NEGEM

Quantifying and Deploying Responsible Negative Emissions in Climate Resilient Pathways

Stakeholder views on NETP governance

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Executive Summary

There is now increasing discussion about the potential contribution of Negative Emission Technologies and Practices (NETPs) in achieving the ambitions set out in the international climate agreements and meeting net-zero emissions by 2050. However, deciding what role NETPs should play in achieving these goals will require collaboration and dialogue between policymakers and various stakeholders, particularly the private sector and NGOs. Understanding different stakeholders' perceptions of NETPs, as well as their interactions and dialogue, is therefore critical to anticipating the realistic potential of future deployment of NETPs.

The use of NETPs to achieve European climate goals is contested by some stakeholders, due to the uncertainties related to their potential and the resource consumption that many NETPs entail. Moreover, communication and dialogue among different stakeholders is often hampered by prejudices about other stakeholders and the adoption of different, often incompatible, framings and narratives. Thus, deployment of NETPs presents challenges that are not only technical or economic, but also social, related to the perception and interaction between key stakeholders.

One objective of this deliverable is therefore to better understand the perceptions of different stakeholders, particularly private sector and NGO actors, concerning NETPs and their potential role in reaching European climate targets. Even more challenging (and interesting) is to understand how these perceptions evolve through dialogue among stakeholders and especially how different framings affect these dynamics.

To capture these dynamics, we conducted a series of workshops (5 events in all, held between June and October 2021) involving over 100 stakeholders, mainly members of environmental NGOs or private sector (operating, for example, in the energy, oil & gas, agroforestry, or transport sectors). The workshops included a quasi-experimental design, with surveys before the event and during the event, to capture the evolution of perceptions. While the pre-workshop survey captures the initial awareness and perception of NETPs (and in particular afforestation/reforestation, soil carbon sequestration, Bioenergy with Carbon Capture and Storage (BECCS), Direct Air Carbon Capture and Storage (DACCS), and enhanced weathering) and European climate policies, the following surveys were developed to capture the effects of stakeholder discussion and of framing. Therefore, in each event ample space was given to stakeholder discussions on the potential role of different NETPs in European climate policies, initially in small homogeneous groups (with stakeholders from the same group) and later in larger and heterogeneous groups, with a final Q&A with a representative of the European Commission. Moreover, to isolate the effects of framing on the evolution of perceptions and on the dialogue between the various stakeholders, the workshops differed in the framing that participants were primed to adopt. A short initial video pushed participants in one half of the workshops to focus the conversation on the more logical/scientific elements of the debate, while for the other half more attention was devoted to emotional/moral considerations.

The main results that emerged underline deep differences in the perception of NETPs among the different stakeholders, with a tendency of NGOs to favour ecological solutions over geological ones and a greater scepticism towards the use of NETPs to reach European targets, while the private sector participants are found to be more enthusiastic towards NETPs overall and particularly those that involve technologies that produce industrial co-benefits, such as BECCS.

A first implication we can draw is with respect to differing perceptions and prescriptions among stakeholder groups over the ideal path to reach net-zero emissions. While NGOs demand that EU policies should focus solely on reducing emissions (and, if CDR should be necessary, rely mostly on afforestation/ reforestation

and soil carbon sequestration), the private sector sees the deployment of (a broader set of) NETPs more favourably.

However, awareness of these technologies, and in particular DACCS and enhanced weathering, remains low among stakeholders, although greater awareness is linked to more positive perceptions of these NETPs. One clear implication for policy is therefore the need to improve awareness of less mainstream NETPs, which may improve their perception.

Similarly, differences emerge between different European countries, underlining how homogeneous policies within the European Union could fail not only because of the different economic needs and resources of the territory, but also because of the different degree of acceptance of NETPs in different geographical areas. For example, members of organizations in Eastern Europe are more positive towards ecological solutions. These differences underscore how a one-size-fits-all view of the European Union may not be effective.

Furthermore, our results reveal that interaction and dialogue among stakeholders has an effect in changing stakeholders' perceptions, which should not be considered as static but rather evolving and dynamic. In general, stakeholder discussion reduced positive perceptions about most NETPs and the policies that incentivize them, both among stakeholders with greater initial awareness and confidence in their opinions and among those with less conviction. In fact, the discussion allowed for discussion of potential risks associated with these technologies. An important implication is therefore that of ensuring a dialogue between key constituents as this allows for the development and consolidation of stakeholder perceptions and favors their contribution in informing policies that are more aware of the risks associated with the use of various NETPs, and consequently more likely to limit them.

Finally, the framing adopted clearly plays a role in influencing perceptions of the various stakeholders and the dialogue between them. In particular, adopting a logical/scientific framing improves perceptions of NETPs, especially ecological ones, compared to an emotional/moral framing. Furthermore, for stakeholders who are more likely to adopt moral framing, such as many NGOs, discussion of moral issues fostered greater openness to dialogue and the perspectives of other stakeholders, while the opposite effect emerged for the private sector. It is therefore critical to fostering dialogue on these issues that each party recognizes which framework is most favoured or most commonly used by other stakeholders, and that efforts be made to adapt their own framing to more closely resemble that favoured by others to encourage a more open and constructive dialogue.

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Introduction

The European Union's path to net-zero emissions will be enormously challenging and requires the concerted efforts and support of diverse stakeholders including private, governmental, and non-governmental sectors (Liu et al., 2018; Zimmermann et al., 2021). In order to meet the ambitious goals laid out in the Climate Pact of the European Green Deal, multilateral organisations and governments will need to engage the private sector and NGOs to develop and govern climate action measures (de Bakker et al., 2019; Mena & Palazzo, 2012; Rasche, 2012).

Crucially, limiting global warming to 1.5°C above preindustrial levels, as enshrined in the Paris Agreement, is likely to require large-scale deployment of negative emission technologies and practices (NETPs) to remove CO_2 from the atmosphere, and reduce the net-impact of human activities by compensating for residual emissions in hard-to-abate sectors and potential overshoot of the atmospheric concentration target (Deliverable 7.2 & 8.1). NETPs cover a wide range of practices and technologies that capture CO_2 through biological storage, as in the case of afforestation/reforestation or soil carbon sequestration, or geological storage, as in the case of bioenergy with carbon capture and storage (BECCS) or direct air carbon capture and storage (DACCS) (Deliverable 2.2). NETPs have different readiness levels, efficiencies, costs, and potential scalabilities that vary across time and geographies.

However, their deployment remains a contested prospect (Cox et al., 2020; Carton et al., 2020). Anderson and Peters (2016) argue they are "not an insurance policy, but rather an unjust and high-stakes gamble". Even when NETPs are considered essential to achieving climate targets, there is also concern that, given the uncertainty about their effectiveness and scalability, NETPs may deter efforts to reduce emissions (NEGEM Deliverable 2.2). Because the topic has only recently attracted attention from mainstream media and policymakers, many of the options are relatively new and even those working in environmental and climate policy may be unfamiliar with specific NETPs. Therefore, stakeholders are in the process of developing their opinions and adjusting them based on new information (O'Bierne et al., 2019; Wolske et al., 2019). As a result, different stakeholders (and even actors within the same stakeholder group or even within the same organisation) may have divergent opinions on which policies the European Union should adopted as they relate to carbon dioxide removal in general as well as specific NETPs. Recent evidence underlines the difficulties in reaching an agreement between these different parties, given stakeholders' different and even conflicting interests and perspectives (e.g., Dentoni et al., 2018; Ferraro et al., 2015; Gray & Purdy, 2018; Reinecke & Ansari, 2015). For instance, a study involving different stakeholders involved in CCS projects in Australia revealed discrepancies on the level and timing of the dialogue among stakeholders that undermined the potential to establish a valuable and open communication about CCS among parties (Dowd & James, 2014).

Stakeholders often approach issues through different frames (i.e., schemes to interpret the world, as per Gofman, 1974) in multi-stakeholder deliberations. In particular, logical/scientific-based and emotional/moral-based frames have been proven to have different effects in stimulating public response to environmental issues (Jones, 2014; Moezzi et al., 2017; Nabi et al., 2018; Nisbet, 2009). Yet little is known about how different frames are applied and modified during interactions within and between stakeholder groups, and what the effects are on deliberative processes. Indeed, frames should not be regarded as static, but rather dynamic, socially constructed, negotiated and transformed (Gofman, 1974). However, divergence and opposition from key stakeholders can slow down deliberations and even undermine the deployment and diffusion of NETPs.

Understanding stakeholders' attitudes toward different solutions and their deliberation processes, the "debate and discussion aimed at producing reasonable, well-informed opinions in which participants are willing to revise preferences in light of discussion, new information, and claims" (Chambers 2003, p. 309), is therefore crucial to determining the realistic potential of different NETPs and their contribution to reach net-zero targets. The objective of this deliverable is thus twofold. On the one hand we investigate the perceptions of different stakeholders (and, in particular, environmental non-governmental organizations, NGOs, and companies in the energy and agroforestry sectors) on potential EU policies regarding the use of NETPs. To this end, we investigate views of some of the most commonly discussed NETPs - specifically afforestation/reforestation, soil carbon sequestration, BECCS, DACCS, and enhanced weathering - as well as stakeholders' levels of awareness and confidence in their opinions. On the other hand, we aim to understand how these opinions are being formed and adapted as a result of dialogue between stakeholders and different framings presented by experts.

To do this, we organized five workshops attended by 103 stakeholders, mainly representatives from NGOs and the private sector, to assess their perceptions of different NETPs and of potential European policies on the topic, the process of dialogue and deliberation within and among stakeholder groups, and the effect of different framings. The methodology and the results obtained are described below.

1. Methods

We started by identifying the set of relevant stakeholders. Through an extensive internet search process, we compiled a database which included 298 environmental NGOs and 279 private sector organisations. Inclusion criteria were a substantive presence in Europe (even in case of organisations with headquarters located on other continents) and an interest in European Union policies for climate change mitigation, either because of the sector, as in the case of climate organizations or companies in the energy sector, or because of a declared interest of the organisation in the deployment of NETPs, expressed through reports, public comments, or media statements (their analysis is the object of Deliverable 5.1 on social license to operate). A few relevant members from each organisation were selected based on their expected knowledge and expertise, interest, and decision-making power within the organisation they represented (e.g. senior policy officers for NGOs, CEOs for NETP developers, or CCS experts / project managers / sustainability managers in larger companies). The final database included a total of over 1000 stakeholder members' contacts.

As we are interested in understanding not just stakeholders' perceptions but also in their interactions and deliberation processes, we organized a series of five virtual two-hour workshops (with a field quasi-experimental design) to bring together different stakeholder groups. Unlike surveys or interviews, this methodology allows us to measure how perceptions change during dialogue with peers and other stakeholder groups.

A random selection of 200 participants (100 NGO members and 100 company members) were invited to participate in the pilot workshop in June 2021. Over 30 participants registered, and 22 participants attended the two-hour workshop (11% attendance rate). Following the results of the pilot workshop, we replicated the event with only some minor adjustment in the logistic of the event, while not altering the manipulation nor the data collection methods (therefore, we are able to integrate the pilot workshop data in the analysis as well). An additional four events were conducted in October 2021, where the remaining 800 stakeholders were invited. 126 participants registered to attend one of the four workshops, and 81 attended (respectively 23, 17, 20, 21 for each of the four events with 10% attendance rate). In total, 103 key stakeholders participated in the study. Keeping the number of participants around 20 allowed for meaningful stakeholder dialogue and interaction that would have been more difficult in larger groups.

For the experimental manipulation, we randomly assigned each workshop a different framing of the need for NETPs to reach the European Green Deal emission targets. Each workshop began with a short pre-recorded video that presented the various NETPs (distinguished based on whether they were ecological – afforestation/reforestation and soil carbon sequestration - or based on geological storage or technology – DACCS, BECCS, and enhanced weathering, as per Deliverable 2.2) using the two pre-selected framings. The control group was presented with a logical/scientific framing, which relied on scientific and numeric information to underline pros and cons of each approach. Examples of the type of information provided include the permanence of each NETP and estimated costs and resource usage. The treatment group was instead presented with an emotional/moral framing of the topic; their video was very similar but underlined the pros and cons of various NETPs from a moral perspective. Arguments included, for instance, opportunities for geographical and inter-generational fairness, risks of deterrence and double counting, or biodiversity concerns (for a detailed account of geographic fairness related to the deployment of NETPs, read Deliverable 4.3). Appendix A and B present the summary slide used in the two videos. Both videos lasted around 10 minutes and were pre-recorded by the same speaker, a well-established expert in the field. The video was presented at the beginning of the workshop, after a short welcome from the organisers.

After the video, participants were divided into two homogeneous sub-groups (NGOs and private sector) to further discuss the content of the videos. They were specifically asked to refer to the pros and cons presented in the video to discuss and then collectively allocate the future European Union climate budget (for simplification estimated to be 50 billion euros/year) between conventional climate mitigation (e.g., switching away from fossil fuels) and carbon dioxide removal, the latter further divided into different NETP subgroups (ecological vs geological storage). Participants were asked to discuss and provide rationales for their allocations of funds that drew on the videos they had just viewed, and to provide clear and detailed policy recommendations. The groups were encouraged to take notes on the discussion on a virtual whiteboard. The conversation was (minimally) moderated by a member of the research team who provided the instructions and made sure participants understood the task. The discussion and the virtual board notes were recorded. After 20 – 30 minutes of discussion, the two sub-groups were reunited to share the results of their discussions, and comment on or ask questions of the other group's budget allocations. The decision to have initial homogeneous discussions followed by larger heterogenous discussions was made to track the effects of discussing these contested subjects with stakeholders of similar background and interests compared to multi-stakeholder dialogues. The goal is to understand whether the frame adopted in the discussion affects the trust between different stakeholders, the deliberation process (being more oppositional or more receptive) and outcome (agreement or disagreement), and whether these effects are differential for the two types of stakeholders considered. In the final 30 minutes, a member of the European Commission, either Fabien Ramos from DG Clima or Yolanda Garcia Mezquita from DG Energy, joined the workshop for a Q&A session with participants. While this section of the workshops was not part of the field experiment, the presence of European officials was used to help entice greater response rate and participation than would be the case for a purely academic-led workshop.

The pilot workshop consisted of two parallel events, one with the control condition (i.e., the logical/scientific framing) and one with the treatment condition (i.e. the emotional/moral frame) to which participants were randomly assigned. For logistical concerns that could limit the time for the discussion, as well as participants' overall experience, the following four workshops only included one condition each. The workshops were paired so that the control and treatment conditions were either on the same day or in two consecutive days. Moreover, each condition was associated with a morning and an afternoon event.

A few days before attending the workshops, stakeholders were asked to fill out a pre-workshop survey to assess their awareness of the five NETPs considered in our study (i.e. afforestation/reforestation, soil carbon sequestration, BECCS, DACCS, enhanced weathering), their perceptions of the deployment strategy and the potential role in European Union policies for each NETP, their confidence level and overall assessment, and their perceptions of other stakeholder groups' reasonableness and understanding. Participants were asked to fill out two additional short surveys during the event. The manipulation check survey, following the video, was administered to track changes in the variables of interest. This survey focused on the effects of the manipulation, measuring the perceived persuasiveness of the video, the perceived focus on logical/scientific and emotional/moral arguments, and the change in the perception of NETPs or in the confidence level of previously stated opinions following the video. The final survey was administered at the end of the larger group discussion (before the Q&A session) and included a second measurement of stakeholders' perceptions of the deployment strategy and potential role for each NETP in EU policies, their confidence level and overall assessment, and perceptions of other stakeholders' reasonableness and understanding (both for homogenous and heterogeneous groups). The full list of items for each of the three surveys is included in Appendix C.

Importantly, in each survey, stakeholders provided sufficient personal information to allow us to generate a unique code in order to match up the responses from all three surveys while preserving respondent anonymity. We excluded 17 respondents from the final analysis because they either did not fill out all three surveys or their entries could not be matched due to mistakes in generating the unique code. The final matched sample was therefore 86 respondents: 46 representatives of NGOs, and 40 representatives of the private sector. Figure 1 shows the geographic distribution of stakeholders within four European macro-regions per the EuroVoc classification. Figure 2 shows the allocation in the two conditions, the stakeholder group, and the date of the participation.

Regarding the geographic distribution of our sample, a number of respondents were based in Brussels and/or considered themselves to be in 'Europe-wide' organisations and there were also a small number who identified themselves as non-European (e.g., they were from international organisations and based outside of Europe but with an interest in European policy). It is important to mention that, although we invited stakeholders to be as representative as possible of the geographic variation within Europe, we had an underrepresentation of participants from Southern European countries and an overrepresentation of participants from Western European countries (in particular from the United Kingdom – 12 participants – and Germany – 8 participants). The former is particularly problematic as all participants from this region were coming from either Greece or Cyprus, while we had no representatives from Italy, Spain, or Portugal. Although we sought to ensure that the number of invitees was balanced and included many from the region and these three countries in particular, the lower attendance rate from this region is in line with the lower number of organisational documents discussing NETPs developed by Southern European organizations (as described in Deliverable 5.1). Overall, these countries seem to be less inclined to join the international conversation regarding NETPs. Therefore, any of the results regarding participants from Southern Europe, despite statistically significant, cannot be generalized, given the small sample size.
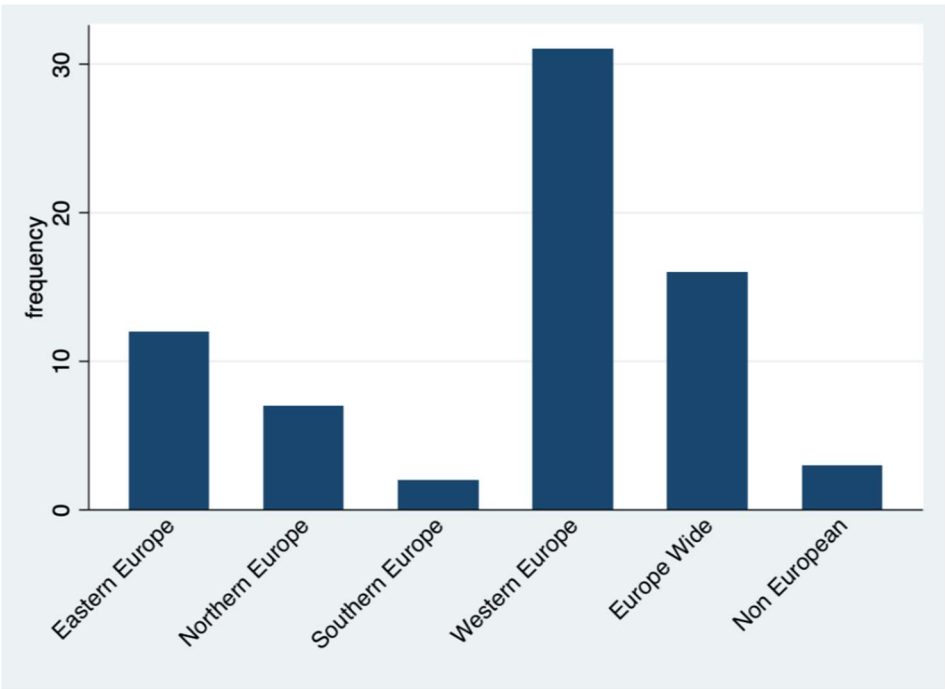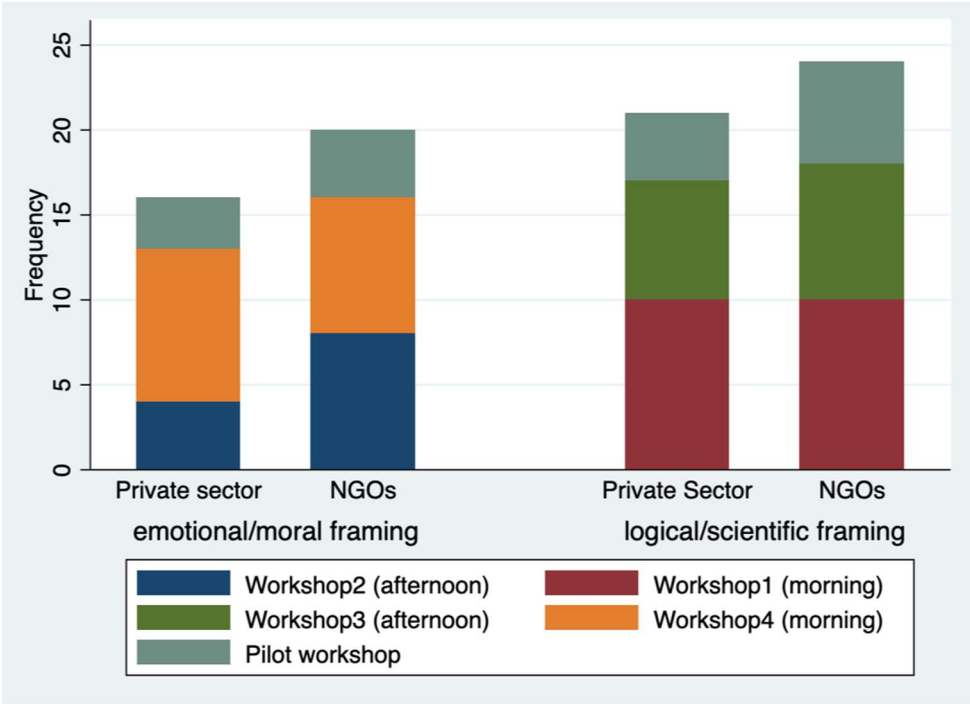
Figure 1 - Sample Geographic Distribution

Figure 2 – Participants Allocation

2. Key findings and policy relevant messages

2.1 Initial Awareness, Attitude, and Confidence in Perceptions of different NETPs

The first set of questions in the pre-event survey was developed to capture stakeholder awareness of different NETPs (i.e., their level of familiarity with specific NETPs considered in this study), their attitude towards them (i.e., their view on the extent to which each NETP should be deployed), and the confidence in their perceptions (i.e., the confidence level in their previous assessment of NETPs). In this section, we briefly discuss the main findings regarding these key variables.

Participants were asked to indicate their awareness of different NETPs (on a scale from 1, extremely low awareness, to 10, extremely high awareness). Overall, we found a higher awareness of ecological solutions, specifically afforestation and reforestation and soil carbon sequestration, compared to geological solutions (DACCS, BECCS, and even more for enhanced weathering). This tendency is more pronounced for environmental NGO participants than for the private sector (Figure 3) and in Eastern regions of Europe (Figure 4), whereas the greater awareness of these NETPs of participants from non-European countries is not meaningful given the small sample. These results are consistent with the results of another workshop organized in December 2020 by WP8 (described in Deliverable 8.1), where participants reported greater awareness of ecological solutions compared to geological ones and an even lower awareness for enhanced weathering or ocean-based solutions.
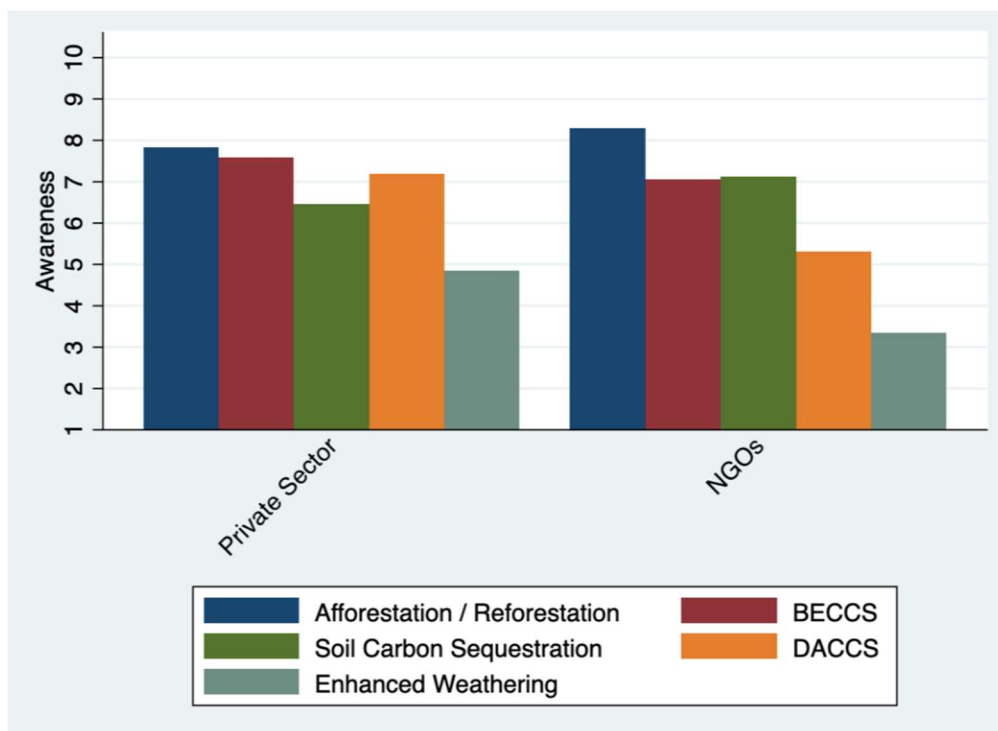

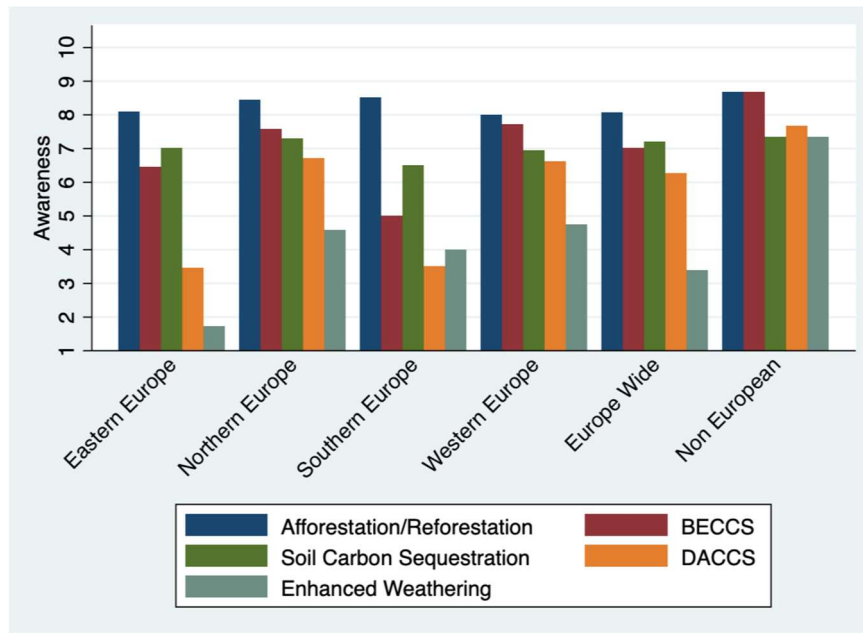*Figure 3 – NETPs Awareness by Stakeholder Group*

Figure 4 – NETPs Awareness by Stakeholder Region

In subsequent questions, participants were asked to indicate their preferences on deployment of different NETPs (on a scale from 1, never use, to 10, use as a primary mechanism across Europe). To make responses comparable across respondents, each value of the scale was associated with a specific label, like "use only in small pilot projects" or "use only in certain areas of Europe"– See Appendix C for the complete list of the labels associated with the values of the scale). Overall, we found that stakeholders had a more positive attitude towards ecological solutions, and specifically afforestation and reforestation and soil carbon sequestration, compared to geological solutions (BECCS, and even more so for DACCS and enhanced weathering). This tendency is more prominent for participants representing environmental NGOs than the private sector (Figure 5) and from Eastern, Northern, and Southern Europe (as illustrated in Figure 6).
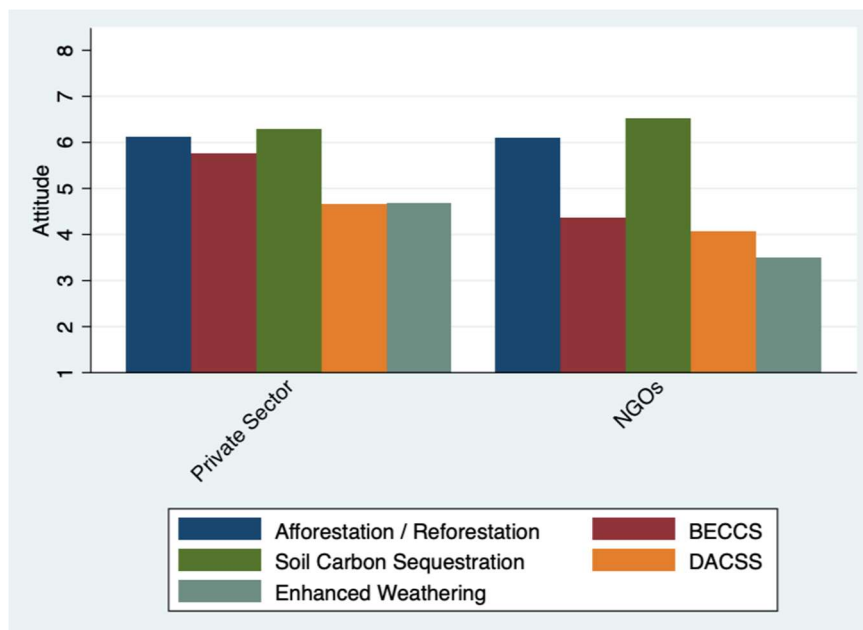

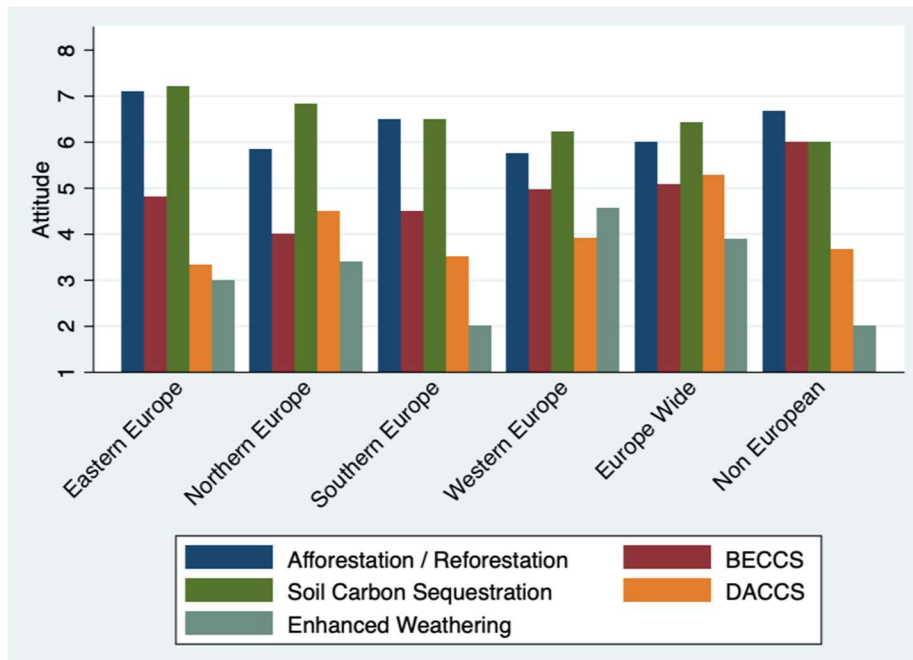Figure 5 – NETPs Attitude by Stakeholder Group

Figure 6 – NETPs Attitude by Stakeholder Region

To identify factors explaining the variance in initial attitudes towards different NETPs, we ran a series of regressions. Table 1 shows the main results. There are no significant differences between NGO and private sector attendees in their attitude towards different NETPs except in the case of BECCS, for which NGO members have a highly significant ($p<0.01$) more negative perception (on average 1.7 points less on the 8-point scale). Importantly, awareness of each NETP is not a significant predictor of attitudes towards specific NETPs, except for DACCS and enhanced weathering (the two NETPs with the lowest average awareness) for which this relationship is positive and significant ($p<0.05$).

This evidence is in partial contrast with previous work that underlines the role of awareness in shaping attitude towards NETPs. These earlier studies, however, were conducted a few years ago (Ashworth et al., 2009; Campbell-Arvai et al., 2017; Tcvetkov et al., 2019) when stakeholder awareness of NETPs was lower than it is at present. This claim is confirmed by evidence coming from the stakeholder report analysis described in Deliverable 5.1 that indicates that over 63% of the organisational documents mentioning NETPs published in the decade 2001-2021 have been released in the last 2 years. Based on our results, we can speculate that rising awareness has led to a more positive attitude towards NETPs that have remained relatively obscure in public discourse since only recently, such as enhanced weathering or DACCS. The Google Trend search reported in Figure 7 reveals that while certain NETPs such as reforestation received constant attention in the past 10 years, BECCS, DACCS and especially enhanced weathering have remained outside mainstream conversations till only very recently. Conversely, awareness might play a more marginal role when NETPs are included in mainstream discussions and are based on natural processes more familiar to the broader society, such as reforestation or soil carbon sequestration. Finally, Eastern European participants, compared to the baseline of non-European participants, have a significantly ($p<0.05$ and 0.1 respectively) more positive attitude towards ecological NETPs (afforestation / reforestation and soil carbon sequestration).
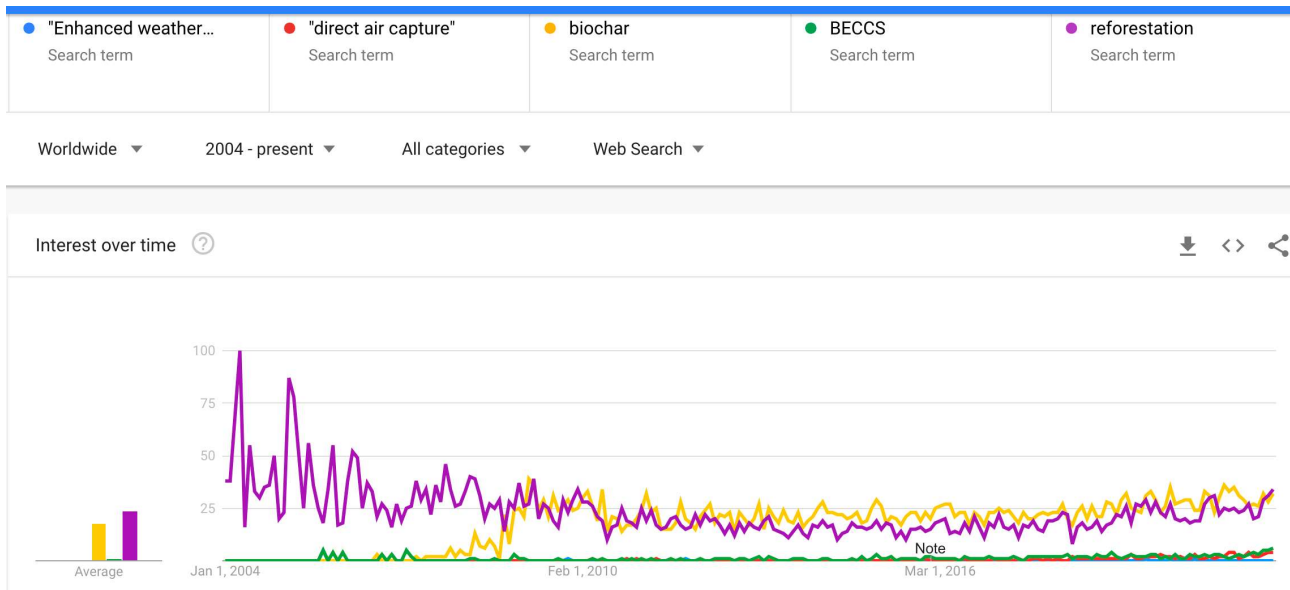
Figure 7 - Google Trend about NETPs

Table 1 – Predictors of NETPs Attitude

Predictors of attitude towards NETPs	Afforestation/ Reforestation	Soil Carbon Sequestration	BECCS	DACCS	Enhanced Weathering
NGO	-0.382	-0.118	-1.651***	-0.126	-0.603
Awareness (for each NETP)	0.048	0.028	-0.009	0.269**	0.261**
Eastern Europe	1.189**	1.247*	0.596	-0.617	-0.474
Northern Europe	-0.271	0.793	-1.026	-0.664	-1.062
Southern Europe	0.388	0.516	-0.561	-0.498	-2.037
Western Europe	-0.340	0.220	-0.125	-1.052	-0.064
European Wide	-0.017	0.429	0.481	0.704	-0.105
_cons	5.899***	5.862***	5.932***	3.119**	3.296***
N	77	71	77	68	49

*p<0.1; **p<0.05; ***p<0.01

Note: Geographic baseline for comparison: Non-European organisations.

Following the workshop, participants were asked to indicate confidence levels associated with their previous assessment of NETPs (on a scale from 1, not at all confident, to 7, extremely confident). Overall, we found that, among relevant stakeholders, there is greater confidence in ecological solutions, specifically afforestation/reforestation and soil carbon sequestration, compared to geological solutions (especially DACCS and enhanced weathering). This tendency is more prominent for participants representing environmental NGOs than for the private sector (Figure 7) and in Eastern and Southern Europe (Figure 8).

Figure 8 – Confidence of NETP Perceptions by Stakeholder Group

Figure 9 – Confidence of NETP Perceptions by Stakeholder Region

Even for this variable, we look for potential predictors using regression models. For the level of confidence in the perception of the different NETPs, we could not find significant differences based on stakeholder groups (NGOs vs private sector) or geographic regions. However, and in contrast with attitudes towards NETPs in general, the level of awareness associated with each NETP is a significant (positive, $p < 0.05$) predictor of the confidence in perception in all cases except for afforestation and reforestation, suggesting that greater awareness of NETPs lead to more confidence in one's perception about them.

Table 2 – Predictors of Confidence in NETP Perception

Predictors of confidence in perceptions of NETPs	Afforestation/ Reforestation	Soil Carbon Sequestration	BECCS	DACCS	Enhanced Weathering
NGO	0.170	0.119	-0.085	0.158	0.187
Awareness (for each NETP)	0.120	0.422***	0.235**	0.344***	0.309***
Eastern Europe	0.596	0.144	-0.049	0.402	0.012
Northern Europe	0.334	0.373	0.487	0.224	-0.456
Southern Europe	0.814	0.551	-0.614	0.049	-1.943
Western Europe	0.076	-0.270	0.309	0.276	-0.068
European Wide	0.526	-0.276	-0.439	-0.404	-0.256
_cons	4.077***	2.143**	2.983***	1.667**	2.114***
N	77	76	78	75	65

*p<0.1; **p<0.05; ***p<0.01

Note: Geographic baseline for comparison: Non-European organisations.

Overall, we found more positive attitudes towards ecological solutions than geological based, a distinction even more prominent for NGO stakeholders and stakeholders from Eastern Europe. Moreover, we found the awareness level to predict the level of confidence associated with one's perceptions but not the perceptions itself, except for the less known NETPs, namely DACCS and enhanced weathering.

2.2 Initial Perception of European Union policies

The second set of questions in the pre-event survey sought to capture stakeholder perceptions of different (potential) European Union level policies (on a scale from -4, strongly disagree, to +4, strongly agree). The six items in this scale refer to the role of carbon dioxide removal (CDR) in reaching European targets (See Appendix C for the full list). The items were based on the results of the Vision workshop described in Deliverable 8.1, where participants overall indicate the need to deploy NETPs in order to achieve more ambitious targets at the European level. What emerges (Figure 9) is that NGO members are less enthusiastic about relying on CDR to reach European Union targets. Table 3 illustrates the results of regression models that confirm that NGO members are significantly (p<0.05) more likely to prefer not relying on CDR to achieve European climate targets. However, both stakeholder groups see CDR use favourably overall, especially if separate targets are enshrined for CDR and emission reduction. Moreover, Table 3 shows how the effect of total awareness (sum of the awareness level of each NETP) and overall confidence in one's perception of NETPs (sum of confidence levels for each NETP) are not significant (or only marginally significant, with p<0.1, to explain a more positive attitude towards deploying CDR to attain the emission targets). Similarly, there are no significant geographic effects except for Northern European participants being significantly (p<0.05) more in favour of European policy focused on emission reduction rather than CO2 removal.
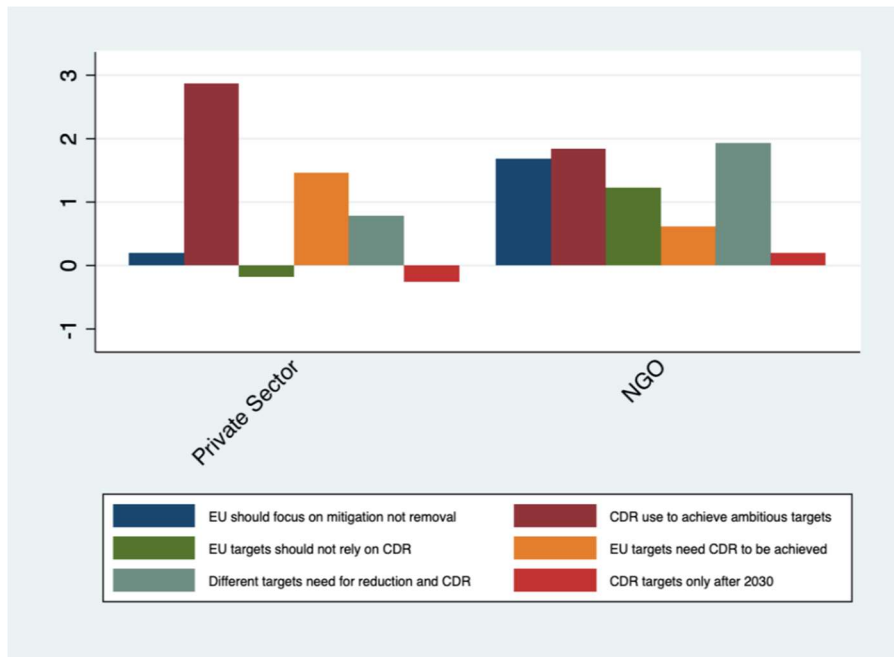
Figure 10 – Policy Attitude by Stakeholder Group

Note: Geographic baseline for comparison: Non-European organisations.

Table 3 – Predictors of Perceptions of European Policies

Perceptions of European policies	EU should focus on mitigation not removal	CDR use to achieve ambitious targets	EU targets should not rely on CDR	EU targets need CDR to be achieved	Different target needs for reduction and CDR	CDR targets only after 2030
NGO	1.157	-0.446	1.824**	-1.044	0.965	0.297
Awareness of NETPs (total)	-0.051	0.063*	-0.024	0.015	0.025	-0.037
Confidence on NETPs perception (total)	-0.043	0.009	-0.040	0.057	0.043	-0.006
Eastern Europe	1.705	-1.170	-0.627	-0.493	0.521	0.040
Northern Europe	2.603**	-1.307	2.099	-1.128	-1.265	-1.899
Southern Europe	0.304	-1.846	0.276	-0.795	-0.598	0.986
Western Europe	1.163	-0.858	0.775	-0.614	0.676	-1.600*
Europe wide	1.070	-1.461	0.897	-0.621	1.284	-0.704
_cons	1.870	1.160	0.768	0.293	-1.408	2.002
N	65	62	62	63	63	62

*p<0.1; **p<0.05; ***p<0.01

Note: Geographic baseline for comparison: Non-European organisations.

2.3 Framing Effect on Attitude towards NETPS

Following the video, participants were asked to fill out a short survey to check the effectiveness of the manipulation. Participants were asked to rate, on a scale from 1 to 10, the perceived persuasiveness of the video message, and the degree to which the arguments were supported by logical/scientific reasoning or emotional/moral reasoning. While there are no differences in the perceived persuasion of the two videos, the emotional/moral video was assessed as significantly (p<0.001) more reliant on emotional/moral reasoning than the other video, confirming the effectiveness of the manipulation.

After the homogenous and heterogenous group discussions, participants were again asked to fill out a third survey where attitudes towards different NETPs, their confidence level, and their perceptions of (potential) European policies.

When comparing the change in attitude towards different NETPs (attitude post-workshop minus attitude pre-workshop), it appears that, for most NETPs, opinions became more negative as a result of the video and the group discussions, especially for the stakeholders who were primed to adopt an emotional/moral framing. For both stakeholder groups, this framing reduced positive views of ecological solutions, in particular. The ANOVA reveals that, for NGO participants, attitudes towards both afforestation/reforestation and soil carbon sequestration was reduced significantly more ($p<0.05$) for the treatment group, while for private sector participants, this result is replicated but only for afforestation/reforestation. By contrast, attitude towards afforestation/reforestation and enhanced weathering increased following the discussion for both NGO and private sector participants who were primed to use logical/scientific arguments.

Table 4 presents the results of regression models developed to explain the change in views of NETPs during the workshop. The manipulation has a significant effect to explain the change in the attitude towards afforestation/reforestation, confirming the ANOVA results. Moreover, even in this case, we did not find a significant effect of the pre-event awareness of NETPs nor confidence about one's perception in explaining the change in attitude. Finally, we found some geographical effects with Western European and members of European-Wide organizations becoming significantly more positive towards BECCS and DACCS respectively compared to the baseline of non-European members, while Southern European members became significantly more positive towards soil carbon sequestration, although these results are not generalizable given the small sample with limited representativeness for the whole region.
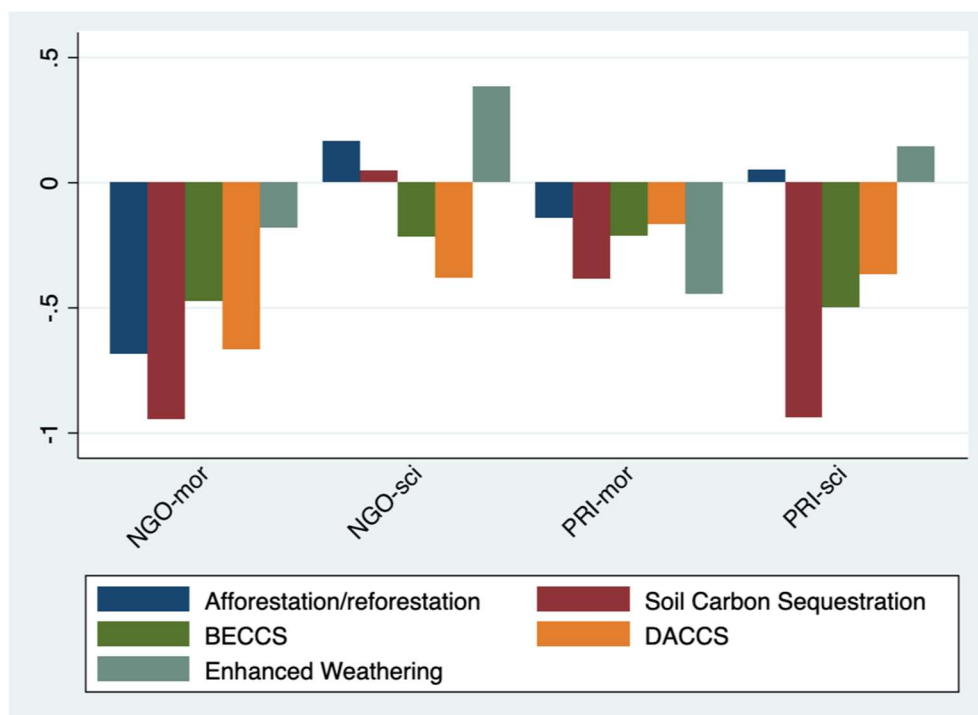

Figure 11 – Change in Attitude by Treatment

Table 4 – Change in Attitude towards NETPs

Change in attitude towards NETPs					
	Afforestation/ Reforestation	Soil Carbon Sequestration	BECCS	DACCS	Enhanced Weathering
NGOsci	0.780**	0.663	0.073	0.457	0.345
PRIsci	0.671*	-0.519	0.036	0.991	0.479
PRImor	0.308	0.081	0.376	0.978	-0.034
Baseline Attitude (pre-workshop)	-0.599***	-0.379**	-0.219**	-0.420***	-0.247*
Confidence (for each NETP)	-0.011	-0.143	0.014	-0.006	0.147
Awareness (for each NETP)	-0.224**	0.145	-0.101	0.016	0.010
Eastern Europe	0.396	-1.265	-0.060	0.904	0.210
Northern Europe	0.711	-0.770	0.287	-0.184	-0.778
Southern Europe	-0.240	1.232**	-0.072	0.623	-0.782
Western Europe	-0.062	-0.570	0.915*	0.921	0.205
European Wide	-0.183	-0.367	-0.003	1.098*	0.741
_cons	4.881***	2.001	0.957	0.082	0.102
N	77	69	76	67	46

*p<0.1; **p<0.05; ***p<0.01

Note: Geographic baseline for comparison: Non-European organisations.

2.4 Framing Effect on Perception of European Policies

When comparing the change (i.e., difference in responses from the first and second surveys) in perception of (potential) European policies happening through the workshop, it appears that perceptions of CDR deployment to reach European targets became more negative following the workshop than before it, as the differences in perception are mostly taking negative values which indicate a reduction in positive perceptions . Figure 11 illustrates these differences. For instance, policy proposals for the European Union to focus only on emission reductions and not rely on CDR were perceived more negatively in the post-workshop survey by all groups (and especially by the private sector representatives), while for some groups the perceived need to deploy CDR became more positive, especially for the groups primed to adopt an emotional/moral framing (significant ANOVA, p<0.1). Moreover, NGO representatives became more favourable towards having separated targets for emission reduction and removals.

Table 5 describes the difference in the change in the perception of (potential) European Policies. Compared to the private sector representatives that were primed to use emotional/moral arguments, the ones using logical/scientific arguments became significantly (p<0.1) more positive about including CDR deployment in the targets only starting from 2030. Interestingly, participants with higher awareness of the different NETPs became more significantly (p<0.05) positive about the fact that the European Union should not rely on CDR. Geographic effects are also prominent as Southern European participants became significantly (p<0.05) more negative about having separate targets for emission reduction and CDR (again with limited generalizability for this inference), while attendees from European-wide organizations

became more positive on the need for the EU to not rely on CDR and, conversely, more negative on including CDR in European targets, at present or after 2030 (p<0.1).
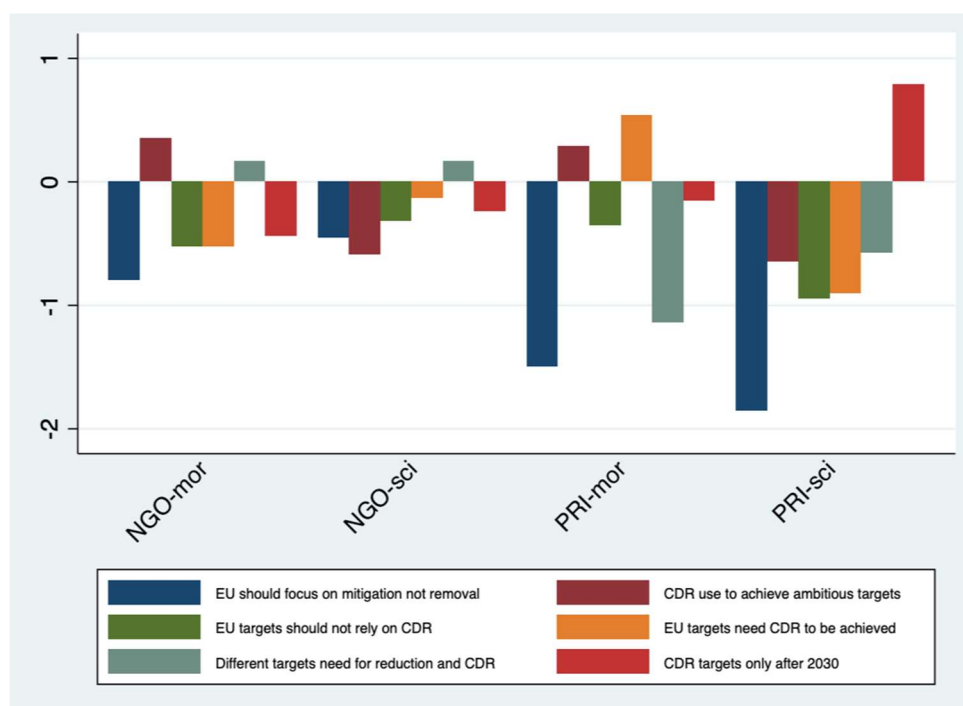

Figure 12 – Change in Perception of Policy by Treatment

Table 5 – Change in Perceptions of European Policies

Change in perceptions of European policies						
	EU should focus on mitigation not removal	CDR use to achieve ambitious targets	EU targets should not rely on CDR	EU targets need CDR to be achieved	Different target needs for reduction and	CDR targets only after 2030
NGOsci	0.014	0.395	0.135	-0.049	0.303	0.306
PRIsci	-0.398	0.650	0.034	0.043	0.047	1.610*
PRImor	-0.389	1.124	1.077	0.859	-0.407	0.426
Baseline policy percerption (pre-workshop)	0.586***	-0.513***	0.445***	-0.653***	0.351***	0.293**
Awareness of NETPs (total)	0.023	0.034	0.070**	0.031	0.021	-0.014
Confidence on NETPs perception (total)	0.073	-0.059*	0.048	-0.021	0.003	0.007
Eastern Europe	0.361	0.748	0.575	-0.380	0.958	-0.178
Northern Europe	-0.226	-0.058	-0.083	-2.239	0.324	-1.303
Southern Europe	-1.176	2.209	-0.929	2.117	-3.213***	-1.458
Western Europe	0.820	-0.383	-0.321	-0.788	-0.076	-1.001
European Wide	0.972	-1.396*	1.467*	-0.352	0.497	-1.579*
_cons	-4.484***	0.993	-4.734***	0.263	-1.593	0.664
="	(1.43)	(1.40)	(1.42)	(2.38)	(1.29)	(1.18)
N	64	61	61	61	61	59

*p<0.1; **p<0.05; ***p<0.01

Note: Geographic baseline for comparison: Non-European organisations.

2.5 Framing Effect on Perception of Other Stakeholder Groups

The last set of questions in the survey investigates how stakeholders perceive the reasonableness and understanding of other stakeholder groups in the discussions around NETPs. In the pre-workshop surveys, we asked participants to assess, on a scale from 0 to 10, the degree to which different stakeholders have reasonable concerns and understanding of other stakeholders' point of view, in order to capture potential ingroup/outgroup biases. We found that NGO representatives have a significantly lower ($p<0.1$ in ANOVA) assessment of the reasonableness of the other stakeholder group (i.e., the private sector) (average: 4.99), compared to the private sector attendees' assessment of NGO reasonableness (average: 5.84). Moreover, the two groups do not significantly differ in their view of government's reasonableness and understanding (average: 5.8 and 5.6 respectively).

After the workshop discussions, we asked participants to assess, again on a scale from 0 to 10, the degree to which the other participants were reasonable and understanding, distinguishing homogeneous group discussions (i.e., smaller group discussions with members of the same stakeholder group) and heterogeneous group discussions (i.e., larger group discussions with different stakeholder groups). As Figure 12 illustrates, NGO representatives had a significantly higher assessment of the reasonableness and understanding of their peers ($p<0.01$ and $p<0.05$ respectively), compared with private sector representatives' assessment of their peers. This finding indicates a higher degree of cohesiveness amongst NGO stakeholder groups. Moreover, NGO participants also provide a significantly higher assessment of the other stakeholder group's reasonableness and understanding ($p<0.1$ and $p<0.01$ respectively). This is surprising considering that, when asked in abstract terms, NGO representatives assessed the private sector reasonableness and understanding as low. However, when asked about the specific private sector representatives they interacted with during the workshop, this negative appraisal was less present. In other words, when asked in abstract terms, NGO representatives might underestimate the reasonableness and understanding of other stakeholder groups, potentially because of responding based on a stereotypical representation of other stakeholders that do not represent the variety of interests and activities of the whole sector. This evidence indicates that although there might be initial outgroup biases toward different stakeholder groups, conversation and dialogue with representatives of the other group (or at least these particular representatives) reduced the bias. Table 6 presents the results of regression models developed to understand the difference in homogenous and heterogenous group perceptions of reasonableness and understanding. We find confirmation that NGO attendees tend to have a higher assessment of other participants' reasonableness and understanding, both other NGOs and from the private sector, especially when primed using the emotional/moral framing ($p<0.05$). By contrast, adopting an emotional/moral framing made the private sector representatives significantly more negative about both the heterogenous and homogenous groups alike ($p<0.05$ and $p<0.1$ respectively). These findings suggest that stakeholder type moderates the effects of framing. In particular, adopting a moral perspective is likely to increase the perceived discrepancy between stakeholder groups for stakeholders that are less inclined to adopt this framing, and to reduce them for stakeholder groups that are more used to adopt a moral framing.

Moreover, geographic differences can also be noticed. Eastern European and Europe-wide participants tend to have a significantly ($p<0.1$ and $p>0.05$ respectively) lower assessment of both homogenous and heterogenous group's reasonableness, while Northern and Southern European participants tend to have a more positive assessment of homogenous and especially heterogenous group understanding ($p<0.05$). This difference might be explained with cultural differences in managing and perceiving conflicts (Hofstede et al., 2005), but also potentially with the fact that certain actors, as in the case of Europe-wide

organizations that are based in Brussels, are more used to dialogues between different stakeholders and therefore have the differences in perspective more salient.
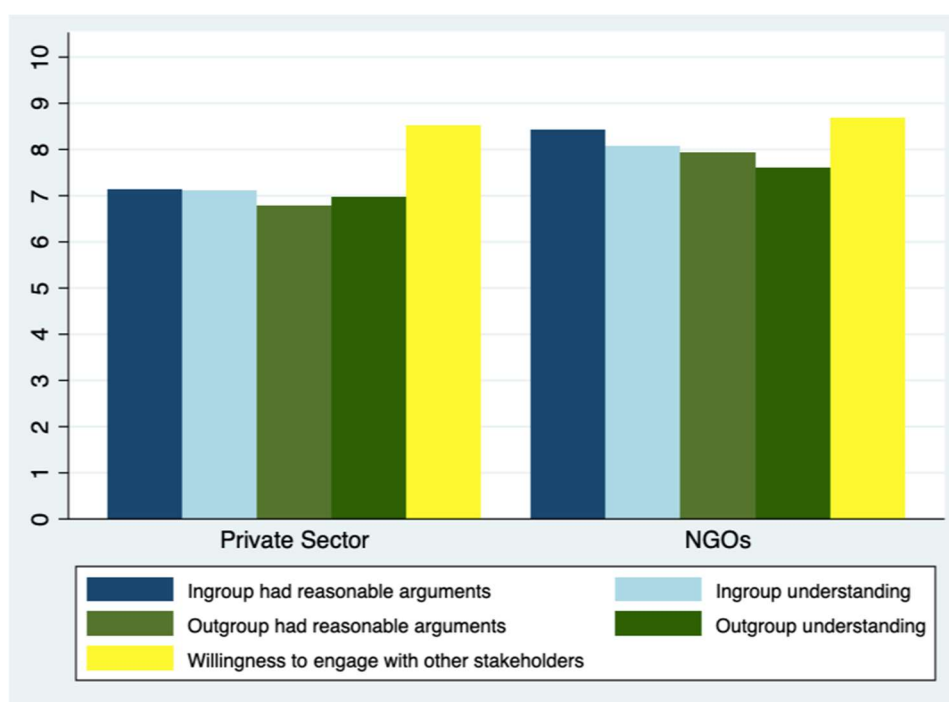

Figure 13 - Perception of Other Stakeholders

Table 6 - Perception of Other Stakeholder Groups

Perception of other stakeholder groups				
	Homogenous group reasonableness	Homogenous group understanding	Heterogeneous group reasonableness	Heterogenous group understanding
NGOsci	0.591	0.507	1.119*	0.310
NGOmor	1.450**	1.640**	1.965***	0.922
PRImor	-1.353*	-0.957	-1.388**	0.144
Awareness of NETPs (total)	-0.094***	-0.022	-0.028	-0.059*
Confidence on NETPs perception (total)	0.042	0.027	0.023	0.051
Eastern Europe	-1.547*	-0.391	-1.387*	0.932
Northern Europe	-0.116	1.368**	0.489	2.646***
Southern Europe	-0.629	-0.978	-0.763	1.400**
Western Europe	-0.771	-0.637	-1.038	0.327
European Wide	-1.669***	-1.401*	-1.578**	0.204
Baseline perception (pre-workshop)			0.321***	0.174
_cons	10.605***	7.808***	6.454***	6.447***
N	64	63	56	54

*p<0.1; **p<0.05; ***p<0.01

Note: Geographic baseline for comparison: Non-European organisations.

3. Conclusions and further steps

In conclusion, employing a quasi-experimental methodology in a series of workshops with NGO and private sector representatives reveals important insights into stakeholder perceptions of different NETPs and their potential role in achieving EU targets of net-zero emissions. We can also learn more about how these perceptions evolve through dialogue with other stakeholders and exposure to different framings.

Some key implications for policy makers emerge. First, our analysis reveals how different stakeholder groups vary in their assessment of different NETPs, and in particular how NGOs have a greater awareness and more favourable attitude toward ecological solutions than geological ones, while this difference is less pronounced for the private sector. Moreover, NGOs tend to have a much more negative view of using CDR to meet European targets – they are significantly more likely than private sector representatives to believe that European Union policies should not rely on carbon dioxide removal and NETPs in order to reach net-zero ambitions.

Second, we find that interaction among different stakeholders has an effect in changing perceptions, both about NETPs and policies regarding their use. Interestingly, this change is independent of the degree of awareness and confidence in one's initial opinions, thus suggesting that dialogue prompts a revision of one's perceptions even for the most experienced or convinced stakeholders. In general, it appears that through discussion, greater awareness of the risks associated with different NETPs and policies on their use is achieved, as perceptions have, on average, become more negative as a result of the workshop, except for lesser known NETPs (such as enhanced weathering).

Third, we found that the framing adopted in the discussion of different NETPs and (potential) policies on their use has an effect on perceptions. However, the direction of this effect is less clear. Adopting a logical/scientific framing seems to foster a positive change in attitude towards NETPs, and in particular towards ecological NETPs. By contrast, adopting an emotional/moral framing affects the dialogue and the perception of other stakeholders in a divergent way: for NGOs, more accustomed to this kind of framing, it favours the dialogue and the perception of understanding among groups, while for the private sector, less accustomed to such an approach, it reduces the perception of reasonableness and understanding. In essence, therefore, the mismatch between the framing normally adopted and that used in the discussion reduces the opportunity for dialogue. Implications of this finding suggest that, for NGOs and private sector representatives to be more successful in communicating with other stakeholder groups, they might try to adopt the other stakeholder's preferred framing. Similarly, policy might be more effective if they communicated using the appropriate framing with each stakeholder, which requires moving away from a one-size-fits-all approach to communications.

Finally, we found geographic differences within European countries that suggests that in order to gain the cooperation and favour of different stakeholders, differences between regions or countries need to be taken into account.

In sum, the interaction between different stakeholders and the ensuing dialogue is fundamental to the development of perceptions about NETPs and their potential deployment – perceptions should not be understood as static and crystallized but as dynamic and evolving via discussion. The next steps focus on triangulating and deepening the results obtained in this series of workshops with a quasi-experimental design through other data collections, including interviews with different stakeholders, large pan-European surveys, and analysis of reports from different organizations.

In preparing this report, the following deliverable/s have been taken into consideration:

D#	Deliverable title	Lead Beneficiary	Type	Dissemination level	Due date (in MM)
2.2	Interactions and trade-offs between nature-based and engineered climate change solutions	UOXF	R	Public	17
4.3	Identify Member state targets for CDR	ICL	R	Public	17
5.1	Measuring Social License to Operate for Different NETPs	UCAM	R	Public	18
7.2	Extended MONET-EU	ICL	R	Public	17
8.1	Stocktaking of scenarios with negative emission technologies and practises. Documentation of the vision making process and initial NEGEM vision	VTT	R	Public	8

References

Anderson, K. Peters, G.P. (2016). The Trouble with Negative Emissions, *Science* 354(6309), 182-183.

Ashworth, P., Pisarski, A., & Thambimuthu, K. (2009). Public acceptance of carbon dioxide capture and storage in a proposed demonstration area. Proceedings of the Institution of Mechanical Engineers, Part A: *Journal of Power and Energy*, 223(3), 299-304.

Campbell-Arvai, V., Hart, P. S., Raimi, K. T., & Wolske, K. S. (2017). The influence of learning about carbon dioxide removal (CDR) on support for mitigation policies. *Climatic Change,* 143(3), 321-336.

Carton, W., Asiyanbi, A., Beck, S., Buck, H. J., & Lund, J. F. (2020). Negative emissions and the long history of carbon removal. *Wiley Interdisciplinary Reviews: Climate Change*, 11(6), 671.

Chambers, S. (2003). Deliberative democratic theory. *Annual Review of Political Science*, 6(1), 307–326.

Cox, E., Spence, E., & Pidgeon, N. (2020). Public perceptions of carbon dioxide removal in the United States and the United Kingdom. *Nature Climate Change,* 10(8), 744-749.

Dentoni, D., Bitzer, V., & Schouten, G. (2018). Harnessing wicked problems in multi-stakeholder partnerships. *Journal of Business Ethics*, 150(2), 333–356.

de Bakker, F. G., Rasche, A., & Ponte, S. (2019). Multi-stakeholder initiatives on sustainability: A cross-disciplinary review and research agenda for business ethics. *Business Ethics Quarterly*, 29(3): 343-383.

Anne-Maree Dowd & Mallory James (2014) A Social Licence for Carbon Dioxide Capture and Storage: How Engineers and Managers Describe Community Relations, Social Epistemology, 28:3-4, 364-384,

Ferraro, F., Etzion, D., & Gehman, J. (2015). Tackling grand challenges pragmatically: Robust action revisited. *Organization Studies*, 36(3), 363–390.

Gofman, J. (1974). *Frame analysis*. Harvard University Press.

Gray, B., & Purdy, J. (2018). *Collaborating for our future: Multistakeholder partnerships for solving complex problems*. Oxford University Press

Hoffman A. J. (2011). Talking Past Each Other? Cultural Framing of Skeptical and Convinced Logics in the Climate Change Debate. *Organization & Environment*, 24(1):3-33.

Hofstede, G., Hofstede, G. J., & Minkov, M. (2005). Cultures and organizations: Software of the mind (Vol. 2). New York: Mcgraw-hill.

Jones, M. D. (2014). Communicating climate change: Are stories better than "just the facts"?. *Policy Studies Journal*, 42(4), 644-673.

Kahan, D.M. (2013). Ideology, motivated reasoning, and cognitive reflection. *Judgment and Decision Making*, 8, 407-424

Liu, J., Hull, V., Godfray, H. C., Tilman, D., Gleick, P., Hof, H., Pahl-Wostl, C., Xu, Z., Chung, M. G., Sun, J., & Li, S. (2018). Nexus approaches to global sustainable development. *Nature Sustainability*, 1(9), 466–476

Mena, S., & Palazzo, G. (2012). Input and output legitimacy of multi-stakeholder initiatives. Business Ethics Quarterly, 527-556.

Moezzi, M., Janda, K. B., & Rotmann, S. (2017). Using stories, narratives, and storytelling in energy and climate change research. *Energy Research & Social Science*, 31, 1-10.

Nabi, R. L., Gustafson, A., & Jensen, R. (2018). Framing climate change: Exploring the role of emotion in generating advocacy behavior. *Science Communication*, 40(4), 442-468.

Nisbet, M. C. (2009). Communicating climate change: Why frames matter to public engagement. *Environment*, 51, 514-518.

O'Beirne, P., Battersby, F., Mallett, A., Aczel, M., Makuch, K., Workman, M., & Heap, R. (2020). The UK net-zero target: Insights into procedural justice for greenhouse gas removal. *Environmental Science & Policy*, 112, 264-274.

Rasche, A. (2012). Global policies and local practice: Loose and tight couplings in multi-stakeholder initiatives. Business Ethics Quarterly, 679-708.

Reinecke, J., & Ansari, S. (2015). What is a "fair" price? Ethics as sensemaking. *Organization Science*, 26(3), 867–888.

Tcvetkov, P., Cherepovitsyn, A., & Fedoseev, S. (2019). Public perception of carbon capture and storage: A state-of-the-art overview. *Heliyon,* 5(12), e02845.

Wolske, K. S., Raimi, K. T., Campbell-Arvai, V., & Hart, P. S. (2019). Public support for carbon dioxide removal strategies: the role of tampering with nature perceptions. *Climatic Change*, 152(3), 345-361.

Zimmermann, A., Albers, N., & Kenter, J. O. (2021). Deliberating our frames: How members of multi-stakeholder initiatives use shared frames to tackle within-frame conflicts over sustainability issues. *Journal of Business Ethics*, 1-26.

Appendix A – Summary slide for the logical/scientific video

Appendix B – Summary slide for the emotional/moral video

Appendix C – Survey questions

PRE-EVENT SURVEY

The following questions aim to understand your perceptions of different carbon dioxide removal mechanisms.

Please answer the following questions to the best of your ability. Responses will be kept anonymous and are meant to provide a snapshot of your opinions, whether they are firmly held or still evolving.

There are different technologies and practices under consideration to remove carbon dioxide from the atmosphere and permanently store it on land, underground, or in the ocean, many of which are still under development and little known.

How familiar are you with the following carbon dioxide removal technologies and practices? Select one answer per approach.

Please give your answer on a scale of 0 to 10, where 0 means "Completely unfamiliar - never heard of this" and 10 means "Completely familiar".

1. Afforestation/Reforestation: Planting trees to absorb carbon dioxide from the atmosphere. Afforestation refers to planting trees where they did not previously exist; reforestation refers to planting trees where they were previously removed.

- ○ 0 - Completely unfamiliar
- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ 5 - Neither familiar nor unfamiliar
- ○ 6
- ○ 7
- ○ 8
- ○ 9
- ○ 10 - Completely familiar

2. Bioenergy with carbon capture and storage (BECCS): Growing biomass (plant material) to be combusted for bioenergy. Carbon emissions from power generation are captured and stored, often underground.

- ○ 0 - Completely unfamiliar
- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ 5 - Neither familiar nor unfamiliar
- ○ 6
- ○ 7
- ○ 8
- ○ 9
- ○ 10 - Completely familiar

3. Direct air capture with carbon storage (DACCS): Capturing carbon dioxide directly from the air using chemical processes and storing it in underground reservoirs.

- ○ 0 - Completely unfamiliar
- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ 5 - Neither familiar nor unfamiliar
- ○ 6
- ○ 7
- ○ 8
- ○ 9
- ○ 10 - Completely familiar

4. Enhanced weathering: Accelerating earth's carbon cycle by crushing rocks and dispersing them to increase mineralisation of the absorption of carbon dioxide.

- ○ 0 - Completely unfamiliar
- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ 5 - Neither familiar nor unfamiliar
- ○ 6
- ○ 7
- ○ 8
- ○ 9
- ○ 10 - Completely familiar

5. Soil carbon sequestration: Land management changes (such as sustainable soil management, changing farming practices or biochar use) to increase the soil organic carbon content.

- ○ 0 - Completely unfamiliar
- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ 5 - Neither familiar nor unfamiliar
- ○ 6
- ○ 7
- ○ 8
- ○ 9
- ○ 10 - Completely familiar

The following questions aim at understanding your perception of European Union climate policies.

1. To what extent do you agree with the following statements:

	1 - Strongly agree	2	3	4	5 - Neither agree nor disagree	6	7	8	9 - Strongly disagree	⊘ Don't know
The European Union policies should focus on reducing carbon dioxide emissions instead of removing it from the atmosphere	○	○	○	○	○	○	○	○	○	○
Carbon dioxide removal mechanisms should complement reducing emissions in order to achieve more ambitious targets	○	○	○	○	○	○	○	○	○	○
The targets set by the European Union (55% greenhouse gas emission reduction by 2030 and carbon neutrality by 2050) should not rely on carbon removal and offsetting mechanisms	○	○	○	○	○	○	○	○	○	○
The European Union target of reducing greenhouse gas emissions by 55% by 2030 and achieving carbon neutrality by 2050 can only be achieved by including carbon removal and offsetting mechanisms	○	○	○	○	○	○	○	○	○	○
The European Union decision to separate targets for carbon dioxide removal and emissions reduction to reach carbon neutrality is the right approach	○	○	○	○	○	○	○	○	○	○
Carbon dioxide removal should not be included in EU targets before 2030 but could be included after 2030 subject to certain criteria	○	○	○	○	○	○	○	○	○	○

We now ask you your opinion on the same set of carbon dioxide removal technologies and practices as described previously.

Imagine you were responsible for advising on the best climate policies for the European Union, which, if any, of the following options do you think should be used? Select one answer per technology.

Although optional, we would also appreciate if you could use the blank space below each question to briefly explain the reasoning behind your choice.

1. Afforestation/Reforestation: Planting trees to absorb carbon dioxide from the atmosphere. Afforestation refers to planting trees where they did not previously exist; reforestation refers to planting trees where they were previously removed.

○ Use as a primary carbon dioxide removal mechanism across Europe

○ Use as a primary carbon dioxide removal mechanism but only in certain areas of Europe

○ Use across Europe, but not as a primary carbon dioxide removal mechanism

○ Use in certain areas of Europe, but not as a primary carbon dioxide removal mechanism

○ Use only if other carbon removal mechanisms are not sufficient

○ Use only in small pilot-scale projects

○ Use only under certain conditions (please specify)

[   ]

○ Never use

○ ⊘ Don't know

Why do you think so? (optional)

2. Bioenergy with carbon capture and storage (BECCS): Growing biomass (plant material) to be combusted for bioenergy. Carbon emissions from power generation are captured and securely stored, often underground.

○ Use as a primary carbon dioxide removal mechanism across Europe

○ Use as a primary carbon dioxide removal mechanism but only in certain areas of Europe

○ Use across Europe, but not as a primary carbon dioxide removal mechanism

○ Use in certain areas of Europe, but not as a primary carbon dioxide removal mechanism

○ Use only if other carbon removal mechanisms are not sufficient

○ Use only in small pilot-scale projects

○ Use only under certain conditions (please specify)

[   ]

○ Never use

○ ⊘ Don't know

Why do you think so? (optional)

3. Direct air capture with carbon storage (DACCS): Capturing carbon dioxide directly from the air using chemical processes and storing it in underground reservoirs.

○ Use as a primary carbon dioxide removal mechanism across Europe

○ Use as a primary carbon dioxide removal mechanism but only in certain areas of Europe

○ Use across Europe, but not as a primary carbon dioxide removal mechanism

○ Use in certain areas of Europe, but not as a primary carbon dioxide removal mechanism

○ Use only if other carbon removal mechanisms are not sufficient

○ Use only in small pilot-scale projects

○ Use only under certain conditions (please specify)

○ Never use

○ ⊘ Don't know

Why do you think so? (optional)

4. Enhanced weathering: Accelerating earth's carbon cycle by crushing rocks and dispersing them to increase mineralisation of the absorption of carbon dioxide.

○ Use as a primary carbon dioxide removal mechanism across Europe

○ Use as a primary carbon dioxide removal mechanism but only in certain areas of Europe

○ Use across Europe, but not as a primary carbon dioxide removal mechanism

○ Use in certain areas of Europe, but not as a primary carbon dioxide removal mechanism

○ Use only if other carbon removal mechanisms are not sufficient

○ Use only in small pilot-scale projects

○ Use only under certain conditions (please specify)

○ Never use

○ ⊘ Don't know

Why do you think so? (optional)

5. Soil carbon sequestration: Land management changes (such as sustainable soil management farming practices or biochar use) which increase the soil organic carbon content.

○ Use as a primary carbon dioxide removal mechanism across Europe

○ Use as a primary carbon dioxide removal mechanism but only in certain areas of Europe

○ Use across Europe, but not as a primary carbon dioxide removal mechanism

○ Use in certain areas of Europe, but not as a primary carbon dioxide removal mechanism

○ Use only if other carbon removal mechanisms are not sufficient

○ Use only in small pilot-scale projects

○ Use only under certain conditions (please specify)

○ Never use

○ ⊘ Don't know

Why do you think so? (optional)

Please indicate the level of the confidence in your assessment of the different carbon dioxide removal options below.

	1 - Not at all confident	2	3	4 - Somewhat confident	5	6	7 - Very confident	⊘ Don't know
Afforestation/Reforestation	○	○	○	○	○	○	○	○
Bioenergy with CCS (BECCS)	○	○	○	○	○	○	○	○
Direct air capture with carbon storage (DACCS)	○	○	○	○	○	○	○	○
Enhanced weathering	○	○	○	○	○	○	○	○
Soil carbon sequestration	○	○	○	○	○	○	○	○

To what extent do you believe there is an agreement on the use of carbon dioxide removal technologies and practices to address climate change within the organization you are affiliated with?

Please give your answer on a scale of 0 to 10, where 0 means "Strong disagreement" and 10 means "Strong agreement".

○ 0 - Strong disagreement

○ 1

○ 2

○ 3

○ 4

○ ⊘ 5 - Neither agreement nor disagreement

○ 6

○ 7

○ 8

○ 9

○ 10 - Strong agreement

○ ⊘ Don't know

Now we would like to know your point of view on the motives and concerns of different stakeholders.

To what extent do you believe that, in general, NGOs have reasonable motives and concerns on the topic of carbon dioxide removal?

Please give your answer on a scale of 0 to 10, where 0 means "Not at all reasonable" and 10 means "Extremely reasonable".

○ 0 - Not at all reasonable

○ 1

○ 2

○ 3

○ 4

○ 5 - Somewhat reasonable

○ 6

○ 7

○ 8

○ 9

○ 10 - Extremely reasonable

○ Don't know

To what extent do you believe that, in general, NGOs are willing to understand the perspective of other stakeholders on the topic of carbon dioxide removal?

Please give your answer on a scale of 0 to 10, where 0 means "Not at all willing" and 10 means "Extremely willing".

○ 0 - Not at all willing

○ 1

○ 2

○ 3

○ 4

○ 5 - Somewhat willing

○ 6

○ 7

○ 8

○ 9

○ 10 - Extremely willing

○ Don't know

To what extent do you believe that, in general, private sector actors have reasonable motives and concerns on the topic of carbon dioxide removal?

Please give your answer on a scale of 0 to 10, where 0 means "Not at all reasonable" and 10 means "Extremely reasonable".

○ 0 - Not at all reasonable

○ 1

○ 2

○ 3

○ 4

○ 5 - Somewhat reasonable

○ 6

○ 7

○ 8

○ 9

○ 10 - Extremely reasonable

○ Don't know

To what extent do you believe that, in general, private sector actors are willing to understand the perspective of other stakeholders on the topic of carbon dioxide removal?

Please give your answer on a scale of 0 to 10, where 0 means "Not at all willing" and 10 means "Extremely willing".

- ○ 0 - Not at all willing
- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ 5 - Somewhat willing
- ○ 6
- ○ 7
- ○ 8
- ○ 9
- ○ 10 - Extremely willing
- ○ Don't know

To what extent do you believe that, in general, European governments have reasonable motives and concerns on the topic of carbon dioxide removal?

Please give your answer on a scale of 0 to 10, where 0 means "Not at all reasonable" and 10 means "Extremely reasonable".

- ○ 0 - Not at all reasonable
- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ 5 - Somewhat reasonable
- ○ 6
- ○ 7
- ○ 8
- ○ 9
- ○ 10 - Extremely reasonable
- ○ Don't know

To what extent do you believe that, in general, European governments are willing to understand the perspective of other stakeholders on this topic?

Please give your answer on a scale of 0 to 10, where 0 means "Not at all willing" and 10 means "Extremely willing".

○ 0 - Not at all willing

○ 1

○ 2

○ 3

○ 4

○ 5 - Somewhat willing

○ 6

○ 7

○ 8

○ 9

○ 10 - Extremely willing

○ Don't know

MANIPULATION CHECK SURVEY

Please answer the following questions about the video presentation you just watched. Responses will be kept anonymous and are meant to provide a snapshot of your opinions, whether they are firmly held or still evolving.

How convincing did you find the arguments in the video presentation?

Please give your answer on a scale of 0 to 10, where 0 means "Not convincing at all" and 10 means "Very convincing".

○ 0 - Not convincing at all

○ 1

○ 2

○ 3

○ 4

○ 5 - Somewhat convincing

○ 6

○ 7

○ 8

○ 9

○ 10 - Very convincing

○ 🚫 Don't know

To what extent do you think the arguments in the video presentation were based on scientific evidence?

Please give your answer on a scale of 0 to 10, where 0 means "None of the arguments was based on scientific evidence" and 10 means "All of the arguments were based on scientific evidence".

○ 0 - None of the arguments were supported by scientific evidence

○ 1

○ 2

○ 3

○ 4

○ 5 - Half of the arguments were supported by scientific evidence

○ 6

○ 7

○ 8

○ 9

○ 10 - All arguments were supported by scientific evidence

○ 🚫 I don't know

To what extent do you think the arguments in the video presentation were based on ethical or moral concerns?

Please give your answer on a scale of 0 to 10, where 0 means "None of the arguments were based on ethical or moral concerns" and 10 means "All of the arguments were based on ethical or moral concerns".

- ○ 0 - None of the arguments were supported by ethical or moral concerns
- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ 5 - Half of the arguments were supported by ethical or moral concerns
- ○ 6
- ○ 7
- ○ 8
- ○ 9
- ○ 10 - All arguments were supported by ethical or moral concerns
- ○ ⃠ I don't know

After listening to the keynote video, people may feel more confident in their assessments, less confident or feel similar to before the keynote. Please indicate any changes in the confidence in your assessment of the different carbon dioxide removal options.

Do you feel more or less confident in your opinion(s) of carbon dioxide removal in general?

Please give your answer on a scale of 0 to 10, where 0 means "Significantly less confident" and 10 means "Significantly more confident".

- ○ 0 - Significantly less confident
- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ 5 - Neither more nor less confident
- ○ 6
- ○ 7
- ○ 8
- ○ 9
- ○ 10 - Significantly more confident
- ○ ⃠ Don't know

After listening to the keynote video, people may feel more positive or more negative about carbon dioxide removal or feel similar to before the keynote. Please indicate any changes in your assessment of the different carbon dioxide removal options below.

Do you feel more positive or more negative about carbon dioxide removal in general?

Please give your answer on a scale of 0 to 10, where 0 means "Significantly more negative" and 10 means "Significantly more positive".

- ○ 0 - Significantly more negative
- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ 5 - Neither more negative nor more positive
- ○ 6
- ○ 7
- ○ 8
- ○ 9
- ○ 10 - Significantly more positive
- ○ ⊘ Don't know

After listening to the keynote video, people may feel more confident in their assessments, less confident or feel similar to before the keynote. Please indicate any changes in the confidence in your assessment of engineering-based carbon dioxide removal.

Do you feel more or less confident in your opinion(s) of engineering-based carbon dioxide removal?

Please give your answer on a scale of 0 to 10, where 0 means "Significantly less confident" and 10 means "Significantly more confident".

○ 0 - Significantly less confident

○ 1

○ 2

○ 3

○ 4

○ 5 - Neither more nor less confident

○ 6

○ 7

○ 8

○ 9

○ 10 - Significantly more confident

○ ⊘ Don't know

After listening to the keynote video, people may feel more positive or more negative about engineering-based solutions or feel similar to before the keynote. Please indicate any changes in your assessment of the engineering-based carbon dioxide removal options below.

Do you feel more positive or more negative about engineering-based carbon dioxide removal options?

Please give your answer on a scale of 0 to 10, where 0 means "Significantly more negative" and 10 means "Significantly more positive".

○ 0 - Significantly more negative

○ 1

○ 2

○ 3

○ 4

○ 5 - Neither more negative nor more positive

○ 6

○ 7

○ 8

○ 9

○ 10 - Significantly more positive

○ ⊘ Don't know

After listening to the keynote video, people may feel more positive or more negative about engineering-based solutions or feel similar to before the keynote. Please indicate any changes in your assessment of the ecosystem-based carbon dioxide removal options below.

Do you feel more or less confident in your opinion(s) of ecosystem-based carbon dioxide removal?

Please give your answer on a scale of 0 to 10, where 0 means "Significantly less confident" and 10 means "Significantly more confident".

○ 0 - Significantly less confident

○ 1

○ 2

○ 3

○ 4

○ 5 - Neither more nor less confident

○ 6

○ 7

○ 8

○ 9

○ 10 - Significantly more confident

○ 🚫 Don't know

After listening to the keynote video, people may feel more positive or more negative about ecosystem-based solutions or feel similar to before the keynote. Please indicate any changes in your assessment of the ecosystem-based carbon dioxide removal options below.

Do you feel more positive or more negative about ecosystem-based carbon dioxide removal options?

Please give your answer on a scale of 0 to 10, where 0 means "Significantly more negative" and 10 means "Significantly more positive".

○ 0 - Significantly more negative

○ 1

○ 2

○ 3

○ 4

○ 5 - Neither more negative nor more positive

○ 6

○ 7

○ 8

○ 9

○ 10 - Significantly more positive

○ ⊘ Don't know

POST-EVENT SURVEY

We now ask you your opinion on the same set of carbon dioxide removal technologies and practices as described previously.

Imagine you were responsible for advising on the best climate policies for the European Union, which, if any, of the following options do you think should be used? Select one answer per technology.

Although optional, we would also appreciate if you could use the blank space below each question to briefly explain the reasoning behind your choice.

1. Afforestation/Reforestation: Planting trees to absorb carbon dioxide from the atmosphere. Afforestation refers to planting trees where they did not previously exist; reforestation refers to planting trees where they were previously removed.

○ Use as a primary carbon dioxide removal mechanism across Europe

○ Use as a primary carbon dioxide removal mechanism in certain areas of Europe

○ Use across Europe, but not as a primary carbon dioxide removal mechanism

○ Use in certain areas of Europe, but not as a primary carbon dioxide removal mechanism

○ Use only when other carbon removal mechanism are not sufficient

○ Use in small pilot projects

○ Use only under certain conditions (please specify)

○ Never use

○ ⊘ Don't know

Why do you think so? (optional)

2. Bioenergy with carbon capture and storage (BECCS): Growing biomass (plant material) to be combusted for bioenergy. Carbon emissions from power generation are captured and securely stored, often underground.

○ Use as a primary carbon dioxide removal mechanism across Europe

○ Use as a primary carbon dioxide removal mechanism in certain areas of Europe

○ Use across Europe, but not as a primary carbon dioxide removal mechanism

○ Use in certain areas of Europe, but not as a primary carbon dioxide removal mechanism

○ Use only when other carbon removal mechanism are not sufficient

○ Use in small pilot projects

○ Use only under certain conditions (please specify)

○ Never use

○ ⊘ Don't know

Why do you think so? (optional)

3. Direct air capture with carbon storage (DACCS): Capturing carbon dioxide directly from the air using chemical processes and storing it in underground reservoirs.

○ Use as a primary carbon dioxide removal mechanism across Europe

○ Use as a primary carbon dioxide removal mechanism in certain areas of Europe

○ Use across Europe, but not as a primary carbon dioxide removal mechanism

○ Use in certain areas of Europe, but not as a primary carbon dioxide removal mechanism

○ Use only when other carbon removal mechanism are not sufficient

○ Use in small pilot projects

○ Use only under certain conditions (please specify)

○ Never use

○ ⊘ Don't know

Why do you think so? (optional)

4. Enhanced weathering: Accelerating earth's carbon cycle by crushing rocks and dispersing them to increase mineralisation of the absorption of carbon dioxide.

○ Use as a primary carbon dioxide removal mechanism across Europe

○ Use as a primary carbon dioxide removal mechanism in certain areas of Europe

○ Use across Europe, but not as a primary carbon dioxide removal mechanism

○ Use in certain areas of Europe, but not as a primary carbon dioxide removal mechanism

○ Use only when other carbon removal mechanism are not sufficient

○ Use in small pilot projects

○ Use only under certain conditions (please specify)

○ Never use

○ ⊘ Don't know

Why do you think so? (optional)

5. Soil carbon sequestration: Land management changes (such as sustainable soil management farming practices or biochar use) which increase the soil organic carbon content.

- ○ Use as a primary carbon dioxide removal mechanism across Europe
- ○ Use as a primary carbon dioxide removal mechanism in certain areas of Europe
- ○ Use across Europe, but not as a primary carbon dioxide removal mechanism
- ○ Use in certain areas of Europe, but not as a primary carbon dioxide removal mechanism
- ○ Use only when other carbon removal mechanism are not sufficient
- ○ Use in small pilot projects
- ○ Use only under certain conditions (please specify)

- ○ Never use
- ○ ⊘ Don't know

Why do you think so? (optional)

The following questions aim at understanding your perception of European Union climate policies

To what extent do you agree with the following statements:

	1 - Strongly agree	2	3	4	5 - Neither agree nor disagree	6	7	8	9 - Strongly disagree	⊘ Don't know
The European Union policies should focus on reducing carbon dioxide emissions instead of removing it from the atmosphere	○	○	○	○	○	○	○	○	○	○
Carbon dioxide removal mechanisms should complement reducing emissions in order to achieve more ambitious targets	○	○	○	○	○	○	○	○	○	○
The targets set by the European Union (55% greenhouse gas emission reduction by 2030 and carbon neutrality by 2050) should not rely on carbon removal and offsetting mechanisms	○	○	○	○	○	○	○	○	○	○
The European Union target of reducing greenhouse gas emissions by 55% by 2030 and achieving carbon neutrality by 2050 can only be achieved by including carbon removal and offsetting mechanisms	○	○	○	○	○	○	○	○	○	○
The European Union decision to separate targets for carbon dioxide removal and emissions reduction to reach carbon neutrality is the right approach	○	○	○	○	○	○	○	○	○	○
Carbon dioxide removal should not be included in EU targets before 2030 but could be included after 2030 subject to certain criteria	○	○	○	○	○	○	○	○	○	○

Now we would like to know your point of view on the different stakeholders motives and concerns.

To what extent do you believe that, in general, other participants in the small group discussion (the allocation exercise) had reasonable motives and concerns on this topic?

Please give your answer on a scale of 0 to 10, where 0 means "Not at all reasonable" and 10 means "Extremely reasonable".

○ 0 - Not at all reasonable

○ 1

○ 2

○ 3

○ 4

○ 5 - Somewhat reasonable

○ 6

○ 7

○ 8

○ 9

○ 10 - Extremely reasonable

○ Don't know

NEGEM

To what extent do you believe that, in general, other participants in the small group discussion (the allocation exercise) were willing to understand the perspective of other participants on this topic?

Please give your answer on a scale of 0 to 10, where 0 means "Not at all willing" and 10 means "Extremely willing".

○ 0 - Not at all willing

○ 1

○ 2

○ 3

○ 4

○ 5 - Somewhat willing

○ 6

○ 7

○ 8

○ 9

○ 10 - Extremely willing

○ Don't know

To what extent do you believe that, in general, other participants in the bigger group discussion (the questions and feedback) had reasonable motives and concerns on this topic?

Please give your answer on a scale of 0 to 10, where 0 means "Not at all reasonable" and 10 means "Extremely reasonable".

○ 0 - Not at all reasonable

○ 1

○ 2

○ 3

○ 4

○ 5 - Somewhat reasonable

○ 6

○ 7

○ 8

○ 9

○ 10 - Extremely reasonable

○ Don't know

To what extent do you believe that, in general, other participants in the bigger group discussion (the questions and feedback) were willing to understand the perspective of other participants on this topic?

Please give your answer on a scale of 0 to 10, where 0 means "Not at all willing" and 10 means "Extremely willing".

- ○ 0 - Not at all willing
- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ 5 - Somewhat willing
- ○ 6
- ○ 7
- ○ 8
- ○ 9
- ○ 10 - Extremely willing
- ○ Don't know

Finally, we would like ask you your opinion on the value of discussion of carbon dioxide removal technologies and practices.

To what extent do you think it is important to engage in a European-wide conversation about carbon dioxide removal technologies and practices with other stakeholders through events and workshops?

Please give your answer on a scale of 0 to 10, where 0 means "Not at all important" and 10 means "Extremely important".

○ 0 - Not at all important

○ 1

○ 2

○ 3

○ 4

○ 5 - Somewhat important

○ 6

○ 7

○ 8

○ 9

○ 10 - Extremely important

○ ⊘ Don't know

After engaging in conversations with other stakeholders, people may feel more confident in their assessments, less confident or feel similar compared to before the discussion. Please indicate any changes in the confidence in your assessment of the different carbon dioxide removal options.

Do you feel more or less confident in your opinion(s) of carbon dioxide removal as a whole?

Please give your answer on a scale of 0 to 10, where 0 means "Significantly less confident" and 10 means "Significantly more confident".

○ 0 - Significantly less confident

○ 1

○ 2

○ 3

○ 4

○ 5 - Neither more nor less confident

○ 6

○ 7

○ 8

○ 9

○ 10 - Significantly more confident

○ ⊘ Don't know

NEGEM

After engaging in conversations with other stakeholders, people may feel more positive or more negative about carbon dioxide removal or feel similar to before the discussion.

Do you feel more positive or more negative about carbon dioxide removal in general?

Please give your answer on a scale of 0 to 10, where 0 means "Significantly more negative" and 10 means "Significantly more positive".

○ 0 - Significantly more negative

○ 1

○ 2

○ 3

○ 4

○ 5 - Neither more negative nor more positive

○ 6

○ 7

○ 8

○ 9

○ 10 - Significantly more positive

○ ⊘ Don't know