How Much Carbon Offsetting and Where?

Implications of Efficiency, Effectiveness, and Ethicality Considerations for Public Opinion Formation

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Abstract

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Keywords: climate change mitigation, carbon offsetting, public preferences, online framing experiment

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1. Introduction

There is strong agreement in the scientific community, led by the Intergovernmental Panel on Climate Change, that greenhouse gas (GHG) emissions must be reduced on a large-scale in order to avoid major climatic changes (Pachauri et al. 2014). Such GHG reductions are likely to result in high opportunity costs for individual citizens and economic actors like firms (Stern 2006). Governments around the world are spending vast amounts of time and effort exploring various policy instruments that could help bring down opportunity costs and thus make ambitious climate policies more acceptable to stakeholders.

Carbon offsetting is one of the most important policy instruments in this respect. It is meant to provide GHG emitters, and their countries as a whole, with flexibility in meeting mitigation targets. The basic idea of carbon offsetting in climate change mitigation is simple: to reach a given GHG reduction target, emitters can either cut emissions within their facilities and operations at their source; or they can fund emission cuts somewhere else within their country or abroad (i.e. carbon offsetting). From a geophysical viewpoint, it is irrelevant where in the world emissions are reduced.[1]

Technically, carbon offsetting involves a monetary investment in a project or activity that abates GHG emissions outside the emitter's own operations or facilities (i.e. not at the source). The emissions reduced by the project offset or compensate for the investing emitter's own emissions. The credited emissions reductions are the difference between the business-as-usual emissions, i.e., GHG emissions had the project *never* been implemented, and the emissions after the project was implemented. The emissions reduced via the project are subsequently quantified in credits, which can be used towards the investing emitter's reduction obligation or sold on a carbon market. Typically, there is a one-to-one ratio of one ton of carbon dioxide or equivalent GHG reduced to one credit.

The number of countries and subnational units that allow for or are considering carbon offsetting is growing. As of mid-2015, political units as diverse as Australia, British Columbia, California, the European Union, Japan, New Zealand, Ontario, Québec, the Regional Greenhouse Gas Initiative[2], South Korea, Switzerland, and Tokyo have implemented legally binding reduction commitments and permit carbon offsetting (International Climate Action Partnership 2015). Existing policies on offsetting differ in two ways, first, in how much of a given reduction target can be met via carbon offsetting, and where projects can occur (i.e. within the country or abroad), as listed in Supplementary Information A.

[1] Offsetting can be voluntary or mandatory. This paper concentrates on offsetting within mandatory reduction targets, particularly, the use of offsetting to meet national emission reduction commitments.
[2] The RGGI is a cooperative effort between Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island and Vermont to reduce GHG emissions from the power sector.

Australia and New Zealand, for instance, are exceptionally flexible with respect to offsetting. Emitters may offset their entire reduction commitment anywhere in the world. This means that Australia and New Zealand's entire mitigation commitment could, in principle, be met with offsets obtained through GHG reduction projects abroad. At the opposite end of the spectrum is the Regional Greenhouse Gas Initiative in the United States, which only allows emitters to offset 3.3 percent of their reduction obligation, while the rest must be achieved at the source, meaning within emitters' own operations and facilities. Moreover, firms' investments must occur domestically within the nine states that comprise the Regional Greenhouse Gas Initiative.

Major differences between political units' policy choices with respect to offsetting in mitigation are a reflection of controversies over their efficiency, effectiveness, and ethicality (see Archer 2010; Belson 2008; Frank 2009; Hyams and Fawcett 2013; Mason 2013; Morgan 2008; Page 2013; Rennie 2009; Sopinka 2007; Story 2008; Stuek 2013; Sutherland 2007). Proponents of carbon offsetting point to large economic efficiency gains (Bumpus 2012), which in turn would allow for more GHG reductions at a lower cost. Opponents voice concerns over the effectiveness of carbon offsetting, mainly over whether carbon offsetting projects are really effective in reducing GHG emissions. Moreover, they question the ethicality of carbon offsetting, arguing that it is not compatible with the polluter pays principle (Dechezleprêtre et al. 2008, Olsen and Fenhann 2008; Haya 2009; Lloyd and Subbarao 2009; Newell et al. 2009).

The growing importance of carbon offsetting notwithstanding, we know rather little about how citizens form preferences concerning this issue, and how controversies over carbon offsetting's economic efficiency, effectiveness, and ethicality, which dominate the academic literature and policy discourse (see Belson 2008; Frank 2009; Krugman 2009; Story 2008; Sutherland 2007), affect these preferences. Public opinion is relevant in this context, since the prevailing public sentiment sets important constraints in the political space within which policies can be developed and implemented in democratic political systems (Holcombe 2006). This is particularly true for matters that are potentially costly to individual citizens, such as the mitigation of GHG. To our knowledge, no prior study has experimentally investigated public preferences with respect to carbon offsetting, along the lines we do in this paper.

Empirically, we focus on the United States since it is the largest GHG emitter in terms of historically accumulated emissions and a key player in global climate policy. Yet it has been particularly reluctant to commit to legally binding GHG reduction targets; therefore, carbon offsetting is likely to play an important role in designing politically viable GHG reduction measures, especially in light of ambivalent public attitudes towards climate change policy. In the 2014 PEW opinion poll, for instance, 71 percent of US respondents felt their country should

do whatever it takes to protect the environment, and 64 percent favored setting stricter emission limits on power plants to address climate change. Yet, in the same poll, only 56 percent agreed that stricter environmental laws are worth the cost[3]. Even though US citizens appear to support environmental action, it is unclear which policies would meet their demands of low cost.

We use an issue framing experiment to investigate whether and how prominent arguments in the carbon offsetting debate, namely arguments concerning efficiency, effectiveness, and ethicality, affect public preferences for including offsetting in mitigation. Compared to standard survey approaches, where we would simply ask respondents whether they approve or disapprove of certain climate policy instruments and then correlate such data with potential explanatory factors, a framing experiment allows us to identify the causal effects of specific arguments on public preferences regarding offsetting. Using this approach, we randomly assign participants a section of text, also known as a frame, which corresponds to one of the different arguments for or against carbon offsetting. After which, we examine whether these treatments (i.e. the frames or section of texts) influence preferences on whether to allow offsetting and where. By showing each participant one particular frame (i.e. controversies over efficiency, effectiveness, and ethicality), we enhance the saliency of the particular argument in the debate for the participant (Borah 2011).

In the next section, we outline key arguments for and against carbon offsetting. These arguments are then, in stylized form, used as frames (i.e. treatment conditions) in the framing experiment. We then describe the research design, present the results, and end with a discussion of policy implications and options for further research. We find that efficiency considerations increase support for international offsetting, while concerns over their effectiveness and ethicality reduce support for international and domestic offsetting. We conclude by discussing these and other results and outlining policy implications.

2. Efficiency, Effectiveness, and Ethicality Considerations: Expected Implications for Policy Preferences

Why are some national GHG mitigation policies very permissive of carbon offsetting and others very restrictive? At least part of the answer lies in the way citizens and relevant groups in society weigh different arguments on offsetting. The principle argument in support of offsetting concerns its low cost and high economic efficiency, while criticism centers on ineffectiveness and problems of ethicality. We investigate how these arguments, hereby referred to as efficiency, effectiveness, and ethicality for parsimony, influence the public's policy

[3] http://www.pewresearch.org/key-data-points/environment-energy-2/

preferences on how to meet national reduction commitments. Each of these arguments is briefly discussed along with our expectations on how framing carbon offsetting with a view to efficiency, effectiveness, and ethicality is likely to impact on people's support for this policy instrument.

2.1 Economic Efficiency

The most common argument in support of carbon offsetting is economic efficiency. With offsetting, emitters have the opportunity to invest in a greater variety of GHG reduction projects, enabling them to find cheaper and more cost-efficient projects than if they were restricted to the small set of projects that would reduce GHG emissions within their own operations or facilities (Tatsutani and Pizer 2008). Moreover, when offsetting is permitted internationally, rather than only within the emitter's home country, costs per unit of GHG mitigation tend to be even lower. As noted by one observer: "You [a firm] can do a lot more for a lot less per ton of GHG emissions reduced in New Delhi or Rio compared to Berlin" (Bumpus 2012 p.2).

It is commonly presumed that individual citizens see a trade-off between the national economy and environmental policy. When the public perceives the national economic situation as unsatisfactory and environmental policy as costly, its support for environmental regulation tends to decrease, and vice versa (Brulle et al. 2012; Daniels et al. 2012; Jacobsen 2013, Scruggs and Benegal 2012; for contrasting evidence, see Kachi, Bernauer, Gampfer 2015). That is, there appears to be a trade-off between GHG mitigation and economic conditions. Since offsetting tends to lower the cost of GHG mitigation, the perceived tradeoff between GHG reductions and economic prosperity might be ameliorated. Therefore, when efficiency gains via offsetting are emphasized, we expect more support for carbon offsetting. Moreover, given that marginal abatement costs are usually lower in less wealthy countries (Gollier and Tirole 2015), we expect efficiency considerations to induce respondents to prefer international over domestic carbon offsetting.

Carbon offsetting not only benefits national economic prosperity via reduced opportunity costs of GHG reductions but also individual consumers. GHG mitigation is costly and firms with reduction obligations tend to pass on the added costs to consumers (OECD 2009). For example, the Finnish Ministry of Trade and Industry conducted an assessment to determine which groups if any would be impacted by GHG emissions limits in the energy sector. Consumers were one of the hardest hit groups because energy companies passed on additional costs (Kara et al. 2008, see also Hintermann 2014, Mokinski and Wölfing 2013, Fezzi and Bunn

2009, Sijm et al. 2008, Smale et al. 2006). More carbon offsetting, and especially international offsetting, is likely to result in less costs being passed on to consumers (i.e. citizens). This is particularly relevant since several studies have shown that high costs to the average household tend to reduce support for climate policy (Bechtel and Scheve (2013); Bernauer and Gampfer 2015)

One might argue, however, that domestic offsetting (i.e. within the respective country) also (co-)benefits the domestic economy and the public, for example, by improving air quality and creating "green" jobs (Bernauer and Gampfer 2015, Balbus 2014, Thurston and Bell 2014). At the same time, it still provides firms with greater flexibility in reaching GHG mitigation targets. This means that, despite potentially greater economic efficiency of investing in offsetting abroad, compared to offsetting domestically, citizens might because of such co-benefits still prefer domestic offsetting. With a view to this ambiguity, we expect the economic efficiency frame to increase support for carbon offsetting, both domestically and internationally.

In light of these arguments, we hypothesize that *individuals exposed to the economic efficiency frame prefer more offsetting (both domestically and internationally) and less GHG reductions at the source (within polluting firms domestically).*

2.2 Effectiveness

A key principle in carbon offsetting is additionality. The latter means that an emissions reduction project, which serves to offset GHG emissions somewhere else, should only be possible as a result of outside investment by the emitter who is offsetting her/his emissions (Hyams and Fawcett 2013). If emitters receive credits for emissions reductions that would have occurred without the offset investment, then the emitter does not effectively reduce emissions.

Arguments about economic efficiency gains of carbon offsetting are in fact countered by widespread skepticism about the additionality and thus effectiveness of GHG offsetting projects (Benecke 2009, Newell, 2012). Critics claim that many if not most additionality claims are dubious. Their assertion is that the bulk of offsetting projects would have occurred anyway without outside investment. As a result, they believe that emitters are often shirking reduction obligations, emissions are not being reduced, and emitters are merely taking credit for emission reductions that would have already happened (Bento et al. 2015, Greenberg and Fang 2015, Erikson et al. 2014). Schneider (2009), for instance, found that the standards of additionality for the Kyoto Protocol's offsetting mechanism, the Clean Development Mechanism, were in serious need of improvement. He states, "Key assumptions regarding additionality are often not

substantiated with credible, documented evidence. In a considerable number of cases it is questionable whether the emission reductions are actually additional," (p. 242).

Assertions of ineffectiveness of carbon offsetting, notably in terms of additionality problems, are often associated with accusations of emitters shirking obligations or even cheating, which in turn are likely to activate opposition to carbon offsetting. Such assertions speak to core values of economic individualism, which have been shown to be particularly strong in the United States, on which we will focus empirically (see below). In his seminal work, Feldman (1988) suggested, for instance, that individuals inform their beliefs based on overarching ideological principles, one of which is economic individualism in US culture. It holds that individuals and firms should get ahead on their own through hard work. Conversely, it emphasizes work ethic and dislike for those who avoid obligations or cheat. Therefore, arguing that carbon offsetting is "cheating" on GHG mitigation is likely lead to less support.

In view of these arguments, we hypothesize that *individuals exposed to the (in)effectiveness frame will be less supportive of carbon offsetting, both domestically and internationally*, *and more supportive of GHG reductions at the source (i.e. within the emitting firms own operations).*

2.3 Ethicality

Another criticism concerns the ethicality of carbon offsetting. Offsetting is frequently portrayed as paying for the right to pollute (e.g. Dhanda and Hartman 2011; Page 2013). Critics find it morally objectionable that GHG emitters could "buy" their way out of responsibility. To emphasize the perceived hypocrisy, offsetting is commonly compared to the sale of indulgences in the Catholic Church, where believers could pay away their sins (Page 2013).

It is likely that the public will respond to such criticism because of the core values of work ethic mentioned above (Feldman 1988). Moreover, in regards to GHG mitigation, the public tends to view the burden of mitigation as lying with firms and the government. Dodds et al. (2008), for instance, investigated individuals' willingness to voluntarily purchase carbon offsets for air travel and also asked respondents about their opinion on who is responsible for emissions reductions from flights. The majority of respondents felt it is the responsibility of the airline and government to reduce GHG. Therefore, presenting offsetting as a means to evade responsibility is likely to lead to less support for this policy instrument.

Thus, presuming the public's assignment of responsibility to firms and government, and based on the argument about core values, we expect *individuals exposed to the ethical frame to be less likely to support carbon offsetting, both domestic and international, and to be more*

supportive of GHG reductions at the source (i.e. within the emitting firms own operations).

In the empirical analysis, we will also explore whether climate change skepticism and prior knowledge of offsetting moderate the effects of the three frames. One might expect arguments on efficiency, effectiveness, and ethicality to have less or no effect on these subgroups. Because climate skeptics are less supportive of GHG mitigation in general, or even fundamentally opposed to it, arguments regarding efficiency, effectiveness, and ethicality of offsetting might be less relevant or even irrelevant to their preferences on GHG mitigation and offsetting. Participants who have heard of offsetting before have probably already encountered these arguments and may already have formed their preferences prior to our experiment. This means that they are less likely to be influenced by our treatments (i.e. frames).[4]

3. Study Design

We use an experimental study design where we randomly expose participants to one of three differently framed arguments on carbon offsetting (i.e. efficiency, effectiveness, ethicality) or no treatment (control group) (Table 1). We then asked respondents to express preferences for or against carbon offsetting. By comparing participants' preferences under treatments to the control condition we can identify the causal effect of the three types of arguments for or against carbon offsetting on public preferences for the use of offsetting in mitigation.

3.1 Treatments

We employ an issue-framing experiment in which we use three treatment conditions, each of which summarizes a particular argument for or against carbon offsetting. In issue framing, the researcher presents survey participants with passages of texts emphasizing particular features of a debate. By showing each participant one frame only we enhance the saliency of a particular argument in the debate and allow for causal identification of that particular argument (Borah 2011). One could, of course, expose survey participants to any combination of the three treatments simultaneously. We decided against such an approach because treating each participant with one frame provides greater clarity with respect to the causal effect of each treatment. However, we do examine treatment effects for a subsample of individuals with prior knowledge of offsets. These individuals are likely to have been exposed to

[4] It might have been useful to also investigate more closely participants who do not support any form of climate policy and/or participants who can be considered climate change deniers; however, we have too few such participants in our sample.

these arguments already, and examining treatment effects for this subgroup can, therefore, allude to effects had we treated participants with all three arguments simultaneously.

After exposing participants to one of the frames or the control, we then asked them to express their preferences with respect to how GHG emissions should be reduced: through reductions at the source, domestic offsetting, or international offsetting, or any combination thereof. Our outcome variable thus captures preferences concerning a fundamental policy-design choice that countries envisaging GHG reductions need to make.

For the wording of the treatment texts, we employed a parallel structure design, meaning that treatments follow a similar format. Each treatment begins with "Experts argue that …" followed by a one-sentence summary of the main argument. After which, we elucidate on the key points and implications. Thus, while the structure of the frames is homogenous across treatments, the content is *not* identical (see Table 1; all treatments are worded for the United States, from which we draw our sample). Participants were exposed to these treatments (or the control condition) after having received some neutrally worded information on climate policy and on what carbon offsetting means (see Supplementary Information D).

Table 1: Treatments (Frames)

Control	-
Efficiency	Experts argue that *it is much cheaper for US firms to meet their reduction obligations if offsetting is permitted abroad* (i.e. outside of the US). Reducing greenhouse gas emissions can be very costly, and some of this cost will be passed on to consumers. For example, in order for the energy sector to meet its reduction obligations without any offsetting, average monthly energy prices for US households (approximately $100) could more than double (approximately $200).[5] Offsetting reduces the costs of greenhouse gas reductions, thereby reducing the cost passed on to you as a consumer.
Effectiveness	Experts argue that, in many cases, *offsetting does not actually reduce greenhouse gas emissions.* Most offsetting projects firms invest in would have occurred even without their investment. Therefore, firms are merely taking credit for what would have happened anyway and are thus avoiding reduction obligations.
Ethicality	Experts argue that *offsetting is unethical*. It allows firms to pay their way out of obligations to reduce greenhouse gas emissions that contribute to global warming. The moral problem with this is that those who create environmental problems should be responsible for solving them, and those who emit greenhouse gases should thus reduce their own emissions, rather than paying others to do so.

[5] The estimated percent increase in average household energy prices ranges from 10 percent (Smale et al. 2006) to as high as 100 percent (Fell et al. 2013). The average US household currently spends around 90 USD (Environmental Protection Agency). We used a range from 100 USD to 200 USD.

3.2 Dependent (Response) Variable

Our objective is to discern how the arguments shown in Table 1 affect preferences for using offsetting as a policy instrument in national GHG mitigation. We asked participants to allocate the United States' reduction target of 1000 megatons (see further below) between international offsetting, domestic offsetting, and reductions at the source (within emitters' operations and facilities). This approach captures preferences concerning the two key features of offsetting: how much offsetting, relative to reductions at the source, should be permitted, and where (domestically, internationally) should offsetting be permitted. Details on how the dependent variable was constructed in the survey instrument can be found in Supplementary Information D.

We then compare the preferred relative allocation of the reduction target between participants in the treatment groups (i.e. efficiency, effectiveness, and ethicality) and the control group (i.e. no treatment).

3.3 Sample

In July 2014, we collected data from 995 participants[6] based in the United States. They were recruited via Amazon Mechanical Turk[7] (AMT), an online crowd-sourcing platform. After recruitment, the participants were directed to an online survey platform, Unipark, where we implemented the survey experiment.

Crowd-sourcing implies a convenience sampling approach, which suits our specific purpose, which is to empirically examine causal effects of frames. That is, we are not interested in how much offsetting the U.S. public supports (i.e. the magnitude). We are only interested in finding out how the three arguments in the offsetting debate (efficiency, effectiveness, ethicality) affect preferences for how this policy instrument should be used in national mitigation. Estimates of such effects are unbiased as long as the treatment groups are unbiased along key covariates. To make sure that demographic characteristics as shown in Supplementary Information B, Table SI- B.1, do not vary significantly between treatment and control group, we used ANOVA analysis[8]. Table SI- B.1 shows descriptive statistics for key demographic variables, comparing our sample and the U.S. population. As can be seen there, our

[6] A total of 1027 persons participated in the survey. 5 participants failed to complete the survey and 27 completed the survey in less than five minutes, indicating low quality responses. These observations were dropped for the main analysis. However, including or excluding these observations does not affect the estimation results.

[7] There has been some debate on the quality of data collected via online surveys. An increasing number of meta-studies show, however, that the quality of data collected through opt-in online surveys is comparable to the quality of data from traditional phone- and mail-based surveys. For instance, Ansolabehere and Schaffner (2014) compare three modes of surveys in the U.S.—an opt-in Internet survey, a telephone survey via Random Digital Dialing (RDD), and a mail-in survey.

[8] Please contact the authors to for the data and R script.

sample is somewhat younger, more educated, liberal, and male than the U.S. population. The descriptive statistics of all other variables in our analysis can be found in Supplementary Information Table SI- B.2.

3.4 Survey Instrument

After consenting to participate in the survey, participants read an introductory description of US climate policy and carbon offsetting. We based our climate policy scenario on the Obama Climate Action Plan (CAP). In 2009, US President Obama unveiled a CAP that aims to reduce GHG emissions by 17 percent below 2005 levels by 2020. The plan focuses on cutting carbon dioxide emissions, preparing for the impacts of climate change, and contributing to global efforts through a series of executive orders. We did not explicitly reference Obama or the CAP in our policy scenario to avoid potential partisan priming effects (Marquart-Pyatt et al. 2014). In addition, we used statistics from the US Environmental Protection Agency to simplify the reduction target and calculate a 15 percent reduction in megatons for the US. The policy description read:

> The United States government is considering a new policy that would reduce greenhouse gas emissions by approximately 15 percent below the current level by the year 2020. Greenhouse gases, above all carbon dioxide, are released during the burning of gasoline, diesel, oil, and coal, which occurs most often in energy production and transportation. These emissions contribute to global warming, also known as climate change. Based on estimates by the US government, under the new policy, the US, as a country, would need to decrease its emissions by approximately 1000 metric megatons (meaning 1000 million metric tons). The graph below illustrates the projected decrease.
>
> To meet this national target (i.e. reduction of 1000 megatons), particular sectors in the US economy would be given specific emissions limits (or caps). These limits are equivalent to the maximum amount of emissions allowed in a given sector. Firms and other entities in these sectors would be required to reduce their emissions by a specific amount (tons of emissions) in order to meet the target for the respective sector. This amount is called a *reduction obligation*. The government is now contemplating using **offsetting** to provide firms with greater flexibility in how they reduce their greenhouse gas emissions.

For the full survey, see Supplementary Information D. To ensure that participants understood the policy description, we added a graphical illustration of carbon offsetting as well as basic comprehension questions (see Supplementary Information D). If participants answered incorrectly, they were redirected to the explanation and were only allowed to progress once they answered correctly.

Participants were then randomly assigned to one of the treatment groups or the control group, as shown in Table 1. After which, participants were asked to express their preferences on

how, if at all, offsetting should be used for meeting GHG mitigation targets. The question read as follows:

> How do you think the US, as a country, should reach the national reduction target of 1000 megatons? There are three mechanisms available. Please review their definitions below.
>
> - International Offsets: US firms invest in offsetting projects outside of the US, and outside the respective firm's own operations and facilities
> - Domestic Offsets: US firms invest in offsetting projects within the US, but outside the respective firm's own operations and facilities
> - By Firms: No offsetting, firms reduce emissions within their own operations and facilities
>
> For each of the three boxes below, please allocate how much of the national reduction target you think should be reduced using these mechanisms...

Underneath this question in the survey were three boxes labeled "By Firms", "International", and "Domestic". In each box, participants were required to allocate part or none of the reduction obligation. For example, if participants were opposed to offsetting, they could allocate 0 to international offsets, 0 to domestic offsets, and 1000 megatons to firm-internal reductions. The sum of boxes had to equal 1000. The order of the boxes and the list in the explanatory text, as shown above, were randomized between participants to avoid priming and ordering effects. Forcing respondents to allocate the full amount of 1000 megatons, in total, across all three categories may not accommodate preferences of climate change skeptics, who are likely to prefer less or even no GHG mitigation at all. The advantage of our approach is that it focuses participants' attention on *how* to reduce emissions, holding the "how much" constant. However, subsequent items in the survey provide information on climate change attitudes and allow for analysis of how being a climate change skeptic and being exposed to a forced choice might affect preferences on carbon offsetting.

3.5 Statistical Approach

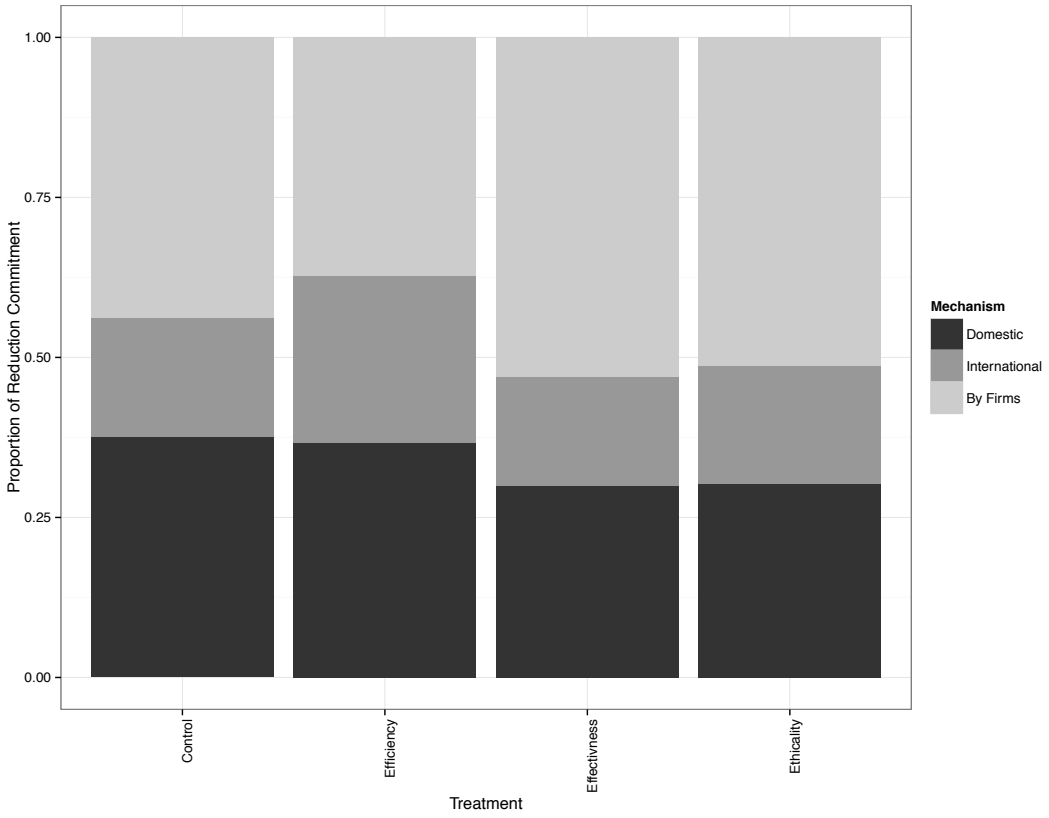
Our objective is to identify differences between treatment groups and the control group in their relative allocation of the reduction obligation to international offsetting, domestic offsetting, or firms (reduction at the source). Thus, we carry out difference-in-means tests, which are traditionally done using ANOVA. However, since participants allocated 1000 megatons between the three options, we must use a method other than ANOVA to account for the dependency between response variables. For example, as soon as a participant allocates x to international offsets and y to domestic offsets, then $1000 - x - y$ will be allocated to firm internal reductions. Thus, the three dependent variables are three proportions adding to one. A participant allocates a certain proportion of the reduction obligation to international offsetting,

i.e., *x/1000*, domestic offsetting, i.e., *y/1000*, and firm internal reductions *(1000 –x –y)/1000*. To analyze multiple proportions, we use a Dirichlet regression (Maier 2015). Dirichlet regression is akin to a multinomial logistic regression applied to proportional data (Maier 2015). The covariates from the Dirichlet regression cannot be interpreted directly since these are transformed similar to a logistic regression (Maier 2015). Yet, the regression analysis will show whether there are significant differences in the relative allocation of the mitigation commitment between international offsetting, domestic offsetting, and international reductions between treatment and control groups.

4. Results

Figure 1 depicts the *mean* proportion of the reduction commitment allocated to domestic offsetting, international offsetting, and firms across treatment groups and control for all participants. The control group allocated approximately 38 percent to domestic offsetting, 18 percent to international offsetting, and 44 percent to firm internal reductions. Participants receiving the effectiveness and ethicality treatments allocated approximately 30 percent of the reduction commitment to domestic offsetting, approximately 20 percent to international offsetting, and approximately half of the reduction commitment to firm-internal reductions. This is in contrast to individuals receiving the economic efficiency frame, who allocated approximately 37 percent, 26 percent, and 37 percent to domestic offsetting, international offsetting, and firm-internal reductions, respectively. Further information on mean proportions can be found in Supplementary Information C, Tables SI-C.1 - SI-C.3.

Figure 1: Allocation of Reduction Commitment By Treatments and Control



We tested for treatment effects with and without covariates amongst all participants (Models 1 and 2), those who had heard of offsets prior to the survey (Models 3 and 4), and climate skeptics (Models 5 and 6) using Dirichlet regression as shown in Table 3. To identify those with prior knowledge, we asked participants: *Have you heard of offsetting prior to the survey.* 47 percent of the sample, 464 participants, had heard of offsets prior to the survey, while 53 percent had not, 522 participants[9]. Models 5 and 6 assess treatment effects amongst climate skeptics. We asked participants: *In your view, what is the most important reason for increases in the Earth's temperature (usually called global warming) over the last century?* Possible answer categories included: pollution due to human activities, natural changes in the environment, the temperature is not increasing, and not sure. Individuals who answered; natural changes in the environment, the temperature is not increasing, or not sure; were labeled as climate skeptics. 76.28 percent of the sample, 759 participants, believed temperature increases were anthropogenic, while 23.72 percent of the sample, 236 participants, were skeptic. Table 2 lists the participants in each treatment group for the whole sample and subsamples, i.e., those who had previously heard of offsets ("Heard"), and skeptics ("Skeptics").

[9] Seven respondents did not fully complete the survey, which is why there are only 986 participants.

Table 2: Number of Participants in Each Treatment and Control Group, All, and By Subsample

	All	*Heard*	*Skeptics*
Control	250	117	53
Efficiency	249	133	58
Effectiveness	250	125	61
Ethicality	246	147	64
N	995	464	236

Random assignment of participants to treatment and control groups means that covariates that, besides the treatment conditions, may also influence preferences on carbon offsetting are controlled for because their distributions are very similar across all groups. Nevertheless, as mentioned above, we also include several covariates in the regression models. Existing research shows that females, younger individuals, those with higher education, and Democrats tend to be more environmentally concerned and express higher levels of environmental policy support (Kachi, Bernauer, Gampfer 2015; Egan and Mullin 2012; Scruggs and Benegal 2012). Income effects on policy support and environmental concern tend to be ambiguous. Higher income individuals are more likely to hold post-materialist values (Inglehart 1981). According to Inglehart (1981), this means that these individuals should be more supportive of environmental policy. However, in the United States, individuals with higher income are more likely to be Republican, which negatively correlates with environmental concern (Marquart-Pyatt et al. 2014). In fact, Kachi, Bernauer and Gampfer (2015) find an insignificant relationship between income and support for climate policy in the United States. The effects of these covariates on preferences for the use offsetting in climate mitigation are not clear, however, since offsetting can be construed as helping or harming the environment. Nonetheless, we estimate models with and without covariates since we are uncertain which will provide the better model fit. We conducted ANOVA analyses to make sure that there were no significant differences in terms of age, sex, political ideology, education, income, and environmental concern amongst treatment groups for the subsamples, i.e., respondents with prior knowledge of offsets, and skeptics.

Table 3: Regression Results

		(1) *All*	*(2)* *All*	*(3)* *Heard*	*(4)* *Heard*	*(5)* *Skeptics*	*(6)* *Skeptics*
Domestic	Efficiency	0.02	-0.03	0.20	0.04	-0.13	-0.50 *
	Effectiveness	-0.24 *	-0.41 ***	-0.30 *	-0.53 ***	0.03	-0.34
	Ethicality	-0.24 ***	-0.41 ***	-0.35 **	-0.48 **	-0.29	-0.44
	Age		-0.01 *		-0.01 *		-0.01 *
	Party		-0.04		0.005		-0.17 **
	Environmental Awareness		-0.11 *		-0.13 *		-0.25 **
	Income		-0.004		-0.002		0.01
	Education		-0.01		0.01		0.11 *
	Sex		0.18 *		0.33 **		-0.14
International	Efficiency	0.28 **	0.28 **	0.41 **	0.34 *	0.26	0.06
	Effectiveness	-0.16	-0.26 **	-0.07	-0.20	0.15	-0.07
	Ethicality	-0.21 *	-0.26 **	-0.11	-0.20	-0.06	-0.28
	Age		-0.01		-0.01 *		-0.01
	Party		-0.06 *		-0.03		-0.12 *
	Environmental Awareness		-0.09 *		-0.11		-0.32 ***
	Income		-0.004		0.0007		0.004
	Education		0.01		0.05		0.15 ***
	Sex		0.15 *		0.30 **		-0.09
Internal Reductions	Efficiency	-0.19	-0.28 **	-0.05 **	-0.18	0.13	-0.18
	Effectiveness	0.11	-0.004	0.02	-0.16	0.42 *	0.17
	Ethicality	-0.10	-0.19	-0.14	-0.30 *	0.53 *	0.18
	Age		-0.01 **		-0.007		-0.02 **
	Party		-0.06 *		-0.04		-0.12 *
	Environmental Awareness		-0.12 **		-0.03		-0.25 *
	Income		-0.0003		-0.002		0.01
	Education		-0.06 *		-0.02		0.02
	Sex		0.19 *		0.34 **		-0.15
	N	995	897	522	474	236	201
	Link Function	Log	Log	Log	Log	Log	Log
	Parameterization	Common	Common	Common	Common	Common	Common
	AIC	-2517	-2228	-1123	-1025	-612	-519.2

Significance: * < 0.05, ** < 0.01, *** < 0.001. Link function is log and the parameterization is common for all models. All dependent variables (International, Domestic, Internal) are fit with an intercept.

Note: Table 3 lists the regression coefficients along with their significance levels, which can be interpreted similar to a logistic regression. Each of these models reports mean differences between treatment groups and the control condition for the three dependent variables: international offsetting, domestic offsetting, or firms reducing GHG emissions within their own facilities and operations. Participants in the control group are the baseline category. For example, in Model 1, which includes all participants, the frames effectiveness and ethicality lead to significantly less of the reduction obligation being allocated to domestic offsetting compared to the control group. As noted above, the coefficients cannot be directly interpreted since these are transformed via a log transformation. We do not indicate

standard errors for two reasons. First, these cannot be easily interpreted as a result of the transformation. Second, since we use a convenience sample, the magnitude of the effect is *not* meaningful, but only the direction of the effect.

In all three groups (i.e. all participants, those who have heard of offsets (Heard), and skeptics (Skeptics) the model with covariates provides a better fit as shown by the AIC. Therefore, we will interpret results from Models 2, 4, and 6.

For all participants (see Model 2 in Table 3), the frames significantly affect preferred allocations of the reduction commitment to domestic and international offsetting in the expected direction; however, only the economic frame significantly affects participants' preferences for firms' internal emission reductions. Participants receiving the economic frame allocate a significantly larger proportion of the reduction obligation towards international and domestic offsetting compared to the control group, and significantly less towards firms' internal reductions, compared to the control, as expected. Participants receiving the efficiency and ethicality frames allocate significantly less of the reduction obligation to international and domestic offsetting; yet there is no effect for firm internal reductions. This latter result may appear counterintuitive. It is true that if less of the reduction commitment is allocated to international and domestic offsetting then more is allocated to firm-internal (i.e. at the source) reductions. However, it does not imply that the difference in firm-internal reductions between the control and efficiency treatments is *significant*.

Neither the efficiency nor ethicality treatments significantly affect participants' allocation of the reduction obligation to firm-internal reductions. This could result from the way individuals assign responsibility. We know from research by Dodds et al. (2008) that individuals regard firms and governments as responsible for emission reductions. According to psychological theories, individuals' perceptions of an actor's responsibility are heavily influenced by the perceived causal role in a particular outcome (Darley and Schultz 1990, Shaver 1985, Schultz and Schleifer 1983, Woolfolk et al. 2006). Woolfolk et al. (2006) illustrated that this finding holds even when no other behavior is available to the actor, meaning that even if the outcome is beyond the actor's control individuals perceive the actor to be accountable. Our treatments did not manipulate whether or not firms were or were not responsible for their emissions. This might be why the public's perception of firms' responsibility, i.e. firm internal reductions, remained insignificant compared to the control condition for the ethicality and effectiveness treatments. Neither of these frames changed participants' perceptions of firms' responsibility to mitigate emissions. However, the economic treatment states that firms' will pass on costs to consumers. We know from Dodds et al. (2008) that the public does not feel responsible for emissions, which is why we could have observed a significant difference for firm-internal reductions for the economic efficiency treatment.

Counter to our expectations, these controversies (efficiency, effectiveness, and ethicality) did affect those who had previously heard of offsets (see Model 4 in Table 3) and skeptics (see Model 6 in Table 3). Mean proportions can be found in Supplementary Information C, Tables SI-C.1 – SI-C.3. For those who had previously heard of offsets, the ethic and effectiveness treatments significantly decreased the amount of the reduction obligation allocated to domestic offsetting while the efficiency treatment significantly increased the amount of the reduction obligation allocated to international offsetting, compared to the control. Surprisingly, the ethicality treatment decreased the amount of the reduction obligation allocated to firm internal reductions, compared to the control, while the effectiveness and economic treatments remained insignificant. This implies that even individuals who are exposed to relevant information on carbon offsetting outside of our experiment are still affected by our treatments.

As expected, the frames did not significantly affect skeptics' allocation of the reduction obligation to international offsetting or firms' internal reductions. However, the efficiency treatment significantly decreased the amount of the reduction commitment allocated to domestic offsetting. This suggests that climate skeptics might care about the way the government mitigates emissions. Similar results have been reported in another study. Bain et al. (2012) found that framing climate change action in terms of technological or economic benefits led climate change deniers to have significantly higher levels of intention to act pro-environmentally. In the same study, these authors showed that messages framed in terms of climate risk reduction led to insignificant changes in behavior amongst climate deniers. Therefore, the effectiveness and ethicality arguments might have fallen into this latter category, while the efficiency gains highlighted by our treatment seem to resonate more.

5. Conclusion

Overall, our findings show that there is substantial support for carbon offsetting as a flexibility mechanism in national GHG reduction policy. They also show that citizens' preferences on carbon offsetting are influenced by considerations of economic efficiency, effectiveness in reducing GHG emissions, and ethicality. As expected, support for international offsetting is stronger and support for firm-internal reductions is weaker when considerations of economic efficiency gains are at the forefront. Moreover, support for offsetting declines when individuals are confronted with arguments about (in)effectiveness and ethicality of offsetting. As expected, the treatment effects are less important and more contradictory with respect to participants with climate-skeptical attitudes and participants who had heard of carbon offsetting before entering our experiment.

Further research could explore whether our findings, which are based on a US sample, uphold for other countries, for instance Germany, which currently has a more ambitious climate policy agenda than the United States. Moreover, it would be interesting to find out how various types of co-benefits that are often highlighted in voluntary carbon offsetting contexts influence preferences for domestic versus international offsetting. Examples of such co-benefits are green technology innovation, local clean air, and biodiversity protection. It would also be interesting to study whether and how much individuals trade off efficiency gains of international offsetting against "home bias" inclinations or political/ideological concerns about investing in carbon offsetting in certain countries they and their government dislike.

In terms of policy implications, our results suggest that policy-makers have sufficient room of maneuver to allow international and domestic carbon offsetting on a considerable scale. Support for international offsetting could be increased by providing credible evidence on efficiency gains of investing in GHG reductions abroad, whereas support for domestic offsetting could be increased by credible evidence on both efficiency gains (relative to non-offsetting) and co-benefits. Concerns about effectiveness of offsetting could be addressed by means of more transparent and strictly enforced rules on additionality. Concerns about ethicality, however, are harder to deal with because they are to a large degree motivated by general moral values.

6. References

Ansolabehere, Stephen, and Brian F. Schaffner. "Does survey mode still matter? Findings from a 2010 multi-mode comparison." *Political Analysis* 22.3 (2014): 285-303.

Archer, Bert. "Bean-counting v. carbon counting; Belt-tightening puts the squeeze on companies' eco efforts." *The Globe and Mail (Canada)* January 27 (2010). Nexis. Web. July 6 2015.

Bain, Paul G., et al. "Promoting pro-environmental action in climate change deniers." *Nature Climate Change* 2.8 (2012): 600-603.

Balbus, John M., et al. "A wedge-based approach to estimating health co-benefits of climate change mitigation activities in the United States. " *Climatic Change* 127.2 (2014): 199-210.

Bechtel, Michael M. and Kenneth F. Scheve. "Mass support for global climate agreements depends on institutional design." *Proceedings of the National Academy of Sciences of the United States of America* 110.34 (2013): 13763–13768.

Belson, Ken. "Port Authority Plans a Web Site to Help Offset Pollution." *The New York Times* April 21 (2008). Retrieved from www.lexisnexis.com/uk/nexis

Benecke, Gudrun. "Varieties of carbon governance: taking stock of the local carbon market in India. " *The Journal of Environment and Development* 18.4 (2009): 346–370

Bento, Antonio M., Ravi Kanbur, and Benjamin Leard. "Designing efficient markets for carbon offsets with distributional constraints." *Journal of Environmental Economics and Management* 70 (2015): 51-71.

Berinsky, Adam J., Gregory A. Huber, Gabriel S. Lenz. "Evaluating online labor markets for experimental research: Amazon.com's Mechanical Turk." *Political Analysis* 20.3 (2012): 351-368.

Bernauer, Thomas and Robert Gampfer. "How Robust is Public Support for Unilateral Climate Policy?" *Environmental Science and Policy* (2015) forthcoming.

Blasch, Julia and Mehdi Farsi. "Context effects and heterogeneity in voluntary carbon offsetting – a choice experiment in Switzerland." *Journal of Environmental Economics and Policy* 3.1 (2014): 1-24.

Borah, Porismita. "Conceptual issues in framing theory: A systematic examination of a decade's literature." *Journal of Communication* 61.2 (2011): 246-263.

Brulle, Robert J., Jason Carmichael, J. Craig Jenkins. "Shifting public opinion on climate change: an empirical assessment of factors influencing concern over climate change in the US, 2002–2010." *Climatic Change*, 114.2 (2012):169–188.

Buhasz, Laszlo. "Canadian Travellers Skeptical, Survey Finds." *The Globe and Mail (Canada)*. September 8 (2007). Nexis. Web. July 6 2015.

Bumpus, Adam. Benefits of the clean development mechanism. Technical report, UNFCCC Secretariat, 2012.

Chong, Dennis and James N. Druckman. "Framing theory." *Annual Review of Political Science* 10 (2007):103–126

Daniels, David P., Jon A. Krosnick, Michael P. Tichy, Trevor Tompson. "Public opinion on environmental policy in the United States." *The Oxford Handbook of US Environmental Policy*. Ed. M. Kraft and S. Kamieniecki. New York: Oxford University Press, 2012. 461-486

Dechezleprêtre, Antoine, Matthieu Glachant, Yann Ménière. "The clean development mechanism and the international diffusion of technologies: An empirical study." *Energy Policy* 36.4 (2008): 1273–1283.

Darley, John M., and Thomas R. Shultz. "Moral rules: Their content and acquisition." *Annual Review of Psychology* 41.1 (1990): 525-556.

Dhanda, K. Kathy and Laura P. Hartman. "The ethics of carbon neutrality: A critical examination of voluntary carbon offset providers." *Journal of Business Ethics* 100 (2011):119–149.

Dodds, Rachel, Markus Leung, and Wayne Smith. "Assessing awareness of carbon offsetting by travellers and travel agents." *Anatolia* 19.1 (2008): 135-148.

Egan, Patrick J., and Megan Mullin. "Turning personal experience into political attitudes: the effect of local weather on Americans' perceptions about global warming." *The Journal of Politics* 74.03 (2012): 796-809.

Erickson, Peter, Michael Lazarus, and Randall Spalding-Fecher. "Net climate change mitigation of the Clean Development Mechanism." *Energy Policy* 72 (2014): 146-154.

Feinberg, Matthew, and Robb Willer. "The Moral Roots of Environmental Attitudes." *Psychological Science* X (2012): 1-7.

Feldman, Stanley. "Structure and consistency in public opinion: The role of core beliefs and values." *American Journal of Political Science* (1988): 416-440.

Fell, Harrison, Erica Moore, and Richard D. Morgenstern. "Cost containment under cap and trade: a review of the literature." *International Review of Environmental and Resource Economics* 5.4 (2011): 285-307.

Fezzi, C., and D. W. Bunn. "Interaction of European carbon trading and energy prices." *JEM* 2.4 (2009): 53-69.

Fordham, Benjamin O., and Katja B. Kleinberg. "How can economic interests influence support for free trade?." *International Organization* 66.02 (2012): 311-328.

Frank, Robert. "Carbon offsets: a small price to pay for efficiency." *The New York Times* May 31 (2009). Retrieved from www.lexisnexis.com/uk/nexis

Gollier, Christian, and Jean Tirole. "Negotiating effective institutions against climate change." (2015).

Greenberg, Daniel, and Clara Changxin Fang. "The Myth of Climate Neutrality: Carbon Onsetting as an Alternative to Carbon Offsetting." *Sustainability: The Journal of Record* 8.2 (2015): 70-75.

Haites, Erik, Maosheng Duan, and Stephen Seres. "Technology transfer by CDM projects." *Climate Policy* 6.3 (2006): 327-344.

Haya, Barbara. "Measuring emissions against an alternative future: Fundamental flaws in the structure of the Kyoto Protocol's Clean Development Mechanism." *University of California, Berkeley Energy and Resources Group Working Paper No. ERG09-001* (2009).

Hintermann, Beat. "Pass-through of CO 2 Emission Costs to Hourly Electricity Prices in Germany." (2014).

Holcombe Randall G. Public Sector Economics: The Role of Government in the American Economy. Upper Saddle River: Pearson Prentice Hall, 2006.

Hultman, Nathan E., et al. "Carbon market risks and rewards: Firm perceptions of CDM investment decisions in Brazil and India." *Energy Policy* 40 (2012): 90-102.

Hyams, Keith, and Tina Fawcett. "The ethics of carbon offsetting." *Wiley Interdisciplinary Reviews: Climate Change* 4.2 (2013): 91-98.

Inglehart, Ronald. "Post-materialism in an environment of insecurity." *The American Political Science Review* (1981): 880-900.

Jacobsen, Grant D. "Do economic conditions influence environmental policy? Evidence from the US Senate." *Economics Letters* 120.2 (2013): 167-170.

Kachi, Aya, Thomas Bernauer, and Robert Gampfer. "Climate policy in hard times: Are the pessimists right?." *Ecological Economics* 114 (2015): 227-241.

Kara, Mikko, et al. "The impacts of EU CO 2 emissions trading on electricity markets and electricity consumers in Finland." *Energy Economics* 30.2 (2008): 193-211.

Krugman, Paul. "It's Easy Being Green." *The New York Times* September 25 (2009). Nexis. Web. July 6 2015.

Lloyd, Bob, and Srikanth Subbarao. "Development challenges under the Clean Development Mechanism (CDM)—Can renewable energy initiatives be put in place before peak oil?." *Energy Policy* 37.1 (2009): 237-245.

Maier, Marco J. "DirichletReg: Dirichlet Regression in R. R package version 0.6-2." 2015.

http://dirichletreg.r-forge.r-project.org/

Mason, Gary. "After smoke clears, taxpayer-funded boondoggle revealed." *The Globe and Mail (Canada)* March 30 (2013). Nexis. Web. July 6 2015.

Marquart-Pyatt, Sandra T., et al. "Politics eclipses climate extremes for climate change perceptions." *Global Environmental Change* 29 (2014): 246-257.

Michaelowa, Axel. "Strengths and weaknesses of the CDM in comparison with new and emerging market mechanisms." *CDM Policy Dialogue* (2012).

Morgan, Gwyn. "Everyone's profiting from carbon offsets. Too bad the environment isn't." The *Globe and Mail (Canada)* January 21 (2008). Nexis. Web. July 6 2015.

Mokinski, Frieder, and Nikolas M. Wölfing. "The effect of regulatory scrutiny: Asymmetric cost pass-through in power wholesale and its end." *Journal of Regulatory Economics* 45.2 (2014): 175-193.

Newell, Peter. "The political economy of carbon markets: The CDM and other stories." *Climate Policy* 12.1 (2012): 135-139.

Newell, Peter, Nicky Jenner, and Lucy Baker. "Governing clean development: A framework for analysis." *Development Policy Review* 27.6 (2009): 717-739.

OECD. Ellis, Jane, and Sara Moarif. "GHG Mitigation Actions." (2009). http://www.oecd.org/env/cc/42474623.pdf

Olsen, Karen Holm, and Jørgen Fenhann. "Sustainable development benefits of clean development mechanism projects: A new methodology for sustainability assessment based on text analysis of the project design documents submitted for validation." *Energy policy* 36.8 (2008): 2819-2830.

Pachauri, Rajendra K., et al. "Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change." (2014): 151.

Page, Edward A. "The ethics of emissions trading." *Wiley Interdisciplinary Reviews: Climate Change* 4.4 (2013): 233-243.

Rennie, Steve. "Ottawa announces details of carbon-offset program." *The Globe and Mail (Canada)* June 11 (2009). Nexis. Web. July 6 2015.

Schneider, Lambert. "Assessing the additionality of CDM projects: practical experiences and lessons learned." *Climate Policy* 9.3 (2009): 242-254.

Schultz, T. R., and M. Schleifer. "Towards a refinement of attribution concepts". *Attribution theory and research: conceptual, developmental and social dimensions.* Eds. J. Jaspars, FD Fincham & M. Hewstoene (1983): 37-62.

Scruggs, Lyle, and Salil Benegal. "Declining public concern about climate change: Can we blame the great recession?." *Global Environmental Change* 22.2 (2012): 505-515.

Seres, Stephen, Erik Haites, and Kevin Murphy. "Analysis of technology transfer in CDM projects: An update." *Energy Policy* 37.11 (2009): 4919-4926.

Shaver, Kelly G. "Attributions of Causality and Responsibility: Discovered or Imposed?." *The Attribution of Blame*. Springer New York, 1985. 137-154.

Sijm, Jos, et al. "The impact of the EU ETS on electricity prices." *Final report to DG Environment of the European Commission* (2008).

Smale, Robin, et al. "The impact of CO2 emissions trading on firm profits and market prices." *Climate Policy* 6.1 (2006): 31-48.

Sopinka, Heidi. "Carbon offsets: a shell game?." *The Globe and Mail (Canada)* May 30 (2007). Nexis. Web. July 6 2015.

Stern, Nicholas Herbert. *Stern Review: The economics of climate change*. Vol. 30. London: HM treasury, 2006.

Story, Louise. "F.T.C. Asks if Carbon-Offset Money Is Winding Up True Green." *The New York Times* January 9 (2008). Retrieved from www.lexisnexis.com/uk/nexis

Stueck, Wendy. "How the Great Bear project is a leader in carbon offsets." *The Globe and Mail (Canada)* January 7 (2013). Nexis. Web. July 6 2015.

Sutherland, Scott. "Green agenda profitable, Premier declares; Carbon offsets could pay for tree-planting." *The Globe and Mail (Canada)* February 16 (2007). Nexis. Web. July 6 2015.

Tatsutani, Marika, and William A. Pizer. "Managing Costs in a US Greenhouse Gas Trading Program: A Workshop Summary." (2008).

Thurston, George D., and Michelle L. Bell. "The human health co-benefits of air quality improvements associated with climate change mitigation." *Global Climate Change and Public Health*. Springer New York, 2014. 137-154.

Woolfolk, Robert L., John M. Doris, and John M. Darley. "Identification, situational constraint, and social cognition: Studies in the attribution of moral responsibility." *Cognition* 100.2 (2006): 283-301.

Youngman Rob, Jake Schmidt, Jin Lee, Heleen de Coninck. "Evaluating technology transfer in the clean development mechanism and joint implementation." *Climate Policy* 7.6 (2007): 488–499.

SUPPLEMENTARY INFORMATION (SI)

Supplementary Information A: Carbon Offsetting Policies

Table SI-A.1: Carbon Offsetting Policies in Selected Countries

	GHG Emission Reduction Target	*Where offsetting is permitted?*	*How much of the reduction commitment can be met with offsets?*
Australia[10]	Reduce emissions by 5 percent below 2000 levels by 2020	No restriction	No restriction
British Columbia (Canada)[11]	Reduce emissions by 33 percent below 2007 levels by 2020 and 80 percent by 2050	British Columbia	No restriction
California (USA)[12]	Reduce GHG emissions to 1990 levels by 2020	United States	8 percent
European Union[13]	• Reduce GHG emissions 20 percent below 1990 levels by 2020 • Reduce GHG emissions 40 percent below 1990 levels by 2030	Least Developed Countries	Aggregate use in the EU cannot exceed 50 percent
Japan[14]	Reduce emissions by 3.8 percent below 2005 levels by 2020	Mongolia, Bangladesh, Ethiopia, Kenya, Maldives, Viet Nam, Laos, Indonesia, Costa Rica, Palau, Cambodia	No limit
New Zealand[15]	Reduce emissions by 50 percent below 1990 levels by 2050	No restriction	No limit
Ontario (Canada)[16]	• Reduce emissions by 15 percent below 1990 levels by 2020 • Reduce emissions by 80 percent below 1990 levels by 2050	Undecided	
Québec (Canada)[17]	Reduce emissions by 20 percent below 1990 levels by 2020	Québec	8 percent
Regional Greenhouse Gas Initiative (USA)[18]	The RGGI is a cap-and-trade scheme for the energy sector in nine north-eastern states with a new 2014 cap of 91 million short tons. The RGGI CO_2 cap then declines 2.5 percent each year from 2015 to 2020. The RGGI CO_2 cap represents a regional budget for CO_2 emissions from the power sector.	In member states of the RGGI	3.3 percent
South Korea[19]	Reduce emissions by 37 percent below business-as-	Pre-2020:	10 percent

[10] http://www.smh.com.au/federal-politics/political-news/other-countries-airyfairy-on-climate-change-says-tony-abbott-as-australia-delays-new-emissions-target-announcement-20150713-giazve.html
[11] http://www2.gov.bc.ca/gov/content/environment/climate-change/policy-legislation-programs/legislation-regulations
[12] http://www.arb.ca.gov/cc/ab32/ab32.htm
[13] http://ec.europa.eu/clima/policies/brief/eu/
[14] Kuramochi, Takeshi. *GHG mitigation in Japan: an overview of the current policy landscape*. WRI Working Paper. World Resources Institute and the Institute for Global Environmental Strategies, 2014.
[15] http://www.mfe.govt.nz/climate-change/reducing-greenhouse-gas-emissions/emissions-reduction-targets
[16] http://www.ontario.ca/document/ontarios-climate-change-update-2014
[17] http://www.mfe.govt.nz/climate-change/reducing-greenhouse-gas-emissions/emissions-reduction-targets
[18] http://www.rggi.org/
[19] http://www.reuters.com/article/2015/06/30/us-climatechange-southkorea-idUSKCN0PA04N20150630

	usual levels by 2030	South Korea Post-2020: Includes International	
Switzerland[20]	Reduce emissions by 50 percent below 1990 levels by 2030	No restriction	8 percent
Tokyo (Japan)[21]	Reduce emissions 20 percent below 2005 levels by 2030	Tokyo	No limit
		Abroad	33 percent

Supplementary Information B: Sample and Population Characteristics; Descriptive Statistics for Other Variables in the Analysis

Table SI-B.1: Sample and Population Characteristics

		Frequency	*Percent*	*U.S. Population 2013 (Percent)*
Sex	Male	551	57	49.2
	Female	420	43	50.8[22]
Age Group	18 to 20	18	2	2.7[23]
	20 to 30	445	45	14.04
	30 to 40	225	23	12.93
	40 to 50	111	11	13.3
	Over 50	100	10	57.03
Educational attainment	High school diploma or less	97	10	42.1
	Some college	304	31	19.61
	Associate's degree	112	11	9.37
	Bachelor's degree	347	35	18.73
	Master's or professional degree	119	12	8.72
	Doctorate	28	3	1.47[24]
Family Income	$0-$49,999	332	40	38.97[25]
	$50,000 to $99,999	298	36	32.55
	$100,000 to $124,999	51	6	9.47
	Over $125,000	144	17	19.01
Ideology	Left	167	18	4.8[26]
	Mostly left	314	33	13.3
	Centre	272	29	49.9
	Mostly right	128	14	17.7
	Right	65	7	11
Party	Democrat	469	51	32[27]
	Independent	253	27	38

[20] http://www.bafu.admin.ch/dokumentation/medieninformation/00962/index.html?lang=en&msg-id=56394
[21] http://www.theguardian.com/environment/2015/apr/09/japan-to-pledge-20-co2-cut-reports
[22] http://quickfacts.census.gov/qfd/states/00000.html
[23] http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk
[24] http://www.census.gov/hhes/socdemo/education/data/cps/2013/tables.html
[25] http://www.census.gov/hhes/www/cpstables/032014/faminc/toc.htm
[26] http://www.worldvaluessurvey.org/WVSOnline.jsp
[27] http://www.pewresearch.org/data-trend/political-attitudes/party-identification/

	Republican	201	22	24

Table SI-B.2: Descriptive Statistics for Other Variables in the Analysis

Purpose	*Question*	*Possible Answers*	*Frequency*	*Percentage*
Prior Knowledge of Offsets	Have you ever heard of offsets prior the survey?	Yes	522	53
		No	464	47
Climate Skeptics	In your view, what is the most important reason for increases in the Earth's temperature (usually called global warming) over the last century?	Pollution due to human activities	759	76
		Natural changes in the environment	150	15
		Temperature is not increasing	55	6
		Not sure	31	3
Environmental Awareness	How important is the issue of global warming to you personally?	Extremely important	202	20
		Important	375	38
		Somewhat important	323	33
		Not at all important	95	9

Supplementary Information C: Results

Table SI-C.1 Mean Allocation for All Participants

	Domestic	*International*	*By Firms*
Control	0.377	0.185	0.439
Efficiency	0.367	0.260	0.373
Effectiveness	0.300	0.170	0.530
Ethicality	0.303	0.184	0.513

Table SI-C.2 Mean Allocation for Climate Skeptics

	Domestic	*International*	*By Firms*
Control	0.425	0.197	0.379

Efficiency	0.352	0.263	0.386
Effectiveness	0.337	0.198	0.465
Ethicality	0.290	0.163	0.548

Table SI-C.3 Mean Allocation for Participants with Prior Awareness of Offsets

	Domestic	*International*	*By Firms*
Control	0.379	0.185	0.436
Efficiency	0.388	0.257	0.359
Effectiveness	0.305	0.195	0.500
Ethicality	0.321	0.194	0.485

Supplementary Information D: Survey Instrument (following pages)

Print version

Questionnaire

1 Consent form

Please read the following statement carefully. If you choose to participate, please click on the button next to "I have read and understood the consent form and agree to participate in this survey." If you choose not to participate, please click on the "Cancel" button at the bottom of this page and return the HIT on Mechanical Turk. This survey is carried out for a research project led by Professor Dr. Thomas Bernauer from ETH Zürich. Its objective is to better understand personal opinions concerning international politics. The survey is for scientific purposes only. It has no commercial or government-related purpose.

There are no known risks for you if you decide to participate in this survey, nor will you experience any costs when participating in the survey. The information you provide will help us understand opinions concerning international politics. This survey is anonymous. The information you provide in this survey will not be stored or used in any way that could reveal your personal identity.

If you have any questions or concerns about completing the questionnaire or about participating in this survey, you may contact us at thbesurveyone@gess.ethz.ch or write to Thomas Bernauer, ETH Zurich, Haldeneggsteig 4, 8092 Zurich, Switzerland.

The ETH Zurich Ethics Review Commission has reviewed and approved this project. If you have any concerns about your rights in this survey, please contact us at thbesurveyone@gess.ethz.ch or Raffael Iturrizaga from the ETH Zurich Ethics Review Commission at raffael.iturrizaga@sl.ethz.ch or +41 44 632 2354 with reference to its decision EK 2012-N-41.

○ I have read and understood the consent form and agree to participate in this survey.

2 Welcome page

Dear participant,

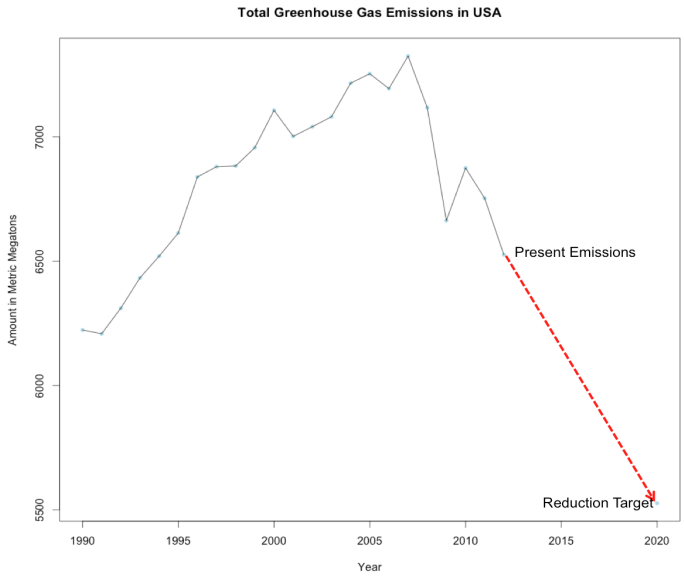
Welcome to the survey. We very much appreciate your contribution. Our research will only produce meaningful results if you read and think about each question carefully and express your true opinion. Thank you for keeping this in mind! We anticipate that it will take you about 15 minutes to complete this survey.

Thank you in advance!

3 IntroGovtPolicy

The United States (US) government is considering a new policy that would

reduce greenhouse gas emissions by approximately 15 percent below the current level by the year 2020. Greenhouse gases, above all carbon dioxide, are released during the burning of gasoline, diesel, oil, and coal, which occurs most often in energy production and transportation. These emissions contribute to global warming, also known as climate change. Based on estimates by the US government, the US, as a country, would need to **decrease its emissions by approximately 1000 metric megatons** (meaning 1000 million metric tons) under the new policy. The graph below illustrates the planned decrease of emissions.



4 AgreePolicy

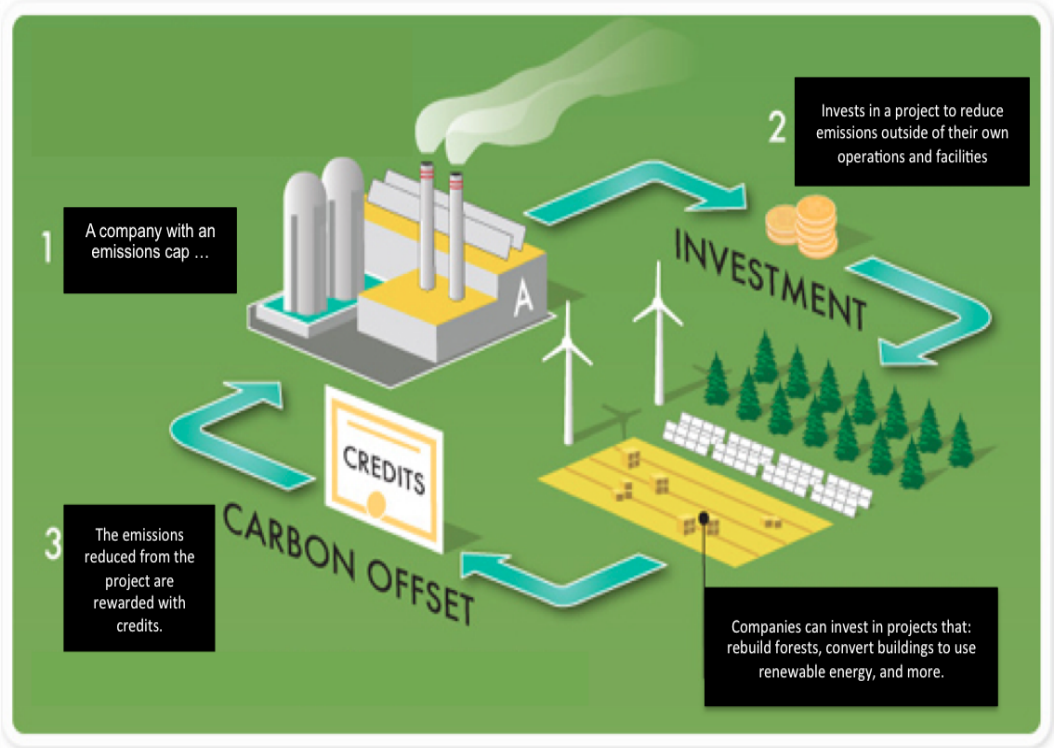
In your view, should the US government adopt such a policy?

- Yes
- No
- Don't know
- Don't Care

5 How?

Suppose the US government is adopting this policy. In order for emitters of greenhouse gases, above all firms, to meet the national reduction target, the government is considering whether to permit **offsetting**. This would provide firms in regulated economic sectors with greater flexibility in how they reduce their greenhouse gas emissions. The next page describes what offsetting is.

6 ExplanationOffsets



Offsetting is when **a firm** (Point 1 in the diagram) **invests in a project to reduce greenhouse gas emissions outside of its own operations and facilities, either in the United States and/or abroad** (Point 2). Projects range from planting new forests to absorb carbon dioxide emissions to promoting renewable energy use in order to avoid emissions. The emissions that are reduced or avoided by the project are converted into credits, which then belong to the firm that funded the offsetting project. Typically, reducing greenhouse gas emissions by one ton (e.g. carbon dioxide) is awarded with one credit (Point 3). Investing firms can use awarded credits towards their own reduction obligation. Or they can sell such credits to other firms who can then use them towards their reduction obligations.

Imagine Company A has a reduction obligation of five tons and invests in an offsetting project that converts Company B's factory from coal to solar power. This reduces Company B's emissions by two tons of carbon dioxide and thus generates two credits. If Company A uses these credits towards its own reduction obligation, two tons are removed from the overall reduction target of five tons. Now, Company A only has three tons left to reduce. The remaining three tons could be reduced either with more offsetting, or by cutting emissions in their own operations or facilities.

6.1 ComprehensionQuestion

Offsetting is when a firm …

If your answer is incorrect, you will be redirected back to the explanation.

- ○ Invests in a project to reduce emissions in its own operations and facilities

- ○ Invests in a project to reduce emissions outside its own operations and facilities
- ○ Lobbies the government not to adopt a new policy for reducing emissions
- ○ Don't Know

7.1.1 RV_Control

How do you think the US, as a country, should reach the national reduction target of 1000 megatons? There are three mechanisms availabe. Please review their definitions below.

- **International Offsets:** US firms invest in offsetting projects outside of the US, and outside the respective firm's own operations and facilities
- **Domestic Offsets:** US firms invest in offsetting projects within the US, but outside the respective firm's own operations and facilities
- **By Firms:** No offsetting, firms reduce emissions within their own operations and facilities

For each of the three boxes below, **please allocate how much of the national reduction target, you think should be reduced using these mechanisms**. The values in the boxes can range from 0 to 1000. However, the total of all three boxes must equal 1000.

	International Offsets	Domestic Offsets	By Firms
Amount (in megatons)			

7.2.1 EconomicEfficiency

Experts argue that *it is much cheaper for US firms to meet their reduction obligations if offsetting is permitted abroad* (i.e. outside of the US). Reducing greenhouse gas emissions can be very costly, and some of this cost will be passed on to consumers. For example, in order for the energy sector to meet its reduction obligations without any offsetting, average monthly energy prices for US households (approximately $100) could more than double (approximately $200). Offsetting reduces the costs of greenhouse gas reductions, thereby reducing the cost passed on to you as a consumer.

7.2.2 RV_EE

How do you think the US, as a country, should reach the national reduction target of 1000 megatons? There are three mechanisms availabe. Please review their definitions below.

- **International Offsets:** US firms invest in offsetting projects outside of the US, and outside the respective firm's own operations and facilities
- **Domestic Offsets:** US firms invest in offsetting projects within the US, but outside the respective firm's own operations and facilities
- **By Firms:** No offsetting, firms reduce emissions within their own operations and facilities

For each of the three boxes below, **please allocate how much of the national reduction target, you think should be reduced using these mechanisms**. The values in the boxes can range from 0 to 1000. However, the total of all three boxes must equal 1000.

	International Offsets	Domestic Offsets	By Firms
Amount (in megatons)			

7.3.1 Additionality

Experts argue that, in many cases, *offsetting does not actually reduce greenhouse gas emissions.* Most offsetting projects firms invest in would have occurred even without their investment. Therefore, firms are merely taking credit for what would have happened anyway and are thus avoiding reduction obligations.

7.3.2 RV_Additionality

How do you think the US, as a country, should reach the national reduction target of 1000 megatons? There are three mechanisms availabe. Please review their definitions below.

- **International Offsets:** US firms invest in offsetting projects outside of the US, and outside the respective firm's own operations and facilities
- **Domestic Offsets:** US firms invest in offsetting projects within the US, but outside the respective firm's own

operations and facilities

- **By Firms:** No offsetting, firms reduce emissions within their own operations and facilities

For each of the three boxes below, **please allocate how much of the national reduction target, you think should be reduced using these mechanisms**. The values in the boxes can range from 0 to 1000. However, the total of all three boxes must equal 1000.

	International Offsets	Domestic Offsets	By Firms
Amount (in megatons)			

7.4.1 Unethical

Experts argue that *offsetting is unethical*. It allows firms to pay their way out of obligations to reduce greenhouse gas emissions that contribute to global warming. The moral problem with this is that those who create environmental problems should be responsible for solving them, and those who emit greenhouse gases should thus reduce their own emissions, rather than paying others to do so.

7.4.2 RV_Unethical

How do you think the US, as a country, should reach the national reduction target of 1000 megatons? There are three mechanisms availabe. Please review their definitions below.

- **International Offsets:** US firms invest in offsetting projects outside of the US, and outside the respective firm's own operations and facilities

- **Domestic Offsets:** US firms invest in offsetting projects within the US, but outside the respective firm's own operations and facilities

- **By Firms:** No offsetting, firms reduce emissions within their own operations and facilities

For each of the three boxes below, **please allocate how much of the national reduction target, you think should be reduced using these mechanisms**. The values in the boxes can range from 0 to 1000. However, the total of all three boxes must equal 1000.

	International Offsets	Domestic Offsets	By Firms
Amount (in megatons)			

7.5 Standard page

#v_568#

- Answer option 1
- Answer option 2
- Answer option 3
- Answer option 4
- Answer option 5

8.1 TempIncWhy

In your view, what is the **most important** reason for increases in the Earth's temperature (usually called global warming) over the last century?

- Pollution due to human activities
- Natural changes in the environment
- Not sure
- The temperature is not increasing

8.2 PersonalImportanceGW

How much have you thought about global warming before today?

- A lot
- Some
- A little
- Not at all

Do you feel you would be able to describe in very simple terms to another person what the problem of global warming is?

- Yes
- To some extent
- No

How often do you watch, listen to, or read news media reporting on global warming or discuss the issue with colleagues, friends, or family?

- ○ Never
- ○ Rarely
- ○ Sometimes
- ○ Often
- ○ Very often

Do you feel you have a strong, weak, or no opinion on what should be done about global warming?

- ○ Strong
- ○ Weak
- ○ No opinion

How important is the issue of global warming to you personally?

- ○ Extemely important
- ○ Important
- ○ Somewhat important
- ○ Not at all important

8.3 SocietyGW

In your view, what do American voters think about policies against global warming?

- ○ Almost all voters want such policies
- ○ Most voters want such policies
- ○ Opinions are split half-half
- ○ Most voters oppose such policies
- ○ Almost all voters oppose such policies

9.1 Party preference

What would you call yourself...?

- ○ Strong Democrat
- ○ Weak Democrat
- ○ Lean Democrat
- ○ Independent

- ○ Lean Republican
- ○ Weak Republican
- ○ Strong Republican
- ○ Not sure
- ○ Other, please specify:

9.1.1 Political views

How would you place your political views on the scale from "left" to "right", generally speaking?

- ○ Left
- ○ Mostly left
- ○ Centre
- ○ Mostly right
- ○ Right
- ○ Don't know

9.2 Demographics I

When were you born?

1996
1995
1994
1993
1992
1991
1990
1989
1988
1987
1986
1985
1984
1983
1982
1981
1980
1979
1978
1977
1976
1975
1974
1973
1972
1971
1970

1913
1912
1911
1910
1909
1908
1907
1906
1905
1904
1903
1902
1901

Please indicate your gender.

- Female
- Male

What is the highest level of education you have completed? Please select from the drop down menu.

--- please select ---
Doctoral degree
Professional degree
Master's degree
Bachelor's degree
Associate's degree, academic
Associate's degree, occupational
Some college, no degree
High school graduate
11th grade
10th grade
9th grade
7th - 8th grade
5th - 6th grade
1st - 4th grade
None

What is your current job?

9.3 Demographics II

Which state do you live in?

AL Alabama
AK Alaska
AZ Arizona
AR Arkansas
CA California
CO Colorado
CT Connecticut
DE Delaware
FL Florida
GA Georgia
HI Hawaii
ID Idaho
IL Illinois
IN Indiana
IA Iowa
KS Kansas
KY Kentucky
LA Louisiana
ME Maine
MD Maryland
MA Massachusetts
MI Michigan
MN Minnesota
MS Mississippi
MO Missouri
MT Montana
NE Nebraska
NV Nevada
NH New Hampshire
NJ New Jersey
NM New Mexico
NY New York
NC North Carolina
ND North Dakota
OH Ohio
OK Oklahoma
OR Oregon
PA Pennsylvania
RI Rhode Island
SC South Carolina
SD South Dakota
TN Tennessee
TX Texas
UT Utah
VT Vermont
VA Virginia
WA Washington
WV West Virginia
WI Wisconsin
WY Wyoming
AS American Samoa
DC District of Columbia
GU Guam
MP Northern Mariana Islands
PR Puerto Rico
VI Virgin Islands of the United States

Do you live in a...?

- ○ City
- ○ Suburb
- ○ Rural area

In which country were you born?

United States
Afghanistan
Albania
Algeria
Andorra
Angola
Antigua and Barbuda
Argentina
Armenia
Australia
Austria
Azerbaijan
Bahamas
Bahrain
Bangladesh
Barbados
Belarus
Belgium
Belize
Benin
Bhutan
Bolivia
Bosnia and Herzegovina
Botswana
Brazil
Brunei
Bulgaria
Burkina Faso
Burma
Burundi
Cambodia
Cameroon
Canada
Cape Verde
the Central African Republic
Chad
Chile
China
Colombia
Comoros
Congo (Republic)
Congo (Democratic Republic)
Costa Rica
Cote d'Ivoire
Croatia
Cuba
Cyprus

Sierra Leone
Singapore
Slovakia
Slovenia
Solomon Islands
Somalia
South Africa
Spain
Sri Lanka
Sudan
Suriname
Swaziland
Sweden
Switzerland
Syria
Taiwan
Tajikistan
Tanzania
Thailand
Timor-Leste
Togo
Tonga
Trinidad and Tobago
Tunisia
Turkey
Turkmenistan
Tuvalu
Uganda
Ukraine
United Arab Emirates
United Kingdom
Uruguay
Uzbekistan
Vanuatu
Venezuela
Vietnam
Yemen
Zambia
Zimbabwe

Only if you were born outside the United States, since when have you lived in the US?

Not Applicable
2010
2009
2008
2007
2006
2005
2004
2003
2002
2001
2000
1999
1998

1941
1940
1939
1938
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1936
1935
1934
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1903
1902
1901

9.4 HeardOffsets

Have you ever heard of offsetting prior to this survey?

- ○ Yes
- ○ No

9.5 Income

What was the estimated annual income for your household for 2013?

If you feel uncomfortable answering this question, you may skip it and continue with

the next question.

Prefer not to say
Under $5,000
$5,000 to $9,999
$10,000 to $14,999
$15,000 to $19,999
$20,000 to $24,999
$25,000 to $29,999
$30,000 to $34,999
$35,000 to $49,999
$50,000 to $54,999
$55,000 to $59,999
$60,000 to $64,999
$65,000 to $69,999
$70,000 to $74,999
$75,000 to $79,999
$80,000 to $84,999
$85,000 to $89,999
$90,000 to $94,999
$95,000 to $99,999
$100,000 to $104,999
$105,000 to $109,999
$110,000 to $114,999
$115,000 to $119,999
$120,000 to $124,999
$125,000 to $129,999
$130,000 to $134,999
$135,000 to $139,999
$140,000 to $144,999
$145,000 to $149,999
$150,000 to $154,999
$155,000 to $159,999
$160,000 to $164,999
$165,000 to $169,999
$170,000 to $174,999
$175,000 to $179,999
$180,000 to $184,999
$185,000 to $189,999
$190,000 to $194,999
$195,000 to $199,999
$200,000 and over

10 Comments

In the field below you can enter any comments you have regarding our questions and texts, or the survey in general.

FINAL STEPS TO COMPLETE THE SURVEY AND RECEIVE PAYMENT

Tables and Figures for:

How Much Carbon Offsetting and Where?

Implications of Efficiency, Effectiveness, and Ethicality Considerations for Public Opinion Formation

Table 1: Treatments (Frames)

Control	-
Efficiency	Experts argue that *it is much cheaper for US firms to meet their reduction obligations if offsetting is permitted abroad* (i.e. outside of the US). Reducing greenhouse gas emissions can be very costly, and some of this cost will be passed on to consumers. For example, in order for the energy sector to meet its reduction obligations without any offsetting, average monthly energy prices for US households (approximately $100) could more than double (approximately $200).[1] Offsetting reduces the costs of greenhouse gas reductions, thereby reducing the cost passed on to you as a consumer.
Effectiveness	Experts argue that, in many cases, *offsetting does not actually reduce greenhouse gas emissions.* Most offsetting projects firms invest in would have occurred even without their investment. Therefore, firms are merely taking credit for what would have happened anyway and are thus avoiding reduction obligations.
Ethicality	Experts argue that *offsetting is unethical*. It allows firms to pay their way out of obligations to reduce greenhouse gas emissions that contribute to global warming. The moral problem with this is that those who create environmental problems should be responsible for solving them, and those who emit greenhouse gases should thus reduce their own emissions, rather than paying others to do so.

[1] The estimated percent increase in average household energy prices ranges from 10 percent (Smale et al. 2006) to as high as 100 percent (Fell et al. 2013). The average US household currently spends around 90 USD (Environmental Protection Agency). We used a range from 100 USD to 200 USD.

Figure 1: Allocation of Reduction Commitment By Treatments and Control

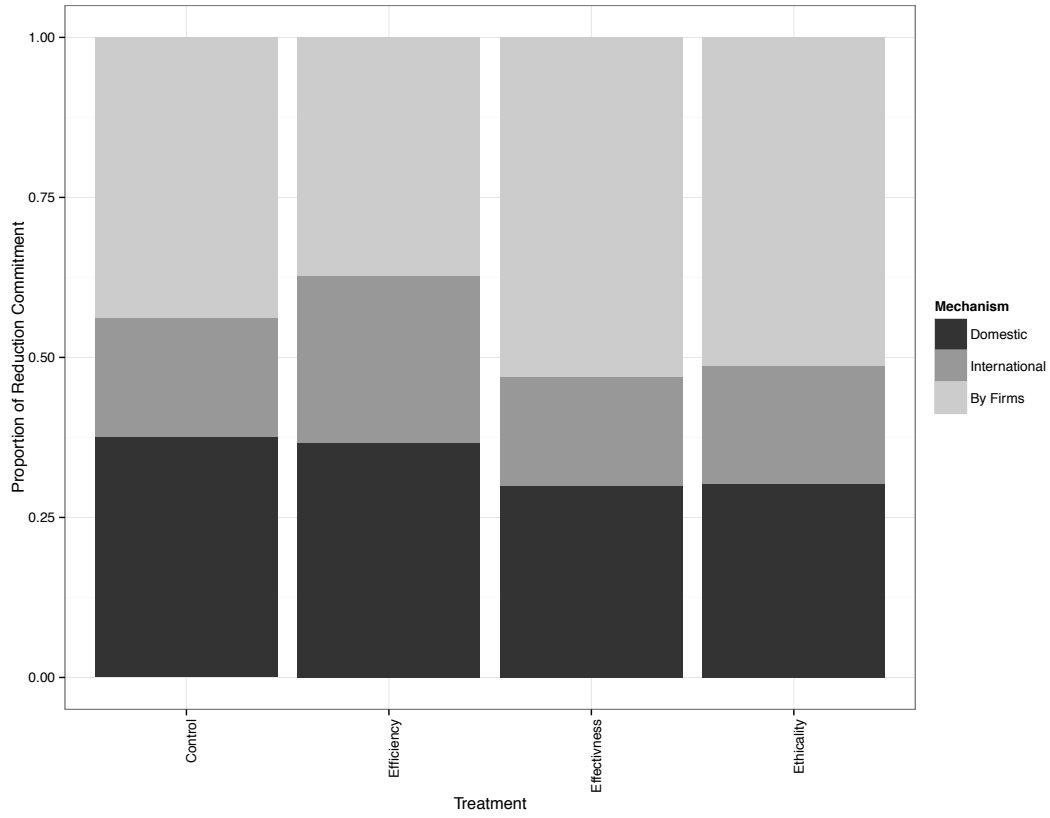

Table 2: Number of Participants in Each Treatment and Control Group, All, and By Subsample

	All	*Heard*	*Skeptics*
Control	250	117	53
Efficiency	249	133	58
Effectiveness	250	125	61
Ethicality	246	147	64
N	995	464	236

Table 3: Regression Results

		(1) *All*	*(2)* *All*	*(3)* *Heard*	*(4)* *Heard*	*(5)* *Skeptics*	*(6)* *Skeptics*
Domestic	Efficiency	0.02	-0.03	0.20	0.04	-0.13	-0.50 *
	Effectiveness	-0.24 *	-0.41 ***	-0.30 *	-0.53 ***	0.03	-0.34
	Ethicality	-0.24 ***	-0.41 ***	-0.35 **	-0.48 **	-0.29	-0.44
	Age		-0.01 *		-0.01 *		-0.01 *
	Party		-0.04		0.005		-0.17 **
	Environmental Awareness		-0.11 *		-0.13 *		-0.25 **
	Income		-0.004		-0.002		0.01
	Education		-0.01		0.01		0.11 *
	Sex		0.18 *		0.33 **		-0.14
International	Efficiency	0.28 **	0.28 **	0.41 **	0.34 *	0.26	0.06
	Effectiveness	-0.16	-0.26 **	-0.07	-0.20	0.15	-0.07
	Ethicality	-0.21 *	-0.26 **	-0.11	-0.20	-0.06	-0.28
	Age		-0.01		-0.01 *		-0.01
	Party		-0.06 *		-0.03		-0.12 *
	Environmental Awareness		-0.09 *		-0.11		-0.32 ***
	Income		-0.004		0.0007		0.004
	Education		0.01		0.05		0.15 ***
	Sex		0.15 *		0.30 **		-0.09
Internal Reductions	Efficiency	-0.19	-0.28 **	-0.05 **	-0.18	0.13	-0.18
	Effectiveness	0.11	-0.004	0.02	-0.16	0.42 *	0.17
	Ethicality	-0.10	-0.19	-0.14	-0.30 *	0.53 *	0.18
	Age		-0.01 **		-0.007		-0.02 **
	Party		-0.06 *		-0.04		-0.12 *
	Environmental Awareness		-0.12 **		-0.03		-0.25 *
	Income		-0.0003		-0.002		0.01
	Education		-0.06 *		-0.02		0.02
	Sex		0.19 *		0.34 **		-0.15
	N	995	897	522	474	236	201
	Link Function	Log	Log	Log	Log	Log	Log
	Parameterization	Common	Common	Common	Common	Common	Common
	AIC	-2517	-2228	-1123	-1025	-612	-519.2

Significance: * < 0.05, ** < 0.01, *** < 0.001. Link function is log and the parameterization is common for all models. All dependent variables (International, Domestic, Internal) are fit with an intercept.

Note: Table 3 lists the regression coefficients along with their significance levels, which can be interpreted similar to a logistic regression. Each of these models reports mean differences between treatment groups

and the control condition for the three dependent variables: international offsetting, domestic offsetting, or firms reducing GHG emissions within their own facilities and operations. Participants in the control group are the baseline category. For example, in Model 1, which includes all participants, the frames effectiveness and ethicality lead to significantly less of the reduction obligation being allocated to domestic offsetting compared to the control group. As noted above, the coefficients cannot be directly interpreted since these are transformed via a log transformation. We do not indicate standard errors for two reasons. First, these cannot be easily interpreted as a result of the transformation. Second, since we use a convenience sample, the magnitude of the effect is *not* meaningful, but only the direction of the effect.