the polar cap and ice caps to melt and the seawater to expand, causing the sea level to rise. In some areas, local sea currents can cause a higher or lower sea level near the coast. Around the Netherlands the rising sea level may accumulate to 85 centimetres this century. Lower lying areas in the world now may be submerged. For example, countries that consist of groups of small islands are expected to be partially or completely submerged in the course of this century as a result of the rise in sea level. Nature will be affected all over the world, and natural habitats will disappear as a result of the increase in temperature and the rise in sea level. As a result, many species of plants and animals may face extinction. Coral reefs are very vulnerable and may disappear because of the global rise in temperature. Vulnerable countries or natural areas may be affected or may disappear.

Rising water in and around the Netherlands

In the Netherlands, the increase in temperature on earth could mean that the Dutch will more often be confronted with rivers flooding because of heavy rains. To avoid this, the government has decided to dedicate areas as flood meadows to cope with temporary excesses of river water. The establishment of these areas and the increase in flood risk areas will diminish the areas available for living and working. Additional measures will have to be taken to protect the coastline from the rise of the sea level and the anticipated heavier storms. The coastal defences must be strengthened, for instance by raising the dykes. In addition, the river dykes will need to be raised to prevent flooding. Overall, protective measures may be necessary and the Dutch areas for living and working may be diminished.

Victims in poor countries

Not all countries will have the means to adapt. The poorest countries of the world are probably the least able to take adequate measures. The negative consequences of global warming will usually be strongest in warmer, and often poorer, countries. Floods, for example, already cause tens of thousands of deaths worldwide on an annual basis, and this number may increase exponentially over the course of the century. These deaths will, for the most part, occur in poor countries. Developing countries will also be increasingly exposed to threats such as famine and infectious diseases. Because of this, many people in poor countries may be forced to emigrate.

Summers in the Netherlands
In the Netherlands, the summers will on average be warmer. There will be more heat waves. People in poor health (for example the elderly) will fall ill more often and die of heat and of the increase in germs. The warmer summers may cause an increased incidence of tropical diseases in the Netherlands. Expectations are that more allergies will occur and that more diseases will be spread by insects, such as Lyme's disease.

Winters in the Netherlands
The winters in the Netherlands will be less cold. There will be fewer cold fronts, so that fewer people will fall ill or die because of the cold.

C.2. Reducing CO_2 emissions in houses and buildings

This package aims to reduce CO_2 emissions by 25 million tonnes in 2030, by reducing the energy use of buildings such as houses, schools and swimming pools. Examples include improving insulation, double glazing or high-efficiency glazing, more efficient appliances and changing behaviour. Moreover, techniques should be used to generate energy locally, for example with solar panels, solar boilers and heat pumps. A solar boiler uses the heat of the sun to heat water, for example for the shower or for central heating. A heat pump is a device that makes sustainable use of the environment (e.g. air or water) to heat your dwelling in the winter and to cool it in the summer. To realise this package, a combination of these measures is required. Energy saving in building can for example be realised through improved insulation and more efficient appliances, but also by changing behaviour, for example lowering the thermostat by one degree. Energy efficiency involves a reduction in the energy that is needed to realise the same result. For example, a reduction in the energy that is needed to heat a medium-sized dwelling. More efficient appliances, improved insulation in dwellings and more efficient energy use will reduce the energy use while still realising the same result.

Contribution to environmental quality
Once this package of measures has been implemented, air pollution will decrease. And the noise hindrance is also likely to decrease (due to improved insulation). There will also be less waste and water use will be reduced. Some systems may still need fuel from coal or gas. As more energy is generated locally, differences in local air quality can be expected.

Use of natural resources
For this package appliances and machines will be developed which are not only more efficient, but also have a longer operating life. As a result, appliances and machines will need to be replaced less often. This reduces the use of materials needed to make these appliances and machines. It also reduces the amount of waste, because materials are used more efficiently and because appliances and technologies are not discarded as quickly as before. Rare metals will be needed to make energy efficient appliances, for example energy saving lamps or solar panels. The demand for such metals will increase and therefore raise their price. Rules will need to be drafted to improve their reuse.

Availability of energy
As less energy is needed for houses and buildings, the pressure on the electricity grid will decrease. This will reduce the risk of a power outage. On the other hand, using solar panels to generate energy at home will not result in a constant energy supply (the sun does not always shine), which actually increases the risk of a power outage. As fewer raw materials need to be imported, this package reduces the dependency on energy obtained from politically unstable regions. This package is therefore likely to result in the availability of sufficient energy.

Economic consequences
People will need to invest to make houses and buildings more energy-efficient. For most households, this will amount to one thousand to a few thousand euros. However, houses that have poor insulation may face higher costs. It may not be possible to earn back all these investments. To generate energy locally, expensive equipment will often need to be purchased. More efficient appliances such as an efficient washing machine or a freezer are usually more expensive to buy. However, as they are more efficient and often also have a longer life than less efficient appliances, it may be possible to earn back part of or even the entire investment.

Consequences for employment
As the measures for this package need to be implemented quickly, new jobs will arise to carry out all the renovations of the houses and buildings. There may not be enough people who can do the work before 2030. As a result, the prices of renovations may rise and waiting lists may arise.

Consequences for houses and buildings
This package will implement strict measures to enforce energy efficiency improvements of new houses and buildings. Improving the efficiency of poorly insulated houses and buildings may even become obligatory. Improved insulation will in most cases increase living comfort, decrease noise hindrance from outside and decrease humidity and moulds inside the house.

Price
This package encourages people to decrease their energy use. This can be realised, for instance, by raising the energy tax. This will increase the price of energy, but to what extent is not known. The government may possibly decide to use the additional income from the energy tax to lower other taxes. As houses and buildings are becoming more energy efficient, energy use will decrease.

C.3. Reducing the CO_2 emission in industry

The aim of this package is to reduce CO_2 emissions by 25 million tonnes in 2030. This package addresses energy saving in the Dutch industry. Examples of measures that can be taken to save energy include the use of energy sources with low CO_2 emissions, the development of new, ground-breaking techniques to manufacture products, changing the design of products so that fewer materials are needed, and improving materials use and reuse. Making power plants more efficient is not included in this package.

Contribution to environmental quality

Once this package of measures for energy efficiency has been implemented, the air pollution will decrease. And the noise hindrance is also likely to decrease (due to improved insulation). There will also be less waste and water use will sometimes be reduced. Reducing the number of products and the amount of materials used will lower the need for extracting and processing natural resources.

Availability of energy
As the manufacturing of products requires less energy, the load on the electricity grid is lower. This will reduce the risk of a power outage. On top of this, the package will also reduce the dependency on energy supplied by politically unstable regions. This package is therefore likely to result in the availability of sufficient energy.

Economic consequences
In the past, the Netherlands used to be frontrunner in the field of knowledge and application of energy efficiency, but this has diminished in the past years. More strict rules on CO_2 emission and energy saving in production could give impetus to reinforcing that position once again.

Consequences for employment
It is not entirely clear what the exact consequences of this package are for employment. Some studies show that the number of jobs will increase, whereas others claim that the number of jobs will slightly decrease. If rules for energy saving in industry were to be implemented in the Netherlands only, there could be a risk that businesses decide to relocate to other countries to avoid having to comply with the stricter regulations of the Netherlands, hence improving their competitive position. This could lead to the loss of jobs of people in the Netherlands.

Consequences for industry
This package will require ground-breaking technologies, which cost more money. These ground-breaking technologies are more expensive for the industry. Due to these additional costs for the industry, some products may become more expensive for the customer. In this package, the industry is responsible for clearing packaging and reusing products. One example is the implementation of a packaging deposit, not only for soft drinks, but for many more types of packages or products. To ensure that this package is truly realised, the government will need to impose strict rules on the industry. Measures will be developed for the industry to make certain technical adjustments, and subsidies and taxes will for example be used for investments in energy saving in manufacturing.

Consequences for consumers
As products are manufactured much more energy efficiently in this package, some products may be more difficult to market or may become more expensive. As the industry is responsible for recycling products, measures will be implemented to stimulate recycling among consumers, for example information provision, or penalties for not separating waste.

C.4. Electricity from wind turbines at sea

The aim of this package is to reduce the CO_2 emission by 25 million tonnes in 2030 by building 15 wind farms in the Dutch part of the North Sea. These wind turbines deliver electricity. The wind farms will be placed at various locations along the Dutch coast at a distance of minimally 20 kilometres off the coast.

Consequences for view
For this package, 15 wind farms with a total of 2000 wind turbines will be placed in the Dutch part of the North Sea. These wind turbines will be about 150 metres high, including the rotor blades, which are up to 60 metres long. On some days of the year, when there is a very clear view, some wind turbines may be visible from the coast.

Consequences for birds
Every year, one wind turbine causes 18 to 28 birds to die because they fly into the rotor blades. The number of birds that die because of wind mills is less than one hundredth of all birds that due because of human activity, for example because they collide with windows, buildings, cars, trains or airplanes, or due to oil disasters, domestic cats or agricultural pesticides. With this package, more wind turbines will be built, but as they are placed far away from the coast, these wind turbines are expected to kill fewer birds compared to the wind turbines on land.

Consequences for fish and mammals at sea
So far, research has shown that the movements of fish and mammals are not influenced by wind turbines ate sea, as long as their natural habitat is not too much disrupted by large wind farms. It is still unknown which kind of disruption would cause hindrance for fish and mammals. Wind turbines can act as artificial reef and offer protection to fish, allowing the fish population in the North Sea to grow. The installation and placing of wind turbines may be harmful for fish and mammals.

Consequences for fishery
Placing wind farms at sea will decrease the fishing grounds in the Dutch part of the North Sea. The wind farms are expected to take up one-twentieth of the Dutch North Sea. It may be that the entire area where the wind turbines are placed, including a safety zone, will no longer be accessible to fishermen. The main effects will be loss of fishing grounds and possibly additional sailing times to reach the areas where fishing is allowed.

Availability of energy
As wind farms depend on the availability of wind, they sometimes produce too much electricity, or too little at other times. In 2030, there will be various options to store a surplus of electricity such that it can be used at a later stage (i.e. at times of low wind), for example temporary storage of energy by means of water reservoirs, hydrogen, or the use of other sustainable energy sources. To enable transport of the surplus of electricity, expansion of the capacity of the electricity grid will be needed and the existing grid will need to be used more efficiently. This will lead to additional electricity cables.

Consequences for employment
This package involves the building and maintenance of many wind turbines. This is expected to lead to about 18,000 new jobs, most of which in the Netherlands. Most jobs are needed for the building, planning and installation of wind turbines. A limited number of jobs involve maintenance to the wind turbines.

Price
The price of electricity that will be generated with this package will be 10-15% higher for households in 2030 compared to what they pay for electricity today. The industry will need to pay 20-70% more for electricity generated by wind turbines.

C.5. Conversion of biomass into fuel and electricity

The aim of this package is to decrease the CO_2 emission by 25 million tonnes by having part of the cars drive on fuel from biomass or by firing power plants with biomass. Biomass is a term that covers all kinds of organic materials such as wood, grass, organic (fruit, garden and vegetable) waste, straw, and so on. Biomass can be used to replace fossil fuels in the generation of electricity, but also to produce car fuel. Plants absorb CO_2 when they grow. This CO_2 is released upon incineration of the biomass. The incineration of plants does not release more CO_2 into the air than the amount that is absorbed from the air by these plants, which makes biomass CO_2 neutral. The package itself is not entirely CO_2 neutral, as CO_2 is released when using land for growing biomass crops and because the biomass also needs to be transported and processed. To have sufficient biomass available in 2030 to decrease the CO_2 emission by 25 million tonnes, it is estimated that the majority of the biomass will need to be obtained from abroad. Both in the Netherlands and abroad, the largest share of this biomass is converted into modern biofuel for cars. To convert biomass into biofuel, biofuel plants will need to be built. Part of the oil refineries, where crude oil is converted into petrol and diesel, may possibly also be slowly converted into or replaced by biofuel plants.

A smaller part of the biomass will be converted into electricity in the Netherlands in 5 to 8 large power plants in seaports such as Rijnmond, Eemshaven or Terneuzen.

Contribution to environmental quality
Deployment of this package in 2030 will slightly reduce air pollution and improve air quality in the Netherlands.

Land use for biomass with certificate
Land is needed to obtain biomass. To obtain enough biomass for this package, a land area the size of once or twice the surface of the Netherlands will be required. That is why most of the biomass will be imported from regions such as Latin America, Southern and Eastern Africa, Eastern Europe/Russia and Southeast Asia. Biomass that is thus produced in a responsible manner (for example from grass or trees) will be given a certificate (comparable to for example the certificate for hardwood). Responsible biomass can generate more income and more employment as well as reduce poverty in the above-mentioned regions. Moreover, the cultivation of this type of crop can improve the land quality and lead to more sustainable agriculture.

Land use for biomass without certificate
Some experts think that the Netherlands will be able to import enough certified biomass for this package. Other experts, however, think that this may not be possible, for example when other countries also start importing large quantities of biomass. Biomass without certificate is not always produced responsibly, which may have serious consequences for the areas where the biomass is cultivated. In the worst case, water reserves may become exhausted in these areas, and other types of agriculture and woods may be destroyed and small farmers chased away.

Influence on food production
When many countries start using biomass, this may require so much agricultural land that less land is available for growing food crops. By improving agriculture in areas with low yields, the same amount of food crops can be grown with less land use, thus leaving more land for the cultivation of biomass. Biomass can also be planted in soil that is unsuitable for other types of agriculture. Biomass cultivation may in some cases lead to more agricultural

land. Land that was previously unsuitable for growing food crops may become suitable for food crops as a result of biomass cultivation. Agricultural or forestry waste, which otherwise would not have been used (e.g. waste wood, saw dust or straw) can be used as biomass.

Biomass cultivation can lead to competition with food crop cultivation, but at the same time also improve soil management, stimulating better and more efficient food crop cultivation.

Availability of energy
The feedstocks that are needed to generate energy need to be partly imported from other countries. We aim to reduce our dependency on the political decisions of only a few countries (cf. our strong dependency on oil from the Middle East). Biomass can be obtained from many more countries compared to for example petroleum. As a result, the package will reduce the dependency on energy supplied by politically unstable regions. This package is therefore likely to result in the availability of sufficient energy.

Consequences for employment
The sectors of industry and transport may benefit from large-scale import of biomass and the establishment of new industry. This package will probably not create more jobs in the agricultural sector, but is likely to create more jobs in technical functions, in trade and in the ports. People that are currently employed in the oil and gas sector will probably switch to the biomass industry. This is likely to increase employment in the areas from which biomass is imported.

Economic consequences
In this package, fossil fuels are replaced by biomass. To this end, one tenth of the existing production based on fossil fuel will need to be replaced by biomass. Existing infrastructure can be used for transport of biomass, hence there is no need for additional investments. Some investments are needed though for the conversion of existing power plants or the construction of new ones.

Price
This package will lead to a biofuel price in 2030 which is comparable to the price of petrol or diesel produced from oil. The price of electricity is expected to stay at today's level, both for consumers and for the industry.

C.6. Conversion of coal or gas into electricity with underground storage of CO_2

The aim of this package is to reduce the CO_2 emission by 25 million tonnes by capturing CO_2 arising in gas-fired and coal-fired plants and partly storing the CO_2 underground in the Netherlands or under the seabed of the Dutch part of the North Sea. CO_2 capture can take place in existing power plants or be integrated in new plants. The CO_2 capture technique allows for capturing the largest part of the emission, i.e. 80 to 90% of the CO_2. CO_2 capture does use quite some energy, however. With this package, about half of all energy generated with coal and gas in 2030 will come from power plants with CO_2 capture technology. The technique of CO_2 storage is already applied in other ways, but not yet on this scale. This package can only be used temporarily as the available space in which CO_2 can be stored is limited. Based on our current knowledge of the Dutch soil, there is an estimated storage capacity of 100 to 300 years. However, further research into safety and availability is needed to determine if this entire storage capacity can actually be used. Further research may also demonstrate that there is more storage capacity available than currently expected.

Contribution of coal mining to pollution
The coal that is needed for the power plants is mined abroad. In some countries, the immediate surroundings of coal mines are often heavily polluted, and to a lesser extent in other countries. Strongly depending on the countries from which the Netherlands imports its coal for this package, the country, the water and the air in the vicinity of the mine may get slightly to very heavily polluted. The miners' working conditions differ strongly per country.

Contribution to environmental quality
Next to reducing the CO_2 emission, the technique also reduces other hazardous substances that are emitted by the power plants. Implementation of this package in 2030 will reduce air pollution and improve the environmental quality. In some cases, the deployment of CO_2 storage may lead to increased emission of other gases that are harmful for the environment, because certain chemical substances need to be used to capture the CO_2.

Safety of CO_2 transportation in pipelines
Air that contains too much CO_2 is hazardous and even lethal in case of very high concentrations. During CO_2 transportation, a pipeline may spring a leak, causing CO_2 to be emitted into the air. There is a small risk that the amount of CO_2 that lingers in the air is so large that it is hazardous for humans, animals and plants. The risk of such as leakage is comparable to the current risk of gas leakages in underground natural gas pipelines in the Netherlands. This package will require up to 600 to 1000 kilometres of pipeline, part of which subsea. With this quantity of pipelines, accidents may be expected to occur once every two years, but this need not always lead to CO_2 escaping into the air. Expectedly, careful monitoring may reduce the risk of leakage in a CO_2 pipeline to practically zero.

Safety of underground storage of CO_2
Similar to gas extraction, CO_2 injection into the ground may cause minor earth quakes. It may lead to cracks in buildings in the area.
Once CO_2 has been stored underground, leakage may occur as a result of poorly sealed wells and through the cracks and tears in the sealing layer of the underground space. If an underground space continues to leak for years, this will partly undo the emission reduction of the package. Although experts are not sure how much CO_2 would be released into the air, this will probably involve very small amounts. Moreover, there is a very small risk that leaked CO_2 accumulates in low-lying, confined spaces such as basements. This could be harmful, even lethal, for humans, animals and plants that occupy such kind of space.

There is a small risk that leaked CO_2 acidifies the groundwater in the area. If this is drinking water, it renders the water unsuitable for consumption unless an additional treatment step is conducted. Careful monitoring will expectedly reduce the risk of CO_2 leakage from underground spaces to practically zero.

Availability of energy
The raw materials needed to generate energy need to be partly imported from other countries. Our aim is to limit our dependency on the political decisions of only a few countries (cf. our currently high dependency on the Middle East for oil). Coal can be imported from numerous countries. Gas, however, can be imported from fewer countries. This package is likely to result in the availability of sufficient energy.

Price

The price of electricity that will be generated with this package will be 10-15% higher for households in 2030 compared to what they pay for electricity today. The industry will need to pay an additional 40-100% for electricity from biomass with CO_2 storage.

C.7. Conversion of biomass into electricity and fuel with underground CO_2 storage

The aim of this package is to reduce the CO_2 emission by 25 million tonnes by means of replacing fossil fuels by biomass and by capturing and storing CO_2. Biomass is a term that covers all kinds of organic materials such as wood, grass, organic (vegetable, fruit and garden) waste, straw, and so on. Biomass can be used to replace fossil fuels in the generation of electricity, but also to produce car fuel. Plants absorb CO_2 when they grow. This CO_2 is released upon incineration of the biomass. The incineration of plants does not release more CO_2 into the air than the amount that is absorbed from the air by these plants, which makes biomass CO_2 neutral. In addition, this package combines the use of biomass with CO_2 storage. The CO_2 that is released upon incineration of biomass is stored. A power plant that is fired with biomass removes half of or the entire amount of CO_2 from the air that a coal-fired plant emits into the air. To have sufficient biomass available in 2030 to decrease the CO_2 emission by 25 million tonnes, it is estimated that the majority of the biomass will need to be obtained from abroad. A small share of the plants that produce energy or fuel will be converted and 2 to 3 new plants will be built to enable the production of electricity from biomass and CO_2 storage. Not all CO_2 emissions can be captured that are emitted when incinerating biomass for energy. In some techniques, this amounts to one third of the emission.

Contribution to environmental quality
Implementation of this package in 2030 will reduce air pollution.

Land use for biomass with certificate
Land is needed to obtain biomass. To obtain sufficient biomass for this package, the largest share of biomass will be imported from regions such as Latin America, Southern and Eastern Africa, Eastern Europe/Russia and Southeast Asia. Without CO_2 storage, the amount of land needed for biomass production will amount to once or twice the total surface area of the Netherlands. However, as less biomass production is needed to reduce the same amount of CO_2 if CO_2 storage is deployed, this will also reduce the amount of land needed. Biomass that is produced responsibly (for example from grass or trees) will be given a certificate (comparable to for example the certificate for hardwood). Responsible biomass can generate more income and more employment as well as reduce poverty in the above-mentioned regions. Moreover, the cultivation of this type of crop can improve the land quality and lead to more sustainable agriculture.

Land use for biomass without certificate
Some experts think that the Netherlands will be able to import sufficient biomass with certificate for this package. However, other countries think that this may not be feasible, for example when other countries also start importing large amounts of biomass. Biomass without certificate is not always produced responsibly, which may have serious consequences for the areas where the biomass is cultivated. In the worst case, water reserves may become exhausted in these areas, while other types of agriculture and woods may be destroyed and small farmers chased away.

Influence on food production
When many countries start using biomass, this may require so much agricultural land that less land is available for growing food crops. By improving agriculture in areas with low yields, the same amount of food crops can be grown with less land use, thus leaving more land for the cultivation of biomass. Biomass can also be planted in soil that is unsuitable for other types of agriculture. Biomass cultivation may in some cases lead to more agricultural land. Land that was previously unsuitable for growing food crops may become suitable for food crops as a result of biomass cultivation. Agricultural or forestry waste, which otherwise would not have been used (e.g. waste wood, saw dust or straw) can be used as biomass.

Biomass cultivation can lead to competition with food crop cultivation, but at the same time also improve soil management, stimulating better and more efficient food crop cultivation.

Availability of energy
The raw materials needed to generate energy need to be partly imported from other countries. Our aim is to limit our dependency on the political decisions of only a few countries (cf. our currently high dependency on the Middle East for oil). Biomass can be obtained from many more different countries compared to for example petroleum. Therefore, this package will reduce the dependency on energy supplied by politically unstable regions. This package is therefore likely to result in the availability of sufficient energy.

Consequences for employment
Industry and transport may benefit from large-scale biomass import and the establishment of new industry. This package will probably not create more jobs in the Dutch agricultural sector, but it will create more jobs in technical functions, in trade and in the ports. People that are currently employed in the oil and gas sector will probably switch to the biomass industry. This is likely to increase employment in areas from which biomass is imported.

Economic consequences
In this package, fossil fuels are replaced by biomass. To this end, one tenth of the existing production based on coal, oil and gas will need to be replaced by biomass. Existing infrastructure can be used for transportation of biomass, hence there is no need for additional investments. When the combination of biomass and CO_2 storage is used in smaller biomass installations, this will require additional investments in an infrastructure that is suited for this purpose. Investments are needed to convert existing power plants or to build new ones. Smaller installations will face higher costs.

Price
The price of electricity that will be generated with this package will be 10-30% higher for households in 2030 compared to what they pay for electricity today. The industry will need to pay an additional 40% to 100% more.

C.8. Electricity from nuclear plants.

The aim of this package is to reduce the CO_2 emission by 25 million tonnes in 2030 by generating electricity in 4 to 5 nuclear plants, one of which is an existing plant: Borssele. Nuclear plants use uranium as a source of energy. Uranium ore is obtained through mining. When generating electricity from uranium, CO_2 is not produced. The amount of uranium needed for this package will be available for at least one hundred years, even if more countries start using uranium and hence increase its global use. More uranium is likely to be found in other places and the amount of uranium needed to produce a certain amount of electricity will probably decrease over time. Therefore, there will be sufficient uranium for these plants for a long time.

Radioactive radiation under normal operating conditions
Under normal operating conditions, nuclear plants produce very small particles that emit very small quantities of radioactive radiation, which is lower than the radiation that is present in the environment by nature. This amount does not cause any health problems in the short term. Some experts think that there will not be any consequences in the long term for mankind and nature of very low quantities of radioactive waste, while other experts feel that there is not enough knowledge on this topic to make such statements. Miners who extract the substances from the mines, which are needed for this package, are exposed to substances that may be carcinogenic.

Nuclear waste
The preparation of uranium for use in nuclear plants, but especially the deployment in the nuclear plant itself, leads to nuclear waste. A small part of this nuclear waste is highly radio-active for thousands of years; it emits very much radiation, which is limited by packaging the waste. In this package, nuclear waste will probably be stored deeply underground. Experts think that this storage method will be safe for the first centuries to come and that leakage will not occur. Experts think that the risk of leakage after this period is extremely small, but they acknowledge the existence of uncertainties, because it is hard to predict what will happen underground. Some experts think that by 2030 nuclear waste can be treated such that it will only be highly radioactive for 500 to 1000 years. Other experts doubt whether this nuclear waste treatment technique will be advanced enough to be ready for use in 2030. Leakage can be hazardous for the health of plants, animals and humans, for example when this leakage occurs near ground water. This can be prevented by not storing the nuclear waste near ground water, but there is no full certainty that after thousands of years the groundwater will not have come any nearer the storage facility. All in all, the best prediction that experts can make is that the risk of danger to the health of plants, animals and humans caused by leakage is extremely small.

Safety of nuclear plants
The nuclear plants in this package have been built such that human intervention is not needed to check the system for failures or to solve them. A protective dome will be built around the nuclear plants. The new nuclear plants will be safer than the current generation of nuclear plants, as for example the nuclear plant in Fukushima. The nuclear plants in this package are as safe as, for example, the current chemical industry in the Netherlands. The risk of a serious accident is very small. An example of a very serious accident with the nuclear plants in this package is when there is an accident involving the reactor. People who are within a 1500 metre distance from the plant will need to be evacuated and never be allowed to return there. The area of about 20 by 40 kilometres around the plant will also need to be evacuated. This area will be entirely unusable for at least one year, but this may be much longer. As the new plants are even safer than the current ones, the risk of a very drastic accident is very small (one in a million). However, some experts say that these risks cannot be estimated and that the risks are in fact underestimated. The largest risk for the plant in Borssele is flooding. If new plants are built at similar locations, the dikes will need to be raised there.

Protecting plants against attacks

Some people are concerned about the risk of terrorist attacks against nuclear plants, which will have devastating results. The plants in this package are very well-protected. Accidents with the reactor are difficult to accomplish with bombs or by means of plane crashes on top of or near the plants. Sabotage by employees is not impossible yet very difficult.

Nuclear plants and nuclear weapons

Proliferation of nuclear weapons means that countries that do not have such weapons are able to develop them or that they may fall in the hands of terrorists. According to some experts, this proliferation of nuclear weapons becomes more likely due to the development and use of nuclear plants. Some experts think that the risk of collecting knowledge about nuclear technology for nuclear plants is that it also raises knowledge about nuclear weapons. Moreover, some experts think that the development of materials for nuclear plants may also increase the materials that can be used for nuclear weapons. Other experts say that there is no link between the development and use of nuclear plants and the proliferation of nuclear weapons.

Availability of energy

The raw materials needed to generate energy need to be partly imported from other countries. Our aim is to limit our dependency on the political decisions of only a few countries (cf. our currently high dependency on the Middle East for oil). Uranium can be obtained from many more different countries compared to for example petroleum. Therefore, this package will reduce the dependency on energy supplied by politically unstable regions. Moreover, uranium reserves can easily be realised, as uranium takes up relatively little space. This package is therefore likely to result in the availability of sufficient energy.

Consequences for employment

The construction of new nuclear plants yields new jobs. Approximately 1500 jobs will be involved in the building and set-up of one plant. Another 500 jobs will need to be filled to keep the plant in operation.

Price

The electricity generated with this package will be about 10-30% lower compared to electricity from coal- or gas-fired electricity plants. The costs involved in building a nuclear plant are very high. These costs will be higher if more safety measures are taken, or if waste from the plant is processed to reduce the duration of the radioactivity. It is unknown if and how much this will raise the price of electricity from nuclear energy.

Appendix D. **Questionnaire (Dutch)**

B1000 : Deel 1	Begin block

B1001 : Intro blok 1	Begin block

T1 : Intro 1a	Text

Not back

Vragen over nieuwe manieren om energie op te wekken
In Nederland wordt veel energie gebruikt. Bijvoorbeeld verwarming, licht, elektrische apparaten en vervoer vragen allemaal energie. Naar verwachting gaan we in Nederland steeds meer energie gebruiken. Bijna alle manieren waarop we momenteel energie opwekken zijn schadelijk voor het milieu en beïnvloeden het klimaat. In de toekomst is het nodig meer vormen van energie te gaan gebruiken die minder schadelijk zijn voor het milieu en het klimaat niet beïnvloeden.
Wat vinden Nederlanders er van?
Wat er precies moet gebeuren staat nog niet vast. ECN en de Universiteit Leiden voeren een onderzoek uit waarin de Nederlandse bevolking in de gelegenheid gesteld wordt haar mening te geven over enkele nieuwe mogelijkheden om energie op te wekken.
De resultaten van dit onderzoek worden in een rapport verwerkt, dat bijvoorbeeld de regering en het parlement kan helpen beslissingen te nemen.

T2 : Intro 1b	Text

Not back

Deze beslissingen zijn belangrijk, omdat de keuzes bepalend zijn voor de leefomstandigheden in Nederland in de nabije toekomst.
Dit onderzoek biedt u de mogelijkheid uw mening te laten horen.
Omdat we een volledig beeld van de in Nederland heersende meningen nastreven, is het belangrijk dat iedereen die wij benaderen, dus ook u, aan het onderzoek meedoet.
Uw mening zal strikt vertrouwelijk verwerkt worden.

T3 : Intro 1c	Text

Not back

Voor u aan het onderzoek begint, willen we u graag op de hoogte stellen van de lengte en de aard van het onderzoek. Het kost mensen gemiddeld vijf kwartier om deze vragenlijst in zijn geheel af te ronden. Sommige mensen doen er minder lang over, maar sommige mensen hebben meer tijd nodig. In het onderzoek wordt veel informatie gegeven, die lastig gevonden kan worden. Daarom raden wij u aan pas met de vragenlijst te beginnen op een moment dat u daar tijd en rust voor heeft.
Sommige mensen pauzeren tussendoor graag. Dat is natuurlijk geheel aan uzelf. In het kader van het onderzoek zouden wij u vriendelijk willen verzoeken om eventuele pauzes pas te houden nadat u de eerste mogelijkheid voor energiegebruik in Nederland heeft beoordeeld. Verderop in de vragenlijst zal nogmaals aangegeven worden welk moment wij hiermee bedoelen.

T4 : Intro 1d **Text**

Not back

De onderwerpen die in dit onderzoek aan bod komen zijn voor de meeste mensen geen dagelijkse kost. De onderwerpen die aan bod komen zijn bijvoorbeeld het broeikaseffect en verschillende mogelijkheden voor energiegebruik in de toekomst. Een manier om mensen te helpen een mening te vormen over een onderwerp, is door informatie aan te bieden over het betreffende onderwerp. In dit onderzoek krijgt u dan ook uitgebreide informatie over verschillende mogelijkheden voor energiegebruik in de toekomst en over aanverwante onderwerpen. Daarnaast is het echter ook noodzakelijk vast te stellen welke mening mensen hebben wanneer zij deze informatie nog niet hebben gekregen. Zo kan onderzocht worden welke mening mensen nu, zonder de informatie in deze enquête, hebben over deze onderwerpen. Ook kan zo onderzocht worden hoeveel mensen zelf al weten van deze onderwerpen.

T5 : Intro 1e **Text**

Not back

Voordat u informatie krijgt stellen we u daarom een aantal vragen, die verderop in de enquête nogmaals gesteld worden. Omdat aan deze vragen de eerste keer dus geen informatie vooraf gaat, zou het kunnen dat deze vragen nogal vreemd overkomen. Van sommige onderwerpen in de enquête is het zelfs waarschijnlijk dat de meeste mensen er niets van weten, en er dus ook geen vragen over kunnen beantwoorden.

B102 : Blok Voorleggen Onderwerpen **Begin block**

T6 : Intro 2 **Text**

Not back

Nu leggen we u een aantal onderwerpen voor, omdat we willen weten van welke onderwerpen u misschien wel eens gehoord heeft. Veel hiervan is nog onbekend bij de meeste mensen, dus wees niet bang om aan te geven wanneer u weinig van een onderwerp weet. U krijgt steeds eerst de vraag of u wel eens van het onderwerp gehoord heeft. Daarna krijgt u steeds de vraag wat u van het onderwerp vindt. U kunt daar uw antwoord geven door een rapportcijfer te geven. We begrijpen dat er aan de onderwerpen soms voordelen én nadelen kunnen zitten. We zijn geïnteresseerd in uw mening over het geheel genomen. U kunt echter ook invullen dat u geen mening over dit onderwerp heeft.

B201 : Blok C1. klimaatverandering **Begin block**

Q1 : Cq1 **Single coded**

Not back

Hebt u wel eens van klimaatverandering gehoord?

1 O Nee, nooit van gehoord
2 O Ik heb er van gehoord, maar ik weet niet wat het is
3 O Ja, en ik weet er een beetje van af
4 O Ja, en daar weet ik behoorlijk wat van af

T7 : Intro 2a | **Text**

Not back

U kunt bij deze vragen en een aantal van de volgende vragen de knop met "Geen mening" gebruiken

ASK ONLY IF Q1=2,3,4

Q2 : Cqcijf1 | **Matrix**

Not back

Wat vindt u van klimaatverandering?

	Zeer slecht	1	2	3	4	5	6	7	Zeer goed

ASK ONLY IF Q1=2,3,4

Q3 : Cqcijf1b | **Numeric**

Min 1 | Max 10 | Not back

Kunt u de klimaatverandering een rapportcijfer geven?

Hoe beter u dit verschijnsel vindt, hoe hoger het rapportcijfer.

T8 : Intro 2b | **Text**

Not back

Let op: Bij een aantal van de komende vragen is het waarschijnlijk dat de meeste mensen er niets van weten. Wees dus niet bang in te vullen dat u ergens niets van weet, de kans is groot dat bijna niemand van de ondervraagden het weet!

B201 : Blok C1. klimaatverandering | **End block**

B202 : Blok C2. CO2 uitstoot in huizen en gebouwen | **Begin block**

Q4 : Cq2 | **Single coded**

Not back

Hebt u weleens gehoord van het verminderen van CO2 uitstoot in huizen en gebouwen?

1 O Nee, nooit van gehoord
2 O Ik heb er van gehoord, maar ik weet niet wat het is.
3 O Ja, en ik weet er een beetje van af
4 O Ja, en daar weet ik behoorlijk wat van af

ASK ONLY IF Q4=2,3,4

Q5 : Cqcijf2 — Numeric

Min 1 | Max 10 | Not back

Kunt u "Het verminderen van CO2 uitstoot in huizen en gebouwen" een rapportcijfer geven?

Hoe beter u deze mogelijkheid vindt, hoe hoger het rapportcijfer.

[ ]

B202 : Blok C2. CO2 uitstoot in huizen en gebouwen — End block

B203 : Blok C3. CO2 uitstoot in de industrie — Begin block

Q6 : Cq3 — Single coded

Not back

Hebt u weleens gehoord van het verminderen van CO2 uitstoot in de industrie?

1 O Nee, nooit van gehoord
2 O Ik heb er van gehoord, maar ik weet niet wat het is.
3 O Ja, en ik weet er een beetje van af
4 O Ja, en daar weet ik behoorlijk wat van af

ASK ONLY IF Q6=2,3,4

Q7 : Cqcijf3 — Numeric

Min 1 | Max 10 | Not back

Kunt u "Het verminderen van CO2 uitstoot in de industrie" een rapportcijfer geven?

Hoe beter u deze mogelijkheid vindt, hoe hoger het rapportcijfer.

[ ]

B203 : Blok C3. CO2 uitstoot in de industrie — End block

B204 : Blok C4. elektriciteit van windmolens op zee — Begin block

Q8 : Cq4 — Single coded

Not back

Hebt u weleens gehoord van elektriciteit van windmolens op zee?

1 O Nee, nooit van gehoord
2 O Ik heb er van gehoord, maar ik weet niet wat het is
3 O Ja, en ik weet er een beetje van af
4 O Ja, en daar weet ik behoorlijk wat van af

ASK ONLY IF Q8=2,3,4

Q9 : Cqcijf4 — Numeric

Min 1 | Max 10 | Not back

Kunt u "Elektriciteit van windmolens op zee" een rapportcijfer geven?

Hoe beter u deze mogelijkheid vindt, hoe hoger het rapportcijfer.

B204 : Blok C4. elektriciteit van windmolens op zee — End block

B205 : Blok C5. biomassa naar elektriciteit en brandstof — Begin block

Q10 : Cq5 — Single coded

Not back

Hebt u weleens gehoord van het omzetten van biomassa naar elektriciteit en brandstof?

1 O Nee, nooit van gehoord
2 O Ik heb er van gehoord, maar ik weet niet wat het is.
3 O Ja, en ik weet er een beetje van af
4 O Ja, en daar weet ik behoorlijk wat van af

ASK ONLY IF Q10=2,3,4

Q11 : Cqcijf5 — Numeric

Min 1 | Max 10 | Not back

Kunt u "Het omzetten van biomassa naar elektriciteit en brandstof" een rapportcijfer geven?

Hoe beter u deze mogelijkheid vindt, hoe hoger het rapportcijfer.

B205 : Blok C5. biomassa naar elektriciteit en brandstof — End block

B206 : Blok C6. kolen of gas in elektriciteit — **Begin block**

Q12 : Cq6 — **Single coded**

Not back

Hebt u weleens gehoord van het omzetten van kolen of gas in elektriciteit waarbij CO2 ondergronds wordt opgeslagen?

1 ○ Nee, nooit van gehoord
2 ○ Ik heb er van gehoord, maar ik weet niet wat het is.
3 ○ Ja, en ik weet er een beetje van af
4 ○ Ja, en daar weet ik behoorlijk wat van af

ASK ONLY IF Q12=2,3,4

Q13 : Cqcijf6 — **Numeric**

Min 1 | Max 10 | Not back

Kunt u “Het omzetten van kolen of gas in elektriciteit waarbij CO2 ondergronds wordt opgeslagen” een rapportcijfer geven?

Hoe beter u deze mogelijkheid vindt, hoe hoger het rapportcijfer.

B206 : Blok C6. kolen of gas in elektriciteit — **End block**

B207 : Blok C7. biomassa naar elektriciteit en brandstof — **Begin block**

Q14 : Cq7 — **Single coded**

Not back

Hebt u weleens gehoord van het omzetten van biomassa naar elektriciteit en brandstof waarbij CO2 ondergronds wordt opgeslagen?

1 ○ Nee, nooit van gehoord
2 ○ Ik heb er van gehoord, maar ik weet niet wat het is.
3 ○ Ja, en ik weet er een beetje van af
4 ○ Ja, en daar weet ik behoorlijk wat van af

ASK ONLY IF Q14=2,3,4

Q15 : Cqcijf7 — **Numeric**

Min 1 | Max 10 | Not back

Kunt u "Het omzetten van biomassa naar elektriciteit en brandstof waarbij CO2 ondergronds wordt opgeslagen" een rapportcijfer geven?

Hoe beter u deze mogelijkheid vindt, hoe hoger het rapportcijfer.

B207 : Blok C7. biomassa naar elektriciteit en brandstof — **End block**

B208 : Blok C8. elektriciteit uit kerncentrales — **Begin block**

Q16 : Cq8 — **Single coded**

Not back

Hebt u weleens gehoord van elektriciteit uit kerncentrales?

1 O Nee, nooit van gehoord
2 O Ik heb er van gehoord, maar ik weet niet wat het is.
3 O Ja, en ik weet er een beetje van af
4 O Ja, en daar weet ik behoorlijk wat van af

ASK ONLY IF Q16=2,3,4

Q17 : Cqcijf8 — **Numeric**

Min 1 | Max 10 | Not back

Kunt u "Elektriciteit uit kerncentrales" een rapportcijfer geven?

Hoe beter u deze mogelijkheid vindt, hoe hoger het rapportcijfer.

B208 : Blok C8. elektriciteit uit kerncentrales — **End block**

B102 : Blok Voorleggen Onderwerpen — **End block**

B1001 : Intro blok 1 — **End block**

B1010 : Blok voorbeelden 1 — **Begin block**

T9 : Intro 3a	Text

Not back

Zoals gezegd kunt u in dit onderzoek uw oordeel geven over mogelijkheden voor energie in de toekomst en aanverwante zaken. U heeft dit zojuist gedaan zonder dat u van te voren informatie kreeg. In het vervolg krijgt u wel informatie. U krijgt informatie over zeven verschillende mogelijkheden voor energiegebruik in de toekomst in Nederland. Al deze mogelijkheden hebben bepaalde kenmerken en brengen natuurlijk ook bepaalde gevolgen met zich mee. U krijgt informatie over die kenmerken en gevolgen. Ook krijgt u informatie over de gevolgen van de huidige manieren om energie op te wekken, en hoe deze het milieu en het klimaat beïnvloeden.

U kunt straks aangeven in welke mate u die gevolgen voordelig of nadelig vindt. Op die manier kunt u zich een beeld vormen van elk van de zeven mogelijkheden voordat u uw totaaloordeel bepaalt over elke mogelijkheid. Bovendien kunt u zo uw mening over die gevolgen kenbaar maken.

T10 : Intro 3b	Text

Not back

In dit onderzoek kunt u uw oordeel geven over zeven verschillende mogelijkheden voor energiegebruik in de toekomst in Nederland. Al deze mogelijkheden hebben bepaalde kenmerken en brengen natuurlijk ook bepaalde gevolgen met zich mee. U krijgt informatie over die kenmerken en gevolgen.

Ook krijgt u informatie over de kenmerken en gevolgen van de huidige manieren om energie op te wekken, en hoe deze het milieu en het klimaat beïnvloeden.

U kunt aangeven in welke mate u die gevolgen voordelig of nadelig vindt.

Op die manier kunt u zich een beeld vormen van elk van de zeven mogelijkheden voordat u uw totaaloordeel bepaalt over elke mogelijkheid. Bovendien kunt u zo uw mening over die gevolgen kenbaar maken.

T11 : Intro 3c	Text

Not back

Er wordt u nu eerst verteld hoe u uw mening over die gevolgen kunt geven. Dit gebeurt aan de hand van een aantal voorbeelden. Deze voorbeelden hebben vaak niets met energie te maken.

T12 : Intro 3d	Text

Not back

Maatregelen of activiteiten kunnen nadelen hebben. Op dit scherm staat een aantal mogelijke nadelen van willekeurige maatregelen. Leest u ze eens door.
1. Een ongeluk met als gevolg enkele doden
2. Een ongeluk met als gevolg een paar duizend doden
3. Een zeer kleine kans op een ongeluk met als gevolg een paar duizend doden
4. Een zeer kleine kans op duizeligheid bij het gebruik van een pijnstiller

T13 : Intro 3e	**Text**

Not back

Waarschijnlijk vindt u deze voorbeelden niet alle vier een even groot probleem. Het is de bedoeling dat u voor ieder gevolg aangeeft hoe groot u het nadeel vindt door een getal tussen 1 en 9 in te vullen.
Het getal 1 staat hierbij voor een zeer klein nadeel, het getal 9 staat voor een zeer groot nadeel. Hoe groter u een nadeel vindt, hoe hoger het getal dat u invult. Omgekeerd geldt: hoe kleiner u het nadeel vindt, hoe lager het getal dat u invult.
Op het volgende scherm kunt u achter ieder gevolg op het scherm invullen hoe groot of hoe klein u het nadeel vindt.

Q18 : VB01	**Left-Right Matrix**

Not back

Voorbeeldvraag 1. Een ongeluk met als gevolg enkele doden.

U kunt hier aangeven hoe groot u het nadeel vindt		
Heel klein nadeel	□□□□□□□□□□	Heel groot nadeel

Q19 : VB02	**Left-Right Matrix**

Not back

Voorbeeldvraag 2. Een ongeluk met als gevolg een paar duizend doden.

U kunt hier aangeven hoe groot u het nadeel vindt		
Heel klein nadeel	□□□□□□□□□□	Heel groot nadeel

Q20 : VB03	**Left-Right Matrix**

Not back

Voorbeeldvraag 3. Een zeer geringe kans op een ongeluk met als gevolg een paar duizend doden.

U kunt hier aangeven hoe groot u het nadeel vindt		
Heel klein nadeel	□□□□□□□□□□	Heel groot nadeel

Q21 : VB04	**Left-Right Matrix**

Not back

Voorbeeldvraag 4. Een zeer kleine kans op duizeligheid bij het gebruik van een pijnstiller.

U kunt hier aangeven hoe groot u het nadeel vindt		
Heel klein nadeel	□□□□□□□□□□	Heel groot nadeel

T14 : Intro 4a	**Text**

Not back

Er is wat voor te zeggen om een ongeluk met als gevolg een paar duizend doden als een groter nadeel te zien dan een ongeluk met als gevolg enkele doden. Dat kunt u in uw beoordeling aangeven door een hoger getal in te vullen achter een ongeluk met als gevolg een paar duizend doden. Probeert u in uw beoordeling rekening te houden met dergelijke verschillen.
Het zou kunnen dat u straks in de enquête gevolgen tegenkomt, die u als groter nadeel wil beoordelen dan vorige gevolgen die u als 'zeer groot nadeel' had beoordeeld. In dit geval kunt u altijd terugbladeren om uw eerdere antwoord te veranderen.

T15 : Intro 4b	**Text**

Not back

Het is u wellicht opgevallen dat in sommige voorbeelden wordt gezegd dat iets zeker gebeurt, terwijl in andere voorbeelden wordt gezegd dat er bijvoorbeeld een zeer kleine kans is dat een nadeel optreedt.
Mogelijk heeft u daar ook rekening mee gehouden in uw beoordeling. Het is immers erger wanneer het optreden van een nadeel zeker is dan wanneer de kans klein is dat het nadeel zal optreden. Straks zult u ook dergelijke onzekere gevolgen tegenkomen. Probeert u daar rekening mee te houden.

T16 : Intro 4c	**Text**

Not back

U weet nu hoe u aan kunt geven hoe groot of hoe klein u nadelen van een maatregel vindt. In dit onderzoek krijgt u straks niet alleen nadelen maar ook voordelen te beoordelen.
Hoe dit in zijn werk gaat zullen we duidelijk proberen te maken aan de hand van voorbeeldvragen die niet met energievoorziening te maken hebben.

T17 : Intro 4d	**Text**

Not back

De voorbeeld-enquête gaat over een pijnstiller. Voordat u aangeeft wat u van deze pijnstiller vindt, krijgt u informatie over de pijnstiller. We willen u vragen om deze informatie op de volgende manier te beoordelen:

Wanneer u een gevolg geheel onbelangrijk vindt, kunt u dit aangeven door op het vakje voor onbelangrijk te klikken. Het kan ook zijn dat u het gevolg een voordeel of nadeel vindt. Dan kunt u op het vakje voor voordeel of nadeel klikken.

Als u het gevolg niet onbelangrijk, maar een nadeel of voordeel vindt, kunt u vervolgens aangeven in welke mate.

Eerder vertelden we dat u altijd kunt terugbladeren om uw eerdere antwoord te veranderen. Dit geldt niet voor de vraag of u iets onbelangrijk, een voordeel of nadeel vindt. Dat kunt u niet achteraf veranderen, omdat andere ingevulde antwoorden dan weer uitgewist worden. De mate waarin u iets een voordeel of nadeel vindt kunt u wel veranderen.

B31 : VB5 — **Begin block**

Q22 : VB05A — **Single coded**

Not back

Voorbeeldvraag 5. De pijnstiller van Merk X kost €9,55 per 24 tabletten.
Vindt u dit gevolg onbelangrijk, een voordeel of een nadeel?

1 O Onbelangrijk
2 O Nadeel
3 O Voordeel

ASK ONLY IF Q22=2

Q23 : VB05B — **Left-Right Matrix**

Not back

Hoe klein of groot vindt u het nadeel?

Heel klein nadeel	□□□□□□□□□□□	Heel groot nadeel

ASK ONLY IF Q22=3

Q24 : VB05C — **Left-Right Matrix**

Not back

Hoe klein of groot vindt u het voordeel?

Heel klein voordeel	□□□□□□□□□□□	Heel groot voordeel

B31 : VB5 — **End block**

B32 : VB6 — **Begin block**

Q25 : VB06A — **Single coded**

Not back

Voorbeeldvraag 6. Het gebruik van Merk X brengt een zeer kleine kans op duizeligheid met zich mee.
Vindt u dit gevolg onbelangrijk, een voordeel of een nadeel?

1 O Onbelangrijk
2 O Nadeel
3 O Voordeel

ASK ONLY IF Q25=2

Q26 : VB06B **Left-Right Matrix**

Not back

Hoe klein of groot vindt u het nadeel?

Heel klein nadeel	☐☐☐☐☐☐☐☐☐☐	Heel groot nadeel

ASK ONLY IF Q25=3

Q27 : VB06C **Left-Right Matrix**

Not back

Hoe klein of groot vindt u het voordeel?

Heel klein voordeel	☐☐☐☐☐☐☐☐☐☐	Heel groot voordeel

B32 : VB6 **End block**

B33 : VB7 **Begin block**

Q28 : VB07A **Single coded**

Not back

Voorbeeldvraag 7. Het gebruik van Merk X kan in combinatie met alcohol tot misselijkheid leiden. Vindt u dit gevolg onbelangrijk, een voordeel of een nadeel?

1 O Onbelangrijk
2 O Nadeel
3 O Voordeel

ASK ONLY IF Q28=2

Q29 : VB07B **Left-Right Matrix**

Not back

Hoe klein of groot vindt u het nadeel?

Heel klein nadeel	☐☐☐☐☐☐☐☐☐☐	Heel groot nadeel

ASK ONLY IF Q28=3

Q30 : VB07C **Left-Right Matrix**

Not back

Hoe klein of groot vindt u het voordeel?

Heel klein voordeel	☐☐☐☐☐☐☐☐☐☐	Heel groot voordeel

B33 : VB7	**End block**

B34 : VB8	**Begin block**

Q31 : VB08A	**Single coded**

Not back

Voorbeeldvraag 8. Veel pijnstillers zorgen ervoor dat mensen zich niet goed kunnen concentreren en suf worden. De pijnstiller van Merk X heeft deze bijwerking veel minder.
Vindt u dit gevolg onbelangrijk, een voordeel of een nadeel?

1 O Onbelangrijk
2 O Nadeel
3 O Voordeel

ASK ONLY IF Q31=2

Q32 : VB08B	**Left-Right Matrix**

Not back

Hoe klein of groot vindt u het nadeel?

Heel klein nadeel	□□□□□□□□□□□	Heel groot nadeel

ASK ONLY IF Q31=3

Q33 : VB08C	**Left-Right Matrix**

Not back

Hoe klein of groot vindt u het voordeel?

Heel klein voordeel	□□□□□□□□□□□	Heel groot voordeel

B34 : VB8	**End block**

ASK ONLY IF Q25=3 or Q28=3

T18 : Intro 5aa	**Text**

Not back

U heeft één of meer van de gevolgen van Merk X als voordeel beoordeeld. Hoewel u daar natuurlijk vrij in bent, is er ook wat voor te zeggen om de mogelijke bijwerkingen van een pijnstiller als nadeel te zien.

T19 : Intro 5a	**Text**

Not back

Het is u daarnet misschien opgevallen dat in het laatste gevolg van Merk X eerst een nadeel werd beschreven, en daarna werd aangegeven dat dit nadeel bij de pijnstiller van Merk X veel minder voorkomt. Dit gevolg van Merk X is dus minder nadelig dan na het lezen van de eerste zin lijkt. In de eigenlijke enquête zult u straks ook dergelijke gevolgen tegenkomen, waarbij een vroeger nadeel nu opgeheven of verminderd is. Hoewel een dergelijk gevolg dus eerst een nadeel lijkt, hoeft dat niet zo te zijn. Probeert u daar rekening mee te houden.

T20 : Intro 5b	**Text**

Not back

U heeft waarschijnlijk wel gezien dat een van de voorbeeld-nadelen over een zeer kleine kans op duizeligheid ook in de voorbeeld-enquête staat. We kunnen kijken wat u toen geantwoord heeft.

ASK ONLY IF Q21 ST=1 & SC=1 and Q26 ST=1 & SC=1

T21 : Intro 5b1	**Text**

Not back

De getallen zijn gelijk. Dat lag ook voor de hand: het is immers hetzelfde gevolg.

ASK ONLY IF not Q21 ST=1 & SC=1 and Q26 ST=1 & SC=1

T22 : Intro 5b2	**Text**

Not back

De getallen zijn niet gelijk. U heeft wellicht uw redenen gehad om een andere beoordeling te geven. U kunt zich mogelijk ook voorstellen dat dezelfde gevolgen met hetzelfde getal beoordeeld kunnen worden.

T23 : Intro 5c	**Text**

Not back

U krijgt nu achtergrond informatie over energiegebruik in Nederland en de gevolgen daarvan. U kunt altijd één of meerdere schermen terug gaan als u iets nog eens wil lezen of iets wat u heeft ingevuld wilt verbeteren. Door op het vakje ‘terug’ te klikken kunt u een scherm terug gaan.

Onthoudt u hierbij nog wel dat u niet kunt veranderen of u iets onbelangrijk, een nadeel of een voordeel vindt.

B1010 : Blok voorbeelden 1	**End block**

B1100 : Achtergrondinformatie vragenlijst energie	**Begin block**

T24 : Intro 6	**Text**

Not back

Achtergrondinformatie vragenlijst energie

ECN heeft in samenwerking met de Universiteit Leiden, Universiteit Utrecht en Ecofys deze vragenlijst samengesteld onder begeleiding van een breed samengestelde groep van energiedeskundigen. U krijgt informatie over de verschillende mogelijkheden om aan de groeiende vraag naar energie te voldoen. Deze informatie die we u voorleggen is goedgekeurd door deze groep van deskundigen. Dat betekent dat deze deskundigen het er over eens zijn dat de informatie een betrouwbaar beeld geeft van de verschillende aspecten van energie. De mogelijkheden die in de vragenlijst naar voren komen om in de toekomst aan de vraag naar energie te voldoen, geven geen volledig overzicht. Een volledig overzicht zou te veel zijn voor in een vragenlijst.

Energiedeskundigen hebben een schatting gemaakt van de vraag naar energie in het jaar 2030. Zij verwachten dat mede door de verwachte economische groei deze vraag groter zal zijn dan op dit moment. Er zijn verschillende mogelijkheden om in de groeiende vraag naar energie te voorzien.

B1101 : blok 1a	**Begin block**

T25 : Intro 6a1	**Text**

Not back

Hoe komen wij aan onze energie en waar gebruiken wij energie voor?
Energie wordt verkregen uit energiebronnen, zoals olie, kolen en aardgas. Deze brandstoffen gebruiken we om warmte of elektriciteit te maken. Naast olie, kolen en aardgas kan er ook energie geproduceerd worden uit water, wind, zon en biomassa (planten, bomen, en groente-, fruit-, en tuinafval). Deze vormen noemen we hernieuwbare energiebronnen, omdat de voorraad hiervan nooit opraakt. In Nederland worden voornamelijk olie en aardgas gebruikt om te voorzien in onze energiebehoefte.

T26 : Intro 6a2	**Text**

Not back

Huishoudens, bedrijven, industrie en vervoer zijn de belangrijkste gebruikers van energie. Woningen in Nederland worden vooral verwarmd met aardgas. Elektriciteit gebruiken we voor licht en elektrische apparaten. Voertuigen zoals auto’s en vrachtwagens rijden op olie (in de vorm van diesel of benzine). De industrie gebruikt brandstoffen om warmte en elektriciteit te maken voor haar processen.
In Nederland staan grote elektriciteitscentrales die aardgas of kolen als brandstof gebruiken voor de opwekking van elektriciteit. Ook staat er een kerncentrale voor de productie van elektriciteit. Het is ook mogelijk om in kleinere installaties elektriciteit op te wekken. Deze installaties staan meestal bij bedrijven. De warmte die vrijkomt bij deze elektriciteitsopwekking wordt zo veel mogelijk benut door de bedrijven zelf. Soms wordt deze warmte ook gebruikt voor verwarming van huizen en kantoren. Verder wordt ongeveer een vijfde van de elektriciteit die we gebruiken in Nederland ingevoerd uit het buitenland.

T27 : Intro 6a3	Text

Not back

In Nederland wordt nu nog maar een kleine hoeveelheid energie opgewekt uit hernieuwbare bronnen (water, wind, zon en biomassa). Elektriciteit wordt gemaakt met behulp van windmolens, zonnecellen en waterkracht. Ook wordt er elektriciteit opgewekt door de verbranding van biomassa. Biomassa kan bijvoorbeeld zijn: snoeihout en groente-, fruit- en tuinafval of geïmporteerd hout en palmolie. Warm water komt soms uit een zonneboiler. Nu worden brandstoffen voor auto's en bussen voornamelijk uit olie gemaakt. In de toekomst kunnen we daarvoor vaker brandstoffen gebruiken die uit biomassa worden gemaakt.

B1101 : blok 1a	End block

B1102 : blok 1b	Begin block

ASK ONLY IF Q2222=1

T28 : Intro 6b1a	Text

Not back

Wat betekent energieopwekking met olie, gas en steenkool voor ons klimaat?
De lucht in de dampkring rond de aarde bestaat uit verschillende gassen, onder andere stikstof, zuurstof en koolstofdioxide. Koolstofdioxide of CO2 wordt een broeikasgas genoemd. Broeikasgassen in onze dampkring zorgen ervoor dat een deel van de warmte die de aarde van de zon ontvangt niet kan ontsnappen naar de ruimte. Dit zogenoemde broeikaseffect zorgt voor een leefbaar klimaat op aarde. Zonder dit broeikaseffect zou het ongeveer 32 graden kouder zijn op aarde. Maar bij de opwekking van energie met brandstoffen als olie, aardgas en steenkool komt extra CO2 vrij in onze dampkring. Daardoor wordt het broeikaseffect versterkt. De versterking van het broeikaseffect leidt tot een stijging van de gemiddelde temperatuur op aarde. De afgelopen honderd jaar is de gemiddelde temperatuur op aarde met ongeveer 0.8 graden Celsius toegenomen.

ASK ONLY IF Q2222=2

T125 : Intro 6b1b	**Text**

Not back

Wat betekent energieopwekking met olie, gas en steenkool voor ons klimaat?

Uit eerder onderzoek is gebleken dat mensen vaak twijfelen over wat koolstofdioxide of CO2 nu precies is. Daarom leggen we hier een aantal dingen uit.

De lucht in de dampkring rond de aarde bestaat uit verschillende gassen, onder andere stikstof, zuurstof en koolstofdioxide. Koolstofdioxide of CO2 wordt een broeikasgas genoemd. Het is een gas dat van nature voorkomt in de dampkring. Broeikasgassen in onze dampkring zorgen ervoor dat een deel van de warmte die de aarde van de zon ontvangt niet kan ontsnappen naar de ruimte. Dit zogenoemde broeikaseffect zorgt voor een leefbaar klimaat op aarde. Zonder dit broeikaseffect zou het ongeveer 32 graden kouder zijn op aarde. Maar bij de opwekking van energie met brandstoffen als olie, aardgas en steenkool komt extra CO2 vrij in onze dampkring. Daardoor wordt het broeikaseffect versterkt. De versterking van het broeikaseffect leidt tot een stijging van de gemiddelde temperatuur op aarde. De afgelopen honderd jaar is de gemiddelde temperatuur op aarde met ongeveer 0.8 graden Celsius toegenomen.

Er zijn ook andere aspecten van CO2 waar mensen onzeker over zijn. CO2 komt vrij als mensen uitademen en is niet schadelijk wanneer het in contact komt met de huid. Als oude batterijen en accu’s lekken kunnen er chemische stoffen vrijkomen, maar dat zijn andere stoffen dan CO2. In spuitbussen met haarlak of deodorant zit geen CO2. Vroeger zaten er wel vaak CFK’s in, een andere stof die slecht is voor het milieu, maar dat komt tegenwoordig bijna nooit meer voor. Verder is CO2 geen brandbaar of explosief gas.

ASK ONLY IF Q2222=3

T126 : Intro 6b1c	**Text**

Not back

Wat betekent energieopwekking met olie, gas en steenkool voor ons klimaat?

Uit eerder onderzoek is gebleken dat mensen vaak twijfelen over wat koolstofdioxide of CO2 nu precies is. Daarom leggen we hier een aantal dingen uit.

De lucht in de dampkring rond de aarde bestaat uit verschillende gassen, onder andere stikstof, zuurstof en koolstofdioxide. Koolstofdioxide of CO2 wordt een broeikasgas genoemd. Sommige mensen weten niet dat het een gas is dat van nature voorkomt in de dampkring. Broeikasgassen in onze dampkring zorgen ervoor dat een deel van de warmte die de aarde van de zon ontvangt niet kan ontsnappen naar de ruimte. Sommige mensen weten niet dat dit zogenoemde broeikaseffect zorgt voor een leefbaar klimaat op aarde. Zonder dit broeikaseffect zou het ongeveer 32 graden kouder zijn op aarde. Wat sommige mensen verder niet weten is dat bij de opwekking van energie met brandstoffen als olie, aardgas en steenkool extra CO2 vrijkomt in onze dampkring. Daardoor wordt het broeikaseffect versterkt. De versterking van het broeikaseffect leidt tot een stijging van de gemiddelde temperatuur op aarde. De afgelopen honderd jaar is de gemiddelde temperatuur op aarde met ongeveer 0.8 graden Celsius toegenomen.

Er zijn ook andere aspecten van CO2 waar mensen onzeker over zijn. Sommige mensen weten niet dat CO2 vrij komt als mensen uitademen en dat het onschadelijk is wanneer het in contact komt met de huid. Als oude batterijen en accu's lekken kunnen er chemische stoffen vrijkomen. Sommige mensen weten niet dat dat andere stoffen zijn dan CO2. Sommige mensen weten niet dat in spuitbussen met haarlak of deodorant geen CO2 zit. Vroeger zaten er wel vaak CFK's in, een andere stof die slecht is voor het milieu, maar dat komt tegenwoordig bijna nooit meer voor. Verder weten sommige mensen niet dat CO2 geen brandbaar of explosief gas is.

T29 : Intro 6b2a	**Text**

Not back

Het overgrote deel van de energie op aarde wordt momenteel opgewekt met brandstoffen zoals olie, aardgas en steenkool. In Nederland is dit bijvoorbeeld ongeveer 96 procent. De verwachting is dat ook de komende 50 jaar een groot deel van de energie uit olie, aardgas en steenkool komt. Experts verwachten dat de gemiddelde temperatuur op aarde in het jaar 2100 1.1 tot 6.4 graden Celsius hoger zal zijn dan in 1990. Hoeveel graden de temperatuur precies zal stijgen, hangt mede af van de toekomstige uitstoot van broeikasgassen. Wanneer de uitstoot van broeikasgassen niet verminderd wordt, zal de temperatuur meer stijgen dan wanneer de uitstoot wel verminderd wordt. Een lagere uitstoot zorgt dus voor minder temperatuurstijging, niet voor een daling in temperatuur. De temperatuurstijging wordt veroorzaakt door CO2 uitstoot in de hele wereld, niet alleen door de uitstoot in Nederland.

T30 : Intro 6b3 — **Text**

Not back

De gemiddelde temperatuurstijging op aarde kan allerlei gevolgen hebben die het leven van veel mensen kunnen beïnvloeden. De gemiddelde temperatuurstijging betekent echter niet dat het overal op aarde evenveel warmer wordt. Dit kan het klimaat zodanig beïnvloeden dat het in sommige streken droger wordt, of natter, of winderiger. U krijgt nu informatie over de gevolgen van de temperatuurstijging door het broeikaseffect. De mate waarin de gevolgen hieronder zullen optreden, hangt af van hoeveel de temperatuur stijgt. De gevolgen van een wereldwijd gemiddelde temperatuurstijging die hieronder beschreven staan, zijn te wijten aan de uitstoot van broeikasgas in de hele wereld (dus niet alleen de Nederlandse uitstoot). Gevolgen van de temperatuurstijging betekenen niet altijd een verslechtering, sommige gevolgen van temperatuurstijging kunnen voor bepaalde gebieden positief zijn.

B1102 : blok 1b — **End block**

B1121 : TEMP21 — **Begin block**

Q34 : TEMP21A — **Single coded**

Not back

We vragen u nu een aantal gevolgen van de temperatuurstijging door het broeikaseffect te beoordelen.

Droogte
De verwachte temperatuurstijging heeft gevolgen voor het klimaat over de hele wereld. Sommige gebieden in de wereld kunnen door de opwarming van het klimaat te maken krijgen met grotere droogte. Er is een redelijke tot grote kans dat daardoor vaker dan nu oogsten verdorren en honger kan ontstaan. Vooral gebieden waar het nu al relatief droog is zullen hiermee te maken krijgen. Vindt u dit gevolg onbelangrijk, een voordeel of een nadeel?

1 O Onbelangrijk
2 O Nadeel
3 O Voordeel

ASK ONLY IF Q34=2

Q35 : TEMP21B — **Left-Right Matrix**

Not back

Hoe klein of groot vindt u het nadeel?

Heel klein nadeel	□□□□□□□□□□□	Heel groot nadeel

ASK ONLY IF Q34=3

Q36 : TEMP21C **Left-Right Matrix**

Not back

Hoe klein of groot vindt u het voordeel?

Heel klein voordeel	□□□□□□□□□□□	Heel groot voordeel

B1121 : TEMP21 **End block**

B1122 : TEMP22 **Begin block**

Q37 : TEMP22A **Single coded**

Not back

Warmte

In gebieden waar de temperatuur nu laag is, bijvoorbeeld Siberië, zal het klimaat waarschijnlijk minder koud worden. Landbouwopbrengsten kunnen hier hoger worden. In sommige gebieden kunnen nieuwe natuurgebieden ontstaan.
Vindt u dit gevolg onbelangrijk, een voordeel of een nadeel?

1 ○ Onbelangrijk
2 ○ Nadeel
3 ○ Voordeel

ASK ONLY IF Q37=2

Q38 : TEMP22B **Left-Right Matrix**

Not back

Hoe klein of groot vindt u het nadeel?

Heel klein nadeel	□□□□□□□□□□□	Heel groot nadeel

ASK ONLY IF Q37=3

Q39 : TEMP22C **Left-Right Matrix**

Not back

Hoe klein of groot vindt u het voordeel?

Heel klein voordeel	□□□□□□□□□□□	Heel groot voordeel

B1122 : TEMP22 **End block**

B1123 : TEMP23 **Begin block**

Q40 : TEMP23A — **Single coded**

Not back

Extremer weer

In andere gebieden kan het broeikaseffect leiden tot verandering in extreme gebeurtenissen zoals hevige regenval, sneeuwval en stormen. Experts verwachten dat de hevigheid, duur en intensiteit van veel van dergelijke gebeurtenissen toe zullen nemen. Stormen, ook orkanen, zullen zeer waarschijnlijk heviger worden en meer schade veroorzaken. Door hevige regenval, sneeuwval en stormen wordt de kans op overstromingen in veel gebieden groter.
Vindt u dit gevolg onbelangrijk, een voordeel of een nadeel?

1 O Onbelangrijk
2 O Nadeel
3 O Voordeel

ASK ONLY IF Q40=2

Q41 : TEMP23B — **Left-Right Matrix**

Not back

Hoe klein of groot vindt u het nadeel?

Heel klein nadeel	□□□□□□□□□□	Heel groot nadeel

ASK ONLY IF Q40=3

Q42 : TEMP23C — **Left-Right Matrix**

Not back

Hoe klein of groot vindt u het voordeel?

Heel klein voordeel	□□□□□□□□□□	Heel groot voordeel

B1123 : TEMP23 — **End block**

B1124 : TEMP24 — **Begin block**

Q43 : TEMP24A — **Single coded**

Not back

Stijging zeespiegel
De temperatuurstijging zorgt ervoor dat een deel van het poolijs en ijskappen smelten en het zeewater uitzet, waardoor de zeespiegel stijgt. In sommige gebieden kan stroming in de zee voor een hogere of lagere zeespiegel bij de kust zorgen. Rond Nederland kan de zeespiegelstijging daardoor oplopen tot 85 centimeter in deze eeuw. Door de stijging van de zeespiegel komen sommige lager gelegen gebieden in de wereld onder water te liggen. Van bijvoorbeeld landen die bestaan uit groepen kleine eilanden, wordt verwacht dat ze, door de zeespiegelstijging, in de komende eeuw deels tot volledig onder water verdwijnen. Over de hele wereld zal de natuur aangetast worden en zullen natuurgebieden verdwijnen door de stijging van de temperatuur en van de zeespiegel. Hierdoor kunnen plantensoorten en diersoorten uitsterven. Ook de zeer kwetsbare koraalgebieden kunnen door temperatuurstijging verdwijnen. Kwetsbare landen of natuurgebieden kunnen dus aangetast worden of verdwijnen.
Vindt u dit gevolg onbelangrijk, een voordeel of een nadeel?

1 O Onbelangrijk
2 O Nadeel
3 O Voordeel

ASK ONLY IF Q43=2

Q44 : TEMP24B — **Left-Right Matrix**

Not back

Hoe klein of groot vindt u het nadeel?

Heel klein nadeel	☐☐☐☐☐☐☐☐☐☐	Heel groot nadeel

ASK ONLY IF Q43=3

Q45 : TEMP24C — **Left-Right Matrix**

Not back

Hoe klein of groot vindt u het voordeel?

Heel klein voordeel	☐☐☐☐☐☐☐☐☐☐	Heel groot voordeel

B1124 : TEMP24 — **End block**

B1125 : TEMP25 — **Begin block**

Q46 : TEMP25A **Single coded**

Not back

Stijgend water in en om Nederland

Voor Nederland zou de temperatuurstijging op aarde kunnen betekenen dat we vaker met overstromingen van rivieren te maken krijgen door heftige regenval. Om dit te voorkomen heeft de overheid besloten gebieden aan te wijzen om meer rivierwater tijdelijk op te kunnen vangen. Het instellen van deze gebieden en de toename van risicogebieden voor overstromingen verkleint het gebied waarop we kunnen wonen en werken. Er zullen extra maatregelen nodig zijn om de kustlijn te beschermen tegen de stijging van de zeespiegel en de waarschijnlijk hevigere stormen: De zeewering moet versterkt worden (bijvoorbeeld door de dijken op te hogen). Ook rivierdijken zullen opgehoogd moeten worden om overstromingen te voorkomen. Al met al kunnen er dus beschermende maatregelen nodig zijn en het Nederlandse woon- en werkgebied kan kleiner worden.
Vindt u dit gevolg onbelangrijk, een voordeel of een nadeel?

1 O Onbelangrijk
2 O Nadeel
3 O Voordeel

ASK ONLY IF Q46=2

Q47 : TEMP25B **Left-Right Matrix**

Not back

Hoe klein of groot vindt u het nadeel?

Heel klein nadeel	□□□□□□□□□□□	Heel groot nadeel

ASK ONLY IF Q46=3

Q48 : TEMP25C **Left-Right Matrix**

Not back

Hoe klein of groot vindt u het voordeel?

Heel klein voordeel	□□□□□□□□□□□	Heel groot voordeel

B1125 : TEMP25 **End block**

B1126 : TEMP26 **Begin block**

Q49 : TEMP26A — Single coded

Not back

Slachtoffers in arme landen
Niet alle landen hebben de mogelijkheden om zich aan te passen. Daarom is het waarschijnlijk dat de landen in de wereld die nu het armst zijn, het minst in staat zijn om voldoende maatregelen te treffen. De negatieve gevolgen van de opwarming zullen in veel gevallen het sterkst zijn in warmere, en veelal armere, landen. Het is dan ook waarschijnlijk dat de armste landen het sterkst getroffen zullen worden door de gevolgen van de temperatuurstijging. Bijvoorbeeld overstromingen veroorzaken wereldwijd nu al enkele tienduizenden doden per jaar, maar dit kan in de komende eeuw oplopen tot een veelvoud daarvan. Deze doden zullen vooral in arme landen vallen. Ook zullen ontwikkelingslanden in verhoogde mate blootstaan aan bedreigingen als hongersnood en besmettelijke ziekten. Hierdoor kunnen veel mensen in arme landen genoodzaakt zijn om te emigreren.
Vindt u dit gevolg onbelangrijk, een voordeel of een nadeel?

1 ○ Onbelangrijk
2 ○ Nadeel
3 ○ Voordeel

ASK ONLY IF Q49=2

Q50 : TEMP26B — Left-Right Matrix

Not back

Hoe klein of groot vindt u het nadeel?

Heel klein nadeel	□□□□□□□□□□□	Heel groot nadeel

ASK ONLY IF Q49=3

Q51 : TEMP26C — Left-Right Matrix

Not back

Hoe klein of groot vindt u het voordeel?

Heel klein voordeel	□□□□□□□□□□□	Heel groot voordeel

B1126 : TEMP26 — End block

B1127 : TEMP27 — Begin block

Q52 : TEMP27A — Single coded

Not back

Zomers in Nederland
In Nederland zullen de zomers gemiddeld warmer zijn. Er zullen meer hittegolven voorkomen. Mensen met een zwakke gezondheid (bijvoorbeeld hoogbejaarden) zullen vaker ziek worden en sterven door de hitte en door de toename van ziektekiemen. Door de warmere zomers is het mogelijk dat tropische ziekten vaker in Nederland voorkomen. Ook wordt verwacht dat meer allergieën zullen voorkomen en dat er meer ziekten worden overgedragen door insecten, bijvoorbeeld de ziekte van Lyme.
Vindt u dit gevolg onbelangrijk, een voordeel of een nadeel?

1 O Onbelangrijk
2 O Nadeel
3 O Voordeel

ASK ONLY IF Q52=2

Q53 : TEMP27B — Left-Right Matrix

Not back

Hoe klein of groot vindt u het nadeel?

Heel klein nadeel	□□□□□□□□□□□	Heel groot nadeel

ASK ONLY IF Q52=3

Q54 : TEMP27C — Left-Right Matrix

Not back

Hoe klein of groot vindt u het voordeel?

Heel klein voordeel	□□□□□□□□□□□	Heel groot voordeel

B1127 : TEMP27 — End block

B1128 : TEMP28 — Begin block

Q55 : TEMP28A — Single coded

Not back

Winters in Nederland

De winters zullen in Nederland minder koud zijn. Er zullen minder koudegolven zijn. Daardoor zullen minder mensen ziek worden door de kou en minder mensen sterven.
Vindt u dit gevolg onbelangrijk, een voordeel of een nadeel?

1 O Onbelangrijk
2 O Nadeel
3 O Voordeel

ASK ONLY IF Q55=2

Q56 : TEMP28B — **Left-Right Matrix**

Not back

Hoe klein of groot vindt u het nadeel?

Heel klein nadeel	☐☐☐☐☐☐☐☐☐☐	Heel groot nadeel

ASK ONLY IF Q55=3

Q57 : TEMP28C — **Left-Right Matrix**

Not back

Hoe klein of groot vindt u het voordeel?

Heel klein voordeel	☐☐☐☐☐☐☐☐☐☐	Heel groot voordeel

B1128 : TEMP28 — **End block**

B1129 : BKO KBC — **Begin block**

Q58 : BKO — **Left-Right Matrix**

Not back

Wat is uw algemene waardering van het versterkte broeikaseffect?

Zeer slecht	☐☐☐☐☐☐☐	Zeer goed

Q59 : BKC — **Numeric**

Min 1 | Max 10 | Not back

Kunt u het versterkte broeikaseffect een rapportcijfer geven?

Hoe beter u het versterkte broeikaseffect vindt, hoe hoger het rapportcijfer.

B1129 : BKO KBC — **End block**

B1103 : blok 1c — **Begin block**

T32 : Intro 6c	Text

Not back

Internationale afspraken
Veel landen in de wereld wensen het broeikaseffect te verminderen. Daarom zijn er internationale afspraken gemaakt om de uitstoot van CO2 terug te dringen. Ook Nederland vindt het zeer belangrijk om de uitstoot van CO2 te verminderen.
Hoe kunnen we de uitstoot van CO2 verminderen?
Er zijn drie manieren om CO2 uitstoot te verminderen.

T33 : Intro 6c1	Text

Not back

De eerste manier is door te besparen op energie. Dit kan door mensen en bedrijven aan te sporen minder energie te gebruiken. Bijvoorbeeld door minder warm te stoken, of door minder auto te rijden. Een andere manier is om apparaten die energie gebruiken zuiniger te maken. Ook huizen, auto's en fabrieken zouden zuiniger gemaakt kunnen worden. Deze zuinigere apparaten, huizen, auto's of fabrieken gebruiken minder energie, maar leveren hetzelfde resultaat. Dit wordt ook wel energiezuinigheid of energie-efficiëntie genoemd.

ASK ONLY IF Q2222=1,2

T34 : Intro 6c2a	Text

Not back

De tweede manier is door te zorgen dat er geen of veel minder CO2 ontstaat bij het opwekken van energie. Dit is bijvoorbeeld zo bij zonne-energie, windenergie, waterkracht en kernenergie. Bij energieopwekking door verbranding van biomassa (zoals hout en groente-, fruit-, tuin- en kweekafval of bijvoorbeeld palmolie) ontstaat wel CO2, maar dit zou ook zijn ontstaan wanneer deze planten op natuurlijke wijze zouden zijn vergaan. Wanneer planten groeien, nemen ze CO2 op. Deze CO2 komt vrij wanneer de planten vergaan of verbrand worden. De opwekking van energie door verbranding van plantenafval levert dus wel CO2 uitstoot op, maar dit zou bij het vergaan van deze planten ook gebeuren.
Deze energiebronnen leveren nu minder dan 5 procent van de energie die we in Nederland gebruiken. Sommige van deze energiebronnen zullen in de komende tientallen jaren meer ingezet worden dan nu het geval is. Andere, zoals waterkracht, zullen waarschijnlijk niet veel meer ingezet worden. Energie uit waterkracht is in Nederland zeer beperkt doordat er nauwelijks hoogteverschillen zijn. Windenergie, energie uit biomassa en kernenergie zouden wel meer ingezet kunnen worden. Maar het is onwaarschijnlijk dat, ook als er bespaard wordt op energie, deze energiebronnen de komende tientallen jaren voldoende energie leveren om volledig in de Nederlandse behoefte te voorzien. Van hele nieuwe mogelijkheden, zoals kernfusie, is het zeer onwaarschijnlijk. Daardoor blijft het gebruik van brandstoffen als kolen, aardgas en olie de komende tientallen jaren zeer waarschijnlijk.

ASK ONLY IF Q2222=3

T127 : Intro 6c2b **Text**

Not back

De tweede manier is door te zorgen dat er geen of veel minder CO2 ontstaat bij het opwekken van energie. Sommige mensen weten niet dat er geen of veel minder CO2 vrijkomt bij het opwekken van energie met bijvoorbeeld zonne-energie, windenergie, waterkracht en kernenergie. Sommige mensen weten verder niet dat bij energieopwekking door verbranding van biomassa (zoals hout en groente-, fruit-, tuin- en kweekafval of bijvoorbeeld palmolie) wel CO2 ontstaat, maar dit zou ook zijn ontstaan wanneer deze planten op natuurlijke wijze zouden zijn vergaan. Wanneer planten groeien, nemen ze CO2 op. Deze CO2 komt vrij wanneer de planten vergaan of verbrand worden. De opwekking van energie door verbranding van plantenafval levert dus wel CO2 uitstoot op, maar dit zou bij het vergaan van deze planten ook gebeuren.
Deze energiebronnen leveren nu minder dan 5 procent van de energie die we in Nederland gebruiken. Sommige van deze energiebronnen zullen in de komende tientallen jaren meer ingezet worden dan nu het geval is. Andere, zoals waterkracht, zullen waarschijnlijk niet veel meer ingezet worden. Energie uit waterkracht is in Nederland zeer beperkt doordat er nauwelijks hoogteverschillen zijn. Windenergie, energie uit biomassa en kernenergie zouden wel meer ingezet kunnen worden. Maar het is onwaarschijnlijk dat, ook als er bespaard wordt op energie, deze energiebronnen de komende tientallen jaren voldoende energie leveren om volledig in de Nederlandse behoefte te voorzien. Van hele nieuwe mogelijkheden, zoals kernfusie, is het zeer onwaarschijnlijk. Daardoor blijft het gebruik van brandstoffen als kolen, aardgas en olie de komende tientallen jaren zeer waarschijnlijk.

T35 : Intro 6c3 **Text**

Not back

De derde manier om CO2 uitstoot te verminderen, is door te zorgen dat bij de energieopwekking met brandstoffen als aardgas en kolen minder CO2 in de lucht komt. Dit kan door de CO2 die vrijkomt bij energieopwekking met aardgas en kolen grotendeels af te vangen en voor altijd ondergronds op te slaan, bijvoorbeeld in lege aardgasvelden. Deze methode noemen we CO2 afvang en opslag. Doordat de CO2 wordt opgeslagen kan deze niet meer in de lucht komen en dus ook niet meer bijdragen aan het broeikaseffect.

T36 : Intro 6c4 **Text**

Not back

Om het risico van een versterkt broeikaseffect sterk te verminderen is het nodig om veel minder CO2 uit te stoten. In 2050 moet dat wereldwijd 60 procent tot 80 procent minder zijn dan we nu uitstoten. Daarmee kan de temperatuurstijging waarschijnlijk beperkt worden tot 2 graden Celsius. Dat is de maximale stijging waarbij deskundigen denken dat de gevolgen te overzien zijn. Hierbij is er vanuit gegaan dat de rijke landen hun uitstoot meer beperken dan arme landen.

T37 : Intro 6c5	**Text**

Not back

Om in 2050 de uitstoot zover terug te brengen is het al in 2030 nodig om 40 procent minder CO2 uit te stoten dan nu. Zoals u eerder al gelezen hebt, zijn er drie methoden om uitstoot van CO2 te verminderen: besparing van energie, vervanging van CO2-uitstotende brandstoffen door windenergie, kernenergie of biomassa en CO2 afvang en opslag. Deskundigen hebben zeven pakketten geselecteerd die met behulp van één van deze methoden in staat zijn om al in 2030 de CO2 uitstoot te verminderen met 40 procent. In deze enquête krijgt u informatie over deze zeven pakketten. Deskundigen verwachten dat deze zeven pakketten belangrijke mogelijkheden vormen om in 2030 CO2 uitstoot te verminderen. Eén pakket is onvoldoende om de gewenste vermindering van CO2 uitstoot te halen. Er zijn daarvoor vier pakketten nodig.

Om in Nederland 40 procent van de CO2 uitstoot te verminderen, moet er 100 miljoen ton CO2 minder uitgestoten worden. Maar met elk pakket in deze enquête wordt de CO2-uitstoot met 25 miljoen ton CO2 verminderd. Vier pakketten samen stoten wel (4 x 25 miljoen =) 100 miljoen ton CO2 minder uit. Kortom, als alle maatregelen die in een pakket zijn beschreven worden uitgevoerd wordt er 25 miljoen ton CO2 minder uitgestoten. Door invoering van vier van de zeven pakketten zou dus 100 miljoen ton CO2 minder uitgestoten worden. Dat is 40% van de totale CO2 uitstoot nu.

B1103 : blok 1c	**End block**

B1104 : blok 1d	**Begin block**

T38 : Intro 6d1	**Text**

Not back

De zeven pakketten zijn:
1. Het verminderen van CO2 uitstoot in huizen en gebouwen
2. Het verminderen van CO2 uitstoot in de industrie
3. Elektriciteit van windmolens op zee
4. Omzetten van biomassa naar elektriciteit en brandstof
5. Omzetten van kolen of gas in elektriciteit waarbij CO2 ondergronds wordt opgeslagen
6. Omzetten van biomassa naar elektriciteit en brandstof waarbij CO2 ondergronds wordt opgeslagen
7. Elektriciteit uit kerncentrales

T39 : Intro 6d2	Text

Not back

Bij het samenstellen van de informatie over de gevolgen van de pakketten hebben deskundigen bepaalde aannames gemaakt. Ze gingen bijvoorbeeld van het volgende uit:
- Nederland is niet het enige land waar de CO2 uitstoot wordt teruggedrongen, maar alle landen in de wereld streven hiernaar
- De vermindering van 40 procent is gebaseerd op de verwachte economische groei. Meer groei tot 2030 dan verwacht kan er voor zorgen dat de toename van de uitstoot van CO2 hoger is dan berekend. In dat geval zal dus een grotere hoeveelheid CO2 verminderd moeten worden.
- Aangenomen wordt dat de energieomzetting in Nederland gebeurt. Bijvoorbeeld elektriciteitsopwekking of het maken van warmte gebeurt in Nederland. Wel is het mogelijk aardgas, kolen, uranium en biomassa uit andere landen in te voeren
- Elk pakket bespaart 25 miljoen ton CO2 uitstoot

T40 : Intro 6d3	Text

Not back

U krijgt straks informatie over de zeven pakketten voordat we u vragen een keuze te maken. Mocht u graag pauze willen houden tussendoor, dan willen wij u vriendelijk verzoeken te proberen om geen pauze te houden voordat u minstens één van de pakketten beoordeeld heeft.

T41 : Intro 6d4	Text

Not back

Samengevat leidt het huidige energiegebruik uit kolen, olie en gas tot een te grote uitstoot van het broeikasgas CO2. Het klimaat verandert hierdoor. De temperatuur zal sterk toenemen met gevolgen voor waterhoogte, de landbouw, natuur, zeespiegel en de gezondheid. Vanwege deze gevolgen en de bijkomende kosten, wil de overheid maatregelen nemen. Er zijn verschillende opties om de CO2 uitstoot te verminderen. Men kan het gebruik van energie terugdringen, andere bronnen gebruiken (zoals windenergie, biomassa of kernenergie) of wel kolen en gas gebruiken maar dan de vrijkomende CO2 ondergronds opslaan. Alle zeven pakketten beschreven in deze enquête hebben gemeenschappelijk dat ze leiden tot een gelijke afname van CO2. Vier pakketten samen komt overeen met de doelstelling om de uitstoot in 2030 met 40 procent te verlagen ten opzichte van nu.

T42 : Intro 6d5	Text

Not back

U heeft ondertussen behoorlijk wat informatie te lezen gekregen. Het is belangrijk dat u deze informatie goed in u heeft opgenomen voordat u de rest van de enquête invult. Om te zien of alles duidelijk uitgelegd is en u alles heeft begrepen, worden nu een aantal vragen gesteld over de voorgaande informatie.

B1104 : blok 1d	End block

B1131 : COV01	Begin block

Q60 : COV01 — Single coded

Not back

Wordt momenteel ongeveer 95 procent van de energie die gebruikt wordt in Nederland opgewekt met behulp van kolen, gas en olie?

1 ○ Nee, het is ongeveer 75 procent
2 ○ Ja
3 ○ Nee, het is bijna 100 procent

ASK ONLY IF Q60=2

T43 : Intro COV01a — Text

Not back

Inderdaad, dat is juist. Momenteel wordt inderdaad ongeveer 95 procent van de energie die gebruikt wordt in Nederland opgewekt met behulp van kolen, gas en olie.

ASK ONLY IF Q60=1,3

T44 : Intro COV01b — Text

Not back

Dit antwoord is niet juist. Momenteel wordt ongeveer 95 procent van de energie die gebruikt wordt in Nederland opgewekt met behulp van kolen, gas en olie.

B1131 : COV01 — End block

B1132 : COV02 — Begin block

Q61 : COV02 — Single coded

Bij de huidige opwekking van energie met behulp van kolen in Nederland...

1 ○ wordt er geen CO2 uitgestoten naar de dampkring
2 ○ wordt er wel CO2 uitgestoten naar de dampkring

ASK ONLY IF Q61=1

T45 : Intro COV02a — Text

Not back

Dit antwoord is niet juist. Bij de huidige opwekking van energie met behulp van kolen in Nederland wordt er wel CO2 uitgestoten naar de dampkring.

ASK ONLY IF Q61=2

T46 : Intro COV02b | **Text**

Not back

Inderdaad, dat is juist. Bij de huidige opwekking van energie met behulp van kolen in Nederland wordt er wel CO2 uitgestoten naar de dampkring.

B1132 : COV02 | **End block**

B1133 : COV03 | **Begin block**

Q62 : COV03 | **Single coded**

Bij de huidige opwekking van energie met behulp van gas in Nederland...

1 ○ wordt er geen CO2 uitgestoten naar de dampkring
2 ○ wordt er wel CO2 uitgestoten naar de dampkring

ASK ONLY IF Q62=1

T47 : Intro COV03a | **Text**

Not back

Dit antwoord is niet juist. Bij de huidige opwekking van energie met behulp van gas in Nederland wordt er CO2 uitgestoten naar de dampkring.

ASK ONLY IF Q62=2

T48 : Intro COV03b | **Text**

Not back

Inderdaad, dat is juist. Bij de huidige opwekking van energie met behulp van gas in Nederland wordt er wel CO2 uitgestoten naar de dampkring.

B1133 : COV03 | **End block**

B1134 : COV04 | **Begin block**

Q63 : COV04 | **Single coded**

Door de uitstoot van CO2 bij de huidige opwekking van energie met kolen, gas en olie...

1 ○ wordt het broeikaseffect versterkt
2 ○ wordt het broeikaseffect verminderd
3 ○ blijft het broeikaseffect gelijk

ASK ONLY IF Q63=2,3

T49 : Intro COV04a	**Text**

Not back

Dit antwoord is niet juist. Door de uitstoot van CO2 bij de huidige opwekking van energie met kolen, gas en olie wordt het broeikaseffect versterkt.

ASK ONLY IF Q63=1

T50 : Intro COV04b	**Text**

Not back

Inderdaad, dat is juist. Door de uitstoot van CO2 bij de huidige opwekking van energie met kolen, gas en olie wordt het broeikaseffect versterkt.

B1134 : COV04	**End block**

B1135 : COV05	**Begin block**

Q64 : COV05	**Single coded**

Wanneer het broeikaseffect versterkt wordt...

1 ○ Gaat de gemiddelde temperatuur op aarde omhoog
2 ○ Gaat de gemiddelde temperatuur op aarde omlaag
3 ○ Blijft de gemiddelde temperatuur op aarde hetzelfde

ASK ONLY IF Q64=2,3

T51 : Intro COV05a	**Text**

Not back

Dit antwoord is niet juist. Wanneer het broeikaseffect versterkt wordt gaat de gemiddelde temperatuur omhoog.

ASK ONLY IF Q64=1

T52 : Intro COV05b	**Text**

Not back

Inderdaad, dat is juist. Wanneer het broeikaseffect versterkt wordt gaat de gemiddelde temperatuur omhoog.

B1135 : COV05 **End block**

B1136 : COV06 **Begin block**

Q65 : COV06 **Single coded**

Wanneer de uitstoot van CO2 blijft toenemen zoals nu, zal de gemiddelde temperatuur op aarde tot 2099...

1 O meer dan 6.4 graden Celsius stijgen
2 O waarschijnlijk 1.1 tot 6.4 graden Celsius stijgen
3 O waarschijnlijk 1.1 tot 6.4 graden Celsius dalen
4 O zeker 1.1 tot 6.4 graden stijgen

ASK ONLY IF Q65=1,3,4

T53 : Intro COV06a **Text**

Not back

Dit antwoord is niet juist. Wanneer de uitstoot van CO2 blijft toenemen zoals nu, zal de gemiddelde temperatuur op aarde tot 2099 waarschijnlijk 1.1 tot 6.4 graden Celsius stijgen.

ASK ONLY IF Q65=2

T54 : Intro COV06b **Text**

Not back

Inderdaad, dat is juist. Wanneer de uitstoot van CO2 blijft toenemen zoals nu, zal de gemiddelde temperatuur op aarde tot 2099 waarschijnlijk 1.1 tot 6.4 graden Celsius stijgen.

B1136 : COV06 **End block**

B1137 : COV07 **Begin block**

Q66 : COV07 **Single coded**

Welke stelling is juist?

1 O Alle zeven pakketten zorgen ervoor dat er geen CO2 ontstaat
2 O Alle zeven pakketten hebben gemeen dat er veel minder CO2 in de lucht wordt uitgestoten
3 O Alle zeven pakketten hebben gemeen dat er meer CO2 in de lucht wordt uitgestoten dan bij de huidige manieren van energie opwekking

ASK ONLY IF Q66=1,3

T55 : Intro COV07a | **Text**

Not back

Dit antwoord is niet juist. Alle zeven pakketten hebben gemeen dat er veel minder CO2 in de lucht wordt uitgestoten.

ASK ONLY IF Q66=2

T56 : Intro COV07b | **Text**

Not back

Inderdaad, dat is juist. Alle zeven pakketten hebben gemeen dat er veel minder CO2 in de lucht wordt uitgestoten.

B1137 : COV07 | **End block**

B1138 : COV08 | **Begin block**

Q67 : COV08 | **Single coded**

Vier van de zeven pakketten (waarover deze vragenlijst gaat) zorgen samen voor een vermindering van CO2 uitstoot in 2030 vergeleken met nu

1 O van ongeveer 100 procent
2 O van ongeveer 40 procent
3 O van ongeveer 20 procent
4 O deze pakketten streven niet naar een vermindering van CO2 uitstoot

ASK ONLY IF Q67=1,3,4

T57 : Intro COV08a | **Text**

Not back

Dit antwoord is niet juist. Vier van de zeven pakketten (waarover deze vragenlijst gaat) zorgen samen voor een vermindering van CO2 uitstoot in 2030 vergeleken met nu van ongeveer 40 procent.

ASK ONLY IF Q67=2

T58 : Intro COV08b | **Text**

Not back

Inderdaad, dat is juist. Vier van de zeven pakketten (waarover deze vragenlijst gaat) zorgen samen voor een vermindering van CO2 uitstoot in 2030 vergeleken met nu van ongeveer 40 procent.

B1138 : COV08 | **End block**

B1139 : COV09 | **Begin block**

Q68 : COV09 | **Single coded**

Kernenergie en windenergie verminderen de CO2 uitstoot omdat

1 ○ er geen CO2 ontstaat bij het opwekken van elektriciteit met behulp van windmolens of kerncentrales
2 ○ er wel CO2 ontstaat bij het opwekken van elektriciteit met behulp van windmolens of kerncentrales, maar deze CO2 afgevangen wordt en opgeslagen
3 ○ er wel CO2 ontstaat bij het opwekken van elektriciteit met behulp van windmolens of kerncentrales, maar net zo veel als eerder is opgenomen uit de lucht

ASK ONLY IF Q68=2,3

T59 : Intro COV09a | **Text**

Not back

Dit antwoord is niet juist. Kernenergie en windenergie verminderen de CO2 uitstoot omdat er geen CO2 ontstaat bij het opwekken van elektriciteit met behulp van windmolens of kerncentrales.

ASK ONLY IF Q68=1

T60 : Intro COV09b | **Text**

Not back

Inderdaad, dat is juist. Kernenergie en windenergie verminderen de CO2 uitstoot omdat er geen CO2 ontstaat bij het opwekken van energie met behulp van windmolens of kerncentrales.

B1139 : COV09 | **End block**

B1140 : COV10 | **Begin block**

Q69 : COV10 | **Single coded**

De opwekking van energie met behulp van biomassa vermindert de CO2 uitstoot omdat….

1 O er geen CO2 ontstaat bij het opwekken van energie met biomassa
2 O er wel CO2 ontstaat bij het opwekken van energie met biomassa, maar deze CO2 afgevangen wordt en opgeslagen
3 O er wel CO2 ontstaat bij het opwekken van energie met biomassa, maar net zoveel als toch al zou ontstaan wanneer de biomassa was vergaan

ASK ONLY IF Q69=1,2

T61 : Intro COV10a | **Text**

Not back

Dit antwoord is niet juist. De opwekking van energie met behulp van biomassa vermindert de CO2 uitstoot omdat er wel CO2 ontstaat bij het opwekken van energie met biomassa, maar net zoveel als toch al zou ontstaan wanneer de biomassa was vergaan

ASK ONLY IF Q69=3

T62 : Intro COV10b | **Text**

Not back

Inderdaad, dat is juist. De opwekking van energie met behulp van biomassa vermindert de CO2 uitstoot omdat er wel CO2 ontstaat bij het opwekken van energie met biomassa, maar net zoveel als toch al zou ontstaan wanneer de biomassa was vergaan

B1140 : COV10 | **End block**

B1141 : COV11 | **Begin block**

Q70 : COV11 | **Single coded**

De opwekking van energie met behulp van biomassa waarbij CO2 wordt afgevangen en opgeslagen vermindert de CO2 uitstoot omdat…

1 O er geen CO2 ontstaat bij het opwekken van energie met biomassa met CO2 opslag
2 O er wel CO2 ontstaat bij het opwekken van energie met biomassa met CO2 opslag, maar net zoveel als toch al zou ontstaan wanneer de biomassa was vergaan
3 O er wel CO2 ontstaat bij het opwekken van energie met biomassa met CO2 opslag, maar dat is net zoveel als toch al zou ontstaan wanneer de biomassa was vergaan en bovendien wordt een groot deel van deze CO2 afgevangen en opgeslagen

ASK ONLY IF Q70=1,2

T63 : Intro COV11a	Text

Not back

Dit antwoord is niet juist. De opwekking van energie met behulp van biomassa vermindert de CO2 uitstoot omdat er wel CO2 ontstaat bij het opwekken van energie met biomassa, maar net zoveel als toch al zou ontstaan wanneer de biomassa was vergaan en bovendien wordt een groot deel van deze CO2 afgevangen en opgeslagen

ASK ONLY IF Q70=3

T64 : Intro COV11b	Text

Not back

Inderdaad, dat is juist. De opwekking van energie met behulp van biomassa vermindert de CO2 uitstoot omdat er wel CO2 ontstaat bij het opwekken van energie met biomassa, maar net zoveel als toch al zou ontstaan wanneer de biomassa was vergaan en bovendien wordt een groot deel van deze CO2 afgevangen en opgeslagen

B1141 : COV11	End block

B1142 : COV12	Begin block

Q71 : COV12	Single coded

De pakketten in deze enquête die kolen en gas gebruiken verminderen de CO2 uitstoot omdat...

1 O er geen CO2 ontstaat bij het opwekken van energie met behulp van kolen en gas
2 O er wel CO2 ontstaat bij het opwekken van energie met behulp van kolen en gas, maar deze CO2 afgevangen wordt en opgeslagen
3 O er wel CO2 ontstaat bij het opwekken van energie met behulp van kolen en gas, maar net zoveel als in de jaren er voor is opgenomen uit de lucht

ASK ONLY IF Q71=1,3

T65 : Intro COV12a	Text

Not back

Dit antwoord is niet juist. De pakketten in deze enquête die kolen en gas gebruiken verminderen de CO2 uitstoot omdat er wel CO2 ontstaat bij het opwekken van energie met behulp van kolen en gas, maar deze CO2 afgevangen wordt en opgeslagen

ASK ONLY IF Q71=2

T66 : Intro COV12b | **Text**

Not back

Inderdaad, dat is juist. De pakketten in deze enquête die kolen en gas gebruiken verminderen de CO2 uitstoot omdat er wel CO2 ontstaat bij het opwekken van energie met behulp van kolen en gas, maar deze CO2 afgevangen wordt en opgeslagen.

B1142 : COV12 | **End block**

B1100 : Achtergrondinformatie vragenlijst energie | **End block**

B1150 : Merk X 1 | **Begin block**

T67 : Intro 7a1 | **Text**

Not back

U krijgt straks informatie over de gevolgen van zeven pakketten.
De informatie is door deskundigen samengesteld. Dit betekent dat u gevolgen te zien krijgt die volgens deskundigen belangrijk zijn. Wat deskundigen echter niet kunnen bepalen is of u de gevolgen van belang vindt en hoe nadelig of voordelig u een bepaald gevolg vindt.

T68 : Intro 7a2 | **Text**

Not back

Straks wordt u gevraagd de gevolgen van de verschillende pakketten te beoordelen. Daarna wordt u gevraagd een keuze te maken uit de verschillende pakketten. Hoe dit laatste in zijn werk gaat zullen we duidelijk maken aan de hand van de voorbeeldvragen die u eerder invulde.

T69 : Intro 7a3 | **Text**

Not back

In de voorbeeld-enquête heeft u de gevolgen van pijnstiller merk X beoordeeld.

U heeft informatie gehad over de gevolgen van merk X, en vervolgens heeft u deze gevolgen beoordeeld.

B1151 : Merk X 1b | **Begin block**

T70 : Intro 7b1	Text

Not back

We laten Uw oordelen over de gevolgen van Merk X nog even zien.
U heeft
-prijs
-kans op duizeligheid
-kans op misselijkheid
-kansop sufheid
Beoordeeld als nadeel.
U heeft deze nadelen beoordeeld met de waardes
-prijs X (1)
-kans op duizeligheid X (1)
-kans op misselijkheid X (1)
-kans op sufheid X (1)
U heeft geen gevolgen als voordeel beoordeeld.
U heeft geen gevolgen als onbelangrijk beoordeeld.
Uw oordelen zetten we op het volgende scherm in een tabel.
Druk op <ENTER> of klik op VERDER

T71 : Intro 7b2	**Text**

Not back

Wij bieden u een hulpmiddel aan dat gebruikt kan worden bij het bepalen van uw totaaloordeel over Merk X. Uw totaaloordeel is wat u al met al van Merk X vindt. De computer maakt een soort verlies en winstrekening op. Dat werkt als volgt: Gevolgen die u een nadeel vond, en waarbij u hebt aangegeven hoe groot u dit nadeel vond (een getal tussen 1 en 9), worden door de computer opgeteld tot een totale nadeelscore. Gevolgen die u een voordeel vond en waarbij u hebt aangegeven hoe groot u dit voordeel vond (een getal tussen 1 en 9), worden door de computer opgeteld tot een totale voordeelscore. Natuurlijk zijn gevolgen die u onbelangrijk vond niet in de winst- en verliesrekening meegenomen, maar ze verschijnen wel met een nulletje in de kolom ‘onbelangrijk’.
<TABEL>
stelling Prijs
stelling Kans op duizeligheid
stelling Kans op misselijkheid
stelling Kans op sufheid
Onbelangrijk
0
NADEEL
1 = heel klein nadeel,
9 = heel groot nadeel
VOORDEEL
1 = heel klein voordeel,
9 = heel groot voordeel
Invoegen if {VB05A} = 1: 0
Invoegen if {VB05A} = 2: {VB05B}
Invoegen if {VB05A} = 3: {VB05C}
Invoegen if {VB06A} = 1: 0
Invoegen if {VB06A} = 2: {VB06B}
Invoegen if {VB06A} = 3: {VB06C}
Invoegen if {VB07A} = 1: 0
Invoegen if {VB07A} = 2: {VB07B}
Invoegen if {VB07A} = 3: {VB07C}
Invoegen if {VB08A} = 1: 0
Invoegen if {VB08A} = 2: {VB08B}
Invoegen if {VB08A} = 3: {VB08C}
Klik nu de knop “bereken” boven aan het scherm aan.

T72 : Intro 7b3	**Text**

Not back

Wij bieden u een hulpmiddel aan dat gebruikt kan worden bij het bepalen van uw totaaloordeel over Merk X. Uw totaaloordeel is wat u al met al van Merk X vindt. De computer maakt een soort verlies en winstrekening op. Dat werkt als volgt: Gevolgen die u een nadeel vond, en waarbij u hebt aangegeven hoe groot u dit nadeel vond (een getal tussen 1 en 9), worden door de computer opgeteld tot een totale nadeelscore. Gevolgen die u een voordeel vond en waarbij u hebt aangegeven hoe groot u dit voordeel vond (een getal tussen 1 en 9), worden door de computer opgeteld tot een totale voordeelscore. Natuurlijk zijn gevolgen die u onbelangrijk vond niet in de winst- en verliesrekening meegenomen, maar ze verschijnen wel met een nulletje in de kolom `
<TABEL>
stelling Prijs
stelling Kans op duizeligheid
stelling Kans op misselijkheid
stelling Kans op sufheid
Onbelangrijk
0
NADEEL
1 = heel klein nadeel,
9 = heel groot nadeel
VOORDEEL
1 = heel klein voordeel,
9 = heel groot voordeel
Invoegen if {VB05A} = 1: 0
Invoegen if {VB05A} = 2: {VB05B}
Invoegen if {VB05A} = 3: {VB05C}
Invoegen if {VB06A} = 1: 0
Invoegen if {VB06A} = 2: {VB06B}
Invoegen if {VB06A} = 3: {VB06C}
Invoegen if {VB07A} = 1: 0
Invoegen if {VB07A} = 2: {VB07B}
Invoegen if {VB07A} = 3: {VB07C}
Invoegen if {VB08A} = 1: 0
Invoegen if {VB08A} = 2: {VB08B}
Invoegen if {VB08A} = 3: {VB08C}
[u]TOTALE NADEELSCORE
TOTALE VOORDEELSCORE
[/u]
Tik een 9 in om verder te gaan:
9:verder

Q72 : VB09D **Left-Right Matrix**

Not back

<TABEL>

stelling Prijs
stelling Kans op duizeligheid
stelling Kans op misselijkheid
stelling Kans op sufheid

Onbelangrijk
0

NADEEL
1 = heel klein nadeel,
9 = heel groot nadeel

VOORDEEL
1 = heel klein voordeel,
9 = heel groot voordeel

Invoegen if {VB05A} = 1: 0
Invoegen if {VB05A} = 2: {VB05B}
Invoegen if {VB05A} = 3: {VB05C}
Invoegen if {VB06A} = 1: 0
Invoegen if {VB06A} = 2: {VB06B}
Invoegen if {VB06A} = 3: {VB06C}
Invoegen if {VB07A} = 1: 0
Invoegen if {VB07A} = 2: {VB07B}
Invoegen if {VB07A} = 3: {VB07C}
Invoegen if {VB08A} = 1: 0
Invoegen if {VB08A} = 2: {VB08B}
Invoegen if {VB08A} = 3: {VB08C}

[u]TOTALE NADEELSCORE
TOTALE VOORDEELSCORE
[/u]

We vragen u nu om uw totaaloordeel, dus hoe u al met al over deze pijnstiller denkt. Het ligt voor de hand dat u hierbij rekening houdt met uw eigen beoordelingen van de gevolgen. Daarbij is het natuurlijk handig om uw eigen totale nadeelscore te gebruiken. Mocht u ergens gevolgen als voordeel beoordeeld hebben, dan kunt u uw totale voordeelscore natuurlijk ook in uw keuze betrekken.

Voorbeeldvraag 9.

Wat is uw totaaloordeel over Merk X, op een schaal van slecht naar goed?

Zeer slecht	☐☐☐☐☐☐☐	Zeer goed

Q73 : VB09E | **Numeric**

Min 1 | Max 10 | Not back

Vul nu uw totaaloordeel in over deze pijnstiller, uitgedrukt in een rapportcijfer (van 1 tot 10) . Hoe beter u de pijnstiller vindt, hoe hoger het rapportcijfer.

Uw rapportcijfer voor pijnstiller X:

B1151 : Merk X 1b | **End block**

T73 : Intro 7c1 | **Text**

Not back

U hebt nu uw algemene waardering uitgesproken voor merk X. U zou ook de mogelijkheid kunnen hebben te kiezen uit twee merken pijnstillers, merk X en merk Y. Stelt u zich voor dat u merk Y op dezelfde manier kunt boordelen. U hebt dan van beide merken pijnstillers de gevolgen beoordeeld. U hebt beide merken pijnstillers een rapportcijfer gegeven. Nu zou u een beslissing kunnen maken, welke pijnstiller u het beste vindt.
Dit was natuurlijk maar een voorbeeld. In dit voorbeeld ging het niet om een werkelijk te maken keuze.
Bovendien kreeg u maar weinig informatie over de pijnstillers. Hierdoor kwam de werkwijze van de enquête misschien wat omslachtig over. Straks krijgt u echter informatie over meer keuzemogelijkheden en bovendien over meer gevolgen per keuzemogelijkheid.
U zult zien dat de werkwijze van de enquête u dan helpt om de gevolgen van de keuzemogelijkheden (de zeven energiepakketten) op een rijtje te zetten. De werkwijze is straks precies hetzelfde als in het voorbeeld.

T74 : Intro 7c2 | **Text**

Not back

Straks zult u op de manier waarop u merk X beoordeelde, ook de zeven pakketten kunnen beoordelen. Eerst krijgt u de gevolgen van een pakket te beoordelen. Daarna krijgt u een overzicht van uw beoordelingen. Met dit overzicht kunt u uw totale nadeelscore en uw totale voordeelscore van het pakket berekenen. Vervolgens kunt u het pakket als geheel beoordelen. Op dezelfde manier kunt u ook de andere pakketten beoordelen.
Nadat u de zeven pakketten op deze manier beoordeeld hebt, krijgt u aan het eind een overzicht van de rapportcijfers die u de zeven pakketten gegeven hebt. Op dit punt kunt u straks, als u dat wilt, rapportcijfers veranderen. Daarbij kunt u, als u dat wilt, eerdere overzichten van beoordelingen van gevolgen nog eens bekijken.
Daarna kunt u kiezen welke vier pakketten uw voorkeur hebben.

T75 : Intro 7c3	Text

[**Not back**]

De informatie over de gevolgen van de verschillende pakketten is door deskundigen samengesteld. Dit betekent dat u gevolgen te zien krijgt die volgens deskundigen belangrijk zijn. Wat deskundigen echter niet kunnen bepalen is of u een bepaald gevolg belangrijk vindt. Daarom vragen we dat aan u.

T76 : Intro 7c4	Text

[**Not back**]

Niet alle gevolgen van de verschillende pakketten worden vermeld. U krijgt alleen informatie over punten waarop de pakketten verschillen. Zo geldt voor alle pakketten dat ze zorgen voor dezelfde hoeveelheid vermindering van CO2 uitstoot. Hoewel dit belangrijk is, zult u deze informatie niet tegenkomen. Het is immers hetzelfde voor alle pakketten en het helpt u dus niet bij het maken van een keuze.
In de voorbeeld-enquête over pijnstillers hebben we bijvoorbeeld ook niet vermeld dat een kenmerk van beide pijnstillers is dat ze pijn stillen. Dit geldt voor beide merken in gelijke mate en helpt dus niet bij het maken van een keuze.

T77 : Intro 7c5	Text

[**Not back**]

Het zal u straks misschien opvallen dat veel van de gevolgen van de pakketten nadelen zijn. Dit komt voor een deel omdat de voordelen van de pakketten vaak voor alle zeven pakketten gelden en dus niet vermeld zijn. Denk bijvoorbeeld aan het kenmerk dat we net noemden, de hoeveelheid vermindering van CO2-uitstoot. Alle pakketten hebben dus ook belangrijke voordelen, ook al staan ze niet bij de gevolgen die we u vragen te beoordelen.

T78 : Intro 7c6	Text

[**Not back**]

Als u bij een van de pakketten informatie over een bepaald gevolg tegenkomt, wil dat niet zeggen dat u bij alle pakketten informatie over dat gevolg zult tegenkomen.
Bij één pakket krijgt u bijvoorbeeld informatie over gevolgen voor vissen en zoogdieren in zee. Bij andere pakketten niet, omdat deze pakketten geen gevolgen hebben voor vissen en zoogdieren in zee.

T79 : Intro 7c7	**Text**

Not back

Gevolgen van pakketten worden ook niet vermeld, wanneer ze niet verschillen van gevolgen die nu ook plaatsvinden. U krijgt alleen informatie over gevolgen die anders zijn dan de gevolgen van de huidige energiewinning.

Een voorbeeld zijn de gevolgen voor luchtkwaliteit voor mensen. Bij sommige pakketten staat hier niets over vermeld, omdat de gevolgen voor luchtkwaliteit niet veranderen ten opzichte van nu. Dat betekent dus niet dat er helemaal geen gevolgen zijn voor de luchtkwaliteit, slechts dat deze gevolgen niet veranderen ten opzichte van nu.

T80 : Intro 7c8	**Text**

Not back

Wanneer een bepaald gevolg niet optreedt bij een pakket terwijl dat in de huidige situatie wel zo is, staat dit in het gevolg vermeld. Wanneer er bijvoorbeeld door een pakket geen luchtvervuiling door uitlaatgassen optreedt, staat dit vermeld als een vermindering van uitlaatgassen ten opzichte van nu.

Slechts een enkele keer staat een gebrek aan een bepaald gevolg uitdrukkelijk wel vermeld. Dit is het geval wanneer veel mensen lijken te denken dat er een gevolg is, terwijl deskundigen weten of verwachten dat dit gevolg niet zal optreden.

T81 : Intro 7c9	**Text**

Not back

Voor deze enquête is door meerdere onderzoekers van verschillende achtergronden zeer veel inspanning verricht om evenwichtige en recente informatie te verzamelen van vele experts. Hiervoor zijn experts van bedrijven, overheid, milieuorganisaties en universiteiten geraadpleegd, in binnen- en buitenland. Desondanks zijn niet alle gevolgen van de pakketten bekend. Voor sommige pakketten zijn over bepaalde gevolgen wel veel gegevens, terwijl er voor andere pakketten helemaal geen gegevens zijn over die gevolgen. Bijvoorbeeld bij technologieën die al veel gebruikt zijn, is uit ervaring bekend hoeveel ongelukken er gebeuren en onder welke omstandigheden dit gebeurt. Bij modernere technologieën, zoals wind of biomassa, zijn hierover veel minder gegevens. Toch is het waarschijnlijk dat bij het gebruik van deze pakketten ook ongelukken gebeuren. Hoewel het dus bij veel pakketten waarschijnlijk is dat er ongelukken gebeuren, is maar voor een deel van de pakketten bekend hoeveel precies. Omdat de vergelijking tussen de pakketten oneerlijk zou worden wanneer zulke nadelige gevolgen bij sommige pakketten wel vermeld staan, en bij andere pakketten niet, staan dit soort gevolgen niet in de enquête vermeld.

T82 : Intro 7c10	**Text**

Not back

Een gevolg dat om deze reden ontbreekt bij alle pakketten is de veiligheid voor mensen bij het winnen van grondstoffen die nodig zijn voor het pakket, en eventuele bouw en onderhoudswerkzaamheden die nodig zijn voor het pakket. Hierbij kunt u bijvoorbeeld denken aan eventuele ongelukken bij het winnen van kolen of uraniumerts in mijnen, of ongelukken tijdens het winnen van materialen voor de bouw van windmolens. Ook bij het verbouwen van biomassa kunnen ongelukken gebeuren. Bij het vervoer van grondstoffen en bouwmateriaal kunnen ook ongelukken gebeuren. Dit vervoer zou ook meer vervuiling of CO2 uitstoot kunnen opleveren dan nu in de gevolgen vermeld staat.

T83 : Intro 7c11	**Text**

Not back

De laatste opmerking over de vermelding van gevolgen betreft de prijs van energie bij de pakketten. Straks zal het u misschien opvallen dat de energieprijs bij bijna alle pakketten omhoog gaat ten opzichte van de huidige energieprijs. Deskundigen verwachten dat dit niet alleen geldt voor de pakketten in de enquête, maar ook voor andere vormen van energiewinning.

T84 : Intro 7c12	**Text**

Not back

Als u van alle zeven pakketten de gevolgen beoordeeld heeft, wordt u gevraagd vier van de zeven pakketten te kiezen. Met die keuze geeft u aan welke combinatie van vier energiepakketten volgens u de voorkeur verdient om in 2030 40 procent minder CO2 uit te stoten in de lucht.

T85 : Intro 7c13	**Text**

Not back

Nu volgt een omschrijving van het eerste pakket. Daarna volgen de te beoordelen gevolgen.
U kunt altijd één of meerdere schermen terug gaan als u iets nog eens wil lezen of iets wat u heeft ingevuld wilt verbeteren. Door op het vakje 'vorige' te klikken kunt u een scherm terug gaan. Onthoudt u hierbij nog wel dat u niet kunt veranderen of u iets onbelangrijk, een nadeel of een voordeel vindt.

B1150 : Merk X 1	**End block**

B1000 : Deel 1	**End block**

B2000 : Deel 2	**Begin block**

B2001 : Intro blok 2	**Begin block**

B2121 : VB blok 2a	Begin block

T86 : Intro 10	Text

Het verminderen van CO_2 uitstoot in huizen en gebouwen
Het doel van dit pakket is om 25 miljoen ton CO_2 uitstoot te besparen in 2030 door het verminderen van energiegebruik in gebouwen zoals woningen, scholen, zwembaden. Bijvoorbeeld door het verbeteren van isolatie, dubbel glas of hoog rendement glas, efficiëntere apparaten en aanpassingen in gedrag. Daarnaast moet er gebruik gemaakt worden van technieken om lokaal energie op te wekken, zoals zonnepanelen, zonneboilers en warmtepompen. Een zonneboiler gebruikt de warmte van de zon om water te verwarmen voor bijvoorbeeld de douche of de verwarming. Een warmtepomp is een apparaat dat de omgeving (bijvoorbeeld lucht of water) duurzaam gebruikt om uw huis te verwarmen in de winter en te koelen in de zomer. Om dit pakket te realiseren is een combinatie van deze maatregelen noodzakelijk. Energie besparen in gebouwen kan bijvoorbeeld door beter te isoleren en zuinigere apparaten aan te schaffen, maar ook door gedrag aan te passen bijvoorbeeld door de thermostaat een graad lager te zetten. Energiezuinigheid is de vermindering van de energie die nodig is voor gelijk resultaat. Bijvoorbeeld, de energie die nodig is om een middelgroot huis te verwarmen. Door bijvoorbeeld zuinigere apparaten, beter geïsoleerde huizen, en zuiniger omgaan met energie is minder energie nodig voor hetzelfde resultaat.

B2011 : Voorbeelden deel 2A	Begin block

1	Stelling 1 (vraag 77)
2	Stelling 2 (vraag 77)
3	Stelling 3 (vraag 77)
4	Stelling 4 (vraag 77)
5	Stelling 5 (vraag 77)
6	Stelling 6 (vraag 77)
7	Stelling 7 (vraag 77)

Q74 : P1V01A	Single coded

*? TXTB02011
Vindt u dit gevolg onbelangrijk, een voordeel of een nadeel?

1	O	Onbelangrijk
2	O	Nadeel
3	O	Voordeel

ASK ONLY IF Q74=2

Q75 : P1V01B	Left-Right Matrix

Hoe klein of groot vindt u het nadeel?

Heel klein nadeel	☐☐☐☐☐☐☐☐☐☐	Heel groot nadeel

ASK ONLY IF Q74=3

Q76 : P1V01C — **Left-Right Matrix**

Hoe klein of groot vindt u het voordeel?

Heel klein voordeel	□□□□□□□□□□	Heel groot voordeel

B2011 : Voorbeelden deel 2A — **End block**

B2012 : Voorbeelden deel 2A2 — **Begin block**

T88 : Intro 10a2	**Text**

Dit zijn uw oordelen over het pakket
Het verminderen van CO_2 uitstoot in huizen en gebouwen.
<TABEL>
Stelling 1 Bijdrage aan milieukwaliteit
Stelling 2 Gebruik natuurlijke bronnen
Stelling 3 Beschikbaarheid van energie
Stelling 4 Economische gevolgen
Stelling 5 Gevolgen voor de werkgelegenheid
Stelling 6 Gevolgen voor huizen en gebouwen
Stelling 7 Prijs
Onbelangrijk
0
NADEEL
1 = heel klein nadeel,
9 = heel groot nadeel
VOORDEEL
1 = heel klein voordeel,
9 = heel groot voordeel
Invoegen if {P1V01A} = 1: 0
Invoegen if {P1V01A} = 2: {P1V01B}
Invoegen if {P1V01A} = 3: {P1V01C}
Invoegen if {P1V02A} = 1: 0
Invoegen if {P1V02A} = 2: {P1V02B}
Invoegen if {P1V02A} = 3: {P1V02C}
Invoegen if {P1V03A} = 1: 0
Invoegen if {P1V03A} = 2: {P1V03B}
Invoegen if {P1V03A} = 3: {P1V03C}
Invoegen if {P1V04A} = 1: 0
Invoegen if {P1V04A} = 2: {P1V04B}
Invoegen if {P1V04A} = 3: {P1V04C}
Invoegen if {P1V05A} = 1: 0
Invoegen if {P1V05A} = 2: {P1V05B}
Invoegen if {P1V05A} = 3: {P1V05C}
Invoegen if {P1V06A} = 1: 0
Invoegen if {P1V06A} = 2: {P1V06B}
Invoegen if {P1V06A} = 3: {P1V06C}
Invoegen if {P1V07A} = 1: 0
Invoegen if {P1V07A} = 2: {P1V07B}
Invoegen if {P1V07A} = 3: {P1V07C}
Klik nu de knop “bereken” boven aan het scherm aan.

T89 : Intro 10a3	**Text**

Dit zijn uw oordelen over het pakket
Het verminderen van CO2 uitstoot in huizen en gebouwen.
<TABEL>
Stelling 1 Bijdrage aan milieukwaliteit
Stelling 2 Gebruik natuurlijke bronnen
Stelling 3 Beschikbaarheid van energie
Stelling 4 Economische gevolgen
Stelling 5 Gevolgen voor de werkgelegenheid
Stelling 6 Gevolgen voor huizen en gebouwen
Stelling 7 Prijs
Onbelangrijk
0
NADEEL
1 = heel klein nadeel,
9 = heel groot nadeel
VOORDEEL
1 = heel klein voordeel,
9 = heel groot voordeel
Invoegen if {P1V01A} = 1: 0
Invoegen if {P1V01A} = 2: {P1V01B}
Invoegen if {P1V01A} = 3: {P1V01C}
Invoegen if {P1V02A} = 1: 0
Invoegen if {P1V02A} = 2: {P1V02B}
Invoegen if {P1V02A} = 3: {P1V02C}
Invoegen if {P1V03A} = 1: 0
Invoegen if {P1V03A} = 2: {P1V03B}
Invoegen if {P1V03A} = 3: {P1V03C}
Invoegen if {P1V04A} = 1: 0
Invoegen if {P1V04A} = 2: {P1V04B}
Invoegen if {P1V04A} = 3: {P1V04C}
Invoegen if {P1V05A} = 1: 0
Invoegen if {P1V05A} = 2: {P1V05B}
Invoegen if {P1V05A} = 3: {P1V05C}
Invoegen if {P1V06A} = 1: 0
Invoegen if {P1V06A} = 2: {P1V06B}
Invoegen if {P1V06A} = 3: {P1V06C}
Invoegen if {P1V07A} = 1: 0
Invoegen if {P1V07A} = 2: {P1V07B}
Invoegen if {P1V07A} = 3: {P1V07C}
[u]TOTALE NADEELSCORE
TOTALE VOORDEELSCORE
[/u]
Tik een 9 in om verder te gaan:
9:verder

Q78 : P1TOT3 | **Left-Right Matrix**

Dit zijn uw oordelen over het pakket

Het verminderen van CO2 uitstoot in huizen en gebouwen.

<TABEL>

Stelling 1 Bijdrage aan milieukwaliteit
Stelling 2 Gebruik natuurlijke bronnen
Stelling 3 Beschikbaarheid van energie
Stelling 4 Economische gevolgen
Stelling 5 Gevolgen voor de werkgelegenheid
Stelling 6 Gevolgen voor huizen en gebouwen
Stelling 7 Prijs

Onbelangrijk
0

NADEEL
1 = heel klein nadeel,
9 = heel groot nadeel

VOORDEEL
1 = heel klein voordeel,
9 = heel groot voordeel

Invoegen if {P1V01A} = 1: 0
Invoegen if {P1V01A} = 2: {P1V01B}
Invoegen if {P1V01A} = 3: {P1V01C}
Invoegen if {P1V02A} = 1: 0
Invoegen if {P1V02A} = 2: {P1V02B}
Invoegen if {P1V02A} = 3: {P1V02C}
Invoegen if {P1V03A} = 1: 0
Invoegen if {P1V03A} = 2: {P1V03B}
Invoegen if {P1V03A} = 3: {P1V03C}
Invoegen if {P1V04A} = 1: 0
Invoegen if {P1V04A} = 2: {P1V04B}
Invoegen if {P1V04A} = 3: {P1V04C}
Invoegen if {P1V05A} = 1: 0
Invoegen if {P1V05A} = 2: {P1V05B}
Invoegen if {P1V05A} = 3: {P1V05C}
Invoegen if {P1V06A} = 1: 0
Invoegen if {P1V06A} = 2: {P1V06B}
Invoegen if {P1V06A} = 3: {P1V06C}
Invoegen if {P1V07A} = 1: 0
Invoegen if {P1V07A} = 2: {P1V07B}
Invoegen if {P1V07A} = 3: {P1V07C}

We vragen u nu om uw totaaloordeel, dus hoe u al met al over dit pakket denkt. Het ligt voor de hand dat u hierbij rekening houdt met uw eigen beoordelingen van de gevolgen. Daarbij is het natuurlijk handig om uw eigen totale nadeelscore en totale voordeelscore te gebruiken.

Wat is uw totaaloordeel over Het verminderen van CO2 uitstoot in huizen en gebouwen, op een schaal van slecht naar goed?

Zeer slecht	☐☐☐☐☐☐☐	Zeer goed

Q79 : P1TOT4 — **Numeric**

Min 1 | Max 10

Vul nu uw totaaloordeel over dit pakket in, uitgedrukt in een rapportcijfer (van 1 tot 10) . Hoe beter u dit pakket vindt, hoe hoger het rapportcijfer.

T90 : Intro 10a4 — **Text**

Nu volgt een omschrijving van het tweede pakket. Daarna volgen de te beoordelen gevolgen.

B2012 : Voorbeelden deel 2A2 — **End block**

B2121 : VB blok 2a — **End block**

B2122 : VB blok 2b — **Begin block**

T91 : Intro 11 — **Text**

Het verminderen van CO2 uitstoot in de industrie
Het doel van dit pakket is om 25 miljoen ton CO2 uitstoot te besparen in 2030. Dit pakket gaat over energiebesparing in de industriële sector van Nederland. Maatregelen die genomen kunnen worden om energie te besparen in de industrie zijn bijvoorbeeld het gebruik van energiebronnen die een lage CO2 uitstoot hebben, het ontwikkelen van nieuwe en baanbrekende technieken om producten te maken, het veranderen van product ontwerpen zodat minder materialen nodig zijn, en het verbeteren van materiaalgebruik en hergebruik daarvan. Het gaat in dit pakket niet over het zuiniger maken van energiecentrales.

B2021 : Voorbeelden deel 2B — **Begin block**

1	Stelling 1 (vraag 80)
2	Stelling 2 (vraag 80)
3	Stelling 3 (vraag 80)
4	Stelling 4 (vraag 80)
5	Stelling 5 (vraag 80)
6	Stelling 6 (vraag 80)

Q81 : P2V01A — **Single coded**

*? TXTB02021
Vindt u dit gevolg onbelangrijk, een voordeel of een nadeel?

1 ○ Onbelangrijk
2 ○ Nadeel
3 ○ Voordeel

ASK ONLY IF Q81=2

Q82 : P2V01B — **Left-Right Matrix**

Hoe klein of groot vindt u het nadeel?

Heel klein nadeel	□□□□□□□□□□□	Heel groot nadeel

ASK ONLY IF Q81=3

Q83 : P2V01C — **Left-Right Matrix**

Hoe klein of groot vindt u het voordeel?

Heel klein voordeel	□□□□□□□□□□□	Heel groot voordeel

B2021 : Voorbeelden deel 2B — **End block**

B2022 : Voorbeelden deel 2B2 — **Begin block**

T93 : Intro 11a2	**Text**

Dit zijn uw oordelen over het pakket
Het verminderen van CO2 uitstoot in de industrie.
<TABEL>
Stelling 1 Bijdrage aan milieukwaliteit
Stelling 2 Beschikbaarheid van energie
Stelling 3 Economische gevolgen
Stelling 4 Gevolgen voor de werkgelegenheid
Stelling 5 Gevolgen voor industrie
Stelling 6 Gevolgen voor consumenten
Onbelangrijk
0
NADEEL
1 = heel klein nadeel,
9 = heel groot nadeel
VOORDEEL
1 = heel klein voordeel,
9 = heel groot voordeel
Invoegen if {P2V01A} = 1: 0
Invoegen if {P2V01A} = 2: {P2V01B}
Invoegen if {P2V01A} = 3: {P2V01C}
Invoegen if {P2V02A} = 1: 0
Invoegen if {P2V02A} = 2: {P2V02B}
Invoegen if {P2V02A} = 3: {P2V02C}
Invoegen if {P2V03A} = 1: 0
Invoegen if {P2V03A} = 2: {P2V03B}
Invoegen if {P2V03A} = 3: {P2V03C}
Invoegen if {P2V04A} = 1: 0
Invoegen if {P2V04A} = 2: {P2V04B}
Invoegen if {P2V04A} = 3: {P2V04C}
Invoegen if {P2V05A} = 1: 0
Invoegen if {P2V05A} = 2: {P2V05B}
Invoegen if {P2V05A} = 3: {P2V05C}
Invoegen if {P2V06A} = 1: 0
Invoegen if {P2V06A} = 2: {P2V06B}
Invoegen if {P2V06A} = 3: {P2V06C}
Klik nu de knop "bereken" boven aan het scherm aan.

T94 : Intro 11a3	Text

Dit zijn uw oordelen over het pakket
Het verminderen van CO2 uitstoot in de industrie.
<TABEL>
Stelling 1 Bijdrage aan milieukwaliteit
Stelling 2 Beschikbaarheid van energie
Stelling 3 Economische gevolgen
Stelling 4 Gevolgen voor de werkgelegenheid
Stelling 5 Gevolgen voor industrie
Stelling 6 Gevolgen voor consumenten
Onbelangrijk
0
NADEEL
1 = heel klein nadeel,
9 = heel groot nadeel
VOORDEEL
1 = heel klein voordeel,
9 = heel groot voordeel
Invoegen if {P2V01A} = 1: 0
Invoegen if {P2V01A} = 2: {P2V01B}
Invoegen if {P2V01A} = 3: {P2V01C}
Invoegen if {P2V02A} = 1: 0
Invoegen if {P2V02A} = 2: {P2V02B}
Invoegen if {P2V02A} = 3: {P2V02C}
Invoegen if {P2V03A} = 1: 0
Invoegen if {P2V03A} = 2: {P2V03B}
Invoegen if {P2V03A} = 3: {P2V03C}
Invoegen if {P2V04A} = 1: 0
Invoegen if {P2V04A} = 2: {P2V04B}
Invoegen if {P2V04A} = 3: {P2V04C}
Invoegen if {P2V05A} = 1: 0
Invoegen if {P2V05A} = 2: {P2V05B}
Invoegen if {P2V05A} = 3: {P2V05C}
Invoegen if {P2V06A} = 1: 0
Invoegen if {P2V06A} = 2: {P2V06B}
Invoegen if {P2V06A} = 3: {P2V06C}
[u]TOTALE NADEELSCORE
TOTALE VOORDEELSCORE
[/u]
Tik een 9 in om verder te gaan:
9:verder

Q84 : P2TOT3 **Left-Right Matrix**

Dit zijn uw oordelen over het pakket

Het verminderen van CO2 uitstoot in de industrie.

<TABEL>

Stelling 1 Bijdrage aan milieukwaliteit
Stelling 2 Beschikbaarheid van energie
Stelling 3 Economische gevolgen
Stelling 4 Gevolgen voor de werkgelegenheid
Stelling 5 Gevolgen voor industrie
Stelling 6 Gevolgen voor consumenten

Onbelangrijk
0

NADEEL
1 = heel klein nadeel,
9 = heel groot nadeel

VOORDEEL
1 = heel klein voordeel,
9 = heel groot voordeel

Invoegen if {P2V01A} = 1: 0
Invoegen if {P2V01A} = 2: {P2V01B}
Invoegen if {P2V01A} = 3: {P2V01C}
Invoegen if {P2V02A} = 1: 0
Invoegen if {P2V02A} = 2: {P2V02B}
Invoegen if {P2V02A} = 3: {P2V02C}
Invoegen if {P2V03A} = 1: 0
Invoegen if {P2V03A} = 2: {P2V03B}
Invoegen if {P2V03A} = 3: {P2V03C}
Invoegen if {P2V04A} = 1: 0
Invoegen if {P2V04A} = 2: {P2V04B}
Invoegen if {P2V04A} = 3: {P2V04C}
Invoegen if {P2V05A} = 1: 0
Invoegen if {P2V05A} = 2: {P2V05B}
Invoegen if {P2V05A} = 3: {P2V05C}
Invoegen if {P2V06A} = 1: 0
Invoegen if {P2V06A} = 2: {P2V06B}
Invoegen if {P2V06A} = 3: {P2V06C}

We vragen u nu om uw totaaloordeel, dus hoe u al met al over dit pakket denkt. Het ligt voor de hand dat u hierbij rekening houdt met uw eigen beoordelingen van de gevolgen. Daarbij is het natuurlijk handig om uw eigen totale nadeelscore en totale voordeelscore te gebruiken.

Wat is uw totaaloordeel over Het verminderen van CO2 uitstoot in de industrie, op een schaal van slecht naar goed?

Zeer slecht	□□□□□□□	Zeer goed

Q85 : P2TOT4	**Numeric**

Min 1 | Max 10

Vul nu uw totaaloordeel over dit pakket in, uitgedrukt in een rapportcijfer (van 1 tot 10) . Hoe beter u dit pakket vindt, hoe hoger het rapportcijfer.

T95 : Intro 11a4	**Text**

Nu volgt een omschrijving van het derde pakket. Daarna volgen de te beoordelen gevolgen.

B2022 : Voorbeelden deel 2B2	**End block**

B2122 : VB blok 2b	**End block**

B2123 : VB blok 2c	**Begin block**

T96 : Intro 12	**Text**

Elektriciteit van windmolens op zee

Het doel van dit pakket is om 25 miljoen ton CO2 uitstoot te besparen in 2030 door ongeveer 15 windmolenparken in de Nederlandse Noordzee te plaatsen. Deze windmolens leveren elektriciteit. De windmolenparken zullen op verschillende plekken in zee langs de hele Nederlandse kust geplaatst worden op minimaal 20 kilometer uit de kust.

B2031 : Voorbeelden deel 2C	**Begin block**

1 Stelling 1 (vraag 86)
2 Stelling 2 (vraag 86)
3 Stelling 3 (vraag 86)
4 Stelling 4 (vraag 86)
5 Stelling 5 (vraag 86)
6 Stelling 6 (vraag 86)
7 Stelling 7 (vraag 86)

Q87 : P3V01A	**Single coded**

*? TXTB02031
Vindt u dit gevolg onbelangrijk, een voordeel of een nadeel?

1 O Onbelangrijk
2 O Nadeel
3 O Voordeel

ASK ONLY IF Q87=2

Q88 : P3V01B **Left-Right Matrix**

Hoe klein of groot vindt u het nadeel?

Heel klein nadeel	□□□□□□□□□□□	Heel groot nadeel

ASK ONLY IF Q87=3

Q89 : P3V01C **Left-Right Matrix**

Hoe klein of groot vindt u het voordeel?

Heel klein voordeel	□□□□□□□□□□□	Heel groot voordeel

B2031 : Voorbeelden deel 2C **End block**

B2032 : Voorbeelden deel 2C2 **Begin block**

T98 : Intro 12a2	Text

Dit zijn uw oordelen over het pakket
Elektriciteit van windmolens op zee.
<TABEL>
Stelling 1 Gevolgen voor uitzicht
Stelling 2 Gevolgen voor vogels
Stelling 3 Gevolgen voor vissen en zoogdieren in zee
Stelling 4 Gevolgen voor visserij
Stelling 5 Beschikbaarheid van energie
Stelling 6 Gevolgen voor de werkgelegenheid
Stelling 7 Prijs
Onbelangrijk
0
NADEEL
1 = heel klein nadeel,
9 = heel groot nadeel
VOORDEEL
1 = heel klein voordeel,
9 = heel groot voordeel
Invoegen if {P3V01A} = 1: 0
Invoegen if {P3V01A} = 2: {P3V01B}
Invoegen if {P3V01A} = 3: {P3V01C}
Invoegen if {P3V02A} = 1: 0
Invoegen if {P3V02A} = 2: {P3V02B}
Invoegen if {P3V02A} = 3: {P3V02C}
Invoegen if {P3V03A} = 1: 0
Invoegen if {P3V03A} = 2: {P3V03B}
Invoegen if {P3V03A} = 3: {P3V03C}
Invoegen if {P3V04A} = 1: 0
Invoegen if {P3V04A} = 2: {P3V04B}
Invoegen if {P3V04A} = 3: {P3V04C}
Invoegen if {P3V05A} = 1: 0
Invoegen if {P3V05A} = 2: {P3V05B}
Invoegen if {P3V05A} = 3: {P3V05C}
Invoegen if {P3V06A} = 1: 0
Invoegen if {P3V06A} = 2: {P3V06B}
Invoegen if {P3V06A} = 3: {P3V06C}
Invoegen if {P3V07A} = 1: 0
Invoegen if {P3V07A} = 2: {P3V07B}
Invoegen if {P3V07A} = 3: {P3V07C}
Klik nu de knop “bereken” boven aan het scherm aan.

T99 : Intro 12a3	Text

Dit zijn uw oordelen over het pakket
Elektriciteit van windmolens op zee.
<TABEL>
Stelling 1 Gevolgen voor uitzicht
Stelling 2 Gevolgen voor vogels
Stelling 3 Gevolgen voor vissen en zoogdieren in zee
Stelling 4 Gevolgen voor visserij
Stelling 5 Beschikbaarheid van energie
Stelling 6 Gevolgen voor de werkgelegenheid
Stelling 7 Prijs
Onbelangrijk
0
NADEEL
1 = heel klein nadeel,
9 = heel groot nadeel
VOORDEEL
1 = heel klein voordeel,
9 = heel groot voordeel
Invoegen if {P3V01A} = 1: 0
Invoegen if {P3V01A} = 2: {P3V01B}
Invoegen if {P3V01A} = 3: {P3V01C}
Invoegen if {P3V02A} = 1: 0
Invoegen if {P3V02A} = 2: {P3V02B}
Invoegen if {P3V02A} = 3: {P3V02C}
Invoegen if {P3V03A} = 1: 0
Invoegen if {P3V03A} = 2: {P3V03B}
Invoegen if {P3V03A} = 3: {P3V03C}
Invoegen if {P3V04A} = 1: 0
Invoegen if {P3V04A} = 2: {P3V04B}
Invoegen if {P3V04A} = 3: {P3V04C}
Invoegen if {P3V05A} = 1: 0
Invoegen if {P3V05A} = 2: {P3V05B}
Invoegen if {P3V05A} = 3: {P3V05C}
Invoegen if {P3V06A} = 1: 0
Invoegen if {P3V06A} = 2: {P3V06B}
Invoegen if {P3V06A} = 3: {P3V06C}
Invoegen if {P3V07A} = 1: 0
Invoegen if {P3V07A} = 2: {P3V07B}
Invoegen if {P3V07A} = 3: {P3V07C}
[u]TOTALE NADEELSCORE
TOTALE VOORDEELSCORE
[/u]
Tik een 9 in om verder te gaan:
9:verder

Q90 : P3TOT3 **Left-Right Matrix**

Dit zijn uw oordelen over het pakket

Elektriciteit van windmolens op zee.

<TABEL>

Stelling 1 Gevolgen voor uitzicht
Stelling 2 Gevolgen voor vogels
Stelling 3 Gevolgen voor vissen en zoogdieren in zee
Stelling 4 Gevolgen voor visserij
Stelling 5 Beschikbaarheid van energie
Stelling 6 Gevolgen voor de werkgelegenheid
Stelling 7 Prijs

Onbelangrijk
0

NADEEL
1 = heel klein nadeel,
9 = heel groot nadeel

VOORDEEL
1 = heel klein voordeel,
9 = heel groot voordeel

Invoegen if {P3V01A} = 1: 0
Invoegen if {P3V01A} = 2: {P3V01B}
Invoegen if {P3V01A} = 3: {P3V01C}
Invoegen if {P3V02A} = 1: 0
Invoegen if {P3V02A} = 2: {P3V02B}
Invoegen if {P3V02A} = 3: {P3V02C}
Invoegen if {P3V03A} = 1: 0
Invoegen if {P3V03A} = 2: {P3V03B}
Invoegen if {P3V03A} = 3: {P3V03C}
Invoegen if {P3V04A} = 1: 0
Invoegen if {P3V04A} = 2: {P3V04B}
Invoegen if {P3V04A} = 3: {P3V04C}
Invoegen if {P3V05A} = 1: 0
Invoegen if {P3V05A} = 2: {P3V05B}
Invoegen if {P3V05A} = 3: {P3V05C}
Invoegen if {P3V06A} = 1: 0
Invoegen if {P3V06A} = 2: {P3V06B}
Invoegen if {P3V06A} = 3: {P3V06C}
Invoegen if {P3V07A} = 1: 0
Invoegen if {P3V07A} = 2: {P3V07B}
Invoegen if {P3V07A} = 3: {P3V07C}

We vragen u nu om uw totaaloordeel, dus hoe u al met al over dit pakket denkt. Het ligt voor de hand dat u hierbij rekening houdt met uw eigen beoordelingen van de gevolgen. Daarbij is het natuurlijk handig om uw eigen totale nadeelscore en totale voordeelscore te gebruiken.

Wat is uw totaaloordeel over elektriciteit van windmolens op zee, op een schaal van slecht naar goed?

Zeer slecht	☐☐☐☐☐☐☐	Zeer goed

Q91 : P3TOT4	**Numeric**

Min 1 | Max 10

Vul nu uw totaaloordeel over dit pakket in, uitgedrukt in een rapportcijfer (van 1 tot 10) . Hoe beter u dit pakket vindt, hoe hoger het rapportcijfer.

T100 : Intro 12a4	**Text**

Nu volgt een omschrijving van het vierde pakket. Daarna volgen de te beoordelen gevolgen.

B2032 : Voorbeelden deel 2C2	**End block**

B2123 : VB blok 2c	**End block**

B2124 : VB blok 2d	**Begin block**

T101 : Intro 13	**Text**

[u]Omzetten van biomassa naar elektriciteit en brandstof
[/u]Het doel van dit pakket is om 25 miljoen ton CO2 uitstoot te besparen door een deel van de auto's te laten rijden op brandstof uit biomassa en door elektriciteitscentrales te stoken met biomassa. Biomassa is een term voor allerlei organisch materiaal, zoals hout, gras, organisch (groente-, fruit- en tuin-) afval, stro, enzovoort. Biomassa kan gebruikt worden om, in plaats van met fossiele brandstoffen, elektriciteit op te wekken, maar ook om brandstof voor auto's te maken. Wanneer planten groeien, nemen ze CO2 op. Deze CO2 komt bij de verbranding van de biomassa weer vrij. Er komt door de verbranding van planten niet meer CO2 in de lucht dan door die planten uit de lucht was gehaald, waardoor biomassa CO2-neutraal is. Het pakket zelf is niet volledig CO2 neutraal, omdat er CO2 vrijkomt bij het gebruik van land voor het verbouwen van biomassa en omdat de biomassa nog vervoerd en verwerkt moet worden. Om in 2030 genoeg biomassa te hebben om 25 miljoen ton CO2 uitstoot te besparen, zal naar schatting het merendeel van de biomassa ingevoerd moeten worden uit het buitenland. Het grootste deel van deze biomassa wordt dan deels in het buitenland, deels in Nederland omgezet naar moderne biobrandstof voor auto's. Voor de omzetting van biomassa naar biobrandstof zullen biobrandstoffabrieken gebouwd worden. Mogelijk zal ook een deel van de olieraffinaderijen, waar ruwe olie naar bijvoorbeeld benzine en diesel wordt omgezet, langzaam worden omgebouwd tot of vervangen worden door biobrandstoffabrieken.
Een kleiner deel van deze biomassa wordt dan in Nederland omgezet naar elektriciteit in 5 tot 8 grote elektriciteitscentrales in zeehavens als Rijnmond, Eemshaven of Terneuzen.

B2041 : Voorbeelden deel 2D — **Begin block**

1 Stelling 1 (vraag 92)
2 Stelling 2 (vraag 92)
3 Stelling 3 (vraag 92)
4 Stelling 4 (vraag 92)
5 Stelling 5 (vraag 92)
6 Stelling 6 (vraag 92)
7 Stelling 7 (vraag 92)
8 Stelling 8 (vraag 92)

Q93 : P4V01A — **Single coded**

*? TXTB02041
Vindt u dit gevolg onbelangrijk, een voordeel of een nadeel?

1 O Onbelangrijk
2 O Nadeel
3 O Voordeel

ASK ONLY IF Q93=2

Q94 : P4V01B — **Left-Right Matrix**

Hoe klein of groot vindt u het <u>nadeel</u>?

Heel klein nadeel	□□□□□□□□□□□	Heel groot nadeel

ASK ONLY IF Q93=3

Q95 : P4V01C — **Left-Right Matrix**

Hoe klein of groot vindt u het <u>voordeel</u>?

Heel klein voordeel	□□□□□□□□□□□	Heel groot voordeel

B2041 : Voorbeelden deel 2D — **End block**

B2042 : Voorbeelden deel 2D2 — **Begin block**

T103 : Intro 13a2	**Text**

Dit zijn uw oordelen over het pakket
Omzetten van biomassa naar elektriciteit en brandstof.
<TABEL>
Stelling 1 Bijdrage aan milieukwaliteit
Stelling 2 Landgebruik voor biomassa met certificaat
Stelling 3 Landgebruik voor biomassa zonder certificaat
Stelling 4 Invloed op voedselproductie
Stelling 5 Beschikbaarheid van energie
Stelling 6 Gevolgen voor de werkgelegenheid
Stelling 7 Economische gevolgen
Stelling 8 Prijs
Onbelangrijk
0
NADEEL
1 = heel klein nadeel,
9 = heel groot nadeel
VOORDEEL
1 = heel klein voordeel,
9 = heel groot voordeel
Invoegen if {P4V01A} = 1: 0
Invoegen if {P4V01A} = 2: {P4V01B}
Invoegen if {P4V01A} = 3: {P4V01C}
Invoegen if {P4V02A} = 1: 0
Invoegen if {P4V02A} = 2: {P4V02B}
Invoegen if {P4V02A} = 3: {P4V02C}
Invoegen if {P4V03A} = 1: 0
Invoegen if {P4V03A} = 2: {P4V03B}
Invoegen if {P4V03A} = 3: {P4V03C}
Invoegen if {P4V04A} = 1: 0
Invoegen if {P4V04A} = 2: {P4V04B}
Invoegen if {P4V04A} = 3: {P4V04C}
Invoegen if {P3405A} = 1: 0
Invoegen if {P4V05A} = 2: {P4V05B}
Invoegen if {P4V05A} = 3: {P4V05C}
Invoegen if {P4V06A} = 1: 0
Invoegen if {P4V06A} = 2: {P4V06B}
Invoegen if {P4V06A} = 3: {P4V06C}
Invoegen if {P4V07A} = 1: 0
Invoegen if {P4V07A} = 2: {P4V07B}
Invoegen if {P4V07A} = 3: {P4V07C}
Invoegen if {P4V08A} = 1: 0
Invoegen if {P4V08A} = 2: {P4V08B}
Invoegen if {P4V08A} = 3: {P4V08C}
Klik nu de knop “bereken” boven aan het scherm aan.

T104 : Intro 13a3	**Text**

Dit zijn uw oordelen over het pakket
Omzetten van biomassa naar elektriciteit en brandstof.
<TABEL>
Stelling 1 Bijdrage aan milieukwaliteit
Stelling 2 Landgebruik voor biomassa met certificaat
Stelling 3 Landgebruik voor biomassa zonder certificaat
Stelling 4 Invloed op voedselproductie
Stelling 5 Beschikbaarheid van energie
Stelling 6 Gevolgen voor de werkgelegenheid
Stelling 7 Economische gevolgen
Stelling 8 Prijs
Onbelangrijk
0
NADEEL
1 = heel klein nadeel,
9 = heel groot nadeel
VOORDEEL
1 = heel klein voordeel,
9 = heel groot voordeel
Invoegen if {P4V01A} = 1: 0
Invoegen if {P4V01A} = 2: {P4V01B}
Invoegen if {P4V01A} = 3: {P4V01C}
Invoegen if {P4V02A} = 1: 0
Invoegen if {P4V02A} = 2: {P4V02B}
Invoegen if {P4V02A} = 3: {P4V02C}
Invoegen if {P4V03A} = 1: 0
Invoegen if {P4V03A} = 2: {P4V03B}
Invoegen if {P4V03A} = 3: {P4V03C}
Invoegen if {P4V04A} = 1: 0
Invoegen if {P4V04A} = 2: {P4V04B}
Invoegen if {P4V04A} = 3: {P4V04C}
Invoegen if {P3405A} = 1: 0
Invoegen if {P4V05A} = 2: {P4V05B}
Invoegen if {P4V05A} = 3: {P4V05C}
Invoegen if {P4V06A} = 1: 0
Invoegen if {P4V06A} = 2: {P4V06B}
Invoegen if {P4V06A} = 3: {P4V06C}
Invoegen if {P4V07A} = 1: 0
Invoegen if {P4V07A} = 2: {P4V07B}
Invoegen if {P4V07A} = 3: {P4V07C}
Invoegen if {P4V08A} = 1: 0
Invoegen if {P4V08A} = 2: {P4V08B}
Invoegen if {P4V08A} = 3: {P4V08C}
[u]TOTALE NADEELSCORE
TOTALE VOORDEELSCORE
[/u]
Tik een 9 in om verder te gaan:
9:verder

Q96 : P4TOT3 | **Left-Right Matrix**

Dit zijn uw oordelen over het pakket

Omzetten van biomassa naar elektriciteit en brandstof.

<TABEL>

Stelling 1 Bijdrage aan milieukwaliteit
Stelling 2 Landgebruik voor biomassa met certificaat
Stelling 3 Landgebruik voor biomassa zonder certificaat
Stelling 4 Invloed op voedselproductie
Stelling 5 Beschikbaarheid van energie
Stelling 6 Gevolgen voor de werkgelegenheid
Stelling 7 Economische gevolgen
Stelling 8 Prijs

Onbelangrijk
0

NADEEL
1 = heel klein nadeel,
9 = heel groot nadeel

VOORDEEL
1 = heel klein voordeel,
9 = heel groot voordeel

Invoegen if {P4V01A} = 1: 0
Invoegen if {P4V01A} = 2: {P4V01B}
Invoegen if {P4V01A} = 3: {P4V01C}
Invoegen if {P4V02A} = 1: 0
Invoegen if {P4V02A} = 2: {P4V02B}
Invoegen if {P4V02A} = 3: {P4V02C}
Invoegen if {P4V03A} = 1: 0
Invoegen if {P4V03A} = 2: {P4V03B}
Invoegen if {P4V03A} = 3: {P4V03C}
Invoegen if {P4V04A} = 1: 0
Invoegen if {P4V04A} = 2: {P4V04B}
Invoegen if {P4V04A} = 3: {P4V04C}
Invoegen if {P3405A} = 1: 0
Invoegen if {P4V05A} = 2: {P4V05B}
Invoegen if {P4V05A} = 3: {P4V05C}
Invoegen if {P4V06A} = 1: 0
Invoegen if {P4V06A} = 2: {P4V06B}
Invoegen if {P4V06A} = 3: {P4V06C}
Invoegen if {P4V07A} = 1: 0
Invoegen if {P4V07A} = 2: {P4V07B}
Invoegen if {P4V07A} = 3: {P4V07C}
Invoegen if {P4V08A} = 1: 0
Invoegen if {P4V08A} = 2: {P4V08B}
Invoegen if {P4V08A} = 3: {P4V08C}

We vragen u nu om uw totaaloordeel, dus hoe u al met al over dit pakket denkt. Het ligt voor de hand dat u hierbij rekening houdt met uw eigen beoordelingen van de gevolgen. Daarbij is het natuurlijk handig om uw eigen totale nadeelscore en totale voordeelscore te gebruiken.

Wat is uw totaaloordeel over Omzetten van biomassa naar elektriciteit en brandstof, op een schaal van slecht naar goed?

Zeer slecht	☐☐☐☐☐☐☐	Zeer goed

Q97 : P4TOT4 **Numeric**

Min 1 | Max 10

Vul nu uw totaaloordeel over dit pakket in, uitgedrukt in een rapportcijfer (van 1 tot 10) . Hoe beter u dit pakket vindt, hoe hoger het rapportcijfer.

☐

T105 : Intro 13a4 **Text**

Nu volgt een omschrijving van het vijfde pakket. Daarna volgen de te beoordelen gevolgen.

B2042 : Voorbeelden deel 2D2 **End block**

B2124 : VB blok 2d **End block**

B2125 : VB blok 2e **Begin block**

T106 : Intro 14 **Text**

Omzetten van kolen of gas in elektriciteit waarbij CO_2 ondergronds wordt opgeslagen

Het doel van dit pakket is om 25 miljoen ton CO_2 uitstoot te besparen door CO_2 die bij gasgestookte en kolengestookte elektriciteitscentrales ontstaat, af te vangen en ondergronds op te slaan in Nederland of onder de bodem van het Nederlands deel van de Noordzee. Afvang van CO_2 kan bij bestaande elektriciteitscentrales plaatsvinden of ingepast worden in nieuwe centrales. Door CO_2 opslagtechniek kan het grootste gedeelte van de uitstoot, 80-90%, van CO_2 worden afgevangen. Die afvang kost wel wat energie. Met dit pakket zal in 2030 ongeveer de helft van alle energie die opgewekt wordt met kolen en gas, uit elektriciteitscentrales komen waarbij CO_2 afvang worden toegepast. De techniek van CO_2 opslag wordt op andere manieren al wel vaker toegepast, alleen nog niet op deze schaal. Dit pakket kan tijdelijk worden toegepast omdat de ruimte waarin CO_2 opgeslagen kan worden vol raakt. Met de huidige kennis van de Nederlandse bodem is de verwachting dat er voor ongeveer 100 tot 300 jaar opslagruimte is. Verder onderzoek naar veiligheid en beschikbaarheid is echter nodig om te kunnen bepalen of al deze opslagruimte kan worden gebruikt. Onderzoek kan echter ook uitwijzen dat er meer ruimte is dan nu verwacht.

B2051 : Voorbeelden deel 2E **Begin block**

1	Stelling 1 (vraag 98)
2	Stelling 2 (vraag 98)
3	Stelling 3 (vraag 98)
4	Stelling 4 (vraag 98)
5	Stelling 5 (vraag 98)
6	Stelling 6 (vraag 98)

Q99 : P5V01A	**Single coded**

*? TXTB02051
Vindt u dit gevolg onbelangrijk, een voordeel of een nadeel?

1 ○ Onbelangrijk
2 ○ Nadeel
3 ○ Voordeel

ASK ONLY IF Q99=2

Q100 : P5V01B	**Left-Right Matrix**

Hoe klein of groot vindt u het nadeel?

Heel klein nadeel	□□□□□□□□□□	Heel groot nadeel

ASK ONLY IF Q99=3

Q101 : P5V01C	**Left-Right Matrix**

Hoe klein of groot vindt u het voordeel?

Heel klein voordeel	□□□□□□□□□□	Heel groot voordeel

B2051 : Voorbeelden deel 2E	**End block**

B2052 : Voorbeelden deel 2E2	**Begin block**

T108 : Intro 14a2	**Text**

Dit zijn uw oordelen over het pakket
Omzetten van kolen of gas in elektriciteit waarbij CO2 ondergronds wordt opgeslagen.
<TABEL>
Stelling 1 Bijdrage aan vervuiling door kolenwinning
Stelling 2 Bijdrage aan milieukwaliteit
Stelling 3 Veiligheid van CO2 transport in pijpleidingen
Stelling 4 Veiligheid ondergrondse opslag van CO2
Stelling 5 Beschikbaarheid van energie
Stelling 6 Prijs
Onbelangrijk
0
NADEEL
1 = heel klein nadeel,
9 = heel groot nadeel
VOORDEEL
1 = heel klein voordeel,
9 = heel groot voordeel
Invoegen if {P5V01A} = 1: 0
Invoegen if {P5V01A} = 2: {P5V01B}
Invoegen if {P5V01A} = 3: {P5V01C}
Invoegen if {P5V02A} = 1: 0
Invoegen if {P5V02A} = 2: {P5V02B}
Invoegen if {P5V02A} = 3: {P5V02C}
Invoegen if {P5V03A} = 1: 0
Invoegen if {P5V03A} = 2: {P5V03B}
Invoegen if {P5V03A} = 3: {P5V03C}
Invoegen if {P5V04A} = 1: 0
Invoegen if {P5V04A} = 2: {P5V04B}
Invoegen if {P5V04A} = 3: {P5V04C}
Invoegen if {P5405A} = 1: 0
Invoegen if {P5V05A} = 2: {P5V05B}
Invoegen if {P5V05A} = 3: {P5V05C}
Invoegen if {P5V06A} = 1: 0
Invoegen if {P5V06A} = 2: {P5V06B}
Invoegen if {P5V06A} = 3: {P5V06C}
Klik nu de knop "bereken" boven aan het scherm aan.

T109 : Intro 14a3	Text

Dit zijn uw oordelen over het pakket
Omzetten van kolen of gas in elektriciteit waarbij CO2 ondergronds wordt opgeslagen.
<TABEL>
Stelling 1 Bijdrage aan vervuiling door kolenwinning
Stelling 2 Bijdrage aan milieukwaliteit
Stelling 3 Veiligheid van CO2 transport in pijpleidingen
Stelling 4 Veiligheid ondergrondse opslag van CO2
Stelling 5 Beschikbaarheid van energie
Stelling 6 Prijs
Onbelangrijk
0
NADEEL
1 = heel klein nadeel,
9 = heel groot nadeel
VOORDEEL
1 = heel klein voordeel,
9 = heel groot voordeel
Invoegen if {P5V01A} = 1: 0
Invoegen if {P5V01A} = 2: {P5V01B}
Invoegen if {P5V01A} = 3: {P5V01C}
Invoegen if {P5V02A} = 1: 0
Invoegen if {P5V02A} = 2: {P5V02B}
Invoegen if {P5V02A} = 3: {P5V02C}
Invoegen if {P5V03A} = 1: 0
Invoegen if {P5V03A} = 2: {P5V03B}
Invoegen if {P5V03A} = 3: {P5V03C}
Invoegen if {P5V04A} = 1: 0
Invoegen if {P5V04A} = 2: {P5V04B}
Invoegen if {P5V04A} = 3: {P5V04C}
Invoegen if {P5405A} = 1: 0
Invoegen if {P5V05A} = 2: {P5V05B}
Invoegen if {P5V05A} = 3: {P5V05C}
Invoegen if {P5V06A} = 1: 0
Invoegen if {P5V06A} = 2: {P5V06B}
Invoegen if {P5V06A} = 3: {P5V06C}
[u]TOTALE NADEELSCORE
TOTALE VOORDEELSCORE
[/u]
Tik een 9 in om verder te gaan:
9:verder

Q102 : P5TOT3 **Left-Right Matrix**

Dit zijn uw oordelen over het pakket

Omzetten van kolen of gas in elektriciteit waarbij CO2 ondergronds wordt opgeslagen.

<TABEL>

Stelling 1 Bijdrage aan vervuiling door kolenwinning
Stelling 2 Bijdrage aan milieukwaliteit
Stelling 3 Veiligheid van CO2 transport in pijpleidingen
Stelling 4 Veiligheid ondergrondse opslag van CO2
Stelling 5 Beschikbaarheid van energie
Stelling 6 Prijs

Onbelangrijk
0

NADEEL
1 = heel klein nadeel,
9 = heel groot nadeel

VOORDEEL
1 = heel klein voordeel,
9 = heel groot voordeel

Invoegen if {P5V01A} = 1: 0
Invoegen if {P5V01A} = 2: {P5V01B}
Invoegen if {P5V01A} = 3: {P5V01C}
Invoegen if {P5V02A} = 1: 0
Invoegen if {P5V02A} = 2: {P5V02B}
Invoegen if {P5V02A} = 3: {P5V02C}
Invoegen if {P5V03A} = 1: 0
Invoegen if {P5V03A} = 2: {P5V03B}
Invoegen if {P5V03A} = 3: {P5V03C}
Invoegen if {P5V04A} = 1: 0
Invoegen if {P5V04A} = 2: {P5V04B}
Invoegen if {P5V04A} = 3: {P5V04C}
Invoegen if {P5405A} = 1: 0
Invoegen if {P5V05A} = 2: {P5V05B}
Invoegen if {P5V05A} = 3: {P5V05C}
Invoegen if {P5V06A} = 1: 0
Invoegen if {P5V06A} = 2: {P5V06B}
Invoegen if {P5V06A} = 3: {P5V06C}

We vragen u nu om uw totaaloordeel, dus hoe u al met al over dit pakket denkt. Het ligt voor de hand dat u hierbij rekening houdt met uw eigen beoordelingen van de gevolgen. Daarbij is het natuurlijk handig om uw eigen totale nadeelscore en totale voordeelscore te gebruiken.

Wat is uw totaaloordeel over omzetten van kolen of gas in elektriciteit waarbij CO2 ondergronds wordt opgeslagen, op een schaal van slecht naar goed?

Zeer slecht	☐☐☐☐☐☐☐	Zeer goed

Q103 : P5TOT4 Numeric

Min 1 | Max 10

Vul nu uw totaaloordeel over dit pakket in, uitgedrukt in een rapportcijfer (van 1 tot 10) . Hoe beter u dit pakket vindt, hoe hoger het rapportcijfer.

T110 : Intro 14a4 **Text**

Nu volgt een omschrijving van het zesde pakket. Daarna volgen de te beoordelen gevolgen.

B2052 : Voorbeelden deel 2E2 **End block**

B2125 : VB blok 2e **End block**

B2126 : VB blok 2f **Begin block**

T111 : Intro 15 **Text**

Omzetten van biomassa naar elektriciteit en brandstof waarbij CO2 ondergronds wordt opgeslagen
Het doel van dit pakket is om 25 miljoen ton CO2 uitstoot te besparen door fossiele brandstof te vervangen door biomassa en door het opvangen en opslaan van CO2. Biomassa is een term voor allerlei organisch materiaal, zoals hout, gras, organisch (groente-, fruit- en tuin-) afval, stro, enzovoort. Biomassa kan gebruikt worden om, in plaats van met fossiele brandstoffen, elektriciteit op te wekken, maar ook om brandstof voor auto's te maken. Wanneer planten groeien, nemen ze CO2 op. Deze CO2 komt bij de verbranding van de biomassa weer vrij. Er komt door de verbranding van planten niet meer CO2 in de lucht dan door die planten uit de lucht was gehaald, waardoor biomassa CO2-neutraal is. Daarbij is in dit pakket het gebruik van biomassa gecombineerd met de opslag van CO2. De CO2 die vrijkomt bij de verbranding van de biomassa wordt opgeslagen. Een elektriciteitscentrale die met biomassa wordt gestookt haalt de helft tot evenveel CO2 uit de lucht, als een kolencentrale CO2 in de lucht brengt. Om in 2030 genoeg biomassa te hebben om 25 miljoen ton CO2 uitstoot te besparen, zal het merendeel van de biomassa ingevoerd moeten worden uit het buitenland. Een klein gedeelte van de fabrieken die energie of brandstof produceren zullen worden omgebouwd en er zullen 2 of 3 nieuwe fabrieken worden gebouwd om de productie van elektriciteit met biomassa en CO2 opslag mogelijk te maken. Niet alle CO2 uitstoot die vrijkomt bij de verbranding van biomassa voor energie kan worden opgevangen. Bij sommige technieken is dat een derde van de uitstoot.

B2061 : Voorbeelden deel 2F — **Begin block**

1 Stelling 1 (vraag 104)
2 Stelling 2 (vraag 104)
3 Stelling 3 (vraag 104)
4 Stelling 4 (vraag 104)
5 Stelling 5 (vraag 104)
6 Stelling 6 (vraag 104)
7 Stelling 7 (vraag 104)
8 Stelling 8 (vraag 104)

Q105 : P6V01A — **Single coded**

*? TXTB02061
Vindt u dit gevolg onbelangrijk, een voordeel of een nadeel?

1 ○ Onbelangrijk
2 ○ Nadeel
3 ○ Voordeel

ASK ONLY IF Q105=2

Q106 : P6V01B — **Left-Right Matrix**

Hoe klein of groot vindt u het nadeel?

Heel klein nadeel	□□□□□□□□□□□	Heel groot nadeel

ASK ONLY IF Q105=3

Q107 : P6V01C — **Left-Right Matrix**

Hoe klein of groot vindt u het voordeel?

Heel klein voordeel	□□□□□□□□□□□	Heel groot voordeel

B2061 : Voorbeelden deel 2F — **End block**

B2062 : Voorbeelden deel 2F2 — **Begin block**

T113 : Intro 15a2	**Text**

Dit zijn uw oordelen over het pakket
Omzetten van biomassa naar elektriciteit en brandstof waarbij CO2 ondergronds wordt opgeslagen.
<TABEL>
Stelling 1 Bijdrage aan de milieukwaliteit
Stelling 2 Landgebruik voor biomassa met certificaat
Stelling 3 Landgebruik voor biomassa zonder certificaat
Stelling 4 Invloed op voedselproductie
Stelling 5 Beschikbaarheid van energie
Stelling 6 Gevolgen voor de werkgelegenheid
Stelling 7 Economische gevolgen
Stelling 8 Prijs
Onbelangrijk
0
NADEEL
1 = heel klein nadeel,
9 = heel groot nadeel
VOORDEEL
1 = heel klein voordeel,
9 = heel groot voordeel
Invoegen if {P6V01A} = 1: 0
Invoegen if {P6V01A} = 2: {P6V01B}
Invoegen if {P6V01A} = 3: {P6V01C}
Invoegen if {P6V02A} = 1: 0
Invoegen if {P6V02A} = 2: {P6V02B}
Invoegen if {P6V02A} = 3: {P6V02C}
Invoegen if {P6V03A} = 1: 0
Invoegen if {P6V03A} = 2: {P6V03B}
Invoegen if {P6V03A} = 3: {P6V03C}
Invoegen if {P6V04A} = 1: 0
Invoegen if {P6V04A} = 2: {P6V04B}
Invoegen if {P6V04A} = 3: {P6V04C}
Invoegen if {P6405A} = 1: 0
Invoegen if {P6V05A} = 2: {P6V05B}
Invoegen if {P6V05A} = 3: {P6V05C}
Invoegen if {P6V06A} = 1: 0
Invoegen if {P6V06A} = 2: {P6V06B}
Invoegen if {P6V06A} = 3: {P6V06C}
Invoegen if {P6V07A} = 1: 0
Invoegen if {P6V07A} = 2: {P6V07B}
Invoegen if {P6V07A} = 3: {P6V07C}
Invoegen if {P6V08A} = 1: 0
Invoegen if {P6V08A} = 2: {P6V08B}
Invoegen if {P6V08A} = 3: {P6V08C}
Klik nu de knop "bereken" boven aan het scherm aan.

T114 : Intro 15a3	**Text**

Dit zijn uw oordelen over het pakket
Omzetten van biomassa naar elektriciteit en brandstof waarbij CO2 ondergronds wordt opgeslagen.
<TABEL>
Stelling 1 Bijdrage aan de milieukwaliteit
Stelling 2 Landgebruik voor biomassa met certificaat
Stelling 3 Landgebruik voor biomassa zonder certificaat
Stelling 4 Invloed op voedselproductie
Stelling 5 Beschikbaarheid van energie
Stelling 6 Gevolgen voor de werkgelegenheid
Stelling 7 Economische gevolgen
Stelling 8 Prijs
Onbelangrijk
0
NADEEL
1 = heel klein nadeel,
9 = heel groot nadeel
VOORDEEL
1 = heel klein voordeel,
9 = heel groot voordeel
Invoegen if {P6V01A} = 1: 0
Invoegen if {P6V01A} = 2: {P6V01B}
Invoegen if {P6V01A} = 3: {P6V01C}
Invoegen if {P6V02A} = 1: 0
Invoegen if {P6V02A} = 2: {P6V02B}
Invoegen if {P6V02A} = 3: {P6V02C}
Invoegen if {P6V03A} = 1: 0
Invoegen if {P6V03A} = 2: {P6V03B}
Invoegen if {P6V03A} = 3: {P6V03C}
Invoegen if {P6V04A} = 1: 0
Invoegen if {P6V04A} = 2: {P6V04B}
Invoegen if {P6V04A} = 3: {P6V04C}
Invoegen if {P6405A} = 1: 0
Invoegen if {P6V05A} = 2: {P6V05B}
Invoegen if {P6V05A} = 3: {P6V05C}
Invoegen if {P6V06A} = 1: 0
Invoegen if {P6V06A} = 2: {P6V06B}
Invoegen if {P6V06A} = 3: {P6V06C}
Invoegen if {P6V07A} = 1: 0
Invoegen if {P6V07A} = 2: {P6V07B}
Invoegen if {P6V07A} = 3: {P6V07C}
Invoegen if {P6V08A} = 1: 0
Invoegen if {P6V08A} = 2: {P6V08B}
Invoegen if {P6V08A} = 3: {P6V08C}
[u]TOTALE NADEELSCORE
TOTALE VOORDEELSCORE
[/u]
Tik een 9 in om verder te gaan:
9:verder

Q108 : P6TOT3 **Left-Right Matrix**

Dit zijn uw oordelen over het pakket

Omzetten van biomassa naar elektriciteit en brandstof waarbij CO2 ondergronds wordt opgeslagen.

<TABEL>

Stelling 1 Bijdrage aan de milieukwaliteit
Stelling 2 Landgebruik voor biomassa met certificaat
Stelling 3 Landgebruik voor biomassa zonder certificaat
Stelling 4 Invloed op voedselproductie
Stelling 5 Beschikbaarheid van energie
Stelling 6 Gevolgen voor de werkgelegenheid
Stelling 7 Economische gevolgen
Stelling 8 Prijs

Onbelangrijk
0

NADEEL
1 = heel klein nadeel,
9 = heel groot nadeel

VOORDEEL
1 = heel klein voordeel,
9 = heel groot voordeel

Invoegen if {P6V01A} = 1: 0
Invoegen if {P6V01A} = 2: {P6V01B}
Invoegen if {P6V01A} = 3: {P6V01C}
Invoegen if {P6V02A} = 1: 0
Invoegen if {P6V02A} = 2: {P6V02B}
Invoegen if {P6V02A} = 3: {P6V02C}
Invoegen if {P6V03A} = 1: 0
Invoegen if {P6V03A} = 2: {P6V03B}
Invoegen if {P6V03A} = 3: {P6V03C}
Invoegen if {P6V04A} = 1: 0
Invoegen if {P6V04A} = 2: {P6V04B}
Invoegen if {P6V04A} = 3: {P6V04C}
Invoegen if {P6405A} = 1: 0
Invoegen if {P6V05A} = 2: {P6V05B}
Invoegen if {P6V05A} = 3: {P6V05C}
Invoegen if {P6V06A} = 1: 0
Invoegen if {P6V06A} = 2: {P6V06B}
Invoegen if {P6V06A} = 3: {P6V06C}
Invoegen if {P6V07A} = 1: 0
Invoegen if {P6V07A} = 2: {P6V07B}
Invoegen if {P6V07A} = 3: {P6V07C}
Invoegen if {P6V08A} = 1: 0
Invoegen if {P6V08A} = 2: {P6V08B}
Invoegen if {P6V08A} = 3: {P6V08C}

We vragen u nu om uw totaaloordeel, dus hoe u al met al over dit pakket denkt. Het ligt voor de hand dat u hierbij rekening houdt met uw eigen beoordelingen van de gevolgen. Daarbij is het natuurlijk handig om uw eigen totale nadeelscore en totale voordeelscore te gebruiken.

Wat is uw <u>totaaloordeel</u> over Omzetten van biomassa naar elektriciteit en brandstof waarbij CO2 ondergronds wordt opgeslagen, op een schaal van slecht naar goed?

Zeer slecht	□□□□□□□	Zeer goed

Q109 : P6TOT4 **Numeric**

Min 1 | Max 10

Vul nu uw totaaloordeel over dit pakket in, uitgedrukt in een rapportcijfer (van 1 tot 10) . Hoe beter u dit pakket vindt, hoe hoger het rapportcijfer.

T115 : Intro 15a4 **Text**

Nu volgt een omschrijving van het zevende pakket. Daarna volgen de te beoordelen gevolgen.

B2062 : Voorbeelden deel 2F2 **End block**

B2126 : VB blok 2f **End block**

B2127 : VB blok 2g **Begin block**

T116 : Intro 16 **Text**

Elektriciteit uit kerncentrales
Het doel van dit pakket is om 25 miljoen ton CO2 uitstoot te besparen door in 2030 elektriciteit op te wekken in 4-5 kerncentrales waarvan 1 al bestaat: de centrale in Borssele. In kerncentrales wordt de grondstof uranium als energiebron gebruikt. Uraniumerts wordt gewonnen in mijnen. Bij de opwekking van elektriciteit met uranium wordt geen CO2 geproduceerd. De hoeveelheid uranium die nodig is voor dit pakket is nog minimaal honderd jaar beschikbaar, ook als meer landen dan nu uranium gebruiken en het verbruik ervan daarmee wereldwijd toeneemt. Het is waarschijnlijk dat er nog op meer plaatsen uranium gevonden zal worden en dat er in de loop van de tijd minder uranium nodig zal zijn om evenveel elektriciteit te produceren, waardoor centrales nog lang van uranium voorzien kunnen worden.

B2071 : Voorbeelden deel 2G **Begin block**

1	Stelling 1 (vraag 110)
2	Stelling 2 (vraag 110)
3	Stelling 3 (vraag 110)
4	Stelling 4 (vraag 110)
5	Stelling 5 (vraag 110)
6	Stelling 6 (vraag 110)
7	Stelling 7 (vraag 110)
8	Stelling 8 (vraag 110)

Q111 : P7V01A	**Single coded**

*? TXTB02071
Vindt u dit gevolg onbelangrijk, een voordeel of een nadeel?

1 ○ Onbelangrijk
2 ○ Nadeel
3 ○ Voordeel

ASK ONLY IF Q111=2

Q112 : P7V01B	**Left-Right Matrix**

Hoe klein of groot vindt u het nadeel?

Heel klein nadeel	□□□□□□□□□□	Heel groot nadeel

ASK ONLY IF Q111=3

Q113 : P7V01C	**Left-Right Matrix**

Hoe klein of groot vindt u het voordeel?

Heel klein voordeel	□□□□□□□□□□	Heel groot voordeel

B2071 : Voorbeelden deel 2G	**End block**

B2072 : Voorbeelden deel 2G2	**Begin block**

T118 : Intro 16a2	**Text**

Dit zijn uw oordelen over het pakket
Elektriciteit uit kerncentrales.
<TABEL>
Stelling 1 Radioactieve straling bij normaal bedrijf
Stelling 2 Kernafval
Stelling 3 Veiligheid kerncentrales
Stelling 4 Beveiliging centrales tegen aanslagen
Stelling 5 Kerncentrales en kernwapens
Stelling 6 Beschikbaarheid van energie
Stelling 7 Gevolgen voor de werkgelegenheid
Stelling 8 Prijs
Onbelangrijk
0
NADEEL
1 = heel klein nadeel,
9 = heel groot nadeel
VOORDEEL
1 = heel klein voordeel,
9 = heel groot voordeel
Invoegen if {P7V01A} = 1: 0
Invoegen if {P7V01A} = 2: {P7V01B}
Invoegen if {P7V01A} = 3: {P7V01C}
Invoegen if {P7V02A} = 1: 0
Invoegen if {P7V02A} = 2: {P7V02B}
Invoegen if {P7V02A} = 3: {P7V02C}
Invoegen if {P7V03A} = 1: 0
Invoegen if {P7V03A} = 2: {P7V03B}
Invoegen if {P7V03A} = 3: {P7V03C}
Invoegen if {P7V04A} = 1: 0
Invoegen if {P7V04A} = 2: {P7V04B}
Invoegen if {P7V04A} = 3: {P7V04C}
Invoegen if {P7405A} = 1: 0
Invoegen if {P7V05A} = 2: {P7V05B}
Invoegen if {P7V05A} = 3: {P7V05C}
Invoegen if {P7V06A} = 1: 0
Invoegen if {P7V06A} = 2: {P7V06B}
Invoegen if {P7V06A} = 3: {P7V06C}
Invoegen if {P7V07A} = 1: 0
Invoegen if {P7V07A} = 2: {P7V07B}
Invoegen if {P7V07A} = 3: {P7V07C}
Invoegen if {P7V08A} = 1: 0
Invoegen if {P7V08A} = 2: {P7V08B}
Invoegen if {P7V08A} = 3: {P7V08C}
Klik nu de knop “bereken” boven aan het scherm aan.

T119 : Intro 16a3	**Text**

Dit zijn uw oordelen over het pakket
Elektriciteit uit kerncentrales.
<TABEL>
Stelling 1 Radioactieve straling bij normaal bedrijf
Stelling 2 Kernafval
Stelling 3 Veiligheid kerncentrales
Stelling 4 Beveiliging centrales tegen aanslagen
Stelling 5 Kerncentrales en kernwapens
Stelling 6 Beschikbaarheid van energie
Stelling 7 Gevolgen voor de werkgelegenheid
Stelling 8 Prijs
Onbelangrijk
0
NADEEL
1 = heel klein nadeel,
9 = heel groot nadeel
VOORDEEL
1 = heel klein voordeel,
9 = heel groot voordeel
Invoegen if {P7V01A} = 1: 0
Invoegen if {P7V01A} = 2: {P7V01B}
Invoegen if {P7V01A} = 3: {P7V01C}
Invoegen if {P7V02A} = 1: 0
Invoegen if {P7V02A} = 2: {P7V02B}
Invoegen if {P7V02A} = 3: {P7V02C}
Invoegen if {P7V03A} = 1: 0
Invoegen if {P7V03A} = 2: {P7V03B}
Invoegen if {P7V03A} = 3: {P7V03C}
Invoegen if {P7V04A} = 1: 0
Invoegen if {P7V04A} = 2: {P7V04B}
Invoegen if {P7V04A} = 3: {P7V04C}
Invoegen if {P7405A} = 1: 0
Invoegen if {P7V05A} = 2: {P7V05B}
Invoegen if {P7V05A} = 3: {P7V05C}
Invoegen if {P7V06A} = 1: 0
Invoegen if {P7V06A} = 2: {P7V06B}
Invoegen if {P7V06A} = 3: {P7V06C}
Invoegen if {P7V07A} = 1: 0
Invoegen if {P7V07A} = 2: {P7V07B}
Invoegen if {P7V07A} = 3: {P7V07C}
Invoegen if {P7V08A} = 1: 0
Invoegen if {P7V08A} = 2: {P7V08B}
Invoegen if {P7V08A} = 3: {P7V08C}
[u]TOTALE NADEELSCORE
TOTALE VOORDEELSCORE
[/u]
Tik een 9 in om verder te gaan:
9:verder

Q114 : P7TOT3 **Left-Right Matrix**

Dit zijn uw oordelen over het pakket

Elektriciteit uit kerncentrales.

<TABEL>

Stelling 1 Radioactieve straling bij normaal bedrijf
Stelling 2 Kernafval
Stelling 3 Veiligheid kerncentrales
Stelling 4 Beveiliging centrales tegen aanslagen
Stelling 5 Kerncentrales en kernwapens
Stelling 6 Beschikbaarheid van energie
Stelling 7 Gevolgen voor de werkgelegenheid
Stelling 8 Prijs

Onbelangrijk
0

NADEEL
1 = heel klein nadeel,
9 = heel groot nadeel

VOORDEEL
1 = heel klein voordeel,
9 = heel groot voordeel

Invoegen if {P7V01A} = 1: 0
Invoegen if {P7V01A} = 2: {P7V01B}
Invoegen if {P7V01A} = 3: {P7V01C}
Invoegen if {P7V02A} = 1: 0
Invoegen if {P7V02A} = 2: {P7V02B}
Invoegen if {P7V02A} = 3: {P7V02C}
Invoegen if {P7V03A} = 1: 0
Invoegen if {P7V03A} = 2: {P7V03B}
Invoegen if {P7V03A} = 3: {P7V03C}
Invoegen if {P7V04A} = 1: 0
Invoegen if {P7V04A} = 2: {P7V04B}
Invoegen if {P7V04A} = 3: {P7V04C}
Invoegen if {P7405A} = 1: 0
Invoegen if {P7V05A} = 2: {P7V05B}
Invoegen if {P7V05A} = 3: {P7V05C}
Invoegen if {P7V06A} = 1: 0
Invoegen if {P7V06A} = 2: {P7V06B}
Invoegen if {P7V06A} = 3: {P7V06C}
Invoegen if {P7V07A} = 1: 0
Invoegen if {P7V07A} = 2: {P7V07B}
Invoegen if {P7V07A} = 3: {P7V07C}
Invoegen if {P7V08A} = 1: 0
Invoegen if {P7V08A} = 2: {P7V08B}
Invoegen if {P7V08A} = 3: {P7V08C}

We vragen u nu om uw totaaloordeel, dus hoe u al met al over dit pakket denkt. Het ligt voor de hand dat u hierbij rekening houdt met uw eigen beoordelingen van de gevolgen. Daarbij is het natuurlijk handig om uw eigen totale nadeelscore en totale voordeelscore te gebruiken.

Wat is uw totaaloordeel over elektriciteit uit kerncentrales, op een schaal van slecht naar goed?

Zeer slecht	☐☐☐☐☐☐☐	Zeer goed

Q115 : P7TOT4 — **Numeric**

Min 1 | Max 10

Vul nu uw totaaloordeel over dit pakket in, uitgedrukt in een rapportcijfer (van 1 tot 10) . Hoe beter u dit pakket vindt, hoe hoger het rapportcijfer.

☐

B2072 : Voorbeelden deel 2G2 — **End block**

B2127 : VB blok 2g — **End block**

B2001 : Intro blok 2 — **End block**

B2002 : Blok Correctie — **Begin block**

T121 : intro Correctie 1 — **Text**

Not back

U hebt net zeven pakketten beoordeeld. Op dit scherm en enkele volgende schermen gaat u bepalen welke vier pakketten van de zeven pakketten uw voorkeur hebben om in de toekomst op grote schaal toegepast te worden. De totale nadeelscores en voordeelscores en de rapportcijfers die u gaf ziet u hier.

<TABEL>

Q116 : BesNRv1 — **Single coded**

Bij het bepalen van uw voorkeuren voor pakketten, zou u gebruik kunnen maken van de rapportcijfers. Het zou kunnen dat u, nu u alle informatie over de pakketten hebt gelezen en kunt vergelijken, door deze vergelijking anders bent gaan denken over sommige pakketten. In dat geval kunt u in het overzicht een nieuw rapportcijfer geven.
Wilt u één of meer pakketten een nieuw rapportcijfer geven?

1 ○ Ja
2 ○ Nee

ASK ONLY IF Q116=1

Q117 : Correctie 1a — **Multi coded**

Hieronder staan de zeven pakketten met uw nadeel- en voordeelscores en uw oorspronkelijke rapportcijfer. U kunt daar achter een nieuw rapportcijfer intikken. Wilt u het niet veranderen, druk dan op <ENTER>. Mocht u uw beoordeling van de gevolgen van een pakket nog eens willen zien, dan kan dit door '99' in te tikken.

gebruik dus niet de Terug-toets!

1 ☐ pakket 1
2 ☐ pakket 2
3 ☐ pakket 3
4 ☐ pakket 4
5 ☐ pakket 5
6 ☐ pakket 6
7 ☐ pakket 7
8 ○ geen van deze *Exclusive *Position fixed

ASK ONLY IF Q117=1,2,3,4,5,6,7

B2081 : Blok Correctie 1 — **Begin block**

1 pakket 1
2 pakket 2
3 pakket 3
4 pakket 4
5 pakket 5
6 pakket 6
7 pakket 7

Q118 : NRv1p1 — **Numeric**

Min 1 | Max 10

Nieuwe rapportcijfers

B2081 : Blok Correctie 1 — **End block**

Q119 : PKv1 | **Multi coded**

Min 4 | Max 4 | Top of mind 4 answers

We willen u nu vragen welke vier van de zeven pakketten uw voorkeur zou hebben om op grote schaal toegepast te worden. Bepaalt u nu uw keuze welke pakketten uw voorkeur hebben. Let u er op: u moet vier pakketten kiezen

Als u wilt kunt u hierbij gebruik maken van de rapportcijfers en/of de totale nadeelscores en voordeelscores. Uiteraard kunt u (ook) andere overwegingen een rol laten spelen.

1 ☐ Het verminderen van CO2 uitstoot in huizen en gebouwen (PKv1p1)
2 ☐ Het verminderen van CO2 uitstoot in de industrie (PKv1p2)
3 ☐ Elektriciteit van windmolens op zee (PKv1p3)
4 ☐ Omzetten van biomassa naar elektriciteit en brandstof (PKv1p4)
5 ☐ Omzetten van kolen of gas in elektriciteit waarbij CO2 ondergronds wordt opgeslagen (PKv1p5)
6 ☐ Omzetten van biomassa naar elektriciteit en brandstof waarbij CO2 ondergronds wordt opgeslagen (PKv1p6)
7 ☐ Elektriciteit uit kerncentrales (PKv1p7)

Q120 : OnacV1 | **Single coded**

Misschien vond u één of meer van de pakketten volstrekt onaanvaardbaar. Is er bij de zeven pakketten die u beoordeelde, één of meer voor u zo onaanvaardbaar, dat u denkt actie te ondernemen wanneer in Nederland overwogen wordt dit pakket grootschalig te gaan toepassen?

1 ○ Ja
2 ○ Nee

ASK ONLY IF Q120=1

Q121 : OnacV1b | **Multi coded**

Kunt u hier aangeven van welke pakketten u grootschalige toepassing echt onaanvaardbaar vindt?

(Meer antwoorden mogelijk)

1 ☐ Het verminderen van CO2 uitstoot in huizen en gebouwen (OnacV1p1)
2 ☐ Het verminderen van CO2 uitstoot in de industrie (OnacV1p2)
3 ☐ Elektriciteit van windmolens op zee (OnacV1p3)
4 ☐ Omzetten van biomassa naar elektriciteit en brandstof (OnacV1p4)
5 ☐ Omzetten van kolen of gas in elektriciteit waarbij CO2 ondergronds wordt opgeslagen (OnacV1p5)
6 ☐ Omzetten van biomassa naar elektriciteit en brandstof waarbij CO2 ondergronds wordt opgeslagen (OnacV1p6)
7 ☐ Elektriciteit uit kerncentrales (OnacV1p7)

B2002 : Blok Correctie | **End block**

B2000 : Deel 2 | **End block**

B3000 : Deel 3 | **Begin block**

T122 : Intro 21 — **Text**

Not back

In deze enquête werd een speciale werkwijze gevolgd. Voor u een keuze maakte, kreeg u eerst informatie over gevolgen en werd u gevraagd uw mening over die informatie te geven. Deze informatie is door deskundigen samengesteld. Er is op zorgvuldige wijze met de verzameling van informatie omgegaan om de informatie zo evenwichtig en betrouwbaar mogelijk te maken. Wij vragen ons af of dit volgens u ook is gelukt. Daar willen we u een paar vragen over stellen. U kunt uw antwoord geven door het cijfer (tussen 1 en 7) aan te klikken dat uw mening het beste weergeeft.

B3010 : INv1 tm v14 — **Begin block**

Q122 : INv1 — **Left-Right Matrix**

Not back

Infovraag1. In hoeverre vindt u dat u over voldoende informatie beschikt om een keuze te kunnen maken tussen de verschillende mogelijkheden voor energie?

Onvoldoende	☐☐☐☐☐☐☐	Voldoende

Q123 : INv2 — **Left-Right Matrix**

Not back

Infovraag2. In hoeverre had u meer of minder informatie over de gevolgen willen hebben voor u uw oordeel gaf over alle gevolgen in de enquête?

(Als u niet meer of minder informatie had willen hebben, kunt u “4” antwoorden)

Minder	☐☐☐☐☐☐☐	Meer

Q124 : INv3 — **Left-Right Matrix**

Not back

Infovraag3. In hoeverre vindt u de informatie over de gevolgen in de enquête partijdig of onpartijdig?

Onpartijdig	☐☐☐☐☐☐☐	Partijdig

Q125 : INv4 — **Left-Right Matrix**

Not back

Infovraag 4. In hoeverre vindt u de informatie over de gevolgen eenzijdig?

Niet eenzijdig	☐☐☐☐☐☐☐	Eenzijdig

Q126 : INv5 — **Left-Right Matrix**

Not back

Inforvraag5. Hoe duidelijk vindt u de informatie over de gevolgen?

Onduidelijk	☐☐☐☐☐☐☐	Duidelijk

Q127 : INv6 — **Left-Right Matrix**

Not back

Infovraag6. In hoeverre vindt u de informatie over de gevolgen volledig?

Onvolledig	☐☐☐☐☐☐☐	Volledig

Q128 : INv7 — **Left-Right Matrix**

Not back

Infovraag7. In hoeverre was de informatie over de gevolgen voor u nieuw en onbekend?

Onbekend	☐☐☐☐☐☐☐	Bekend

Q129 : INv8 — **Left-Right Matrix**

Not back

Infovraag8. In hoeverre vindt u de hoeveelheid informatie in de enquête gepast?

Te weinig informatie	☐☐☐☐☐☐☐	Te veel informatie

Q130 : INv9 — **Left-Right Matrix**

Not back

Infovraag9. In hoeverre vindt u het prettig dat de informatie en werkwijze soms herhaald werden?

Irritant	☐☐☐☐☐☐☐	Prettig

Q131 : INv10 — **Single coded**

Not back

Infovraag10. Was er een moment tijdens de afname dat u iets onduidelijk vond, of niet begreep wat u moest doen?

1 ○ Ja
2 ○ Nee

ASK ONLY IF Q131=1

Q132 : INv10op | **Open**

Not back

Kunt u hier in uw eigen woorden aangeven wat u onduidelijk of onbegrijpelijk vond?

Q133 : INv11 | **Left-Right Matrix**

Not back

Infovraag11. In hoeverre heeft de werkwijze u geholpen bij het maken van een keuze?

Niet geholpen	□□□□□□□	Wel geholpen

Q134 : INv12 | **Left-Right Matrix**

Not back

Infovraag12. In hoeverre vindt u de werkwijze begrijpelijk?

Niet begrijpelijk	□□□□□□□	Wel begrijpelijk

Q135 : INv13 | **Left-Right Matrix**

Not back

Infovraag13. In hoeverre vindt u de werkwijze eenvoudig of ingewikkeld?

Eenvoudig	□□□□□□□	Ingewikkeld

Q136 : INv14 | **Left-Right Matrix**

Not back

Infovraag14. De mogelijkheden waaruit u kon kiezen stonden vast. In hoeverre voelde u zich hierdoor beperkt in uw keuze?

Niet beperkt	□□□□□□□	Beperkt

B3010 : INv1 tm v14 | **End block**

Q144 : Klim01 | **Left-Right Matrix**

Extra1. In hoeverre bent u er van overtuigd dat het klimaat op aarde de afgelopen eeuw gemiddeld warmer is geworden?

Helemaal niet overtuigd	□□□□□□□	Zeer overtuigd

Q145 : Klim02 **Left-Right Matrix**

Extra2. In hoeverre bent u ervan overtuigd dat het klimaat op aarde de komende eeuw gemiddeld warmer zal worden?

Helemaal niet overtuigd	☐☐☐☐☐☐☐	Zeer overtuigd

Q147 : Klim03 **Left-Right Matrix**

Extra3. In hoeverre bent u er van overtuigd dat de opwarming van de aarde het gevolg is van CO2 uitstoot door de mens?

Helemaal niet overtuigd	☐☐☐☐☐☐☐	Helemaal wel overtuigd

Q148 : Klim04 **Left-Right Matrix**

Extra4. in hoeverre bent u van mening dat er iets gedaan moet worden om CO2 uitstoot te verminderen?

Helemaal niet noodzakelijk	☐☐☐☐☐☐☐	Zeer noodzakelijk

Q149 : Klim05 **Left-Right Matrix**

Extra5. In hoeverre denkt u dat het voor Nederland noodzakelijk is zich te beschermen tegen de mogelijke gevolgen van een warmer klimaat zoals overstromingen, bijvoorbeeld door het ophogen van dijken of het versterken van de zeewering?

Helemaal niet noodzakelijk	☐☐☐☐☐☐☐	Zeer noodzakelijk

Q150 : **Matrix**

Nu volgen nog een aantal stellingen over eigenschappen van CO2. Deze stellingen kunnen waar of onwaar zijn. Geef voor elke stelling aan in hoeverre u zeker weet dat deze stelling waar of niet waar is.

	Ik weet zeker van niet 1	2	3	4	Ik weet zeker van wel 5
CO2 is een gas dat in de natuur voorkomt	○	○	○	○	○
CO2 is explosief	○	○	○	○	○
CO2 is schadelijk bij huidcontact	○	○	○	○	○
CO2 maakt een leefbaar klimaat op aarde mogelijk	○	○	○	○	○

Q151 : **Matrix**

Hierna volgt een aantal stellingen over waar CO2 vandaan komt.

	Ik weet zeker van niet	2	3	4	Ik weet zeker van wel
CO2 komt vrij als je uitademt	○	○	○	○	○
CO2 komt vrij bij gebruik van spuitbussen met haarlak en deodorant	○	○	○	○	○
CO2 komt vrij bij lekkage uit oude batterijen en accu's	○	○	○	○	○
CO2 komt vrij bij het opwekken van energie uit aardgas	○	○	○	○	○
CO2 komt vrij bij het opwekken van energie uit kolen	○	○	○	○	○
CO2 komt vrij bij het opwekken van energie uit biomassa (o.a. hout, planten)	○	○	○	○	○
CO2 komt vrij bij het opwekken van kernenergie	○	○	○	○	○

T123 : Intro 22 **Text**

Not back

Graag zouden we nog willen weten hoe u denkt over een aantal zaken, die veel te maken hebben met het broeikaseffect of energieopwekking. Omdat het hier soms over zaken gaat, waarover u in de enquête geen informatie heeft ontvangen, is het bij deze vragen ook mogelijk om geen mening te geven. U kunt dan op de knop "geen mening" klikken.

B3020 : Klim01 tm Klim05 **Begin block**

1 Stelling 1 (vraag 137) KLIM01
2 Stelling 2 (vraag 137) KLIM02
3 Stelling 3 (vraag 137) KLIM03
4 Stelling 4 (vraag 137) KLIM04
5 Stelling 5 (vraag 137) KLIM05

Q138 : Klim01 **Matrix**

Not back

*? TXTB03020

	1 - Helemaal niet overtuigd	2	3	4	5	6	7 - Helemaal wel overtuigd	geen mening
	○	○	○	○	○	○	○	○

B3020 : Klim01 tm Klim05 **End block**

B3030 : VALUE1 - VALUE16 **Begin block**

Q139 : VALUE1VALUE16 **Matrix**

Not back

Hieronder staan 16 waarden. Achter elke waarde wordt een korte toelichting gegeven over de betekenis van de waarde. Wil je aangeven hoe belangrijk elke waarde is voor jou als leidraad in jouw leven?

De betekenis van de scores is als volgt:

-1 - betekent dat de waarde ingaat tegen jouw principes
0 - betekent dat de waarde niet belangrijk is; het is niet relevant als leidraad voor jouw leven
3 - betekent dat de waarde belangrijk is
6 - betekent dat de waarde zeer (heel erg) belangrijk is
7 - betekent dat de waarde uiterst belangrijk voor jou is als leidraad in jouw leven. Gewoonlijk heeft iemand niet meer dan twee waarden waar aan een 7 toegekend wordt.

Je scores kunnen variëren van -1 tot 7. Hoe hoger het cijfer (0, 1, 2, 3, 4, 5, 6, 7) hoe belangrijker de waarde is als leidraad in je leven. Probeer zoveel mogelijk onderscheid te maken tussen het belang van de waarden door verschillende cijfers aan te kruisen.

Random

	-1 Gaat in tegen mijn principes	0 Niet belangrijk	1	2	3 Belangrijk	4	5	6 Zeer belangrijk	7 Uiterst belangrijk
GELIJKHEID: gelijke kansen voor iedereen	○	○	○	○	○	○	○	○	○
RESPECT VOOR DE AARDE: in harmonie leven met andere soorten	○	○	○	○	○	○	○	○	○
MACHT: controle over andere mensen, dominantie	○	○	○	○	○	○	○	○	○
PLEZIER: genot, vervulling van verlangens	○	○	○	○	○	○	○	○	○
EENHEID MET DE NATUUR: je verbonden voelen met de natuur	○	○	○	○	○	○	○	○	○
EEN VREEDZAME WERELD: vrij van oorlog en conflict	○	○	○	○	○	○	○	○	○
RIJKDOM: materiële bezittingen, geld	○	○	○	○	○	○	○	○	○
GEZAG: het recht om te leiden of op te dragen	○	○	○	○	○	○	○	○	○
SOCIALE RECHTVAARDIGHEID: herstel van onrecht, zorg voor zwakken	○	○	○	○	○	○	○	○	○
GENIETEN VAN HET LEVEN: van eten, seks, ontspanning, etc.	○	○	○	○	○	○	○	○	○

BESCHERMING VAN HET MILIEU: behoud van milieukwaliteit en de natuur	O	O	O	O	O	O	O	O	O
INVLOEDRIJK: invloed hebben op mensen en gebeurtenissen	O	O	O	O	O	O	O	O	O
BEHULPZAAMHEID: werken voor het welzijn van anderen	O	O	O	O	O	O	O	O	O
MILIEUVERVUILING VOORKOMEN: natuurlijke hulpbronnen beschermen	O	O	O	O	O	O	O	O	O
JEZELF VERWENNEN: aangename dingen doen	O	O	O	O	O	O	O	O	O
AMBITIEUS: hardwerkend, eerzuchtig, strevend	O	O	O	O	O	O	O	O	O

B3030 : VALUE1 - VALUE16 **End block**

Q152 : **Single coded**

Tot slot hebben we nog maximaal acht vragen voor u die geen betrekking hebben op de informatie en keuzes die u eerder hebt ontvangen.Omdat er de laatste tijd veel nieuws was over schaliegas, willen we u vragen nog enkele vragen hierover te beantwoorden.

1 O Nee, nooit van gehoord
2 O Ik heb er van gehoord, maar weet niet wat het is
3 O Ja, en ik weet er een beetje van af
4 O Ja, en daar weet ik behoorlijk van af

ASK ONLY IF Q152=2,3,4

Q153 : Matrix

	Helemaal niet	2	3	4	5	6	Helemaal wel
In hoeverre denkt u dat schaliegas een aantrekkelijke economische optie is in Nederland?	○	○	○	○	○	○	○
In hoeverre denkt u dat boren naar schaliegas noodzakelijk is voor de Nederlandse energievoorziening?	○	○	○	○	○	○	○
In hoeverre denkt u dat boren naar schaliegas positieve gevolgen zal hebben?	○	○	○	○	○	○	○
In hoeverre denkt u dat boren naar schaliegas negatieve gevolgen zal hebben?	○	○	○	○	○	○	○

ASK ONLY IF Q152=2,3,4

Q154 : Schalieopen Open

Kunt u een aantal voordelen en/of nadelen noemen?

Als u geen voordelen of nadelen weet, kunt u deze vraag overslaan.

ASK ONLY IF Q152=2,3,4

Q155 : Schalie6 Matrix

	Zeer slecht	2	3	4	5	6	Zeer goed
Wat vindt u van schaliegas?	○	○	○	○	○	○	○

B3000 : Deel 3 End block

B4000 : eind blok — **Begin block**

Q140 : EindeICQ — **Numeric**

Min 1 | Max 10 | Not back

Tot zover het invullen van de vragenlijst. Wilt u deze vragenlijst dan nu beoordelen door een rapportcijfer (van 1 tot 10) te geven?

Als u deze vragenlijst erg vervelend vond, geeft u een 1. Vond u het uitermate interessant, dan geeft u een 10.

Q143 : Cqcijf1 — **Matrix**

Not back

Rapportcijfer

	Zeer slecht	2	3	4	5	6	7	8	9	Zeer goed	geen menin g
	○	○	○	○	○	○	○	○	○	○	○

Q141 : EindOpmerkingen — **Single coded**

Not back

Heeft u verder nog op- of aanmerkingen over deze vragenlijst?

1 ○ Ja
2 ○ Nee

ASK ONLY IF Q141=1

Q142 : V540 — **Open**

Not back

U heeft de rest van het scherm voor uw op- en aanmerkingen!

T124 : Bedankt — **Text**

Not back

Wij danken u zeer hartelijk voor u deelname aan dit onderzoek.

B4000 : eind blok	**End block**