Public preferences for state-level carbon cap-and-trade programs

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ABSTRACT

Using survey-based choice experiments, we assess demand for alternative state-level carbon cap-and-trade programs. Household willingness to pay (WTP) depends upon more than just the emissions reductions that may be achieved. Households definitely care about changes in the numbers of carbon-intensive versus "green" jobs in their own county and whether there will be additional regulations to limit non-global co-pollutant emissions from firms that buy permits. Preferences are somewhat less easy to discern with respect to the share of permits auctioned and revenue recycling options (i.e., the shares of auction revenue used to help households and firms to buy emission reducing equipment, or to support communities/workers that bear a relatively heavier burden due to the program's costs). We specifically model response propensities among invited participants, which makes possible an *ad hoc* correction for sample selection bias in the estimating sample, relative to the general population. Heterogeneous preferences are accommodated via mixed logit and latent class specifications, where individual respondent characteristics predict latent class membership. But we also estimate a model suitable for out-of-sample forecasting of WTP in other regions nationally, where systematic heterogeneity is captured by county-level characteristics. Main results include estimates of the marginal benefit exclusively from a one-tonne carbon emissions reduction (an alternative/complementary measure to the social cost of carbon), the marginal rate of substitution between carbon-sector and green-sector jobs, and a complete set of marginal willingness-to-pay estimates for each distinct program attribute. Our model with county-level observable heterogeneity uses (1) predicted county-level climate-change attitudes from the Yale Climate Map project, and (2) county-level COVID-19 case rates in prior months, given that the survey was fielded primarily during August and September of 2021. For selected carbon cap-and-trade programs, we conduct "benefits-function transfer" exercises that reveal information about the predicted distributional effects of these programs. For each program scenario, outputs include the county-population-weighted marginal size distribution of predicted WTP across the lower-48 U.S. states, along with selected maps conveying the spatial distributions of predicted WTP across these 3,107 counties. The county-level predictions can also be aggregated to the state or regional level. Finally, we assess the differences in our model's predictions with and without the effects of the COVID-19 pandemic, finding that predicted national mean WTP for carbon cap-and-trade programs would have been considerably higher had COVID-19 case rates been everywhere zero.

JEL classifications: Q51, Q52, Q54, Q58

Keywords: Carbon cap-and-trade programs; choice experiments; social benefits of carbon reduction; labor-market impacts of carbon policy; just transition; environmental justice; permit auctions; revenue recycling; sample selection correction; mixed logit; latent class logit; LASSO variable selection; benefits function transfer; size and spatial distributions of carbon policy benefits; pandemic effects on carbon policy demand

1 Introduction

Even as the destructive effects attributed to climate change intensify, as documented by the regularly updated reports from the Intergovernmental Panel on Climate Change (IPCC, 2018, 2021), the United States remains polarized about climate change policy (Egan and Mullin, 2017). Optimal design and successful implementation of carbon mitigation policy has proven to be exceedingly difficult, despite its importance (Aldy and Pizer, 2009). Carbon pricing is often touted as economically efficient and potentially the most politically feasible approach to carbon emissions management (e.g., Metcalf, 2009; Chen and Hafstead, 2019). Carbon cap-and-trade programs have thus gained traction as a promising tool for climate change mitigation (Newell et al., 2014; Raymond, 2019).

Regional carbon cap-and-trade programs have been adopted, but the United States has yet to launch such a program at the federal level (see Schmalensee and Stavins (2017) for discussion). The increasingly urgent need for mitigation policy, along with federal inaction, may necessitate regional coalitions analogous to the Regional Greenhouse Gas Initiative (RGGI), or participation by individual states (besides just California and Washington State) in cap-and-trade programs at a sub-federal level (Fullerton and Karney, 2018).

Lack of support for carbon cap-and-trade programs could be the product of a number of different factors. For instance, conservative politicians who oppose many types of environmental policies have employed the phrase "job-killing regulations" to sour the public against programs like cap-and-trade, despite a lack of conclusive evidence from existing programs (Coglianese et al., 2013). Additionally, market-based carbon emission solutions, like cap-and-trade, have been criticized for their inattention to distributional impacts in general (e.g., Fullerton and Muehlegger, 2019; Goulder et al., 2019b; Pizer and Sexton, 2019; Feger and Radulescu, 2020). A number of the papers in the literature have found evidence that carbon pricing can be regressive (e.g., Burtraw et al., 2009; Grainger and Kolstad, 2010; Moz-Christofoletti and Pereda, 2021). Carbon pricing policies also have the potential to be regressive in terms of their net benefits (Fullerton, 2011). Carbon cap-and-trade programs also raise specific environmental justice concerns (Kaswan, 2008; Farber, 2012). Evidence about the validity of these theoretically possible concerns has been mixed (e.g., Fowlie et al., 2012; Anderson et al., 2018; Hernandez-Cortes and Meng, 2020). They nonetheless remain an impediment to the wider adoption of carbon cap-and-trade programs.

In their review of climate change opinion surveys in the United States, Egan and Mullin (2017) find that political partisanship is the most important determinant of support for carbon-reduction policies, and the gap between Republicans and Democrats has become even more pronounced in recent years. This assessment has been corroborated using revealed preference voting data at the precinct level (e.g., Anderson et al., 2019). This partisan division appears to be due, at least in part, to a considerable effort on the part of some corporations to encourage opposition to climate policies through misinformation campaigns (Farrell, 2016; Westervelt, 2020). If policy makers wish to design a carbon cap-and-trade program that has adequate public support, a better understanding is required of the factors that affect willingness to pursue these programs.

In this study, we conduct a stated-preference survey to measure individual preferences for key attributes of a state-level carbon cap-and-trade program. Using randomized choice experiments in an online instrument, we collect a quota-based sample of 1,050 respondents from the Qualtrics consumer panel. Each respondent is asked to consider six essentially unique cap-and-trade programs. In each choice scenario, the respondent can cast an advisory vote (a) in favor of the program or (b) to keep the status quo (i.e. no program). We then use these six votes per person to estimate a random utility model. The separate marginal utility parameters estimated for this model allow us to calculate individuals' marginal willingness to pay (MWTP) for various program attributes. Our survey also collects selected respondent characteristics which enable us to infer systematic differences in preferences for programs with different attributes (e.g., different labor-market effects, different types of distributional consequences).

One novel feature of our analysis is that we assemble individual or community-level sociodemographic information for every quota-screened and eligible consumer panelist who engages at least minimally with the invitation to consider taking our survey (before knowing the topic of the survey). We collect these individual data (and supplement them with community-level information) regardless of whether the individual completes the survey. This information about all panelists who minimally engage with the survey invitation permits us to estimate a response/nonresponse model, a necessary step if we are to assess and correct for systematic sample selection.[1]

We faced constraints on the geographical scope of our study as a result of our source of funding. As a consequence, our sample is drawn from just one west-coast U.S. state: Oregon. In 2019 and 2020, Oregon's legislature twice attempted, unsuccessfully, to create a carbon cap-and-trade program. Oregon's attempts and failure to launch such a program highlight the complicated and contentious political, environmental, and social concerns regarding environmental regulation (Farber, 2012; Deryugina et al., 2019; Fowlie et al., 2020). Successful passage of a carbon cap-and-trade program for Oregon, as for many other states, will rely on the extent to which policy makers understand population preferences for a number of key program attributes. Notably, the state of Oregon has also recently experienced an onslaught of extreme temperatures and serious wildfires that are most likely attributable, at least in part, to the effects of climate change on long-term drought conditions, so that climate policy is a salient contemporary issue for many Oregon residents.

To preview some of the insights from our study, we find that there is considerable heterogeneity in people's preferences across different types of state-level carbon cap-and-trade programs. However, these programs have many more attributes besides just their costs and the carbon emissions reductions they are expected to achieve. Across five different types of specifications, our average estimates are relatively stable for the marginal willingness to pay exclusively for a program's re-

[1]The survey screens potential respondents against quotas, and we learn the age, race, gender, and income level of every invitee based on their panelist profile. We also collect the zip code of every potential respondent before they learn the topic of the survey. As a technique for ensuring a representative sample, this strategy was approved by our university's Institutional Review Board.

ductions in carbon emissions. These estimates also line up with recent federal-level assumptions about the social cost of carbon used for policy-making in the U.S. We also use LASSO methods (based on prediction success in holdout samples) to identify important county-level observable heterogeneity in the marginal utilities of other relevant attributes of cap-and-trade programs. We use this model to estimate willingness to pay for a variety of different carbon cap-and-trade programs across all 3,107 counties in the lower-48 U.S. states. We illustrate this heterogeneity both in size distributions for WTP and with maps of WTP by county in the U.S.

2 Related Literature and Our Contributions/Innovations

The present study makes contributions to several different veins of research.[2] First, our interest in carbon policy preferences aligns our work with the broader evolving interdisciplinary literature on "climate policy acceptability," including the recent large-scale multi-country effort by Dechezleprêtre et al. (2022). That ambitious project seeks to clarify how people feel about different kinds of climate policies, although they do not conduct a utility-theoretic choice experiment that permits estimation of trade-offs willingly made among program attributes. Earlier social science research about policy support and public acceptability of climate change policies is reviewed by Kyselá et al. (2019), and addressed in Raymond (2019) with reference to existing carbon cap-and-trade programs.

We contribute, more specifically, to a literature that uses stated-preference studies to understand public preferences for carbon pricing policies. For example, in very recent papers, Abildtrup et al. (2024) conduct a multi-country European choice experiment to compare preferences for policies which target renewable energy use, industrial energy efficiency, carbon sequestration, or forest biomass. Alternatively, van der Cam et al. (2023) employ choice experiments to assess preferences for personal carbon allowances, focusing whether carbon price regulations are included

[2]Appendix A provides more-detailed reviews of other papers in the related literature. Here, we merely summarize these papers by group.

and whether advice is made available about how to reduce carbon emissions. Fanghella et al. (2023) focus on alternative burden-sharing rules, the rural/urban distribution of benefits, and the phenomenon of "self-serving bias."

Carattini et al. (2018) provide a survey of stated-preference work up until the time of their review paper, aimed at understanding public opposition to carbon pricing.[3] The bulk of the extant literature focuses on carbon taxes or other broadly defined carbon reduction policies. For instance, Kotchen et al. (2017) conducted a survey of Americans to measure the WTP for a carbon tax as well as preferences for how the tax revenue is spent. Their results indicate a substantial mean WTP ($177 per year). Additionally, 80% of their respondents indicate they would favor using the revenue to fund green projects and 70% would favor using it to support a "just transition" for coal workers. Carattini et al. (2017) use a recent real ballot initiative as their context for a follow-up stated-preference survey. They focus on a carbon tax and find lump sum redistribution of tax revenue and "social cushioning" to be popular. They also find that including more information about a policy improves its acceptability. Likewise, Maestre-Andrés et al. (2021) explore carbon tax acceptability as a function of how the revenue is to be used (i.e., on "climate projects," or to compensate low-income individuals), where they conclude that policy acceptability is more strongly related to perceptions of fairness than perceptions of the policy's effectiveness. Their choice-experiment study follows a related literature review provided in Maestre-Andrés et al. (2019).

Research has found that revenue recycling, and providing the public with tangible public benefits, could significantly improve support for carbon pricing (Amdur et al., 2014; Beiser-McGrath and Bernauer, 2019). In a similar vein, some national-level studies or multi-country studies have focused on measuring preferences for the distribution of costs imposed by a climate change policy (e.g., Lee and Cameron, 2008; Cai et al., 2010; Scasny et al., 2017)). Brannlund and Persson

[3]Other examples of stated preference studies that focus on preferences regarding carbon pricing include Berrens et al. (2004); Aldy et al. (2012); Kotchen et al. (2013); Duan et al. (2014); Yang et al. (2014); Gevrek and Uyduranoglu (2015); Raux et al. (2015); Lee and Heo (2016); Tvinnereim et al. (2017); Li et al. (2019); Rotaris and Danielis (2019); Böhringer et al. (2020); Daziano et al. (2021).

(2012) use an internet-based survey in Sweden to measure preferences concerning an unspecified carbon pricing policy. They described policy alternatives in terms of (a) their development of green tech, (b) their ability to increase climate change awareness, (c) their monthly cost, (d) their *distribution* of costs, and (e) their geographic distribution of carbon reductions. They find that their respondents prefer policies that are (a) progressive, (b) have lower costs, and (c) raise awareness for climate change. On the other hand, Baranzini and Carattini (2017) conduct a qualitative-quantitative hybrid survey and find that individuals are more concerned about the environmental effectiveness of a carbon tax than with the distributional challenges that result, or the potential effects of the tax on firm competitiveness. Public preferences for carbon policies thus may differ systematically across contexts and geographically.

In general, stated-preference studies have avoided asking the public about carbon cap-and-trade programs with multiple varying attributes (e.g., Alberini et al., 2018). However, a few studies have asked respondents about cap-and-trade programs in comparison to other types of programs. For instance, Kotchen et al. (2013) conducted a stated-preference survey that measured WTP for carbon reduction across different policy instruments (e.g. carbon tax, cap-and-trade, and a "policy to regulate carbon dioxide as a pollutant") and find no preference across instruments. However, their survey does relatively little to inform respondents about the substantive differences in the ways these policies would be implemented. Choi et al. (2018) and Baranzini et al. (2018), however, do conduct surveys that focus on "offset" preferences, where offsets are one aspect of many carbon cap-and-trade programs.

To the best of our knowledge, the present study constitutes the most-detailed analysis of preferences for different possible attributes of alternative carbon cap-and-trade programs. Considering the leading role that carbon cap-and-trade programs are presently taking in climate change policy, this is an important contribution. We also contribute to the body of work that focuses more narrowly on public opinion regarding carbon policy specifically at the single-state level (e.g. Holian and Kahn (2015); Burkhardt and Chan (2017), and Anderson et al. (2019)). The U.S. state of

Washington has recently joined the Western Climate Initiative, a carbon market that includes both the state of California and the Canadian province of Quebec. This decision was made by the state in spite of its earlier experiences with proposed carbon taxes. Anderson et al. (2019) use revealed-preference voting data from two failed carbon tax bills in Washington and find that political party affiliation is by far the biggest indicator of support or opposition to the policies, with political ideology accounting for 91% of the variation in vote shares across precincts. This finding is consistent with the broad review of climate change opinion surveys by Egan and Mullin (2017). Our study is based on hypothetical advisory votes, rather than actual voting results, but this strategy allows us to vary the nature of the cap-and-trade program in question, and to explore the explanatory power of individual and county-level data on choices among a wide variety of policies, rather than relying solely on precinct-level data for a single policy.

In the course of our study, we also innovate in the realm of stated-preference methodologies. First, we innovate in the design and implementation of our survey. We optimize our choice tasks for people who take the survey on a smartphone, but maximize their ability to refer back to the specific definitions of each attribute. We plan ahead to facilitate sample-selection modeling—we use preliminary questions that elicit respondent ZIP codes before revealing the topic of the survey, and ask the survey research firm to retain all available individual information about everyone who is invited to take the survey, not just the respondent sample. We elicit the respondent's county of residence at the start of the survey, when the survey software draws one set of randomized generic program attributes from our server to be shown to that individual. On the fly, we then convert the generic percentages for a subset of the attributes into absolute numbers, specifically for that respondent's own county.

We also innovate in terms of our analysis, dictated by our desire to produce an estimated "benefits function" that can potentially be employed across the entire U.S. It is wasteful to limit a study to just one state when the findings can potentially be generalized. In addition to the usual conditional logit, mixed logit, and latent class models, we estimate a specification that relies on LASSO methods to identify important county-level heterogeneity in the marginal utilities for specific cap-and-trade attributes. Mixed logit models can accommodate heterogeneous preferences, but are not suitable for predicting willingness to bear the costs of cap-and-trade programs for populations that differ from the population from which the estimating sample was drawn. Latent class models with individual heterogeneity can be useful for out-of-sample predictions if individual characteristics are known for the prediction population, but this is rare. Political ideologies and climate change attitudes are potent determinants of demand for carbon cap-and-trade programs, but there is a risk that respondents' individual subjective climate attitudes, especially, are jointly endogenous with their climate policy preferences, and this may bias the estimated coefficients. For a model to be used for out-of-sample predictions of cap-and-trade program preferences across the broader U.S., we employ exogenous measures of climate attitudes at the county level from a completely separate series of nationwide climate attitude surveys conducted by researchers as part of a long-running program based at Yale University. Lastly, we also control for, and explore the consequences of netting out the apparent effects of the COVID-19 pandemic on cap-and-trade program preferences.

3 Choice Models

This section outlines our specific random utility models in terms of the cap-and-trade program attributes featured in our survey.

3.1 Homogeneous preferences: Simple conditional logit models

Our choice experiments describe each potential cap-and-trade program in terms of nine attributes. The first two describe the program's basic cost and effectiveness: the monthly cost per household; and the percent change in carbon emissions (where these percentage changes are negative). The next three attributes can be categorized as the program's "distributional consequences": the percent change in carbon-industry jobs (always negative in our scenarios); the percent change in green-industry jobs (always positive); and whether the program would include additional regulations on other pollution. These regulations would prevent co-pollutant levels from increasing in the vicinity of firms that buy carbon permits. Permits allow increases in a firm's emissions of carbon, and when carbon emissions increase, emissions of other co-pollutants often increase as well. The final three program attributes concern the auctioning of carbon permits and the recycling of any auction revenue. We specify the percent of carbon emissions permits that would be auctioned to firms (rather than being given away for free), the percent of auction revenue that would be used to "help households and companies to buy emission reducing equipment" (i.e., private-sector "carbon projects"); and the percent of auction revenue that would be used to "support communities/workers that bear a relatively heavier burden due to the program's costs." Any auction revenue not going to equipment, or to communities/workers, is described as being placed into the state's General Fund to "reduce the burden of other existing state taxes paid by Oregon residents."[4]

Our models are all based on the indirect utility of respondent i under carbon cap-and-trade Program A. Similar to the usual specification for a public policy choice model in the stated-preference literature, our simplest model is linear and additively separable in the attributes for each program:[5].

$$
\begin{aligned}
(1) \qquad V_i^A = {} & \alpha(Y_i - C_i^A) + \beta_1 \mathbf{1}(any\ program)_i^A + \beta_2(\%\Delta carbon\ emissions)_i^A \\
& + \beta_3(\%\Delta carbon\ jobs)_i^A + \beta_4(\%\Delta green\ jobs)_i^A \\
& + \beta_5 \mathbf{1}(pollution\ regs)_i^A + \beta_6(\%permits\ auctioned)_i^A \\
& + \beta_7(\%revenue\ to\ equip)_i^A + \beta_8(\%revenue\ to\ workers)_i^A + \eta_i^A,
\end{aligned}
$$

[4]Our descriptions of the uses of auction revenue as the economy adapts to carbon pricing differ somewhat, semantically, from what has been used in some other studies. For example, Maestre-Andrés et al. (2021), in their choice experiment, describe the expenditure of carbon tax revenues on "climate projects," or on "compensating low-income households."

[5]Our choice scenarios were designed to support exactly this straightforward indirect utility specification (see the arbitrary single instance of our randomized survey instrument in the Supplementary Materials, in particular, section E.24).

The $\mathbf{1}(\textit{any program})_i^A$ indicator is activated for any type of cap-and-trade program and equals zero for the status quo alternative. Given that the three percentages of auction revenue sum to 100, we designate the percent of permit auction revenue going to the state's General Fund as the omitted category, with this share determined by the percentages not destined for the other two uses.[6]

Indirect utility for respondent i under the status quo, V_i^N, involves no policy and therefore no decrease in household income, no carbon reduction, no changes in the numbers of carbon jobs or green jobs in the respondent's county, no extra regulations to prevent increases in local co-pollutants, no auctioned permits and therefore no auction revenue to spend on equipment or communities/workers (or to provide tax relief). For this alternative, $\mathbf{1}(\textit{any program})_i^A = 0$. The utility for the No Program alternative is therefore given simply by:

$$V_i^N = \alpha Y_i + \eta_i^N, \tag{2}$$

since none of the attributes of Program A will be enjoyed.

Each respondent's choice between policy A and the status quo is determined by whether policy A yields greater utility. Let $\Delta V_i^A = V_i^A - V_i^N$ be the difference in indirect utilities for respondent i from policy A and the status-quo option N, so that policy A is chosen if and only if $V_i^A \geq V_i^N$ (i.e., if $\Delta V_i^A > 0$). Individual i's baseline level of income drops out, so our simplest linear-in-variables econometric specification is as follows.

$$\begin{aligned} \Delta V_i^A = {} & \alpha(-C_i^A) + \beta_1 \mathbf{1}(\textit{any program})_i^A + \beta_2(\%\Delta \textit{carbon emissions})_i^A \\ & + \beta_3(\%\Delta \textit{carbon jobs})_i^A + \beta_4(\%\Delta \textit{green jobs})_i^A \\ & + \beta_5 \mathbf{1}(\textit{pollution regs})_i^A + \beta_6(\%\textit{permits auctioned})_i^A \\ & + \beta_7(\%\textit{revenue to equip})_i^A + \beta_8(\%\textit{revenue to workers})_i^A + \varepsilon_i^A, \end{aligned} \tag{3}$$

[6] Thus if $(\%\textit{revenue to equip})_i^A = 0$ and $(\%\textit{revenue to workers})_i^A = 0$, then any and all auction revenue goes exclusively into the state's General Fund to replace existing taxes.

where $\varepsilon_i^A = \eta_i^A - \eta_i^N$, an error term that has a mean of zero.

The respondent is presumed to know their true utility for a specific program. They will vote *for* Program A if the utility difference, ΔV_i^A, is positive, and will vote *against* Program A if the utility difference is negative. The researcher, however, does not observe ε_i^A. The assumed distribution for this random error term determines the functional form of the log-likelihood function used to estimate the preference parameter vector $(\alpha, \beta_1, ..., \beta_8)$ in equation (3) via maximum likelihood methods.

Given that the stochastic structures and the corresponding log-likelihood functions for the models used in this paper are well-documented elsewhere in the literature and familiar to most researchers currently working with choice-experiment data, we relegate the econometric details of this specification, as well as those which follow, to Appendix B in the Supplementary Materials.

The fitted model with its estimated parameters can be used to solve for each respondent's marginal willingness to pay (WTP) for each of the separate policy attributes described in our choice tasks. For the homogeneous-preferences specification in equation (3), we set the utility difference, ΔV^A, equal to zero and solve for the program cost, C_i^{A*}, that would make the representative individual just indifferent between paying the cost and enjoying the benefits of Program A, or keeping the money and doing without Program A. This maximum total willingness to pay for a policy with a specified set of characteristics will be given by the following expression, where $\mathbf{1}(\textit{any program})_i^A = 1$ for every non-status-quo program, resulting in the initial constant term, and researchers typically evaluate WTP at the zero mean of the symmetric error term in the utility-difference function:

$$\widehat{WTP}_i^A = C_i^{A*} = \frac{\hat{\beta}_1}{\hat{\alpha}} + \frac{\hat{\beta}_2}{\hat{\alpha}}(\%\Delta carbon\ emissions)_i^A + \frac{\hat{\beta}_3}{\hat{\alpha}}(\%\Delta carbon\ jobs)_i^A + \frac{\hat{\beta}_4}{\hat{\alpha}}(\%\Delta green\ jobs)_i^A + \frac{\hat{\beta}_5}{\hat{\alpha}}\mathbf{1}(pollution\ regs)_i^A + \frac{\hat{\beta}_6}{\hat{\alpha}}(\%permits\ auctioned)_i^A + \frac{\hat{\beta}_7}{\hat{\alpha}}(\%revenue\ to\ equip)_i^A + \frac{\hat{\beta}_8}{\hat{\alpha}}(\%revenue\ to\ workers)_i^A \tag{4}$$

The marginal willingness to pay for any given program attribute, $\frac{\hat{\beta}_k}{\hat{\alpha}}$, is only *one* type of marginal rate of substitution that can be estimated using this choice model. Marginal rates of substitution between any pair of attributes are given by the *negative* of the ratio of the marginal utilities for each attribute.[7] Equation (3) can thus be used also to quantify other types of trade-offs that people are willing to make in considering carbon cap-and-trade policies, not just the trade-off between net income and each of the non-cost attributes of the program.

For example, another politically important consideration with cap-and-trade programs is the expectation that they will result in a loss of jobs in the carbon-intensive sector. Rather than thinking about willingness to pay (i.e. willingness to put up with higher program costs in order to enjoy more of some non-cost program attribute), we can instead think about willingness to incur job losses in the carbon sector to enjoy the benefits of the program. We could again set the utility difference in equation (3) equal to zero, but instead solve for the $(\%\ carbon\ jobs\ lost)_i^A$ that would make people just indifferent between getting the carbon cap-and-trade program and its carbon-reduction benefits, along with those job losses, or forgoing the program and protecting those jobs. Willingness to swap (WTS) carbon-intensive jobs for a carbon-reduction program with a given set

[7]For the WTP calculations, cost C_i^A is technically the attribute of the program, but we model net income as the factor that drives utility for the consumer. The marginal rate of substitution between program attributes and net income $(Y_i - C_i^A)$ is positive, although the marginal rate of substitution between program attributes and cost itself (C_i^A, a "bad") would be negative, since more of some desirable attribute would be required to make up for a higher cost.

of other attributes could be calculated as:

$$(5) \qquad WTS(\%\Delta carbon\ jobs)_i^A = \frac{\hat{\alpha}}{\hat{\beta}_3}(C_i^A) - \frac{\hat{\beta}_1}{\hat{\beta}_3}$$

$$- \frac{\hat{\beta}_2}{\hat{\beta}_3}(\%\Delta carbon\ emissions)_i^A - \frac{\hat{\beta}_4}{\hat{\beta}_3}(\%\Delta green\ jobs)_i^A$$

$$- \frac{\hat{\beta}_5}{\hat{\beta}_3}\mathbf{1}(pollution\ regs)_i^A - \frac{\hat{\beta}_6}{\hat{\beta}_3}(\%permits\ auctioned)_i^A$$

$$- \frac{\hat{\beta}_7}{\hat{\beta}_3}(\%revenue\ to\ equip)_i^A - \frac{\hat{\beta}_8}{\hat{\beta}_3}(\%revenue\ to\ workers)_i^A$$

Equation (5) allows us to determine what percent of their county's jobs in carbon-intensive industries people would be willing to give up to achieve a given percent *reduction* in carbon emissions, holding all other program characteristics constant (including their own household's costs). This is an elasticity-type measure. Likewise, we can use this equation to determine what percent of their county's jobs in carbon-intensive industries in their county people would be willing to give up to enjoy a given percent increase in their county's green jobs via a cap-and-trade program, holding constant all other program attributes including their own household's cost.

Finally, note that we use the marginal utility of a percentage change in jobs, rather than the marginal utility of net income, in the denominators in the "willingness to swap" formula in equation (5). This equation highlights the availability of an analog to the concept of a *total* willingness to pay. Suppose we are given information about both the household cost and the effectiveness of a carbon cap-and-trade program, along with the percent increase in green jobs that would result, along with the presence/absence of co-pollutant regulations, the auction percentage and revenue recycling plan. Equation (5) can tell us, in the context of that particular cap-and-trade program with all its other attributes, what percentage of jobs in carbon-intensive industries people would be willing to sacrifice to achieve a one percent decrease in carbon emissions via this specific cap-and-trade program.

3.2 Heterogeneous preferences: Mixed logit models

Mixed logit models are *continuous* mixture models. These models have gained popularity in the choice-experiment literature due to their ability to accommodate unobserved heterogeneity in preferences. The mixed logit model starts from a homogeneous-preferences specification as in equation (3). However, instead of assuming that each marginal utility parameter is a true but unknown constant—identical for everyone—the mixed logit specification allows some or all of these marginal utilities to be heterogeneous, in the sense of having a distribution of values across the population represented by the estimating sample. An explicit functional form must be selected for the assumed distribution of each parameter, and the research question expands to concern both (a) the central tendency and (b) the dispersion of these parameters in the population. For normally distributed parameters, then, instead of estimating just the expected value of any given marginal utility (β_k), researchers also estimate the standard deviation (σ_k) of the *distribution* of that marginal utility across the sample (and thus across the population that the sample represents).

Mixed-logit models that allow for unobserved variation in preferences have the advantage of being relatively parsimonious. However, the model does not seek to attribute this heterogeneity to any particular observable respondent characteristics. The estimated model is therefore not necessarily suitable for predicting choices in different populations where "mean preferences" might be expected to be different (i.e., for model transfer to a population for which the estimating sample cannot be considered representative). Likewise, mixed logit models do not help us to identify interesting *systematic* variation in preferences according to observed respondent characteristics. *Observed* preference heterogeneity may be very important to our understanding of the *distributional consequences* of a policy. Instead, a mixed logit model merely accommodates the existence of unobserved heterogeneity in preferences. This flexibility might sufficiently relax the implicit restrictions in the conditional logit choice model to reduce any heterogeneity bias in the estimated sample-mean parameters (analogous to the rationale for using fixed-effects models for panel data in a least-squares context).

3.3 Heterogeneous preferences: Latent class models

Many researchers working with data from choice experiments now automatically entertain latent-class models as well. In these models, it is assumed that each respondent's preferences can be captured as a finite mixture of a small number of underlying preference types, each with it own vector of preference parameters. A "class membership" submodel within the latent class specification explains the probability of a respondent's membership in each preference class as a function of their individual characteristics. Each person's preferences are then a probability-weighted average of the homogeneous preferences estimated for each latent class. The structure of the log-likelihood function, and some considerations during estimation, are described in Appendix B in the Supplementary Materials.

In this study, we estimate two different latent-class models. One explains class membership with a set of relatively exogenous individual-specific respondent characteristics. The second explains class membership with a set of individual-specific ideologies and climate-change attitudes, even though these are less likely to be exogenous to people's stated program choices.

3.4 Heterogeneous preferences: Observable systematic variation

When the researcher has observable information about (preferably exogenous) respondent characteristics, it is possible to estimate models where each marginal utility parameter in the choice model is permitted to vary systematically as a function of these characteristics. Rather than individual preferences being a finite mixture of some small set of underlying preference classes, there are as many different preference functions as there are unique combinations of these respondent characteristics in the sample. In this paper, we introduce (and exploit for our benefits-transfer exercise) "observable" preference heterogeneity in terms of some potentially important characteristics of the county in which the respondent resides.

Let Z_i be a vector of observable exogenous variables that one wishes to assess for their ability to account for systematic variations in cap-and-trade program preferences (where Z_i includes a constant term). The homogeneous-preferences indirect utility-difference function in equation (3) can be generalized by replacing every previously scalar marginal utility parameter with an inner product of (1) a row vector for that respondent's exogenous variables, and (2) a separate column vector (instead of just a scalar) for the α coefficient and each of the β_k coefficients:

$$
\begin{aligned}
(6) \qquad \Delta V_i^A = {} & (Z_i\alpha)(-C_i^A) + (Z_i\beta_1)\mathbf{1}(\textit{any program})_i^A + (Z_i\beta_2)(\%\Delta \textit{carbon emissions})_i^A \\
& + (Z_i\beta_3)(\%\Delta \textit{carbon jobs})_i^A + (Z_i\beta_4)(\%\Delta \textit{green jobs})_i^A \\
& + (Z_i\beta_5)\mathbf{1}(\textit{pollution regs})_i^A + (Z_i\beta_6)(\%\textit{permits auctioned})_i^A \\
& + (Z_i\beta_7)(\%\textit{revenue to equip})_i^A + (Z_i\beta_8)(\%\textit{revenue to workers})_i^A + \varepsilon_i^A,
\end{aligned}
$$

Specifications with individual-level systematic heterogeneity can, of course, always be useful for the assessment of construct validity for the estimated model. I.e., do marginal utilities differ across types of people in ways one would expect? However, for the purpose of out-of-sample benefits-function transfer (one of our main goals in this study), we need to assemble respondent characteristics, Z_i, that are observable not only for the estimating sample, but likewise for the broader population to which we wish to transfer our estimated model. This will often limit the vector Z_i to a set of community-level characteristics (typically, some level of Census jurisdiction), rather than individual characteristics.

With an estimating sample of high-enough quality and sufficient size, each person/household in the estimating sample might be argued to be approximately "representative" of their jurisdiction. Then the fitted model can be combined with analogous community-level characteristics for out-of-sample jurisdictions. If the domains of these characteristics in the estimating sample are sufficiently similar to the domains for the same characteristics in these out-of-sample jurisdictions, implied WTP estimates for a representative person in each of these out-of-sample jurisdictions can be calculated. Weighting of these representative jurisdictional WTP estimates by the relevant population for each jurisdiction is of course necessary, prior to any type of aggregation or averaging across jurisdictions.[8]

4 Outline of Survey and Data

4.1 Sketch of the survey instrument

The survey used for the analysis in this paper was developed during the winter and spring of 2021. We conducted approximate twenty informal trial runs with volunteers, employing "think-aloud" protocols, until all recognized difficulties with the survey's wording were remedied to the fullest extent possible. In the Supplementary Materials, the structure of our survey is described in detail in Appendix C , our attribute-randomization process is explained in Appendix D, and one complete instance of our survey as it would be seen by a respondent (with occasional commentary) is provided in Appendix E.

Carbon cap-and-trade programs are relatively complex ideas, and considerable trial and error was required to limit the reading level required by the survey and to maximize the accessibility of key information. Wherever possible, we used color images (with attribution) to help illustrate ideas and to retain respondent interest. The format was optimized for viewing on a smartphone screen because other recent work with Qualtrics had revealed that more than half of respondents in that earlier study used a smartphone to take their surveys. The tables for each choice task, in particular, are formatted to fit on a single screen without scrolling. These choice tables employ specially designed Javascript code that permits respondents to click on any program attribute in the rows of the very-compact choice table to review a more-extensive description of that attribute.[9]

[8]Note that the substitution of community-level data must be done for both the estimating sample and the population for which the benefits-function transfer is planned. It would be inappropriate, for example, to use individual-specific age and income-bracket indicators to estimate the model, but then to substitute, say, county-level median age and income bracket shares when applying the model for another jurisdiction. Such an approach would run afoul of the "ecological fallacy."

[9]We also convert our randomized choice scenarios to .json format and upload them to our own server. Then as a respondent opens the survey, we use .php code to select one set of the six randomizations to deliver to that respondent.

Our relative success in developing an intelligible survey is documented in Appendix F in the Supplementary Materials, where we include a tabulation of individual respondent's subjective perceptions of researcher bias for or against the types of cap-and-trade programs addressed in the survey. We also include, in the same appendix, every verbatim response to the survey's concluding invitation for respondents to comment on their survey experience.

The survey was in the field from July 28, 2021 until October 5, 2021. An initial test sample of 50 real respondents was collected. There being no apparent problems, the main sample was launched with a target of 1000 completed responses. Quota sampling was used to produce a set of completed responses from Oregon residents for which the marginal distributions of age (over 18), gender, race, and household income are consistent with the marginal distributions for these same variables in the population of Oregon.

In total, and prior to learning anything about the subject matter of the survey, 1630 people who engaged with the invitation from Qualtrics to take the survey also satisfied the preliminary screening criteria for our quotas. These individuals were permitted to start the survey. Of these 1630 people, 580 either dropped out when they learned the topic of the survey, failed to complete all the choice tasks in the survey, were disqualified by Qualtrics as "speeders" (having sprinted through the survey in far too little time to have read anything properly), or were dropped because they entered nonsense answers into text boxes. We use the sample of 1630 for our response/non-response analysis, and the subset of 1050 completed responses for our main analysis.

Other researchers who may wish to adapt this Javascript for use with their own surveys implemented on the Qualtrics platform, or who may wish to mimic our approach to delivering choice-set randomizations to each respondent, are welcome to request copies of this code.

5 Estimation of preference parameters

5.1 Sample Selection

One challenge in using data from a voluntary survey is the risk of systematic sample selection and the resulting potential for biased estimates. If unobserved characteristics that determine an individual's propensity to complete the survey also systematically affect their WTP for these programs, then the WTP estimates from a naive model may be biased. For example, people who work in the logging industry might be less likely to respond to our survey *and* have a lower WTP for carbon emission reductions. If this were the case, and we were to base our estimates strictly on *respondent* preferences, we might tend overestimate WTP for carbon emission reductions in the general population of the state. Alternatively, people in higher income brackets may have higher marginal opportunity costs of their time and thus may be less likely to complete the survey. If these higher-income people are also more willing to pay the costs of carbon cap-and-trade programs, then we might tend to underestimate the WTP in the general population. Given the highly politicized and socially polarizing nature of climate change policies, it seems imperative to evaluate whether our dataset exhibits appreciable sampling bias, and to seek to correct for this bias if it seems to be present.

To address sample selection, we leverage a set of "screening" sociodemographic variables available for all Qualtrics panelists who engaged with the survey invitation. The screening variables include self-reported age, gender, race, and income bracket, as well as the potential respondent's ZIP code of residence.[10] Importantly, this ZIP code information is collected *before* the topic of the survey is revealed. Based on ZIP code, we merge in a host of external information that can be geographically indexed to ZIP code polygons or centroids.[11]

[10]We ask respondents to report the neighborhood ZIP code where they live, if they collect their mail from a PO Box.

[11]Additionally, a handful of automatically collected survey-context variables are known for all respondents (e.g. the date and time when survey was accessed and whether the survey was taken on a mobile device). Of course, we cannot know this information for invited panelists who did not react at all to the notification by Qualtrics that a survey on an unspecified topic was available for them to consider taking. We must assume, therefore, that a panelist's decision to

We then explicitly model the propensity for an invited internet panel member to complete our survey. Ideally, for a representative sample, each invited panelist would be equally likely to respond, so we take the predicted response propensity for each person in the *respondent* sample and subtract the mean predicted response propensity across all *invited* panelists. This produces a variable that would be zero if everyone in the estimating sample had the same response propensity, and this shared response propensity were equal to the average across all invited panelists. For our survey, the mean predicted response propensity for the 1050 people who completed the survey is not zero, but 0.108. People in our estimating sample are thus more likely to have taken the survey than the average person in the invited group, and these response propensities vary systematically with a number of characteristics of the panelist or the ZIP code or county where they live. Table H2 in Appendix H in the Supplementary Materials provides parameter estimates for our response/non-response model. People who complete our survey are systematically different from people who do not, and several dimensions along which the respondent group differs could potentially also be related to their preferences for carbon cap-and-trade programs.

We allow for interactions between our predicted demeaned response propensity, denoted as $dm:\widehat{RP}$, and every program attribute. In most of the five specifications we feature in this paper, two of these interactions tend to have coefficients that are individually statistically significant: the interactions with the "Any Program" indicator, and the interaction with the "Prop change in green jobs" attribute. The interaction with the "Share of permits auctioned" attribute is also marginally significant in our mixed logit model. However, we ultimately retain all of the selection-correction interactions in our featured specifications, to net out as much as possible of any potential selection bias in our coefficients. We then counterfactually simulate what would have been the predicted marginal utility for the program attribute if everyone had a response propensity equal to the mean among all invited participants (i.e., had $dm:\widehat{RP}=0$). We use these selectivity-corrected marginal

react at all to the initial notification by Qualtrics, concerning a survey on an as-yet-unknown topic, is unrelated to their preferences concerning climate policies.

utilities in calculating the implications of our estimates.[12]

5.2 Program choice models: Estimated marginal utilities

Each of our choice scenarios involves a binary choice between one cap-and-trade program and the status quo. Each of our cap-and-trade programs is described in terms of its different levels for each of a common set of attributes. To review, the cost of the program is measured in dollars per household per month. The benefit from the program is the *percentage change in carbon emissions* to be achieved with the program (always negative). However, the proposed cap-and-trade programs differ in a variety of other ways.

The first group of additional attributes includes the program's distributional consequences in terms of jobs in the respondent's own (named) county: the expected *percentage-point change in carbon-intensive industry jobs*, and the *expected percentage-point change in green industry jobs*. In the survey itself, these changes were made more concrete by telling respondents about the approximate number of jobs in each of the two types of industries, in their own (explicitly named) county, and for Oregon as a whole. In the choice tables, these changes were displayed as the corresponding absolute counts for "Carbon industry jobs lost" and "Green industry jobs gained." Test subjects preferred to see absolute changes in job numbers, rather than percentage changes. Our modeling phase, however, revealed that percentage changes had greater explanatory power, so we estimate our models using the underlying labor-market changes in percentage form. Another distributional consequence of the program, related to environmental justice, is an indicator for whether there will be additional regulations to "limit other pollutants." These regulations on co-pollutants would prevent firms that purchase carbon permits from simultaneously increasing their local emissions of conventional pollutants that are not globally uniformly mixing. To the extent

[12] See Appendix H in the Supplementary Materials for details about our response propensity model, including kernel densities for the predicted response propensities among the invited panelists as opposed to the estimating sample, as well as the estimated coefficients on the selection-correction interaction terms for each program attribute in our five featured specifications.

that already-disadvantaged communities are more likely to host sources of pollution, this potential downside of cap-and-trade is an important concern.

Another group of program attributes concerns permit auctions and revenue recycling. Specifically, these attributes include the *percentage share of carbon permits that will be auctioned*, and for any permit auction revenues, the "share of permit auction revenue that will be used to help households and companies to buy emission-reducing equipment," and the "share of revenue that will be used to support communities/workers that bear a relatively heavier burden due to the program's costs." The remaining percentage share of revenues (the omitted numeraire share) will be added to Oregon's General Fund and used to replace other existing tax revenues. Revenue recycling also relates to distributional consequences, as the allocation of this revenue can exacerbate or mitigate the financial burden of a cap-and-trade program.

In Table 1, we consolidate the descriptive statistics for the different program attributes, as well as the individual household characteristics used in two of the models explored in this paper. First, Panel 1 of Table 1 provides descriptive statistics for the different cap-and-trade programs offered to respondents, where each respondent sees a different set of six randomly generated programs, called A through F. Our sample of 6300 programs thus reflects six program choices for each of 1050 respondents.[13]

Inferences derived from choice experiments can sometimes be sensitive to the specification of the choice model and its assumed stochastic structure. All of our specifications focus on the same nine marginal utilities, namely the α parameter and the eight β_k parameters, appearing in equation (3). In this section, we report preference estimates (i.e., these marginal utility estimates) for a set of five different estimating specifications: a conditional logit model; a mixed logit model; two variations of a latent class model; and a streamlined model with observable county-level heterogeneity in preferences identified via LASSO variable-selection methods.

For ease of comparing our estimates of the baseline α and β marginal utility parameters across

[13] See Appendix G for numerous explorations of the raw data from our survey.

specifications, we use Table 2 to report just these conformable baseline marginal utility parameter estimates for all five models. For Model 1, these marginal utilities are the only parameters to be estimated. For Models 2, 3, 4, and 5, however, we provide auxiliary Tables 3, 4, 5 and 7, each reporting estimates for the additional parameters unique to that specification.[14]

5.2.1 Homogeneous preferences: Conditional logit estimates

Our simplest program-choice specification is a straightforward conditional logit model that assumes homogeneous preferences but allows a respondent's predicted survey response propensity to shift all the marginal utilities. Table 2 reports these results as Model 1. The respondent's choice—between the program being offered, and "No Program"—is allowed to depend on all of the program attributes as well as a generic "Any program" indicator variable. The coefficient on the "Any program" indicator conveys the extent to which respondents are systematically more or less likely to choose "Any program" over the status quo alternative, regardless of the attributes of the particular cap-and-trade program they are being offered. Model 1 suggests that respondents, on average, derive positive utility from any kind of cap-and-trade program to reduce carbon emissions, regardless of its attributes. Higher program costs are undesirable, as are higher carbon emissions. The distributional consequences clearly matter: more jobs are desirable, whether they are carbon jobs or green jobs, as are new regulations on other pollutants. The effects of the share of permits auctioned, or the shares of the auction revenues recycled for different purposes, are not discernible in this homogeneous-preferences specification. However, the restrictions implicitly embodied in this simple conditional logit model are rejected by our richer specifications.

[14]Recall that the coefficients on the nine selection-correction terms in each model are relegated to Table H3 in Appendix H in the Supplementary Materials.

5.2.2 Unobserved heterogeneity: Mixed logit estimates

If the researcher has no information beyond just the attributes of the alternatives and a respondent's preferred option in each choice task, the most common way to accommodate heterogeneity in preferences is to explore mixed logit models. The mixed logit model allows for random parameters, where each member of the population is assumed to have a different marginal utility for each attribute, and these marginal utilities have specific parametric distributions). Benefit-cost analysis in the U.S. typically assumes (heroically) that everyone shares the identical marginal utility of income, which would imply a shared marginal disutility of program cost. It is thus common to assume a fixed cost coefficient, because a random cost coefficient in the denominator also further complicates WTP calculations. We follow this convention, and we also assumed fixed coefficients on the interactions between each attribute and the $dm:\widehat{RP}$ selection-correction terms for this model. But we let all of the baseline marginal utilities for the non-cost attributes have normal distributions, and we estimate both their means and standard deviations. Our mixed-logit Model 2 in Table 2 also assumes that each marginal utility other than that for the cost variable is *independently* distributed.[15]

In shifting from Model 1 to Model 2, the mean values of the marginal utilities for most program attributes increase in absolute magnitude (and in some cases, change in their levels of statistical significance). However, the fixed estimate for the cost coefficient also increases, so the net effects on our eventual willingness-to-pay calculations will be smaller. The marginal utility for the shares of auction revenues going to workers/communities becomes significant at the 5% level. If a given cap-and-trade program generates auction revenue, there is thus some suggestion that respondents may approve of revenue recycling directed "to support communities/workers that bear a relatively heavier burden due to the program's costs." However, the estimates suggest that revenue recycling "to help households and companies to buy emissions-reducing equipment" may not be as

[15] We have explored allowing these marginal utilities (other than that for the cost attribute) to have non-zero correlations across respondents. However, a joint likelihood ratio test for the 28 additional parameter correlations does not reject the model with independent parameters, so we report here only the "independent" model.

important.

Table 3 gives Model 2's additional point estimates and standard errors for the estimated standard deviations of these non-cost marginal utility parameters across respondents. The parameter standard deviations for three attributes—i.e., the "Any program" indicator, the indicator for the presence of new regulations on other pollutants, and the share of auction revenues going to communities/workers—are all statistically significantly different from zero, pointing to the existence of statistically discernible heterogeneity across the sample in preferences concerning those three attributes. Notably, there is no statistically significant heterogeneity in preferences for carbon emissions reductions, a point to which we will return later.

5.2.3 Observable heterogeneity: Latent classes depending on characteristics

For each of our two latent-class specifications, only two distinct classes of preferences can be reliably distinguished. In each specification, membership in Class 1 (more "pro-cap-and-trade"), relative to numeraire Class 2 (more "anti-cap-and-trade"), is explained by a different set of respondent characteristics. The two different sets of marginal utility parameters for each of our latent class models are included in Table 2. We report the other membership-related parameters for each model in two separate auxiliary tables.

Latent Class Model (Respondent Characteristics): Our first latent class specification, Model 3, allows class membership to be determined by a set of relatively exogenous (or at least predetermined) respondent characteristics with descriptive statistics shown in Panel 2 of Table 1. The two sets of preference parameters for Model 3 appear in the third and fourth columns of coefficient estimates in Table 2, and the auxiliary coefficient estimates for the single-index class membership model are shown in Table 4. Class membership is a function of broad bins for several sociodemographic characteristics: educational attainment, income, gender, age, parenthood status, past and expected future duration of residence in Oregon, and awareness of forebearers.[16]

For the two discernible classes of preferences for Model 3, the positive baseline marginal utility associated with "Any program" shows that Class 1 preferences are generally in favor of cap-and-trade programs, regardless of their attributes. Class 2 preferences have a tendency to oppose any of these programs. Both preference classes care about the proportional change in carbon emissions (Class 2 relatively more so). Both classes are concerned about the loss of carbon jobs (Class 2 relatively more so). Class 1 cares about new green jobs, but Class 2 does not. Both classes care about new regulations on other pollutants. Among the auction and revenue-recycling attributes, however, only Class 2 preferences are responsive, and only to the share of auction revenue directed to communities/workers.[17]

Latent Class Model (Respondent Ideology and Attitudes): Model 4 in Table 2 also allows two latent classes of preferences but explores how class membership is related to four sets of indicator variables that classify both respondents' self-reported political ideologies and their self-reported individual attitudes about climate change. Section 3 of Table 1 gives descriptive statistics for the proportions of our sample that identify as Democrats or as Republicans (where the omitted category is "Independent or other"). A second dimension is captured by a set of indicators for whether their political ideology is "liberal" or "very liberal" or "conservative" or "very conservative" (relative to the omitted category of "moderate"). A third dimension is captured by a set of indicators for respondents' answers on a five-point Likert scale concerning whether climate change is real and

[16] We included our question about forebearers to permit hypothesis testing about whether someone who feels a greater degree of connection to the past (i.e., inter-generational awareness) may feel more obligated to support policies that will reduce climate change damages for future generations. However, interest in genealogy apparently increases with age. This variable, along with the indicator for age over 65, is likely to be correlated with lesser remaining life expectancy. Thus, they may proxy for a shorter period of time to enjoy any personal benefits from reductions in carbon emissions. There might be a good way to measure inter-generational awareness, but this is not it.

[17] Given that there is no separately estimated scale factor (error variance) for the two sets of preferences, we should be able to compare the marginal utilities for each class. However, keep in mind that each preference class has its own marginal utility of net income (the negative of the cost coefficient), so differences in the other marginal utilities do not translate directly into differences in willingness to pay. In a later section, we consider the marginal WTP estimates implied by each specification.

represents a serious threat. The final set of indicators reflects people's answers to a Likert-scale question about whether climate change is human-caused (where we combine the two "disagrees" categories due to low numbers in the "strongly disagrees" category). We choose these four dimensions of ideology and climate-change attitudes because contemporary news reports (along with the general findings of other research) suggest that these factors were extremely important during Oregon's recent experience with proposed legislation concerning potential carbon cap-and-trade programs.

The marginal utility parameters for the two latent classes of preferences in Model 4 appear as the fifth and sixth columns of estimates in Table 2. The different signs of the coefficients on the "Any program" effect reveal that Class 1 again finds cap-and-trade programs to be desirable in general, whereas Class 2 is more likely to choose "No program," regardless of the levels of the program's attributes. Class 1, in this case, cares about both carbon jobs and green jobs, whereas Class 2 is not particularly concerned about either. Both classes approve of regulations on co-pollutants. Although both classes are statistically indifferent to the share of permits being auctioned, there is some evidence that both preference classes (but especially Class 2) may view as desirable any revenue recycling to support communities/workers that bear a heavier burden due to the program's costs.

Given that we include all four sets of ideological and climate-change attitude variables in the same specification in Model 4, it is possible to consider whether some dimensions dominate. The signs and statistical significance for the estimated coefficients imply that respondents who are worried about climate change and those who feel humans are responsible are more likely to belong to Class 1.

Self-reported climate attitudes are clearly a very strong driver of an individual's preferences for cap-and-trade programs. One interesting result not reported in Table 2, however, is that if we use *only* the party affiliation indicators (e.g. Democrat or Republican as opposed to Independent), Republicans are significantly less enthusiastic about cap-and-trade programs than non-Republicans.

When we control for attitudes about climate change, however, Republicans are actually more likely to support cap-and-trade programs. Perhaps this market-based method for limiting carbon emissions is more appealing to conservatives than to liberals after netting out differences in attitudes about climate change.

On other feature of our two different latent class models is worth noting. These two specifications identify several statistically significant determinants of class membership and produce different point estimates of the various marginal utilities for each preference class. However, we note that a simple chi-squared test fails to reject a hypothesis of equality across preference classes in the estimated marginal utilities specifically for carbon emissions reductions. While some other estimated marginal utilities in each specification clearly differ across preference classes, we again cannot reject that preferences for carbon emissions reductions may be homogenous.

5.2.4 Observable systematic heterogeneity

To glean the greatest value from this survey, it is important to explore whether the lessons from Oregon can potentially be extrapolated to other parts of the U.S. Oregon is sometimes perceived to be a very liberal state, but there is great variation in sociodemographics and political ideologies across the state's urban and rural counties. To permit predictions about preferences for different cap-and-trade programs outside of Oregon, we need a model for preferences that relies only upon observable measures of heterogeneity that are available both (a) for our sample of respondents and (b) for the rest of the lower-48 states.[18]

Given our findings for Model 4—that climate change attitudes tend to dominate preferences across cap-and-trade programs—we take advantage of the Yale Climate Map dataset for U.S. coun-

[18] Myriad ZCTA-level and/or county-level sociodemographic variables (typically in the form of population shares in various categories or brackets) are available across all U.S. states. However, there are some significant risks in attempting to use these variables, basically as proxies for climate change attitudes, to explain differences in respondents' preferences for cap-and-trade programs. Some of our experiences when attempting to use large numbers of these variables are reported in Section 4 of Appendix B in the Supplementary materials. These insights may be helpful for other researchers who seek to implement "benefits function transfers" such as ours.

ties, which is now available for 2021.[19] The providers have conducted a set of compatible surveys over a period of about two decades, using different samples of respondents each time. For each of a long list of questions (stable over time) about respondents' climate change attitudes, they conduct a separate modeling exercise to predict the likely proportions for the Likert-scale responses in every county across the U.S. (i.e., not just for those counties that contributed responses to the underlying surveys).

However, we do not use the raw data in the 2021 Yale Climate Map dataset for the large number of distinct but correlated attitudinal variables. This would result in vast numbers of potential interaction terms for each attribute in our choice models. Instead, we reduce the dimensionality of the problem by first conducting a factor analysis across all these different measures of climate attitudes in the Yale Climate Map data. We extract the most important factor score and use this single measure of climate change attitudes to explain systematic differences in our marginal utility parameters.[20]

Note, then, that the raw Yale Climate Map data, as distributed to users, is already the result of a modeling process conducted by the providers of the dataset. That modeling process will tend to suppress outliers. Then we have further "smoothed" that data by subjecting it to factor analysis to recover just the most important single factor—one that has high loadings on almost all of the Yale Climate Map variables.[21]

One other type of county-level heterogeneity may also be especially important. Given that

[19]These data are described in Howe et al. (2015) and Marlon et al. (2022).

[20]Appendix I in the Supplementary Materials explains in detail the reasoning behind our decision to use only Factor 1, which accounts for more than 80% of the variation across the roughly 60 different response shares predicted for each county in the Yale Climate Map data.

[21]Appendix I in the Supplementary Materials also provides details about the distribution of values for Factor 1 derived from the Yale Climate Map data, both across Oregon counties and nationwide. Four factors for the Yale Climate Map data have eigenvalues in excess of 1.0. Factor 4 is also retained as a shifter of cap-and-trade program preferences by the LASSO algorithm (when we include all four factors). However, across the Oregon counties used in our estimating sample, Factor 1 and Factor 4 are highly correlated, except for one small county with outlying values for these two factors. Therefore the potentially idiosyncratic choices of any respondent from this tiny county will tend to determine the relative coefficients on these two factors, which is undesirable. Factors 2 and 3 explain 8.8% and 3.4% of the variability in the Yale Climate Map data, respectively, but LASSO selects neither of these factors as being useful for making hold-out sample predictions in our data.

our survey was in the field primarily during August and September of 2021, we may also need to worry about the possible effect of the COVID-19 pandemic on people's preferences for carbon cap-and-trade programs. These preferences may have been affected by the competing salience of public health risks presented by the pandemic. Thus our Model 5 also controls for the number of COVID-19 cases reported for the respondent's county, per 100 people, in the months of 2021 leading up to the launch of our survey.

Table 6 gives descriptive statistics for "Yale Climate Map data, Factor 1" and "County COVID cases per 100, 2021"—the two county-level variables in Model 5 that we allow to explain heterogeneity across Oregon counties in preferences for carbon cap-and-trade programs. We report simple means and standard deviations for these variables at three different levels: (1) associated with each respondent in our sample, (2) across just the 36 counties in Oregon, and (3) for all 3,107 counties across the lower-48 U.S. states. One might speculate that these two county-level variables could possibly be correlated, but they are essentially unrelated.[22]

For Model 5, we de-mean the two county-level variables across the estimating sample, so that the estimated coefficients apply at the means of the data. Model 5's estimated baseline marginal utilities are shown in the last column of Table 2. Auxiliary Table 7 provides the additional coefficients on the three interaction terms (between program attributes and our two county-level heterogeneity variables) that survive our LASSO variable-selection process. Importantly, the Yale Climate Map data and the COVID case-rate data are *not* based on each individual respondents' own subjective climate attitudes or personal COVID experiences. Thus the potential endogeneity

[22] Across all 3,107 counties, a simple regression to explain the number of "County COVID cases per 100, 2021" as a function of the "Yale Climate Map data, Factor 1" produces a positive and statistically significant relationship, although the R^2 value is only 0.0026. Similarly, a simple regression to explain COVID cases as a function of voting patterns (i.e., the Democratic vote share in the 2020 Presidential election) likewise reveals a positive and statistically significant relationship, but the R^2 value is similarly small at only 0.0067. In contrast, a simple regression to explain "Yale Climate Map data, Factor 1" as a function of the Democratic vote in 2020 shows a hugely statistically significant slope coefficient and the R^2 value is 0.8670. Population characteristics that explain the Democratic vote thus also explain attitudes towards climate change. In contrast, there is considerable *independent* variation in "County COVID cases per 100, 2021" in the months leading up to our survey. Figure I8 in Appendix I in the Supplementary Materials provides both kernel-density individual size distributions and pairwise scatter plots showing the relationships between these two variables and voting patterns.

bias in our estimates for Model 3, and especially in our estimates for Model 4, is not present to the same extent for Model 5.

Much of the heterogeneity in preferences estimated by Model 5 that is relevant for out-of-sample prediction concerns the marginal utility from Any Program, independent of the program's attributes. Given that Model 5's baseline marginal utility estimates are calculated at the sample means of the county-level variables, they are very close to those from Model 1. However, from Model 1 to Model 5, the maximized log-likelihood improves from -4262.19 to -4213.98 with this county-level heterogeneity, strongly rejecting the homogeneous-preferences specification in Model 1. This improvement in the log-likelihood is admittedly much less than is provided by (a) the mixed-logit model (with unobserved parameter heterogeneity) or (b) either of the latent-class specifications (with individual, but potentially endogenous heterogeneity). However, Model 5 has the advantage that it is better suited for the calculation of representative WTP values for counties outside of Oregon for the remaining conterminous United States. In these other jurisdictions, people are likely to have different attitudes towards climate change and/or different experiences with COVID than the averages for Oregon. Simple average WTP estimates specific to Oregon thus may not apply elsewhere. Rather than a straightforward "benefits transfer," it is more likely that a "benefits-function transfer" will be appropriate.[23]

6 WTP implications of alternative specifications

Recall that the marginal willingness to pay (MWTP) for each program attribute has, in its denominator, the estimated marginal utility of net income (i.e., the negative of the coefficient on monthly cost, as shown in equation (4)). Especially given the estimated differences in the marginal utility of net income across the two pairs of preference classes in Model 3 and Model 4, it is clearly nec-

[23]For our out-of-sample benefit-function transfer exercise, we re-estimate Model 5 using the untransformed levels of our two county-level heterogeneity variables rather than deviations from their means in the sample. The intercept-type estimated coefficient in the "Any Program" marginal utility function takes up the slack.

essary (before comparing implications across our five models) to first use our estimated marginal utilities to calculate some interesting marginal rates of substitution (MRS) and marginal willingnesses to pay (MWTP).

Table 8 reports point and interval estimates for a number of different MRS and MWTP estimates. These are calculated from the asymptotically joint-normal distributions of the maximum likelihood estimates of the parameters in each of our five models.[24]

6.1 The Social Benefit of Carbon (emissions reductions)

The first row in Table 8 shows our different models' implied point estimates of the social benefits from a reduction of one metric ton (tonne) of carbon emissions (SBC). This is a "disembodied" value *solely* for carbon emissions reductions, independent of any of the other included attributes of the cap-and-trade program used to achieve them. Had we left these other attributes unspecified as people made their choices, there would have been a risk of omitted variables bias in our estimates of the SBC. If carbon-sector job losses were left unspecified in these choice tasks, for example, respondents might impute greater job losses in the carbon sector (i.e., a greater undersirable side-effect) associated with cap-and-trade programs that achieve greater reductions in carbon emissions. This assumption on the part of respondents could reduce the apparent value of just the emissions reductions themselves in a model that does not control for labor-market effects.[25]

[24]For Table 8, each of the reported marginal rates of substitution is a simple ratio of just two estimated parameters, so we can take advantage of a convenient user-written tool called wtp.ado, which is available in Stata and appropriate in this context. The code for this tool was developed by Hole (2007), and it allows us to generate point and interval estimates for these simple parameter ratios, with standard errors calculated using the delta method. In a later section of the present paper, we will need to calculate distributions for predicted total willingness to pay (TWTP) for specific cap-and-trade programs. TWTP is a function of all the estimated parameters in the model. For TWTP, we thus rely upon the Krinky-Robb parametric bootstrap method to derive interval estimates.

[25]Various unspecified program attributes may, in respondents' minds, be correlated with included attributes in a choice experiment. This will always be a problem for estimation if people care about the levels of these unspecified attributes (as addressed in Cameron et al., 2011). As Kyselá et al. (2019) report in their review of interdisciplinary research about attitudes toward climate change mitigation policies, "conceptual vagueness and weak theoretical embedding are pervasive" across the 118 studies in their inventory. They point to uncertainty about what, exactly, is being measured in each study. Our survey describes a relatively large number of different features of each program's implementation and impacts, to reduce this uncertainty on the part of our respondents.

To calculate the SBC, our marginal utilities for a 1.0 proportional reduction in carbon emissions (i.e., a 100% reduction), must first be converted to the implied per-tonne basis. Respondents were shown graphics during the survey which conveyed that the approximate aggregate annual amount of carbon emissions for Oregon at the time: about 64 million metric tons. So total carbon emissions per month average about 5.33 million tons, and a 1.0 proportional change would reduce total monthly emissions to zero. The total number of households in Oregon is about 1,649,000. Thus our estimate of the MWTP for a 1.0 proportional change in emissions, shown in the fourth line of Table 8, must be multiplied by $\frac{1{,}649{,}000}{5{,}333{,}333}$ to yield the aggregate willingness to pay by Oregon households to have Oregon's carbon emissions reduced by just one tonne.

According to Model 1 in Table 8, with homogeneous preferences, this SBC estimate is about \$48/tonne of carbon. In contrast, Model 2, with its random utility parameters, implies an average SBC of \$62.[26] For our two latent-class models, the relatively more pro-cap-and-trade Class 1 preferences imply SBCs of \$66 and \$58, but Class 2 preferences imply SBCs of only \$30 and \$21. The LASSO variable-selection methods that produce the specification for Model 5 do not find any consequential heterogeneity across counties in the estimated marginal utility of either net income or carbon emissions, so the SBC for Model 5 is common across all counties and essentially identical to that for Model 1, at \$48.

6.2 Marginal rate of substitution: Green jobs vs. carbon-sector jobs

A second measure of interest, shown in the second row of Table 8, is the implied marginal rate of substitution (MRS) between carbon-sector jobs and green jobs. However, our raw marginal utilities are for a 1.0 *proportional* change in carbon-sector jobs and green jobs in the respondent's own country, rather than for absolute changes in the numbers of jobs of each type. Conversion of

[26]This difference is something of a conundrum, since Model 2 does not reveal statistically significant heterogeneity in the marginal utility of proportional changes in carbon emissions and the marginal utility of net income is assumed to be a constant. The mixed logit model does produce the largest point estimate for the marginal utility of net income, but its estimate for the marginal utility of a porportional change in carbon emissions is even higher. Alternative assumptions about the distributions for the random parameters in Model 2 could yield different estimates, however.

these marginal utilities to the desired MRS thus requires multiplying by the ratio of job counts, so that the absolute number of green jobs willingly sacrificed to keep one carbon job can be calculated as:

$$MRS(\text{Carbon jobs, Green jobs}) = \left[\frac{\beta_{\text{Prop change in carbon jobs}}}{\beta_{\text{Prop change in green jobs}}}\right]\left[\frac{\text{Green jobs}}{\text{Carbon jobs}}\right]$$

This MRS will be smaller when there are relatively more carbon jobs and fewer green jobs, and it will be larger when there are relatively fewer carbon jobs and more green jobs. Without specifying the prevailing ratio of these two types of jobs, then, we cannot quote a single number of green jobs required to compensate for the loss of one carbon-sector job. As a representative value for the needed job ratio, though, we use the state-level ratio, and report a point estimate and a confidence interval for this representative MRS.[27]

In Table 8, for Model 1 with homogeneous preferences and Model 2 with unobserved heterogeneity, our estimates suggest that on average, people need about 1.34 or 1.20 green jobs to make up for each carbon-sector job lost due to a cap-and-trade program. However, our two latent class models reveal very different labor-market trade-offs across the two preference classes. In each case, people with the relatively "pro-cap-and-trade" Class 1 preferences would be satisfied, on average, with only about 0.89 or 0.92 new green jobs for each carbon-sector job lost. For Model 3, we know that Class 1 membership is more likely for people who are college graduates, males, younger people, people who have lived in Oregon for less than 18 years, people who expect to stay in the state for at least two more decades, and people who don't know much about their ancestors farther back than their great-great-grandparents. Being younger and college-educated, these groups may be more confident that they would still be able to retool for a career in a green job, rather than a carbon-sector job. Preference Class 2, however (the relatively anti-cap-and-trade class) would de-

[27] Stata's wtp.ado algorithm can be adapted easily to calculate point and interval estimates for the necessary ratio of marginal utility parameters. Treating the marginal utility estimates as random, but the state-level ratio of the numbers of job of each type as deterministic, we can then calculate the implied distribution for the MRS of interest.

mand about 3.74 new green jobs to make up for each carbon-sector job lost, according to Model 3, but only about 1.47 green jobs for each carbon-sector job lost, according to Model 4.

6.3 Marginal WTP for individual program attributes

The remaining rows in Table 8 report, for each of our models, the calculated marginal willingness to pay (MWTP) per month for a program with "one more unit" of each attribute, along with a 95% confidence interval. For attributes described as proportions or shares, these marginal WTP amounts are for a 1.00 proportional change (i.e., a change from 0% to 100%), or for a 1.00 change in share (i.e., from a 0.0 share to a 1.0 share).[28]

First, consider the baseline WTP for any type of cap and trade program, regardless of its attributes. For Models 1 and 2, the estimated (mean) preferences suggest a positive WTP for any program. However, this baseline positive WTP could be offset, for example, in programs that feature a too-small reduction in carbon emissions or a too-great loss of carbon-sector jobs. Each of our two latent-class models imply very different baseline WTP amounts for any given cap-and-trade program across the two preference classes. In both latent class models, the Class 1 preferences have a positive baseline WTP for a cap-and-trade program on the order of about \$263 and \$237. The Class 2 preferences, however, have a *negative* baseline WTP, on the order of -\$73 and -\$102.[29]

Second, the distributional consequences of alternative cap-and-trade programs will be felt partly through their effects on employment in different sectors. Above, we have addressed the *relative* WTP for these job types via the marginal rate of substitution between jobs in these two sectors, but we can still consider the absolute MWTP for proportional changes in either type of job. Models 1, 2, and 5, with single estimates of the MWTP for jobs in each sector, imply that proportional changes in carbon-sector jobs are valued more highly than proportional changes in

[28] The reported marginal WTP amounts could, of course, be scaled to a 0.01 (i.e. a 1%) change in jobs, or a 0.01 (i.e., 1%) change in share by dividing the MWTP estimate (and its confidence bounds) by 100.

[29] This negative baseline WTP, however, could be overcome for programs that feature a sufficiently large reduction in carbon emissions, a sufficiently small loss of carbon-sector jobs, and/or a sufficiently large increase in green jobs, perhaps augmented by new regulations on other pollutants.

green jobs. However, the two latent-class specifications reveal that the pro-cap-and-trade Class 1 preferences are willing to pay much more for jobs of either type than are Class 2 preferences.

The small value of carbon-sector jobs for Class 2 preferences in Model 4 is particularly striking. Recall that Class 2 membership in Model 4 is dominated by people who do not think climate change is a threat or do not think that it is human-caused. Controlling for those attitudes about climate change, however, people with anti-cap-and-trade Class 2 preferences are *less* likely to be Republicans. This preference class has a marginal willingness to pay for proportional changes in carbon jobs of only $101, and for green jobs of only $77. The corresponding MWTP estimates for pro-cap-and-trade Class 1 in Model 4 are $525 and $643! (These MWTP amounts, of course, are for 100% changes, so the corresponding implied MWTP amounts per month for a 1% change would be only $5.25 and $6.43.) Social justice in terms of the distribution of employment impacts thus seems vastly more important to Class 1 than it is to Class 2, according to Model 4. Still, Model 4's results come with the important caveat that the ideologies and climate-change opinions that drive preference class membership in this model are elicited from the same individuals who are making the choices about carbon cap-and-trade programs, so as striking as these differences may seem, they may be an artifact of endogeneity.

Also capturing a distributional (i.e., environmental justice) consequence of alternative programs, the MWTP is positive in all our models for cap-and-trade policies that include new regulations on co-pollutants. Distributional effects of climate policies may also depend on the extent to which transactions involving carbon permits cause carbon-emitting production to relocate. Production facilities tend to be more likely to be located in (or near) minority communities. If increases in carbon emissions correlate with increases in other types of pollution, residents in the vicinity of plants that buy carbon permits could be disadvantaged. Models 1, 2, and 5 (and Class 1 preferences in both our latent class specifications) imply that programs with new regulations to limit other pollutants are valued about $56 to $69 higher per month than programs without this feature. For Class 2 preferences in both of our latent class models, however, marginal WTP for a program with new regulations on other pollutants is lower, at about half the size (only $30 and $27). MWTP for this feature is thus still positive for Class 2, but this group appears to be relatively less concerned than Class 1 about the environmental justice implications of any cap-and-trade program.

Our estimates of the MWTP for program attributes relating to permit auctions and revenue recycling are less robust. In Table 8, among the estimates of MWTP for each of these three attributes, across the seven sets of preferences we estimate, the confidence interval for the estimate excludes zero in only one case (i.e., this MWTP is positive for Model 2's mixed logit specification, for the share of auction revenue going to support communities/workers that bear a relatively heavier burden due to the program's costs). For completeness, we include all of these MWTP point and interval estimates in Table 8, but we will not focus on the specific values of these estimates because they are so imprecisely estimated. Note, however, that some of the important heterogeneity in Model 5 concerns the marginal utility of the share of permits auctioned. Further research will apparently be needed to identify more-precisely the incremental values that people place on all of these auction-related program attributes.

7 Benefit function transfer: all counties, lower-48 U.S. states

Model 5 allows for observable county-level heterogeneity across our Oregon respondents. We assume that systematic preference heterogeneity across all 36 counties in Oregon mimics the systematic heterogeneity in preferences elsewhere in the U.S. It is then appropriate to combine the preference parameter estimates from our Oregon-only sample with analogous county-level characteristics for all 3,107 counties in the lower-48 U.S. states. We can use our estimated utility parameters to predict an approximate total willingness to pay (TWTP), by a representative household in each county, for any arbitrarily selected cap-and-trade program with specific levels for the program attributes featured in this study.[30]

[30]For each county-level TWTP calculation, we make 1,000 draws from the joint distribution of the Model 5's parameter estimates. We combine each parameter draw with the program attributes and the characteristics of that

7.1 Size distributions: TWTP for programs with different attributes

To illustrate the implications of Model 5 for carbon cap-and-trade program preferences nationally, we first calculate representative TWTP amounts for all 3,107 counties, for six different sets of carbon cap-and-trade programs. Within each set of programs, we systematically vary a specific program attribute (or a pair of attributes) and depict how the population-weighted size distribution of county-level predicted TWTP amounts changes. For these size distributions, we weight each county's predicted TWTP by that county's population (via proportional replication). Row by row, the six panels of Figure 1 convey the following implications of Model 5:

- Panel (a) considers programs that reduce carbon emissions by 10%, 20%, 30%, 40% and 50%, but involve no changes from the status quo for any of the other program attributes (although we acknowledge that significant carbon emissions reductions with absolutely no labor-market effects are unrealistic);
- Panel (b) considers programs that all reduce carbon emissions by 40%, but involve equal percentage decreases in carbon jobs and percentage increases in green jobs, with those changes varying across 0%, 5%, 10%, 15%, and 20%;
- Panel (c) considers programs that reduce carbon emissions by 40% but either (i) have no additional regulations on other pollutants, or (ii) include such regulations;
- Panel (d) considers the same 40% reduction in carbon emissions, but varies the share of permits that are auctioned across 0%, 25%, 50%, 75% and 100%, with all of the auction revenue being directed to the state's general fund to offset existing taxes;
- Panel (e) considers a 40% reduction in carbon emissions and 50% of permits being auctioned, and varies the share of auction revenues being directed to help households and companies to buy emission reducing equipment (instead of simply going into the state's general fund). These shares are varied across 0%, 10%, 20%, 30%, and 40%;
- Panel (f) shows an analogous exercise, but this time for the share of auction revenues being directed to support communities/workers that bear a relatively heavier burden due to the program's costs.

Note that, were it not for the heterogeneity across counties in "Yale Climate Map data, Factor 1" and "County COVID cases per 100, 2021," every county would have the identical predicted TWTP

county and build up a sampling distribution for this TWTP. The size distributions and spatial distributions for any given program presented below employ the means of these 1,000 TWTP estimates for that particular program for each county.

for any given program, based on a single shared set of homogeneous preference parameters. There is considerable heterogeneity in our two county-level variables across the 3,107 counties in the lower-48 U.S. states. As a result, there are marked differences across counties in Model 5's predictions for the representative household's willingness to pay for any given program (in addition to the differences in TWTP across programs that stem from the different attributes of these programs).[31]

7.2 County-level spatial heterogeneity in TWTP for selected programs

The variance that is evident in the size distributions for county-level representative TWTP for different cap-and-trade programs confirms the need for policymakers to be concerned about distributional effects. A closer investigation of the *spatial* heterogeneity in TWTP can highlight some of the likely regional distributional consequences—even if the *identical* carbon cap-and-trade program, at the same per-household cost, were to be imposed on all 3,107 counties.[32]

Geographic heterogeneity in TWTP for carbon cap-and-trade programs can be visualized on a map. We use our fitted Model 5 for a representative household in each of the 3,107 counties in the conterminous U.S. to generate national maps of the predicted mean TWTP, for each county, for two arbitrarily selected cap-and-trade programs. Again, the obvious regional differences in TWTP directly reflect the differences in climate change attitudes captured in our variables called "Yale Climate Map data, Factor 1", and differences in "County COVID cases per 100, 2021."[33]

[31]Despite the county-level heterogeneity in preferences in Model 5, notice that the shapes of the distributions in each panel in Figure 1 do not generally change much as their range changes. These two county-level variables mainly shift the common "Any program" effect. The auction attribute is the only specific program attribute for which our LASSO models also identify the "Yale Climate Map data, Factor 1" as an important out-of-sample predictor. This explains why only those size distributions for programs with varying proportions of permits being auctioned, shown in the graph in the second row of the first column in Figure 1, exhibit somewhat more complex shifts in the shapes of the size distributions with changes in the attribute in question.

[32]Of course, nationwide data availability for our benefits-transfer exercise constrains us to estimate a single representative TWTP for each county, but these between-county differences still obscure extensive within-county differences among individual households (as identified in our Models 2, 3, and 4).

[33]Fanghella et al. (2023) discuss spatial variability in terms of their finding "policies with environmental benefits accruing primarily in rural areas are least preferred." But keep in mind that their environmental benefits are *physical benefits*. In our study, the physical benefits, specifically from carbon emissions reductions, are global, although we find positive demand for carbon cap-and-trade programs with additional regulations to limit localized co-pollutants from firms. Respondents living in rural areas may expect to benefit less from these additional regulations, but the

For our next set of size and spatial distributions, we employ two specific but arbitrary programs, noting that corresponding results could be calculated for *any* combination of program attributes spanned by our study. Program 1 is our "baseline program," with a 40% carbon emissions reduction and zero values for all the other attributes. However, we note that a program with any given percentage of carbon emissions reductions can be rendered more or less desirable to the population by tinkering with the program's other attributes. Program 2 is a single alternative program with the same 40% reduction in carbon emissions, but arbitrary non-zero levels for most of the other attributes. This specific alternative program has a 20% decrease in county-level carbon-sector jobs, a 20% increase in county-level green jobs, 100% of permits auctioned, additional regulations on local co-pollutants for firms that buy permits, and 40% of auction revenue going to support communities/workers that bear a relatively heavier burden due to the program's costs.

In Figure 2, we compare the size distributions of TWTP across all 3,107 counties for Program 1 and Program 2. For baseline Program 1, the county-population-weighted mean WTP is $77. Despite producing the same amount of carbon emissions reductions, the other attributes of Program 2 make it considerably more desirable, with a county-population-weighted mean WTP of $220. Differences in the spatial distributions of WTP for Program 1 and Program 2 are shown in Figure 3 and Figure 4. For the generally more-desirable Program 2, individual counties with predicted TWTP greater than $200/month are much more numerous. Again, these spatial differences stem solely from differences in the Yale Climate Map attitudes and COVID-19 case rates in 2021 leading up to our survey.

Across the maps in Figure 3 and Figure 4, the spatial pattern in county-level TWTP shows higher values in the parts of the U.S. that are understood to be more sympathetic to carbon pricing. This is especially true in regions where various states are already participating in some type of carbon trading (e.g., the Northeastern states, California, and Washington State.). But in addition to

urban/rural differences in our county-level TWTP estimates stem entirely from differences in the variables "Yale Climate Map data, Factor 1" and "County COVID cases per 100, 2021." They do not stem from regional differences in the attributes of the carbon cap-and-trade program in question.

those areas, relatively high predicted TWTP for carbon emissions reductions via state-level carbon cap-and-trade programs are found for northwestern Oregon, southern Texas, southern Florida and some other parts of the eastern seaboard, as well as parts of Arizona, New Mexico, and Colorado. More on this later, when we aggregate our estimates to the state level.

7.3 Evaluating for possible COVID-19 effects on TWTP

We fielded our survey primarily during the months of August and September of 2021, when the COVID-19 pandemic was still a very salient risk. We hypothesized that TWTP estimates from the height of the pandemic might differ from those that might prevail post pandemic. In Model 5, our variable for "County COVID cases per 100, 2021," is determined by LASSO methods (which prioritize hold-out sample predictive ability) to be an important shifter only for the "Any program" effect, rather than for the marginal utilities of any specific program attribute.[34] The size of the "Any program" effect seems to varies inversely with the COVID-19 case rate in the county, so fewer county-level COVID-19 cases would appear to mean a larger "Any program" effect and thus a higher TWTP for any type of carbon cap-and-trade program. We explore how the population-weighted TWTP for any particular cap-and-trade program may have been different in the absence of COVID-19 by counterfactually simulating a situation with zero COVID-19 cases across all counties.

For this exercise, we use just our simplest baseline program—a 40% carbon emissions reduction but zero values for all other program attributes. Figure 5 shows the county-population-weighted size distribution of predicted county-level TWTP amounts in actual COVID-19 conditions versus the counterfactually simulated TWTP distribution for the same program when all COVID-19 case rates are set to zero. The population-weighted mean TWTP across counties increases from $77 to $129, an increase of almost 68%. This suggests that people may have been

[34] Had we relied solely on conventional within-sample statistical significance as a criterion for identifying important preference heterogeneity, we might have concluded that COVID-19 case rates had no appreciable effect on preferences for carbon cap-and-trade programs.

distracted by the pandemic from continuing concerns about the consequences of climate change. Importantly, however, COVID-19 case rates seem to have no important effect on the marginal utility simply for carbon emissions reductions, the parameter that dictates our estimates for the social benefit of a one-tonne reduction in carbon emissions, independent of any other cap-and-trade program attributes.

Possibly, pandemic restrictions cut into household incomes, in addition to diminishing the relative importance of the threats presented by climate change. However, one might worry that by simulating away the effects of COVID-19, when case rates may have tended to reflect differences in exposure avoidance according to political ideologies, we risk losing the influence of these ideologies on TWTP for cap-and-trade programs. This should not be the case. Recall that Model 5 also controls for the climate attitudes captured by our "Yale Climate Map data, Factor 1" variable, and this variable is highly correlated with voting patterns in each county, as demonstrated in Appendix I. Thus, even if we net out pandemic effects in this manner, variation in climate opinions remains in the model, so our counterfactual simulation is less likely to (inadvertently) remove the considerable effects of political ideologies on TWTP.

Corresponding to our simulation of no COVID-19 cases in the months of 2021 leading up to our survey, the map in Figure 6 shows the spatial pattern of increases in predicted TWTP for our baseline program between (a) a scenario with actual COVID-19 county case rates and (b) a counterfactual scenario with zero COVID-19 cases. The darker counties on the map have smaller increases in TWTP for our baseline program when pandemic effects are removed. The lighter counties have larger increases. This evidence suggests that the TWTP amounts featured in this paper's main estimates may be lower bounds on TWTP when a pandemic is not in progress. The lack of precision in our estimate of the coefficient on the interaction between COVID-19 case rates and the "Any program" indicator makes us inclined to be cautious about our "No COVID-19" estimates. Nevertheless, the importance of the same term for prediction (according to the LASSO variable-selection algorithm) compels us to include our COVID-19 findings. In any case, these potential distortions due to the pandemic should be kept in mind.

7.4 Aggregation: State-level or regional heterogeneity in TWTP

Our county-level TWTP estimates are informative, but policymakers may also be interested in differences in TWTP amounts specifically at the state level, since we are considering state-level carbon cap-and-trade programs. Thus we have calculated county-population-weighted mean TWTP at the level of each state, along with the corresponding 5th and 95th percentiles. The results for each individual state (among the lower-48 states plus Washington, DC) are detailed in Table J1 in the Supplementary Materials.

Here, however, we will use our state-level weighted mean TWTP amounts to consider whether the TWTP amounts for states that are already involved in some sort of carbon cap-and-trade program are indeed higher than for states that have not yet joined such a program. Consider the baseline program (with its caveats regarding realism) depicted in Figure 3. Eleven states in the Northeastern U.S. currently participate in the Regional Greenhouse Gas Initiative (RGGI) carbon cap-and-trade program.[35] Mean county-population-weighted TWTP for our baseline program is \$97/month for the RGGI states. For the combined states of California (CA) and Washington (WA), which now both participate in the Western Climate Initiative (WCI) carbon cap-and-trade program, the mean TWTP for our baseline program is a bit larger, at \$111/month (where the WCI program is more comprehensive than the RGGI program). For the set of all other lower-48 U.S. states, however, the county-population-weighted mean TWTP for our baseline program is only \$64/month. For Oregon alone, our point estimate of state-level average TWTP for this program is \$110, consistent with the state's recent efforts to participate in a carbon cap-and-trade program.[36]

[35]These states are Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont (i.e., CT, DE, ME, MD, MA NH, NJ, NY, PA, RI, and VT).

[36]We can also calculate the corresponding mean TWTP amounts for RGGI, CA/WA, and all other states for the generally more-desirable program with TWTP amounts mapped in Figure 4. These three groups of states have county-population-weighted mean TWTP amounts of \$216, \$223, and \$135 per month. Likewise, for the baseline program, but with zero simulated COVID-19 cases shown in Figure 5, these three TWTP amounts are \$161, \$160, and \$113 per month. For Oregon (OR) alone, the predicted county-population-weighted mean TWTP amount is \$214 for the

7.5 Caveats concerning our benefits-function transfer exercise

There are several considerations when interpreting the size and spatial distributions for the TWTP described in our benefit transfer exercise. While we designed our study with benefits-function transfers in mind, our budget limited us to sampling Oregon residents only. Also, the LASSO method we use to identify the county-level interaction terms retained in Model 5 bases its variable selection on forecasting ability for hold-out subsets of the estimating sample. Only one of the three auxiliary (interaction-term) coefficients for Model 5, reported in Table 7, is conventionally statistically significantly different from zero, despite all three variables being important for prediction in hold-out samples. Compared to conventional variable-selection methods that sometimes emphasize the individual statistical significance of coefficients estimated using the full sample, however, LASSO is likely a more suitable criterion for variable selection when our goal is to forecast TWTP amounts for carbon cap-and-trade programs for completely different parts of the U.S.

8 Directions for Future Research

The relative lack of importance of some cap-and-trade program design features might be attributable to the complexity of the programs shown in our survey. Despite extensive pretesting, the average respondent may have found the program attributes overwhelming or confusing. Statistically insignificant marginal utility estimates may simply be a result of inattention to these features on the part of a sufficient number of respondents rather than true indifference concerning their levels. Nevertheless, inattention among members of the public is a feature, unfortunately, of many policy debates. The notion of "libertarian paternalism" might be cast as "choosing the policy that people would prefer *if only they understood or accepted* the best available information." Further analysis of the relationship between respondents' measured and self-reported attention to different program features may help clarify what is going on with the less robustly estimated average

more-desirable program and $142 for the baseline program with zero simulated COVID-19 cases.

marginal utilities found in our study.

9 Conclusions

The research described here was motivated by a concern about the extent to which public support for a carbon cap-and-trade program might be affected by the design of the program. It can be characterized as a study about "policy acceptability," but one with a rigorous underlying microeconomic framework, implemented as a choice-experiment study of preferences over a variety of attributes of potential state-level carbon cap-and-trade programs.

We explore a specification that assumes homogeneous preferences and several specifications that allow for heterogeneous preferences. We include a random-preferences model with purely unobservable heterogeneity and two different latent-class specifications—one with class membership determined by a small set of respondent characteristics and one with class membership determined solely by (potentially endogenous) respondent ideologies and attitudes. Our study focuses on Oregon, a state that is especially relevant to carbon cap-and-trade program policy analysis. However, we design our study such that we can use its estimating specification to allow inferences about preferences for cap-and-trade programs in other parts of the U.S. We thus develop a model with county-level observable heterogeneity only (designed to facilitate benefit-function transfer on a national scale). Where expected, the implications of our different estimating specifications are comparable.

In modeling people's preferences among carbon cap-and-trade programs, we are careful to address potential selection bias. Our Qualtrics sample is quota-based and, therefore, yields a set of respondents with characteristics that match the population of Oregon in terms of the marginal distributions of a handful of observable socioeconomic characteristics. However, people who are invited to participate do not always complete the survey. We do not observe *all* characteristics of dropouts, such as individual attitudes toward climate change, but we intentionally elicit several basic sociodemographic characteristics and ZIP codes from both respondents and non-respondents that allow us to model individuals' response propensities. Our *ad hoc* sample-selection correction method finds some evidence that at least two estimated marginal utilities in our model differ with the respondent's predicted response propensity.[37]

Our study offers several potentially important contributions to the climate change policy debate. First, we contribute new information about the social benefits of carbon emissions reductions. Customarily, the benefits measure for reductions in carbon emissions receiving the greatest attention is the Social Cost of Carbon (SCC), essentially the marginal *avoided* impact of greenhouse gases. There is, however, no consensus on the "true" size of the SCC. Depending on the researcher, agency, administration, or country, the estimate of SCC varies widely (Tol, 2023). Under the Obama administration, the SCC was estimated at $50 per tonne of CO_2 (in 2020 US dollars), with a range of $15-$75, while the Trump administration revalued the SCC at $1-$7 per tonne (Wagner et al., 2021). Subsequently, the Biden administration established an interim central value of $51/ton, and a range between $14 and $152/ton. In 2023, the U.S. Environmental Protection Agency proposed raising the SCC to $190. Thus the official SCC for the U.S. is heavily dependent on the presiding administration, which is unsurprising, considering the substantial differences in TWTP for carbon cap-and-trade programs by political ideologies and climate change attitudes revealed in this and other studies. However, estimates for the SCC also vary markedly within the field of economics, given that the question of how properly to measure the SCC is still up for debate (Pindyck, 2019). Nevertheless, improvement in our ability to estimate the social benefits of carbon emissions reduction programs is imperative if we are to design effective and socially acceptable climate change policies (Aldy et al., 2021).

Our estimates for the Social *Benefits* of Carbon (SBC) emissions reductions constitute a useful complementary willingness-to-pay measure of the extent to which society may value program to

[37]Our sample-selection treatment is more rigorous than most, but could still be improved upon. See a dissertation chapter in Mitchell-Nelson (2022) for a more sophisticated approach.

reduce carbon emissions. Our SBC estimates pertain to the *marginal* value of a one-tonne reduction in carbon emissions, *independent* of any of the other features of the particular cap-and-trade program in question. Our study allows us to control explicitly for the potentially confounding effects of a program's expected impacts on regional labor markets and local pollution. Studies seeking to estimate the social benefits of carbon emissions reductions do not always consider the potential for omitted-variables biases in the estimated marginal utility of carbon emissions reductions that could be created by ignoring these other program attributes.

More-specifically, our SBC measure is the marginal willingness to pay for a one-tonne reduction in carbon emissions via a cap-and-trade program where individual households will bear increased costs. Given that this SBC is based solely on our estimates of the marginal utility of carbon emissions reductions, it is independent of the marginal utilities that households may derive from other attributes of a specific cap-and-trade program (or that they may derive from *any* program, regardless of its specific attributes). This is why we have drawn particular attention to the fact that none of our models has discerned statistically significant heterogeneity across the population in the marginal utility specifically of carbon emissions reductions. This failure to detect statistically significant heterogeneity, as always, could be simply an artifact of insufficient statistical power. However, the prospect of needing to use differentiated SCC values for different populations would present significant political obstacles, so evidence in favor of using just one common value for the social benefits of carbon reduction could be a relief for policymakers. Our research has controlled for numerous other program features that could otherwise account for heterogeneity in willingness to pay, but further careful research is still necessary before concluding that there will always be universality in SBC estimates.[38]

In terms of magnitudes, the SBC estimate from our homogeneous conditional logit specification (Model 1), as well as from our benefits-function transfer specification (Model 5), is on the

[38]In this way, the debate about the correct SCC has much in common with the debate about the correct "value of a statistical life" (VSL), a measure that is vital for decision-making with respect to public policies that reduce people's mortality risks. The VSL, incidentally, informs estimates of the SCC.

order of $48/tonne (albeit with some noise, as implied by the interval estimates for the marginal utility of carbon emissions reductions). This estimate is not too different from the $50/ton to $51/ton SCC estimates adopted by the Obama administration and the Biden administration. This rough correspondence thus suggests a degree of convergent validity for our SBC measure. (The Trump administration's SCC of less than $10/ton has generally been discounted as a legitimate estimate of the social cost of carbon emissions.) This type of demand-based SBC may thus be well-suited as an alternative or complementary way to measure the effects of carbon emissions reductions on social welfare.

In our study, we also help flesh out the complexities of preferences for these types of carbon-pricing programs. Our mixed-logit specification, our two latent-class specifications, and our model with systematic observable heterogeneity used for our benefits-transfer exercises all reveal that different groups in society (and people in different parts of the country) have preferences that indicate markedly disparate willingness to pay for cap-and-trade programs that produce identical-sized carbon reductions. Our work emphasizes that carbon cap-and-trade programs are much more complex than just the carbon emissions reductions they might be expected to achieve. Other program attributes considered in our study lead to our apparently novel measure of the marginal rate of substitution between green-sector and carbon-sector jobs. The "job-killing regulations" rallying cry of numerous industry groups (and the politicians they support) has contributed to the failure of numerous proposed carbon-pricing policies. Our MRS estimate concerning trade-offs between carbon-sector and green-sector jobs may prove to be useful for policymakers hoping to overcome a standard challenge presented by the employment implications of proposed climate change regulations.

The complexity of our survey is not without drawbacks. However, it is one of the most detailed carbon-pricing choice experiments to date. Earlier research has used choice experiments to elicit WTP for different climate policy instruments, such as a general cap-and-trade program versus a general carbon tax, but few other researchers have delved into the varieties of such programs. Our study focuses on state-level programs and their distributional consequences in terms of county-level labor market implications for different sectors and their impacts on local conventional pollutants. These results add to the growing weight of evidence that people are indeed concerned about the likelihood of a "just transition" to an economy with carbon pricing achieved via cap-and-trade programs.

Our choice experiment goes into considerable detail about permit auctions and revenue recycling, but our findings concerning these program attributes are less robust. Still, our LASSO variable-selection process, optimizing out-of-sample forecasting, leads to a specification that exhibits geographical variation in support for auctioning a greater share of carbon permits (with differences depending upon county-level opinions about climate change). There is evidence that people less inclined to approve of cap-and-trade programs would nevertheless like to see the auction revenues from such programs directed toward helping communities/workers that bear a relatively heavier burden due to the program's costs. We note that some other studies report that people prefer carbon-pricing plans when revenues are spent on "carbon-reducing projects," but we find that the amount of permit-auction revenues used "to help households and companies to buy emission-reducing equipment" does not have a discernible effect on support for these programs. Perhaps this difference reflects reduced sympathy for using funds to help private households/companies that could instead support public projects for carbon reductions.

Better utility-theoretic estimates of the value of carbon emissions reductions via alternative carbon cap-and-trade programs could improve benefit-cost analyses of proposed programs. A distinct measure of willingness to pay *specifically for carbon emissions reductions* is a necessary ingredient for any such welfare assessment, but decision-makers should not overlook the potentially powerful effects exerted by other program attributes on total willingness to pay for a given-sized carbon-emissions reduction. Total willingness to pay for a cap-and-trade program implies the public "acceptability" of alternative implementations of these programs. Work like ours affords policy-makers an option to consider in more detail the various local labor market (i.e., "just transition") consequences and local co-pollutant (i.e., "environmental justice") consequences of alternative policies to reduce carbon emissions.

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Figure 1: Size distributions of predicted WTP for programs with varying attributes. Selected programs denoted as X1_X2_X3_X4_X5_X6_X7_X8 feature an X1% carbon reduction, X2% decrease in carbon-sector jobs, X3% increase in green-sector jobs, X4 = 1 if there are additional regulations to limit local co-pollutants, X5% of permits auctioned, X6% of auction revenue to households/firms to buy emission-reducing equipment, and X7% auction revenue to communities/workers that bear a relatively heavier burden due to the program's costs. X8 is the "any program" indicator, which is always on. Each density is based on the predicted mean WTP in a county, replicated in proportion to that county's population. The distribution is not degenerate at a point only because of differing levels of "Yale Climate Map data, Factor 1" and "County COVID cases per 100, 2021" across counties

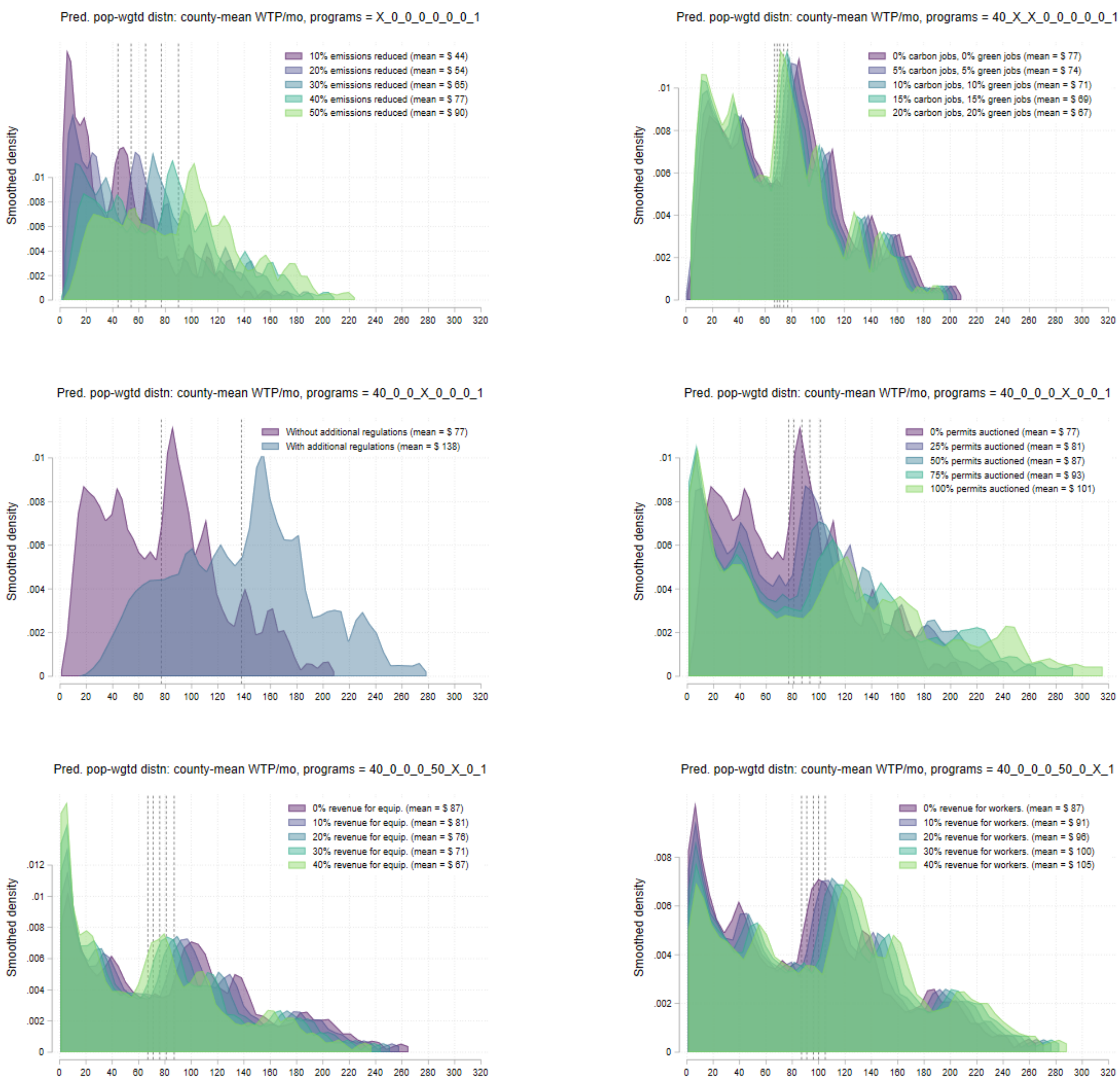

Figure 2: Size distribution of WTP for Program 1 (a baseline program with a 40% emissions reduction and zero for all other program attributes), compared to size distribution for Program 2 (a program with the same 40% emissions reductions, but 20% changes in carbon and green jobs, additional regulations on other pollutants, 100% of permits auctioned, and 40% of auction revenue to communities/workers that bear a relatively heavier burden due to the program's costs)

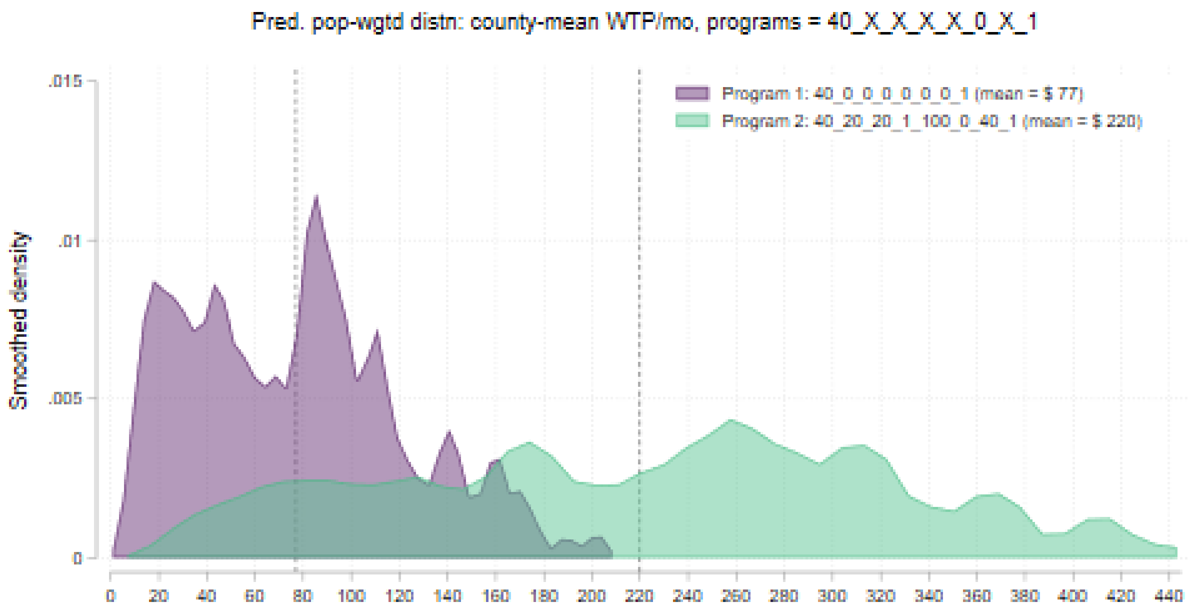

Figure 3: Simulated nationwide spatial distribution of predicted WTP for Program 1 (a baseline cap-and-trade program with a 40% carbon emissions reduction but all other attributes set to zero)

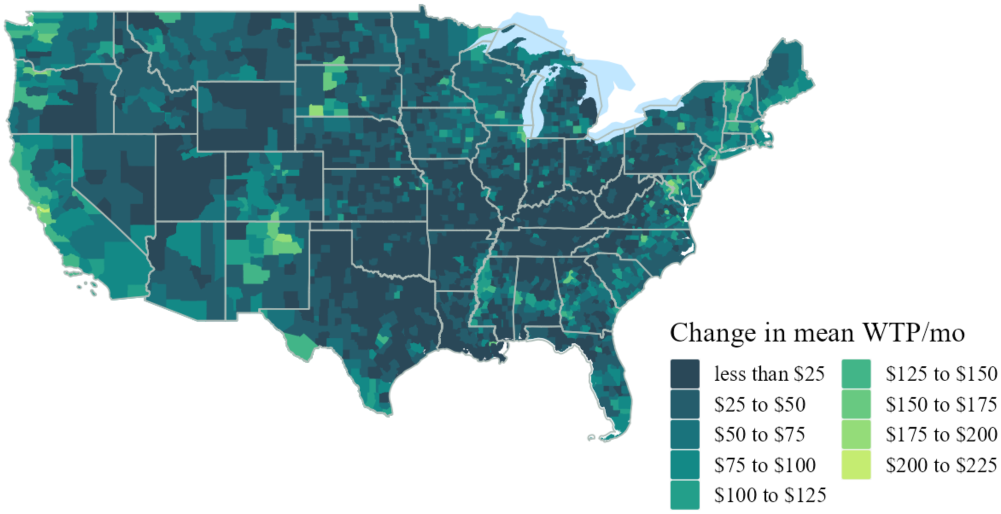

Figure 4: Simulated nationwide spatial distribution of predicted WTP for Program 2 (a program with the same 40% carbon emissions reduction, but 20% changes in carbon jobs and green jobs, additional regulations on other pollutants, 100% of permits auctioned, and 40% of auction revenue to communities/workers that bear a relatively heavier burden due to the program's costs)

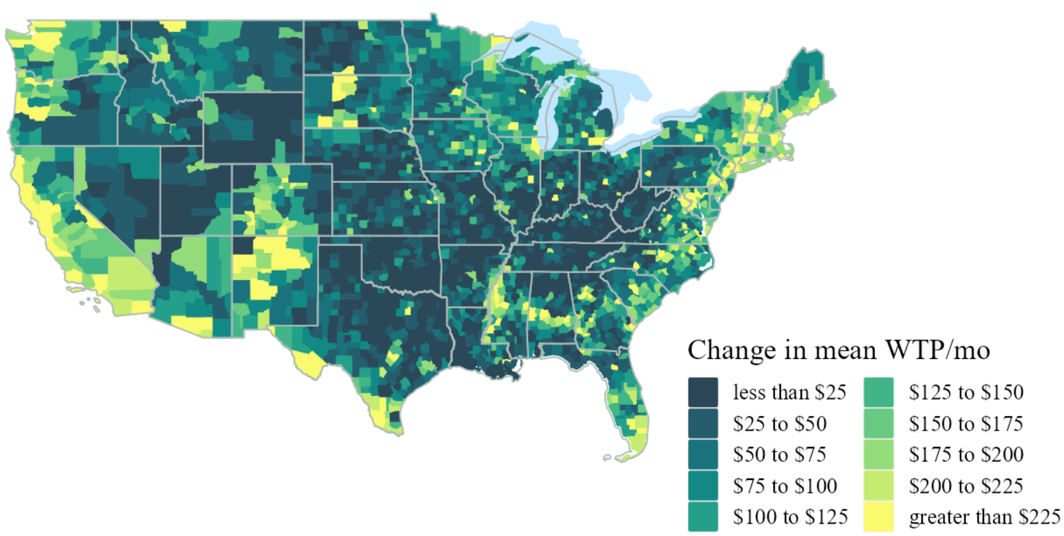

Figure 5: Based on Model 5 estimates: effect of counterfactual simulation of zero COVID-19 case rates during 2021 prior to the survey; comparison of size distributions of WTP for Program 1 (a baseline program with a 40% carbon emissions reduction and zero for all other attributes)

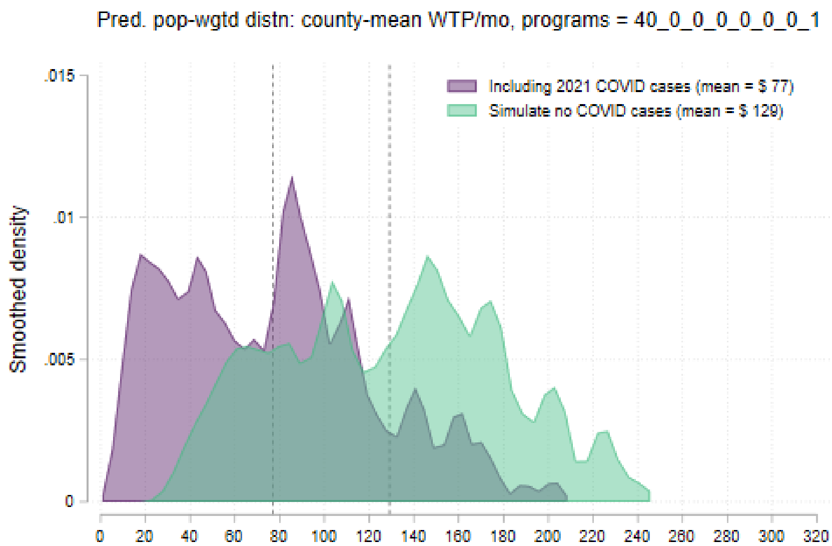

Figure 6: Spatial distribution of *increases* in WTP predicted for Program 1 (baseline program) when we simulate zero COVID-19 cases rates in each county. Implication: lighter counties more distracted from climate change by pandemic's effects

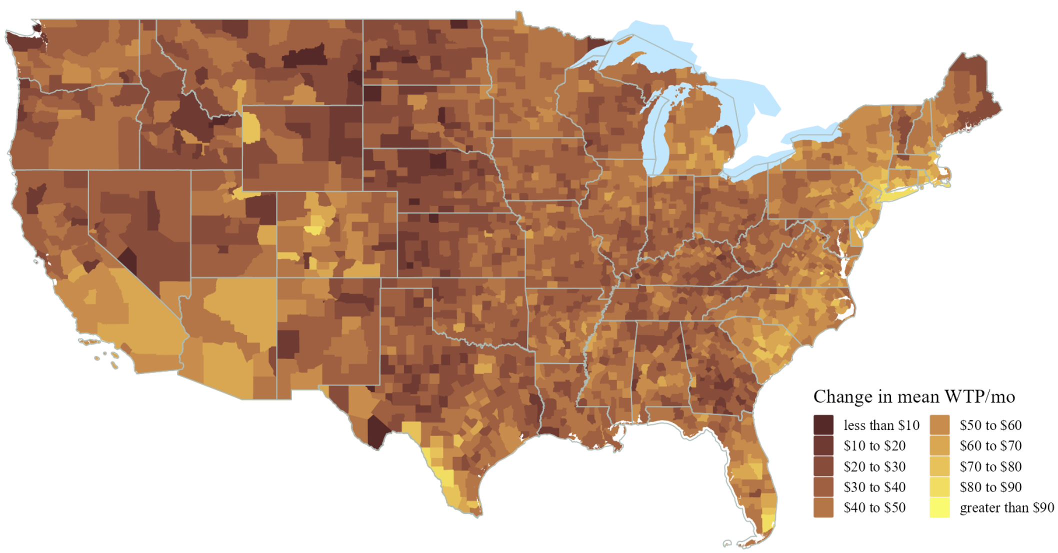

Table 1: Descriptive statistics for cap-and-trade programs and for alternative ways of capturing preference heterogeneity

	mean	(std. dev.)
1. Cap-and-trade program attributes (All models, n=6300 programs)		
Monthly cost	195.31	(101.87)
Prop change in C emissions	-0.456	(0.226)
Prop change in carbon jobs	-0.112	(0.064)
Prop change in green jobs	0.110	(0.062)
1=New regs other pollut.	0.495	
Share of permits auctioned	0.458	(0.230)
Share of rev. for equip.	0.304	(0.213)
Share of rev. to workers	0.305	(0.215)
2. Preference heterogeneity: Individual demographics (Model 3, n=1050 respondents)		
1=College graduate	0.427	
1=Income greater than 75K	0.441	
1=Identifies as non-male	0.527	
1=Own age:18-34	0.335	
1=Own age:65+	0.215	
1=Has no children	0.366	
1=Has resided in Oregon 18+ years	0.702	
1=Expect reside Oregon 20+ years	0.668	
1=Knows ancestors beyond gg-grndprnts	0.403	
3. Preference heterogeneity: Ideology and opinions about climate change (Model 4, n=1050 respondents)		
1=Identifies as Democrat	0.420	
1=Identifies as Republican	0.246	
1=Ideology:Strongly liberal	0.178	
1=Ideology:Somewhat liberal	0.207	
1=Ideology:Somewhat conservative	0.164	
1=Ideology:Strongly conservative	0.099	
1=Str. agree climate change a threat	0.592	
1=Agree climate change a threat	0.223	
1=Disagree climate change a threat	0.048	
1=Str. disagree climate change a threat	0.024	
1=Str. agree climate change human-caused	0.450	
1=Agree climate. change human-caused	0.309	
1=Disagree climate change human-caused	0.068	

Table 2: Marginal utility parameter estimates across alternative specifications (standard errors in parentheses); weighted by county population/sample proportions. All models include selection correction terms, reported in Table H3 in Appendix H in the Supplementary Materials. Models 2 through 5 include auxiliary parameters that allow for heterogeneous preferences, presented in subsequent tables

Model	(1)	(2)	(3)		(4)		(5)
	Homogeneous	Independent	Latent Class, demographics		Latent Class, ideology		For transfer
	Clogit	Mixed Logit	Class 1	Class 2	Class 1	Class 2	(when shifters=0)
Monthly cost	-0.00311***	-0.00826***	-0.00470***	-0.0139***	-0.00502***	-0.0177***	-0.00313***
	(0.000299)	(0.000699)	(0.000444)	(0.00163)	(0.000401)	(0.00249)	(0.000302)
1=Any program	0.155	0.277	1.239***	-1.008**	1.191***	-1.796***	0.150
	(0.118)	(0.236)	(0.182)	(0.394)	(0.163)	(0.584)	(0.118)
Prop change in C emissions	-0.483***	-1.666***	-1.005***	-1.323***	-0.934***	-1.207*	-0.481***
	(0.142)	(0.262)	(0.221)	(0.481)	(0.199)	(0.668)	(0.144)
Distributional consequences (labor market effects and environmental justice):							
Prop change in carbon jobs	1.411***	4.418***	2.886***	3.182*	2.634***	1.779	1.405***
	(0.463)	(0.822)	(0.652)	(1.706)	(0.602)	(2.230)	(0.469)
Prop change in green jobs	1.194**	4.176***	3.676***	0.964	3.226***	1.367	1.209**
	(0.469)	(0.877)	(0.832)	(1.492)	(0.716)	(2.007)	(0.473)
1=New regs other pollut.	0.200***	0.465***	0.295***	0.413**	0.279***	0.473*	0.215***
	(0.0544)	(0.100)	(0.0824)	(0.182)	(0.0747)	(0.265)	(0.0548)
Permit auctions and revenue recycling:							
Share of permits auctioned	0.0818	0.0305	0.0271	0.205	0.0549	0.413	0.0894
	(0.122)	(0.199)	(0.183)	(0.385)	(0.166)	(0.523)	(0.123)
Share of rev. for equip.	-0.211	-0.264	-0.0298	-0.465	-0.114	-0.147	-0.211
	(0.132)	(0.228)	(0.198)	(0.466)	(0.180)	(0.678)	(0.133)
Share of rev. to workers	0.187	0.492**	0.317	0.747*	0.319*	1.237*	0.183
	(0.131)	(0.247)	(0.202)	(0.432)	(0.181)	(0.640)	(0.132)
For auxiliary parameters, see:	n/a	Table 3	Table 4		Table 5		Table 7
Max. log-likelihood	-4262.19	-3188.72	-3276.05		-3169.44		-4213.98
No. respondents	1050	1050	1050		1050		1050
No. choices	6300	6300	6300		6300		6300
No. alternatives	12600	12600	12600		12600		12600

Table 3: Auxiliary parameters for Model 2 in Table 2: Marginal utility parameter standard deviation estimates for the independent mixed logit specification

Parameter standard deviations	Coef. Est.	Std. Err.
σ(1=Any program)	3.142***	(0.181)
σ(Prop change in C emissions)	0.729	(0.526)
σ(Prop change in carbon jobs)	0.393	(1.164)
σ(Prop change in green jobs)	3.676	(2.597)
σ(1=New regs other pollut.)	0.783***	(0.236)
σ(Share of permits auctioned)	0.404	(0.404)
σ(Share of rev. for equip.)	0.0277	(0.762)
σ(Share of rev. to workers)	2.503***	(0.530)

Table 4: Auxiliary parameters for Model 3 in Table 2: Submodel for Class 1 membership propensity as a function of demographic variables.

Class 1 membership	Coef. Est.	(Std. Err.)
1=College graduate	0.338**	(0.152)
1=Income greater than 75K	0.172	(0.153)
1=Identifies as non-male	-0.377***	(0.143)
1=Own age:18-34	0.815***	(0.173)
1=Own age:65+	-0.108	(0.184)
1=Has no children	-0.0264	(0.155)
1=Has resided in Oregon 18+ years	-0.270*	(0.161)
1=Expect reside Oregon 20+ years	0.299*	(0.154)
1=Knows ancestors beyond gg-grndprnts	-0.377***	(0.144)
Constant	0.246	(0.237)

Table 5: Auxiliary parameters for Model 4 in Table 2: Submodel for Class 1 membership propensity as a function of ideology and opinions about climate change.

Class 1 membership	Coef. Est.	(Std. Err.)
1=Identifies as Democrat	0.215	(0.212)
1=Identifies as Republican	0.450*	(0.254)
1=Ideology:Strongly liberal	0.199	(0.273)
1=Ideology:Somewhat liberal	0.345	(0.248)
1=Ideology:Somewhat conservative	-0.105	(0.257)
1=Ideology:Strongly conservative	-0.358	(0.344)
1=Str. agree clim. change a threat	1.924***	(0.340)
1=Agree clim. change a threat	1.238***	(0.305)
1=Disagree clim. change a threat	-0.589	(0.664)
1=Str. disagree clim. change a threat	-2.652	(2.442)
1=Str.agree clim. change human-caused	0.735**	(0.294)
1=Agree clim. change human-caused	0.564**	(0.259)
1=Disagree clim. change human-caused	-0.730	(0.502)
Constant	-1.434***	(0.287)

Table 6: Descriptive statistics for variables capturing county-level heterogeneity in preferences selected by LASSO for Model 5: Compare means (and standard deviations) for respondents in estimating sample, versus unweighted averages for Oregon counties, and for National (lower-48 U.S. states) counties to be employed in benefits-function transfer exercise

	(1) Est. sample county-level data (unwgtd) mean/sd	(2) Oregon county-level data mean/sd	(3) National county-level data mean/sd
Yale Climate Map data, Factor 1	1.506	0.542	-0.013
	(1.077)	(0.962)	(0.997)
County COVID cases per 100, 2021	2.214	2.530	3.592
	(0.580)	(0.945)	(1.385)
Observations	1050	36	3107

Table 7: Auxiliary parameters for Model 5 in Table 2: LASSO-selected systematic variation in marginal utilities according to county-level characteristics (with de-meaned interaction variables selected according to their value for prediction in hold-out samples, rather than the statistical significance of their estimated coefficients)

Systematic heterogeneity in marginal utilities	Coef. Est.	(Std. Err.)
1=Any program		
... $\times$ (dm:Yale Climate Map data, Factor 1)	0.153***	(0.0587)
... $\times$ (dm:County COVID cases per 100, 2021)	-0.0428	(0.0622)
Share of permits auctioned		
... $\times$ (dm:Yale Climate Map data, Factor 1)	0.142	(0.109)

Table 8: Implications of the fitted models: the social benefit of carbon reduction (SBC) is measured in dollars per ton of carbon reduced; the marginal rate of substitution (MRS) between carbon-sector jobs and green jobs is reported as the number of green jobs required to make up for each carbon-sector job lost; marginal WTP (MWTP) estimates are in dollars; MWTP for "proportional changes" are reported for a 1.00 (i.e. 100%) change in the attribute level; MWTP for "shares" pertain for a change in the share from 0.0 to 1.0; MWTP for "indicators" apply as the indicator changes from 0 to 1. Below each point estimate, the 95% confidence interval is given in parentheses, where a zero value is rejected if both confidence limits bear the same sign.

Model	(1) Homogeneous Clogit	(2) Independent Mixed Logit	(3) Latent Class, demographics		(4) Latent Class, ideology		(5) For transfer (when shifters=0)
			Class 1	Class 2	Class 1	Class 2	
SBC reduct. (dollars/ton)	$48	$62	$66	$30	$58	$21	$48
MRS(cbn jobs, grn jobs) @ mix now	1.34	1.2	.89	3.74	.92	1.47	1.32
	(.01, 2.67)	(.6, 1.8)	(.34, 1.44)	(-8.45, 15.93)	(.35, 1.5)	(-4.24, 7.19)	(0, 2.63)
Marginal willingnesses to pay, in dollars							
MWTP(1=Any program)	50	34	263	-73	237	-102	48[a]
	(-23, 123)	(-21, 88)	(182, 345)	(-134, -12)	(171, 304)	(-173, -30)	(-25, 121)
MWTP(Prop change in C emissions)	-155	-202	-214	-96	-186	-68	-154
	(-242, -68)	(-262, -141)	(-301, -127)	(-165, -26)	(-259, -113)	(-142, 5.21)	(-241, -66)
- Distributional consequences (labor market effects and environmental justice):							
MWTP(Prop change in carbon jobs)	453	535	614	230	525	101	449
	(150, 756)	(328, 742)	(322, 906)	(-16, 475)	(279, 772)	(-148, 349)	(144, 754)
MWTP(Prop change in green jobs)	384	505	782	70	643	77	386
	(82, 686)	(297, 714)	(401, 1162)	(-143, 282)	(345, 941)	(-148, 302)	(83, 689)
MWTP(1=New regs other pollut.)	64	56	63	30	56	27	69
	(28, 101)	(31, 81)	(26, 99)	(3.52, 56)	(25, 86)	(-3.01, 57)	(32, 106)
- Permit auctions and revenue recycling:							
MWTP(Share of permits auctioned)	26	3.69	5.75	15	11	23	29[a]
	(-49, 102)	(-43, 51)	(-70, 82)	(-39, 69)	(-54, 76)	(-34, 81)	(-47, 105)
MWTP(Share of rev. for equip.)	-68	-32	-6.34	-34	-23	-8.34	-68
	(-152, 16)	(-86, 22)	(-89, 76)	(-100, 33)	(-93, 48)	(-84, 67)	(-152, 17)
MWTP(Share of rev. to workers)	60	60	67	54	64	70	59
	(-23, 143)	(.09, 119)	(-17, 152)	(-7.52, 115)	(-7.35, 135)	(-.34, 140)	(-25, 142)

Notes: [a] At sample means; heterogeneous across counties with different county-level characteristics.

ONLINE SUPPLEMENTARY MATERIALS

to accompany:

Public preferences for a state-level carbon cap-and-trade program

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Contents

A Appendix: Expanded Discussion of the Related Literature

A.1 Context

While the United States has yet to adopt a federal carbon cap-and-trade program, regional carbon cap-and-trade programs have been adopted (Schmalensee and Stavins, 2017). Federal inaction may necessitate that regional coalitions and states to implement policies (Fullerton and Karney, 2018; Peterson and Rose, 2006). Recently, Oregon attempted twice to adopt a carbon cap-and-trade program. In June of 2019, Oregon's eleven Republican senators fled the state, preventing the passage of HB-2020, Oregon's carbon "cap-and-trade" bill. In spring of 2020, SB-1530, the proposed Oregon cap-and-trade program that was modified to be more palatable to rural Oregonians. Despite the modifications, like its predecessor, SB-1530 was again boycotted by Republicans and defeated. Despite substantial support for a carbon tax amongst economists (e.g., Metcalf, 2009), Oregon has been unable to pass legislation for a carbon cap-and-trade program. Oregon's attempts and (current) failure to create such a program highlights the complicated and contentious political, environmental, and social intersection concerning environmental regulation. Successful passage of a carbon cap-and-trade in Oregon relies on understanding preferences for a number of key program attributes.

A.2 Cap-and-Trade Attributes

Careful consideration was involved in the selection of program attributes to include for the carbon cap-and-trade programs we featured in our survey. [39] We ultimately chose to include nine total attributes for each program, which is clearly not an exhaustive list. It is typically necessary for choice experiments to avoid making unreasonable demands on the cognitive capacity of respon-

[39]The attributes included are: the level of carbon emission reduction, the program's impact on carbon-industry and green-industry jobs, the financial cost of the program to households, the program's permit allocation system, the use of permit auction revenue, and the program's inclusion of additional regulations. To see more details about our own survey instrument, see Appendix C and Appendix E.

dents. So our featured attributes were selected based on their importance to policy makers as well as the public. We will discuss briefly our motivation for including each feature, with the exception of the emissions reduction achieved (which seems self-explanatory).

A.2.1 Jobs

Perhaps the biggest political impediment for carbon cap-and-trade programs, as for other environmental regulations, has been their potential adverse effects on the economy—namely eliminating jobs in certain industries (Coglianese et al., 2013). Paramount to successful and equitable implementation of regulatory policy is ensuring that workers and communities are protected in the transition to a greener economy Look et al. (2021). However, despite the political clamor about job losses, there has been relatively little systematic evidence that significant job losses accompany carbon pricing.[40] Several studies have found a significant negative impact of environmental regulation on jobs, but the authors still argue in these cases that the benefits of the regulations (e.g. the Clean Air Act) have greatly outweighed the costs.[41] A common finding for studies that identify job losses is that the job losses occur in regulated sectors and are often accompanied by new jobs in clean industries (e.g., Yamazaki, 2017; Hafstead and Williams, 2018). However, it should be stressed that it is difficult to assess substitutability among different types of jobs. Even in instances where job losses in some sectors are offset by job gains in other sectors, there can still be significant welfare impacts (Reed Walker, 2013; Sovacool, 2021). Whether warranted or not, concerns about displaced workers remain a key obstacle to public acceptance of carbon emission regulations.[42]

[40] See Berman and Bui (2001); Deschênes (2012); Gray et al. (2014); Liu et al. (2021); Morgenstern et al. (2002); Sheriff et al. (2019); Yamazaki (2017).

[41] See Bartik (2013); Greenstone (2002); Reed Walker (2013)

[42] Some authors have questioned the validity of findings that show an impact of regulations on employment (Belova et al., 2015; Hafstead and Williams, 2019). For example, inappropriate modeling assumptions common to most earlier research could lead to biased results (Hafstead et al., 2018; Hafstead and Williams, 2018).

A.2.2 Costs

Cap-and-trade programs are largely popular because of their promise of efficiency. However, the system's inattention to distributional impacts have been a source of considerable concern.[43]. Fullerton (2011) points out that there are a number of ways in which distributional inequities can result from cap-and-trade programs. The most obvious is the upward pressure that cap-and-trade programs put on prices for carbon-intensive products. If the burden of these higher prices falls disproportionately on lower-income households, then the policy is considered regressive. This burden could be a result of lower-income households consuming relatively more carbon-intensive products (e.g. electric cars remain expensive) than higher-income households. Likewise, lower-income households may spend a larger portion of their income on carbon-intensive products (e.g. electricity bills). There is substantial evidence that carbon-pricing policies are regressive [44]. However, there is also evidence for carbon pricing policies being progressive.[45] [46] In any case, properly addressing the issue of a regressive carbon pricing scheme is challenging because of the distributional effects vary widely across communities and contexts.[47]. Conditional on the need for climate policy, it is possible that market mechanisms, while regressive, could be less regressive than other approaches to carbon management (e.g., Borenstein and Davis, 2016).

[43] See Büchs et al. (2011); Deryugina et al. (2019); Dorband et al. (2019); Farber (2012); Feger and Radulescu (2020); Fullerton and Muehlegger (2019); Goulder et al. (2019a); Pizer and Sexton (2019); Shammin and Bullard (2009); Wang et al. (2016); Williams et al. (2014) Williams et al. (2015)

[44] See Bento (2013); Büchs and Schnepf (2013); Burtraw et al. (2009); da Silva Freitas et al. (2016); Grainger and Kolstad (2010); Kolstad (2014); Jorgenson et al. (2013) Mathur and Morris (2014); Moz-Christofoletti and Pereda (2021); Wier et al. (2005)

[45] Ohlendorf et al. (2021) point out that, even in the case of a progressive policy, higher consumer prices still increase the risk of poverty for low-income households.

[46] See Beck et al. (2015); Cronin et al. (2019); Dorband et al. (2019); and Devarajan (2013).

[47] See Rausch et al. (2011); Ohlendorf et al. (2021); Fullerton et al. (2012); Pashardes et al. (2014); Fischer and Pizer (2019); Dorband et al. (2019); Pizer et al. (2010); Jorgenson et al. (2013); Pizer and Sexton (2019); and Burtraw et al. (2009)

A.2.3 Permit Allocation

Permit allocation has proven itself to be one of the key design features cap-and-trade programs.[48] Emission permits are allocated either based on historical output, through a government-coordinate auction, or a combination of the two (Fischer and Fox, 2007). The benefit of basing permit allocation on historical output is primary attributed to improving political feasibility and reducing the economic burden on firms. However, there is considerable criticism of this allocation system (Huber, 2013; Vesterdal and Svendsen, 2004; Mackenzie et al., 2008). While politically less-palatable, permit auctioning is argued to be the welfare improving option (Cramton and Kerr, 2002; Betz et al., 2010; Belfiori, 2017; Farber, 2012).

A.2.4 Permit auction revenue use

A decision for the government to auction emission permits will lead to a new source of revenue for the government. This revenue could be recycled to ameliorate the distributional issues.[49] Three particular uses are modeled in this study: subsidizing emission-reducing equipment for firms and households, financing adversely affected workers and communities transition, and reducing state taxes. Research has found that revenue recycling and providing the public with tangible public benefits could significantly improve support for carbon pricing (Amdur et al., 2014; Beiser-McGrath and Bernauer, 2019; Raymond, 2019). One caveat to this work is noted by Sallee (2019), who argues that using revenue recycling cannot achieve a Pareto improvement.

[48] Price collars and permit banking are also important considerations of the permit system (Fell et al., 2012; Fuss et al., 2018; Metcalf, 2009; Murray et al., 2009; Hasegawa and Salant, 2015; Burtraw et al., 2005; Metcalf, 2009)

[49] See Boyce (2018); Büchs and Schnepf (2013); Dinan and Rogers (2002); Wang et al. (2016); Bento (2013); Goulder et al. (2019b); Farber (2012); Williams et al. (2015); Parry and Williams (2010); Feger and Radulescu (2020); Grainger and Kolstad (2010); Moz-Christofoletti and Pereda (2021); Aubert and Chiroleu-Assouline (2019); Pizer and Sexton (2019).

A.2.5 Additional Regulations

Climate Change's impacts epitomize the issues of the environmental justice movement.[50] However, despite being one type of a climate change mitigation policy, carbon cap-and-trade programs also raise environmental justice concerns (Farber, 2012; Fowlie et al., 2020; Kaswan, 2008). The primary concern is that a market-based system will inevitably lead to a disproportionate accumulation pollution (i.e., "hotspots") in marginalized communities, while the benefits of the program are enjoyed by higher-income and more-empowered communities (Fowlie and Muller, 2019). Research has turned up little evidence to substantiate this concern (Anderson et al., 2018; Corburn, 2001; Farber, 2012; Fowlie et al., 2012, 2020). Hernandez-Cortes and Meng (2020) used a dispersion model and find that, under California's carbon cap-and-trade program, environmental equity has actually improved.[51] One hypothesis is that the dirtiest places are also the cheapest to clean up (Currie et al., 2020). On the other hand, Grainger and Ruangmas (2018), contrary to Hernandez-Cortes and Meng (2020), used a dispersion model to demonstrate that low-income communities have been exposed to more pollution. Chan and Morrow (2019) find, however, that under the Regional Greenhouse Gas Initiative in the northeastern United States, electricity generation has shifted relatively towards areas with higher marginal damages from SO_2 emissions. Some argue that carbon cap-and-trade programs are not the tool to address other pollutants and should only be relied upon only to address carbon emissions (e.g., Fowlie et al., 2020; Dulaney et al., 2017). Like other distributional issues, others contend that despite their challenges, properly designed cap-and-trade programs can mitigate most threats that these programs pose to environmental justice (e.g., Farber, 2012; Kaswan, 2008).

[50] Mohai et al. (2009) give an excellent overview of Environmental Justice and Banzhaf et al. (2019) provide another good overview more specifically prepared for economists.

[51] Shapiro and Walker (2021) similarly find that offsets do not seem to have created hotspots in California in relation to race or class.

A.3 Political Obstacles

Notwithstanding the considerable economic challenges of designing an optimal carbon cap-and-trade program, perhaps the biggest impediment to policy adoption in the United States is political obstacles (Goulder and Parry, 2008; Jenkins, 2014; Klenert et al., 2018). And at the end of the day, a policy's economic implications are irrelevant if the policy is not passed by lawmakers. Indeed, economic analysis of environmental regulations frequently has little bearing on political popularity (Gillingham et al., 2018). In part, this is due to compromised government integrity (Baranzini and Carattini, 2017; Convery and Redmond, 2013). However, the primary reason carbon cap-and-trade programs and other carbon pricing policies remain largely politically infeasible is due to the public's lack of support (Levi et al., 2020).

Public support for a policy is highly dependent on the narrative surrounding the policy, as well as the framing of the policy (Alló and Loureiro, 2014; Carattini et al., 2018; Bilandzic et al., 2017; Bushell et al., 2017; Dickinson et al., 2013; Terzi, 2020). A considerable amount of effort on the part of energy-intensive corporations has gone toward fostering opposition to climate-change-related policies through misinformation campaigns (Egan and Mullin, 2017; Farrell, 2016; Westervelt, 2018). Additionally, conservative regulation-opposing politicians have used public concerns about the economy to establish an anti-environmental regulation narrative (Coglianese et al., 2013; Egan and Mullin, 2017). The effects of these campaigns can be seen in research which reveals that the more people understand the impacts of climate change, the more they are willing to participate in (or bear the costs of) climate-change mitigation measures (Bain et al., 2012; Bord et al., 2000; Spence et al., 2011; Scannell and Gifford, 2013; Videras et al., 2012).

In the United States, political party affiliation is often the primary determinant in attitudes about climate change and mitigation policies. A review of climate change opinion surveys in the United States finds that not only is partisanship the paramount driver in support for policy, but that the gap between the Republicans and Democrats has become even more pronounced in recent years (Egan and Mullin, 2017). This assessment has been corroborated using revealed preference studies as well. For example, Anderson et al. (2019) use voting data from two failed carbon tax bills in Washington State and find that political party affiliation is by far the biggest indicator of support or opposition to the policies. In their study, political ideology accounts for 91% of the variation in vote shares across precincts.

B Appendix: Details about LogLikelihood Functions

B.1 Choice models with homogeneous preferences: Conditional logit

If each individual in the sample is presented with $t = 1, ..., T$ choices, the joint probability (likelihood) function for this conditional logit model is then given by

$$\mathscr{L}(\beta) = \prod_{i=1}^{M}\prod_{t=1}^{T}\prod_{j=1}^{J}\left(\frac{exp(V_i^{jt})}{\sum_{k=1}^{J} exp(V_i^{kt})}\right)^{y_{itj}} \tag{7}$$

where $y_{itj} = 1$ if alternative j is selected on choice occasion t by individual i, and is zero otherwise. To yield a unique set of parameter estimates, it is necessary to normalize by differencing utility relative to a numeraire alternative—the No Program option in our case, indexed by J, without loss of generality. For the numeraire alternative, this utility difference is zero so the corresponding $exp(V_i^{Nt})$ term in the ratio becomes $exp(0) = 1$:

$$\mathscr{L}(\beta) = \prod_{i=1}^{M}\prod_{t=1}^{T}\prod_{j=1}^{J}\left(\frac{exp(\Delta V_i^{jt})}{1+\sum_{k=1}^{J-1} exp(\Delta V_i^{kt})}\right)^{y_{itj}} \tag{8}$$

In our data, we have M=1050 respondents. There are only two alternatives in each choice set, but $T = 6$ choice sets: $j_1 = (A,N)$, $j_2 = (B,N)$, $j_3 = (C,N)$, $j_4 = (D,N)$, $j_5 = (E,N)$, $j_6 = (F,N)$. Thus the basic form for the "conditional logit" likelihood function for the choices in our study is:[52]

$$\mathscr{L}(\beta) = \prod_{i=1}^{1050}\prod_{t=1}^{6}\prod_{j=1}^{2}\left(\frac{exp(\Delta V_i^{jt})}{1+exp(\Delta V_i^{kt})}\right)^{y_{itj}} \tag{9}$$

where the preference parameters are embedded in the (ΔV_i^{jt}) terms.

The estimated parameters in this random utility model, when derived via maximum likelihood, are distributed asymptotically joint normal (typically with non-zero covariances). Willingness

[52]The model is only slightly more complex if there is more than one choice set for each individual and we wish to accommodate similarities among the choices for any given individual.

to pay estimates, therefore, rely on one of several methods for accommodating the fact that the ratio of two normally distributed random variables has a mean that is undefined. Researchers often make use of the Krinsky and Robb (1986) parametric bootstrap simulation method, which relies on a large number of random draws from the joint distribution of the estimated parameter vector. Each draw is used to calculate either the marginal WTP for a given attribute (e.g. $\hat{\beta}_2/\hat{\alpha}$ for a 1.00 decimal-percent change in carbon emissions), or the total WTP (TWTP) for program A, according to the complete formula in equation (4). Across these random draws of parameters, a sampling distribution can be built up, and descriptive statistics can be produced for the distributions of marginal WTP estimates for specific program attributes, or for the total WTP for program A, are then calculated. Researchers typically report the mean and/or median, along with the 90% or 95% interval, where these values function as point estimates and an interval measure for predicted marginal WTP, either for specific program attributes or for total WTP.[53]

For the formula for the willingness to swap carbon-sector jobs for carbon-emissions reductions in equation (5), a bootstrap approach, or the delta method, or Fieller's method would likewise need to be used to provide point and interval estimates for this percentage, since we are still dealing with ratios of utility parameters estimated by maximum likelihood.

B.2 Choice models with unobserved heterogeneity: Mixed logit

Mixed logit probabilities are the integrals of ordinary conditional logit probabilities, with the integrals taken over the density function for the random parameters in the model. Suppose we begin with the conditional logit choice probabilities that individual i will select alternative j on choice occasion t, where we now denote this logit probability as L_{ijt}. We again normalize on numeraire

[53] Some alternative strategies for deriving interval estimates for either some marginal WTP or for TWTP include the delta method and Fieller's method. Hole (2007) developed an add-in for Stata (wtp.ado) that can calculate marginal WTP measures in clogit models that are linear and additively separable. Another Stata add-in (wtpcikr) supports models that are either linear or logarithmic in the additively separable net income variable and can be used following probit, logit or bivariate probit commands.

alternative $J = N$, to permit unique estimates of the parameters β:

$$L_{ijt}(\beta) = \frac{exp(\Delta V_i^{jt})}{1 + \sum_{k=1}^{J-1} exp(\Delta V_i^{kt})} \tag{10}$$

The mixed-logit probability that individual i will select alternative j is given by:

$$P_{ijt}(\beta) = \int L_{ijt}(\beta) f(\beta) d\beta \tag{11}$$

where $f(\beta)$ is the density function for the parameter vector that accommodates unobserved heterogeneity in preferences, and the observed portion of utility, V_i^{jt} (which captures at least the baseline attributes of each alternative, as featured in equation (1)), is embedded in the $L_{ijt}(\beta)$ term. The mixed logit probability formula can be interpreted as a weighted average of the standard conditional logit formula evaluated at all the different values of the parameter vector β, where the weights are given by the parameter density function $f(\beta)$, also known as the "mixing distribution." We note that if the mixing distribution is degenerate at a set of fixed β parameters, the mixed logit model collapses to just the standard conditional logit model. If the mixing distribution is discrete, the mixed logit model becomes the latent class model (i.e. a finite mixture model) described in the next section.

Mixed logit estimation algorithms permit the user to choose among a variety of parametric distributions for each random parameter. If the parameter vector is assumed to be multivariate normal with mean vector b and covariance matrix W, then the mixed-logit choice probabilities are given by:

$$P_{ijt} = \int \left(\frac{exp(\Delta V_i^{jt})}{1 + \sum_{k=1}^{J-1} exp(\Delta V_i^{kt})} \right) \phi(\beta | b, W) d\beta \tag{12}$$

A log-normal distribution is sometimes preferred, when its ability constrain the sign on a parameter is important (as is sometimes the case when the marginal utility of net income is imprecisely estimated, leading to a nontrivial amount of probability being associated with negative values). Parameters can be modeled as individually noisy but independent from each other, or they can be allowed to be correlated across individuals in the sample. For example, people with a higher-than-average marginal (dis)utility from losses of jobs in the carbon-intensive sector may also derive lower-than-average marginal utility from gains of jobs in the green sector. These could be older workers with less ability to change careers, for example.

In contrast, other people in the sample may have a lower-than-average (dis)utility from losses of carbon jobs but a higher-than-average marginal utility from gains in green jobs. These folks could be younger and still flexible in their career choices. A mixed logit with correlated preference parameters permits these more-general forms of heterogeneity in preferences while still permitting us to estimate "average" preferences for use in scaling WTP estimates from a representative sample to the entire population.

For our model in equation (3), there are eight basic marginal utility parameters. If we allow each of these marginal utilities to be random but independent, the parameter space expands to 16. In such a case where the researcher had enough data to permit all parameters to be random and also correlated across respondents, there would be eight parameter means and eight corresponding parameter standard errors to estimate, along with the $8(8-1)/2 = 28$ off-diagonals of the symmetric parameter covariance/correlation matrix.[54]

For the results reported in this paper, we make use Stata's convenient mixlogit algorithm. Researchers now have the option, however, to shift to the specialized choice-modeling algorithms offered in Apollo, a software package based on the R language, offered by the Choice Modelling Centre at Leeds University in the UK.

In cases where there is more than one choice per individual, there may be some commonalities among different choices by the same individual. In estimation of the mixed logit by maximum

[54] In this paper, we ultimately emphasize our model with systematic heterogeneity according to county-level population characteristics, so we report only the simpler independent mixed-logit model in our comparison across specifications.

simulated likelihood methods, it is appropriate to make one draw from the joint distribution of the preference parameters *per individual*, rather than separate draws for each choice occasion.

As in the body of the paper, we note that he average preferences for our sample of Oregon residents (even after our *ad hoc* adjustments for systematic sample selection) cannot be assumed to be appropriate for scaling to the entire U.S. population. A sample from Oregon alone is unlikely to be representative of the entire lower-48 U.S. states without first controlling for systematic differences in climate-policy preferences across different regions of the U.S.

B.3 Choice models with finite mixtures of preferences: Latent class logit

Many researchers working with choice experiments now automatically entertain latent-class models. In these models, it is assumed that each respondents' preferences can be captured via a finite mixture of a small number of underlying preference types, each with it own vector of preference parameters. These class-specific parameters, β_c, for each preference class c, entering into the expression for ΔV_i^{jt}. Within preference classes $c = 1,..,C$, individual i's choice probabilities across t choice occasions are given by:

$$P_i(\beta_c) = \prod_{t=1}^{T}\prod_{j=1}^{J}\left(\frac{exp(\Delta V_i^{jt})}{1+\sum_{k=1}^{J-1} exp(\Delta V_i^{kt})}\right)^{y_{itj}} \tag{13}$$

These latent preferences are assumed to be homogeneous within class c, so just the nine linear-in-variables preference parameters $\beta_c = (\alpha^c, \beta_1^c, ..., \beta_8^c)$ for our linear-in-variables indirect utility function would be estimated for each class.

Preference parameters can be permitted to vary systematically with one or more observable respondent characteristics to permit estimation of different sets of utility parameters for different groups. For latent class models, however, we *do not observe* class membership. Instead, preference class membership is only *probabilistic*. These distinct sets of preference parameters are subsumed in a model that also employs a class membership equation. The respondent's latent *class* *membership* probability depends not on the attributes of the different cap-and-trade programs, but exclusively on the characteristics of the individual respondent or their jurisdiction. Let s_i be a vector of such (often sociodemographic) characteristics for respondent i or the population in their geographic area (e.g. ZIP code, county, climate division, etc.).

These respondent characteristics do not differ across alternatives in the program choice tasks, so the class-membership part of the model takes the form of a so-called multinomial logit model, where the probability of belonging to a particular class involves a different set of multinomial logit coefficients for each class (although the coefficients for an arbitrarily designated numeraire class are normalized to zero). The same set of respondent characteristics leads to different probabilities of belonging to each preference class only because the *coefficients* on these characteristics differ across classes. Thus if there are C different preference classes, there will be $C-1$ sets of coefficients on the vector of respondent or geographic area characteristics that determine the probabilities of class membership. Then, conditional on class membership, the model embeds conventional conditional-logit-type choice models for each class that involves homogeneous preferences within that class.

The the probability that individual i belongs to preference class c is given by the multinomial logit probability:

$$\pi_{ic}(\theta_c) = \frac{exp(s_i\theta_c)}{1+\sum_{l=1}^{C-1} exp(s_i\theta_l)}, \quad \text{for } c = 1,...,C-1 \tag{14}$$

where the vector s_i typically includes a constant term and θ_c is a conformable vector of class-membership model coefficients for class c, with θ_C normalized to 0 for identification (i.e. so that the θ vectors are uniquely estimated). The full set of class membership coefficients is then $\Theta = (\theta_1, ...\theta_{C-1})$. For the full latent class model, the joint likelihood of individual i's choice will then be:[55]

$$\mathscr{L}_i(B,\Theta) = \sum_{c=1}^{C} \pi_{ic}(\theta_c) P_i(\beta_c) \tag{15}$$

Latent class models can be somewhat balky to estimate when there are many respondent characteristics to consider. Suppose there are k_1 individual or neighborhood characteristics for respondents, k_2 carbon cap-and-trade program attributes, and C latent classes are being entertained. Then the parameter space for the model will be on the order of $(C-1) \times k_1 + C \times k_2$. The greatest success generally comes from starting with an extremely parsimonious specification and gradually adding more respondent characteristics (implicitly freeing up their coefficients to be non-zero). For each additional program attribute, C additional parameters are added to the model. For each additional respondent characteristic, $C-1$ additional coefficients are added. For each additional class of preferences, $k_1 + k_2$ more parameters must be estimated.[56]

B.4 Choice models with systematic observed heterogeneity: Out of sample forecasts

Using zip code information, we can match respondents to their local context and county of residence, including local weather-related conditions, recent drought conditions, and wildfire exposure. This permits us to estimate the effects of respondents' recent exposure to some likely consequences of climate change on their preferences for climate-change mitigation policies. Such models can enhance the explanatory power of models which are solely designed to predict willingness to bear the costs of alternative cap-and-trade programs for Oregon. However, the natural

[55]For repeated choices by the same individual, the model can be estimated to allow for commonalities in choices within an individual.

[56]For the estimates reported in this paper, we use Stata's *lclogit2* algorithm to search for a set of parameter estimates that brings us close to the maximum likelihood solution but does not produce a parameter variance-covariance matrix. These estimates are then used as starting values for the follow-on algorithm, *lclogitml2*, to attain the maximum likelihood solution and produce the parameter variance-covariance matrix needed for hypothesis testing and for the calculation of WTP estimates.

correlations among geocoded variables over a region as small as an individual state can make it difficult to identify the distinct marginal effects of individual variables. Had we been able to extend our survey over a much wider geographical area, variables that could be argued to capture the local salience of climate change might have permitted our study to complement others' work measuring the so-called "exposure effect" (e.g. Spence et al. (2011), Bain et al. (2012), and Scannell and Gifford (2013)).

In models not reported here, we have explored a very wide range of models that employed both ZCTA-level heterogeneity (where available) and county-level heterogeneity in an extensive list of census variables, climate/weather variables, voting patterns, unemployment rates, social vulnerability indexes, FEMA disaster declarations of different types, and drought conditions. We used these variables to build interaction terms with program attributes. This strategy converts the scalar marginal utilities in the basic model into marginal utilities that vary as linear combinations of coefficients and the values of all these proxies for heterogeneity in preferences. Rather than paying attention to conventional measures of the statistical significance of individual parameter estimates on these interaction terms, we relied upon LASSO methods to choose the most important interaction terms for prediction in hold-out samples.

For all of these models, however, the next step in the process (simulating expected WTP for every ZCTA or county in the lower-48 U.S. states) persisted in yielding far too many very large outlying values that seemed highly implausible. The lesson from these exercises was that the smaller the geographic unit involved (especially for ZCTAs), the more likely it is that the share of the population in some particular group across the lower-48 U.S. states will have a value that is far outside the range of values for that variable across comparable units within just the state of Oregon, the sample for which we can estimate preference parameters.[57]

LASSO methods are a valuable tool in the process of variable selection. However, the LASSO

[57] An alternative is to attempt to simulate WTP amounts for only those ZCTAs or counties for which the all of the proportions in the model lie, simultaneously, strictly within the range of values exhibited within Oregon. Unfortunately, this strategy yielded rather too few predictions.

algorithm picks those interaction terms that do the best job of explaining choices in hold-out samples *from the estimating sample*. Variables that do a good job of explaining out-of-subsample choices, even for a representative sample from Oregon, will not necessarily choose variables that do the best job of explaining choices for counties outside of Oregon entirely. Given that our ultimate emphasis in this paper is on models that might reliably transfer to other counties in the lower-48 U.S. states, we do not report in this paper these complex LASSO-informed Oregon-only models drawing from a vast array of possible interaction terms using ZCTA and/or county-level characteristics. Instead of using the ZCTA or county-level sociodemographic variables to explain respondents' cap-and-trade program preferences, we take advantage of the Yale Climate Map data, which is now available for 2021.

C Appendix: Structure of the Survey

Our study was originally conceptualized during the lead-up to consideration of Oregon House Bill 2020 during the state's legislative session during the winter of 2019. However, the vote on that bill never took place because Oregon's Republican house members left the state to prevent attainment of a quorum. We paused the project for several months until Oregon Senate Bill 1530 was proposed for the state's legislative session in the year 2020. An exodus of Republican legislators again occurred. After the 2020 legislative session concluded, however, Oregon experienced the worst wildfire season in years, and significant drought conditions continued. Rather than seeking merely to inform any future legislative debate in Oregon about a particular proposed cap-and-trade program, we redesigned our survey to look for systematic differences in preferences for a wide variety of cap-and-trade programs with different attributes. We sought to provide research that could reveal both (a) preferences across programs with different attributes (e.g., different distributional consequences), and (b) differences across the population in preferences for programs with the same attributes.

C.1 Demographic Questions for Screening

The first section of the survey collects five basic pieces of information about the respondent: place of residence (state), age, gender, race, and income. A sixth question asks the respondent to report their Oregon zip code. Their response is cross-referenced against an exhaustive list of Oregon's residential zip codes. What we call "Demographic Questions for Screening," serves multiple essential purposes.

First, in order to measure heterogeneous willingness to pay (WTP) measures across demographics it is essential that we in fact know what are those demographics.

Second, we would like our 1000 observations to be as representative of Oregon, at least on those five categories, as possible. If the respondent answers the six questions (e.g. *White male,* *age 25-34,* with *income $20,000 - $24,999 a year,* and *lives in the zip code 97219*) and we observe that we already have "enough" respondents fitting that description, then we excuse the respondent from the rest of the survey.

Finally, the preliminary demographic section allows for sample selection correction. Before any information alluding to the content of the survey is revealed (i.e. that the survey is asking about WTP for a carbon cap-and-trade program), the respondent must answer those five basic questions. If the respondent chooses "Prefer not to say" for any of the categories then they are excused from the survey. If the respondent answers the demographic questions and we deem them eligible for the survey (see the second point above) then we introduce the topic of the survey. At this point, some respondents will drop out of the survey. However, because we have already gathered the demographic information about these dropouts we are able to observe what relationship, if any, exists between willingness to take the survey and the aforementioned demographic characteristics. In other words, we are able to observe if sample selection is occurring and correct for it.[58]

C.2 Intro Questions

After completing the initial demographic information, the respondent is sent to the "Basic Information and Consent" page. It is at this point that the topic of the survey is revealed. The respondent is asked to consent to taking the survey. A followup question asks the respondent to confirm that they will provide "thoughtful and honest answers" as recommended by Johnston et al (2017). A "No" to either of these questions results in termination of the survey.

C.3 Background Information

The next section of the survey provides the respondents with some basic information that is relevant to carbon cap-and-trade (CAT) programs. We begin with a brief explanation of climate change,

[58] See **Appendix ??** for explanation of the selection correction procedure.

carbon emissions, and the relationship between the two. We then explain the motivation of understanding Oregonians' preferences concerning a CAT program. Namely, that Oregon legislators have attempted to pass a CAT in Oregon but have failed to do so in large part because specifics of the program were not agreeable. At this point we briefly explain the mechanics of a CAT. The respondent is then prompted with "How familiar are you with carbon cap and trade programs?" The respondent receives more information about how a CAT works if they answer "I should probably review the basics" or "Not familiar at all." The respondent skips this further explanation if they answer "Quite familiar." After the explaining the broad strokes of CAT programs, the survey elucidates which companies will likely be targeted in Oregon. While we cannot know what form policy will take in reality, it is important that the respondents have a similar idea of who is regulated while answering the survey. Because the hypothetical CAT programs our survey asks respondents to make choices about include specific rules about permits[59] we provide a cursory explanation of permits that complements the earlier explanation of carbon cap-and-trade programs. The respondents are able to pursue a more detailed explanation of permits if they feel inclined. The more detailed explanation does not include unique information, but rather provides a fuller explanation that might be more accessible should the cursory explanation leave respondents confused. The next two pages of the survey describe respectively penitential benefits (global and local) and costs (to households, to businesses, and concerns about equity). The final page of this section asks the respondent which county they live in. Using that response we are able to scale the values of the choice tasks to the county level the individual respondent lives in.

C.4 Tutorial on Program Attributes

The next section of the survey's purpose is to prepare respondents for the choice tasks. Each choice task presents a hypothetical program in the form of a table. Due to the complexity of the table it

[59] See **Choice Scenarios** below.

is appropriate to send some time explaining all the moving pieces of the choice task.[60] The table is codified into five "Feature Groups": *Results*, *Carbon Permits, rules*, *Auction Revenue Uses*, *Additional Regulations*, and *Cost to your household*. Each group has between 1 and 3 different features for a total of nine program features for respondents to consider. The nine program features are discussed below. The tutorial walks respondents through each feature of the table. A brief explanation of the feature is provided as well as a graphic that helps explain and provides relief from too much text. In addition to the explanation in the tutorial, the respondents are instructed that throughout the choice tasks a abbreviated description of any specific feature can be called up by clicking on that feature in the table. The values used in the tutorial section are the same values used in the first choice task. This is done to minimize mental effort on the respondent's behalf and to help connect the tutorial with the choice task section. Before the feature-by-feature portion of the tutorial begins, respondents are instructed that the every program displayed in the choice task will begin January 1, 2023. Consequently, the various effects of the program will also begin to accrue January 1, 2023.

Results

The first feature group, *Results*, has three attributes: Carbon emission reduction, Carbon industry jobs lost, and Green industry jobs gained. The first feature, carbon emission reduction, refers to the percent reduction of total annual carbon emissions in Oregon by the year 2050 (relative to current emission levels). By clicking on a link, respondents are able to observe current emission levels in Oregon, which provides context to the reduction goal.

The next feature is *carbon industry jobs lost*. The value presented in the table is not a percent of jobs lost, but rather a sum (e.g. 2,000 jobs). This sum is based in part on the county that the respondent indicated they lived in earlier in the survey.[61] The respondents are instructed that

[60]Pretesting found that thorough explanation was often necessary to convey the parameters of the hypothetical situation we were asking respondents to consider.

[61]We take the current level of carbon industry jobs in a county (e.g. 40,000) and then scale that number by a randomly generated percent (e.g. 5%) and present that number (e.g. 2000) as the number of carbon industry jobs lost.

they should imagine this job loss would occur over the next 30 years–consistent with the carbon emission reduction by 2050. Respondents are able to see how many current[62] carbon industry jobs are in the respondent's own county of residence. Respondents are also shown the total number of carbon industry jobs in Oregon.A link is included that clarifies what the survey means by "carbon industries."

Green industry jobs gained follows the same format as carbon industry jobs lost with the obvious exception that values are based off of green industry jobs, as defined by the BLS.

Carbon Permits, rules

Carbon Permits, rules has only one feature: Share of permits auctioned. This value indicates the percent of the total cap set by the cap-and-trade program that is auctioned. The respondent is reminded that the rest of the permits are allocated for free. The survey does not specify the allocation process, but examples are provided for respondents who are curious earlier in the survey. Respondents have already been provided with information about permits earlier in the survey, but it is important that respondents clearly understand the costs and benefits of this feature. In the pretest, initially testers were often unclear about how this feature worked. The survey includes a detailed visualization of the permit rule system to aid in the explanation.

Auction Revenue Uses

The next feature group is *Auction revenue uses*. One of the primary issues to political feasibility of cap-and-trade programs is concern over some groups (e.g. coal miners or low-income households) being economically devastated by shrinking industries or higher costs of goods. A popular, in theory, way to address this heterogeneous burden is by using the funds from the auctioned permits to target groups or sectors in need of assistance. After consideration, this survey asks respondents to consider three possible ways to spend the auction funds: *fund new equipment*,

[62]Calculations use data from 2019 for the Bureau of Labor Statistics

support communities/workers, and *Oregon tax relief*. There are a multitude of other ways this money could be spent, but we found these categories to be a good balance of both encompassing most of the ways as well as specific enough for respondents to be able to consider clearly. The values presented are in percent terms (summing to %100 across the three uses). Because no specific dollar value is given in terms of total money raised by the auction, respondents similarly do not see a specific amount of money being allocated to these three uses.

Fund new equipment refers to revenue spent to partially or entirely subsidize the purchase of emission reducing equipment for firms or households. In practice, the more general label for spending of this nature might be referred to as "funding green projects." However, that label is fairly vague and we believe that being more specific would result in more thoughtful responses.

Support communities/workers refers to revenue spent on communities or workers in certain industries that bear a relatively heavier burden of the costs of the cap-and-trade program. Often referred to as a *Just Transition*, an essential component of a politically feasible program includes a safety plan for those hurt by the program. Some examples are given, for instance "communities with a lot of carbon-intensive jobs." However, no specific group is explicitly stated as receiving these funds. Furthermore, the vehicle in which the funds are delivered are also left open-ended.

Oregon tax relief refers to revenue spent on reducing the Oregon state taxes. A considerable amount of literature explores the various intricacies using taxes to counteract the costs of carbon pricing. However, in the survey we keep the idea simple to reduce mental effort on the behalf of the respondent. In short, the higher the value this feature takes on the lower "taxes" will be for Oregonians.

Additional Regulations

Additional Regulations has only one feature *limit other pollutants*. This feature is included ad hoc to address environmental justice concerns about unintended hot spots of carbon emission co-pollutants. Under a standard cap-and-trade program, it is possible that certain firms will actually *increase* emissions and thus increase co-pollutants (e.g. NO_x or $PM_{2.5}$). The *limit other pollutants* feature takes on two values, "YES" and "NO." Respondents are instructed of the potential issue of unintended co-pollutant hot spots under a carbon cap-and-trade program and then this feature indicates whether some form of "additional regulation" would be part of the program. The details of the regulation are left vague, and in practice there are many ways to address the co-pollutant issue (e.g. pollution standard, trading ratio or zonal trading). However, we believe this approach to be a good compromise of an accessible idea for respondents that addresses a key issue in carbon cap-and-trade programs.

Cost to your household

The final feature of the table is the cost to households in *Dollars per month*. *Dollars per month* is explained as the "average monthly costs *your household* would bear if the program is adopted." We use the per month unit of time because energy bills, as well as consumption budgets, are frequently considered on a monthly scale. For many households these will be the primary sources of program costs. The respondents are instructed that these costs are unavoidable. A change in energy use or not working in a carbon-intensive industry does not absolve the respondent's household from incurring the cost.

C.5 Choice Scenarios

Each respondent is asked to perform six choice tasks (Program A through Program F). In each choice task they are presented with a hypothetical program in the form of a table (with the features mentioned above) and asked if they would prefer the program or no program. Each program is identical in display and content with the exception of the values that each feature takes on. To reduce mental effort on behalf of the respondent, Program A uses the values displayed in the program attribute tutorial. The choice is presented as a "vote." The idea being, it is quite conceivable that a cap-and-trade program could be on a future ballot in Oregon so the survey does its best to replicate that scenario. This is one way in which the survey addresses the cheap talk issue that is common in contingent valuation methodology.

In a preamble to the first program (Program A) the respondents receive a few additional instructions. First, they are told that the labels of the programs (A through F) are arbitrary and have no relation to the quality of the program. The preamble also clearly states that in for any given program the respondent should only consider this program and no program at all. In other words, we do not want respondents voting against, for instance Program C, because they prefer Program B or some other program that they have conjured up in their head. This point is belabored by making the voting choices for each program "Program *X* to begin January 1, 2023" and "No program at all." The respondents are instructed that voting against a program is a valid choice and that they should act freely since the researchers will not learn their identity. In an additional effort to address cheap talk respondents are instructed that, "In hypothetical choices such as these, people sometimes do not think carefully enough about what they would have to give up to be able to pay the monthly cost of the program. **Please consider what your household would have to sacrifice, if the proposed cap-and-trade program were adopted.**". Finally, respondents are reminded that they are able to review explanations for a program feature by clicking on it in the table.

The survey is designed such that the entire program table is visible on a screen–this includes cell-phone screens. We presume that many respondents will use cell-phones to take the survey and in order to consider all the features of a program the respondent should be able to see them all at the same time. Below each program table the respondent is prompted with, "If Program *X* were the only program to be put to a vote, I would vote for:" followed by the two aforementioned choices.

After the respondent votes on Program A they are taken to different pages depending on their choice. If the respondent votes for Program A they are sent to the next choice task. If the respondent votes for no program they are asked to indicate from a menu of options all the reasons they voted against the program:

- *Too much emission reduction*

- *Too little emission reduction*
- *The economic impacts were too costly*
- *Did not approve of the auction revenue use*
- *Too many permits were auctioned*
- *Too few permits were auctioned*
- *Did not approve of the Additional Regulations on other pollutants*
- *The benefits of Oregon or the World do not justify ANY cost*
- *Program A did not seem believable*
- *Some other reason*

We are able to deduce from the respondents choices here whether they have valid economic reasons for voting no, or whether their no vote signals scenario rejection. [63]

From this page, people who voted no on Program A are then asked if they would vote for any carbon cap-and-trade program. More specifically they are asked to choose from three options: "I did not like **Program A**, but there might be some type of program, at some cost low enough for me, for which I could possibly vote 'Yes"', "Carbon cap-and-trade programs are a BAD idea. The government should not interfere with the free market. **I would vote "No" for ANY carbon cap-and-trade program**!" and "Something needs to be done about carbon emissions, but **a carbon cap-and-trade program is not the solution.**" If the respondent indicates that there is a program they could conceivably vote for they are sent to the Program B choice task. If at this point the respondent indicates they would not vote for any carbon cap-and-trade program they are skipped through the choice tasks to the next section of the survey–this saves the respondent unnecessary effort. If the respondent indicates that something needs to be done about carbon emissions, but the solution is not cap-and-trade they are sent to a further clarifying page.

[63] An example of a valid reason would be "The economic impacts were too costly." An example of an invalid reason would be "Too little emission reduction." We consider this an invalid reason, because the alternative to Program A is no emission reduction. So this answer indicates that the respondent is not operating in the framework of the hypothetical scenario.

If a respondent votes against Program A and indicates that carbon cap-and-trade programs are not the appropriate policy response they are asked if they would prefer a carbon cap-and-trade program to no policy at all. If at this point they indicate that they would prefer a cap-and-trade program to nothing at all they are sent to the Program B choice task. If they are staunchly opposed to cap-and-trade programs they are skipped through the choice tasks. Respondents who end up at this page are asked what policy they would prefer to a cap-and-trade program. This is asked after completing the choices tasks or after being skipped through the choice tasks as determined by their answers.

After completing the choice tasks, respondents are asked to indicate which of the program features were most important to them. For respondents who made it through all choice tasks but voted for no in all six choice tasks, they are asked to explain the reasons they did so. They choose from a menu of options:

- *I am not convinced that climate change is actually happening*
- *Even if climate change is actually happening, I don't believe that anything we do (or don't do) will make any real difference*
- *I don't think Oregon produces enough carbon emissions to matter. Instead, states and countries with more heavy industries should be required to cut back*
- *I would be hurt by the effect of the program on my livelihood or the cost of things I buy*
- *I would be hurt by the effect of the program on the cost of transportation*
- *These choice tasks were just too difficult for me to process*
- *Some other reason (Please specify)*

In this way we are able to gain a better understanding of what features are important to them, despite having no "choices."

C.6 Follow-up Questions

In the final section of the survey the respondent is asked a serious of additional socio-demographic questions. Some of these questions would be quite informative if asked to ask in initial demographic question section. For instance, political ideology and political party affiliation are likely determinants in a respondent's propensity to dropout of the survey. However, due to IRB restrictions this is not possible.

Years in Oregon

Two questions are asked concerning respondents' residence in Oregon. First we ask respondents "*How many years have you lived in Oregon*" (with a sliding scale from 0 - 100), and then we follow up with "*How many more years do you expect to keep living in Oregon?*" (with a sliding scale from 0 - 100). These questions are included for two separate purposes. The first is to test the hypothesis: Are people who feel more connected to a geographic area (in this case, Oregon) more likely to support long term environmental policy (in this case, carbon cap-and-trade) in that area? The second purpose of this particular pair of questions is to screen out inattentive/careless respondents and bots. Both can potentially be detected by illogical uses of the sliders–especially when cross-referenced against the age question asked at the beginning of the survey. For instance, bots are often programmed to max out sliders. In this case answering 100 years to both years lived so far and future years lived in Oregon will raise a flag.[64]

General Socio-demographic Questions

We include a series of additional basic socio-demographic questions. The questions are multiple/single choice, with the inclusion of "Prefer not to say" for each question, unless stated otherwise. We force a response to the questions but a respondent's choice of "Prefer not to say" does

[64] A very detailed assessment of invalid responses in an online survey panel was provided by Robert Johnston in a session entitled "Contemporary Guidance for Stated Preference Studies: An Update (roundtable)" at the 2021 Annual Conference of the Society for Benefit-Cost Analysis.

not end the survey for them at this point. The questions in the order that they appear are:

- *What is your ethnicity?*. Choices include: “Hispanic,” “Non-Hispanic,” or “Other.”
- *Which industries provide a significant amount of your household’s income?*. We provide a menu of standard NAICS categories with specifically relevant subsectors broken out separately (e.g. Wood Product Manufacturing and Forestry/Logging are separate categories).
- *Politically, do you consider yourself to be:*. Choices range from “Strongly conservative” to “Strongly liberal.”
- *What political party do you most strongly identify with?*. Choices include: “Republican,” “Democrat,” and “Independent.”
- *What is your highest level of education?*. Choices include: “Less than high school,” “High school graduate,” “Some college,” “Bachelor’s degree,” “Master’s degree,” “Doctoral degree,” and “Trade or technical school.”
- *Which best describes your current employment status?*. Choices include: “Self-employed or small business owner,” “Employee, working full-time,” “Employee, working part-time,” “Not employed, looking for work,” “Not employed, NOT looking for work,” “Retired,” “Disabled, not able to work,” “Full-time student,” “Student with part-time work,” and “Other.”

Attitudes about Climate Change

Respondents are asked a serious of questions pertaining to their attitudes about climate change. Recall that in the background information section of the survey climate change was briefly discussed. The survey takes the stance that climate change is real, which can be, unfortunately, read as a political stance by some Americans. It is likely that people willing to participate in the survey will need to have some basic acceptance that climate change is real. However, it is informative to have a more nuanced understanding of respondents’ attitudes.

Respondents are prompted with, *Climate change is real, and is a serious threat to humanity*. Response options include: “Strongly agree,” “Agree,” “Neutral,” “Disagree,” and “Strongly Disagree.” If the respondent selects “Strongly disagree” they are skipped past the remainder of the climate change questions.

If they choose any other option respondents are prompted with, *Climate change is the result of human activity*. Response options include: “Strongly agree,” “Agree,” “Neutral,” “Disagree,” and “Strongly Disagree.” If the respondent selects “Strongly disagree” or “Disagree” they are skipped past the remainder of the climate change questions.

Finally, respondents are asked, *Who is most responsible for slowing or preventing climate change? (Select all that apply).*Response options include: “Local governments,” “The Federal government,” “Households,” “Companies,” “People who are wealthier,” “People who are responsible for more emissions,” “Other” and “Everyone equally.”

Generational Questions

Following the climate change attitude portion of the survey, respondents are then asked two generational questions. First they are asked, *Do you have any of the following? (Check all that apply)* with response options of: “Children,” “Grandchildren,” “Great-grandchildren,” “Other descendants (please specify),” “None of the above,” and “Don’t know / not sure.” They are then asked, *How many generations back can you trace at least some of your ancestors? (Check the greatest number)* with response options ranging from “1 generation (i.e. just your parent(s))” to “7 or more generations.” The hypothesis is that people who see themselves as being remembered as well as they remember their ancestors might be more concerned about climate change and what they do about it now. While the questions perhaps appear non sequitur, being too direct in testing this hypothesis would potentially lead to social desirability bias.[65]

[65] Respondents answer how they would like to be seen rather than how they actually feel. While an online survey format helps mitigate this, a loaded question like, “Do you care about future generations?” could lead to untruthful responses.

Energy Use Questions

Respondent's are asked two questions concerning fuel-type. First respondents are asked, *What is the primary fuel you use to heat your dwelling?*. Response options include: "Natural gas," "Electricity from a conventional power plant," "Electricity from solar panels or wind power," "Electricity (unsure about source)," "Wood or wood pellets," "Passive solar (heated water)," "Other (please specify)," "I don't heat my dwelling," and "Don't know / not sure." Respondents are also asked to indicate *What are your most common forms of transportation? (Check as many as apply)*. Response options include: "Personal vehicle (gasoline or diesel)," "Personal vehicle (hybrid)," "Personal vehicle (electric)," "Public transportation (bus or train)," "Taxi or ride-sharing (e.g., Uber or Lyft)," "Bicycle," "Walking," and "Other (please specify)."

It is likely that a large portion of the average costs to households resulting from a carbon cap-and-trade program will come through the form of higher energy prices. While we have already managed to glean information about respondents' attitudes concerning higher energy costs it is informative to be able to connect a respondent's attitude about higher costs and their actual energy use. While in the choice task we instruct respondents to assume costs are unavoidable, it is likely that higher energy costs would be more salient for those that use natural gas to heat their homes or always commute via a personal vehicle.[66] Energy-type use also helps identify which individuals are willing (and able) to make personal efforts to mitigate climate change. Identifying this preference is informative in our WTP analysis.

Feedback Questions

We give respondents three separate prompts to provide feedback on the survey. The feedback, in addition to informing future studies, also aids in our data collection.

[66]It should also be noted that higher energy costs are also more salient for low-income households, because a larger portion of their income goes towards energy use. Recall, income level is one of the demographic pieces of information that is required in order to be eligible for the survey.

The first feedback prompt is concerned with research team bias. There are two versions (version A and version B) of the prompt page that are randomly assigned to individual respondents. Both version A and B of the prompt page read, *It seemed like the research team wanted me to:*. The difference in the versions is that the order in which the menu of response choices is inverted fro version B. The response choices, in the order that they appear in version A, include: "**definitely vote AGAINST** a carbon cap-and-trade program," "**probably vote AGAINST** a carbon cap-and-trade program," "vote **according to my own beliefs**," "**probably vote FOR** a carbon cap-and-trade program," and "**definitely vote FOR** a carbon cap-and-trade program." To reiterate, version B has the same choices but an inverted order. The randomized inversion of the response choices is to test for response order bias from the respondents. An ideal survey would result in all respondents choosing "vote **according to my own beliefs**." However, non-systematic even distributions "**probably vote AGAINST** a carbon cap-and-trade program," "vote **according to my own beliefs**," and "**probably vote FOR** a carbon cap-and-trade program" are also acceptable. It is possible that due to the politically charged nature of climate change and related policies, that simply asking about attitudes toward a carbon cap=and-trade program will lead the respondent to assume the research team is biased in favor of a program.

The second feedback prompt asks the respondent to rate the survey using a five star rating system on four categories: "Understandable," "Relevant to you," "Interesting," and "Informative." In addition to providing useful feedback to future studies, this prompt also serves two additional purposes. First, low scores, especially for "Understandable," give us an idea about the quality of a particular respondent's submission. If a respondent only gives the survey 1 out of 5 stars for "Understandable" then we know that the choice tasks were likely not performed with full comprehension. Second, this star system provides another chance to draw attention to respondents (or bots) who are speeding through the surveys.

Finally, respondents are given an open-ended prompt for feedback. The primary goal of this prompt is to detect respondents who are speeding through the survey or bots. Bots in particular will often enter gibberish or nonsensical answers. Of course, it always encouraging to read thoughtful comments from respondents.

D Appendix: Choice Experiment Randomizations

D.1 Unique Choice Tasks

Each choice task table (e.g. Program A) is populated with values randomly generated according to a set of parameters. There is no correlation in values between any of the individual surveys or across any of the six choice tasks within each survey. With 1000 respondents and 6 choice tasks per respondent there are a total of 6000 independently generated choice task tables.

If the scenarios in a choice experiment involve a short list of attributes, and if each attribute has only a small number of discrete values, and if will be plausible to respondents that any value of one attribute could be combined with any value of any other attribute, then software exists whereby "design efficiency" can be optimized. However, we have a relatively large number of distinct cap-and-trade program attributes to accommodate, and some of them cannot be independent (e.g., shares must sum to one an cannot exceed one). Likewise, pretesting of the survey instrument confirmed that people where skeptical about "large" programs with small costs, or about "small" programs with large costs, so that at least some degree of correlation needed to be built into the attribute levels for each choice scenario. While the specifications we include in the present paper are linear and additively separable (albeit in terms of proportions or shares), we wished to preserve our ability to distinguish among models where utility is smoothly nonlinear in variables. If it is a maintained hypothesis that the derivatives of the indirect utility function are constant, then only two distinct values of each attribute will typically be sufficient to identify these derivatives, but we plan to explore nonlinearities, so we desired many different values for each attribute.

D.2 Parameters Used to Generate Randomizations

We populate the choice task tables (hypothetical carbon cap-and-trade programs) with values from a structured randomized data generation process. This process emphasizes both realistic hypothetical carbon cap-and-trade programs and a distribution of values with enough granularity and orthogonality to allow for precise estimation. All 6,000 programs in the survey (6 programs per respondent times 1000 respondents) are independently generated. There are nine program features and each of these nine features is included in every program. Individual features are determined according to their own specific process. Some of the processes are interdependent, but a degree of random noise of independence is present in each process to avoid too much collinearity across variables. The only attribute values that are specific to Oregon in the choice tasks are the *carbon jobs lost* and *carbon jobs gained*, and these values can be fairly easily modified for other geographic locations. The processes can be seen below.

D.3 Carbon Reduction Values:

Carbon reduction values are independently drawn with replacement from a uniform distribution: 10, 20, 30, 40, 50, 60, 70, 80. We believe that this distribution gives us enough granularity for estimation while also allowing respondents to easily understand the amount of carbon reduction a program will accomplish. These values are presented as percent reductions achieved by 2050 relative to current emission levels.

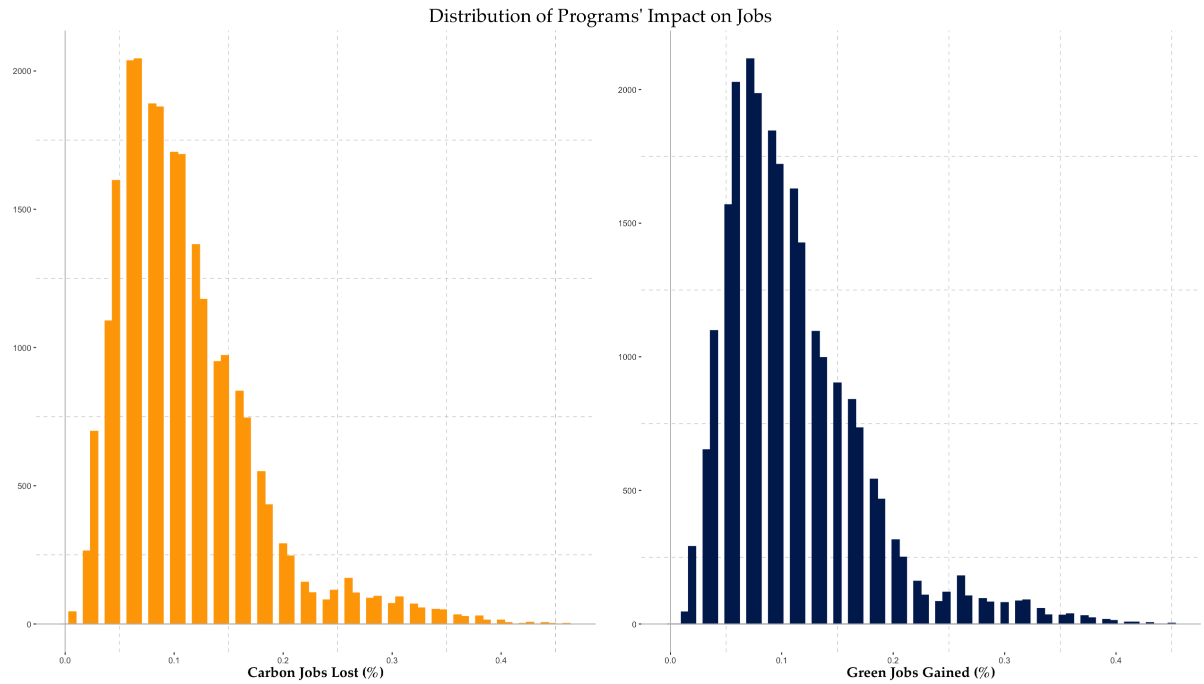
D.4 Jobs Values

Carbon Jobs Lost and Green Jobs Gained were independently drawn from the following distribution:

$$Value \in \{0.01, 0.02, 0.03, 0.04, 0.05, 0.06, 0.08, 0.10, 0.15, 0.25, 0.30\}$$

$$Probability \in \{0.02, 0.10, 0.11, 0.13, 0.20, 0.15, 0.11, 0.09, 0.05, 0.03, 0.01\}$$

Where *value* indicates the value drawn from the distribution and *probability* indicates the value of drawing the corresponding value. For example, there is a 13% chance of drawing 0.04. The draws for both types of job (carbon and green) were drawn independently and with replacement. These values are generated to reflect percent of jobs lost (gained) as the result of a cap-and-trade program. These values are then uploaded into the survey. However, the values that populate the choice task tables that respondents see are modified. The values that actually populate the tables are the product of these randomly generated values and the current level of jobs in the county in which the respondent resides. For instance, if for a respondent i Program A's *green jobs gained* draw took on the value of 0.06 and *respondent i* indicated they lived in Multnomah County (327,000 current green jobs) then the value *respondent i* would see in the Program A table for *green jobs gained* would be $0.06 * 327,000 = 19,620$ jobs. For *respondent i* Program B's *green jobs gained* draw took on the value of 0.01 then the value *respondent i* would see in the Program B table for *green jobs gained* would be $0.01 * 327,000 = 3,270$ jobs. Below is the distribution of generated values used in the survey with $N = 10,000$.



D.5 Share of Permits Auctioned Values:

The share of permits auctioned are independently drawn with replacement from a uniform distribution: 10, 20, 30, 40, 50, 60, 70, 80. These values are presented as the percent of total permits in the cap-and-trade program that would be auctioned, with the remainder being given away to firms at no cost. In some cap-and-trade programs the percent of permits auctioned will increase overtime. However, including this dynamic process in the survey is likely to overwhelm respondents so we simplified the process by suggesting the percent of permits auctioned is static throughout the existence of the program. The lower bound of 10% was chosen so that the revenue auction uses are always relevant. The upper bound of 80% was chosen to reflect the reality of how cap-and-trade programs have played out so far. For instance, there is precedent in the Small Business Regulatory Enforcement Fairness Act (SBREFA) that some of the permits must be allocated free of charge, so as not to cause excessive financial burden.

D.6 Permit Auction Revenue Uses:

There are three potential uses for auction revenues: purchase or subsidize cleaner equipment for households and firms, support workers and communities that are disproportionately burdened by program costs, and reduced Oregon taxes.

1. Clean equipment: values are drawn independently from uniform distribution: $equipment_i \in \{0,10,20,30,40,50,60,70\}$.

2. Support for workers and communities: values are drawn independently from uniform distribution: $support_i \in \{0,10,20,30,40,50,60,70\}$.

3. Tax Reduction: the values for tax reduction are determined by the values for the preceding two revenue use values. Tax value for instance i is calculated by $100 - equipment_i - support_i$. If this value is negative for a generated program that program is filtered out of the randomizations pool. The process guarantees that the three auction revenue uses sum to 100 as well as non-negative values for the tax feature. Because the equipment values and support values both have a mean of value of 35 the tax values have a mean of 30. We are willing to accept this slight imbalance to guarantee respondents see clean round numbers in the program tables.

D.7 Additional Regulations On Other Pollutants Values:

Additional regulation on other pollutants can take on two values: "YES" and "NO." These values are drawn independently with a 50% chance of either value being realized. The values are completely orthogonal to all other values in a program.

D.8 Cost Values:

Cost values are generated according to the following formula:

$$cost_i = K * \left[55 + \beta_i * benefit_i + \alpha_i * auctioned_i - \gamma_{1i} * equipment_i - \gamma_{2i} * support_i - \gamma_{3i} * taxes_i + H_i\right]$$

$\beta \in \{0.25,\ 0.5,\ 1,\ 2,\ 3\}$

$\alpha \in \{0,\ 1,\ 2\}$

$\gamma_1 \in \{0,\ 0.25,\ 0.5,\ 0.75\}$

$\gamma_2 \in \{0,\ 0.25,\ 0.5,\ 0.85\}$

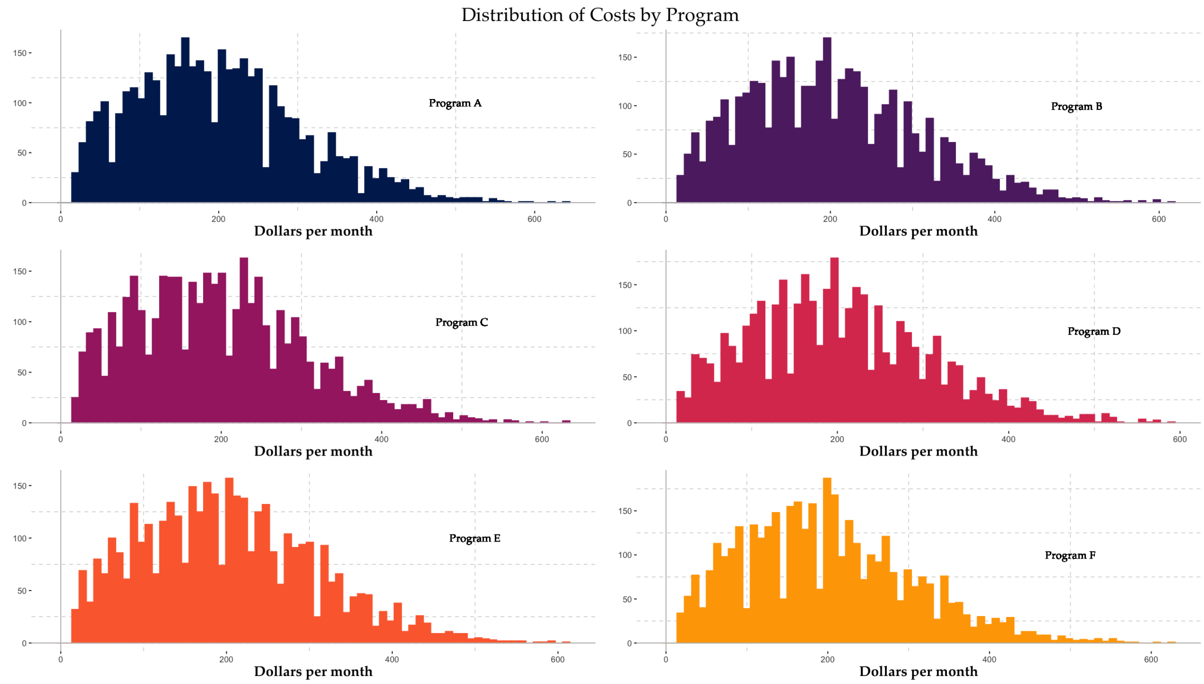
$\gamma_3 \in \{0,\ 0.25,\ 0.5,\ 0.85\}$

$H \in \{-50, 150, 20\}$

$K = 1.08$

Values for cost of the program were expressed in \$ per month. As indicated by the subscripts $cost_i$ is generated specific to the other relevant values for $program_i$ and these values are scaled by values randomly generated for each $program_i$. In other words, all 11 variables are regenerated for each program randomization. Logically, the higher the target emission reduction ($benefit$) the higher the cost of the program so β takes on a positive value. α also takes on a positive value under the rationale that if permits are auctioned it will increase production costs for firms. This will raise consumer prices as well as lead to more job loss in carbon-intensive industries. All of the permit auction revenue use variables (buying new equipment, support for communities and workers, and reducing taxes) would likely lead to directly or indirectly to lower costs to individuals. The term H enters the equation as a random shock to cost as a way to increase orthogonality across programs. K was used to scale the cost variable up so that respondents were voting affirmative on programs approximately half of the time. We set a price floor of \$20 for every program so that if the data generation process resulted in any cost $> \$20$ it was filtered from the randomizations pool.

Below is the distribution of generated values used in the survey with $N = 10,000$.



E Appendix: One Instance of the Survey (Screenshots)

E.1 State of residence

The screening questions on the first 8 pages of this survey of Qualtrics panelists are completed before the page that contains the Consent to Participate in the actual survey. The Consent page is where the respondent first learns about the topic of the survey. This ordering is crucial to any ability to model systematic response/non-response (attrition from the random sample of Qualtrics panelists). Qualtrics prefers that respondents who are ineligible because quotas have already been met should be apprised of this fact before they get too far into a survey for which their answers are not needed. We require that potential respondents, still naïve about the topic of the survey, should at least be willing to supply their state of residence (always Oregon for this study) their age, gender, race, and household income bracket. These are the quota criteria for inclusion.

However, we also require that they enter their ZIP code at the end of the screening section. Our overall target sample (1000) is not large enough to warrant quotas by ZIP code within Oregon, but we need this information to permit us to link every one of these screened and eligible respondents to external auxiliary data that can be geocoded to ZIP codes. For this climate-related study, these external data sources include Census ZCTA data, NOAA climate division data, 2020 Presidential election data by county, state legislative district voting data for Oregon for 2016, along with spatial data on the recent history of wildfires and drought levels. These neighborhood/county characteristics can be used as proxies for the salience of climate change problems to people who live in the same area as the eligible respondent. The partisan reactions to Oregon's actual proposed carbon cap-and-trade programs in recent years suggests that political ideologies in the respondent's neighborhood may make programs to reduce carbon emissions either very attractive or readily dismissed. For the latter group, we expect a lower likelihood of continuing with the survey to completion, after the topic of the survey is revealed.

Qualtrics can target Oregon in issuing survey invitations. However, to prevent non-Oregonians from pretending to be from Oregon, we first check to see whether respondents choose "Oregon" when given an opportunity to choose their state. (If they don't choose Oregon, they are given one opportunity to choose again, and are terminated if they don't choose "Oregon" at least on the second try. The follow-up double-check page is not shown here.)

We need to make sure the set of people who take this survey represents the general population of the relevant states. So first, we need to verify that this study still needs information from more people who are like you.

Select the state where you live:

E.2 Age

What is your age bracket?

- Under 18 years
- 18 to 24 years
- 25 to 34 years
- 35 to 44 years
- 45 to 54 years
- 55 to 64 years
- 65 to 74 years
- 75 years or older
- Prefer not to say

E.3 Gender

What is your gender?

- ○ Male
- ○ Female
- ○ Non-binary
- ○ Prefer not to say

E.4 Race

What is your race?

- ○ White
- ○ Black or African-American
- ○ Asian
- ○ American Indian or Alaska Native
- ○ Native Hawaiian or Pacific Islander
- ○ Some other race
- ○ Prefer not to say

E.5 Household income

In 2020, approximately what was your total annual household income, using these standard income brackets?

Click this blue text for a pop-up that explains who counts as your household. Click the X in the upper right to close the pop-up, or just click anywhere on the screen outside the pop-up.

- ◯ Less than $20,000
- ◯ $20,000 to $24,999
- ◯ $25,000 to $29,999
- ◯ $30,000 to $49,999
- ◯ $50,000 to $74,999
- ◯ $75,000 to $99,999
- ◯ $100,000 to $124,999
- ◯ $125,000 to $149,999
- ◯ $150,000 to 174,999
- ◯ $175,000 to $199,999
- ◯ $200,000 or more
- ◯ Prefer not to say

E.6 ZIP code

We validate the respondent's zip code entry by checking it against a list of "standard" Oregon ZIP codes—namely ZIP codes that are not for post-office boxes and are not "unique" (typically for government agencies or other large institutions that have their own internal mail systems). Unique ZIP codes are more likely to be workplaces.

What is the 5-digit Oregon ZIP code **where you live**? (This information will help verify that the set of people who take this survey will represent all regions.)

← →

E.7 Check ZIP code

In the background, this page checks whether the zip code you entered, **97403**, is a valid **neighborhood** ZIP code in Oregon.

Meanwhile, if you are taking this survey on a computer, laptop or larger tablet, please maximize the window.

Click through to see the result for the ZIP code you entered.

E.8 Confirm standard ZIP code

Excellent. The ZIP code you entered, **97403**, appears to be valid neighborhood ZIP code in Oregon

E.9 Consent to Participate

This page is where respondents first learn the topic of the survey. We expect that upon learning that the survey will be about carbon cap-and-trade programs to deal with climate change, some share of respondents to lose interest, while others will find the topic especially salient. The questions asked prior to this page allow us to assemble ZIP-code-level, county-level or other geo-coded variables that can help us identify the respondent's community and how its characteristics may be systematically different than the neighborhoods of other potential respondents who either do, or do not, continue to complete the entire survey.

Basic Information & Consent

Excellent. You have qualified for this study. Now we need to tell you a bit more about the study and get your formal consent to take part.

Study Procedures: Oregon's government has been considering a **carbon cap-and-trade** program in the state. If you are a resident of Oregon, and you decide to participate in this research study, you will be asked to complete a **roughly 15-minute survey** about whether and how Oregon should set up a program like this. (The survey may take longer if you haven't heard much about carbon cap-and-trade and you choose to study more of the optional background information we provide.)

We will first explain a bit about carbon cap-and-trade programs and how such a program might work in Oregon. Next, we will **show you some different versions of programs**. Each time, you will be asked to consider the program and to **vote yes or no**. We will then gather some information that will help us understand how preferences for these programs differ across groups of people.

Questions About this Survey? This survey project is funded by the Department of Economics at the University of Oregon. If you have questions or concerns about this survey, or about the study that will use the data it collects, please contact the research team: Professor Trudy Ann Cameron, (cameron@uoregon.edu), or project manager Garrett Stanford, Ph.D. candidate (gos@uoregon.edu), both at the Department of Economics, University of Oregon, Eugene, OR, 97403-1285.

Questions About the Protection of Research Subjects? The University of Oregon's Research Compliance Services can be reached at researchcompliance@uoregon.edu, or at 541-346-2510.

Participation in this Study is Voluntary. Refusal to participate will involve no penalty or loss of any benefits to which the subject is otherwise entitled, and the subject may discontinue participation at any time.

Are you eligible and willing to be a participant in this study? By clicking Yes, you certify that you are an Oregon resident at least 18 years or older, and you consent to have the information you provide used in this study.

- ◯ Yes
- ◯ No

E.10 Oath

We care about the quality of our data. Do you commit to thoughtfully provide your best answers to each question in this survey?

- ◯ I will provide thoughtful and honest answers
- ◯ I will not provide thoughtful and honest answers
- ◯ I can't promise either way

E.11 Introduction to climate change

Climate Change:

2017 Eagle Creek wildfire near Cascade Locks, OR (AP photo: Genna Martin)

Almost all climate scientists now agree that greenhouse gases resulting from human activities are causing Earth's climate to change. They also say that climate change has already begun to cause a variety of problems around the world, including droughts, extreme weather, and wildfires.

However, some people remain unconvinced. Some have doubts about whether climate change is really happening. Others agree that the climate seems to be changing, but they question whether humans are responsible.

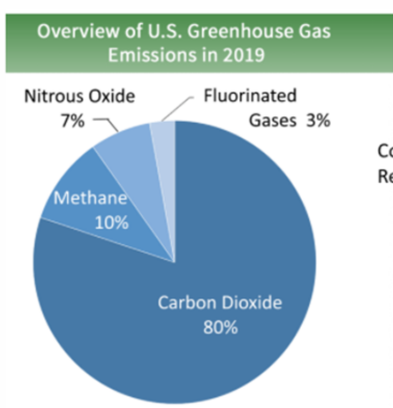
(https://www.cnn.com/2021/06/10/us/klamath-oregon-drought-water-war/index.html; photo: Gregg Canes, CNN)

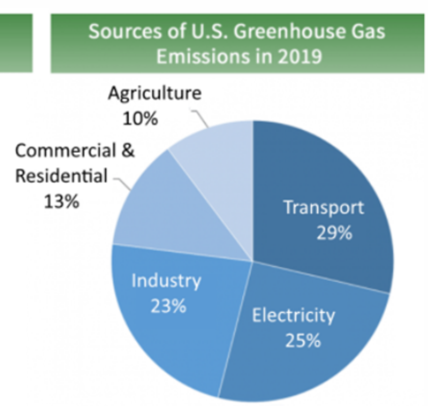
E.12 Introduction to carbon emissions

Carbon Emissions:

The most common greenhouse gas that humans create is **carbon dioxide**. These carbon gas emissions are made when we burn fossil fuels. These fuels power cars, trucks and jets. They include the natural gas that heats our homes, and the coal that some power plants burn to make electricity. Carbon emissions also come from factories and industrial plants.

The following pie charts shows the types and sources of greenhouse gases in the U.S., for 2019, according to the Environmental Protection Agency (EPA):





E.13 Introduction to controversy of cap-and-trade in Oregon

Controversy

Climate activists demonstrate in favor of cap-and-trade bill at Oregon Capitol (Dirk VanderHart photo/OPB)

Loggers and truckers rallying against cap-and-trade bill at Oregon Capitol (Marilyn Deutsch photo @marilyndeutsch)

Twice in recent years, Oregon legislators have considered beginning **carbon cap-and-trade programs.** However, the legislators could not agree on the specifics of the programs. This survey is designed to reveal how different Oregonians feel about a wide variety of possible cap-and-trade programs.

A **carbon cap-and-trade program** is a way to reduce carbon emissions from factories, power plants, and other major sources.

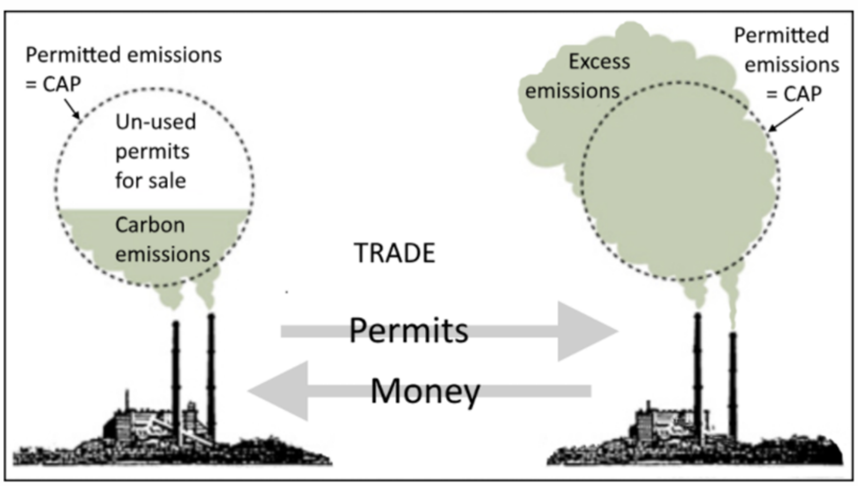
In a cap-and-trade system, the government gives each polluting company some number of permits for carbon emissions. A company's pollution must be less than or equal to the number of permits it has. Each company can decide if they would like to use all their permits themselves, to cover their own carbon emissions, or **trade (sell)** some of their permits to other companies. The company *selling* the permit will get money from the company that *buys* the permit.

How familiar are you with carbon cap and trade programs?

- ○ Quite familiar
- ○ I should probably review the basics
- ○ Not familiar at all

E.14 Introduction to cap-and-trade programs

Cap and Trade



Adapted from image by Ann Carlson, LegalPlanet (UCLA Law), 11/16/11

Here's how a carbon cap-and-trade program works.

- **STEP 1:** The government decides on an overall “cap” on carbon emissions. The cap limits how many total carbon emissions will be allowed across all businesses (companies).
- **STEP 2:** The government gives out permits to businesses. Businesses are allowed to release only the amount of carbon emissions covered by the number of permits they own. The total number of permits given out is equal to the cap decided in Step 1.
- **STEP 3:** Permit holders are allowed to trade! This means businesses will buy and sell permits.
- Over time, steps 1 through 3 are repeated. At intervals, the overall cap is made smaller and smaller so that total carbon emissions become less and less.

Carbon cap-and-trade programs are attractive because they reduce carbon emissions while minimizing the overall burden on businesses. Companies that have a hard time reducing their carbon emissions can buy extra permits from other businesses who can more cheaply reduce their carbon emissions.

Remember: You can click on most **blue text** for explanations!

Now back to the survey!

E.15 Introduction to program coverage

Which companies are regulated by carbon cap-and-trade?

If Oregon adopts a carbon cap-and-trade program, it must decide which types of companies will be regulated (i.e., which companies will be required to have carbon permits for their carbon emissions). In general, companies that pollute more and create more carbon emissions will be part of the program.

(clockwise from left: utilityproducts.com; oregonlive.com; wsj.com)

It is hard to know exactly which companies will be regulated. However, likely candidates include (but may not be limited to):

- Power plants
- Manufacturing plants
- Transportation companies (airlines, truck lines, train lines etc.)
- Timber and logging companies
- Oil and natural gas companies

E.16 Introduction to program coverage, continued

It is hard to know exactly which companies will be regulated. However, likely candidates include (but may not be limited to):

- Power plants
- Manufacturing plants
- Transportation companies (airlines, truck lines, train lines etc.)
- Timber and logging companies
- Oil and natural gas companies

Thus there are **three** main considerations for permits:

- Share of total permits that will be sold at auction (where the rest will be free).
- If some permits are given away for free, how are these free permits divided up?
- What is done with the money from permit auctions

○ Learn more about carbon permit auctions

○ Continue with survey

E.17 Introduction to permit auctions

How many permits will be sold?

When it comes to deciding how many of the total permits the government auctions (sells to companies) it is a balancing act. The **most important thing** to remember is that, in general, **more permits auctioned means more emission reduction and more costs to businesses**. On the flip side, less permits auctioned means less emission reduction and fewer costs to businesses.

Let's think about why this is the case.

1. First, let's consider the situation when all permits are given to companies for free. In this situation, a company will only have to spend money on permits if it wants to buy additional permits from other companies. So in some sense a company can still create emissions for free (as long as it doesn't exceed the permits it was given).
2. Now let's consider the situation when all permits are auctioned to companies. In this situation, a company will have to pay for all of its permits. If a company wants to produce three tones of carbon emissions it must buy three permits from the government or other companies. No more free emissions!

There is a lot of evidence from existing carbon cap-and-trade programs that the more permits that are auctioned the greater the amount of emissions are reduced. However, naturally companies are usually opposed to the government auctioning permits.

In practice, the situations where ALL permits are auctioned or ALL permits are free rarely occur. If you would like to know how free permits can be divided up and what can be done with the money from auctioned permits click "Learn more" below.

○ Learn more

○ Back to survey

E.18 Introduction to grandfathering process

How are free permits distributed?

In the case when the government has decided to give permits away for free how many permits companies receive can be complicated and politically tense. It is important to remember that only companies that are regulated (subject to the cap-and-trade program) will receive permits.

There are many ways that the free permits can be distributed. Below are three potential ways:

1. Each company recives an equal share of the permits. For, example, if 10 permits are given away for free and there are 5 companies then each company gets two permits for free.
2. Companies that have traditionally created more carbon emissions recieve **more** permits. This is called "Grandfathering" and is designed to reduce costs on businesses while still reducing emissions.
3. Companies that have traditionally created more carbon emissions recieve **less** permits. This is called " Reverse Grandfathering" and is designed to put more pressure on the higher polluting plants.

If you would like to know what can be done with the money from auctioned permits click "Learn more" below.

○ Learn more

○ Back to survey

E.19 Introduction to revenue distribution

What can be done with permit auction money?

If some carbon emissions permits are auctioned (sold) to companies by the state, then the revenue raised could be used in at least three different ways:

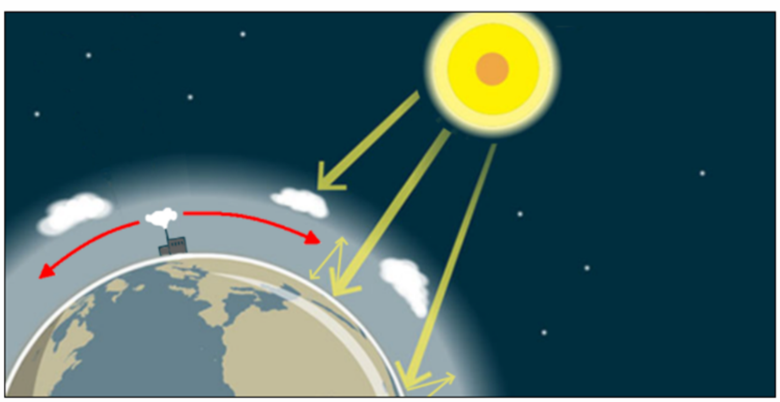
1. To pay for new equipment that will reduce carbon emissions (Details)
2. To support communities and/or workers while they adapt to the cap-and-trade program (Details)
3. To add to Oregon's General Fund, allowing some existing Oregon taxes to be reduced (Details)

E.20 Introduction to benefits of carbon emissions reductions

Benefits of carbon reductions

Global benefits (climate change):

Carbon emissions produced anywhere will spread around the entire globe. So if Oregon reduces its carbon emissions, the **whole world benefits** from less carbon in the atmosphere.



(Image adapted from a British Geological Survey diagram)

The diagram above shows just one factory, in just one location on the globe. The factory's carbon emissions rise into the atmosphere and eventually spread all around the earth (**the red arrows**). Carbon emissions from sources in Oregon do the same thing. When the atmosphere has more carbon dioxide, it holds in more of the sun's heat (**the yellow arrows**).

Regional benefits (other pollutants):

The photo below shows a day in Portland, Oregon, with poor air quality. Sometimes, air pollution in Oregon is due to wildfires burning somewhere in the region. Other times, air pollution comes from factories and vehicles.

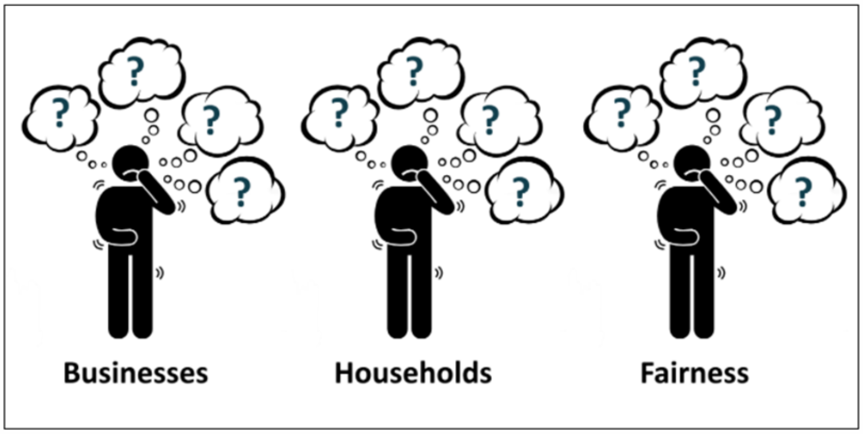
(Photo: Mason Walker, Portland Business Journal blog, 2016)

Depending on how the cap-and-trade program is designed, some benefits could be **received by Oregonians only**. Some types of cap-and-trade programs can:

- Also reduce other pollutants that result from the burning of fossil fuels. Burning fossil fuels can harm air quality, as in the picture above. The benefits of reduced air pollution would be felt by communities living close to polluters.
- Provide opportunities for farmers, ranchers, and forest owners to raise new revenue.
- Improve Oregon's chances to get a head-start on growing new types of industries (and jobs) in the green sector.

E.21 Introduction to possible distributional concerns

Possible concerns



(Adapted from graphic by Gan Khoon Lay)

Alongside the benefits of a carbon cap-and-trade program, some challenges will result from the extra cost of doing business when carbon permits are required.

Challenges for businesses: higher operating costs

Challenges for households: more expensive products

Equity and fairness concerns: unfair burden

These challenges can be lessened by careful program design but they exist nonetheless! Which of these challenges *especially* concern you? (check any that apply)

- ☐ The burdens on businesses
- ☐ The burdens on households
- ☐ Equity and fairness
- ☐ None of the above

E.22 Oregon county of residence

The respondent selects an Oregon county from the drop-down list provided.

In which Oregon county do you live? We'll describe carbon programs in terms of their effects on people in your area.

Along with each county's name below, we provide that county's population.

E.23 Confirm county of residence

If this confirmation page shows that the respondent checked the wrong county, they get to choose again, after which we just have to assume that they have the right county. This page runs some javascript in the background to associate a variety of county variables with the respondent's own county, and these variables are quoted later in the survey as the effects of each proposed cap-and-trade program are described in quantitative terms.

Your survey questions will be tailored to the county where you live. Your choice on the last page has been recorded as:

Lane County (2019 population = 382,067)

Is this the right county?

- ○ Yes
- ○ No

E.24 Introduce program summary tables

Policy summaries

Soon, we will ask you to consider some possible carbon cap-and-trade programs for Oregon.

One at a time, we will describe each of six possible programs using compact tables like the one below.

- On the left in blue are the features of the program. Click on the blue text in the table at any time for explanations!
- On the right will be the value for each feature

For **every program** you are shown, it would take a while to get things set up. You should assume that **each program would begin January, 1, 2023.** In other words, permits will be required for carbon emissions starting January 1, 2023. This means all of the costs and benefits will also begin to accumulate as of January, 1, 2023.

This is just an example. **You don't need to do anything yet!**

Program:	A
Results by 2050:	
Carbon emissions reduction	70%
Carbon industry jobs lost	18,200
Green industry jobs gained	13,000
Carbon permits, rules:	
Share of permits auctioned	70%
Auction revenue uses:	
Fund new equipment	40%
Support communities/workers	60%
Oregon tax relief	0%
Additional regulations:	
Limit other pollutants	NO
Cost to your household:	
Dollars per month	$405
Click blue text for details	A

First, we will use the next few screens to explain how to interpret each group of features. Remember, you can click on any feature name for a pop-up window with more information.

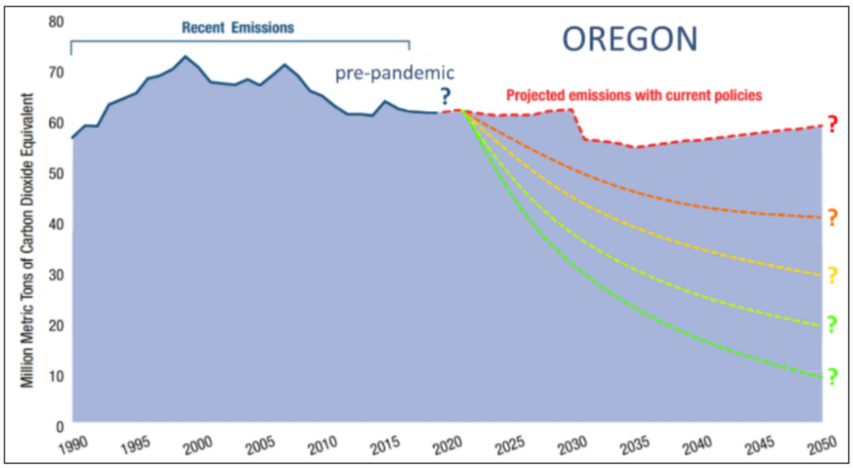
E.25 Explain Feature Group 1

FEATURE GROUP 1: Results

The first three rows in the table will give the general environmental and economic effects of the program. Next to each box is the value that will appear for your Program A.

- - - - - - - -

Carbon emissions reduction?



(Adapted from Oregon Department of Energy/Energy in Oregon/Greenhouse Gas Emissions Data)

The row of the table with information about the carbon emissions reduction for the cap-and-trade program will look like this:

Carbon emissions reduction	70%

This is the percent reduction of total *annual* carbon emissions in Oregon by the year 2050, relative to Oregon's current carbon emissions.

- - - - - - - -

Carbon industry jobs lost?

(The Oregonian, Motoya Nakamura photo)

Lane County had about 79,500 jobs in carbon industries in 2019. Oregon as a whole had about 970,021 carbon industry jobs in 2019.

The row of the table with information about carbon industry jobs will look like this:

Carbon industry jobs lost	18,200

These are the jobs lost in carbon-intensive industries **in Lane County** in the next 30 years as the economy adapts to the cap-and-trade program. Nobody knows for certain how many carbon industry jobs will be lost, but the values shown are based on the latest economic research.

- - - - - - - -

Green industry jobs gained?

(The Oregonian, Benjamin Brink photo)

Lane County had about 86,300 jobs in green industries in 2019. Oregon as a whole had about 1,098,486 green industry jobs in 2019.

The row of the table with information about green industry jobs will look like this:

Green industry jobs gained	13,000

These are the jobs gained in green industries **in Lane County** in the next 30 years as companies and households work out ways to reduce their carbon emissions. Nobody knows for certain how many green industry jobs will be gained, but the values shown are based on the latest economic research.

Review full summary table

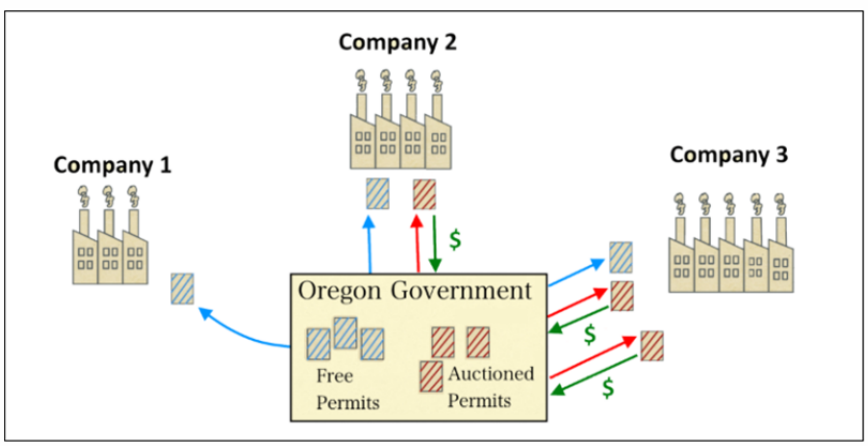
E.26 Explain Feature Group 2

FEATURE GROUP 2: Carbon permits, rules

Companies will try harder to reduce their carbon emissions if they have to pay for permits.

Selling some carbon permits at auction also **raises revenue** that can be used to help companies and workers adapt to a lower-carbon world.

Share of permits auctioned?



The row of the table indicates the percent of total available carbon permits that will be sold to companies at auction:

Share of permits auctioned	70%

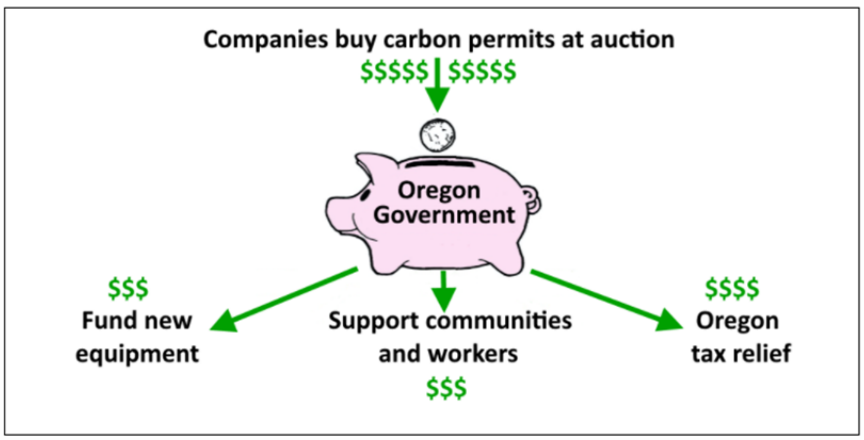
In this case 70% of total available carbon permits will be sold. The rest will be given to participating companies for free, according to a formula based on their past carbon emissions. If companies are unable or unwilling to buy permits, they must get by with only their free permits.

Review full summary table

E.27 Explain Feature Group 3

FEATURE GROUP 3: Auction revenue uses

How will permit auction revenue be spent?



Three rows in each table describe how money from the carbon permit auction would be spent.

Fund new equipment?

Fund new equipment	40%

Share of permit auction revenue that will be used to help households and companies to buy emission reducing equipment. Such equipment might include an energy efficient washing machine for a family, or more energy efficient machinery for a factory.

- - - - - - - -

Support communities/workers?

Support communities/workers	60%

Share of revenue that will be used to support communities/workers that bear a relatively heavier burden due to the program's costs. This might include communities with a lot of carbon-intensive jobs, or groups/communities that spend a large proportion of their income on energy for heating or transportation.

- - - - - - - -

Oregon tax relief?

Oregon tax relief	0%

Share that will go into Oregon's state tax fund. More revenue from permit auctions would allow Oregon to reduce the burden of other existing state taxes paid by Oregon residents.

Review full summary table

E.28 Explain Feature Group 4

FEATURE 4: Additional Regulations

(Adapted from "Beware of Air" image at nrdc.org)

A cap-and-trade program will reduce **overall** carbon emissions. Many companies will emit less carbon, but permit trading may allow some companies to emit *more*.

Companies that end up producing more carbon emissions may also produce greater amounts of other pollutants.

To protect surrounding communities, a cap-and-trade program may come with additional regulations on these other pollutants.

Limit other pollutants	NO

A **YES** for this feature means that there will be regulations to limit other pollutants to safe levels. A **NO** means that this program includes no additional safeguards against increases in other pollutants.

Review full summary table

E.29 Explain Feature Group 5

FEATURE 5: Cost to your household

(Images, by row: dynamicslr.com; spacecoastdaily.com; oregonbusiness.com; ecotextile.com)

The last row of the summary table for each cap-and-trade program will give your MONTHLY cost of the program.

Dollars per month	$405

These are the unavoidable average monthly costs that *your household* would bear if the program is adopted. These higher costs might result *directly or indirectly* from higher energy prices or from the loss of jobs in carbon-intensive industries.

NOTE: It is possible you *may* see a program or two with VERY high costs in your version of this survey. We don't expect many people to vote for these costly programs.

Review full summary table

E.30 Program A choice

Program A

This screen is your FIRST chance to vote on a program. You will be asked about six different programs. Their arbitrary labels A through F have nothing to do with the quality of each program.

- Each time you vote, ignore any other programs we may have described elsewhere
- Imagine that the option being offered for each vote is the ONLY one available

In any one vote:

- If the program being offered is **better than no program at all**, you should vote "Yes" for the program
- If the monthly cost of the program would be *just too high* for your household or your community—given what it would accomplish and how it would work—you should feel free to vote "No"

Please consider all the features of Program A below, and **vote as if this were a real and secret ballot**. Your actual vote on a secret ballot might be different from the way you would vote if you had to raise your hand in public, and that is OK. We need to know what would happen for a real secret ballot in Oregon. Remember that the research team will not be able to connect your choices to you as an individual.

Remember that **job losses and job gains listed are for Lane County only**.

In hypothetical choices such as these, people sometimes do not think carefully enough about what they would have to give up to be able to pay the monthly cost of the program. **Please consider what your household would have to sacrifice, if the proposed cap-and-trade program were adopted.**

Be sure to consider all the features of a program. If you need to review the explanation for a feature, click on its name (any blue text), then **vote at the bottom of this screen.**

Program:	A
Results by 2050:	
Carbon emissions reduction	70%
Carbon industry jobs lost	18,200
Green industry jobs gained	13,000
Carbon permits, rules:	
Share of permits auctioned	70%
Auction revenue uses:	
Fund new equipment	40%
Support communities/workers	60%
Oregon tax relief	0%
Additional regulations:	
Limit other pollutants	NO
Cost to your household:	
Dollars per month	$405
Click blue text for details	**A**

If Program A were the only program to be put to a vote, I would vote for:

- ○ Program A to begin January, 1, 2023
- ○ No program at all

E.31 Follow-up to "No" vote: Reasons for vote

Please indicate why you would vote "No program at all" on Program A. Check as many reasons as apply.

- ☐ Too much emission reduction
- ☐ Too little emission reduction
- ☐ The economic impacts were too costly
- ☐ Did not approve of the auction revenue use
- ☐ Too many permits were auctioned
- ☐ Too few permits were auctioned
- ☐ Did not approve of the Additional Regulations on other pollutants
- ☐ The benefits of Oregon or the World do not justify ANY cost
- ☐ Program A did not seem believable
- ☐ Some other reason

E.32 Follow-up to "No" vote: Will you always vote no?

A cap-and-trade program is not everyone's preferred way to reduce overall carbon emissions. In this survey, we are assuming that the **only alternative** to a cap-and-trade program is **no carbon emission reduction policy.**

- ○ **I would still vote "No" for ANY carbon cap-and-trade program!**
- ○ A cap-and-trade program **could be** better than no policy, even though I would rather have some other program for carbon reduction.

E.33 Program B choice

Program B

Now assume that Program A had never been proposed, and instead, that Program B was the only carbon cap-and-trade program under consideration. **Here is your second vote.** Assume that **only Program B is now available**.

Again, vote as if this were a real and secret ballot. If Program B (with its different set of features) would leave you worse off than having no program at all for carbon reduction, you should vote for “No Program”.

Program:	B
Results by 2050:	
Carbon emissions reduction	60%
Carbon industry jobs lost	11,200
Green industry jobs gained	5,200
Carbon permits, rules:	
Share of permits auctioned	30%
Auction revenue uses:	
Fund new equipment	60%
Support communities/workers	0%
Oregon tax relief	40%
Additional regulations:	
Limit other pollutants	YES
Cost to your household:	
Dollars per month	$270
Click blue text for details	**B**

If Program B were the only program to be put to a vote, I would vote for:

- ○ Program B to begin January, 1, 2023
- ○ No program at all

E.34 Program C choice

Program C

Now suppose that **neither** Program A nor Program B has been proposed or discussed. Instead, the ballot gives you a choice between **Program C** and **No Program**.

Program:	C
Results by 2050:	
Carbon emissions reduction	30%
Carbon industry jobs lost	5,600
Green industry jobs gained	13,800
Carbon permits, rules:	
Share of permits auctioned	10%
Auction revenue uses:	
Fund new equipment	10%
Support communities/workers	30%
Oregon tax relief	60%
Additional regulations:	
Limit other pollutants	NO
Cost to your household:	
Dollars per month	$ 80
Click blue text for details	C

If Program C were the only program to be put to a vote, I would vote for:

- ◯ Program C to begin January, 1, 2023
- ◯ No program at all

E.35 Program D choice

Program D

Now erase Programs A, B, and C from your mind. If you were asked to choose instead between just Program D and No Program, how would you vote?

Program:	D
Results by 2050:	
Carbon emissions reduction	60%
Carbon industry jobs lost	11,200
Green industry jobs gained	13,800
Carbon permits, rules:	
Share of permits auctioned	20%
Auction revenue uses:	
Fund new equipment	40%
Support communities/workers	10%
Oregon tax relief	50%
Additional regulations:	
Limit other pollutants	YES
Cost to your household:	
Dollars per month	$180
Click blue text for details	**D**

If Program D were the only program to be put to a vote, I would vote for:

- ○ Program D to begin January, 1, 2023
- ○ No program at all

E.36 Program E choice

Program E

As before, your task on this screen is to decide if you would rather have Program E or no program at all. Assume that Program E, rather than any of the programs on earlier screens, has ended up on the ballot. How would you vote?

Program:	E
Results by 2050:	
Carbon emissions reduction	80%
Carbon industry jobs lost	12,800
Green industry jobs gained	19,000
Carbon permits, rules:	
Share of permits auctioned	80%
Auction revenue uses:	
Fund new equipment	20%
Support communities/workers	0%
Oregon tax relief	80%
Additional regulations:	
Limit other pollutants	YES
Cost to your household:	
Dollars per month	$325
Click blue text for details	E

If Program E were the only program to be put to a vote, I would vote for:

- ◯ Program E to begin January, 1, 2023
- ◯ No program at all

E.37 Program F choice

Program F

Program F is the final cap-and-trade program we will ask you to consider. Suppose that NONE of the previously offered programs are available. As always, you should feel free to vote "Yes" or "No" on this program, based on whether or not you expect it to make you better off.

Program:	F
Results by 2050:	
Carbon emissions reduction	10%
Carbon industry jobs lost	4,800
Green industry jobs gained	5,200
Carbon permits, rules:	
Share of permits auctioned	40%
Auction revenue uses:	
Fund new equipment	60%
Support communities/workers	30%
Oregon tax relief	10%
Additional regulations:	
Limit other pollutants	NO
Cost to your household:	
Dollars per month	$ 75
Click blue text for details	F

If Program F were the only program to be put to a vote, I would vote for:

- ◯ Program F to begin January, 1, 2023
- ◯ No program at all

E.38 Follow-up to “No” vote

For any of Program A through Program F, if the respondent votes “No” on that program, the survey follows up with the list shown on this page, of potential reasons for voting against these programs. We opted to show this follow-up question only in association with Program F, to avoid repeating the identical screenshot every time.

Please indicate why you would vote “No program at all” on Program F.

- [ ] Exactly the same reasons why I voted against any previous Programs
- [ ] Too much emission reduction
- [ ] Too little emission reduction
- [ ] The economic impacts were too costly
- [ ] Did not approve of the auction revenue use
- [ ] Too many permits were auctioned
- [ ] Too few permits were auctioned
- [ ] Did not approve of the Additional Regulations on other pollutants
- [ ] The benefits of Oregon or the World do not justify ANY cost
- [ ] Program F did not seem believable
- [ ] Some other reason

E.39 Preferences for policies other than cap-and-trade

You indicated earlier that you would prefer another type of policy to cap-and-trade when it comes to addressing carbon emissions. What type of policy would you prefer? (Check all that apply)

- ☐ A tax on carbon emissions
- ☐ Carbon emissions standards (i.e., rules for maximum carbon emissions)
- ☐ Technology standards (i.e., rules about carbon-reducing technologies that must be installed)
- ☐ A subsidy for carbon emissions reductions (i.e. the government offers money if carbon-emissions are reduced)
- ☐ Not sure / Don't know
- ☐ Other (Please specify)

E.40 Most important attributes

Think back over all of your program choices. Which program features did you find were **the most important to you**? Select as many as apply.

- ☐ Carbon emissions reduction by 2050
- ☐ Carbon industry jobs lost
- ☐ Green industry jobs gained
- ☐ Share of carbon permits auctioned
- ☐ Use of auction revenue to fund new equipment
- ☐ Use of auction revenue to support communities/workers
- ☐ Use of auction revenue for Oregon tax relief
- ☐ Additional regulations to limit other pollutants
- ☐ Cost of the program to your household
- ☐ None of these features were important to me

E.41 Attachment to Oregon

How many years have you lived in Oregon? (Move the slider)

0 10 20 30 40 50 60 70 80 90 100

How many more years do you expect to keep living in Oregon? (Move the slider)

0 10 20 30 40 50 60 70 80 90 100

E.42 Ethnicity

What is your ethnicity?

- Hispanic
- Non-Hispanic
- Other
- Prefer not to say

E.43 Sectors providing household income

Which of these industries provides a significant amount of your household's income, either **directly** (through wages and/or business income) or **indirectly** (through pension and/or investment income)? (choose all that apply)

- ☐ My household depends on income from investments that are broadly diversified across most of these industries
- ☐ Accommodation and Food Services
- ☐ Administrative and Support and Waste Management and Remediation Services
- ☐ Agriculture, Fishing and Hunting
- ☐ Arts, Entertainment, and Recreation
- ☐ Construction
- ☐ Educational Services
- ☐ Finance and Insurance
- ☐ Forestry and Logging
- ☐ Health Care and Social Assistance
- ☐ Information
- ☐ Management of Companies and Enterprises
- ☐ Mining, Quarrying, and Oil and Gas Extraction
- ☐ Other Manufacturing
- ☐ Other Services, except Public Administration
- ☐ Professional, Scientific, and Technical Services
- ☐ Public Administration
- ☐ Real Estate and Rental and Leasing
- ☐ Retail Trade
- ☐ Truck Transportation
- ☐ Utilities

E.44 Political ideology

Politically, do you consider yourself to be:

- ○ Strongly conservative
- ○ Somewhat conservative
- ○ Moderate
- ○ Somewhat liberal
- ○ Strongly liberal
- ○ Prefer not to say

E.45 Political party identification

Which political party do you most strongly identify with?

- ○ Republican
- ○ Democrat
- ○ Independent

E.46 Educational Attainment

What is your highest level of education?

- ○ Less than high school
- ○ High school graduate
- ○ Some college
- ○ Bachelor's degree
- ○ Master's degree
- ○ Doctoral degree
- ○ Trade or technical school
- ○ Prefer not to say

E.47 Employment status

Which best describes your current employment status?

- ○ Self-employed or small business owner
- ○ Employee, working full-time
- ○ Employee, working part-time
- ○ Not employed, looking for work
- ○ Not employed, NOT looking for work
- ○ Retired
- ○ Disabled, not able to work
- ○ Full-time student
- ○ Student with part-time work
- ○ Other
- ○ Prefer not to say

E.48 Attitude: climate change real and serious

"Climate change is real, and is a serious threat to humanity."

- ○ Strongly Agree
- ○ Agree
- ○ Neutral
- ○ Disagree
- ○ Strongly Disagree

E.49 Attitude: climate change human-caused

"Climate change is the result of human activity."

- ◯ Strongly Agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly disagree

E.50 Attitude: responsibility to fix climate

Who is most responsible for slowing or preventing climate change? (Select all that apply)

- ☐ Local governments
- ☐ The Federal government
- ☐ Households
- ☐ Companies
- ☐ People who are wealthier
- ☐ People who are responsible for more emissions
- ☐ Other
- ☐ Everyone equally
- ☐ No one in particular
- ☐ Don't know / not sure

E.51 Inter-generational concern: descendants

Do you have any of the following? (Check all that apply)

- ☐ Children
- ☐ Grandchildren
- ☐ Great-grandchildren
- ☐ Other descendants (please specify)

[ ]

- ☐ None of the above
- ☐ Don't know / not sure

E.52 Inter-generational concern: ancestors

How many generations back can you trace at least some of your ancestors? (Check the greatest number)

- ○ 1 generation (i.e., just your parent(s))
- ○ 2 generations (i.e. your grandparent(s))
- ○ 3 generations (i.e., your great-grandparent(s))
- ○ 4 generations
- ○ 5 generations
- ○ 6 generations
- ○ 7 or more generations
- ○ Don't know / not sure

E.53 Primary heating fuel used

What is the primary fuel you use to heat your dwelling?

- ○ Natural gas
- ○ Electricity from a conventional power plant
- ○ Electricity from solar panels or wind power
- ○ Electricity (unsure about source)
- ○ Wood or wood pellets
- ○ Passive solar (heated water)
- ○ Other (please specify)

[ ]

- ○ I don't heat my dwelling
- ○ Don't know / not sure

E.54 Usual forms of transportation

What are your most common forms of transportation? (Check as many as apply)

- ☐ Personal vehicle (gasoline or diesel)
- ☐ Personal vehicle (hybrid fuel)
- ☐ Personal vehicle (electric)
- ☐ Public transportation (bus or train)
- ☐ Taxi or ride-sharing (e.g., Uber or Lyft)
- ☐ Bicycle
- ☐ Walking
- ☐ Other (Please specify)

[ ]

- ☐ Prefer not to say

E.55 Perception of researcher bias

This question about research bias was randomly presented in one of two orders for the answers. Half of respondents saw a list that put "definitely vote FOR a carbon cap-and-trad program" at the top. The other half saw the same list, but in reverse order. This is intended to minimize any systematic order effects if the order is not included as an explanatory variable.

It seemed like the research team wanted me to:

- ◯ **definitely vote FOR** a carbon cap-and-trade program
- ◯ **probably vote FOR** a carbon cap-and-trade program
- ◯ vote **according to my own beliefs**
- ◯ **probably vote AGAINST** a carbon cap-and-trade program
- ◯ **definitely vote AGAINST** a carbon cap-and-trade program

E.56 Attitude: Respondent's experience with survey

Please rate the survey you just took (type a number between 1 and 5 in each box):

Understandable

Relevant to you

Interesting

Informative

E.57 Feedback text message

Thank you for sharing your opinions about different types of carbon cap-and-trade programs. If you wish, please provide some feedback before you go:

F Appendix: Verbatim Feedback from Respondents

F.1 Respondent perceptions of bias on the part of the research team

In designing a stated-preference choice-experiment survey to measure willingness to pay, the goal is usually to try to pitch the issue so that as many respondents as possible are of the opinion that the research team is not biased one way or another, either for or against the types of policies that are the focus of the survey. Unfortunately, it can sometimes be rather difficult to convince people that the research team does NOT think a carbon cap-and-trade program is a good idea, or why else would they be studying these programs? Respondents also seem often to assess the research team's bias for a policy as relative to their own biases, so it is probably unwise to use responses to this sort of a question to "correct" the willingness-to-pay estimates derived from the study. With these caveats in mind, we can report the distribution of respondents' perceptions of researcher bias in Table F1. The modal response, at least, is that the research team is unbiased (i.e., slightly over 51% of the estimating sample). However, there are more respondents who perceive that the research team likes cap-and-trade programs (about 42%) than there are who perceive that the research team is opposed to cap-and-trade programs (about 6.5%)

Table F1: Respondent perceptions of researcher bias concerning cap-and-trade programs like those being addressed in the survey

Perceived direction of researcher bias concerning cap-and-trade programs	Freq.	Percent	Cum.
Definitely against	41	3.90	3.90
Probably against	27	2.57	6.48
Neutral	540	51.43	57.90
Probably for	221	21.05	78.95
Definitely for	221	21.05	100.00
Total	1,050	100.00	

F.2 Universe of feedback from respondents concerning our survey

The final question on our survey invited optional respondent feedback. The precise wording of the question was: "Thank you for sharing your opinions about different types of carbon cap-and-trade programs. If you wish, please provide some feedback before you go:" A multi-line text box invited longer comments, should the respondent desire to provide feedback.

The following table is the universe of non-empty responses to this question. We include this information for other prospective survey designers, since respondent feedback can be useful to the design of future surveys.

Table F2: Verbatim responses to final feedback question on the survey

Arbitrary identifier	Survey started	Text of feedback
R_3D7PDK0bhlro3Ac	7/30/2021 17:32	Such an interesting an eye opening survey. Really enjoyed this one.
R_2ck2EzkMgLq0aow	7/30/2021 17:33	Hope we get some form of a program passed! People will complain about cost.
R_1mLyJabWMChTUpF	7/30/2021 17:34	Thank you
R_2YQ95lwSeIvXwFF	7/30/2021 17:40	We need to slow climate change or else Good survey
R_2VOMtxCaX3ha0gH	7/30/2021 17:44	I love how this survey introduced and laid out the information. Everything was super clear, concise, and well done. I learned a lot:)
R_290lXPQHBCkYOjD	7/30/2021 17:52	No thank tou
R_SW8X41HynCIyev7	7/30/2021 18:09	Great survey thanks
R_06Tq4DfIUOLlH33	7/30/2021 18:22	No thanks
R_1OCQ9jnRqttAKV8	7/30/2021 18:48	I do not trust the government to be equitable or to use the funds in the manner in which was described
R_dbPiKnj9I5ImVvr	7/30/2021 18:59	Thank you for giving me information on a subject of such importance. We need to do something! IMO the wealthy business owners care very little about future generations, or even our earth. I don"t like that jobs will be lost, although other jobs will be gained, so I think for those that lose employment maybe training in a new field will be beneficial, for them, their families and their future generations.
R_qDQhUesi0BphP9f	7/30/2021 20:55	Thanjs
R_2wQQxkSdAXXJ0WX	7/30/2021 21:19	amazing and interesting survey! was never bored throughout it!
R_2wNZy5kvFKjcLPj	7/31/2021 11:47	Find a better solution
R_3kiVjihUmsFTE5O	7/31/2021 12:29	No thank you. Trump 2024
R_7TE9CE9XHBRyXYt	7/31/2021 14:21	â¦â¦â¦â¦.
R_2PaP1Kv49IT6b4M	7/31/2021 6:23	Very well put. Together survey I liked it

Continued on next page

Table F2 – continued from previous page

R_DkteoAYG6IRXPtD	7/31/2021 8:32	N/a
R_1erv5RTKfSjiUSQ	7/31/2021 9:26	I found this fascinating and exciting that we may actually get something going to help the pollution problem and slow climate change. I enjoyed this survey
R_6YzWCuoGLZeWAI9	8/10/2021 17:22	Very clear and concise. Presented in easy, bite sized pieces of info.
R_3QEkk5aIaOx0oYN	8/10/2021 18:05	The pay needs to be way way way higher for this "survey" if u want quality answers and data to your research. I promise u that u are NOT getting 100% real answers from people. I took the time but I know plenty of people who couldhavedsked their way through for the tiny incentive u gave to take on all the information required to understand to answer the questions correctly.
R_cZ08g8gZ2VTPgD7	8/10/2021 18:30	Very interesting survey
R_3dFduan3iduoD2Q	8/10/2021 19:33	Great survey!!!
R_b2xiBgLGjvaDfJ7	8/10/2021 20:57	It was nothing but pro cap and trade propaganda put forth by probably an indoctrinated group of students who never really had to struggle.
R_2woU9rGRGga1kwQ	8/10/2021 21:17	Thank you, I learned a lot tonight and will be paying more attention to this issue.
R_pJLzOwIqqPccVgJ	8/10/2021 8:17	Seems like these programs are going to involve a lot of beurocratic red tape that are just going to drive companies out of state and maybe out of the country.
R_DOaAXYtdr35MfqV	8/11/2021 10:20	Very comprehensive
R_qRAbWWkvq4WhFtL	8/11/2021 10:30	Thank you! I think this is a great and important survey.
R_1gjZ1sdSRuNtpch	8/11/2021 10:56	I like learning more about climate change. I"m not very informed but I know there is a lot of misinformation going around.
R_0kZlhxlwmrnAIlX	8/11/2021 10:58	Company, local government and fedral government need to stop making dams as well iy is the main issue for droughts and secound reason for drought is in oregon we have bad forest management so fires get huge and big due to all the under growth and then you need more water to put them out better manage ment all around is what we need better manage ment on dams forests and carbon producing companies
R_3JFxnBYnxx5u4em	8/11/2021 11:03	Thank you for making the effort to create this survey and ask people to figure out what would be best for everyone. In an ideal world this change would be cheap and free. This change is important for the future of our world. Yeah, the sun will explode but we can slow that down and the burning of earth by preserving earth as best we can and protecting earth as best we can for as long as we can until we can leave if that will be necessary. Saying we don"t find some way to refuel the sun so it doesn"t explode and burn earth. *shrug*
R_1CEzDOPi4jhOpk4	8/11/2021 11:04	Interesting.
R_2SCgM9iWqjWwvC1	8/11/2021 11:04	More info
R_3fNKMCovVmUuhlb	8/11/2021 14:16	Na
R_cCLOag2Bfl55QIN	8/11/2021 14:58	No thank you
R_w5fJ4YujchiLNnj	8/11/2021 16:36	No
R_1ONQYQyJvrucFl4	8/11/2021 17:05	thank you this was awesome
R_3IaBZTwl8MdbrP5	8/11/2021 20:19	This was a very good survey.
R_Q4yjlgMpzpSVNoB	8/11/2021 20:40	No feedback. Good survey. Keep it up.
R_qJ8m693Fci9VtAZ	8/11/2021 23:59	Anything Oregon does is a drop in the bucket compared to the pollution that China and other countries generate. The governor is an idiot.
R_3oNlih5PTG3lZnN	8/11/2021 3:39	interesting survey

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R_2SGZuvYKjHEUyJ4	8/11/2021 6:36	Jobs gained in the green sector should outweigh jobs lost in carbon emitting sector. Industries emitting more should be âincentivizedâ to reduce. If that"s in tax"s or costs. Individual household costs should be offset in taxes. Increase incentives for households to go green. Burden should reflect greatest contributors to emissions not the general public.
R_2qEIfWQDjv0dT3k	8/11/2021 7:28	Good survey
R_30ub7IGzmyA1wRz	8/11/2021 8:07	Thank you for the time to take this survey. It was interesting to learn about the cap and trade and gain a better understanding.
R_3HwshwbHSHuvn7c	8/11/2021 9:26	Good
R_qwkOP0fJmCa9DC9	8/12/2021 0:30	Very interesting survey
R_ebNVjjQQ4QY26lj	8/12/2021 14:05	Good survey, lots of info.
R_0OLd5Xe2VUbgZkR	8/12/2021 15:14	fun survey
R_CaELBBS2sEHCizL	8/12/2021 15:22	I just hope we calm down on carbon emissions. But we have been a little
R_d11nxgfoNVP3KPD	8/12/2021 15:41	More needs to be done to power through Renewal energy sources
R_1ihDpkmDttDEzrA	8/12/2021 19:23	The more appealing the carbon cap-and-trade appears to the general consumer is low household cost AND minimal job losses the more likely it would pass.
R_1HkRMfxUS1hIuNr	8/13/2021 12:28	Nice article
R_9Gmz8l2aaukcxlT	8/14/2021 19:07	Cap and trade is going to be difficult to get buy in from a lot of people. Maybe exclude logging from the regulations. Look at margins in some industries, some may not be able to cut emissions without losing money or shutting down. Be careful not to cut off your nose to spite your face. If we lose roo many jobs the economy may not be able to recover. Maybe slow down with the emissions reduction.
R_2THjsiExSeaM36S	8/15/2021 10:16	:)
R_2wSqxwKVJL5EHl1	8/15/2021 16:50	thanks for the information
R_31L7G9ALUQMBxp7	8/15/2021 21:08	I don"t belive cap and trade is a moral way to force changes not everyone agrees with. We are highly considering leaving this state after youngest graduates due to increased extreme liberal programs that keep creeping into all parts o life. We believe that the climate is changing (and always has) but certainly not mostly from CO2 and cows. Fossil fuels and nuclear are so much more efficient and consistent than wind or solar. Until battery storage for these is greatly improved they are only usable when it"s sunny or windy. While supplementing with a more stable source is doable but requires so much more expense than just using the steady power from a more reliable source. I"m also unsure why Natural Gas which has zero CO2 is never discussed.
R_3G8IjWBKEO3aBpT	8/15/2021 22:05	Good jon
R_3rM3jzvPmt8nOLv	8/15/2021 8:04	A cap and trade is a no go for me. Job loss is a great now because of the ongoing "pandemic". Cap and trade would further create more jobs lost, and create an increase cost to every type of good imaginable with very little given in return. This is another attempt to have more government control. WE should"ve been looking at controlling carbon emissions back in the 60"s and 70"s where it was the greatest.
R_bBf9eMj4Um44kYV	8/16/2021 17:53	My issue with the options presented are that the ones that reduced a reasonable amount of carbon was devastating on the job market or on cost per month to families. There MUST be a way to balance it better because CLEARLY we need to take some action. Although I have no children or grandchildren to worry about and I am OLD and won"t be here for the worst of climate change, I still care deeply and we MUST do something.
R_bpaCDLlgMIzVzB7	8/16/2021 18:47	N/A
R_3PNza79jby9j5tS	8/16/2021 18:58	Don"t know

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R_9Fzjj4zJoKJ2ATf	8/16/2021 19:32	This was very informative! Thank you!
R_2SIZFoHN47yIbAk	8/16/2021 19:34	Noticed what seems to be a common error when discussing carbon emissions stating that vehicles emit carbon dioxide not carbon monoxide that is what is the result of motor vehicle operations. Everyone seems to ignore that carbon dioxide is the primary food for green plants - implying that what we should really be looking at is reducing our reduction of trees and plants and actually plant more.
R_1gjV33O1RBVHG1y	8/16/2021 20:58	Appreciate learning cap an trade
R_1j7c5vWb8KCfjvb	8/16/2021 20:58	It was a good survey
R_25SpcbqzoSCsY6U	8/16/2021 21:55	Great
R_1f7tHcWVURapL2d	8/17/2021 12:14	no
R_8BUpssMIhXpIHrH	8/17/2021 16:32	Good survey
R_1i4mNTpwBpjKUe2	8/17/2021 19:51	i know we as a nation need to start making changes
R_piONTnkZiQsextn	8/17/2021 19:52	Na
R_Olh3mlxgkjtr7Il	8/17/2021 19:52	Great topic.
R_ZIRAIhNDcnfwXoB	8/17/2021 1:49	A great survey .. cuz nothing more important than our health
R_2BmI4F5GvGgDwJ5	8/17/2021 23:45	N
R_294ypaYkTxaRsl8	8/17/2021 6:23	My problem is Captain trade is it always ends up costing smaller but this is not the larger businesses larger businesses somehow always keep out of these things and leave the financial costs on small businesses which hurt your community
R_1poCEuC5PoODWxo	8/18/2021 10:58	Anytime the government sass another level of bureaucracy it is costly, inefficient, and a mess.
R_8f9qQbmuNVSp5zH	8/18/2021 11:15	None
R_6ik2Dddu5C0D3pf	8/18/2021 11:23	action on climate change is needed now. we must use all available tools that we have now and improve them as we get smarter
R_0BCs0KygOCai7XX	8/18/2021 15:39	its a good survey and i like it.
R_3iUReEkFOz4MVXB	8/18/2021 17:25	I think this survey has good points on why we need carbon emission reductions in the world because of how climate change is effective humans, animals and many other forms of life on earth. We should all do something right now rather than later on.
R_2QrE4QLo5tPXLKS	8/18/2021 1:29	I have both worked at a survey call center and don"t a lot of surveys. This was one of the best I have ever seen. It was professional, informative, and unbiased.
R_Xoo8vWeUokuELeN	8/18/2021 2:04	It was really informative and I like the layout too see definitions of the topics.
R_2bIuam2u6GxJnYV	8/19/2021 13:07	great survey, very informative
R_0pjcO4m0PsjW6Qx	8/19/2021 15:27	Presenting each program separately was good; however, it would have also been useful to have them presented together to compare aspects within a singular "picture" as opposed to each individually. Similar to when you are shopping various products online, how you"re capable of doing side-by-side comparisons of features.
R_3EbWYLeZpDCtcEw	8/19/2021 20:09	Great survey.
R_27H8uGBlWTz4e3C	8/19/2021 6:28	Climate change is real we must all step up to the challenge to reverse the effects.
R_3hyhuFxdpE1gIhx	8/19/2021 7:37	I did learn a lot

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Table F2 – continued from previous page

R_CfzGCoxgcT9LCeZ	8/20/2021 18:48	Very nice. Very very fresh my friends. Lovr the survey!
R_2aM6UvgK5UYhTEy	8/20/2021 21:51	Global warming is real. We should do our part.
R_utb7sTe9hmgbma5	8/21/2021 10:03	Free the workers from responsibility and hold corporations accountable for their actions which is resulting in the death and destruction of our planet. That"s all, thanks
R_1FDHRaJTqpRDqaF	8/21/2021 15:43	No thanks
R_1dlVxhtsp92UzWU	8/21/2021 17:15	I learned a lot taking this survey!
R_RELvBGchLm23SJH	8/21/2021 17:43	Thank you for letting me be a part of this survey!
R_ulUK65dPaNfw9Hj	8/21/2021 17:54	best survey yet. Keep up the good work
R_1IN6Xs2EWVrTpy5	8/21/2021 17:54	Great survey subject
R_2QtHMSCW219ziUI	8/21/2021 18:03	None at this time
R_WkTzOzYvWGI9TP3	8/21/2021 9:03	It much more great survey.
R_3p8TMOVBEUNdOUa	8/21/2021 9:51	This was very easy to follow and i appreciate the level of detail and the easy to understand graphics that were put into the information sections of this
R_22zUeCmjYYexDNv	8/22/2021 0:56	none
R_27QIK5ymKDQh6eN	8/22/2021 0:57	Very interesting survey
R_3GfD6XAsnU2Rpdy	8/22/2021 11:25	Thank You!
R_2amkwSuiAE7r6gY	8/22/2021 11:36	The monthly household costs all seemed pretty exorbitant to someone on SSI – even the lowest amount was more than 10% of my income. Whatever the chosen program, a good share of the auction money will have to be spent on relief for low-income households or we"ll be in a pretty bad situation. (If you do another survey on this in the future, perhaps you could take that into account.)
R_1pGd52hzj1XUabz	8/22/2021 12:38	Ok
R_3ssMVntxm8nVEZF	8/22/2021 13:34	Good Survey!
R_3qksrBMXDkAwkvz	8/22/2021 16:24	No
R_2XiLXXjJTi4eeLM	8/22/2021 16:32	Global warming is real please reach out to the right people to stop it before we all fry!!!!
R_1gIyWwALvmkoNnj	8/22/2021 17:44	This survey was fascinating and educational yet did not portray a bias one way or the other on a very controversial topic. Thank you for the chance to learn and participate in my views as a contribution to the thought process.
R_5cEKSqWPA3GO0Kt	8/22/2021 19:07	No thank you
R_1r7Gt6d6cZLQYyO	8/22/2021 23:08	Thank you
R_87JYb2V5m6d0Mrn	8/22/2021 5:11	Oregon has money in reserve to use instead of taxing citizens.
R_1gpx5dJ9x9aPZMs	8/23/2021 12:37	Thank you so very much for the great opportunity to participate in this important survey! ðð½
R_2VEyFFuk2tjKWxB	8/23/2021 13:25	I learned something today, that I will carry with me into the future. Thanks.
R_3G8RgZsLToZW9Iq	8/23/2021 13:26	it is exciting
R_29aGT58Dc9yWYv4	8/23/2021 14:01	Very interesting survey
R_tKWfL9ibDuqZxzX	8/23/2021 14:48	Good survey. Learned something.

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R_pMni1dmiUI0CiR3	8/23/2021 15:00	Carbon cap-and-trade programs are nothing more than the Progressive"s way of oppressing business and controling the common man. Another method of the Progressive"s to move the country further to the left. I do not believe they really care about carbon emmisions. It"s just another way to elivate their elite status and cause the rest of the population to become more dependent on the government handout.
R_3iHXCYVFATa6AH4	8/23/2021 17:11	I am not a believer in any kind of Federal or State government legislating in the marketplace. If you want the proof of that just check Amtrak or off track betting in N.Y. Government and politicians screw up everything they touch.
R_81c5h1QoHnnjkuB	8/23/2021 18:59	Thanks for survey
R_1LUSy3Wb6eRjrHL	8/23/2021 21:18	Great survey, very salient questions and problems.
R_OxHPGQp4NLhndDj	8/23/2021 21:42	I like the survey. I learned alot
R_bpwVVnsk6ygteRb	8/23/2021 22:52	This was a cool survey and it"s really informative
R_1kNPcz8zK1s8kRZ	8/23/2021 23:01	I really appreciate the blue text that provided additional context for the issues presented
R_2VCjZF4nMHu6cUP	8/23/2021 3:21	Ok
R_1g7KIM8xaBhlCKu	8/23/2021 4:32	Would have liked a better understanding where monthly household cost were coming from, I.E. fuel ,food,electric utilities or natural gas, groceries ect, a breakdown of percentage?
R_1CqdYkOnN85zbaH	8/23/2021 6:45	The weather is changing day by day. We are facing a lot of calamities these days. It"s very important to save our environment. We need to take proper steps to reduce green house gas from our environment and we have to plant more and more trees. Thank you for asking.
R_2PhdgDMZHZjeLL3	8/23/2021 8:42	I think as a resident I want to make sure others in these industries can find a new trade. I know they hear this type of thing and get scared and automatically flip out and shoot it down. But if these specific people could be encouraged or incentivized to move to a green sector that could help? Or I"m dreaming haha. I appreciate Oregon for trying to do this. Historically we have been progressive. I"d vote for a plan that YES limits other pollutants, limits future pollution, and does not cost the household more than $200 or so
R_2QlBlHmfZ4GZtl8	8/23/2021 8:53	I enjoyed this survey and actually learned some
R_2434emmPsyuhy6n	8/23/2021 9:10	I think not al citizens having to bear costs for climate change are very high when businesses should pay the highest amount.
R_3dWjRKsvK1dn502	8/24/2021 0:01	Nothing additional
R_3nGY5gnaMS7ySUL	8/24/2021 0:52	Very informative survey. Didn"t know the Oregon government was considering a cap on carbon emissions
R_3NCibWGOuxEgxwn	8/24/2021 13:40	Great information, although I did see some inconsistencies of information. Also, a very strong bias opinion on the topic
R_2xQnrCATeqx6BWw	8/24/2021 15:16	nice!
R_2v0pNLUs6lmfi6L	8/24/2021 17:06	Great survey! Educational + easy to complete. I do wish I had the option to go back & save my place as I wanted to revisit the previous Programs & since I couldn"t, I had to refill the survey; but it was worth it.
R_cvuUb7qvW8dkAjn	8/24/2021 23:25	Carbon caps aren"t enough.
R_27EhxlMB6zigEAH	8/24/2021 23:49	Thanks
R_bPJzm92n9aeEtbP	8/24/2021 2:26	Liked this survey. Different very thought provoking
R_1i8MugFQhBHc09G	8/24/2021 4:34	Superlative survey. A win/win as it provided excellent feedback to you and provided an excellent education to the survey participant re the particularities of the cap-and-trade initiative.

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R_2TRgLsV12h5h5mL	8/25/2021 12:08	Thank you for the information
R_3qkZozmqfwCsbn7	8/25/2021 19:52	I wish more was explained about the household cost estimated. Is that just the elevated cost for goods and services provided by merchandisers? I would have voted much more in favor of those costs then; seems expected. Or is that amount an estimated out of pocket cost or tax paid directly by myself to the government or other committee in charge of this plan? I am living leanly as it is and would prefer the costs go to the companies instead of me. Or I need to know how much of my money is going where exactly; ie not to campaign costs and overhead.
R_yloMsGuzSfTGikh	8/25/2021 19:57	Thanks for increasing my awareness!
R_2aS30I0kL3v28Xy	8/25/2021 23:44	I like the survey I have taken for where I live in Clackamas Oregon
R_1JXFNHzS8vNzl8l	8/26/2021 10:03	I got lots of information about carbon cap.
R_2YFKXhUPx3z5Gy4	8/26/2021 12:41	This survey was really nice
R_31AjNrGPlezXNcq	8/26/2021 18:40	I think the survey was informative but may not be the most understandable to the typical audience, especially those with little schooling. A video may be more effective in breaking down what was included here.
R_2RaeVUUQ0tI8co4	8/26/2021 19:47	I was thoughtful in my answers but feel I could of understood the charts more. I started to feel tired and became impatient. I wonder if I would vote differently tomorrow, after a study session.
R_1eWwN6JlhkvWEpF	8/26/2021 22:10	Please do your part to save the planet.
R_urmnJYF2Fpe5WUx	8/26/2021 23:25	I can say its really good to know about our mather earth. And do what is good for everyone. And take good care of it. The cost reflects . Thanks
R_1PRzAHmAnQ86kC2	8/27/2021 11:04	Good survey
R_2TtmePKKLLHAHQf	8/27/2021 18:02	None of the above
R_22MtjhbgK7lHGHO	8/27/2021 21:14	This is a very vital problem we are facing and the more information, the better!
R_3oBEs09sdZnVphH	8/27/2021 21:41	nothing I can think of, Have a nice day!
R_3HhS3OVyoSatq1S	8/27/2021 2:11	I don"t know
R_Wv1ntSFZv3ZCQh3	8/27/2021 2:38	This was a good and informative survey. I enjoyed it. Thanks for asking.
R_22tBKKTZwupggql	8/28/2021 12:12	I like this survey so much and I know so things which I don"t know before.
R_1eKTbwlKUVeDTCY	8/28/2021 13:47	It"s a bs program
R_3Vsqa4LYhQ94fsZ	8/28/2021 16:14	No thank you
R_1PTyLvsWmK4mPfL	8/28/2021 16:29	I felt that all of the proposals fell short in the amount of the emission reduction for a 30 year period. At my age, 30 years is not relevant, but it is for my children and grandchildren.
R_3FJPKcA3wAsZuJ9	8/28/2021 16:36	It was informative and quick
R_5sSAlXBx0nxKvMl	8/28/2021 17:38	Decent
R_1jq4gnQ3K833NoM	8/28/2021 17:44	I would like to know more where can I find the info
R_PUNPGQJ2Uf9f9cJ	8/28/2021 1:53	Maybe show a video instead of making people read the important info
R_Dl40O7GAyrc39v3	8/28/2021 20:41	Before participating in this survey I had no idea that this was a thing that was being talked about. Thank you for giving me something to think about and research further!
R_9yN8jZKUqyri48h	8/28/2021 21:44	It was very informal to learn about climate change and maybe make a impact on the climates

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R_2e4FYotxYpGtXGE	8/28/2021 22:19	None
R_1C9gU5xorp19Ytr	8/29/2021 0:29	i loved this survey because it was informative and i was able to learn a few things that i didn"t even know about
R_2OH0akuSC6stxLA	8/29/2021 10:20	Your choices of political affilation did not include Libertatian which it should have. It appears that several of the current issues are missed by you, such as a political class that will not do their job such as desalinazion plants and population control. Without stopping countries from poluting the oceans and without China and India being accountable a more serious peoblem will confront us soon, no fish in the oceans. Lack of clean water.
R_2xEGwY5Np0w8hWJ	8/29/2021 13:45	Reducing emissions will be expensive & maybe even painful to some, BUT if we don"t do something it will only get worse. We need to starting doing something
R_2QM6g9SV0BiKy9P	8/29/2021 16:01	Don"t want to
R_2AGxYbEbb2zGuMm	8/29/2021 16:23	Very interesting questions
R_2AFpxYZspWdOvA5	8/29/2021 16:29	no additional feedback
R_31dfMDx97lWsCWP	8/29/2021 16:55	Had no idea this was coming. Something does need to be done. I guess we will all feel pain of some sort
R_2uEXmaqTLtsisx1	8/29/2021 16:58	Try to minimize household cost would be better idea. Somewhere $150 would be reasonable.
R_xu6GvKWsUqBQOC5	8/29/2021 17:02	Let those who can afford it most pay the most/lose the least from this plan. Money returned to the state should be disbursed to lower income households to offset the greater costs to them. Worker and communities who lose income should get the most support.
R_3si7yvyDy8pWwlQ	8/29/2021 17:35	I appreciate this informative survey
R_3EA5haEeqTUtjuZ	8/29/2021 18:05	Thank you
R_1nO39Ldj3YAxXdB	8/29/2021 18:47	No
R_11jRxMZzOfYx1Hi	8/29/2021 18:58	The surgery was really nice i loved how it talked about climate change
R_004u2AnIoYRAURb	8/29/2021 19:19	I understand what cap and trade is all about now - thanks!
R_1Qae2GKfy2deaUt	8/29/2021 20:59	No
R_2rJHAOgVgJ1gSpH	8/29/2021 21:02	I think the majority of people are coming to the realization that climate change is real; however, Americans are so slow to implement change and those who would oppose these changes do so for mostly political and financial reasons.
R_2E0hLr8Pt1UAgId	8/29/2021 21:18	Whatever we do, in 50 years it will be wrong
R_2z5Vlx5k5L838Te	8/29/2021 21:37	We support 3 generations, 5 people total, from a small family business. As much as we wish to help solve pollution, we would really suffer with monthly costs over about $100, and even that would effect our family future
R_3sCLEosJSvKd23n	8/29/2021 5:09	No thanks
R_1dy8WlpSahToNwL	8/29/2021 5:21	No fight the fight.
R_1MX29jrgGCAHIHH	8/29/2021 7:31	I"m all good
R_2ZDoHjBTn1k8Gtv	8/29/2021 8:55	I enjoyed the new information.
R_2sYkB3dCvoN4AyT	8/29/2021 9:51	I really found this survey informative.
R_BXugEo4drrtnx3X	8/30/2021 11:10	Please consider how many homeless people and how many low income families are already struggling. We are the little guys nobody considers, and we are your neighbors, family, and friends. We deserve to live a meaningful life too

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R_12hx62VZvIcrqUY	8/30/2021 12:22	Thankyou for the information , it was very enlightening.
R_3PIigQBWqwUq2i6	8/30/2021 12:33	It is interesting to talk about this topic since we ourselves are destroying the planet and nobody does anything, it is good to be informed and know what is trying to do something
R_27DTVzcAqZjyFPo	8/30/2021 14:31	Technology is available today that could be used without the economic downsides to the cap-and-trade. For example, there is a company called Bloom Energy that produces fuel cells, which convert Natural Gas, Propane, Methane, Bio-fuels, which virtually no carbon emissions. Imagine not electric batteries for cars (very costly and environmentally unsound) or solar panel batteries, no longer being required. It"s the emissions we are after and Bloom energy provides a reasonable alternative. Also, just because Oregon does a cap and trade policy does not mean that our efforts would affect the global climate change. China, Russia, Europe, etc. must all get in or the changes will not be effected.
R_1IMnQv4Nup7yzpa	8/30/2021 15:23	I loved this surgery !
R_1rp2akHEWE9XuGW	8/30/2021 15:27	Would people living on just social security, below the federal poverty level, still have to pay the same amount for household costs or is it based on household income? I didn"t see any explanation as to how this figure was established. If it was proportionate to your income I would have been more favorable to voting yes on the various scenarios.
R_27l4a3fUQhp8NlR	8/30/2021 15:40	Thought provoking.
R_1f40lj32taj8YU9	8/30/2021 16:10	poor study
R_4HDwcKqvTEGOCat	8/30/2021 16:44	I enjoyed reading the explanations of any future vote we"ll need to make.
R_1MVRAODsIPkesA2	8/30/2021 16:59	The information we have about the earth in general is not that very old. We cannot justify climate change we we know so little about the cycles of our planet over vast periods of time. Carbon dating is what we rely upon for our information but carbon dating to see in the past in not reliable. You can lab reproduce a specimen that can carbon date to 30,000 to 50,000 years old in a matter of hours in a laboratory. We know so little about the earth"s cycles.
R_2rubJXps8WHTXf2	8/30/2021 17:25	These programs won"t make a difference in my opinion if Countries like China, and India don"t reduce their pollution.
R_21hMIgiKHGJ2DwD	8/30/2021 17:31	Climate change exists. The earth"s climate changes. Humans have an influence. Total cause? No. A brook flows, things get in the way, this causes change like speed/idle,. Humans put things in the brook, more changes, I.e. direction, flow. If humans can put less stuff in the brook, less changes, but there will be changes. This is climateâ¦always changing. Can humans help the change. I hope so. Thank you for your work. Amazing stuff you provided.
R_12QmJ0MgUYR6DGy	8/30/2021 18:25	The idea that cap and trade would pass off expenses to individual households makes the concept unappealing. Corporations are already milking us for everything they can, avoid taxes, grossly underpay their workers, and make exorbitant profits at the expense of the people and the earth. It is unfair to plan a way to further drain us when so many are already barely getting by and now would be expected to absorb the costs of corporations that must change some of their industrial practices to mitigate climate change that they caused by those same greedy short sighted practices. They out source to foreign countries with no labor or environmental regulations because THEY DON"T CARE ABOUT ANYTHING BESIDES THEIR BOTTOM LINE. Now they want the people to absorb the costs accrued from changing a few of their greedy practices? NO corporations need to be held accountable and they can absorb these costs from their profits and bonuses.

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R_3CW1OO4SOeZJNko	8/30/2021 18:38	We here a lot about climate change in the mid 70"s we were told a new ice age was coming than in the 90"s they started saying global warming was happening. The models they produced had no bearing on reality showing incredible increased in heat in a very short time. None of those model"s came close to what has actually transpired. I live on the Oregon coast and if the ocean level"s are rising it must be very slowly because I have walked on these beaches since 1965 and they look no different now in 2021. The last 3 summers I have noticed that fall has started in the month of July with leaves changing color early not waiting for more traditional time like September. The sun is the largest driver of our climate and with the low sun activity we may be seeing a cooling trend over the next few years so spending a lot of time and money on trying to stop climate change maybe we should try to understand why our models do not register reality. Florida and New York City were supposed to be underwater 10 years ago. Far as Green jobs go just exactly what would those be...installing solar cells to generate power...I live on the Oregon coast and I have news for you we have fog all summer long and you can not generate a lot of power from the sun when it"s foggy now you could set up solar cells inland a ways and get some sunlight but than you would have to have power lines to bring the power where it"s needed and what would be the cost and benefit to do that.
R_WccPqH2XGIsAD73	8/30/2021 19:05	I just turned 71. and have seen how the world has changed and from carbon gas has affected are air. the world needs to do some thing to improved the air.
R_3qTZEkALvURB6Vi	8/30/2021 21:13	thank you
R_2rC4eEghAQwbd5B	8/30/2021 21:20	My low score on "informative" is because this is a long-time area of interest for me. I cannot use solar power without destroying magnificent oaks. I believe that carbon pricing may be a fairer system than cap-and-trade. THe main problem is that our military runs on oil, and so we protect our interests abroad in terms of oil acquisition, as well as US$ hegemony for oil purchase and global loans.
R_bEmmlOCVHVEbIad	8/30/2021 22:24	Thank you
R_1CHMlxXjI6Kdzd3	8/30/2021 22:27	Doing this survey made me more informed about the carbon cap-and-trade programs. One is never too old to learn.
R_qxq4nJOeWAP5iO5	8/30/2021 3:50	No thank you
R_1H7FKF8f14GOCf0	8/30/2021 4:54	I really don"t have any opinion but if it"s going to help us all in general and why not go for it
R_12EYzfTrdOs6phW	8/30/2021 9:03	When you ask why I voted against a certain Program, it would have helped if you showed the program alongside my possible choices so I could recall what I liked or disliked about the Program I voted down.
R_CmlEr96Bcd6pqvf	8/31/2021 0:06	good/helpful explanation of carbon cap and trade program
R_VInZyRufBWZkVod	8/31/2021 0:07	This survey is very educational amd a great way to make people take time to think about subjects they most likely never think about . And it"s important for these discussions to take place
R_6FOtjMli5c9n5fz	8/31/2021 10:55	I didn"t like the amount of job loss, and cap and trade seems like it would need A LOT of oversight to manage.
R_3ltwBoNyAQ9Gi7i	8/31/2021 12:20	Thank you for inviting me to indeed my input on your survey. For such a complex subject, this survey was as simplified as much as possible, it seemed to me.
R_3D5DldDmiBYtAV8	8/31/2021 14:19	Great information
R_2378QzL2If1K2aI	8/31/2021 16:08	This survey was a little bit interesting, but also pretty boring unfortunately.

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R_ZE0C31QpP4dLE2Z	8/31/2021 1:32	One thing surveys apply to are people who are married or live with someone and who have children/grandchildren. I have none of those areas. I think adding something like unmarried or single would be good. God has not blessed me with any of that. This whole "title" is completely new to me, but the subject matter is partially new and partially known. I found it interesting that you covered everything from households to small and conglomerate businesses and the employment side. This is exactly what happened in going from moonshine to alcohol being legalized AND from manual to electronic means in homes and businesses like horses/buggies to vehicles. All are massive and global changes. As a point, I try to buy from companies that have a footprint in Oregon even if buying is online. Example is that Amazon has a warehouse in HIllsboro, OR so our Oregonians are employed there. Keeping the spending dollars in Oregon for our folks is important to help to keep our economy more robust now and in the future.
R_1Ii0cbkzBf8FNkM	8/31/2021 3:15	Keep oregon green with a place for wildlife and country folk without taxing their animals. They people life off the land as much as they can and let their neighbors Contribute to think nuggets grown on chickens as chocolate milk comes from brown cows. And when you look for land to developers don"t take the middle of a hay field needed for horses. You may not Think it hurts, there isn"t enough money to buy the hearths and memories of our ansestors.
R_1QLbYXMGUr2GnZx	8/31/2021 5:45	I hope the world becomes a better place.
R_1dHnjxyJHIhJMgm	8/31/2021 7:36	I saw only one option, I thought I was going to see 6.
R_2R2IItuFfuwsYzR	8/5/2021 14:11	None
R_2E5CS03arySfC7y	8/5/2021 14:26	None
R_ZJJyGULqLrB7MSB	8/5/2021 14:37	I"ve never taken a survey like this before. Thankyou for giving me the opportunity to learn a little more from this survey.
R_12MGwe4xCekwKEC	8/5/2021 14:44	I don"t have any feedback to provide at this time.
R_2Cj1h6ounyN3kuP	8/5/2021 15:32	Very detailed
R_1DUdJdrzWz1exSl	8/5/2021 15:36	Hi
R_3EsC8ioOKhara0p	8/5/2021 15:41	Thank you for an opportunity to learn about types of carbon cap-and-trade programs. Its very helpful to knowledge more depth of emissions we need to take a control to reduce climate drastic changes from now on and in the future.
R_85HCxPAzksPVUOd	8/5/2021 16:24	I believe there should be a cap and trade program. Just work out the details to not pass so much on to thr households and make it fair to all.
R_1GH9ImZBsEZYrT9	8/5/2021 16:46	Love the information I received taking this survey.
R_PMNBKjuP6c3d5cJ	8/5/2021 19:22	Very interesting and informative survey
R_DBpkCj8kMpqA08x	8/5/2021 20:20	I have none
R_2qCKIjuQuWZIbG6	8/6/2021 0:10	Thank you for the concise explanations. It really helped guide my choices for votes!
R_3ff3wJu978G3agc	8/6/2021 11:36	Too much reading. Not interested in this enough to be able to keep my attention easily
R_8Aoy3JkceGu7KMN	8/6/2021 12:20	As a former research assistant at the UO, I"m interested in the non-neutral phrasing you used in this survey.
R_2ZIhERL3zY3XAoG	8/6/2021 17:24	Carbon tax isn"t going to help. Has anyone ever heard of the ice age? The dinosaurs lived in a time in the planet"s history when the earth was much warmer on a global scale. Then the ice age happened. About 32000 years ago the earth started moving back to where it was. Nothing humans did reversed the ice age and nothing is related to carbon, that"sa lie perpetrated on people to part them from their money and freedom.
R_1l0n4ok530bomVH	8/6/2021 19:59	No feedback to provide
R_23Wtm3yTF8Et2c0	8/9/2021 21:50	The less time the democrats are around in politics is better for the earth and population.

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R_3exckSvKotu1enA	9/1/2021 10:06	Educational outreach explaining the benefits of Cap and Trade may aid in changing minds of the resistors.
R_2AWPyhnyjkTG7vE	9/1/2021 11:37	Excellent survey truly providing you with information which I need for a better understanding of such subject
R_2PcDo25kzomXtuL	9/1/2021 14:41	I am 89 yo. I returned to Oregon where I was born, after a lifetime doing research. Much of this activity was in atmospheric physics. As a result, I can find no evidence of global climate change, and I believe there is no such thing as a "greenhouse gas". So, who benefits from Cap and Trade? Well, Al Gore embarked on this when his personal wealth was approx. $2 million. he is now worth $200 million according to WSJ. Other Super wealthy Californians have been promoting this scheme for years. We also have to consider profoundly corrupt politicians. Consider the fact that Oregon built a nuclear power plant, and decided to demolish it a few years later. I don"t think we want to entrust such a huge program to profoundly corrupt politicians.
R_1Q0AB2YuTnORvCu	9/1/2021 19:12	I migh5 have changed my vote if options were different order but minimally.
R_3PS2BcRnmT0EJVf	9/1/2021 19:39	All of us must work together to solve Climate Change concerns. I think Oregon"s Cap and Trade initiative to be more fair than other alternatives, and represents a creative means of addressing this very serious issue of attempting to cool the planet down as well as curtail green gas emissions. The cost to individual households in some of the scenarios seem prohibitive. Local and national legislators from both sides of the aisle must work together to creatively pay for Cap and Trade schemes to spread the cost. Poor people simply cannot afford to pay for industry"s greed.
R_yQHeSxqDJjPjVYd	9/1/2021 20:23	It"s was boring and I wish it was something more interesting.
R_3MxHXel5TufumY9	9/1/2021 20:58	Since the industrial revolution began, we are just experimenting.
R_r78NcDpPdvGT3eV	9/1/2021 21:10	Interesting survey
R_3NLjZzj6hjynwsH	9/1/2021 22:22	I like to know
R_2YmFeRxNsbNRxp4	9/1/2021 22:38	none
R_1Ke7t6XCfEBSZ4k	9/1/2021 2:51	Be good to natur
R_1g6pmezq0nRzGoR	9/10/2021 14:53	I like F the best!
R_1NxAKlWEoMasQmp	9/10/2021 3:02	Very interesting and learned a lot.
R_24dsZPPIf2twh1i	9/11/2021 10:32	Great articles made .e.want to vote
R_1rH9tM9VikRAL2t	9/11/2021 12:38	Very in informative, but a little too lengthy.
R_10IuuHdTVbWlQsd	9/11/2021 13:25	Nothing to add
R_2OVH4TYbb7ig4Hw	9/11/2021 13:40	Good survey. Hope the points are there too
R_2zOVDOaakbUb0Iq	9/11/2021 14:35	Stay healthy, stay safe!
R_URwDa8CGkD1YBzj	9/11/2021 18:08	No matter which way the issues go, the consumer will ultimately pay the price. If companies pay more to operate their businesses, consumers will pay more.
R_3pqXN0Maht6QUyL	9/11/2021 18:09	It was a decent survey
R_Xudk6RuHYEkqhSF	9/11/2021 18:12	all good
R_XhSTlBnfthItbbz	9/11/2021 18:36	None
R_2WNcZlTD3WtbA0m	9/11/2021 18:40	Tbh idk
R_3PpFeNIG3xuUsFO	9/11/2021 18:44	A lot of info

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R_1f0YQHxNMJ3IVOs	9/11/2021 18:56	Climate change sucks
R_3nPFyzMTuNaiobs	9/11/2021 19:02	I dont understand why not allowing other pollutants isnt in every plan . It also does mot make sense to me that if a company sells their permits they would be allowed to pollute more
R_1OCrfH4lvi9NZhc	9/11/2021 19:08	we as a people need to makes changes before it's to late.
R_2xyD2PJHI0J62MZ	9/11/2021 19:27	you pay now or you pay later with you"re life. Tax corporations and manufacturers who never pay the fair share of taxes.
R_2QLguR76QsHrTbD	9/11/2021 19:29	I really appreciated how the information was broken down and easy for me to understand about a subject i had previously known very little about.
R_zeDTVB0neIV8aTD	9/11/2021 19:32	I don"t disagree about climate change. But I don"t believe it"s all human caused. I think it"s just part of the normal cycle the earth goes through.
R_3nwrTwSLDOGHSWb	9/11/2021 19:35	In this area goverment making rules that hurt more than help. We have forest fires,bad forest management,and air is not heathly to breathe.
R_1msfcUWF8tjTvIT	9/11/2021 19:37	Thank you for doing this!
R_24pbIwzkKunGd76	9/11/2021 19:43	The survey was very interesting and contained very good information.
R_1GCeTM4Wg170YxP	9/11/2021 20:22	N/A
R_1NC8FhS0MeNkdYl	9/11/2021 20:37	None
R_daIB0wptYpuA0OR	9/11/2021 20:58	Thank you for this survey. It was very informative and helps much more to understand the terminology. I definitely agree that climate change is real and change needs to happen. However, it is also very scary to me as I live on less than $1,000 a month. My apartment is heated with natural gas...if it changes, housing costs are going to rise. They are already high in this area, and so is homelessness. My vehicle is gas powered...if these changes happen, I will have to buy a hybrid...I can"t afford to buy a new car. If we don"t abide by the new changes, insurance and fuel costs will most likely rise. Worst of all, because this is unaffordable, me and people like me will still be part of the problem rather than the solution!
R_a4sbRdSFABCyLqV	9/11/2021 21:01	No
R_33cYLbpj83Txeg2	9/11/2021 21:10	I enjoyed this survey and hope more people get to see it!
R_2uNFnCZhO4d5Qtg	9/11/2021 21:26	keep giving the information more and more are realizing the thruth.
R_3PoZBHNwPzT6DbM	9/11/2021 21:48	I am scared for the future of my generation and the generations that follow. The threat of climate change is imminent and existential, all action that can be taken to slow it should be taken.
R_tYW3BFp5EgYHXDH	9/11/2021 22:06	Thank you for sharing the knowledge and including me on this survey!
R_1ILeHcSACyNHGVA	9/11/2021 22:32	Thank you for letting me share my opinion
R_1JUSgwPKpMkCQLw	9/11/2021 22:32	Good survey and can be very helpful for Oregonians who have no idea on what"s happening today in our world.
R_1oEYM3hpTCeongW	9/11/2021 23:29	It really is scary these times we live in, something has to give. I don"t think for Oregon a personal income tax is fair or right or will solve Climate change.
R_1OC8NbrKq9TaGF0	9/12/2021 0:10	Nothing. Thank you.
R_3dNihX6j8Y5o0Co	9/12/2021 0:22	I like that they care about the environment
R_CdL4MunODwnwwIp	9/12/2021 22:24	No

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R_3CnTPfYkTd6hVzr	9/12/2021 3:18	I could talk about this quite a bit. But I don"t believe climate change is a problem for us. Okay maybe not that it"s not a problem. But I don"t believe that it"s because of humans. I think it"s just another topic to discuss to make a problem to divide us Americans mostly. If globally warming were real how come planets in our solor system have experienced âglobal warmingâ issues with no people living on them. I think after thousands of years the world planets etc are going to slowly make huge impacts on it"s structure. If this was an issue why is it only been talked about now I feel it"s just another reason to get people to argue with each other to divide us. It"s another reason to shut down businesses it"s another reason to charge more money to live here it"s another reason to destroy America it"s all political
R_2QSYdD8eAp5XZKX	9/12/2021 4:10	I believe the carbon tax is a good idea, Teaching and educating the public on better ways to reduce the carbon imprint and effective ways to do it would help.
R_2y7ODnHVaS12eA7	9/12/2021 4:48	thank you for using larger text
R_3J4sY0psGClMm3G	9/12/2021 4:54	its very good
R_3Jsjfu5CEBr5h4I	9/12/2021 5:00	none
R_22Y0Es6EB2CIQZS	9/12/2021 5:58	no
R_1gME3xUE2FlDKU3	9/12/2021 6:43	Took longer than expected
R_1QnBGlvsGVTBPqc	9/12/2021 6:51	When you show a screen asking why I voted for or against the program you showed on the previous screen, why not have that program displayed on the side so I can easily remember what I liked or disliked about it?
R_1pVFxwDvZx7CvRd	9/12/2021 7:47	someone will be making a ton of money from these programs and I guarantee that it won"t be we the people.
R_2YaHSK7tG5V3xnw	9/12/2021 8:16	As I stated climate change is a serious issue and I cannot get passed what the leaders of this country and of Oregon has done to our America and for that reason I would vote against anything they try to pass without believing they are doing it for their own poltical gain. As of today I will never stand by anything our government is in favor of. The leaders of Oregon do not do what is best for communities only what is best for them.
R_3HM23LmPmDdrxUI	9/12/2021 8:56	We all need to take part in reducing our own carbon footprint. Everyone needs to pay their fair share. I need to pay my share for using natural gas and electricity, gasoline for my car. Companies that have more carbon emissions need to pay for what they are polluting. I say auction all permits and every year increase those costs. We will need to force a replacement for or build governmental industries. God made us highly intelligent and even though we knew it was wrong we have taken shortcuts to improve our bottom line when we knew it affected our environment. Time to stop it and I believe the government could have prevented most of this had we not allowed certain industries in our country.
R_2AHfoycVmeePqvE	9/12/2021 9:06	$215 more money per household will just make it harder for the average long-time Oregonian. Our state is so wrongly taxed in so many ways. Make takes equitable–whomever uses it, pays for it. I"m a lifelong Oregonian and instead of this idea, charge people to drive like the DOT has brought up. More and more people and cars is a real problem–start charging people auto taxes for the amount of miles they drive. Whomever drives the most, pays the most!!! This would also reduce traffic on our roads. I work full time and drive less than 5000 miles/yr in my auto and always have for 40+ years. Most people drive like 25,000 miles or more. Charge them by the mile!! That will reduce a great amount of Carbon Dioxide. Charge the autos coming across our boarder of Oregon a toll coming in—just to pass through, etc.
R_3IYPlQFDFPB56PZ	9/12/2021 9:33	I"m not sure any of this will work we don"t have control over the world
R_1rwDgn5RmqKumGR	9/12/2021 9:37	I will not support any kind of legislation that doesn"t allow me to vote on it.
R_3szXx1cJ0PUv9eV	9/12/2021 9:41	nothing in particular
R_3LXbAc7jfjdody0	9/13/2021 15:54	The survey was very informative
R_210Ucx2ibaWuSad	9/13/2021 20:35	I learned a lot, and appreciate the education.

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R_1pSWnPYlVwNryaO	9/14/2021 10:06	nothing to add
R_1n0faYTbDoN1gLj	9/15/2021 20:43	Thank you for an educational and bias free delight of a survey
R_cGtCHA9oTFvGG2d	9/15/2021 7:14	None
R_3qJ784TDNlpAvwo	9/16/2021 22:47	Gfsk
R_vrf7Xr7FQSSHV7j	9/17/2021 10:50	If this is going to be coming soon, I would love to see more information advertised to the public. This is the first I heard of this.
R_2Bhbp15dgtrnFjg	9/17/2021 13:43	Fantastic Survey! Thank for all of the knowledge!
R_1OUnXuidmAVogLj	9/17/2021 15:54	n/A
R_1mVrzLkA1TXmjZM	9/17/2021 16:02	thx
R_30tPCDNGnPqLudG	9/17/2021 19:50	nope
R_0wDwXruSMOQyGo9	9/17/2021 8:53	Thank you
R_3vXW4rq4MC1ZXtn	9/18/2021 0:54	Great survey thanks
R_2S6yP1EmPMvq7a9	9/18/2021 11:01	I like how people start to know more about the climate change
R_1q1CGARVCS4LzDo	9/18/2021 11:30	Raising taxes doesn"t change the climate.
R_ON06GR2PJTE3qbn	9/18/2021 14:15	Very good
R_1C91E8CWsQO9Zmj	9/18/2021 14:59	Thank You!
R_2SH9o6smP4At0kO	9/18/2021 16:33	The most informative survey I have ever taken. The survey had more information that could be absorbed in a few minutes that I have read. Very well done.
R_3FQYNyEjh7C1MAA	9/18/2021 1:52	Try to reduce the use of disposable products and drive as little as possible
R_Y9NeH2ZSy5TP4rv	9/18/2021 20:32	Fun survey
R_4NqpU8jHkdQsRP3	9/18/2021 20:41	I am very active in the CUT-OUT of Pollution in our environment due to the fossil fuels and I personally ride my electric longboard to and from every single location that I have to visit each day. I STRONGLY SUPPORT the TRANSITION to GREEN, Electric and non pollution causing ways to cut out any unnecessary waste and trash on Earth
R_2sTlURbPq13cPAs	9/18/2021 22:28	Thanks for the quick surveys
R_3HMr1AGpWDAhzBD	9/18/2021 8:27	we all have to act before it"s too late
R_33dkQZ44qH7r4KG	9/19/2021 0:23	I really like the subject that this survey was on. I wasn"t sure what content you guys were going to offer at first. I live in Eugene Oregon and gaining awareness on Climate change is very relevant in the community. Carbon emissions are one of the main culprits of climate change
R_Og9CNpHkegKuiQx	9/19/2021 11:09	U should give some available answers that u don"t agree with so people can tell more of there truth
R_ZqSFF09fbx9UEk9	9/19/2021 17:21	Hey this was propaganda to scare people about climate change to force them to vote on cap and trade.
R_1FnT4sMVd7Xhlm7	9/19/2021 22:17	I definitely liked the survey. I just wish it was a little bit more informative but it really is relevant to today"s life

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R_3pi12WtTSC0GMs9	9/19/2021 2:24	I think we are humans need to not take away the jobs that built the society we all live in and enjoy and actually develop new ways to do those Jobs that are actually not creating emissions and as humans we need to start thinking about how to relocate because the plants already ruined and we all have made our way of life so important to our lives that it"s not going to change easily and we should put our energy and efforts elsewhere
R_0BXMBnN4C2COmgF	9/2/2021 0:24	it is very important to talk about this topic and climate change
R_bNtmqSu2RXya7vz	9/2/2021 10:28	No opinions that you would care to hear about.
R_2dnBHjewMtXF81W	9/2/2021 11:29	Grubhub hun
R_2qgi2piRy6g5CbD	9/2/2021 12:57	I know climate change is a big problem but this bill if passed would hurt a lot of small businesses
R_25BMUa2aAH24eXS	9/2/2021 13:37	Thank you so very much for the opportunity and letting me do this survey. It was very informational very thought-provoking and I enjoyed it very much thanks again! ð
R_2tsqy2shEdJeigp	9/2/2021 14:43	Wish there"s more surveys like this was interesting to more more about carbon caps
R_exJbLTDOxI7PvdT	9/2/2021 16:27	Nothing more to add at this time
R_3k4wvcx7JcdXz1R	9/2/2021 18:24	No thanks.
R_28LJHAU4y0Um3Yx	9/2/2021 1:07	None
R_22QuiTZaD7PkK6v	9/2/2021 20:04	No thank you
R_3NHSEsLNtXrEwDi	9/2/2021 20:56	Cape and trade is horrible. And horrible for the people of Oregon.
R_20Zmsyfw6mTryob	9/2/2021 23:31	Great
R_3g2bjgudbB3Fw0D	9/2/2021 4:11	Thank you for the information.
R_2rSgneCyYAy9FWT	9/2/2021 9:04	Really interesting survey. This topic has been on my mind lately.
R_21v5CzBxkyQYMuQ	9/20/2021 17:02	great survey
R_ah2gOSIdV3pOBuV	9/20/2021 18:45	I live it everyday and never give up. Oregon is the best.
R_zVe4VQQDwvAoVXz	9/20/2021 9:11	Feedback
R_3qeNTMCWI5qLe1c	9/21/2021 19:01	It was a good survey
R_11XeHjGAwY1BN3Q	9/23/2021 8:50	Not at this time.
R_3g8icvurnMqZDpl	9/24/2021 10:39	Thank you.
R_3knCXD2QwWTvCHi	9/24/2021 14:15	Great survey, thank you for the neutrality.
R_9pHs6JsJitUyJwJ	9/24/2021 19:51	Sounds like a beneficial plan to lower carbon emissions.
R_2eXAJ6nNzLG4y0t	9/24/2021 8:45	Thank you
R_1Iddg9kNrIbafRX	9/25/2021 22:08	Great
R_1rBPzFS1dlhdAIa	9/25/2021 3:29	No thanks.
R_2TXmXgzL7XaXM5h	9/26/2021 20:54	I seriously doubt that ANY carbon regulation in the US will have any impact so long as China continues to outpace everyone on gas emissions and the global community does nothing to stop them.
R_1kSsjEFlFB2Rseh	9/28/2021 16:33	It"s always nice

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R_ezfeHKQ9IHQwtnb	9/28/2021 21:41	N/A
R_2QPq1KimVM9xgay	9/28/2021 23:26	The survey was great
R_3HFvfCGLNLgkm7i	9/28/2021 2:28	Environmental protection does not affect the work and rest of Americans all the time, and carbon emission is a major factor affecting the environment. We should pay attention to this matter, jointly improve the ecological environment and protect our home
R_1LUzbnVzYIDFlKr	9/3/2021 0:11	Perhaps if you lowered my taxes I could afford $3000 per year higher expenses for your carbon dream. Portland is becoming so expensive, we really can"t afford paying more! Our sewer bill just went up, our water bill is more expensive this year, electric, nat gas... Now oil and gasoline are going up. When does the little guy get a break? When do tax paying citizens benefit from all the liberal programs Oregon government puts into place? You build the Max that no one rides and that I continue to subsidize. Why not charge people the actual cost of a max ride and let me keep my money? Until you can figure out a way that your idea will financially benefit me, I"ll always vote no on a new government tax.
R_3NEwJ2fuKArf8y6	9/3/2021 10:32	Es interesante
R_3plJRXtB9DlLX7a	9/3/2021 10:55	Well thought out and easy to navigate survey. Best I"ve seen on the platform
R_eyNohCmYbAWhsaZ	9/3/2021 11:07	Great survey
R_3qTLc0OSSpd9cO3	9/3/2021 11:40	Thank you for informative and educating information! This is very relevant to me and my community!
R_vDjTixxhBkxgkyl	9/3/2021 12:20	This survey was really cool
R_1f46Dl4TVYyXuBE	9/3/2021 17:10	This was an intense survey, with a lot of information. I wondered about the use of images (like the first image of fire, or the images of polluted sky or protests), as it seems like they really push the cap-and-trade/pro-climate change viewpoint (which I agree with) and make the survey less objective, or possibly make people more on the conservative side of things less likely to complete it.
R_27QcxYRCuH797pM	9/3/2021 19:00	I"m very interested in the program and support it if it is affordable for us or our home. We are on a limited income, and can"t really afford the fees per home or the possible expenses of the plans. The $90.00 was really pushing it.
R_2fjrJozpXM4LfFd	9/3/2021 21:08	I love surveys like this!
R_3CKs7r7G3yD6RQb	9/3/2021 22:25	This was a great survey! I loved all the information that was given
R_2rITLkclGl5ZBkR	9/3/2021 23:14	Offer a company solutions, or make the new company have a permit before even building. Make economic electric cars more affordable.
R_1OT8EgOXDKb8rGH	9/3/2021 8:52	It was very informative
R_25sXmYBvd5NGnzC	9/4/2021 12:13	Thank you
R_qX9HtSBy8YQUsZX	9/4/2021 14:12	None
R_24uXB9bRVnJMTnB	9/4/2021 15:14	Interesting and relevant
R_5uQCQ3ZLRTSmSFr	9/4/2021 16:37	The biggest thing glossed over by the green energy proponents is the additional cost of the greatly larger number of jobs required to make the same amount of output. Seems pretty stupid from a practical standpoint to not highlight this context. It is always sold as a good thing to create additional jobs, while ignoring the ineffeciency.
R_3JlMlssvr2DwVkI	9/4/2021 18:03	Cap and trade is a scam by Democrats to Try to control and take more money from people.
R_2TNPCfRSQoYrvZl	9/4/2021 18:36	Program F would be the best choice.

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R_RPq2lwsGGUzKImJ	9/4/2021 19:09	1) Letting companies but sell or trade these permits is a bad idea. Why, because the bigger polluters are the biggest cash makers. at 2 to 2.5 percent a year reducing pollution. It will be five to ten years before we see much locally so why give the worst a way to prolong this level of pollution. 2) The areas in industry that pollute the most and the stuff we consume of these needs to be looked into with the of removing say plastic wrap for plastic bottles. 3) Everything the household does daily when being ecological is by choice, so why can"t we not work on cutting down on what will go to the dump.
R_330V6RVSQA9UTVb	9/4/2021 19:16	So many families are truly struggling in my community. While we ALL should be concerned about our planet and take responsibility for our part in caring for it. It is hard to support something that could make it even harder for people to survive. I do not want to see even more people lose their jobs, and possibly homes.
R_0UuPWpNlXlhuWUV	9/4/2021 19:49	Cap and trade in any form is horrible. And wrong for Oregon. Govt cant manage money they have now, you think they"d actually give back with any of this money?!?! So what if you add jobs, what do you tell the peoples who"s livlyhood you took away?!
R_2dfNuYPPLlJak4G	9/4/2021 23:26	Oregon gets something like 70% of its power from Hydro. Why are you whining about carbon credits?? Just convert to electric and build more hydroelectric dams............
R_3EGzsy7bX1StmIa	9/4/2021 8:52	Interesting made me think
R_1lmJdPBIi7oWPmG	9/4/2021 9:59	great, fun survey
R_3O3A5jOo82C2EhT	9/5/2021 0:47	The information was well-explained to where I was able to understand it, but in a way that kept it short and sweet. It was unbiased and allowed me to feel free to be able to think and vote for myself, and really stressed and pushed that, which I greatly appreciated. It was really informative, too, and I learned about something new that is important and relevant to me, and I had some fun learning it! Great little survey, and thank you for letting me be a part of it! Keep up the good work!
R_2qwv5FKBuKUS6Ys	9/5/2021 12:59	No feedback
R_1DYAH7I5j05q2AP	9/5/2021 13:26	This survey was really good
R_21mFgeaDQR1Y3pl	9/5/2021 13:52	Great survey, I think students across Oregon would benefit from doing this!
R_3Nwwf2wIt1X2MgG	9/5/2021 15:45	Love it. Let"s do something.
R_3jTgNtd18whjiQt	9/5/2021 15:57	It is horribly offensive to ask someone what their gender is. I do not have a gender. It"s like asking someone what kind of soul they have. I not only do not believe in gender identity, but the idea of having a gender is traumatic and oppressive to me. Ask for a person"s sex, not their gender. Not everyone has a gender, but everyone has a sex.
R_1LksNedMrRlXHJl	9/5/2021 16:02	i loved this survey because i learned so much
R_ptUj6kNFcHfJ7nr	9/5/2021 16:30	Nothing to add
R_Du9qKOpKxIk84Uh	9/5/2021 16:57	I am all for being more green but it shouldnt cost more prices are already way too high natural should cost less.
R_egmfq0XcmXyPqP7	9/5/2021 17:28	Carbon cap is being placed in the wrong area. Oregon has gone down in pollution, maybe not much but we have by something like 1% or more where russia and china has gone way up. Force them to make a change and stop punishing the ones who are doing something already about it! We can not make up for someone elses failures all the time!
R_2TZPmYmuBzj09O0	9/5/2021 17:53	My beliefs are the earth is going thru a heat cycle. Accelerated by humans. We have only been keeping record of temps and climate for such a short time compared to the age of the earth. There have been several Ice ages and I dont believe SUVs melted that ice.
R_0BcSOTqNTUM0RGN	9/5/2021 18:06	This was very informative.
R_28P2Re1hXI7HH99	9/5/2021 18:22	Great survey and information.
R_26gtTGfkKC29Gta	9/5/2021 18:25	Thank you that was very interesting, i actually never thought about a cap and trade program

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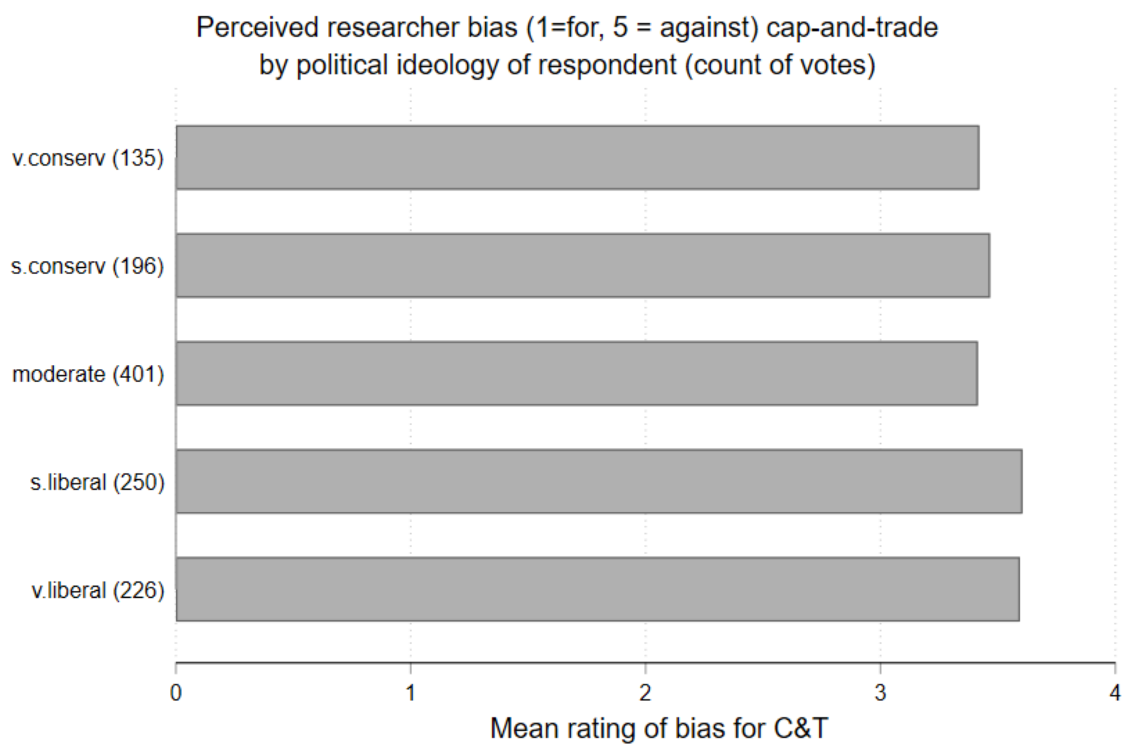
R_29ib5QsxH9i0wsi	9/5/2021 18:57	Carbon cap seems like good idea although I think there are too many variables to get it done
R_2Bqv6w7gE6cK7WZ	9/5/2021 19:07	thank you for this very important work!
R_1gS0e0EHMxJO0MV	9/5/2021 20:21	I love it hope we get more like this
R_3iDyvfJpYmIQYBm	9/5/2021 20:49	Thank you so much for sharing learned alot
R_OvSrQNT5vE2Ua6R	9/5/2021 21:30	I think equipment purchase assistance for small businesses is really important. Also not related to this exactly but towns like Eugene need to stop allowing healthy trees to be cut down. Also it seems that usable buildings are allowed to be demolished to building apartments. Seems so wasteful. Institutions are short sighted.
R_5zQWU4Q4mTaId1v	9/5/2021 8:58	Thanks for this vital research.
R_3RrzKSqJAWASVPx	9/6/2021 0:52	In general I am in favor of caps but not so much the trade portions. I can see big business who is polluting the most affording the extra permits to allow them to continue business as usual.
R_3sBsskYLokFTnru	9/6/2021 11:03	No feedback at this time
R_w1NRVJLsxkga0gx	9/6/2021 12:32	It was great
R_1pA8ZoTe4CtgilE	9/6/2021 14:10	Good survey
R_yD6H7PA8coV6uU9	9/6/2021 15:05	Thank you for the information
R_VOspZbegC8uQWfD	9/6/2021 17:10	Thank you
R_3PHPv1C3YX9HqvL	9/6/2021 17:43	N/A
R_6X8JGrU2ko6qcrD	9/6/2021 19:24	Good stuff bud
R_sETUVATtYiL7f57	9/6/2021 7:01	C & T is another government scam to fleece more revenue $$ to alleviate their addiction to tax & spend stream. Special interests have lobbied our elected officials into their pocket. The âScam-demicâ was planned and is rolling along.
R_2bT9RprI1Db9roi	9/6/2021 9:00	I am very surprised that this survey was the work of only ONE graduate student & ONE professor. This was quite a lengthy & complex series of statements that were WELL ILLUSTRATED and with copyright credits for every photograph! The optional pop-up explanations were very helpful to me, particularly since I had not heard of some of these nuances of CAP & TRADE before today. I felt that the competitive plans that I was asked to review & vote on were NOT trying to shift my opinion, but were rather objective, each in their own standing! I personally have previous experience, decades ago, in survey design, implementing surveys & survey tabulation, so I have a fair understanding of what sort of work the Economics student & professor still have waiting ahead of them, as you collect response from this very interesting survey. I wish you a lot of success on this project, and I honestly hope that Oregon"s legislators of BOTH political parties read & absorb the results of this survey. [...self identification omitted...]
R_2lOJCSp3OVluzrr	9/7/2021 14:13	I"m glad I could do something that might be useful in the decision making
R_2vZCnNj2UzXj5zP	9/7/2021 16:06	Survey worked great very enjoyable to fill out and complete.
R_3qsMa7ckN5ffKrD	9/7/2021 7:41	Carbon cap sounds like a great idea. Trying to implement it would be had to do.
R_3m7CuDV0LNlwAfS	9/8/2021 16:39	Thank you for taking action. Any of these plans is better than none. One wonders about the morality of allowing an undereducated electorate vote on the existance of the species.
R_2qsFN8eN4CXd432	9/8/2021 21:44	Fun time with the Surveys
R_2B8VbeyewZu3mpR	9/9/2021 10:00	Liked how much info there was to learn
R_2PnStK3FSehCubT	9/9/2021 10:59	wow - I sure learned - and understood a lot of information. This will be a VERY hard problem to solve - and it will sure NOT be able to please everyone!!!

G Appendix: Descriptive Statistics for Some Basic Variable Relationships

Given the randomizations of the attributes of the cap-and-trade programs offered to different respondents, it is informative to look at the joint distributions among a variety of respondent characteristics and some key relationships between these and the way they interact with the survey.

G.1 Relationships among respondent characteristics and attitudes

Figure G1



G.2 Share of "YES" votes for program by category of respondent

Figure G2: categories are shifted

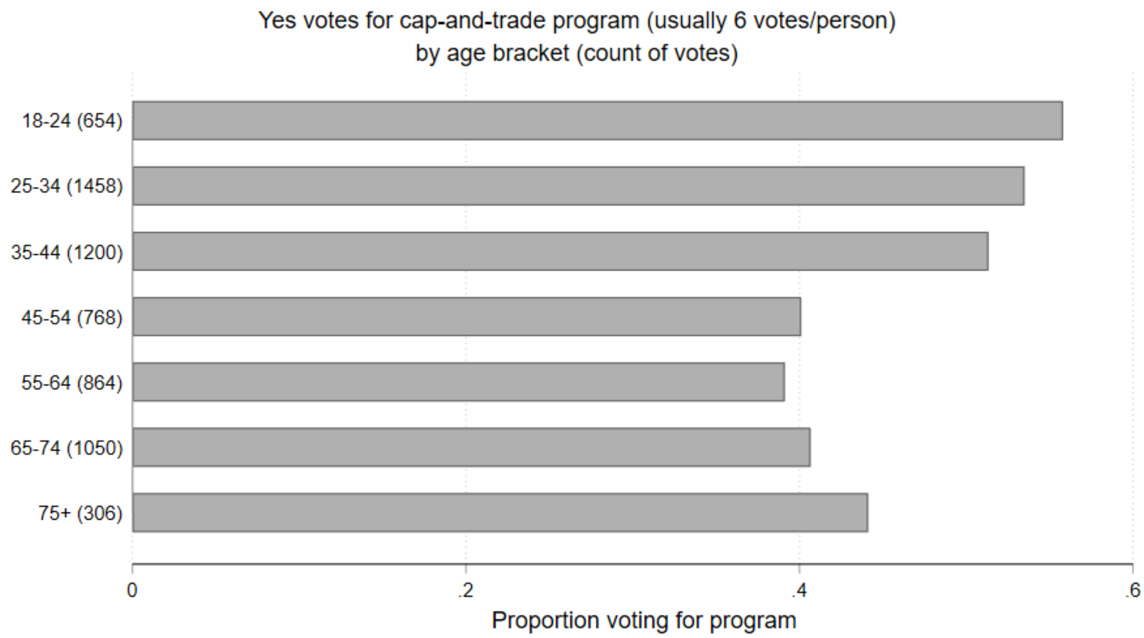


Figure G3

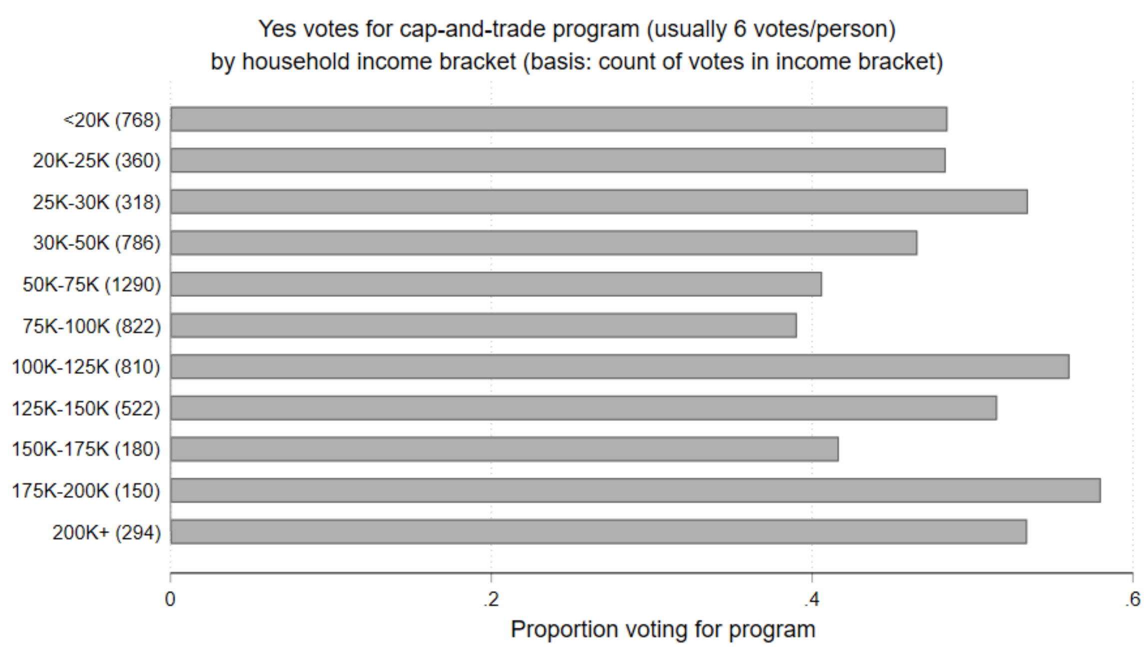


Figure G4

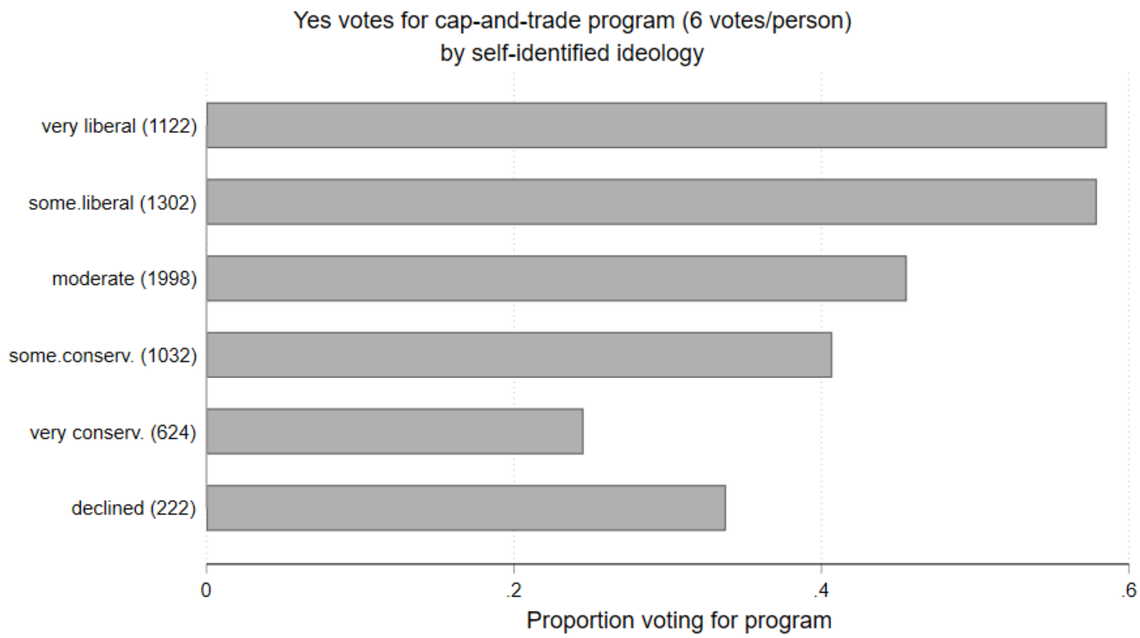


Figure G5

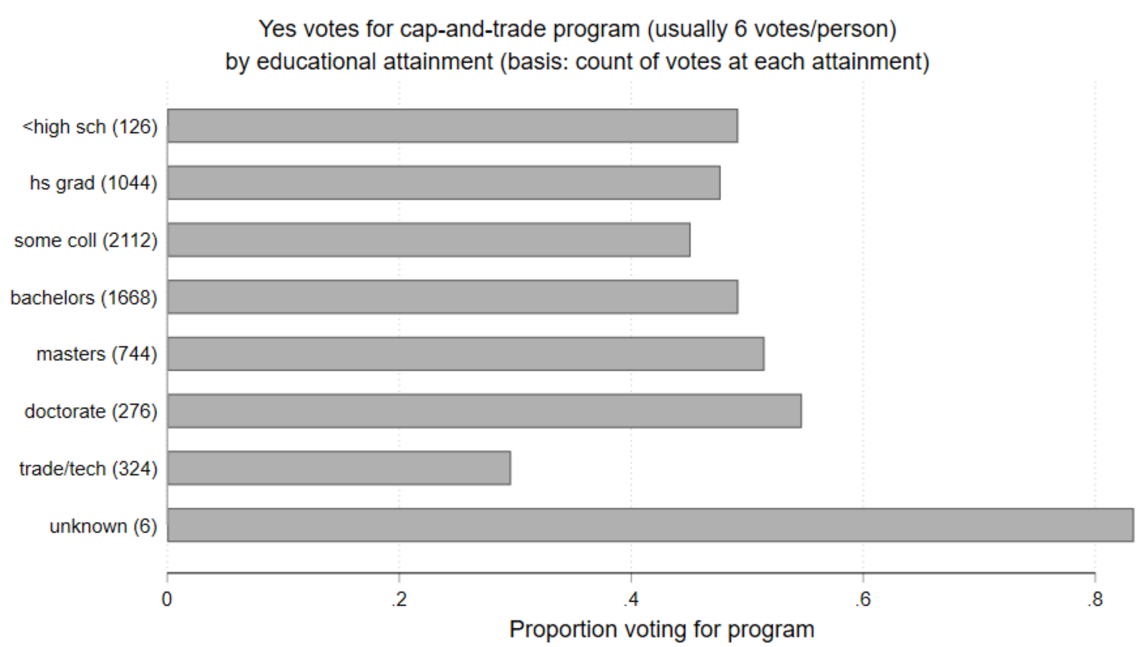


Figure G6

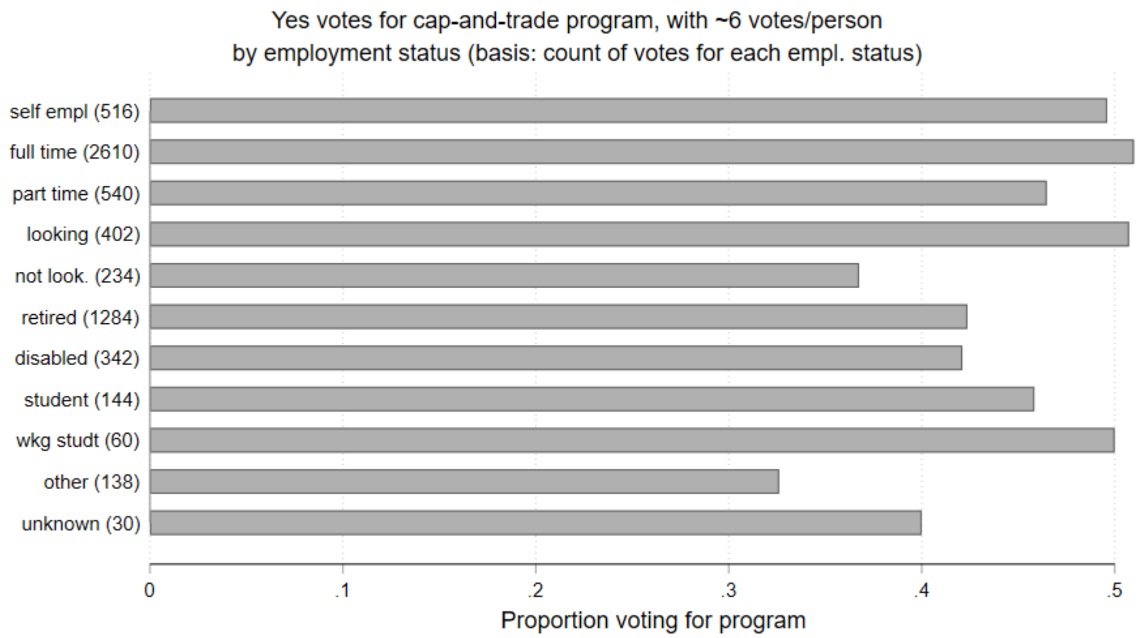


Figure G7

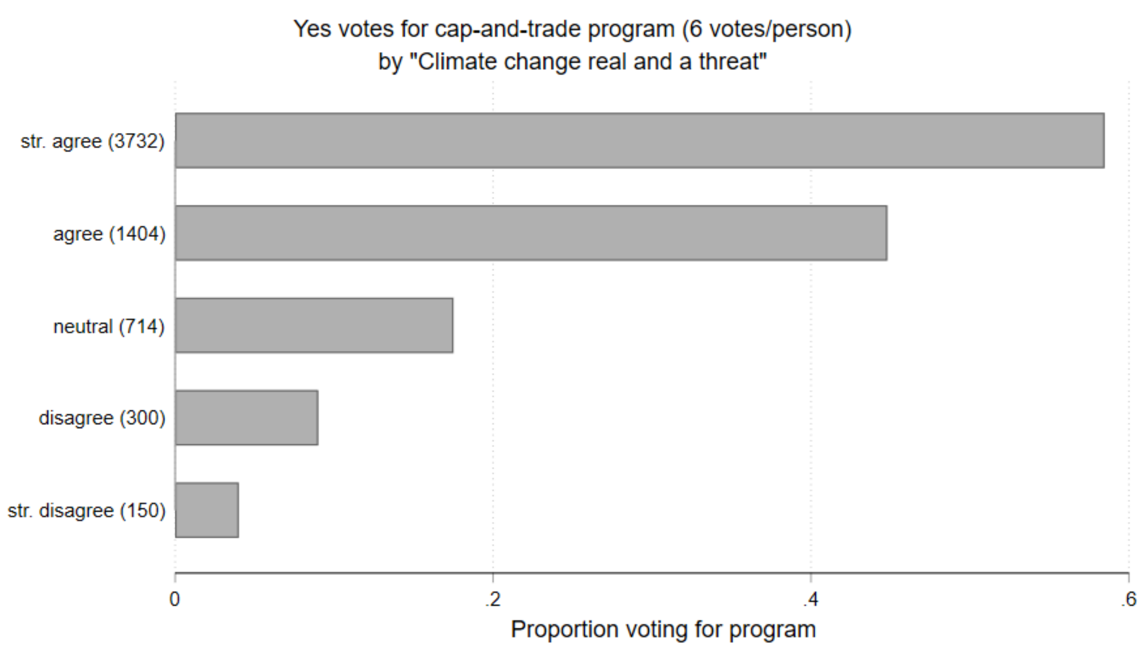


Figure G8

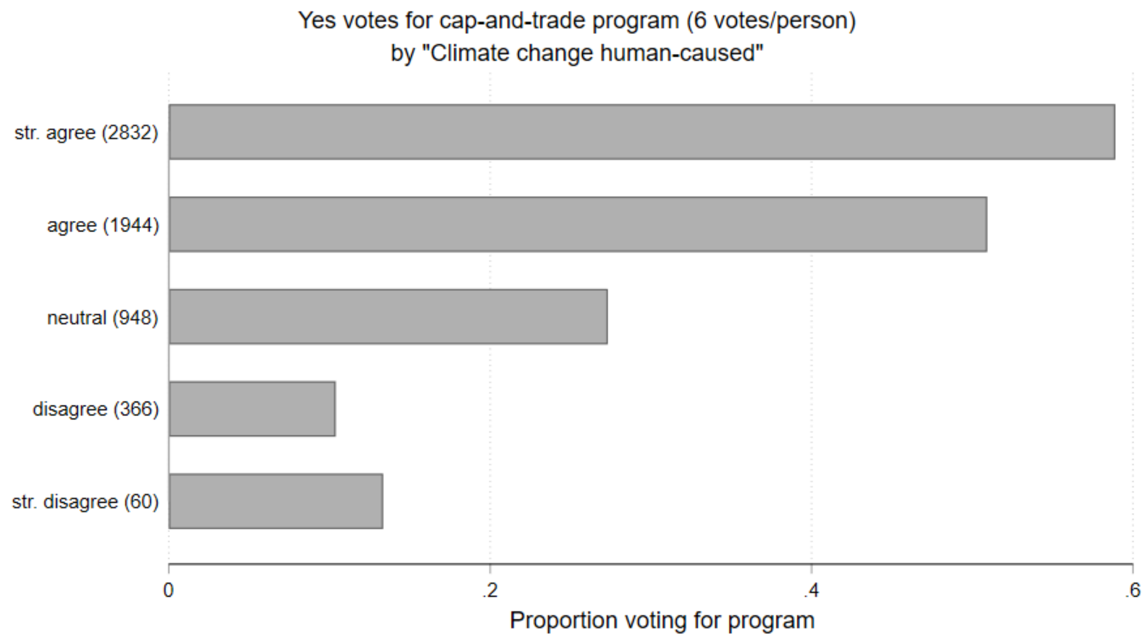


Figure G9

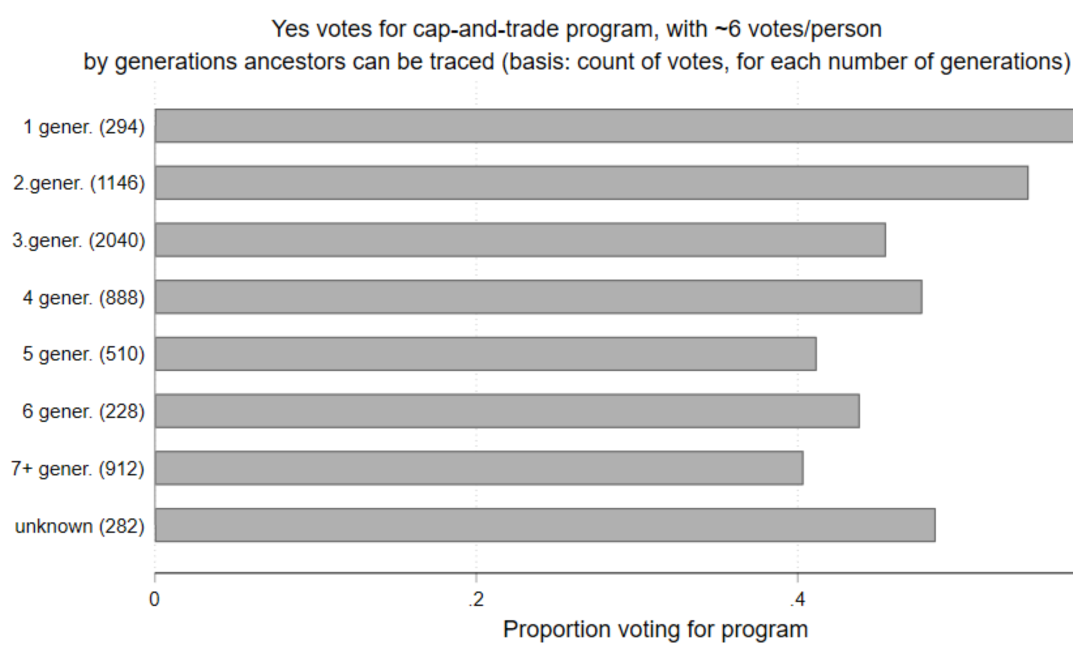


Figure G10

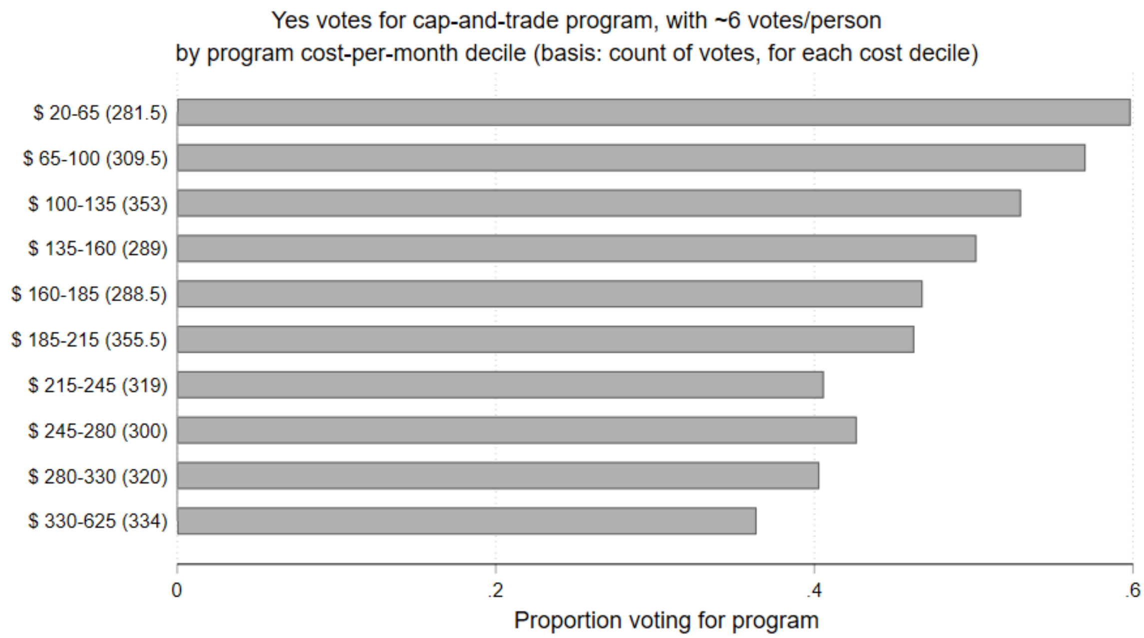
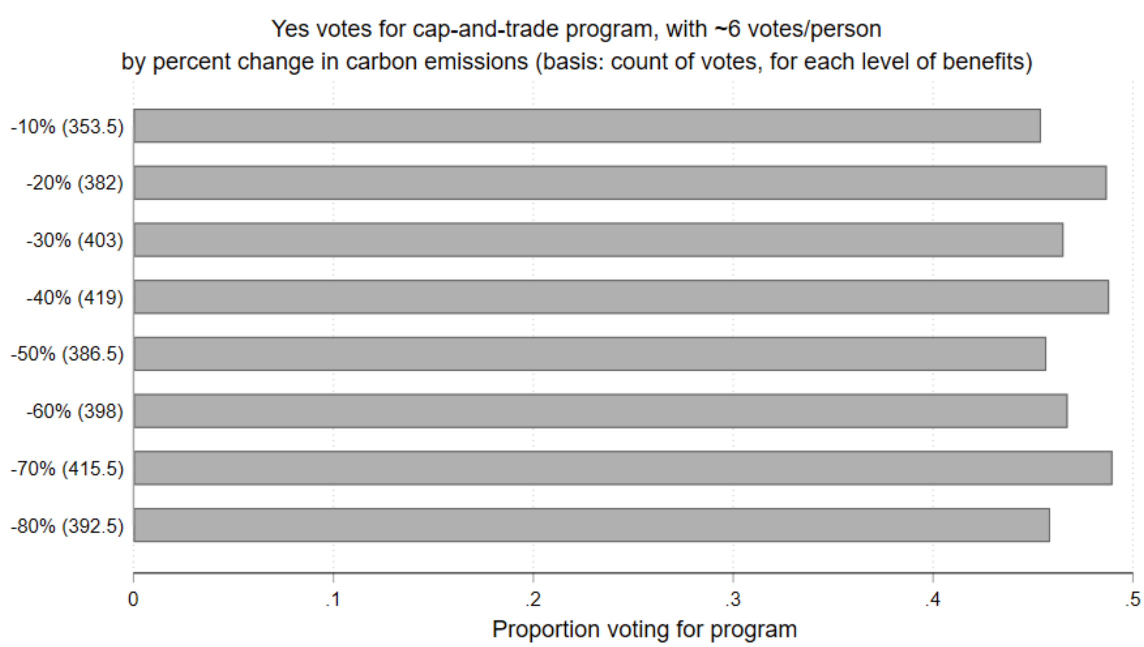


Figure G11

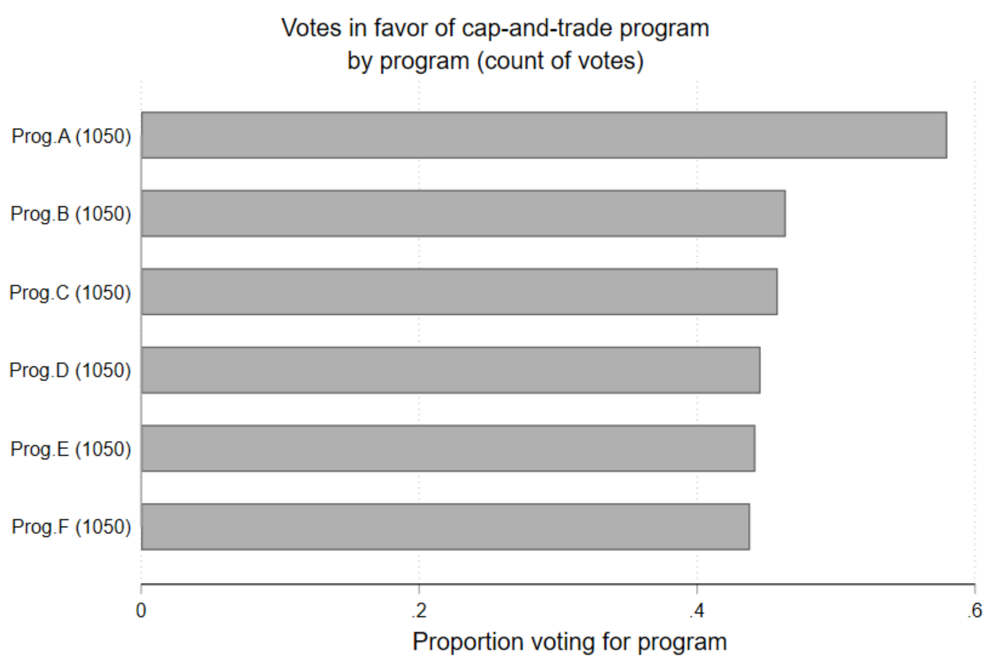


G.3 Share of "YES" votes by aspect of choice task

Recall that each respondent is asked to consider six different carbon cap-and-trade programs, Program A through Program F. All choice experiments that offer respondents more than just a single choice must contend with what happens as the respondent works through a sequence of choices. The attributes of Program A, unique to each individual, are incorporated into that individual's tutorial material as we explain the different groups of program features. Despite this, respondents may require a "burn-in" period as they get their bearings with these choice tasks (and potentially develop some personal choice heuristics). As the respondent works through the six choice tasks, they may also begin to experience fatigue, which may deplete their cognitive resources. Sometimes, respondents may rally as they realize they have reached the final choice task.

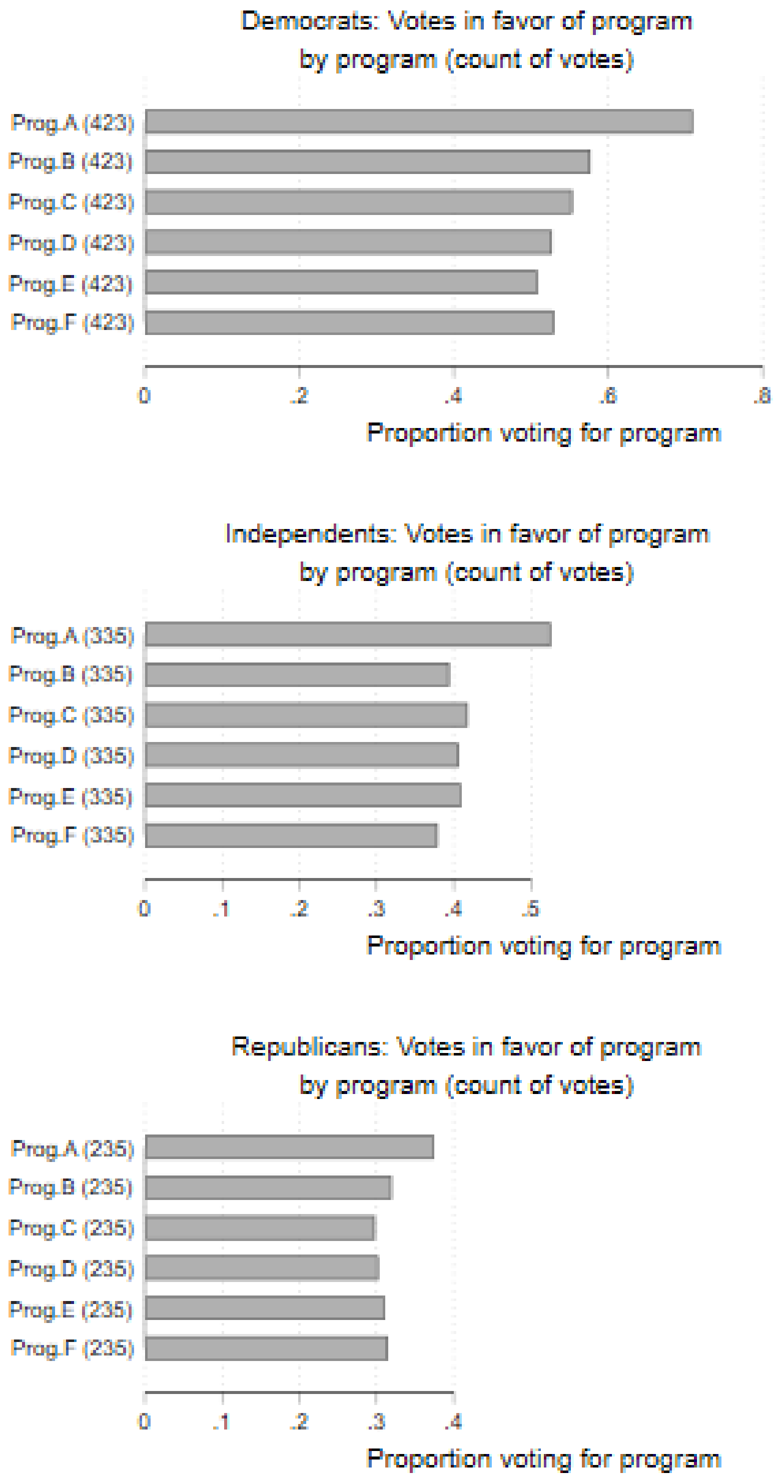
In this section, all of the figures show the progression in the specified variable as the individual works through Programs A through F. All of the attributes are randomized, as explained in Appendix D. Thus it is something that is going on with the respondent's engagement as they work through the six choices that leads to changes in voting patterns, not any systematic difference in the attributes of the cap-and-trade programs they are asked to consider.

Figure G12



Attitudes toward climate change policy are known to differ substantially along partisan lines. Thus we break out these voting patterns across choice tasks by party affiliation.

Figure G13



Democrats: Votes in favor of program
by program (count of votes)
Prog.A (423)
Prog.B (423)
Prog.C (423)
Prog.D (423)
Prog.E (423)
Prog.F (423)
0
.2
.4
.6
.8
Proportion voting for program
Independents: Votes in favor of program
by program (count of votes)
Prog.A (335)
Prog.B (335)
Prog.C (335)
Prog.D (335)
Prog.E (335)
Prog.F (335)
0
.1
.2
.3
.4
.5
Proportion voting for program
Republicans: Votes in favor of program
by program (count of votes)
Prog.A (235)
Prog.B (235)
Prog.C (235)
Prog.D (235)
Prog.E (235)
Prog.F (235)
0
.1
.2
.3
.4
Proportion voting for program

Figure G14

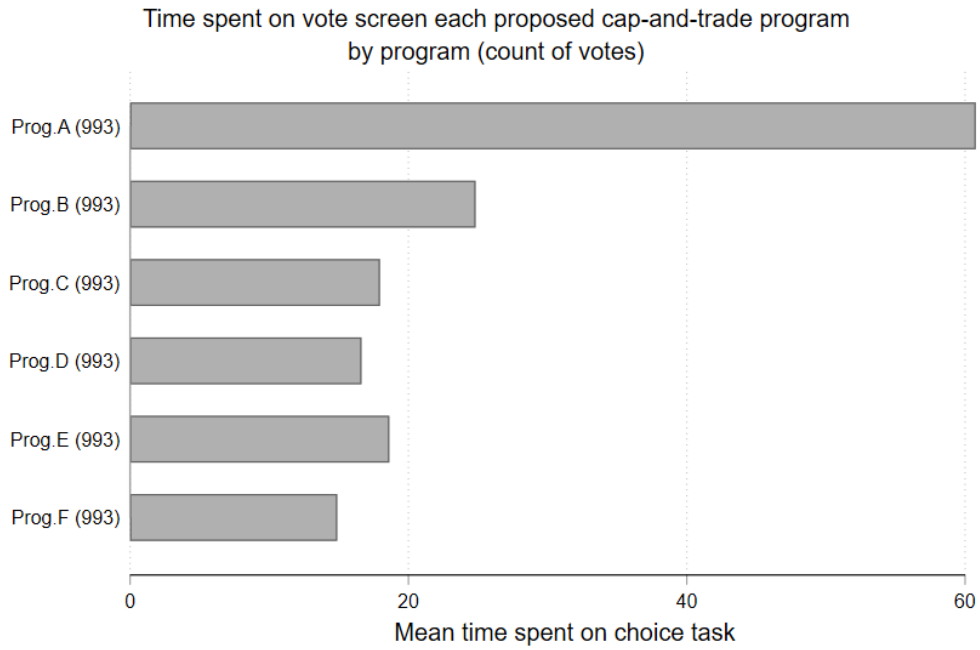


Figure G15

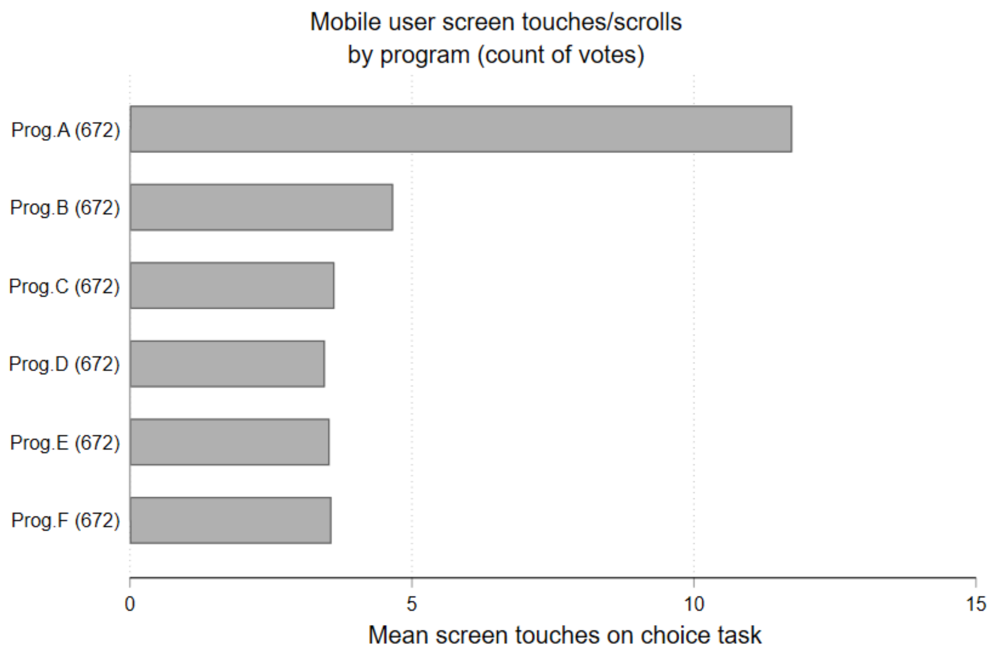
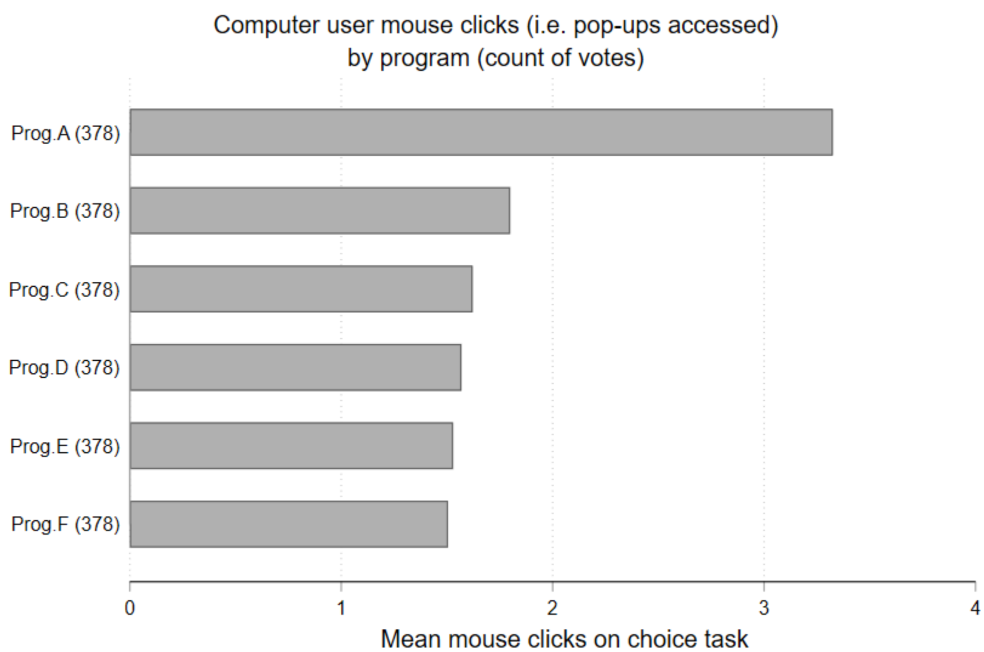


Figure G16



Computer user mouse clicks (i.e. pop-ups accessed)
by program (count of votes)
Prog.A (378)
Prog.B (378)
Prog.C (378)
Prog.D (378)
Prog.E (378)
Prog.F (378)
0
1
2
3
4
Mean mouse clicks on choice task

G.4 Identical distributions of program attributes across tasks?

Figure G17

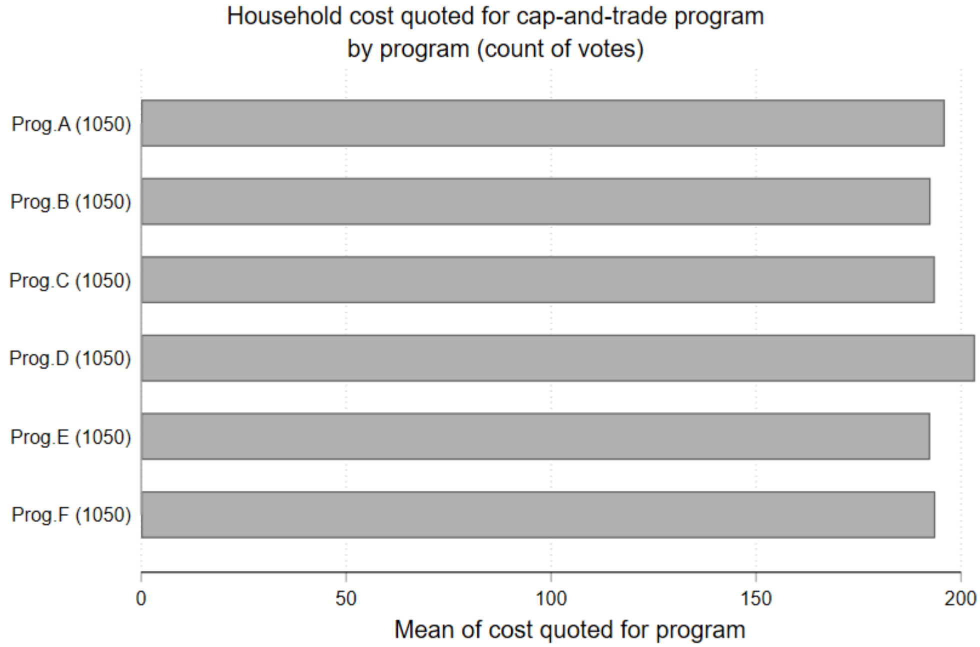


Figure G18

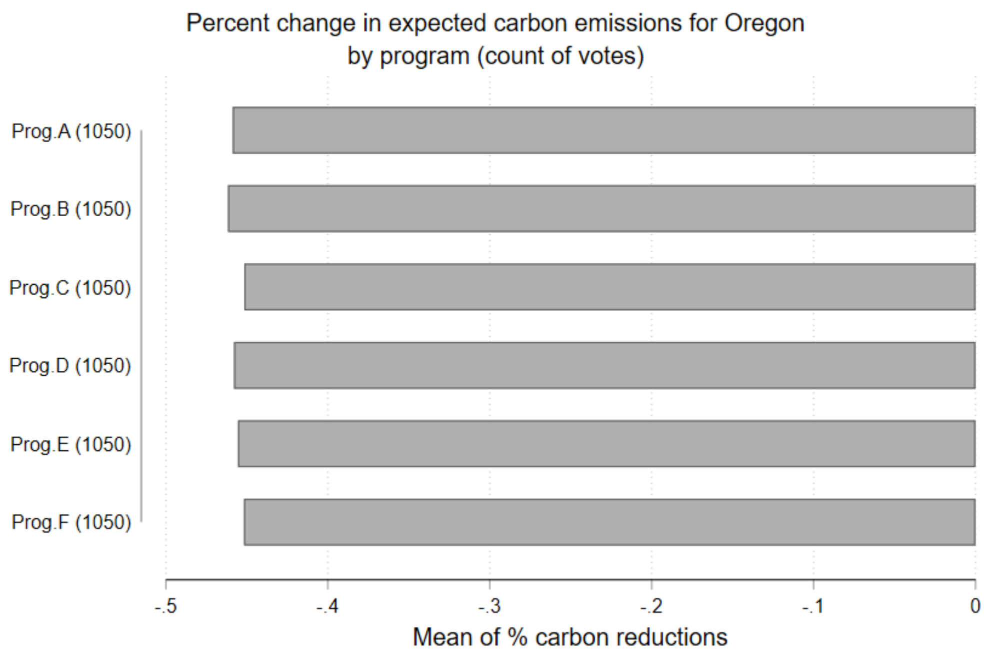


Figure G19

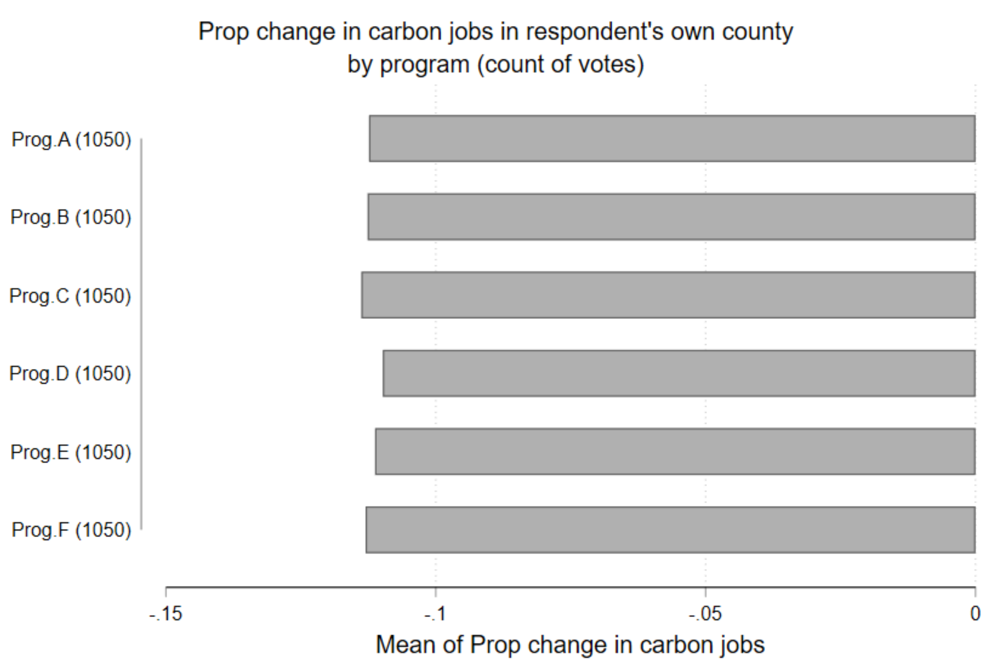


Figure G20

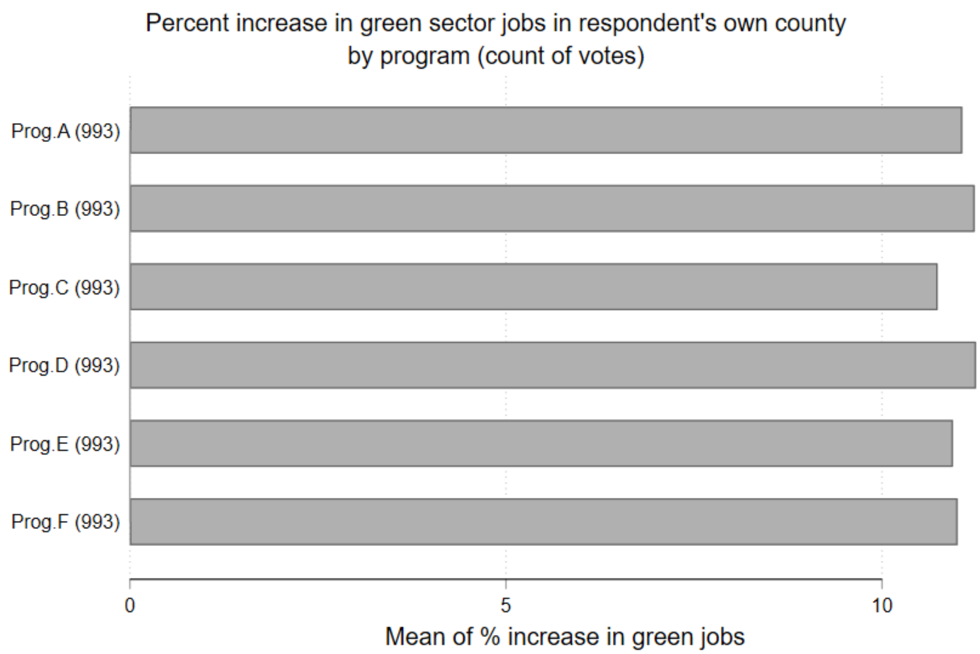


Figure G21

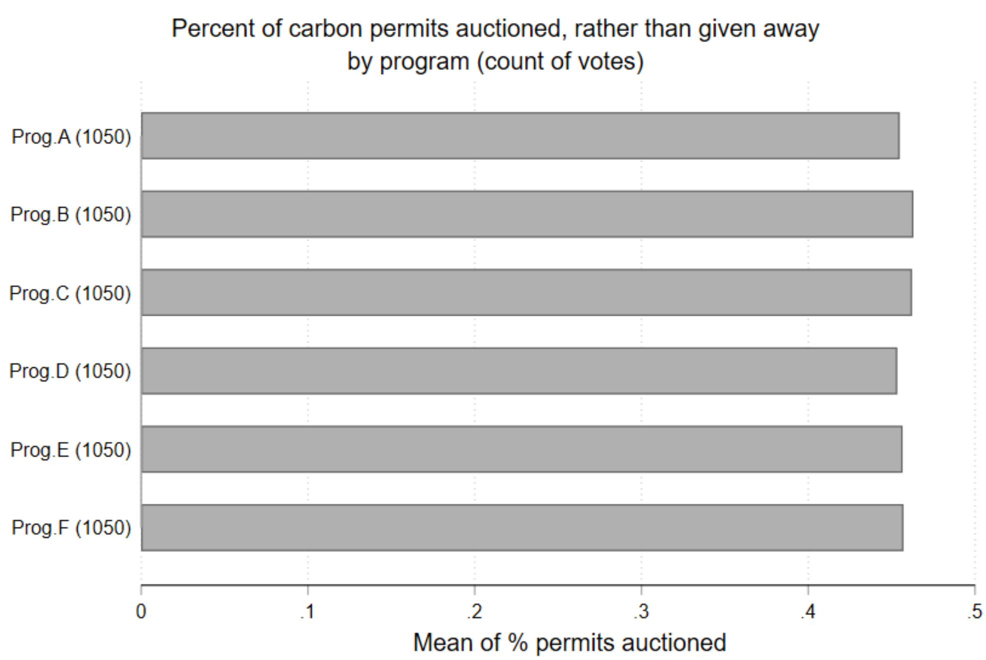


Figure G22

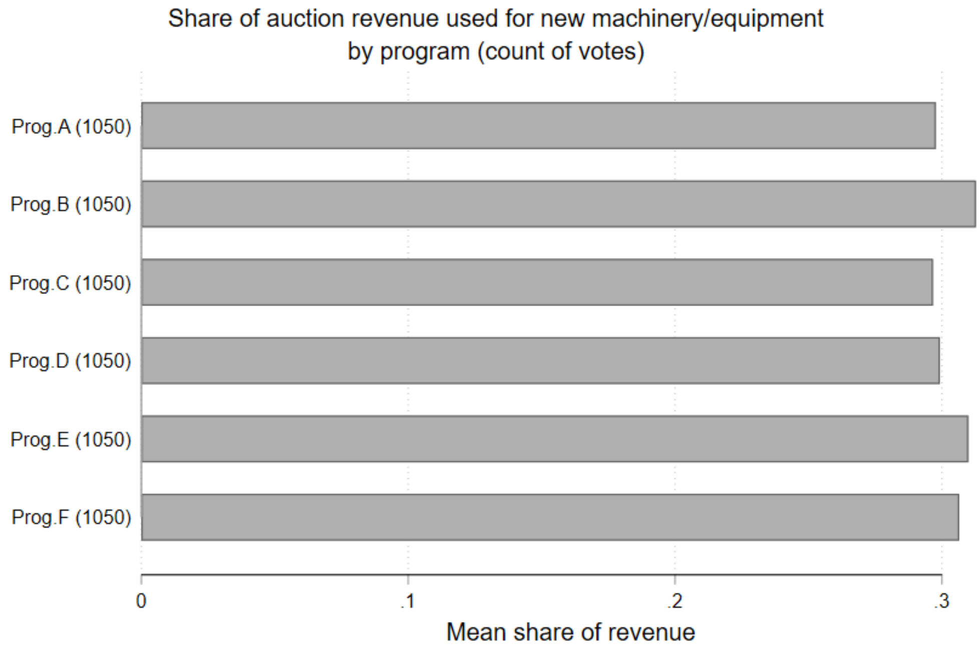


Figure G23

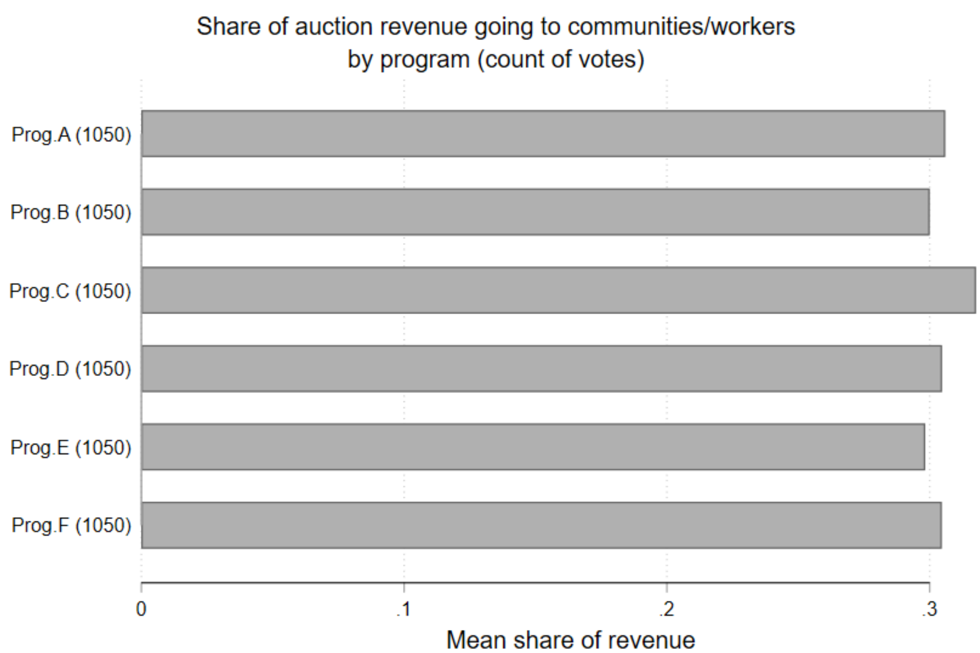


Figure G24

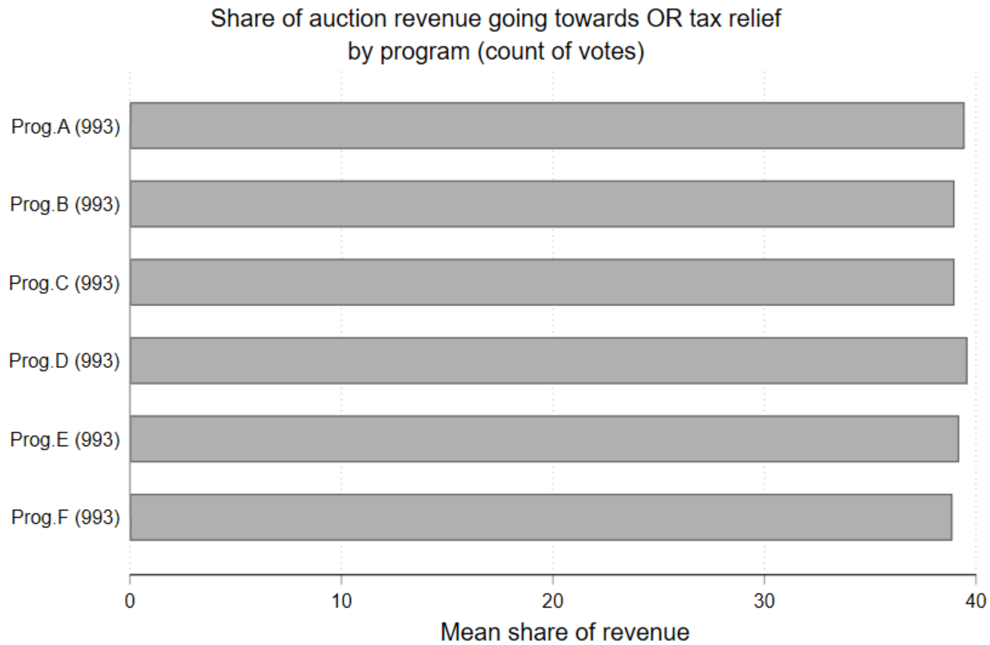
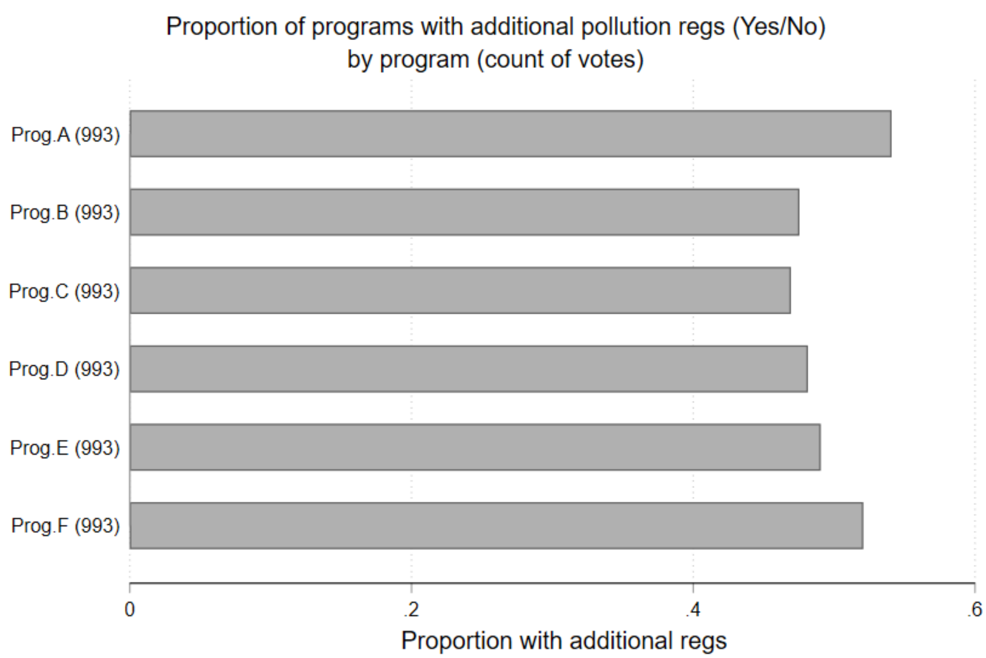


Figure G25



G.5 Votes as a function of non-mutually exclusive categories

Figure G26

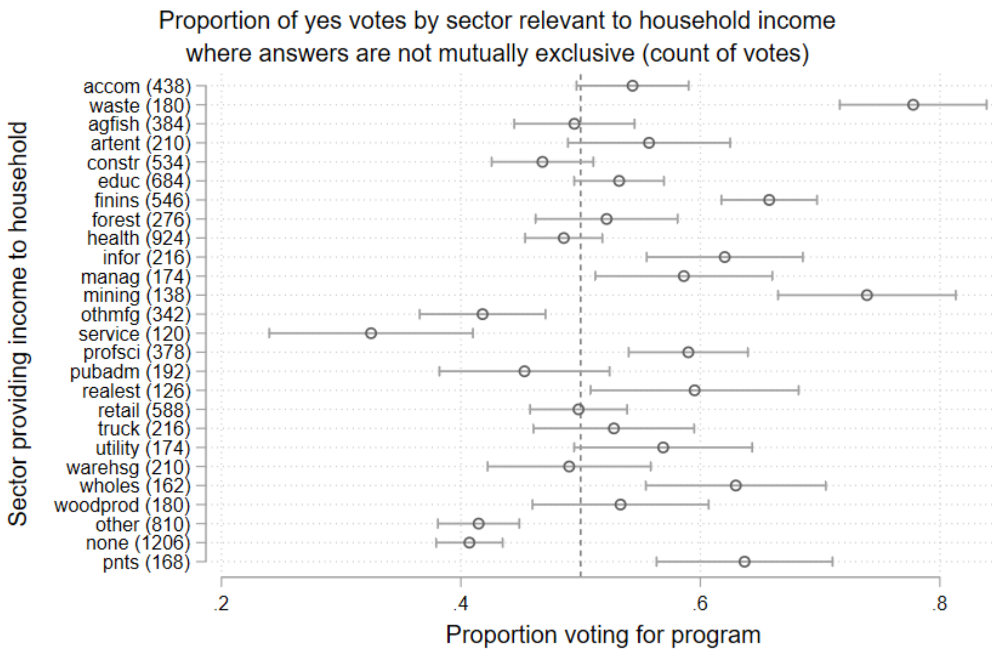


Figure G27

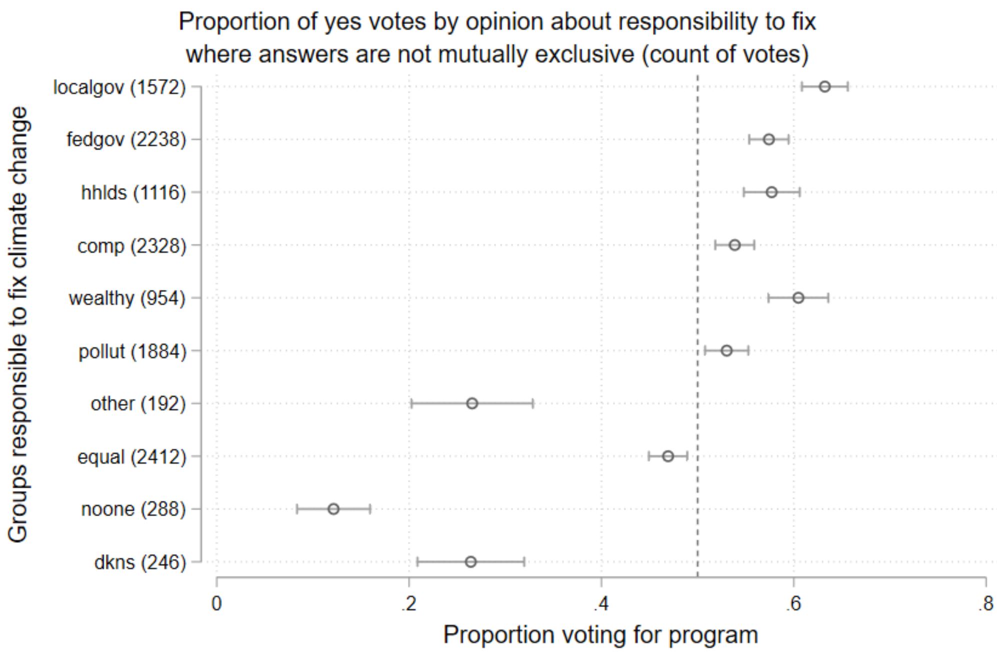


Figure G28

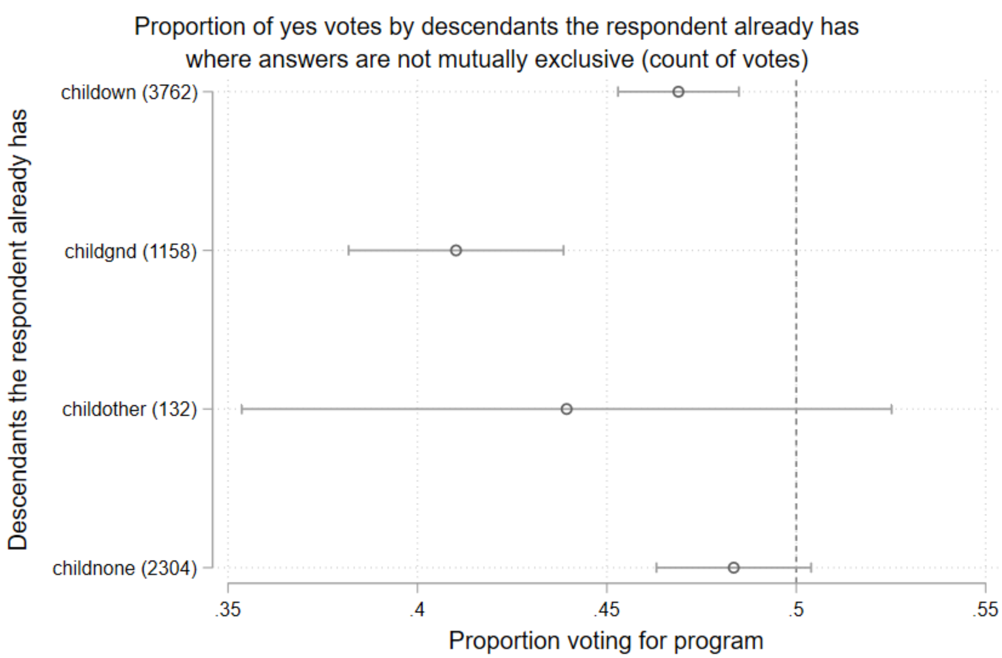
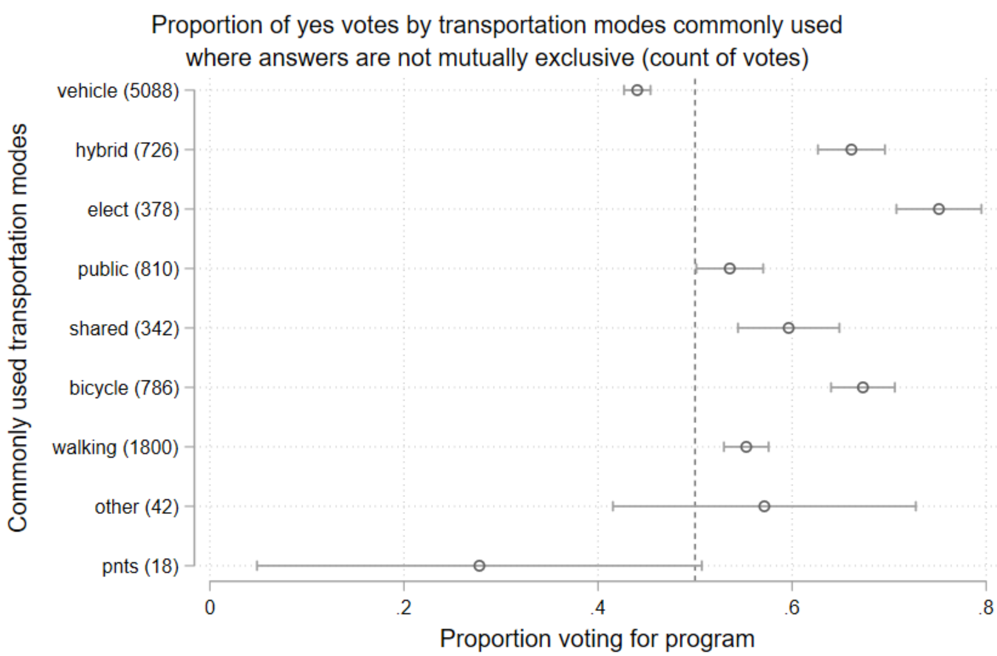


Figure G29


Proportion of yes votes by transportation modes commonly used
where answers are not mutually exclusive (count of votes)
vehicle (5088)
hybrid (726)
elect (378)
public (810)
shared (342)
bicycle (786)
walking (1800)
other (42)
pnts (18)
Commonly used transportation modes
0
.2
.4
.6
.8
Proportion voting for program

H Appendix: Selection Model and Selection Correction

H.1 Geography for Population and Sample

First, we can illustrate the basic spatial representativeness of our sample by showing maps that depict the county-level concentrations of population in Oregon, in Figure H1 and the corresponding county-level concentration of observations in our estimating sample, in Figure H2. The roughly proportional relationship across Oregon counties, between numbers of respondents in the estimating sample and numbers of people in the population, is reflected in Figure H3.

For this paper, we correct for sample selection in terms of the willingness of individuals to complete a carbon cap-and-trade survey. However, another potential type of sample selection remains unavoidable: people who are willing to take an (internet) survey upon an invitation from Qualtrics may not be representative of the general population. While this other form of sample selection is perhaps of lesser concern, it exists nonetheless for every consumer research panel and is difficult to address.

H.2 Variable Selection for Sample-Selection Model

H.2.1 Inventory of candidate explanatory variables

To correct for sample selection, we use a probit model to estimate an invited participants propensity to complete the survey. We have relatively little information for every invited participant beyond their age, sex, race and income, but we also elicited the ZIP code where they live (prior to these potential respondents learning the topic of our survey). Thus, for a large share of these invited participants, we can merge in ZIP-code-level neighborhood characteristics as potential determinants of their interest in participating in a survey about climate policy.

When creating the zip-code-level profiles, we cast a wide net to find candidate explanatory variables. The external data sets we employed to create profiles of each respondent's neighborhood include: the American Community Survey 5-year ZCTA-level data (2014-2019), the MIT Election Data and Science Lab's County Presidential Election Returns (2020), Oregon State Office Returns for 2016 state legislative district votes (by major party), drought data from National Drought Mitigation Center, and wildfire data from Wildland Fire Decision Support System. We create population proportion sociodemographics (e.g. share of the population for each ZIP code that has access to the internet) as well as a number of climate-related statistics for each zip code (e.g. Drought Monitor rating, or distance to the nearest wildfire in 2020). The zip-code-level profiles are constructed to capture political ideologies, salience of climate change, and other sociodemographics that we hypothesize may impact each potential respondent's propensity to continue with the survey, to completion, after learning its topic.

It is not feasible to include, simultaneously, the full set of variables (self-reported screening sociodemographic variables from the survey and all the available zip code variables, and their interactions) in a single probit model. This is far too large a list of variables, given that we have only 1630 invited participants and 1050 completed survey questionnaires. Thus we resort to LASSO methods, in R, to pair down the list of potentially useful explanatory variables. We use all of our available data from panelist profiles (gender, age, race, and income bracket) as well as all our assembled geo-coded data linked to each invited participant by their zip code (where zip code is available), as potential regressors for our selection model.[67]

If a respondent drops out of the survey at any point after the consent page, they are considered non-respondents and get the value of 0 for the indicator variable *Got to end of survey*. In addition to being zero for cases of attrition, the variable *Got to end of survey* will take on the value of 0 if the survey response is deemed to be of insufficient quality (e.g. where the respondent gave nonsense answers to questions that required a typed

[67]We conduct our LASSO estimation using the "glmnet" package as implemented in R.[68].

Figure H1

County population (1,000s)

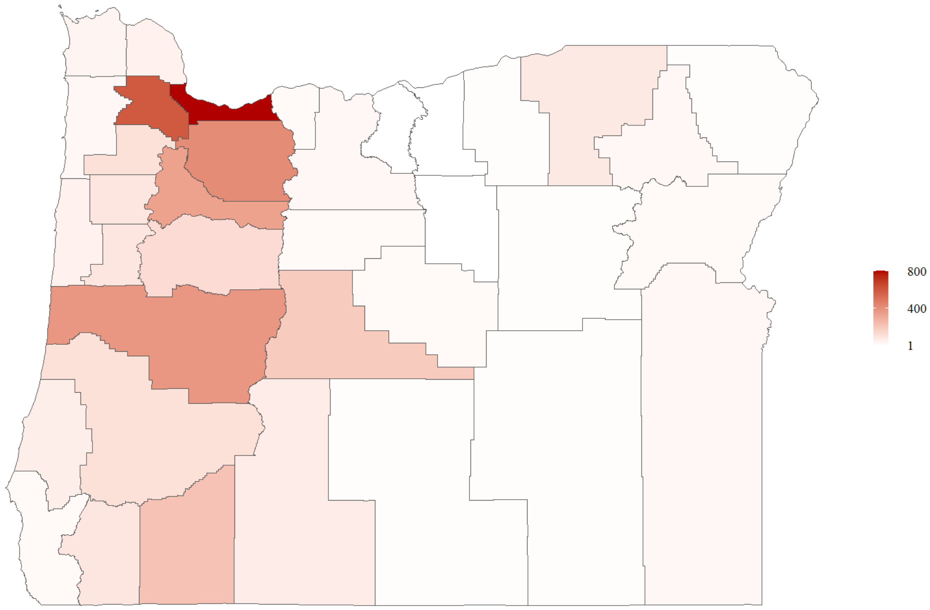


Figure H2

Respondents per county

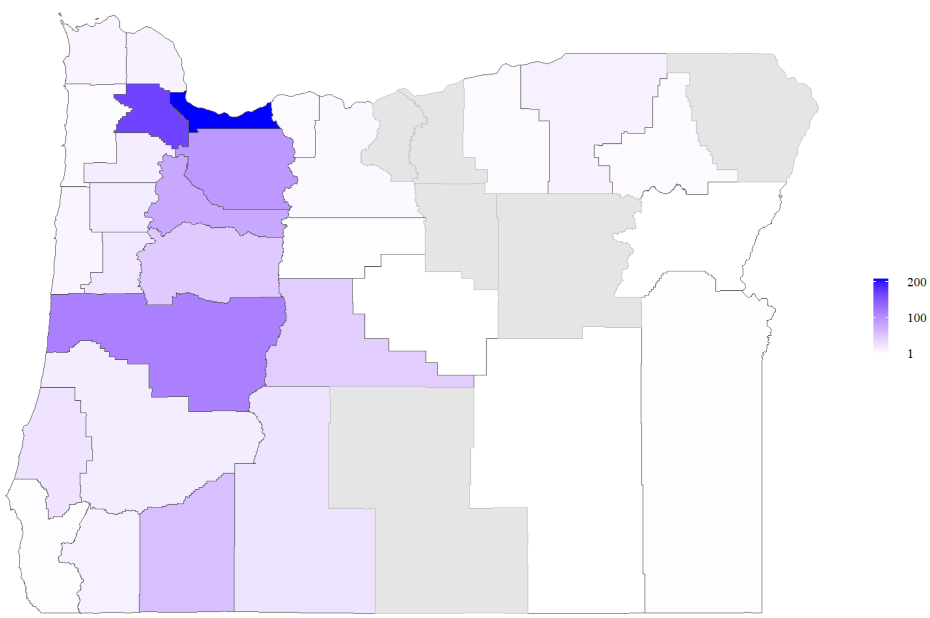
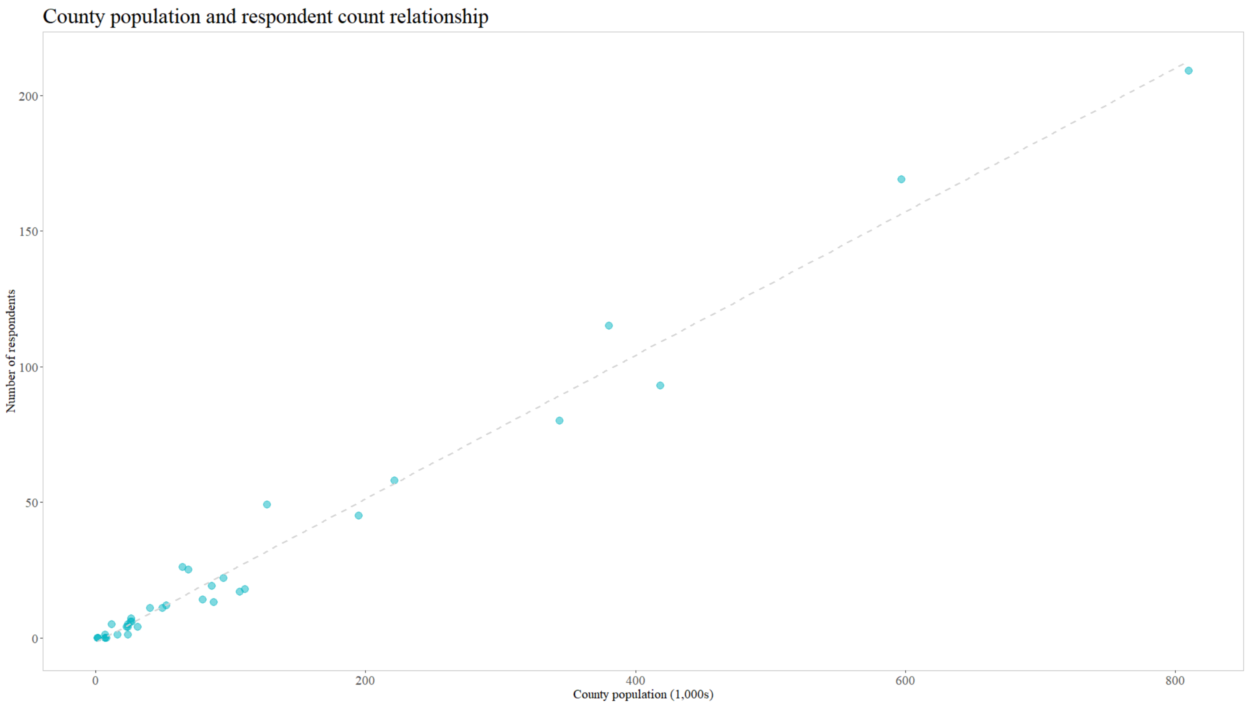


Figure H3



response, or when the total time to complete the survey was too little to have permitted anyone to have read the questions with sufficient attention to provide an informed response (i.e. less than 7.5 minutes to complete the survey).

Complete, the dependent variable for the LASSO equation, is a binary indicator variable that takes on the value of 0 if the respondent does not complete the survey or if they complete the survey in less than 7.5 minutes. Our response rate, $\frac{complete\ surveys}{total\ surveys}$, is 64%.[69]

Table H1 shows the descriptive statistics for the available explanatory variables that LASSO methods determine to be relevant in predicting people's propensities to respond to the survey. The variables shown were retained by LASSO estimation either individually or as part of a pairwise interaction. The first row, *Outcome: 1=Got to the end of the survey*, is the response rate for this survey. This relatively high response rate, about 65%, may reflect Oregonians' strong feelings (both positive and negative) toward climate policy. Rows *1=Gender female* through *1=Used a mobile device* represent information collected by the survey for all individuals who make it through the screening process. The variables in the subsequent rows are for the respondent's ZIP code (Census ZCTA), county, or other geographic proximity.

[69]The average completion time in the soft launch of the survey was 15 minutes. Anyone who completed the survey in less than half of the average completion time (i.e. 7.5 minutes) was determined a "speeder" and their response was considered invalid on the grounds that they were not providing thoughtful responses.

Table H1: Descriptive statistics: individual explanatory variables used in response/non-response models (retained by LASSO estimation either individually or as part of a pairwise interaction term)

	mean	sd
Outcome: 1=Got to end of survey	0.644	0.479
1=Used a mobile device	0.678	0.467
1=Used iPhone OS	0.335	0.472
1=Used Windows OS	0.230	0.421
1=Started survey on a Tue	0.111	0.314
1=Start: hour end. at 02:00	0.020	0.141
1=Start: hour end. at 09:00	0.037	0.190
1=Own age:18 to 24 yrs	0.129	0.336
1=Own age:25 to 34 yrs	0.247	0.431
1=Own age:75 yrs and up	0.058	0.234
1=Own race:Black	0.041	0.199
1=Own race:Asian	0.058	0.234
1=Own race:Amer. Indian	0.029	0.169
1=Own race:Other	0.037	0.190
1=Own hhld inc:lt 20K	0.142	0.349
1=Own hhld inc:125-150K	0.070	0.255
1=Own hhld inc:220K up	0.040	0.197
ZCTA pr:Native Hawaiian/Pacific Islander	0.004	0.005
ZCTA pr:Two or more races	0.079	0.027
ZCTA pr:Widowed	0.049	0.018
ZCTA pr:Heat=Solar energy	0.001	0.002
ZCTA pr:Commute=60 min or more	0.057	0.034
Nearest wildfire 2020, sqmi area	71.629	118.484
Wildfire w/in 20mi zip centr; 2011 sqmi	1.472	12.853
Wildfire w/in 50mi zip centr; 2015 sqmi	26.363	100.578
Cnty pr:Native; born in state of residence	0.457	0.056
Cnty pr:Indus=Accomm./food services	0.074	0.015
Cnty pr:Heat=Fuel oil kero etc.	0.015	0.014
County COVID cases/50K Jun'21	89.665	37.424
County COVID deaths/50K Jun'21	1.262	0.939
Observations	1630	

H.2.2 Probit selection model

LASSO methods are used to identify a set of regressors that have good out-of-sample predictive ability. We use these variables in a probit model to estimate response propensities for a model that uses the explanatory variables (levels and interactions) that are retained by our LASSO models, where these variables are summarized in Table H1).

H.3 Selection Correction Strategy

Our sample-selection correction method is an ad hoc two-step model that does not attempt to take into account any additional unobserved heterogeneity that may account for non-random selection into the respondent sample. We use an ordinary binary probit specification, with our full sample of 1630 invited participants, to explain whether each invited participant submits a completed survey. The fitted probit "index" (the linear combination of estimated probit parameters and explanatory variables) can be interpreted as a latent respondent characteristic called "propensity to complete this survey." We calculate the fitted completion propensity for every invited participant and calculate the mean fitted response propensity across all of these invitees. We then subtracting this mean from each fitted individual propensity. The "de-meaned response propensity" ($dm:\widehat{RP}_i$)

will therefore be zero among the full set of 1630 invited participants.

Suppose the set of respondents who complete the survey are all as likely to provide a a complete and valid response as the overall pool of invited participants. Then we would expect that the mean response propensity among those who complete the survey would also be zero. However, in this case, the average person contributing a completed survey has a greater response propensity than the average in the pool of invited participants. It is possible that people who are more likely to respond to a survey about cap-and-trade programs for carbon emissions are simultaneously likely to be willing to pay more for these programs. If this is the case, our models will tend to overestimate average WTP in the general population.

If we assume that preferences across cap-and-trade programs can differ systematically according to response propensities, we can simply allow the fitted response propensity to shift each marginal utility parameter in the program choice model.[70] We can then simulate what the preference parameters would have been, had every person among the invited participants been equally likely to complete a survey, with a response propensity equal to the average response propensity among all invited participants. Specifically, we simulate the preference parameters that would obtain if the *demeaned* response propensity for each person in the sample of completed responses had been zero.

Unlike a conventional Heckman two-step correction method, this ad hoc procedure relies upon a wide variety of *observable* characteristics of the set of invited participants (or their neighborhoods) to explain response propensities. Unlike the Heckman correction method, there is no assumption of a truncated bivariate normal joint distribution for errors in the response/non-response model and the outcome model.

The variables selected by LASSO are thus used to estimate the probit model shown in Table H2, and the fitted model is used to calculate a response propensity for each person in the sample of eligible respondents (recall those who cleared the screening process to the point of encountering the subject of the survey are eligible. We subtract from each individual's response propensities our estimate of the mean response propensity in the eligible group. In the Figure H4, we plot the distribution of these response propensities for the entire set of invited participants and for the subset of invitees who completed the survey with responses that passed our basic quality assessment. In the kernel density for each group, we include vertical lines at zero for the "eligible" group, and at the mean (0.073) of the de-meaned response propensity when the sample is limited to just the respondent group.

Table H2: Binary probit parameter estimates for selection model (regressors selected by LASSO methods from a much larger inventory of potential explanatory variable at the individual, ZCTA, and county level; lambda = min)

	Estimate	
Outcome: 1=Got to end of survey		
1=Used a mobile device	-0.147	(0.128)
1=Used iPhone OS	-0.120	(0.0821)
1=Used Windows OS	0.388***	(0.137)
1=Started survey on a Tue	-0.189*	(0.105)
1=Start: hour end. at 02:00	0.448*	(0.254)
1=Start: hour end. at 09:00	0.692***	(0.203)
1=Own age:18 to 24 yrs	-0.291***	(0.106)
1=Own age:25 to 34 yrs	-0.170**	(0.0814)
1=Own age:75 yrs and up	-0.787***	(0.152)

Continued on next page

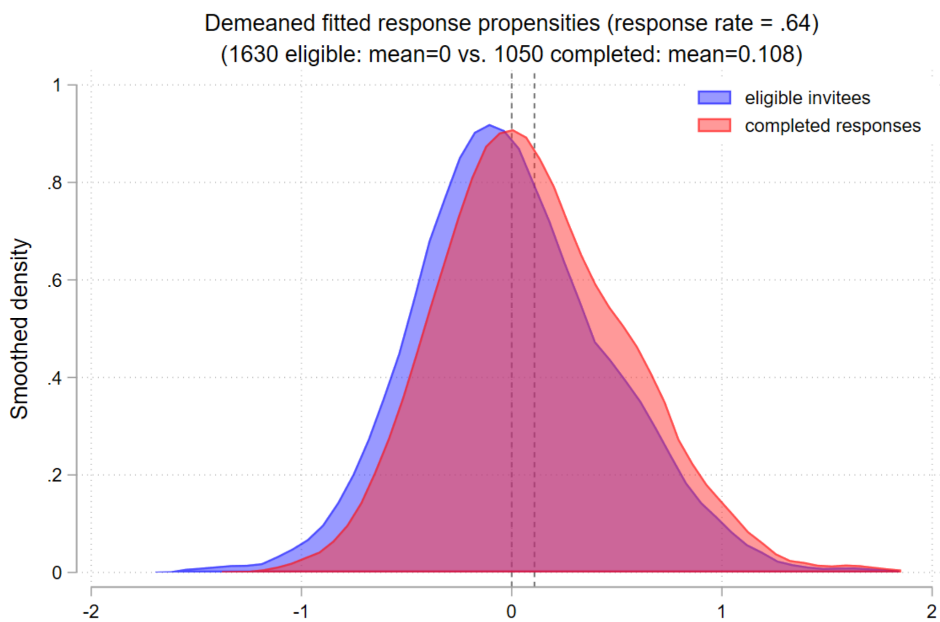
[70] As in two-stage-least-squares estimation using least squares methods, it is important that there be at least some "instruments" for response propensity that do not also enter directly into the utility function being estimated at the core of the analysis.

Table H2 – continued from previous page

1=Own race:Black	-0.234	(0.164)
1=Own race:Asian	-0.397***	(0.139)
1=Own race:Amer. Indian	-0.477**	(0.196)
1=Own race:Other	0.331*	(0.183)
1=Own hhld inc:lt 20K	-0.178*	(0.0979)
1=Own hhld inc:125-150K	0.291**	(0.143)
1=Own hhld inc:220K up	0.277	(0.179)
ZCTA pr:Native Hawaiian/Pacific Islander	-9.131	(6.345)
ZCTA pr:Two or more races	-3.242**	(1.320)
ZCTA pr:Widowed	-4.638**	(2.210)
ZCTA pr:Heat=Solar energy	36.21*	(21.42)
ZCTA pr:Commute=60 min or more	2.506**	(1.106)
Nearest wildfire 2020, sqmi area	0.000185	(0.000339)
Wildfire w/in 20mi zip centr; 2011 sqmi	-0.00396	(0.00294)
Wildfire w/in 50mi zip centr; 2015 sqmi	-0.000403	(0.000361)
Cnty pr:Native; born in state of residence	-0.0716	(0.785)
Cnty pr:Indus=Accomm./food services	-1.606	(2.540)
Cnty pr:Heat=Fuel oil kero etc.	-2.787	(2.787)
County COVID cases/50K Jun'21	0.00132	(0.00114)
County COVID deaths/50K Jun'21	0.113**	(0.0465)
Constant	0.878**	(0.443)
Max. log-likelihood	-973.00	
No. respondents	1630	

Note: Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Figure H4



Demeaned fitted response propensities (response rate = .64)
(1630 eligible: mean=0 vs. 1050 completed: mean=0.108)
Smoothed density
eligible invitees
completed responses
1
.8
.6
.4
.2
0
-2
-1
0
1
2

Table H3: Sample selection correction terms for the models in Table 2 in the body of the paper: Estimated coefficients on all interaction terms of program attributes and de-meaned fitted response propensity (where "dm" = demeaned across all eligible survey invitees).

Model	(1) Homogeneous Clogit	(2) Independent Mixed Logit	(3) Latent Class, demographics		(4) Latent Class, ideology		(5) For transfer (when shifters=0)
			Class 1	Class 2	Class 1	Class 2	
[(Monthly cost) × (dm:$\widehat{RP}$)	0.000378	0.0000441	-0.000931	0.00352	-0.000738	0.00603	0.000360
	(0.000669)	(0.00172)	(0.000971)	(0.00291)	(0.000880)	(0.00423)	(0.000685)
(1=Any program) × (dm:$\widehat{RP}$)	0.596**	0.860	1.350***	0.439	1.309***	0.423	0.651**
	(0.257)	(0.563)	(0.422)	(0.728)	(0.374)	(1.074)	(0.256)
(Prop change in C emissions) × (dm:$\widehat{RP}$)	0.0314	0.235	-0.197	-0.298	0.170	-1.021	0.0878
	(0.308)	(0.541)	(0.497)	(0.941)	(0.438)	(1.318)	(0.311)
(Prop change in carbon jobs) × (dm:$\widehat{RP}$)	0.431	0.914	0.418	1.041	-0.0301	4.435	0.332
	(1.005)	(1.716)	(1.500)	(3.067)	(1.361)	(4.223)	(1.011)
(Prop change in green jobs) × (dm:$\widehat{RP}$)	-3.261***	-3.928*	-3.287	-3.230	-3.161*	-3.014	-3.218***
	(1.073)	(2.029)	(2.049)	(3.186)	(1.621)	(4.299)	(1.086)
(1=New regs other pollut.) × (dm:$\widehat{RP}$)	-0.117	0.142	-0.0386	0.183	-0.0190	0.218	-0.109
	(0.121)	(0.214)	(0.184)	(0.348)	(0.168)	(0.490)	(0.122)
(Share of permits auctioned) × (dm:$\widehat{RP}$)	-0.372	-0.781*	-0.389	-0.595	-0.512	0.228	-0.349
	(0.271)	(0.447)	(0.408)	(0.806)	(0.371)	(1.196)	(0.275)
(Share of rev. for equip.) × (dm:$\widehat{RP}$)	-0.00850	-0.0835	-0.370	-0.0649	-0.289	-0.686	-0.0195
	(0.294)	(0.491)	(0.438)	(0.888)	(0.403)	(1.206)	(0.294)
(Share of rev. to workers) × (dm:$\widehat{RP}$)	-0.0448	0.0873	-0.105	-0.264	-0.165	-1.504	-0.0536
	(0.294)	(0.549)	(0.471)	(0.842)	(0.412)	(1.241)	(0.295)

Standard errors in parentheses.

I Appendix: Processing the 2021 Yale Climate Map data, and its relationship to COVID-19 case rates

I.1 Reducing the dimensionality of the array of 2021 Yale Climate Map opinions

Table I1 lists the variables available for 2021 in the Yale Climate Map database. We have systematized the variable names and shortened the descriptions, to facilitate labeling during our analysis. In the original data, these opinions are elicited using a five-point Likert scale. The two lowest categories and the two highest categories are combined, leaving a "neutral" middle category. Using the techniques described in Howe et al. (2015) and Marlon et al. (2022), these opinions in a series of representative national surveys are modeled as a function of a variety of sociodemographic, geographic, and political variables available at the county level, and these models are then used to predict the likely population proportions of individuals with each opinion category for all U.S. counties.

Table I1: For comparison, different implications of estimated utility parameters across specifications

affweathersup = 2021:agree that GW is affecting the weather in the US
affweatheropp = 2021:disagree that GW is affecting the weather in the US
citizenssup = 2021:think citizens themselves should be doing more to address GW
citizensopp = 2021:think citizens themselves should be doing less to address GW
CO2limitssup = 2021:support setting strict limits on existing coal-fire power plants
CO2limitsopp = 2021:oppose setting strict limits on existing coal-fire power plants
congresssup = 2021:think Congress should be doing more to address GW
congressopp = 2021:think Congress should be doing less to address GW
consensussup = 2021:believe that most scientists think GW is happening
consensusopp = 2021:believe there is a lot of disagreement among scientists about GW
corporsup = 2021:think corporations and industy should be doing more to address GW
corporopp = 2021:think corporations and industy should be doing less to address GW
devharmsup = 2021:think GW will harm people in developing countries substantially
devharmopp = 2021:think GW will harm people in developing countries minimally

Continued on next page

Table I1 – continued from previous page

discusssup = 2021:discuss GW occasionally or often with friends and family
discussopp = 2021:discuss GW rarely or never with friends and family
drillANWRsup = 2021:support drilling for oil in the Arctic National Wildlife Refuge
drillANWRopp = 2021:oppose drilling for oil in the Arctic National Wildlife Refuge
drilloffshsup = 2021:support expanding offshore drilling for oil and natural gas
drilloffshopp = 2021:oppose expanding offshore drilling for oil and natural gas
expsup = 2021:agree they have personally experienced effects of GW
expopp = 2021:disagree they have personally experienced effects of GW
fundrenewsup = 2021:support funding research into renewable energy sources
fundrenewopp = 2021:oppose funding research into renewable energy sources
futuregensup = 2021:think GW will harm future generations substantially
futuregenopp = 2021:think GW will harm future generations minimally
governorsup = 2021:think their governor should be doing more to address GW
governoropp = 2021:think their governor should be doing less to address GW
happeningsup = 2021:think that GW is happening
happeningopp = 2021:do not think that GW is happening
harmplantssup = 2021:think GW will harm plants and animal species substantially
harmplantsopp = 2021:think GW will harm plants and animal species minimally
harmUSsup = 2021:think GW will harm people in the US substantially
harmUSopp = 2021:think GW will harm people in the US minimally
humansup = 2021:think that GW is caused mostly by human activities
humanopp = 2021:think GW is caused mostly by natural environmental changes
localoffisup = 2021:think their local officials should do more to address GW
localoffiopp = 2021:think their local officials should do less to address GW
mediaweeklysup = 2021:hear about GW in the media at least weekly
mediaweeklyopp = 2021:hear about GW in the media several times a year or less often
personalsup = 2021:think GW will harm them personally substantially
personalopp = 2021:think GW will harm them personally minimally
presidentsup = 2021:think the President themselves should be doing more to address GW
presidentopp = 2021:think the President should be doing less to address GW
prioritysup = 2021:say a candidate's views on GW are important to their vote
priorityopp = 2021:do not say a candidate's views on GW are important to their vote
rebatessup = 2021:support tax rebates for energy-efficient vehicles, solar panels
rebatesopp = 2021:oppose tax rebates for energy-efficient vehicles, solar panels
reducetaxsup = 2021:support requiring fossil fuel companies to pay a carbon tax
reducetaxopp = 2021:oppose requiring fossil fuel companies to pay a carbon tax
regulatesup = 2021:support regulating CO2 as a pollutant
regulateopp = 2021:oppose regulating CO2 as a pollutant
supportRPSsup = 2021:support requiring utilities to produce 20% renewable electricity
supportRPSopp = 2021:oppose requiring utilities to produce 20% renewable electricity

Continued on next page

Table I1 – continued from previous page

teachGWsup = 2021:agree that schools should teach about GW	
teachGWopp = 2021:disagree that schools should teach about GW	
timingsup = 2021:think GW will start to harm people in U.S. now/within 10 years	
timingopp = 2021:think GW will harm people in the US in 25 years or later, or never	
worriedsup = 2021:worried about GW	
worriedopp = 2021:are not very worried about GW	
taxdivsup = 2014:support a carbon tax if refunded to every American household	
taxdivopp = 2014:oppose a carbon tax if refunded to every American household	

This list of county-level predicted opinion-share variables far too long to interact with every cap-and-trade program attribute in our choice experiment, and thereby to allow preferences to vary systematically with all these opinion shares. However, we noticed in our exploration of the correlation matrices and scatterplots and for all pairs among these opinion-share variables that many of them were very highly correlated. This suggests that a smaller number of independent factors may underlie this extensive set of often-related opinion shares.

We thus employ the "factor" command in Stata 18 to identify a smaller number of factors that account for much of the variation in the 2021 Yale Climate Map data. Table I2 shows that only the first four factors have eigenvalues greater than 1.0 (a common rule-of-thumb for selecting the appropriate number of factors). The first factor can explain more than 80% of the variation in the predicted Yale attitude proportions at the county level. The second factor explains only an additional 8.8%, the third factor, 3.46% and the fourth factor, 2.02%. Collectively, these four factors explain roughly 95% of the variation in the predicted Yale attitude proportions.

Table I2: First few rows of "factor" results

Factor analysis/correlation				Number of obs = 3,140	
Method: principal factors			Retained factors = 4		
Rotation: (unrotated)				Number of params = 242	
Factor	|	Eigenvalue	Difference	Proportion	Cumulative
Factor1	|	49.53438	44.12648	0.8060	0.8060
Factor2	|	5.40790	3.28200	0.0880	0.8940

Continued on next page

Table I2 – continued from previous page

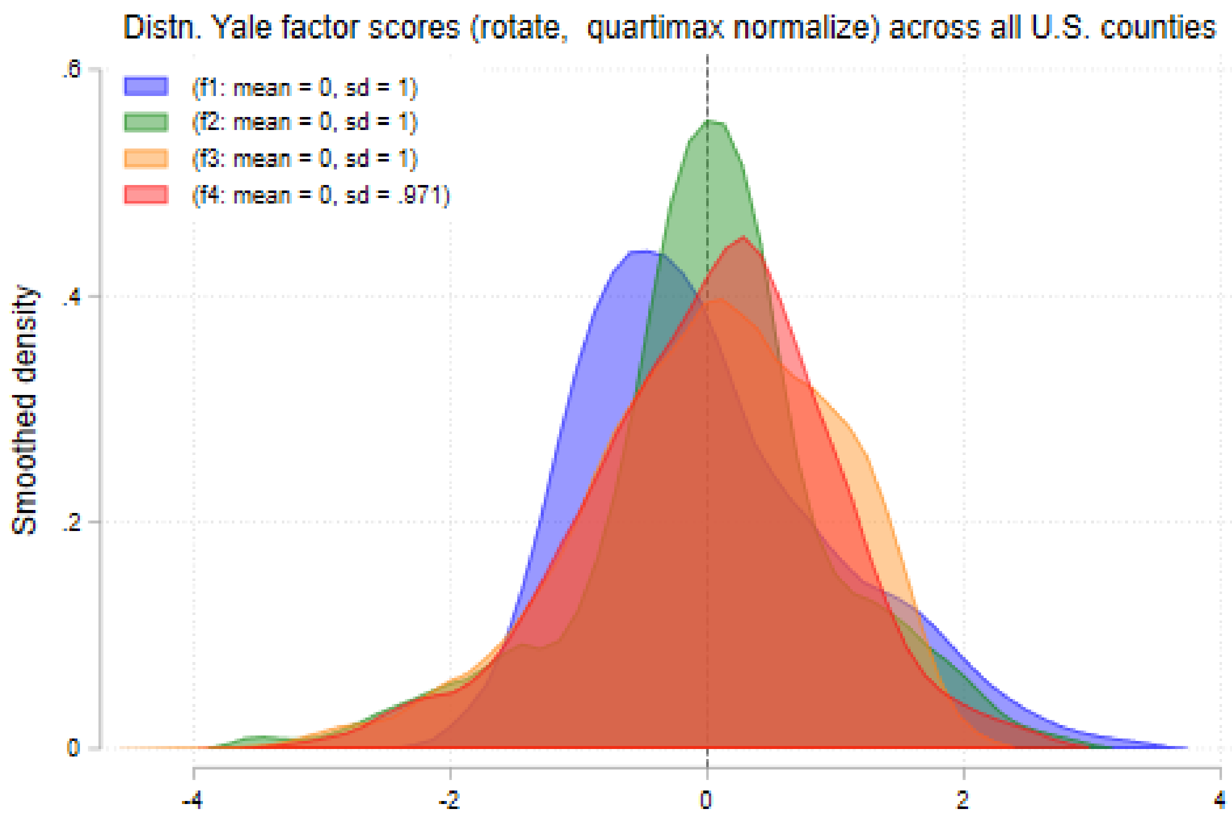
Factor3	|	2.12590	0.88299	0.0346	0.9286
Factor4	|	1.24291	0.52346	0.0202	0.9488
Factor5	|	0.71945	0.23373	0.0117	0.9605
Factor6	|	0.48572	0.14301	0.0079	0.9684
Factor7	|	0.34271	0.03179	0.0056	0.9740
Factor8	|	0.31093	0.06425	0.0051	0.9790
Factor9	|	0.24668	0.05105	0.0040	0.9830
Factor10	|	0.19563	0.03800	0.0032	0.9862
...					

We elect to employ a normalized "quartimax" rotation of these factors, since it seems that one general underlying attitudinal/opinion factor is likely contributing to all of the predicted opinion shares at the county level. The matrix of factor loadings (which shows how the underlying Yale variables are combined to produce the first four factors) reveals that factor 1 has very high loadings (i.e., higher than 0.80 or lower than -0.80) on all but seven of the underlying Yale Climate Map variables, and "uniqueness" among these underlying variables is correspondingly low.

Each of our four opinion-share factors is normalized to have mean zero and standard deviation one. Figure I1 shows the marginal distributions for each of our four factors across all 3140 U.S. counties (and county-equivalents) for which complete data are available.

We initially sought to use all four of these factors to explain systematic variation in respondent preferences for our Oregon-only sample of individual respondents. Then, we planned to use our fitted model to extrapolate these preferences to all counties in the U.S. For this to be appropriate, it is helpful if the supports of the distributions for these new variables across Oregon counties are similar to their supports for the set of all U.S. counties. To assess the degree of overlap in the supports for the distributions of factors 1 through 4 in Oregon counties versus all other U.S. counties, we prepared the densities shown in Figure I2.

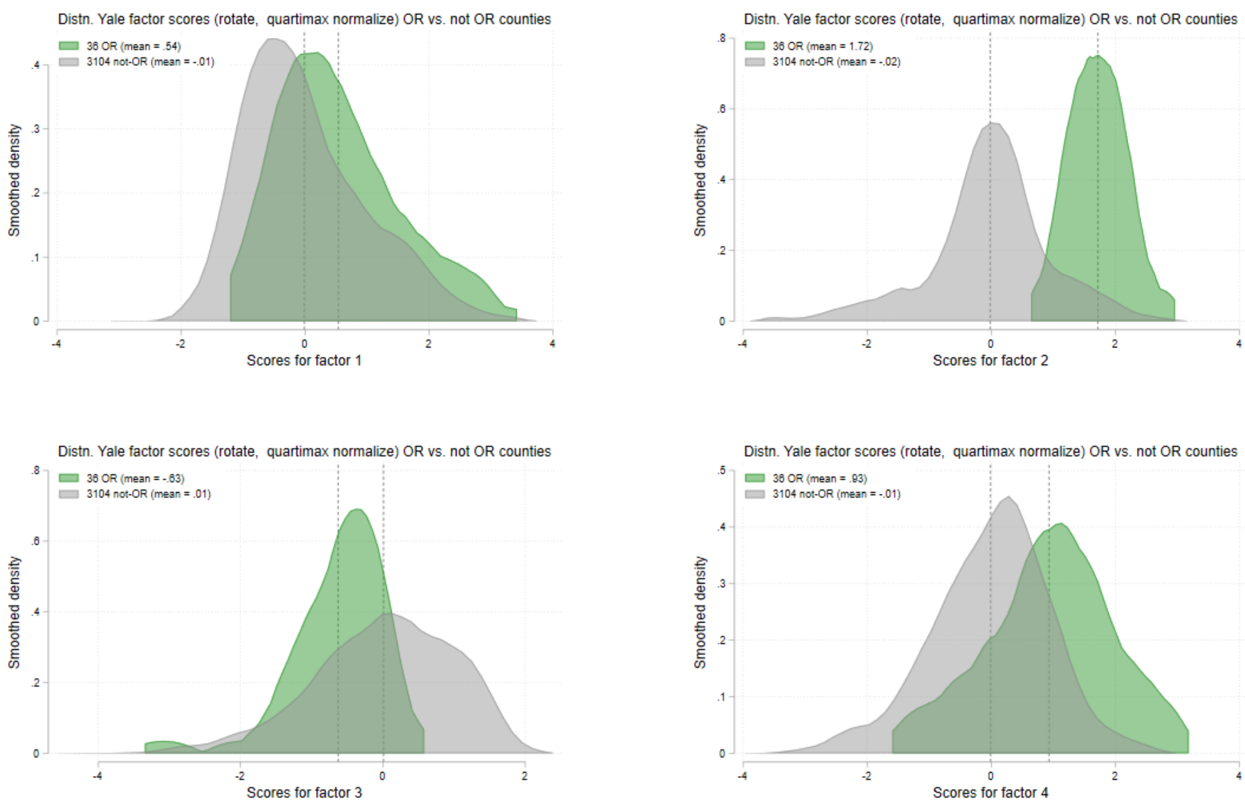
Figure I1: Distributions of 2021 Yale Climate Map factors 1-4 (normalized quartimax rotation, across all U.S. counties)



Factor 1 exhibits considerable overlap in the distributions between Oregon and non-Oregon counties. It is clear, however, that factor 2 and factor 3 take on a lot of values across non-Oregon counties that are well outside the range of values exhibited for Oregon counties. It would thus seem inadvisable to rely on such extensive out-of-sample forecasts about preferences for cap-and-trade programs (and therefore about WTP for these programs). Factor 4 appears to exhibit somewhat better overlap between the Oregon and non-Oregon county distributions, but some perplexing results led us to identify a risk in relying on this factor in fitting a predictive model using Oregon-only data.

Figure I3 shows scatter plots for all pairs of factor 1 through factor 4, with the values for Oregon's 36 counties shown in red. The first plot in the second row of plots in the figure shows the relationship between factor 1 and factor 4. The *marginal* ranges for each of factor 1 and factor 4 within Oregon appears to exhibit reasonably good coverage relative to the corresponding *marginal* range for all other U.S. counties. Upon closer inspection, however, with the exception of one Oregon county in the lower left of that scatter, there is a very strong linear relationship between factor 1 and factor 4 across the 36 Oregon counties upon which we estimate preferences for cap-and-trade programs. The joint outlier, with low values for both factor 1 and factor 4, is FIPS code 41049, Morrow County, Oregon (2020 Census population = 12,186). The 24 total policy choices of the four respondents in our estimating sample who are from Morrow County will have an outsized effect on the apparent marginal effects of factor 1 and factor 4 on the marginal utility of any given cap-and-trade program attribute. The risks presented by multicollinearity in the presence of an outlier argue strongly for omitting factor 4 on these grounds. Only factor 1 remains.

Figure I2: Distributions of factors 1 through 4, 2021 Yale Climate Map (normalized quartimax rotation) for Oregon counties (green) versus all other U.S. counties (gray)



We thus allow preferences in our estimating specification to vary systematically with the level of factor 1 from the Yale Climate Map data. We can allow *every* marginal utility in the model to vary with this factor, but to achieve a parsimonious model with good predictive ability in hold-out samples, we employ LASSO methods (using glmnet in R). Using the lambda.min criterion, the only surviving interaction terms imply that the marginal utility from any program varies systematically with factor 1, as does the marginal utility from the percent of carbon permits that would be auctioned. We then use this model to predict preferences and WTP for a representative individual from every county in the U.S., and then weight the implied WTP amounts by county populations over 18 years of age, to predict the distribution of WTP among the adult population for each of several benchmark cap-and-trade programs in our set of simulations.

I.2 Oregon as compared to California and Washington State

Oregon has been established as likely differing rather substantially in its range of climate opinions compared to the full set of other counties in the U.S. Nevertheless, it is instructive to see how Oregon's climate opinions compare to those in the two adjacent West Coast states, California and Washington. Washington state recently confirmed its intentions to join the cap-and-trade program established by California (the Western Climate Initiative) that includes the Canadian province of Quebec.

Figure I4 compares the marginal distributions of our four factors from the Yale Climate Opinion data for Oregon versus California, and Figure I5 shows the six pairwise relationships between these factors for Oregon (in solid red) versus California (open blue circles). Oregon tends to have larger values for factor 1 and smaller values for factor 2 than does California, but there is relatively more overlap in the two distributions for factors 3 and 4. There are also noticeable shifts in the support for the joint distributions of pairs of factors in some cases.

Figure I3: Joint distributions of pairs among factors 1 through 4 2021 Yale Climate Map (normalized quartimax rotation, Oregon counties (in red) versus all other U.S. counties)

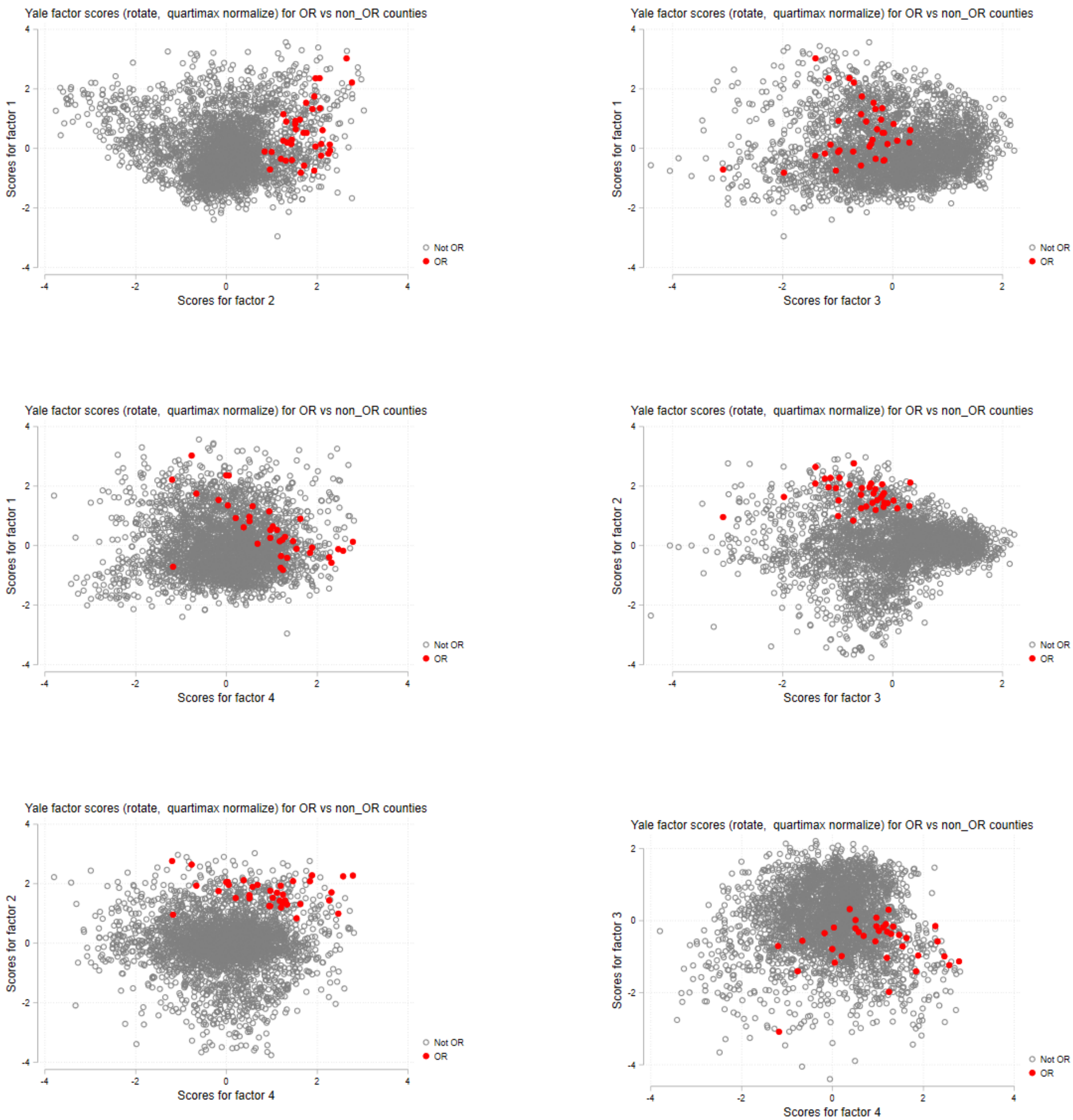


Figure I4: Marginal distributions of factors 1 through 4 derived from the 2021 Yale Climate Map data (normalized quartimax rotation) for Oregon counties (in green) versus all other California counties (in blue)

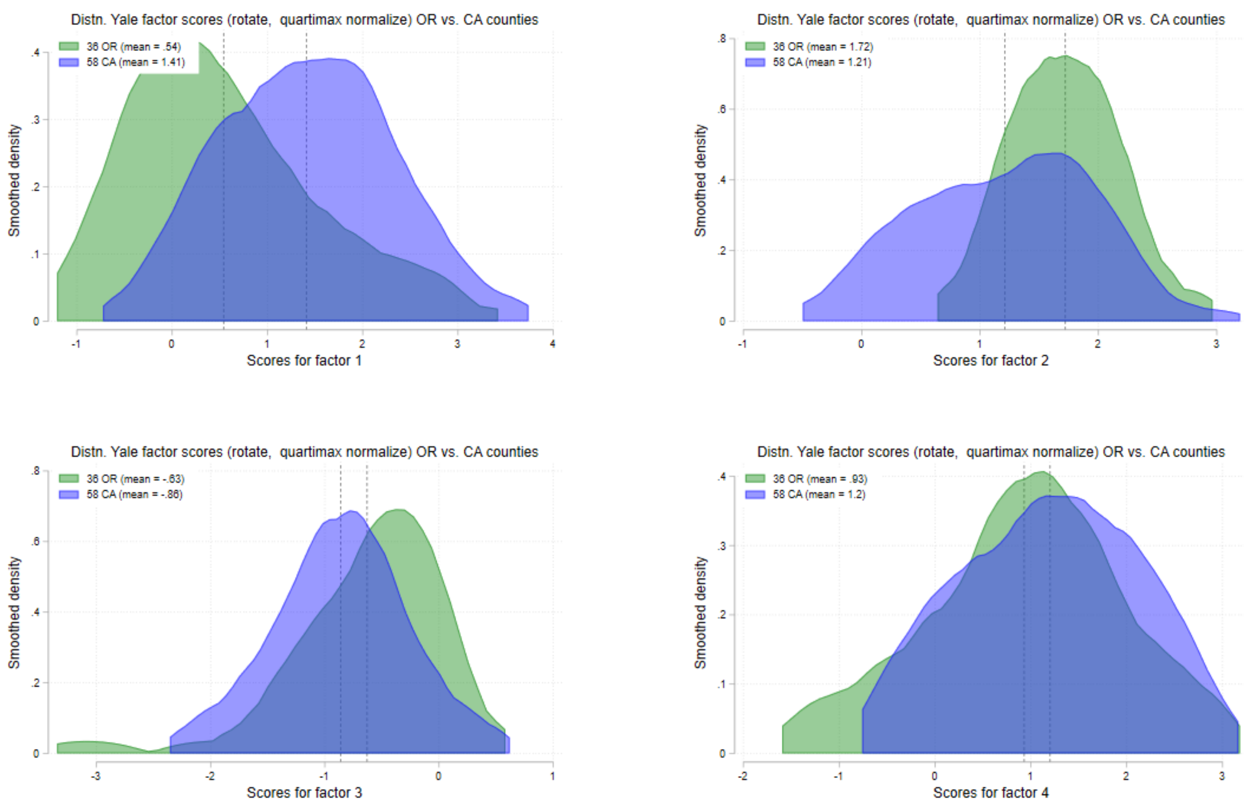


Figure I6 and I7 show the corresponding marginal and pairwise distributions for Washington state. There is somewhat more overlap in the range of Yale Climate Map factors for Oregon and Washington, suggesting that Washington State's population may have climate preferences more similar to those in Oregon.

Figure I5: Joint distributions of pairs among factors 1 through 4 derived from the 2021 Yale Climate Map data (normalized quartimax rotation) for Oregon counties (in red) versus California counties (in blue)

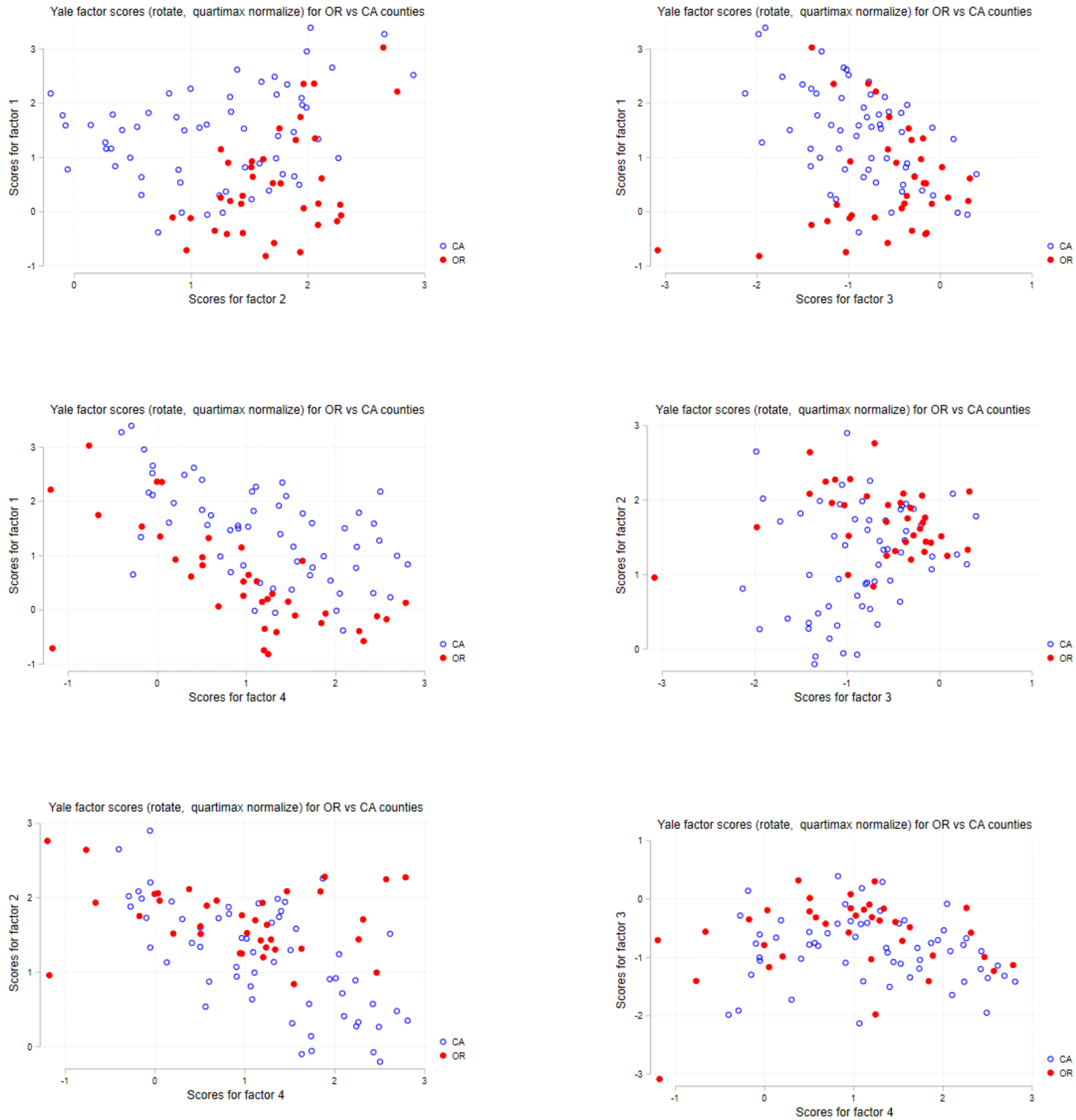


Figure I6: Distributions of factors 1 through 4, 2021 Yale Climate Map (normalized quartimax rotation) for Oregon counties (green) versus Washington counties (purple)

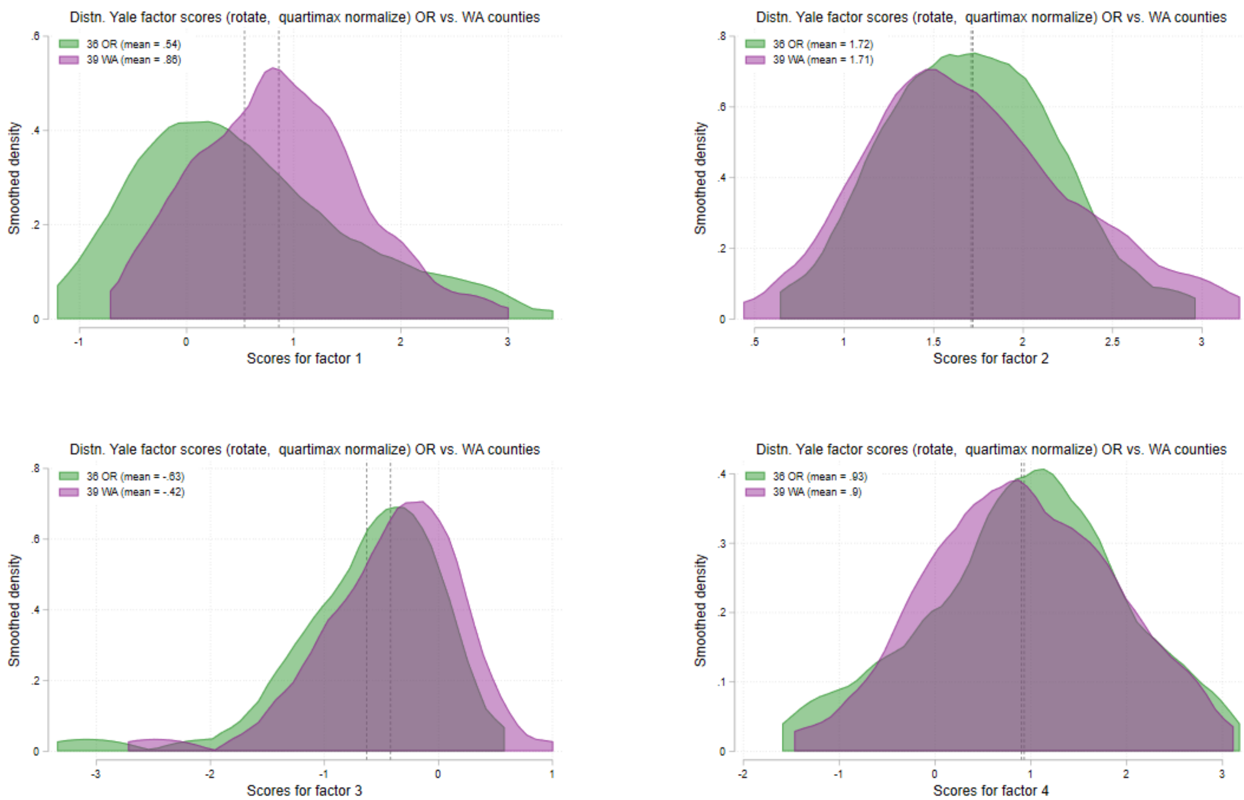
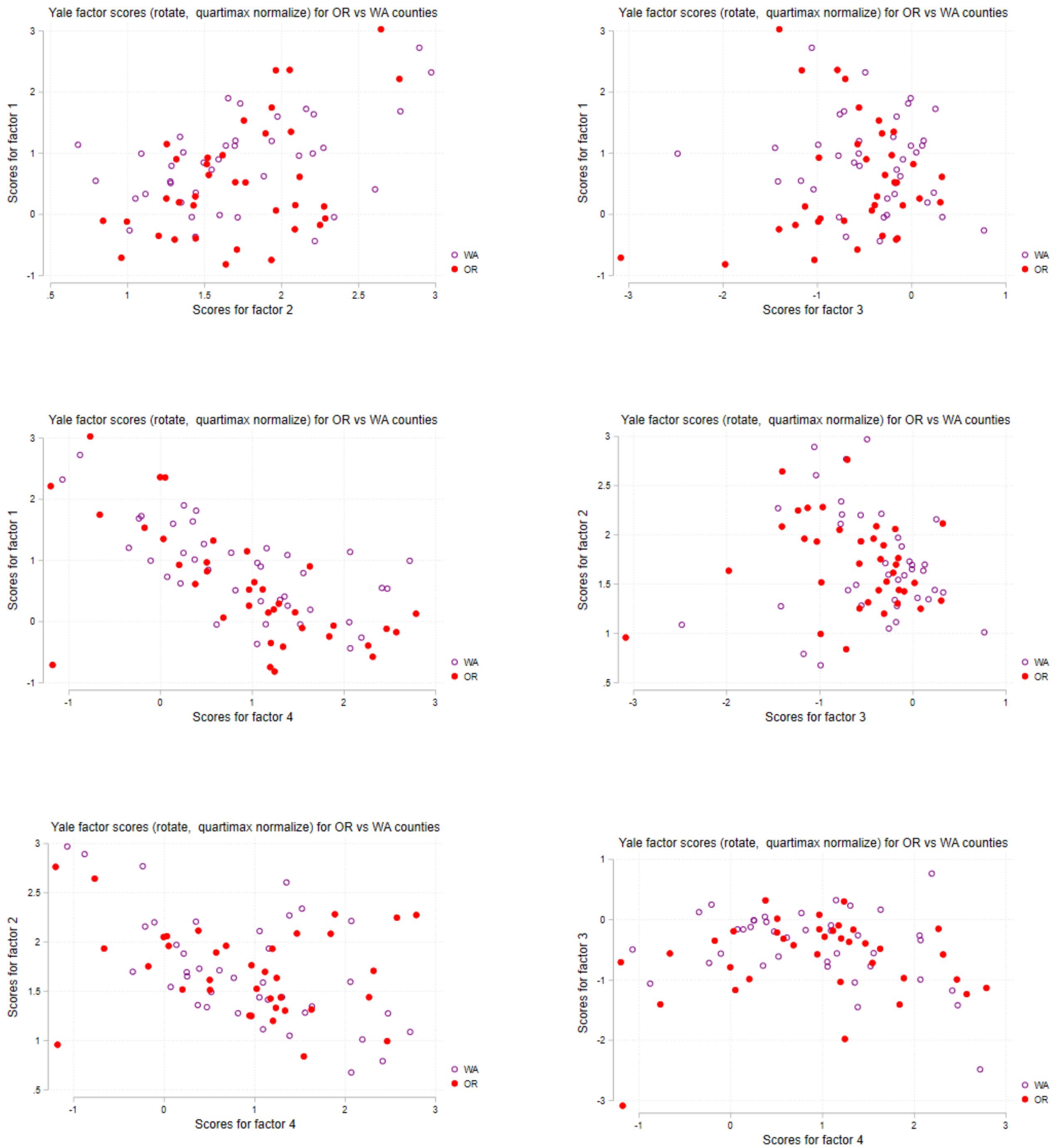


Figure I7: Joint distributions of pairs among factors 1 through 4 derived from the 2021 Yale Climate Map data (normalized quartimax rotation) for Oregon counties (in red) versus Washington counties (in purple)



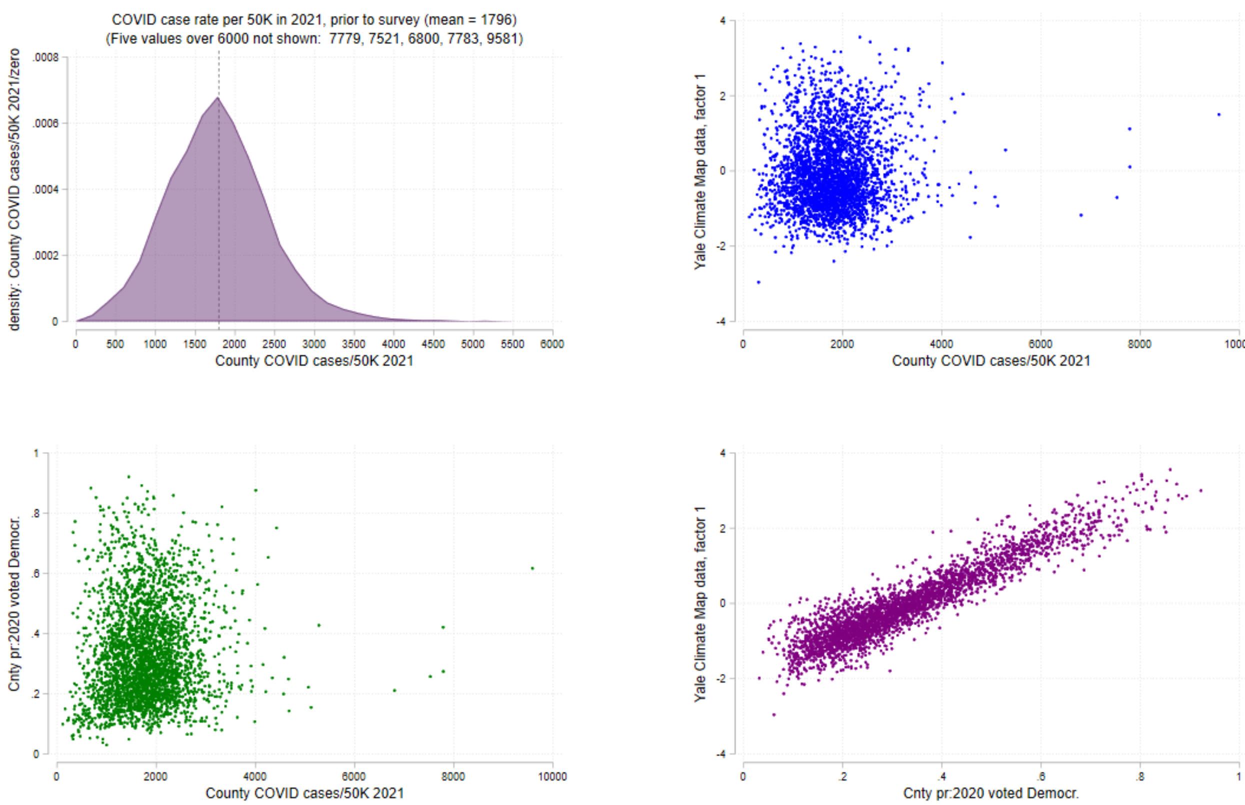
I.3 Clues about why the LASSO algorithm retains only Yale Climate Map factor 1 and the 2021 COVID case rate as shifters

In developing our analyses, we planned to control for the COVID-19 case rate across different counties in the U.S. so that we would have the option to "simulate out" the effects of the pandemic on willingness-to-pay for state-level carbon cap-and-trade programs. There is considerable evidence, however, that COVID-19 case-rates were correlated with political ideologies, and political ideologies are known to be related to attitudes about climate change (and thus likely related to attitudes about carbon cap-and-trade programs). If we planned to simulate zero covid cases, we expected that it would be important to control for the political environment in each county. The Yale Climate Map data, reduced to its most-important factor (factor 1) can certainly be expected to play an important role in explaining people's willingness to bear the costs of a carbon cap-and-trade program.

We initially allowed all three of these variables to shift every marginal utility in the model, and allowed LASSO methods to determine which interaction terms did the best job of out-of-sample prediction. No LASSO specification retained interactions involving all three variables.

We also explored an ad hoc specification where we interacted all three variables with our "Any program" indicator. Within the estimating sample, all three interaction terms were statistically significant. However, the predicted WTP amounts from this specification varied widely, so we began to suspect some multicollinearity. Figure I8 reveals the likely source of the problem. The most important Yale Climate Map factor (factor 1) is very strongly correlated with the proportion of Democratic votes in a county (ρ = 0.9311). Fortunately, however, the COVID-19 case rate in a county is not particularly correlated with either the Yale Climate Map factor (ρ = 0.0521) or the proportion of Democratic votes (ρ = 0.0820). Given that the Yale Climate Map factor embodies a host of climate attitudes, we elect to retain this factor in our models (allowing it simultaneously to control for political preferences), and allow the COVID-19 case rate to shift the "Any program" effect (as recommended by the LASSO variable selection algorithm).

Figure I8: Graphs showing the distribution of COVID case rates, and the relationships among COVID case rates, the Yale Climate Map factor 1, and the county proportion of votes for the Democratic Party candidate in the 2020 Presidential election.



J Appendix: State-level WTP estimates for each of the lower-48 U.S. states

J.1 Tabulated estimates for each state

Table J1: State mean WTP estimates corresponding to the estimates displayed in the maps shown in Figures 3, **??**, and 4, where the representative WTP for each county in a state is weighted by county population; accompanied by 5th and 95th percentiles of the state-level distribution.

FIPS Code	State Abbrev.	Baseline program WTP mean	(5%, 95%)	Better program mean	(5%, 95%)	Baseline w/o COVID mean	(5%, 95%)
1	AL	36	(8, 95)	72	(5, 211)	79	(33, 152)
4	AZ	52	(29, 100)	117	(56, 226)	112	(74, 164)
5	AR	34	(9, 82)	68	(9, 186)	79	(42, 141)
6	CA	111	(67, 201)	237	(135, 395)	163	(108, 228)
8	CO	78	(24, 143)	168	(44, 302)	129	(73, 196)
9	CT	93	(46, 120)	211	(104, 268)	156	(99, 186)
10	DE	69	(52, 78)	162	(122, 184)	137	(113, 150)
11	DC	173	(173, 173)	351	(351, 351)	215	(215, 215)
12	FL	71	(26, 100)	161	(48, 233)	132	(71, 182)
13	GA	78	(12, 168)	158	(12, 343)	120	(41, 213)
16	ID	39	(14, 61)	72	(19, 132)	76	(45, 107)
17	IL	105	(18, 159)	217	(23, 327)	151	(56, 205)
18	IN	49	(14, 99)	100	(17, 212)	93	(48, 148)
19	IA	59	(25, 122)	118	(41, 234)	99	(61, 147)
20	KS	53	(15, 111)	108	(16, 235)	95	(46, 159)
21	KY	31	(7, 89)	62	(5, 201)	75	(34, 148)
22	LA	44	(12, 164)	88	(13, 329)	86	(41, 202)
23	ME	81	(42, 114)	171	(96, 230)	127	(83, 157)
24	MD	128	(40, 190)	262	(73, 375)	172	(76, 224)
25	MA	112	(67, 164)	248	(159, 360)	176	(134, 236)
26	MI	65	(24, 113)	143	(41, 250)	122	(72, 173)
27	MN	79	(22, 147)	164	(39, 297)	124	(63, 187)
28	MS	46	(12, 113)	92	(11, 235)	89	(41, 157)
29	MO	50	(12, 92)	103	(13, 197)	96	(46, 142)
30	MT	50	(24, 111)	97	(35, 224)	90	(60, 147)
31	NE	50	(15, 79)	97	(17, 165)	88	(43, 120)
32	NV	83	(33, 100)	179	(48, 199)	133	(62, 143)

Continued on next page

Table J1 – continued from previous page

33	NH	70	(55, 110)	157	(128, 231)	126	(112, 157)
34	NJ	101	(32, 144)	231	(62, 326)	173	(89, 226)
35	NM	89	(16, 139)	180	(24, 274)	129	(57, 170)
36	NY	102	(40, 175)	234	(87, 378)	176	(93, 242)
37	NC	63	(15, 109)	138	(21, 246)	118	(56, 175)
38	ND	38	(14, 58)	65	(13, 121)	70	(43, 99)
39	OH	58	(14, 124)	120	(17, 261)	103	(48, 173)
40	OK	28	(8, 55)	55	(7, 124)	72	(37, 107)
41	OR	110	(26, 189)	214	(48, 367)	142	(63, 216)
42	PA	73	(17, 167)	157	(26, 352)	127	(59, 223)
44	RI	77	(46, 86)	181	(107, 204)	150	(109, 165)
45	SC	47	(19, 112)	101	(30, 256)	104	(64, 183)
46	SD	46	(20, 107)	89	(21, 211)	85	(54, 139)
47	TN	41	(9, 100)	84	(7, 218)	86	(38, 157)
48	TX	65	(12, 115)	140	(10, 257)	117	(42, 179)
49	UT	43	(12, 81)	89	(13, 181)	90	(43, 137)
50	VT	109	(61, 142)	222	(129, 279)	148	(104, 173)
51	VA	87	(14, 174)	184	(19, 329)	137	(51, 208)
53	WA	110	(41, 169)	221	(82, 333)	148	(83, 201)
54	WV	21	(7, 56)	38	(6, 130)	64	(37, 115)
55	WI	71	(32, 147)	141	(55, 291)	109	(68, 180)
56	WY	23	(10, 70)	36	(6, 147)	56	(29, 113)

Eleven states in the Northeastern U.S. currently participate in the Regional Greenhouse Gas Initiative (RGGI) carbon cap-and-trade program. These states are CT, DE, ME, MD, MA NH, NJ, NY, PA, RI and VT. Mean county-population -weighted WTP for RGGI states for the first ("basic") program above is $97. For the states of CA and WA, which now both participate in the Western Climate Initiative carbon cap-and-trade program, this mean WTP is $111. For all the other lower-48 U.S. states, the mean WTP is only $64. Corresponding to the second set of WTP estimates above, for the program with more-desirable attributes, the mean WTP amounts for these three group of states are $216, $223, and $135. Corresponding to the third setof WTP estimates in this table, netting out COVID effects, mean WTP amounts for these same state groups are $161, $160, and $113.

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