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Discussion Paper No. 10-068

**The Demand for Climate Protection –
An Empirical Assessment for Germany**

Andreas Löschel, Bodo Sturm, and Carsten Vogt

ZEW

Zentrum für Europäische
Wirtschaftsforschung GmbH

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Non-technical summary

During the last two decades, the issue of international cooperation in climate protection has received increasing attention in economic research. The main focus has been on the underlying economic incentives for sovereign states to reach international environmental agreements. Besides the fundamental incentive problems of international cooperation, climate change policy has an important political economy dimension. National climate protection targets have to be politically acceptable to the domestic constituency. Moreover, even without international and national climate policies, individuals reduce CO₂ emissions and voluntarily contribute to the global public good climate protection via carbon offsets. An empirical evaluation of the demand for carbon offsets and the people's willingness to pay (WTP) for climate protection is thus crucial for assessing the prospects of climate change mitigation.

Essentially, two methods for measuring the WTP for a particular good are available: First, one can infer the WTP from observing some economic transactions, i.e. the so-called revealed preferences approach. Second, one can ask people what they are willing to spend on some amount of a particular good or what quantity they are willing to purchase at a given price. This method is known as the stated preferences approach. Against the background of climate mitigation policies, all studies in the past that tried to measure WTP are varieties of the stated preferences approach. Thus, so far the WTP for climate protection has been derived from hypothetical decision situations only.

This study aims at eliciting the participants' real WTP for climate protection with the revealed preference approach. We conducted an experiment where people faced the opportunity to buy allowances from the European Emissions Trading Scheme (EU ETS). The sample consisted of 202 individuals from the residential population of Mannheim, Germany. Participants of the experiment received € 40 and obtained information about (i) climate change and its effects on environment and human society and (ii) the EU ETS. Five prices were shown to each participant. The participants then indicated which quantity of permits they would like to buy for each price. After the experiment, one of the five prices was randomly selected and transactions were conducted accordingly. This method was chosen to guarantee incentive-compatibility and to implement a decision situation which is familiar to consumers since they have to state their demand at a given price. Purchased allowances were withdrawn from the EU ETS. From the observed price-quantity-combinations we derived participants' demand and the corresponding WTP. The experiment consisted of two treatments "Baseline" and "Reputation". In the latter, subjects knew in advance that they could obtain a certificate, verifying the purchased amounts.

The main result is that WTP for carbon reduction is very low: It amounts to approximately € 12 per ton of CO₂. Compared to the figures previously reported by stated preference studies on the WTP for climate protection this amount is fairly small. Moreover, the median WTP for our sample is zero. With respect to the treatment variable (certification of CO₂ reduction), we find a positive reputation effect, i.e. the quantity climate protection demanded in the reputation treatment was significantly higher compared to the baseline treatment. The analysis of data on socio-economic variables as well as of attitudes towards global warming shows a negative age-effect and a positive effect of the formal educational level. An additional determinant of demand for climate protection is the preference for political parties: voters of the Green Party buy more permits.

Das Wichtigste in Kürze

Obwohl der Klimaschutz seit Jahren mit hoher Priorität auf der politischen Agenda steht, ist die Höhe der realen Zahlungsbereitschaft für das globale Gut Klimaschutz weitestgehend unbekannt. Die reale Zahlungsbereitschaft für Klimaschutz stellt aber eine zentrale Größe dar, wenn es um die Bereitschaft eines Landes geht, sich zu bindenden Emissionsreduktionen zu verpflichten. Damit ein Land Vermeidungsaktivitäten unternimmt, die zumindest kurz- und mittelfristig signifikante Kosten verursachen, muss eine hinreichend hohe Zahlungsbereitschaft in der Bevölkerung existieren. Auch für freiwillige private Aktivitäten im Klimaschutz ist eine positive Zahlungsbereitschaft notwendig.

Wie hoch die Zahlungsbereitschaft für Klimaschutz ist, kann letztlich nur empirisch ermittelt werden. Grundsätzlich gibt es zwei Methoden zur Ermittlung der Zahlungsbereitschaft für ein Gut. Erstens, die Zahlungsbereitschaft kann aus einer realen ökonomischen Transaktion abgeleitet werden. Zweitens, man kann Menschen fragen, was sie unter bestimmten Bedingungen für das Gut zu zahlen bereit sind. Alle verfügbaren Studien zur Zahlungsbereitschaft für Klimaschutz nutzen solche Befragungen. Es wird somit die hypothetische Zahlungsbereitschaft für Klimaschutz erhoben.

In dieser experimentellen Studie wird erstmals die reale Nachfrage nach Klimaschutz ermittelt und damit zugleich die reale Zahlungsbereitschaft für Klimaschutz erhoben. Auf Grund der Existenz des Europäischen Emissionshandels für Kohlendioxid (CO₂) ist es möglich, direkt die reale Nachfrage für die Stilllegung von CO₂-Zertifikaten unter kontrollierten Bedingungen zu erheben. An der hier vorgestellten Studie nahmen 202 Mannheimer Bürger im Alter von 18 bis 75 Jahren teil. Die Teilnehmer erhielten eine Aufwandsentschädigung in Höhe von 40 €, wurden über den Klimawandel und die Wirkungsweise des Emissionshandels informiert und konnten schließlich – freiwillig und anonym – CO₂-Zertifikate kaufen. Jeder Teilnehmer konnte für fünf verschiedene Preise die individuelle Nachfrage nach Zertifikaten angeben, wobei schließlich ein Preis als bindend ausgelost wurde. Der verwendete Mechanismus zur Ermittlung der Nachfrage ist anreizkompatibel, d.h., jeder Teilnehmer hatte einen Anreiz, seine tatsächliche individuelle Nachfrage anzugeben. Die an die Teilnehmer verkauften Zertifikate wurden erworben und stillgelegt. Damit wurde die Gesamtmenge aller zur Verfügung stehenden Zertifikate im Emissionshandel exakt um diese Menge reduziert, d.h., es wurde ein realer Beitrag zum Klimaschutz geleistet.

Insgesamt sind 62 % der nachgefragten Mengen Null, so dass der Median der realen Zahlungsbereitschaft Null ist. Das arithmetische Mittel der realen Zahlungsbereitschaft beträgt hingegen ca. 12 € pro Tonne CO₂. Ältere Teilnehmer kaufen deutlich weniger Zertifikate als jüngere. Dagegen kaufen Teilnehmer mit höherem Bildungsniveau und Wähler der Grünen deutlich mehr Zertifikate. Darüber hinaus haben Teilnehmer, deren Kaufentscheidung beurkundet wird, eine höhere Nachfrage nach Klimaschutz.

The Demand for Climate Protection

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An Empirical Assessment for Germany

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Abstract: In this paper, we investigate the real demand for climate protection. For this purpose we conducted a framed field experiment with a sample of the residential population in Mannheim, Germany. Participants were endowed with € 40 and given the opportunity to contribute to climate protection by purchasing European Union Allowances. Purchased allowances were withdrawn from the European Emissions Trading Scheme (EU ETS). While the median willingness to pay (WTP) for climate protection is zero the mean WTP is approximately € 12/tCO₂. We analyse determinants of the observed individual demand behaviour and discuss the potential consequences, which result from the remarkably low WTP and its distribution for German climate policy.

JEL classification: Q51, Q54, C93

Keywords: Experimental economics, demand for climate protection, climate change, willingness to pay

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1 Introduction

During the last two decades, the issue of international cooperation in climate protection has received increasing attention in economic research. The main focus has been on the underlying economic incentives for sovereign states to reach international environmental agreements. Since climate protection is a problem of providing a global public good, it is faced with severe incentive problems for governments that try to maximise their net economic benefits. The game-theoretical literature has provided important insights into the difficulties of establishing effective and efficient cooperation on the provision of climate protection (see Finus 2001 for an overview).

Beyond the fundamental incentive problems of international cooperation, climate change policy has an important political economy dimension. National climate protection targets have to be politically acceptable to the domestic constituency. In the standard political economy approach, any government is motivated by the objective of maximizing its political income, i.e. the probability of being re-elected. In order to be re-elected, the government must consider the preferences of the pivotal voter, who can be approximated by the median voter in a democracy. Thus, the national median voter imposes a restriction on what would be acceptable to a government in international environmental negotiations. Ultimately, one would expect a government only to enter into agreements that are acceptable to the median voter. From a political economy point of view, thus, the median voter's willingness to pay (WTP) for environmental protection determines the outcome of international environmental negotiations. Surprisingly, this fact has been widely ignored (one notable exception is Congleton 1992). Moreover, even without international and national climate policies, individuals reduce CO₂ emissions and contribute voluntarily to the global public good (see Hamilton et al. 2008 for an overview of voluntary carbon markets). These carbon offsets are analysed theoretically by Kotchen (2009) and Gans and Groves (2010). An empirical evaluation of the demand for carbon offsets and the people's WTP for climate protection is thus crucial for evaluating the prospects of climate change mitigation.

Essentially, two methods for measuring the WTP for a particular good are available: First, one can infer the WTP from observing some economic transaction, i.e. the so-called revealed preferences approach. Second, one could ask people what they would be willing to spend for some amount of the good, or what quantity they would be willing to purchase at a given price. This method is known as stated preferences approach. Against the background of climate

mitigation policies, all studies in the past that tried to measure WTP are varieties of the stated preferences approach. Due to the hypothetical character of the decision situation given in this approach (Shogren 2005, Murphy et al. 2005), the reliance on stated preferences only is surprising. Meanwhile, however, the revealed preference approach can be used as a complementary method to observe preferences for climate protection: Since 2005, the European Emissions Trading Scheme (EU ETS) has been in place. This enables researchers to offer the purchase of emissions allowances from the EU-market and in turn directly observe the demand for climate protection or respectively the WTP. Our paper follows this approach. We conducted a framed field experiment (see Harrison and List 2004 for a classification of experiments) in which people were given the opportunity to buy European Union Allowances (EUAs) from the EU ETS. Participants of our experiment received € 40. To induce the demand for climate protection the following method was applied: Five prices were shown to each participant. The participants then indicated which quantity of permits they would like to buy for each price. After the experiment, one of the five prices was randomly selected and transactions were conducted accordingly. This method was chosen to guarantee incentive-compatibility and to implement a decision situation which is familiar to consumers since they have to state their demand at a given price. Purchased allowances were withdrawn from the EU ETS. From the price-quantity-observations we derived participants' demand and the corresponding WTP. Our experiment consisted of two treatments "Baseline" and "Reputation". In the latter, subjects knew in advance that they could receive a certificate, verifying the purchased amounts.

In the experiment, participants were given a real-life opportunity to contribute to climate protection – a global public good characterised by non-rivalry and non-excludability – by purchasing EUAs. It is evident that in the experiment described, individuals only have marginal impact on global emissions. Similarly, a small single country will also be unable to significantly influence global emission. This approach differs from hypothetical scenarios usually chosen in stated preference studies, in which participants are required to state their WTP under the assumption that climate protection will be collectively provided at a specific level (see Johnson and Nemet 2010 for a survey). Thus, in our study we elicit the real WTP for climate protection from a purely individual perspective without any assumption on collective action to provide emissions reduction.

Our main result is that WTP for CO₂ reduction is very low: It amounts to approximately € 12 per ton of CO₂ (tCO₂). Compared to the figures previously reported by stated preference studies on the WTP for climate protection, this amount is relatively small. Moreover, the

median WTP for our sample is zero. With respect to the treatment variable (certification of CO₂ reduction), we find a positive reputation effect, i.e. the quantity of climate protection demanded in the reputation treatment was significantly higher compared to the baseline treatment. The analysis of data on socio-economic variables as well as attitudes towards global warming showed a highly significant negative age-effect and a highly significant positive effect on the formal educational level. An additional determinant of demand for climate protection is the preference for political parties: voters of the Green Party buy more permits.

The paper is structured as follows. In Section 2 we briefly survey the literature on WTP for the mitigation of global warming. Section 3 explains our setting for measuring the demand for climate protection and thus the WTP for the reduction of one tCO₂. In Section 4 states the results. Section 5 contains a discussion of our findings and concludes.

2 Literature overview: A broad range of numbers

Several stated preferences studies have recently explored the question of WTP for the mitigation of climate change. In general, there are two kinds of studies: (i) studies that estimate WTP as a total amount of money or percentage of income people are willing to give up per unit of time, e.g. within a year, in order to achieve a specific amount of mitigation, and (ii) studies that measure WTP as the amount of money people would be willing to spend on the reduction of one tCO₂. In a recent survey, Johnson and Nemet (2010) surveyed 27 studies and achieved the result that the WTP for climate protection ranged between \$22-\$437 per household annually, with a mean of \$167 and a median of \$135. One major problem of comparing different WTP is the fact that the values were surveyed under different scenarios. Thus, the environmental goods evaluated in the WTP estimates vary extensively. Since in our study participants were offered EUAs, we refer to the second branch of studies which obtains WTP values measured in monetary units per tCO₂.

MacKerron et al. (2009) estimate the WTP for voluntary carbon offsets against an aviation-related background. Participants of their study were asked what they would be willing to pay to offset their CO₂ emissions during a hypothetical flight from New York to London. Using a dichotomous contingent valuation design, they estimated the mean WTP for the offset to be approximately £ 24/tCO₂. In the second part of their study they try to identify the value of several co-benefits that might be associated with the reduction of CO₂ (like, e.g. human development or conservation of biodiversity). Their main findings are that co-benefits are

positively valued and the total WTP for offsetting, including co-benefits, is higher compared to WTP for offsetting alone. In a similar study, Brouwer et al. (2007) asked passengers at the Amsterdam Schiphol airport for their WTP to reduce CO₂ emissions caused by their flights. Brouwer et al. (2007) used a double bounded dichotomous CV design, enabling them to estimate WTP's upper and lower bounds. The mean WTP for the reduction of one tCO₂ across all passengers amounts to € 25, with a remarkable geographic variety: Mean WTP for Asians is the lowest amount with a value of € 10/tCO₂ while it is highest for Europeans (mean value of € 41/tCO₂). The average WTP is well in line with figures reported in MacKerron et al. (2009).

Achtnicht (2009) measures WTP for the reduction of CO₂ using data from interviews with more than 600 potential car-buyers across Germany. The interviewees were presented a stated preference choice experiment consisting of hypothetical car types that differed in various characteristics like, e.g., price, propulsion technologies, fuel type and CO₂ emissions per 100 kilometres. Relying on a utility maximisation approach and employing a mixed-logit model, the WTP for the reduction of one tCO₂ can be indirectly inferred from the choices revealed in the survey. On average the estimated WTP amounts to € 476/tCO₂, which is much higher than the above mentioned estimates.

Viscusi and Zeckhauser (2006) analysed the willingness to pay higher petrol taxes in order to avoid global warming among Harvard graduate students in law and public policy. They identified an average WTP of \$ 0.79 per gallon of petrol and the median WTP to be \$ 0.44. Since there is a constant relation between petrol input and CO₂ emissions, these values can easily be converted into \$ 89/tCO₂ (mean) respectively \$ 50/tCO₂ (median).¹ Given these values and assuming an annual average mileage of 10,000 miles, participants would in general be willing to spend approximately \$ 1,500/year (\$ 125/month). In addition, Viscusi and Zeckhauser ask for the WTP/income percentage ratio. They find that people are willing to spend 3 % of their personal annual income. This translates into \$ 4,500/year, a much higher estimate than the value obtained from the petrol tax design. Viscusi and Zeckhauser attribute this difference to anchoring effects and prefer the estimate of willingness to pay derived from the specific petrol tax question instead of the results from the income vehicle.

¹ One liter of petrol leads to 2,333 gram of CO₂. Of course, this calculation assumes that the WTP is not affected by the frame of the hypothetical decision situation.

This literature overview shows that WTP figures, in case of global warming, are highly diverse. WTP seems to be sensitive to a couple of factors, including the particular design of the study, e.g. which policy options participants face. Moreover, the number of topics included in a survey may influence participants' valuation (the so-called "embedding effect"). And last but not least, also distributional consequences affect WTP. Cai et al. (2008) analyse the impact of distributional preferences on WTP for mitigation of climate change. Their results provide strong evidence that WTP is heavily affected by the distributional impacts of the relevant policy framework. This contradicts the (neo-)classical assumption that efficiency and equity concerns can be separated. In a similar study, Lee and Cameron (2008) also demonstrate eco-system impacts and burden sharing of mitigation efforts to have dramatic impacts on WTP.

The existent estimates are exclusively based on the stated preferences approach. While there have been considerable efforts to improve its validity – cheap talk script (Cummings and Taylor 1999, Olar et al. 2007) and the use of certainty scales (Champ et al. 2005) are demand revealing techniques which try to minimise the hypothetical bias – decision making in the survey approach remains hypothetical. Therefore this study assesses the WTP for climate protection with a complementary method – a framed field experiment.

3 The experiment

The aim was to find out whether people would indeed be willing to spend the amounts stated for climate protection, if it was their own *real* money. To elicit the WTP for a reduction of atmospheric CO₂ we used an experimental approach asking people to give up real money as an alternative to the survey approach. The EU ETS was employed as a vehicle and emission reductions were directly sold to the subjects. This section presents the procedures used in the experiment, first the mechanism to elicit the WTP for CO₂ allowances followed by the descriptions of the concrete implementation.

3.1 Mechanism design

Experimental studies have applied a wide variety of incentive-compatible mechanisms to elicit the WTP for goods. In general, a mechanism is considered incentive-compatible if an individual's dominant strategy is to behave in such a way that valuations are truthfully revealed. For example, the following incentive-compatible procedures were used in recent literature: the Vickrey 2nd price auction (e.g. Noussair et al. 2002, Hayes et al. 1995), the

random n th price auction (e.g. List 2003, Huffman et al. 2007), and the Becker-DeGroot-Marschak (BDM) mechanism (e.g. Noussair et al. 2004, Lusk and Fox 2003). In our study, we decided to use a modification of the BDM mechanism (Becker et al. 1964), in order to elicit the real demand for climate protection. Each participant was confronted with five different prices ordered from high to low. Prices were randomly selected from a uniform distribution of prices in € 0.20 steps between € 0.20 and € 5.00. Each participant indicated the quantity she or he would be willing to buy at each of the five prices. Finally, one of the prices was randomly selected and the transaction was carried out at the corresponding price. Participants who did not wish to buy permits at a specific price indicated a quantity of zero.

Selecting the mechanism to elicit individuals' real demand, we had to account for the heterogeneity of the participants in the experiment. In particular, we had to ensure that the mechanism rules were comprehensible, also to people who were not familiar with the rather artificial decision situation in the experiment. For our experiment, the BDM mechanism seemed to be appropriate, since this mechanism is relatively simple and creates an individual demand function with five price-quantity-combinations. Moreover, the procedure of asking the participants for the quantity demanded at a given price we chose, corresponds to the participants' everyday live decision situation.

3.2 Implementation

For the recruitment of participants, around 2,200 letters of invitation were randomly distributed in Mannheim city centre, Germany. The information that people received at this stage was that there would be a survey in which they could buy products and that they would receive a remuneration of € 40. Since several studies show that if people bid using windfall money they are likely to overstate their WTP (e.g. Cherry 2001, Cherry et al. 2002), it was already emphasised in the letter that the amount of € 40 was a remuneration for taking part in the study. By doing so participants should feel being entitled to the money. A relatively high remuneration was used in order to avoid underrepresentation of people with high opportunity costs of time. The experiment took place in March 2010 on the premises of the Centre for

2 The price range (between € 2/tCO₂ and € 50/tCO₂) was chosen according to observed and expected EUA prices. The average closing spot price of EUAs on the environmental trading exchange BlueNext was € 12.87/tCO₂ in March 2010. The impact assessment of the Climate change and renewable energy package estimated carbon prices in the range of € 30/tCO₂ to € 39/tCO₂ by 2020 (European Commission 2008). Most recent forecasts are between € 20/tCO₂ and € 40/tCO₂ for Phase 3 of the EU ETS (Thomson Reuters 2010, Barclays Capital 2010, Löschel et al. 2010).

European Economic Research (ZEW) in Mannheim, Germany. A total of 202 participants took part in the experiment. Each of the six sessions had 28 to 39 participants.³ At the beginning of each session, participants individually drew lots to determine their ID number (which was kept private). Afterwards, they received the remuneration of € 40 and the instructions.⁴ Finally, participants could choose a table. Participants were not allowed to talk to each other. If they had questions, the experimenter answered them privately.

Experimental sessions lasted for about 60 to 75 minutes. At first, participants filled out an initial questionnaire enquiring about socio-economic characteristics and climate change. Then, the selling procedure was explained in the instructions. Participants additionally saw a first presentation of a concrete (but unrelated to CO₂ permits) example of the BDM mechanism and had to fill out a short quiz that checked their understanding. After that, participants were given information about (i) climate change and its effects on the environment and human society, and (ii) the EU ETS. In the information about the EU ETS we put emphasis on the fact that buying and withdrawing permits actually reduces the EU emissions. Participants were reassured that all transactions would be carried out and that the final purchases and withdrawing of permits would be announced on the ZEW webpage. Finally, participants were informed that they had the opportunity to buy permits in 100 kg units with their own money and could therefore contribute to the overall reduction of CO₂ emissions. In order to make individual CO₂ emissions more tangible participants saw a second presentation with three specific examples of activities resulting in emissions of 100 kg CO₂.⁵ Then each participant was given five different prices ordered from high to low. Each participant had to announce the quantity she or he would like to purchase. By doing so, the maximal expenditures were limited to € 40. The fact that all decisions were voluntary was stressed before this decision. Finally, participants filled out a second questionnaire answering questions about possible motives to contribute (or not to contribute) to climate protection. Afterwards, participants left the room one-by-one. Participants who had announced positive quantities had to draw lots to determine the price at which the transaction would take place. Each subject paid the corresponding amount of money and received the information where the

³ The actual response rate, however, was higher than 9 % because during the registration we screened all applications according to gender and age, i.e. people from certain age groups that were already overrepresented in the sample were not allowed to take part.

⁴ See Annex II for the translated instructions.

⁵ We choose the following examples: (i) a 720 km drive with a VW Golf 1.4 TSI leads to 100 kg CO₂, (ii) the electricity consumption of a two-person household in 19 days also leads to 100 kg CO₂, and (iii) 100 kg CO₂ are 0.9 % of the annual average per capita CO₂ emissions in Germany.

results of the study would be published at the ZEW webpage. After that, participants left the institute. All other participants had already left the institute directly after the second questionnaire.

The total quantity of permits, 52.5 tons, was bought and directed to the DEHSt account 170-34-34. The only purpose of the account is to delete permits at the end of the year. The whole process was made public.

Our experiment contained one treatment variable. In order to analyse possible effects of reputation when contributing to the global public good a subset of participants (N = 67 of 202) could receive a certificate. The certificate listed the name of the participant and the quantity bought. Furthermore, the procedure and the aim of the study were briefly described. Subjects were informed about the certificate in advance during the second presentation.

4 Results

In this section we present the results of the experiment. First, we briefly describe the pool of selected participants followed by the results of the first questionnaire on attitudes with regard to climate change. Second, we analyse the purchase decision and compute the average WTP for climate protection. The third part analyses the results of the second questionnaire on buying motives. Finally, the findings of regression models are presented in order to analyse the determinants of subjects' demand for climate protection.

4.1 Pool of participants and their attitudes towards climate change

Before announcing their purchase decisions, participants answered a first questionnaire. The main purpose of this questionnaire was to collect data about socio-economic characteristics and the attitudes and experiences with respect to climate change. Tables 3 and 4 (see Annex I) present the participants' socio-economic characteristics. Our subject pool covered all required age groups for men as well as for women. With respect to the variables 'age' and 'sex' our pool represented the residential population of Mannheim (StaLa BWL 2007). The hypothesis of equal relative frequencies for male and female age groups between the selected participants and the resident population cannot be rejected.⁶ Quite surprisingly, the fraction of voters with

⁶ Chi-squared = 4.94, df = 3, $p = 0.176$ for male subjects and chi-squared = 4.75, df = 3, $p = 0.192$ for female subjects. There are four age groups: 18-24, 25-39, 40-64, and 65-75.

“green preferences” among our subjects was relatively high, since 23 % would vote for the Green Party. This figure is nearly twice as high as the proportion of votes that this party achieved in the last election of the state parliament in Baden-Wuerttemberg (in 2006: 11.7 %).⁷

Tables 5, 6 and 7 (Annex I) present participants’ attitudes and experiences with regard to climate change. With respect to the level of information about climate change, half of the participants were “*averagely informed*” (51 % of all subjects), and about one third was rather “*well informed*”. Besides, 52 % of the participants stated that media influence on their own perception of climate change was very strong or rather strong. Climate change matters: 52 % were “*rather concerned*” about climate change and about 12 % were “*very concerned*”. However, there were also participants who remained neutral (17 %) with respect to this issue or “*rather not concerned*” (13 %) or “not at all concerned” (4 %). Participants’ attitude differed with respect to the expectation of negative consequences caused by climate change for their own personal life: 48 % expected negative consequences, 52 % did not. Positive consequences caused by climate change were only expected by 8 %, 90 % did not expect positive effects.

Among the participants there seemed to be awareness that intergenerational equity may be affected by climate change. While about 24 % stated that climate change posed a “*rather serious or very serious threat*” to them or their families, about 38 % stated that climate change posed such a threat to their children and about 84 % to future generations in general. Also intra-generational equity was an issue. About 34 % stated that climate change posed a “*rather serious or very serious threat*” to people in Germany, about 52 % stated that climate change posed such a threat to people in other industrialised countries and about 86 % indicated that climate change was a threat to people in developing countries.

Being asked whether they had been personally affected by negative effects of climate change about 9 % indicated “*yes*”, only about 4 % confirmed that they had been affected positively by climate change. The relative majority of participants (41 %) thought that the impacts of climate change are already visible. About 39 % expected that the impacts will become visible within the next 50 years. The overwhelming majority (87 %) supported the statement that

⁷ See <http://www.landtagswahl-bw.de>. Recent polls, however, indicate a higher fraction of votes (27 %) for the Green Party. See http://www.presseportal.de/pm/7169/1678447/swr_suedwestrundfunk (accessed on September 8th 2010).

“there is still a need for commitment to fight climate change”. Only about 6 % disagreed with this statement.

We also asked participants who should be responsible for measures against climate change. On the one hand, participants were convinced that their *“personal behaviour has an influence on climate change”*. About 70 % rather agreed or even fully agreed with this statement. Even more, about 74 % rather agreed or fully agreed with the statement that their behaviour to avoid climate change *“can encourage others ... to behave the same way”*. On the other hand, 83 % did not agree or rather did not agree with the statement that *“the government is solely responsible for measures against climate change”*. We also asked subjects how they would evaluate two popular CO₂ abatement measures. About 66 % rather agreed or even fully agreed with the statement that *“German citizen[s] should use as little electricity as possible”* in order to mitigate climate change. In the same way about 78 % supported the statement that *“German citizen[s] should use their car ... as little as possible”* in order to mitigate climate change.

4.2 Quantity demanded and willingness to pay for climate protection

In this section, we analyse participants' bidding behaviour. As mentioned before, five prices ranging from € 0.20 to € 5.00 in € 0.20 steps were randomly selected and all decisions could have led to real purchases. Therefore, the number of observations is 1010. Table 1 summarizes the bidding behaviour. At all prices the median quantity (in 100 kg CO₂) purchased is zero. The arithmetic mean of the quantity purchased is 2.83, i.e. 283 kg CO₂, indicating the existence of outliers on the right tail of the quantity distribution. With decreasing prices on average more permits are purchased. For the highest prices (price p in €Cent), i.e. the price interval $420 \leq p \leq 500$, the mean quantity amounts to 0.59 only. For the lowest prices, i.e. the price interval $20 \leq p \leq 100$, the mean quantity purchased amounts to 8.41, i.e. 841 kg CO₂.

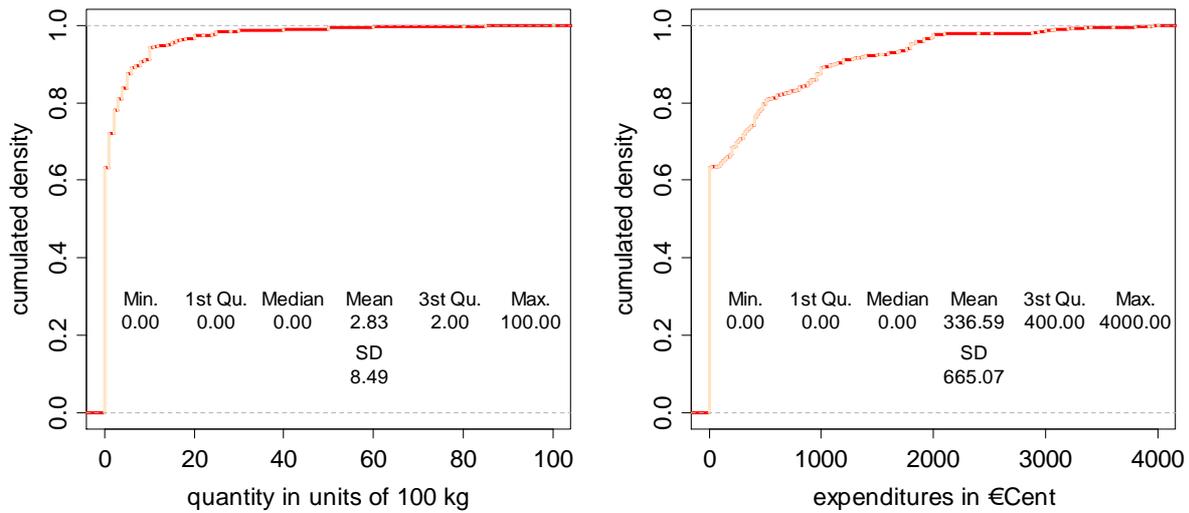
Table 1: Summary of bidding behaviour

Price range (in €Cent)↓	Units (in 100 kg CO ₂)					
	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
$420 \leq p \leq 500$	0.00	0.00	0.00	0.59	0.50	9.00
$320 \leq p \leq 400$	0.00	0.00	0.00	0.76	1.00	11.00
$220 \leq p \leq 300$	0.00	0.00	0.00	1.12	1.00	14.00
$120 \leq p \leq 200$	0.00	0.00	0.00	3.33	5.00	28.00
$20 \leq p \leq 100$	0.00	0.00	1.00	8.41	10.00	100.00
All prices (in €Cent)↓						
$20 \leq p \leq 500$	0.00	0.00	0.00	2.83	2.00	100.00

The figures in Table 1 suggest a downward-sloping demand curve for climate protection, which will be discussed in more detail in Section 4.4. Figure 1 depicts the cumulated density function for quantities (in units of 100 kg CO₂, on the left side) and for expenditures (in €Cent, on the right side)⁸ Furthermore, the values for minimum, 1st quartile, median, mean, standard deviation (SD), 3rd quartile and maximum are indicated. Both distributions are characterised by a high frequency of observations on the left tail. With respect to quantities, a total of 75 % were below or equal to 2 units, i.e. 200 kg CO₂. The maximum quantity demanded is 100 units. A slightly less extreme ratio holds for the expenditure: 75 % are below or equal to €Cent 400, the maximum is €Cent 4,000, i.e. a few individuals were willing to spend all their remuneration on climate protection. Furthermore, 62 % of all quantities (and therefore also of all expenditures) are zero, i.e. across the entire price range a majority of individuals did not purchase emission reductions at all. Thus, the median values for quantities and expenditures are zero, but the mean values are positive (the mean quantity is 2.83 units of 100 kg, the mean expenditure is 336.59 €Cent).

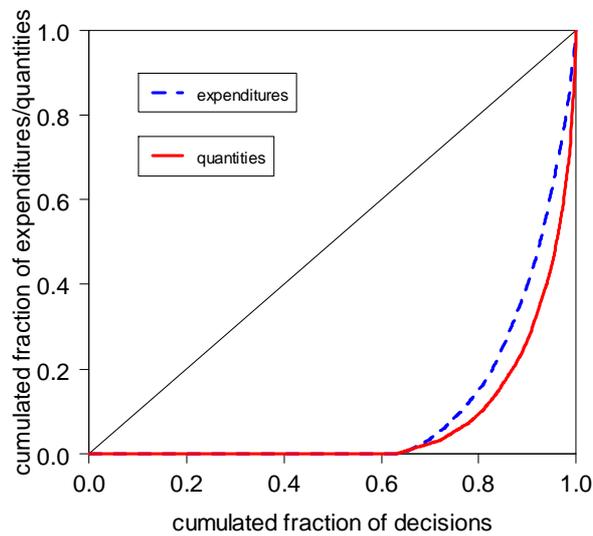
⁸ Revenues are equivalent to subjects' expenditures.

Figure 1: Cumulated density function for quantities (left) and expenditures (right)



From the data above we can compute the mean WTP for climate protection by dividing the mean expenditure (€Cent 336.59) by the mean quantity demanded (2.83 units of 100 kg CO₂). This leads to the mean WTP of €Cent 118.91 for one unit of 100 kg CO₂, i.e. € 11.89/tCO₂. The median WTP is zero.

Figure 2: Lorenz curve for quantities and expenditures



The Lorenz curve in Figure 2 confirms the impression that quantities as well as expenditures are highly concentrated. The highest 20 % of all quantities (expenditures) contribute to approximately 91 % (85 %) of the sum of all quantities (expenditures). Thus, the data show a very dichotomous distribution of two types: a majority of participants with a zero WTP and few individuals who contribute significantly to climate protection.

Directly after the purchase decision participants were asked to guess the current market price for one unit CO₂ (= 100 kg CO₂). On average, participants overestimated the CO₂ price (see Table 8 in Annex I). In March 2010, the average closing spot price of the European Union Allowances on the environmental trading exchange BlueNext was € 12.87/tCO₂. One third believed that the price for one unit ranges between € 2 and € 10 per 100 kg CO₂. Only 12 % had correct expectations with respect to the market price, i.e. they estimated the CO₂ prices to be between € 1 and € 2 per 100 kg CO₂. However, almost all individuals were rather unsure about their price estimation, two thirds of subjects guessed when they were asked for their price estimates.

4.3 Participants' motives to buy or to refuse to buy

Directly after the purchasing decision participants were requested to answer questions about their buying motives. The questions were structured according to potential arguments to contribute to the global public good climate protection (see Tables 9 and 10 in Annex I). Being asked why they would like to contribute, the absolute majority stated that their contribution did not depend on other people's choices or decisions: 84 % agreed to the statement *“I want to contribute to climate protection – regardless what others do”*.⁹ Reciprocity as a motive for contributions was less important. Only 55 % stated that they would like to contribute because of the expectation that others would follow this example. Intra-generational equity was another important motive in the public debate on climate change. In our sample, the participants confirmed this assumption: 74 % of the participants contributed *“because especially people in poor countries will suffer from the consequences of climate change and [I] they want to do something against it”*. However, the argument that industrialised countries, among them Germany, caused climate change and thus people would be obliged to contribute more to climate protection received less affirmation (64 %). Besides intra-generational equity also intergenerational equity was an issue: 82 % bought permits because future generations will suffer from climate change and the participants wanted to do something against it. The protection of flora and fauna as a buying motive was important for 76 % of the participants.

⁹ If not otherwise mentioned, we aggregate the observations for *“rather applicable”* and *“absolutely applicable”* (Tables 9, 10 and 11 in Annex I) in this section.

Other motives to purchase climate protection were, however, less important: “*the government is not doing enough against climate change*” (49 % approval), “*it is my moral obligation*” (49 %) and “*because it is important to protect the creation*” (44 %). According to the answers, social pressure was not a motive for buying. Being asked whether they bought “*because [my] their environment (family, friends, colleagues) expect [me] them to*”, only 11 % agreed. For 45 % this motive was irrelevant. Due to the fact that there was direct contact to the ZEW staff during the experiment, participants might have been felt pushed to buy. However, considering the received answers this was rather not the motive. Being asked whether they “*buy permits, because the organizers of this event expect [me] them to*” 64 % of subjects stated that this statement did absolutely not hold for them.

In our experiment, 83 of 202 participants, i.e. 41 %, did not buy at any price. We enquired about possible motives not to buy and looked at the approval rates afterwards (Table 11 in Annex I).¹⁰ The majority of (52 %) who did not buy any permit stated that “*they [I] do not think their [my] buying of permits will actually reduce emissions in Europe*”. This motive is well-known from the standard economic model of the *homo oeconomicus*. As the effect of the individual contribution to climate protection is costly but has negligible effects on climate protection, it is a dominant strategy not to contribute. Furthermore, 41 % of those participants who refused to buy believe that “*the market for permits does not work. We need prohibitions and commands*”. That means that a relative majority seemed to mistrust emission trading as such. They are less concerned about technical problems with measurement and control of CO₂ emissions. Only 18 % stated that they did not buy permits because “*emissions ... [can't] actually be measured and controlled*”. Another motive for not buying was that participants already behaved in a climate conscious way. For 42 % this was a relevant motive not to buy permits. Also distributional concerns seem to be a reason for subjects not to buy permits although the interpretation of answers is ambiguous here. On the one hand 36 % refused to buy “*because emissions trading anyhow suits the interests of the large scale industry only*”. On the other hand only 22 % refused to buy permits because companies had received them for free and the latter would thus be subsidised. Remarkably, only for 20 % the argument “*emissions trading is principally unethical*” was a motive not to buy. Again, responses show that participants trusted the ZEW. Only 7 % did not buy permits because they did not trust

¹⁰ We implemented these questions after the first session. Subjects of the first session who didn't buy were counted as “no answer”.

ZEW. On the contrary this motive not to buy was absolutely not applicable for 35 % of participants.

4.4 Regression models

In order to analyse determinants of individual demand behaviour, we provide regression estimates of the general form $\log Q = f(\log P, Z)$. $\log Q$ is the natural log of the demanded quantity + 1, $\log P$ is the natural log of the price and Z is a vector of other independent variables. Since the dependent variable is censored from below, we use tobit regressions. Table 2 lists three different models to explain $\log Q$. The first model is simply an estimate for the demand function $\log Q = f(\log P)$. The estimated coefficient (-0.363) is negative and above -1 , thus indicating a negatively sloped and inelastic demand function. The second model incorporates the price, different socio-economic characteristics and reputation as explanatory variables. The third model incorporates participants' attitudes towards climate change. Dummy variables are indicated with a "D".

The significant regression results (at least $p < 0.1$) for the socio-economic variables can be summarised as follows. Males have a higher demand for climate protection than females. Older persons buy fewer permits than younger people. The individual income positively influences the willingness to contribute to climate protection. Participants with a university degree buy more permits. Voters of the Green Party also contribute more to climate protection. Furthermore, participants in the reputation treatment buy more permits than subjects in the no reputation treatment. In line with socio-economic variables several attitudes towards climate change influence the willingness to contribute to climate protection. Participants who stated that media influence on their own perception of climate change was rather strong bought more permits. The same holds for participants who are at least "rather strong" concerned about impacts of climate change. Finally, participants who believe that personal activity for climate protection is rather important have a stronger demand for climate protection.

Table 2: Tobit regressions

	(1)	(2)	(3)
<i>independent variables</i> ↓	<i>log Q</i>	<i>log Q</i>	<i>log Q</i>
<i>log P</i>	-0.363*** (10.91)	-0.373*** (11.88)	-0.363*** (12.29)
<i>male_D</i>		0.120** (2.23)	0.159*** (2.93)
<i>age</i>		-0.014*** (7.36)	-0.013*** (7.32)
<i>income</i>		0.051*** (2.97)	0.037** (2.26)
<i>religion_D</i>		-0.001 (0.02)	-0.019 (0.36)
<i>child_D</i>		0.059 (0.86)	0.065 (0.97)
<i>edu_uni_D</i>		0.165*** (2.88)	0.195*** (3.50)
<i>party_green_D</i>		0.269*** (4.03)	0.181*** (2.92)
<i>reputation_D</i>		0.163*** (2.70)	0.113* (1.95)
<i>info_cc_D</i>			-0.062 (1.17)
<i>media_infl_D</i>			0.123** (2.37)
<i>concerns_cc_D</i>			0.103* (1.78)
<i>pers_activ_D</i>			0.352*** (6.05)
<i>enc_other_D</i>			0.046 (0.70)
<i>gov_resp_D</i>			-0.108 (1.24)
Constant	1.720*** (9.99)	1.994*** (10.29)	1.552*** (8.15)
Observations	1010	960	960
Pseudo R-squared	0.05	0.10	0.13

Notes:

(i) *, **, *** significance at 10 %, 5 %, 1 %. Coefficients indicate marginal effects on unconditional expected value. Absolute value of z statistics are in parentheses.

(ii) Definition of variables: *log Q*: natural log of quantity in units of 100 kg demanded + 1; *log P*: natural log of price in €Cent; *male_D*: 1 (0) if male (female), *age*: age in years; *income*: 1 if household income < 1 k€, 2 if 1 k€ ≤ income < 2 k€, 3 if 2 k€ ≤ income < 3 k€, 4 if 3 k€ ≤ income < 4 k€, 5 if 4 k€ ≤ income < 5 k€, 6 if income ≥ 5 k€; *religion_D*: 1 (0) if religious (not religious); *child_D*: 1 (0) if at least one child (no children); *edu_uni_D*: 1 (0) if university education (other); *party_green_D*: 1 (0) if green voter (other); *reputation_D*: 1 (0) if treatment reputation (other); *info_cc_good_D*: 1 (0) if information about climate change is at least good (other); *media_infl_D*: 1 (0) if media influence on the perception of climate change is at least rather strong (other); *concerns_cc_D*: 1 (0) if concerns about climate change are rather strong (other); *pers_activ_D*: 1 (0) if personal activity for climate protection is rather important (other); *enc_other_D*: 1 (0) if encouraging others for climate protection is rather important (other); *gov_resp_D*: 1 (0) if governmental responsibility for climate protection is rather important (other).

In general, the statistically significant effects of independent variables on the quantity demanded are only small in their magnitudes. There are, however, some interesting differences in the quantitative effects. According to the estimated coefficient in model (3), which shows the marginal effect of the independent variable (“var”) on the unconditional expected value of the dependent variable (“log *Q*”), men, on average purchase 0.17 units more

than women.¹¹ If we compare a 20-year-old participant with a 70-year-old, the older participant buys on average 0.92 units less. The effect of income can be computed in a similar way. If we take a participant with an income between € 5,000 and € 6,000 she or he on average purchases 0.20 units more compared to participants with an income below € 1,000. The remaining variables with statistically significant effects are dummy variables and their quantitative effect on the demand can be computed accordingly. The strongest effect is generated by participants who believe that personal activity for climate protection is rather important. Those participants on average demand 0.42 units more. The effect of reputation, significant at the 10 %-level, has only a small effect. Participants in the reputation treatment on average buy 0.20 units more.

5 Discussion and conclusion

Several studies on the WTP for climate protection were written in the last decade. The existing studies are characterised by various definitions of the good to be valued. Moreover, the studies exclusively rely on surveys and use hypothetical scenarios to elicit stated preferences. The payment mechanisms employed range from household costs in general to specific increases for energy or fuel. The studies analyse a broad range of explanatory variables such as climate awareness, environmental values, risk perception, uncertainty and perceived fairness. Estimates of annual WTP to pay for households and WTP per tCO₂ reduction vary enormously due to the differences described above, but also because of attitudes, socio-economic characteristics and geography.

We have complemented existing studies on the WTP in several aspects: First, we confront subjects with a real decision situation in which they can contribute to climate protection. Thereby, we elicit the real WTP for climate protection from a purely individual perspective without any assumption on collective action to provide emissions reduction. Second, we make use of an established mechanism for climate protection, the EU ETS. Allowances purchased by our participants were bought and withdrawn from the EU ETS. We found that WTP is higher with increasing levels of income, education, with greener political views and concerns about severe impacts of climate change. WTP for climate protection decreases with age and is lower for females than for males. There is also a positive reputation effect. Our analysis also showed a very dichotomous distribution of two types: a majority of subjects with a very low

¹¹ Computed as follows: $\Delta \log Q / \Delta \text{var} = 0.159 \Leftrightarrow Q = 1.17 \Leftrightarrow \text{quantity demanded} = Q - 1 = 0.17$ units.

WTP and few individuals who would spend almost everything on climate protection. Without doubt, our most important results are the overall low average WTP per tCO₂ and the zero median WTP for climate protection. If people are asked to give up real money, WTP per tCO₂ for climate protection is obviously much lower than in existing hypothetical studies.

This is indeed an “inconvenient truth” from a political economy perspective: There seems to be no political majority for substantial, i.e. costly climate policy. A majority of voters is not willing to bear significant costs in order to mitigate climate change. These results are quite remarkable given the fact that our study was conducted in Germany, a high income country, where concerns about climate change have existed for a long time. One might infer that WTP for climate protection in countries with lower income, less information and less concern among the public will be even lower (Carlsson et al. 2010 show this in a multiple country study for China, Sweden and the US). Thus, it seems plausible to assume that our low estimate of WTP is indeed an upper bound for WTP in other countries. On the other hand, an overwhelming majority of participants is concerned about the impacts of climate change and wants policy makers to do something against global warming because future generations or poor countries will suffer. Moreover, most participants seem to be willing to contribute unconditionally to climate mitigation, i.e. even without cooperative givings by others. This display of good will, however, does not result in a corresponding higher WTP, but it might help to explain the existing deficiencies in international climate agreements. The presumably overall low WTP for climate protection might to some extent explain why the Kyoto Protocol – so far the only existing international climate agreement – reduced to a mere symbolic policy (see e.g. Böhringer and Vogt 2004, Endres et al. 2000).

However, the median voter model can only partly explain what happens in real-life. While most countries, which ratified the Kyoto Protocol, are far away from reaching their reduction targets – which is by and large in line with the symbolic policy conjecture derived from low WTP – very few countries¹² like Germany enacted costly climate policies in the past and substantially reduced their CO₂ emissions. This observation is not in line with the conclusions from the median voter model in combination with our empirical low estimate of WTP. Other factors like the impact of green pressure groups might explain why German climate policy

¹² To be precise, besides Germany it is only Great Britain which is on track with its Kyoto obligation.

tended to deviate from the median voter outcome in the past.¹³ However, a thorough analysis and discussion of these issues is well beyond the scope of this paper.

¹³ For the impact of interest groups on EU climate policy see Michaelowa (1998).

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Annex I: Descriptive statistics of questionnaires

Table 3: Socio-economic characteristics of participants – part I

#	Variable	State	Frequency abs.	Frequency in %
1	Gender	Male	99	49.00
		Female	102	50.50
		No answer	1	0.50
2	Age	18 – 25	30	14.85
		26 – 35	53	26.24
		36 – 45	27	13.37
		46 – 55	38	18.81
		56 – 65	27	13.37
		66 – 75	17	8.42
		No answer	10	4.95
3	Family status	Married	55	27.23
		Unmarried with partner	61	30.20
		Single	62	30.69
		Other	23	11.39
		No answer	1	0.50
4	Children in household	1	18	8.91
		2	16	7.92
		3	7	3.47
		4	2	0.99
		No	152	75.25
		No answer	7	3.47
5	Education	University	94	46.53
		Grammar school	47	23.27
		Intermediate school	34	16.83
		Secondary school	22	10.89
		No graduation	2	0.99
		No answer	3	1.49
6	Nationality	German	170	84.16
		Turkish	6	2.97
		Russian	1	0.50
		Italian	2	0.99
		Other	21	10.40
		No answer	2	0.99
7	Household net income	Less than € 1,000	49	24.26
		€ 1,000 - € 2,000	71	35.15
		€ 2,000 - € 3,000	38	18.81
		€ 3,000 - € 4,000	16	7.92
		€ 4,000 - € 5,000	10	4.95
		More than € 5,000	8	3.96
		No answer	10	4.95
8	Religion	Yes	125	61.88
		No	76	37.62
		No answer	1	0.50
		Σ	202	100.00

Table 4: Socio-economic characteristics of participants – part II

#	Variable	State	Frequency abs.	Frequency in %
9	Voting behavior	Christian Democratic / Christian Social Union	33	16.34
		Social Democratic Party	38	18.81
		Green Party	47	23.27
		Free Liberal Party	19	9.41
		Left Party	12	5.94
		Others	6	2.97
		Nonvoter	24	11.88
		No answer	18	8.91
10	Profession	Employee	77	38.12
		Worker	4	1.98
		Public Officer	11	5.45
		Self-employed	15	7.43
		Apprentice / Trainee	0	0.00
		Pupil	2	0.99
		Student / doctoral candidate	38	18.81
		Retiree	30	14.85
		Unemployed	13	6.44
		Others	9	4.46
		No answer	3	1.49
11	Member of an environmental organisation	Yes	13	6.44
		No	185	91.58
		No answer	4	1.98
		Σ	202	100.00

Table 5: Attitudes and experiences with respect to climate change – part I

#	Variable	State	Frequency abs.	Frequency in %
12	Please rate your level of information regarding climate change. I am...	Very poorly informed	2	0.99
		Rather poorly informed	14	6.93
		Averagely informed	104	51.49
		Rather well informed	66	32.67
		Very well informed	14	6.93
		No answer	2	0.99
13	To what extent are you influenced by mass media regarding your perception of the consequences of climate change?	Not at all influenced	4	1.98
		Rather not influenced	21	10.40
		Neutral	69	34.16
		Rather strong influenced	92	45.54
		Very strong influenced	14	6.93
		No answer	2	0.99
14	Are you concerned about climate change?	Not at all concerned	9	4.46
		Rather not concerned	26	12.87
		Neutral	34	16.83
		Rather concerned	106	52.48
		Very concerned	25	12.38
		No answer	2	0.99
15	Do you expect noticeable negative consequences of climate change for your personal life?	Yes	96	47.52
		No	104	51.49
		No answer	2	0.99
16	Do you expect noticeable positive consequences of climate change for your personal life?	Yes	16	7.92
		No	182	90.10
		No answer	4	1.98
17	To what extent do you think that climate change poses a serious threat to you and your family?	No serious threat	36	17.82
		Rather no serious threat	52	25.74
		Neutral	61	30.20
		Rather serious threat	45	22.28
		Very serious threat	3	1.49
		No answer	5	2.48
17	To what extent do you think that climate change poses a serious threat to your children (if applicable)?	No serious threat	9	4.46
		Rather no serious threat	13	6.44
		Neutral	28	13.86
		Rather serious threat	60	29.70
		Very serious threat	16	7.92
		No answer	76	37.62
17	To what extent do you think that climate change poses a serious threat to future generations in general?	No serious threat	5	2.48
		Rather no serious threat	9	4.46
		Neutral	16	7.92
		Rather serious threat	99	49.01
		Very serious threat	70	34.65
		No answer	3	1.49
17	To what extent do you think that climate change poses a serious threat to friends, acquaintances, colleagues?	No serious threat	24	11.88
		Rather no serious threat	45	22.28
		Neutral	70	34.65
		Rather serious threat	52	25.74
		Very serious threat	5	2.48
		No answer	6	2.97
		Σ	202	100.00

Table 6: Attitudes and experiences with respect to climate change – part II

#	Variable	State	Frequency abs.	Frequency in %
17	To what extent do you think that climate change poses a serious threat to people in Germany in general?	No serious threat	23	11.39
		Rather no serious threat	37	18.32
		Neutral	69	34.16
		Rather serious threat	60	29.70
		Very serious threat	8	3.96
		No answer	5	2.48
17	To what extent do you think that climate change poses a serious threat to people in other industrialized countries?	No serious threat	11	5.45
		Rather no serious threat	30	14.85
		Neutral	49	24.26
		Rather serious threat	80	39.60
		Very serious threat	25	12.38
		No answer	7	3.47
17	To what extent do you think that climate change poses a serious threat to people in developing countries?	No serious threat	4	1.98
		Rather no serious threat	5	2.48
		Neutral	13	6.44
		Rather serious threat	69	34.16
		Very serious threat	105	51.98
		No answer	6	2.97
18	Have you been personally affected by negative effects of climate change?	Yes	18	8.91
		No	181	89.60
		No answer	2	0.99
21	Have you been personally affected by positive effects of climate change?	Yes	8	3.96
		No	191	94.55
		No answer	3	1.49
24	When do you expect the impacts of climate change to become visible?	Never	6	2.97
		In more than 100 years	10	4.95
		Within the next 100 years	16	7.92
		Within the next 50 years	55	27.23
		Within the next 10 years	23	11.39
		Already visible	83	41.09
		No answer	9	4.46
25	Do you think that there still is a need for commitment to fight climate change?	Yes	175	86.63
		No	13	6.44
		Don't know	12	5.94
		No answer	2	0.99
		Σ		202

Table 7: Attitudes and experiences with respect to climate change – part III

#	Variable	State	Frequency abs.	Frequency in %
26	To what extent do you agree to the statement: I believe my personal behavior has an influence on climate change?	Do not agree	9	4.46
		Rather not agree	28	13.86
		Don't know	19	9.41
		Rather agree	100	49.50
		Fully agree	41	20.30
		No answer	5	2.48
26	To what extent do you agree to the statement: My behavior to evade climate change can encourage others in my environment to behave the same way?	Do not agree	7	3.47
		Rather not agree	15	7.43
		Don't know	28	13.86
		Rather agree	101	50.00
		Fully agree	48	23.76
		No answer	3	1.49
26	To what extent do you agree to the statement: The government is solely responsible for measures against climate change?	Do not agree	95	47.03
		Rather not agree	72	35.64
		Don't know	10	4.95
		Rather agree	14	6.93
		Fully agree	7	3.47
		No answer	4	1.98
26	To what extent do you agree to the statement: To mitigate climate change every German citizen should use as little electricity as possible?	Do not agree	5	2.48
		Rather not agree	26	12.87
		Don't know	33	16.34
		Rather agree	99	49.01
		Fully agree	35	17.33
		No answer	4	1.98
26	To what extent do you agree to the statement: To mitigate climate change every German citizen should use their car as a means of transport as little as possible?	Do not agree	3	1.49
		Rather not agree	25	12.38
		Don't know	13	6.44
		Rather agree	94	46.53
		Fully agree	64	31.68
		No answer	3	1.49
		Σ	202	100.00

Table 8: Price appraisals

#	Variable	State	Frequency abs.	Frequency in %
27	Summary of the price estimations (for 1 unit = 100 kg CO ₂)	< € 1	39	19.31
		€ 1 - € 2	25	12.38
		€ 2 - € 10	66	32.67
		€ 10 - € 100	39	19.31
		> € 100	20	9.90
		No answer	13	6.44
28	How sure are you about your price estimation?	I know it	4	1.98
		Sure	0	0.00
		Rather sure	5	2.48
		Rather unsure	48	23.76
		I don't know, I guessed	135	66.83
		No answer	10	4.95
29	Will you talk about this event and your behavior in it with your family, your friends or your colleagues?	Yes	167	82.67
		No	5	2.48
		Don't know	27	13.37
		No answer	3	1.49
		Σ	202	100.00

Table 9: Buying motives of participants – part I

#	Variable	State	Frequency abs.	Frequency in %
30	I want to buy certificates, because I want to contribute to climate protection – regardless of what others do.	Absolutely not applicable	2	1.68
		Rather not applicable	3	2.52
		Neutral	13	10.92
		Rather applicable	48	40.34
		Absolutely applicable	52	43.70
		No answer	1	0.84
30	I want to buy certificates, because I think that others also contribute to climate protection.	Absolutely not applicable	11	9.24
		Rather not applicable	11	9.24
		Neutral	30	25.21
		Rather applicable	52	43.70
		Absolutely applicable	14	11.76
		No answer	1	0.84
30	I want to buy certificates, because especially people in poor countries will suffer from the consequences of climate change and I want to do something against it.	Absolutely not applicable	2	1.68
		Rather not applicable	11	9.24
		Neutral	17	14.29
		Rather applicable	56	47.06
		Absolutely applicable	32	26.89
		No answer	1	0.84
30	I want to buy certificates, because the industrialized countries, among them Germany, have played a decisive role in causing climate change.	Absolutely not applicable	3	2.52
		Rather not applicable	13	10.92
		Neutral	25	21.01
		Rather applicable	50	42.02
		Absolutely applicable	26	21.85
		No answer	2	1.68
30	I want to buy certificates, because future generations will suffer from the consequences of climate change and I want to do something against it.	Absolutely not applicable	2	1.68
		Rather not applicable	6	5.04
		Neutral	11	9.24
		Rather applicable	52	43.70
		Absolutely applicable	46	38.66
		No answer	2	1.68
30	I want to buy certificates, because the flora and fauna will suffer from the consequences.	Absolutely not applicable	4	3.36
		Rather not applicable	8	6.72
		Neutral	16	13.45
		Rather applicable	59	49.58
		Absolutely applicable	31	26.05
		No answer	1	0.84
Σ			119	100.00

Table 10: Buying motives of participants – part II

#	Variable	State	Frequency abs.	Frequency in %
30	I want to buy certificates, because the government is not doing enough against climate change.	Absolutely not applicable	5	4.20
		Rather not applicable	23	19.33
		Neutral	32	26.89
		Rather applicable	35	29.41
		Absolutely applicable	23	19.33
		No answer	1	0.84
30	I want to buy certificates, because my environment (family, friends, colleagues) expect me to.	Absolutely not applicable	53	44.54
		Rather not applicable	32	26.89
		Neutral	20	16.81
		Rather applicable	12	10.08
		Absolutely applicable	1	0.84
		No answer	1	0.84
30	I want to buy certificates, because the organizers of this event expect me to.	Absolutely not applicable	76	63.87
		Rather not applicable	16	13.45
		Neutral	19	15.97
		Rather applicable	6	5.04
		Absolutely applicable	1	0.84
		No answer	1	0.84
30	I want to buy certificates, because it is my moral obligation.	Absolutely not applicable	23	19.33
		Rather not applicable	12	10.08
		Neutral	25	21.01
		Rather applicable	48	40.34
		Absolutely applicable	10	8.40
		No answer	1	0.84
30	I want to buy certificates, because it is important to protect the creation.	Absolutely not applicable	16	13.45
		Rather not applicable	14	11.76
		Neutral	36	30.25
		Rather applicable	36	30.25
		Absolutely applicable	16	13.45
		No answer	1	0.84
Σ			119	100.00

Table 11: Refusing motives of participants

#	Variable	State	Frequency abs.	Frequency in %
31	I do not want to buy certificates, because I do not think that my buying of certificates will actually reduce emissions in Europe.	Absolutely not applicable	7	8.43
		Rather not applicable	4	4.82
		Neutral	3	3.61
		Rather applicable	23	27.71
		Absolutely applicable	20	24.10
		No answer	26	31.33
31	I do not want to buy certificates, because a market for certificates does not work. We need official prohibitions and commands.	Absolutely not applicable	5	6.02
		Rather not applicable	6	7.23
		Neutral	8	9.64
		Rather applicable	22	26.51
		Absolutely applicable	12	14.46
		No answer	30	36.14
31	I do not want to buy certificates, because I already act in a climate conscious way.	Absolutely not applicable	1	1.20
		Rather not applicable	3	3.61
		Neutral	14	16.87
		Rather applicable	18	21.69
		Absolutely applicable	17	20.48
		No answer	30	36.14
31	I do not want to buy certificates, because emissions trading anyhow suits the interests of the large scale industry only.	Absolutely not applicable	3	3.61
		Rather not applicable	10	12.05
		Neutral	12	14.46
		Rather applicable	24	28.92
		Absolutely applicable	6	7.23
		No answer	28	33.73
31	I do not want to buy certificates, because I think that emissions trading is principally unethical.	Absolutely not applicable	14	16.87
		Rather not applicable	8	9.64
		Neutral	16	19.28
		Rather applicable	12	14.46
		Absolutely applicable	5	6.02
		No answer	28	33.73
31	I do not want to buy certificates, because I would buy certificates from companies which have received them for free and by that subsidy them.	Absolutely not applicable	5	6.02
		Rather not applicable	9	10.84
		Neutral	21	25.30
		Rather applicable	14	16.87
		Absolutely applicable	4	4.82
		No answer	30	36.14
31	I do not want to buy certificates, because I do not trust ZEW.	Absolutely not applicable	29	34.94
		Rather not applicable	11	13.25
		Neutral	8	9.64
		Rather applicable	4	4.82
		Absolutely applicable	2	2.41
		No answer	29	34.94
31	I do not want to buy certificates, because I do not think that emissions can actually be measured and controlled.	Absolutely not applicable	12	14.46
		Rather not applicable	11	13.25
		Neutral	15	18.07
		Rather applicable	9	10.84
		Absolutely applicable	6	7.23
		No answer	30	36.14
		Σ	83	100.00

Annex II: Transcript of written instructions

Instructions

Welcome to the Centre for European Economic Research (ZEW) in Mannheim!

Thank you for participating in this scientific survey about consumer decisions. In this file you will find all information you will need during the survey. During the event you will have the opportunity to return to the previous pages. But **please do not read the upcoming pages** unless we ask you to.

Please follow the instructions attentively and please **do not talk** to the other participants.

Please be assured that the data we collect today will only be used to compare results between groups of participants. We will **not publish any individual data** of the participants.

ID: 1S1

Questionnaire I

Please answer the following questions by ticking the according box or filling the blanks.

General questions

1. Please state your marital status:

- Married
Unmarried with partner
Single
Other

2. Please state your sex:

- Male
Female

3. Please state your age: _____

4. Are you a member of a religious community?

- Yes
No

5. How many children live in your household? (If you do not have any children please fill out all age groups with a 0)

- 0-3 years _____
4-7 years _____
8-12 years _____
13-18 years _____
Older than 18 _____

6. Please state the institution at which you have acquired your highest professional degree:

- University/University of Applied Sciences
Grammar School
Intermediate School
Secondary School
None

7. Please state your nationality of origin:

- German
Turkish
Russian
Italian
Other, (please state): _____

8. How much money is available in **your household** per month (net income)?

- Less than € 1,000
- € 1,000- € 2,000
- € 2,000- € 3,000
- € 3,000- € 4,000
- € 4,000- € 5,000
- More than € 5,000
- No comment

9. If Sunday were Election Day, which party would you vote for?

- CDU/CSU – Christian Democratic Union/Christian Social Union
- SPD – Social Democratic Party
- Alliance 90/ Green Party
- FDP – Free Liberal Party
- Die Linke – Left Party
- Others
- I do not vote.
- No comment

10. Please state your professional occupation

- Employee
- Worker
- Unemployed
- Apprentice/Trainee
- Public officer
- Pupil
- Self-employed
- Student/ doctoral candidate
- Retiree
- Others

11. Are you a member of an initiative or organisation promoting environmental protection?

- Yes
- No

Climate Change Questions

ZEW carries out research projects on climate change. Therefore, we would like to ask you to answer some questions on climate change.

12. Please rate your level of information regarding climate change. I am...

Very poorly informed	Rather poorly informed	Averagely informed	Rather well informed	Very well informed
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

13. To what extent are you influenced by mass media (newspapers, TV, internet) regarding your perception of the consequences of climate change?

Not at all influenced	Rather not influenced	Neutral	Rather strongly influenced	Very strongly influenced
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

14. Are you concerned about climate change?

Not at all concerned	Rather not concerned	Neutral	Rather concerned	Very concerned
<input type="text"/>				

15. Do you expect noticeable negative consequences of climate change for your personal life?

Yes

No

16. Do you expect noticeable positive consequences of climate change for your personal life?

Yes

No

17. To what extent do you think that climate change poses a serious threat to the respective areas?

Area ↓	No serious threat	Rather no serious threat	Neutral	Rather serious threat	Very serious threat
For me and my family					
For my children (if applicable)					
Future generations in general					
Friends, acquaintances, colleagues					
People in Germany in general					
People in other industrialised countries					
People in developing countries					

18. Have you been personally affected by negative effects of climate change?

Yes

No (if no, please proceed to question 21)

19. If yes, which effects?

20. How strong were these negative effects for you personally?

Very weak	Rather weak	Neutral	Rather strong	Very strong

21. Have you been personally affected by positive effects of climate change?

Yes

No (if no, please proceed to question 24)

22. If yes, which effects?

23. How strong were these positive effects for you personally?

Very weak	Rather weak	Neutral	Rather strong	Very strong

24. When do you expect the impacts of climate change to become visible?

Never	In more than 100 years	Within the next 100 years	Within the next 50 years	Within the next 10 years	Already visible

25. Do you think that there still is a need for commitment to fight climate change?

- Yes
- No
- Don't know

26. To which extent do you agree to the following statements?

Statement↓	Do not agree	Rather not agree	Don't know	Rather agree	Fully agree
I believe my personal behavior has influence on climate change.					
My behavior to evade climate change can encourage others in my environment to behave the same way.					
The government is solely responsible for measures against climate change.					
To mitigate climate change every German citizen should use as little electricity as possible.					
To mitigate climate change every German citizen should use their car as a means of transport as little as possible.					

General Information

Today, we will offer you a certain product to purchase. In a few minutes you will learn which product it is and how the sale will be conducted. No one except for the ZEW team will learn about your statements from the event.

As we want to assess how many units of the product **you** want to purchase, we would like to ask you **not** to talk to the other participants.
Should you have any questions please signal us and we will come to you.

The process of sale can be explained in three steps:

1. Introduction of the product

Before we ask you to make a purchase offer we will briefly introduce the product to you.

2. Quantity you want to buy with different pricing

You will receive a list with five prices for one unit of the product. You can state the quantity you want to purchase at the respective price. You can also state the quantity zero if you do not wish to purchase anything (there is **no obligation to buy**). At the end of the event you will draw **one** of the prices by lot. You will then buy the chosen quantity at the drawn price.

3. Payment

When leaving the room you will draw **one** price. You will then buy the quantity you have stated at this price. Please note: If you **purchase the product**, you have to use **your own money** (but: your expenditures cannot exceed € 40).

Soon we will discuss a short example with you.

Please note:

With these rules of purchase it is **in your own interest** to state only the quantity you **actually want to buy** at the respective prices. Please state only **truthful** information.

Comprehension Test

We will now carry out a short test to check if you have fully understood the rules of purchase. To answer the questions please fill in the blank or tick the box next to the question. Please signal if you have finished answering all questions and we will come to you.

Please take a look to the statements in the following table. A participant has stated how many units of the product he wants to buy if the respective price is drawn.

Please note:

The maximum expenditures for each price are € 10 in this example.

No.	Price per unit	How many units do I want to buy at this price?	How many units can I buy in total at this price?	Expenditures = Price x Units
1	€ 5.00	0	2	€ 0.00
2	€ 4.00	0	2	€ 0.00
3	€ 3.00	1	3	€ 3.00
4	€ 1.00	3	10	€ 3.00
5	€ 0.50	4	20	€ 2.00

Q: How many units will the participant buy if price no. 2 is drawn?
_____ units.

Q: How many units will the participant buy if price no. 5 is drawn?
_____ units.

Q: Which amount in Euros will the participant pay if price 3 is drawn?
€ _____

What do I have to do, if I do not want to purchase the product at a certain price?

I state any quantity and hope that this price is not drawn

I state the quantity zero.

What do I have to do if I want to buy exactly three units of the product at a certain price?

a) I state more than three units at this price.

b) I state less than three units at this price.

c) I state three units at this price.

Information on Climate Change

Please read the information provided on this page.

You have about 10 minutes to do so.

Global climate change is seen as a serious environmental problem faced by mankind. The great majority of climate scientists expects the global average **temperature** to rise by **1.1 to 6.4 degrees Celsius** until the year 2100. There is hardly any denial that mankind largely contributes to climate change by emitting greenhouse gases, especially carbon dioxide (CO₂). CO₂ originates from burning of fossil fuels like coal, oil or natural gas in industrial processes and energy production, or combustion engines of cars and lorries. CO₂ is a global pollutant, i.e. each quantity unit of CO₂ emitted has the same effect on the climate regardless of the location where the emission has occurred. There are several consequences from rising temperatures. The most important consequences will be stated here:

The **sea level** will rise by **18 to 59 cm** worldwide until the year 2100. Low lying coastal regions may be threatened by floods.

Extreme weather events like extreme heat waves, strong rainfalls and tropical storms are likely to become more frequent.

Due to the shift of climate zones **pathogens** can spread to more northern areas than before. In southern Italy several cases of dengue fever were reported. Dengue fever is a dangerous infectious disease which usually occurs in tropical areas only.

Climate change does not only have negative consequences, but also **positive effects**. The number of heat-related deaths might increase because of more frequent periods of heat. However, due to milder winters there will be a lower number of deaths by extreme cold.

The **consequences of climate change** will **vary regionally** resulting in substantial consequences for agriculture. Countries in the south which today are already hot and dry will become even hotter and dryer. Especially African countries will have to expect lower crop yields. Countries in the north might profit from climate change. In Canada and the northern parts of the USA higher crop yields can be expected.

Briefly summarised: in **Germany** the following effects can be expected: Until 2050 the mean temperature will rise by **1.25 to 1.5 degrees Celsius**. **Winters** will become milder **and more humid** and **summers** will be **hotter and dryer**.

Sources used:

Intergovernmental Panel on Climate Change (IPCC)

German Federal Environment Agency (Umweltbundesamt)

World Health Organization(WHO)

Information on European Emissions Trading

Please read the information provided on this page.
You will have about 10 minutes to do so.

In 2005 the European Union has implemented the emissions trading system for carbon dioxide (CO₂). Emissions trading is the central instrument of climate policy in Europe. It follows a simple principle: The European Commission, together with the member states, has determined the amount of CO₂ to be emitted altogether in the respective sectors (energy production and energy intensive industries) until 2020. This total amount will be distributed to the companies by the state in the form of emission rights (“**permits**”). For each quantity unit of CO₂ emitted, the company has to give a permit to the state. The permits can be traded between companies.

For each quantity unit of CO₂ emitted e.g. by a power plant, the plant operator has to prove his permission to do so in the form of a permit. This leads to an important consequence: If the **total amount** of permits is **reduced**, the **total emissions** will be **lower**, simply because plant operators do not possess enough emission allowances. That means if a permit for one quantity unit is obtained from the market and is being “**retired**” (i.e. deleted) **the total CO₂ emissions are reduced by exactly this quantity amount**. The opportunity to retire permits actually exists in the framework of the EU Emissions Trading System. In Germany the German Emissions Trading Authority (DEHSt) regulates Emissions trading. The authority holds a **retirement account** with the account number DE-230-17-1. If permits are transferred to this account they will be withdrawn from circulation, i.e. deleted, by the end of each year.

Emissions trading has one central advantage: It guarantees that the abatement of CO₂ emissions occurs where it is the cheapest option. Companies with opportunities to abate carbon in a cost-efficient way will sell their permits on the market, whereas companies with high abatement costs can acquire permits at a relatively low price. This trade is beneficiary for both sides and guarantees for the emission reduction target to be achieved at minimal costs.

Altogether, European energy producers and energy intensive industries were allowed to emit about **two billion tons of CO₂** in the year 2009. As a benchmark: **global CO₂ emissions** per year amount for **29 billion tons of CO₂**.

Summarising, it can be stated that if the **total amount** of permits in the EU Emissions Trading System is **reduced**, the **total CO₂ emissions** in Europe **decrease**.

Purchase of CO₂ Permits

Explanation

You are given the opportunity to buy permits of the EU Emissions Trading System at this event. ZEW will **buy** the amount of permits chosen and will **retire** them. Thus, you have the opportunity to contribute to the reduction of the actual CO₂ emissions in Europe.

The purchase of the permits will be **attested by an independent body**. The amount of permits purchased by each participant will be published on the ZEW website displaying the participant number (**no** names will be displayed).

If you wish, ZEW will issue an official record about the amount of your permits purchased at the end of the event.

Introduction of the product “CO₂ permits”.

One unit equals 100 kilograms of CO₂

Quantity you want to buy at each price.

Please state in the table below the quantity of units (100 kg each) you are willing to buy at each price. When leaving the room you will draw by lot **one** of the five prices. You will then buy the quantity of units you have stated at this price.

Important note: There is no obligation to buy!
Permits purchased have to be paid!

Please note:

Your maximum expenditures for each price are € 40

The unit is 100 kg of CO ₂				
No.	Price per unit	How many units do I want to buy at this price?	How many units can I buy in total at this price?	Expenditures = Price x Units
1	5.00 €		8	
2	2.00 €		20	
3	1.50 €		26	
4	1.00 €		40	
5	0.50 €		80	

Questionnaire II

Please fill in questionnaire II.

27. Emission allowances of the European Emissions Trading System (certificates) are traded on the stock exchange. How would you estimate the price of such a permit on the stock exchange?

100 kg of CO₂ cost € _____.

28. How sure are you about your estimation of question 27?

I know it	Sure	Rather sure	Rather unsure	I don't know, I guessed.

29. Will you talk about this event and your behaviour in it with your family, your friends or your colleagues?

- a) Yes
- b) No
- c) I don't know

Please answer the following questions only if you want to buy permits. That means if you have stated a positive quantity (> 0) at any of the prices in the auction of the permits.

30. I want to buy permits, because...

Reason ↓	Absolutely not applicable	Rather not applicable	Neutral	Rather applicable	Absolutely applicable
...I want to contribute to climate protection – regardless of what others do.					
... I think that others also contribute to climate protection.					
... especially people in poor countries will suffer the consequences of climate change and I want to do something against it.					
... the industrialised countries, among them Germany, have played a decisive role in causing climate change.					
... future generations will suffer the consequences of climate change and I want to do something against it.					
... the flora and fauna will suffer the consequences.					
... the government is not doing enough against climate change.					
... my environment (family, friends, colleagues) expects me to.					
... the organisers of this event expect me to.					
... it is my moral obligation.					
... it is important to protect the creation.					

31. I do not want to buy permits, because...

Reason ↓	Absolutely not applicable	Rather not applicable	Neutral	Rather applicable	Absolutely applicable
... I do not think that my buying of permits will actually reduce emissions in Europe.					
... a market for permits does not work. We need official prohibitions and commands.					
... I already act in a climate conscious way.					
... emissions trading anyhow suits the interests of the large scale industry only.					
... I think that emissions trading is principally unethical.					
... I would buy permits from companies which have received them for free and by that subsidy them.					
... I do not trust ZEW.					
... I do not think that emissions can actually be measured and controlled.					

More reasons: _____ ...

Leaving the room

Please leave the room only when we have asked you to.

After leaving the room you will draw a price by lot and pay the certificates you have chosen to buy at this price.

Thank you very much for participating!