‘What the public think about Carbon Dioxide Removal’ Technical Appendix: methods

The information in this report is based on research conducted by LC^{3}M researchers at Cardiff University, using in-depth qualitative workshops and a large survey in the UK and the US.

Workshop design and protocol

To explore what people think about Carbon Dioxide Removal, researchers designed a series of 6-hour workshops, held on two evenings a week apart. Using established methods for exploring public perceptions of new or unfamiliar technologies, the workshops provided an open space for participants to explore ideas with each other. We designed a range of activities to explore perceptions of three Carbon Dioxide Removal technologies, as well as people’s attitudes to the general idea of removing CO_2 from the atmosphere.

The first evening of the workshops started with a discussion about ‘ways of reducing the risk of climate change’. After an ice-breaker, the facilitator gave a presentation about three types of climate change action: changing energy supply, changing energy demand, and adapting to climate change impacts, followed by a whole-group discussion. We then gave a very short introduction to the idea of removing CO_2 from the atmosphere, before introducing the three technologies with posters around the room, using the cartoon images and text shown in the main report. Participants moved freely among the posters, using sticky notes to write comments and questions, which we discussed as a group. At the end of the first evening we set a homework task to discuss the workshop with friends and family, and to look things up on the internet. Participants then filled out a short questionnaire, asking for their opinions on CO_2 removal and the three technologies on a scale of 1-10, as well as the reasons for their responses. Copies of stimulus materials are published in supplementary materials in *Nature Climate Change.*[i]

The second evening started with a discussion of the homework task. We then looked at Enhanced Weathering in more detail, focusing on six topics – three positive, three negative – which emerged from a series of interviews we had conducted with experts in Spring 2018, published in *Environmental Values*.[ii] We presented the topics using quotes from the interviews, in a random order. In small groups of 2-3, participants discussed a quote, followed by whole-group discussion. The second evening ended with a ‘reflections and feedback’ session, and a Q&A for participants to ask questions to the research team. We held this session last to avoid biasing the discussions with our responses. At the very end, participants filled out another questionnaire, with the same questions as on the previous evening so we could test for change over time, as well as asking for their feedback on the workshop.

Workshop sample and recruitment

We held six workshops in six locations in the UK and US between November 2018 and February 2019. In each country, we chose a large diverse city (Cardiff and Chicago), a small University town (Norwich and Champaign-Urbana, IL), and a rural area (Norfolk and mid-Illinois). We chose East Anglia and Illinois because grain agriculture may be a key location for deploying Enhanced Weathering.

47 participants took part. Our recruitment was not intended to be statistically representative of the population; rather, we recruited a diverse group of participants to provide a rich and meaningful dataset, aiming for age and gender balance and a demographic profile which roughly mirrored that of the location (see Table 1). We used topic-blind recruitment, telling people it was a workshop about “solutions to global challenges”. Recruitment was conducted by a professional recruitment company in the UK, and the University of Illinois Extension Office in the US. Participants were given a cash honorarium for their time.

Table 1. Summary table of demographics for deliberative workshops participants.

		Cardiff	Chicago	Norwich	Champaign-Urbana	Rural Norfolk	Rural Illinois
	Total N	8	8	8	8	8	7
Gender	**Male**	4	2	4	3	4	5
	Female	4	6	4	5	4	2
Age	**18 – 24**				2		
	25 – 34	1	1	3		2	1
	35 - 44	1	4	2	1	1	1
	45 – 54	4	1	1	1		
	55 - 64		1	1	3	4	2
	65+	2	1	1	1	1	3
Education	**None**		1			1	1
	Level 1/ High school diploma	4		5		5	1
	Level 2/ Associate degree	2	2	2		1	2
	Level 3/ Bachelor degree	1	3	1	5	1	
	Level 4/ Postgrad degree	1	2		3		3
	Other						

Survey procedure

The survey was designed to measure perceptions of climate change and public understanding of Carbon Dioxide Removal. The survey was administered through Qualtrics in February and March 2019, using online panels for the recruitment process. Quotas were set for age, gender, education and geographical region to ensure that the sample was representative of the public in each country (see table 2 for demographic information). 1000 people in the UK and 1026 people in the US took part; the US sample was slightly larger to ensure that our quotas were met. The survey was designed after extensive piloting and feedback from technical and language experts.

Survey questions

The survey first asked a series of questions about people's understanding of and attitudes towards climate change. They were then asked to write down the first three words or images which came to mind when they heard the term 'Carbon Dioxide Removal', to find out the associations which first spring to people's minds.

Next, we provided a short description of Carbon Dioxide Removal:
"Scientists and policymakers have become more interested in carbon dioxide removal or 'CDR' as a strategy that may slow or reverse climate change. These strategies remove excess carbon dioxide (CO_2) from the atmosphere through various biological, chemical or physical processes. The carbon dioxide would be stored by plants, in soils, or deep underground and in the deep ocean so that it cannot contribute to an increase in the Earth's temperature."

After this description, we asked people how much they knew about CDR before today. We then asked how much they agreed with the following eight statements:

- There may be negative impacts of CDR technologies on the environment
- CDR technologies will lower the drive to cut emissions
- CDR technologies are being driven more by profit than the public interest
- CDR technologies will mainly benefit rich countries and impact on poor countries
- CDR technologies could help to provide more time to reduce emissions
- It will be cheaper to use CDR technologies than to reduce the consumption of fossil fuels
- CDR technologies will help slow climate change down faster than by simply cutting greenhouse gas emissions
- CDR only deals with the symptoms and not the causes of emissions

Table 2: Demographic characteristics of survey participants

		UK (N = 1000)		US (N = 1026)	
		N	**%**	**N**	**%**
Gender	**Male**	492	49.2	502	48.9
	Female	508	50.8	524	51.1
Age	**18 – 24**	131	13.1	134	13.1
	25 – 34	169	16.9	170	16.6
	35 - 44	161	16.1	162	15.8
	45 – 54	169	16.9	174	17
	55 - 64	159	15.9	165	16.1
	65+	211	21.1	221	21.5
Education	**No qualification/Less than high school**	221	22.1	114	11.1
	Other	83	8.3	-	-
	Level 1/ High school diploma	140	14	300	29.2
	Level 2/ Associate degree	151	15.1	288	28.1
	Level 3/ Bachelor degree	121	12.1	169	16.5
	Level 4/ Postgraduate degree	284	28.4	155	15.1

Contact details

All aspects of this project were approved by the Psychology Ethics Committee at Cardiff University: psychethics@cardiff.ac.uk

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[i] Cox, E., Spence, E. and Pidgeon, N. (2020) Public perceptions of carbon dioxide removal in the United States and United Kingdom, *Nature Climate Change,* doi 10.1038/s41558-020-0823-z

[ii] Cox, E., Spence, E. and Pidgeon, N. (2020) Incumbency, trust, and the Monsanto effect: stakeholder discourses on Greenhouse Gas Removal, *Environmental Values,* 29, 2, 197-220