Findings Brief for Equity Considerations for Greenhouse Gas Emissions Cap and Trade Legislation in Oregon

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Findings Overview

Historically marginalized populations and vulnerable communities experience disproportionate rates of adverse health outcomes, educational attainment, economic opportunity, and exposure to environmental hazards. Thus, these communities are more likely to experience disparate impacts from the consequences of climate change. Programs targeting greenhouse gas (GHG) emissions and co-pollutants are one way to address both climate change and environmental justice.

This brief shares findings from a research project that investigated equity concerns related to possible Oregon cap-and-trade legislation.[1] Such legislation would offer a market-based approach to reducing GHG emissions through economic incentives. Similar adopted and implemented legislation in California offers important learning opportunities about how to ensure people most vulnerable to the effects of climate change are supported and protected through cap-and-trade legislation (Troung 2014).[2]

In this study we examine how to define and map those communities most vulnerable to the disparate impacts of climate change, identify how specific producers of GHG co-pollutants might create 'hot spots,' and explore how to distribute community benefits to these communities. The work for this project included an extensive review of existing cap-and-trade programs and climate change and health vulnerability assessments, scholarly and practice related literature, as well as interviews with and a survey of Oregon environmental and equity experts to understand how equity goals can be achieved in an Oregon GHG cap-and-trade program. We conducted extensive demographic and spatial analysis to identify and locate the most vulnerable communities to the disparate impacts of climate change as well researched and mapped the relevant producers of GHG emissions and co-pollutants.[3]

Defining and Locating the Most Vulnerable Communities to Climate Change in Oregon

In order to identify those community members most likely to be disproportionately affected by climate change and thus in need of the most consideration for GHG cap-and-trade legislation, we identified variables commonly used in climate change vulnerability assessments around the country as well as discussed in the academic literature. From this list of variables we determined which variables were available across data sets for the state of Oregon.

We sought to use the smallest set of variables possible in order to make it easier for practitioners to obtain, access data for future analyses, and build upon for future work. We chose simplicity over complexity to begin developing more complex indices in the future to ensure equity could be considered in the short term. Based on this work we identified five demographic variables and two exposure variables to combine into a weighted index to rank census tracts across the state.

We identified income, race, education, employment, age, cancer risk, and respiratory hazard at the census tract level as the most effective combination of variables at an appropriate geography for analysis. The demographic variables (income, race, education, employment, and age) capture who is

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[1] For an overview see: State of Oregon Department of Environmental Quality. February 2017. *Considerations for Designing a Cap-and-Trade Program in Oregon*. State of Oregon. Downloaded: http://www.oregon.gov/deq/FilterDocs/ghgmarketstudy.pdf

[2] California recently extended their cap-and-trade program via Assembly Bill 398.

[3] Like any study we are limited by the availability of data as well as its integrity. More discussion about the data sources we selected can be found in the final report. We want to note in particular that these data sets are known to not capture the actual county and the complexity of lives for people of color.

most vulnerable to the impacts of climate change because of their life circumstances (Williams et. al. 2016). The two exposure variables reflect the degree to which people are exposed to air toxics.[4] Together, these two sets of variables capture people most likely to experience negative social determinants of health in their lives (Who Health Organization 2017). People's demographic characteristics often determine their likelihood of being exposed to pollutants. For instance, neighborhoods with more low-income residents and/or people of color are more likely to have polluters sited near or in them (Collins et al. 2016; Troung 2014). Further, people with lower socio-economic status tend to have less ability to move away environmental hazards, access and influence political power structures to address pollutants, and obtain health care. Because of the role these demographic characteristics play in life outcomes, we gave more weight to them in calculating the overall index score. Descriptions of the variables, index scoring and rationale, and additional details follow in the next sections.

Defining the target population

We recommend using the below demographic variables to determine who constitutes the most vulnerable populations to climate change across the state. The variables we selected are consistent with metrics used in other social and health vulnerability and environmental justice risk indices. The recommended variables also reflect community experts' perspectives on demographic characteristics that put marginalized communities most at risk to disproportionately experiencing the impacts of climate change. The variables include:

- Race: Percentage of nonwhite populations (US Census)[5]
- Income: Percentage of an area's population with incomes below 200% of the federal poverty limit (US Census)
- Education: Percentage of the population over 25 years of age without a high school degree/diploma (US Census)
- Unemployment rate: Percentage of the eligible population over 16 years of age not employed (US Census)
- Age: Percentage of the population over 65 years of age and under 10 years of age (US Census)

California does not include race in its comparative index because of a statutory preemption on using race as a component of public policy-making. Fortunately, Oregon does not have the kind of preemption that California does. Race remains one of the most significant predictors and explanatory factors for health outcomes, political and social capital, educational outcomes, and exposure to environmental hazards, we elected to use race as a definitional component for this work. As a metric, it captures specific vulnerabilities that either require significantly more variables to demonstrate risk, or metrics that that may not reflect the experiences of people of color.

However, given California's work and the complexities of discussing race, our community partners requested that we examine how the index ranking would function without a race variable at all.

[4] Two concerns have been raised about the NATA data specific to their use in this study and future work. First, they may reinforce biases against Native American reservations found in datasets. Second, NATA data are older (2011) and the likelihood that NATA data will continue to be updated remains unclear.

[5] All US Census data is from: US Census Bureau. 2011-2016. *American Community Survey 5-Year Estimates*. Downloaded: https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml.

Removing race from the equation resulted in several census tracts, namely with large Native American populations and/or with reservations, falling dramatically in the ranking. Given the known challenges Native American communities face coupled with concerns about data integrity and the Census count for Native communities and other people of color, we believe race should be included.[6]

We also recommend using environmental exposure data to help capture the risks related to air toxics. Additional environmental exposure variables such as exposure to lead could be added to future indices; however, as discussed below, we recommend focusing on demographic characteristics. The environmental exposure variables we recommend at this point are:

- Cancer Risk: An estimate of an individual's cancer risk as the result of a lifetime of exposure to a range of point and mobile source air toxins (US Environmental Protection Agency National Air Toxics Assessment)[7]
- Respiratory Hazard Index: An estimate of adverse health effects identified by length of time and concentration of exposure to a range of point and mobile source air toxins (US Environmental Protection Agency National Air Toxics Assessment)

We did not incorporate variables related to economic regions that face serious threats from climate change, or living in areas likely to negatively impacted by climate change such as heat islands or flood plains. We were unable to locate reliable state-level data that captured the relative risks of how climate change may harm local economies or threatens specific areas.

Analytical Geography Level

The definition variables should use US Census geography at the census tract level. Higher geographies such as city, place, or county level are too broad to capture the specific issues related to place based burden or vulnerability. Lower level geographies such as Census block group or Census block often produce high margins of error, especially for communities of color or other marginalized groups.

Index Score

The 7 variables at the US census tract level should be combined to create an index score. This allows the census tracts to be ranked from most to least vulnerable to the effects of climate change. We recommend an index based on the z-scores of each variable. Z-scores allow data to be standardized for comparative purposes.

Based on our analyses, scholarly literature, and community input, we recommend the socio-economic variables be given a collective weight of 90% in the score with the environmental exposure variables constituting 10% of the score.[8] While exposure to environmental hazards threatens all people, those people from wealthy backgrounds have greater access to healthcare, remediation services, and political

[6] We mapped those US census tracts in Oregon where the tracts had z-scores above 1 for those people who identify as other than non-Hispanic white. Collectively, these tracts included 17% of the total state's population, 22% of the state's population living below 200% of the poverty level, and 35% of the state's population of color.
[7] All NATA data from: US Environmental Protection Agency. 2011. National Air Toxics Assessment. Washington, DC: U.S. Environmental Protection Agency. Available: https://www.epa.gov/national-air-toxics-assessment/2011-nata-assessment-results.
[8] Given some of the issues raised about the NATA data, future analyses could examine further reducing the weight of the exposure indicators, or removing the exposure variables altogether. We do not recommend adding additional exposure variables at this time.

arenas. Wealthier individuals have a greater ability to address, overcome, or be resilient to exposure to environmental hazards.

Given the challenges people from lower income backgrounds face, we further recommend doubling the weight of the income within the demographic variable score. For similar reasons, we also recommend doubling the weighting of the race measure within the demographic variable score. People of color experience disparities in health, educational attainment, etc. Doubling the weighting of the race measure allows for these disparities to be captured in the overall score.

With these considerations we recommend the following index score:

$$Index = 5.00\% \cdot Cancer\ Risk + 5.00\% \cdot Respiratory\ Hazard + 25.71\% \cdot Race + 25.71\% \cdot Poverty + 12.86\% \cdot Education + 12.86\% \cdot Unemployment + 12.86\% \cdot Age\ /\ 7\ (total\ number\ of\ variables)$$

Label

Legislation or programming related to GHG carbon markets should use either "communities experiencing disparate impacts of climate change" or "communities vulnerable to climate change" to label or name the target population. The phrase "most impacted" was paired with "communities experiencing disparate impacts of climate change" in the survey and several meetings. However, we think it could also be used with "communities vulnerable to climate change."

Locating those most vulnerable to the impacts of climate change

The following map displays the top 10%, 25%, and 50% of Oregon census tracts based on their vulnerability to the impacts of climate change score (See Figure 1 for the state of Oregon and Figure 2 for a zoomed in view of the Portland metropolitan area). The higher the score, the higher their ranking. The top 50% of census tracts are referred to as the "most vulnerable" census tracts throughout the rest of the report. The decision to use these percentages was for the purpose of analysis. In California they identified the top 25% of those most vulnerable tracks for their cap-and-trade programming. We provided three percentage points to display visually how vulnerability shifted through the state and across the rankings.

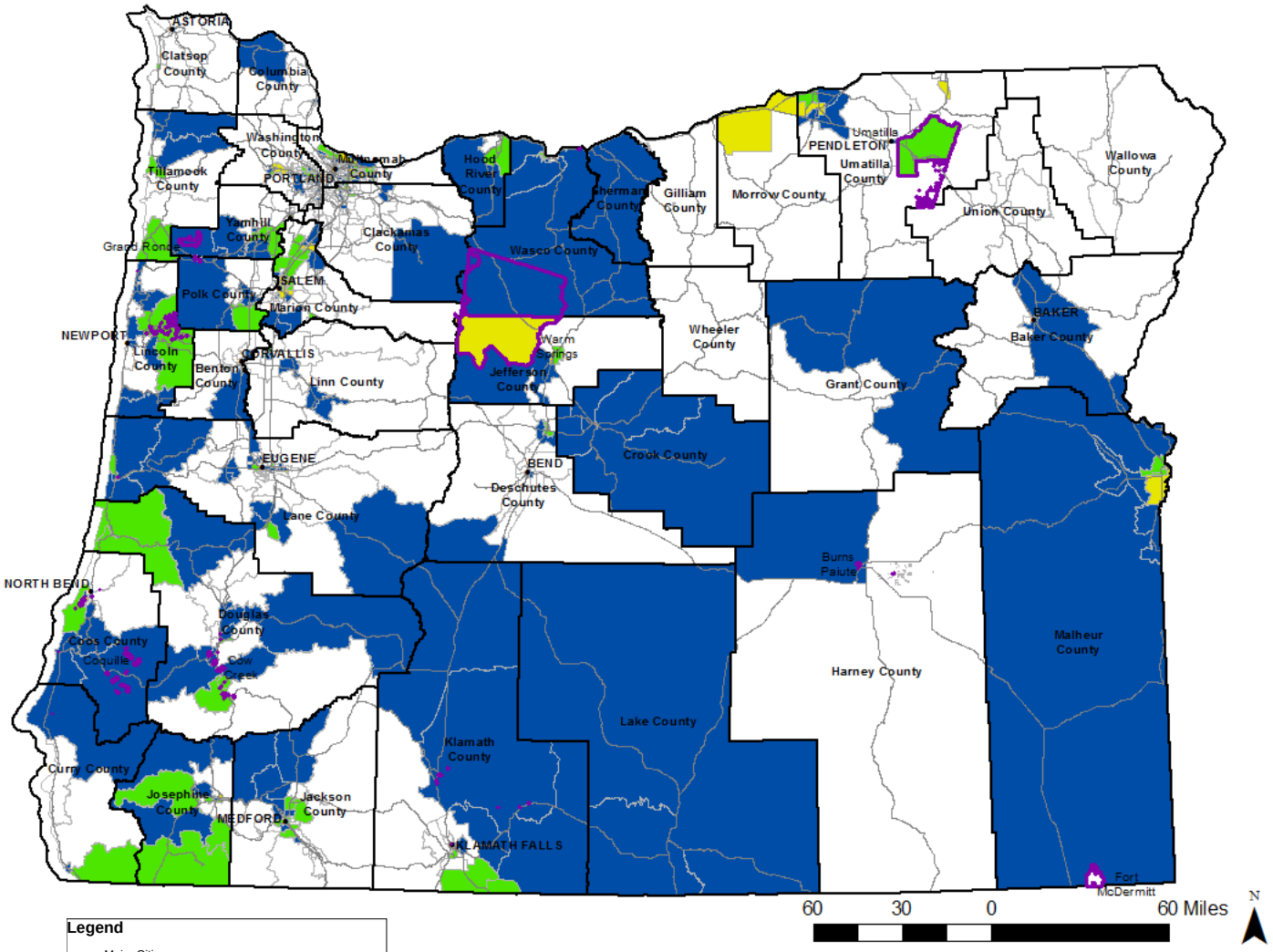

Figure 1: Top 10%, 25%, and 50% of Census Tracts Most Vulnerable to Climate Change in Oregon. *GIS data source: US Census Bureau and State of Oregon. Index scores are based on data from: U.S. Census American Community Survey (ACS) 2011-2015 5 year estimates and the National Air Toxics Assessments (NATA) 2011.*

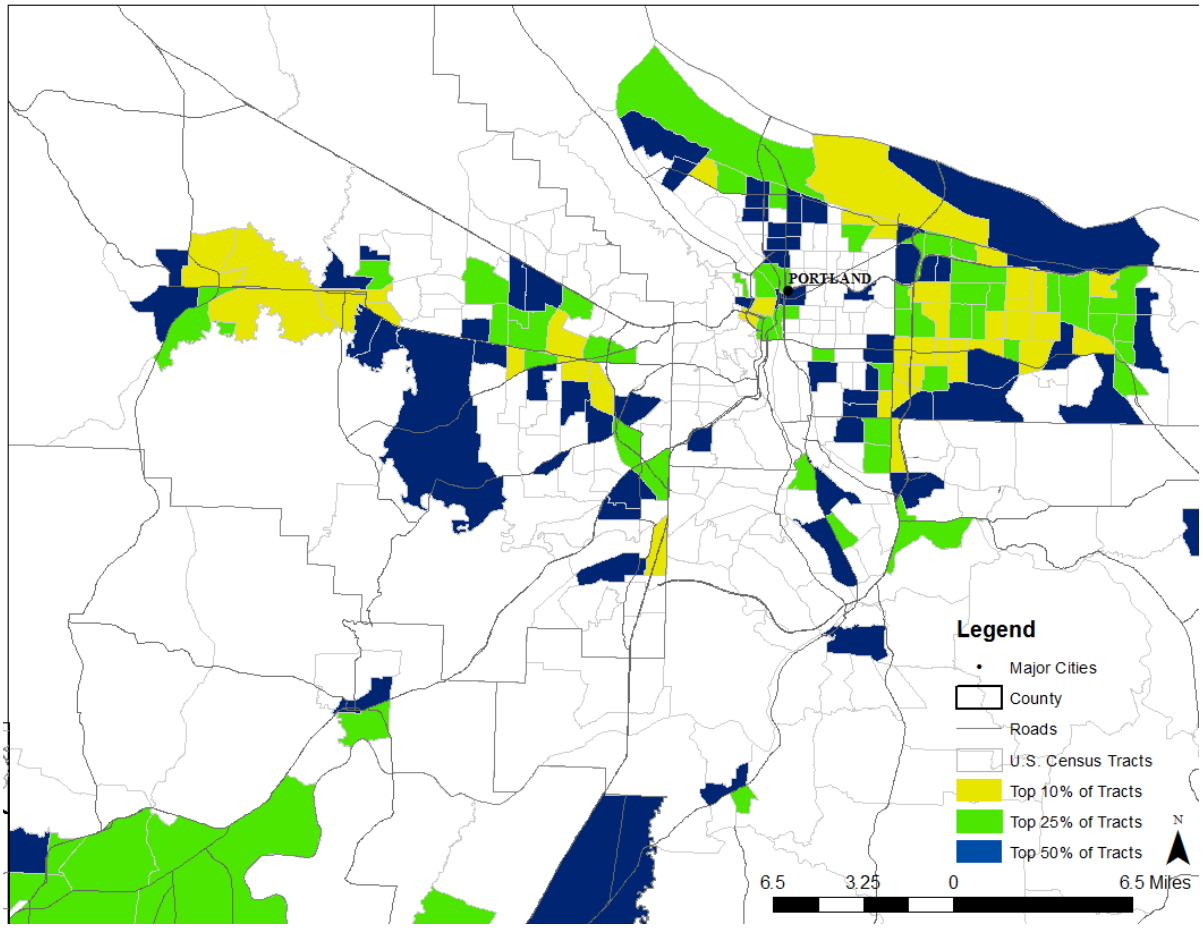

Figure 2*:* Top 10%, 25%, and 50% of Census Tracts Most Vulnerable to Climate Change in Oregon Zoomed View of Portland Metropolitan Area. *GIS data source: US Census Bureau and State of Oregon. Index scores are based on data from: U.S. Census American Community Survey (ACS) 2011-2015 5 year estimates and the National Air Toxics Assessments (NATA) 2011*

Economically Distressed Areas

The initial Oregon legislation introduced in 2016 (SB 1574) stated that economically distressed areas (EDA) would receive 40% of the revenue generated through a cap-and-trade program.[9] EDAs include economically distressed counties (EDCo) and economically distressed cities (EDCi). The definition of an ED area includes similar criteria to the definition we recommend here for identifying the most vulnerable census tracts. The definition of an economically distressed county includes metrics for employment and income among others. For an economically distressed city outside of a county the metrics include educational attainment, employment, poverty, and income. The map at the end of this section shows the intersection between EDAs and the top 50% of most vulnerable census tracts.

We analyzed two sets of census tracts: 1) the complete set of Oregon tracts, and 2) Oregon census tracts divided between economically distressed and non-economically distressed counties (EDCo and non-EDC). To determine whether the EDCo and non-EDC census tracts should be treated separately or

[9] "Economically distressed area" means an area designated as distressed by the Oregon Business Development Department under ORS 285A.020 and 285A.075.
https://olis.leg.state.or.us/liz/2016R1/Downloads/MeasureDocument/SB1574/Introduced

combined, we compared the total state population and the percentages of the state's population in poverty and population of color in the most vulnerable census tracts. We found that separating the EDCo tracts did not add to the number of people living in poverty captured in the top 50% of Census tracts, and did not substantially alter the number of people of color reflected in the total population of the top 50%.

To conduct this comparison, we left economically distressed cities are geographies in the non-EDC data set. EDCi do not follow census tract boundaries. For consistency and ease of analysis, we included those areas in the non-economically distressed county data set to run preliminary analysis. Because these areas have low levels of economic obtainment, many are identified in the top 50% of the most vulnerable census tracts in the index for non-economically distressed counties.[10]

Because of the findings of the comparison and the complexities of the geographies, we recommend analyzing the Census tracts across the state as one population, not differentiating between non-EDC census tracts and EDC census tracts. Because the EDC definition includes some of the same metrics we use to create an index score, the EDC census tracts tend to be ranked highly. Further, given the complexity of analyzing the ED cities located in non-EDC counties, we believe treating all tracts as one population helps ensure a more equitable comparison across census tracts.

There are several reasons a given EDCos' or EDCis' census tracts may not be ranked highly in this index. One is that EDCo and EDCi definitions include components of their jurisdictional boundaries relative economic health. Our index focuses on spatial determinants of health meaning that we focus on individuals and clusters of individuals regardless of the overall economic health of their communities. Future research may examine how well an individual's or spatial concentration of individuals' vulnerability intersects with a county's or city's economic health. To ensure that each EDCo has at least one census tract described as "most" vulnerable, the top 65% of census tracts would need to be used, expanding beyond the top 50% we use in this report. This would also capture all but seven of the census tracts that include significant portions of EDCi boundaries.

Please note that some of the EDCs are sparsely populated or may have all of their population concentrated in one urban area. The state declares an entire county to be economically distressed and this will include all of their census tracts. Our analysis focuses on Census tracts themselves, meaning that some census tracts within an economically distressed county may not be highly ranked in the vulnerability index. This may be due to few people living in the tract, or relatively affluent people in that particular area. For instance, in EDC Harney County the geographically smaller census tract (9601) includes about 5,000 people, and is in the top 50% of census tracts based on its vulnerability score. The other tract (9602) is geographically larger, but fewer people live there (about 200 people).

[10] Oregon's definition for EDAs uses ACS 5-year estimates for education rates, unemployment rates, income, and poverty rates. Our identified most vulnerable tracts intersect with 41 of the 52 economically distressed cities across Oregon. The cities include: Astoria, Barlow, Carlton, Creswell, Estacada, Gaston, Gearhart, Hepner, Ione, Johnson City, Molalla, Philomath, and Warrenton. These cities have significant portions of their land located in a total of 16 census tracts that not in the top 50% of the most vulnerable census tracts.

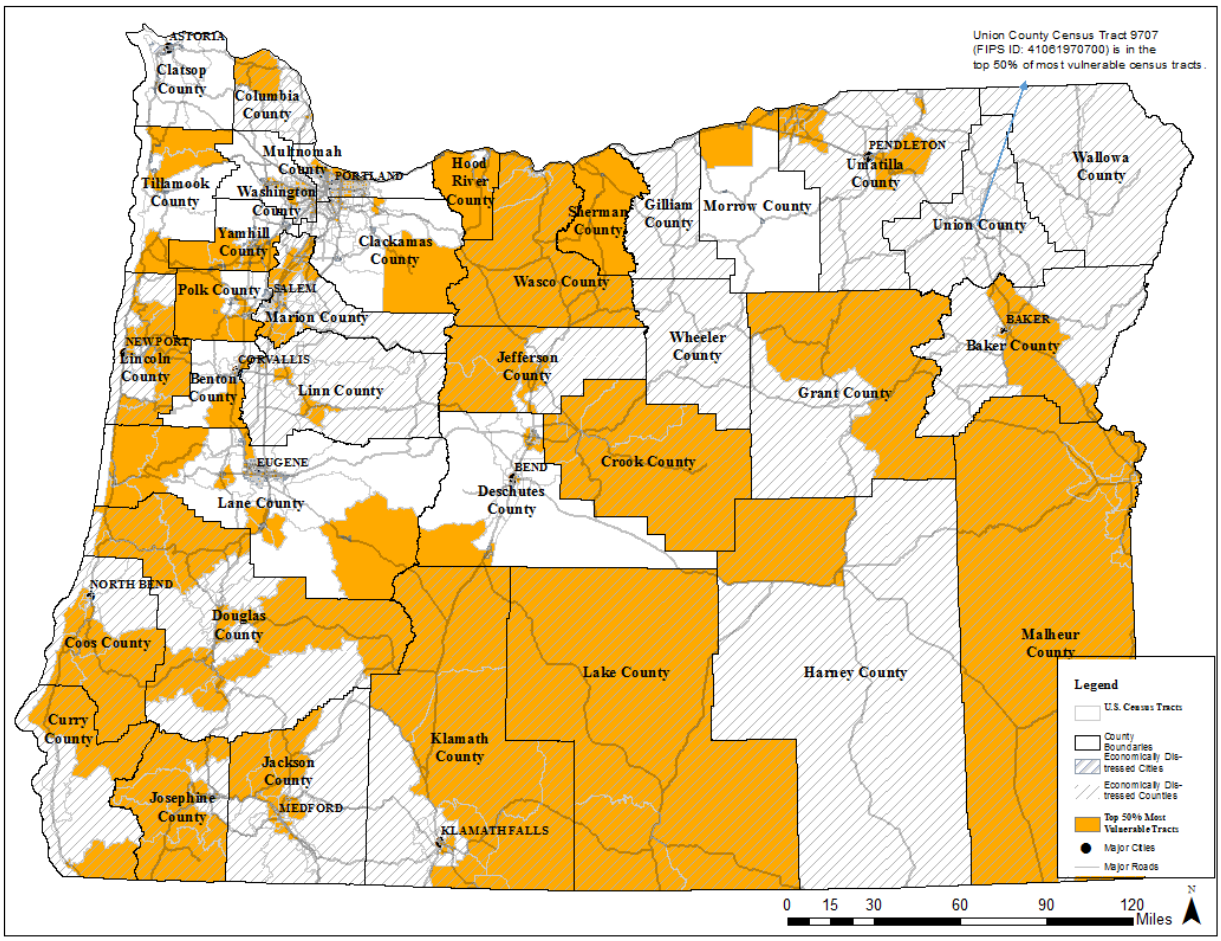

Figure 2: Economically Distressed Areas and Top 50% of Census Tracts Based on Vulnerability Index. *GIS data source: US Census Bureau and State of Oregon. Index scores are based on data from: U.S. Census American Community Survey (ACS) 2011-2015 5 year estimates and the National Air Toxics Assessments (NATA) 2011.*

Potential Co-Pollutant Hot Spots

One concern with the proposed greenhouse gas cap-and-trade policy in Oregon is that it may result in localized concentrations (or hot spots) of co-pollutant emissions in communities vulnerable to climate change. Hot spots are areas of potential "localized concentrations" of toxics or pollutant emissions which may result in "elevated risks of adverse health effects (CA AB 2588, 1987: section 44301). GHG cap-and-trade policy is not typically designed to regulate co-pollutants, and when trading of GHG allowances occurs, facilities may choose to purchase allowances to continue the same level of production, or even expand production; therefore, localized co-pollutant hot spots are a "plausible outcome" under cap-and-trade (Morag-Levine 2007: 104). While many vulnerable communities are exposed to higher concentrations of both point (stationary) and mobile source greenhouse gas emissions, studies have indicated co-pollutants from mobile sources such as motor vehicles tend to be reduced as the result of policies that are aimed at reducing fossil fuel usage or encouraging usage of renewable energy sources.[11] The effect on co-pollutants from point sources tends to be less straightforward. Therefore, this analysis focuses exclusively on analyzing potential hot spots of co-pollutants from point (stationary) sources that may result from a greenhouse gas cap-and-trade policy, and its implications on Oregon communities.

We find that the top three CO_2e emitting industries for point sources in Oregon are fossil fuel and other electric power generation, solid waste landfill, and paper and paperboard mills, accounting for over 78% of all point source anthropogenic emissions. The manufacturing processes for these facilities release co-pollutants such as NOX, CO, sulfur dioxide (SO2), methane (CH4), particulate matter and other air toxins (US Environmental Protection Agency 1997: 38-40), which are associated with negative health impacts. Geographically, the largest concentrations of point source CO_2e emissions are located in the Oregon counties of Morrow, Umatilla, and Columbia. Both Umatilla and Columbia Counties are identified as Economically Distressed counties (Business Oregon 2017a), and Morrow County contains four Economically Distressed cities.

Forty-nine facilities throughout Oregon produced greater than 25,000 metric tons of CO_2e emissions in 2015. Of these 49 facilities, 67% (33 facilities) are located near populations and could pose potential co-pollutant health risks. Sixteen facilities are located within two miles of low-density residential areas and 17 facilities are located within densely populated areas or regional population centers. The sectors of Paper Mills, Paperboard Mills, Iron and Steel Mills, and Solid Waste Landfills pose the highest potential population risks for hot spots due to the combination of high co-pollutant limits and number of facilities within two miles of dense regional population centers.

Table 1: Regulated facilities located within 2 miles of densely populated areas in Census Tracts vulnerable to climate change

Facility Name	Industry Type	County
DPR Construction Inc	Electronics Manufacturing	Multnomah
Entek International LLC	All Other Plastics Product Manufacturing	Linn
International Paper Company	Paperboard Mills	Lane
Microchip Technology Inc	Electronics Manufacturing	Multnomah
Oregon State University	Colleges Univ and Professional Schools	Benton
Oreida Foods Inc	Frozen Specialty Food Manufacturing	Malheur
Owens-Brockway Glass Container Inc.	Glass Container Manufacturing	Multnomah
St John's Landfill	Solid Waste Landfill	Multnomah

[11] State of Oregon Department of Environmental Quality. February 2017. *Considerations for Designing a Cap-and-Trade Program in Oregon*. State of Oregon. Downloaded: http://www.oregon.gov/deq/FilterDocs/ghgmarketstudy.pdf

Focusing on census tracts identified as vulnerable to climate change, we find that 31 of the 49 potentially regulated facilities are located in these tracts. However, only eight of these facilities are located within two miles of densely populated areas or regional population centers. Many of the eight facilities (see Table 1) belong to the industry sectors of frozen food manufacturing, universities and electronics manufacturing, and tend to emit relatively low amounts of harmful co-pollutants such as CO, NOx, SO2 and PM according to the most recent DEQ permits held by the facilities, with the exception of the glass container manufacturing facility.

Top Industry Sectors

In Oregon, the top three carbon dioxide equivalent (CO_2e) emitting industry sectors account for over 79% of all point source anthropogenic emissions: fossil fuel and other electric power generation, solid waste landfill, and paper and paperboard mills. These three industries produced a combined 10,265,875 metric tons of CO_2e emissions in 2015. We used the Oregon DEQ 2015 Greenhouse Gas Facility Emissions dataset of all facilities holding air quality permits for the following analysis.[12]

Geographic Distribution

Forty-two U.S. census tracts (5.1% of all Oregon tracts) contain facilities with point source CO_2e emissions greater than 25,000 metric tons that are potentially within the scope of the cap-and-trade policy. According to U.S. Census estimates, 5% of the total population of Oregon lives within these 42 tracts (207,829 people). These 42 tracts account for 5% of Oregon's communities of color (42,758 people who identify as non-white), and 5% of Oregonians living under 200% of the Federal Poverty Limit (75,102 people). See Figure 2 for the facility distribution throughout the State of Oregon. Fossil fuel electric power generation facilities are the largest emitters of CO_2e, and hold DEQ air quality permits that allow for the largest amounts of co-pollutants such as CO, NO_x and SO2. However, none of these facilities has visible populations located within two miles of the sites.

[12] See: Oregon Department of Environmental Quality. 2017b. 2015 Greenhouse Gas Facility Emissions. Retrieved from: http://www.oregon.gov/deq/FilterDocs/GHGFacilityEmissions.pdf.

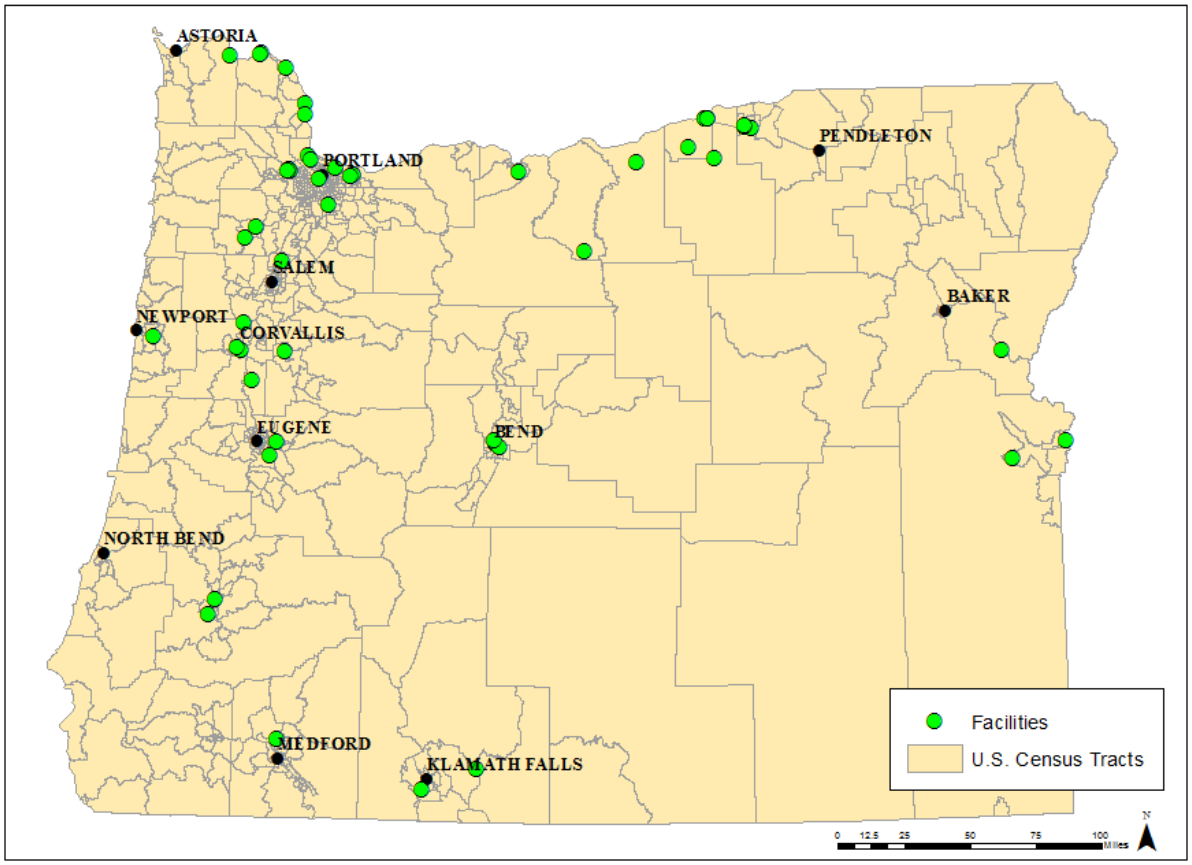

Figure 3: Distribution of Greenhouse Gas Emitting Facilities in Oregon. *All facilities with Air Quality Permits from the Oregon Department of Environmental Quality that produced over 25,000 metric tons of CO_2e emissions in 2015. Data source: Oregon Department of Environmental Quality 2015 Greenhouse Gas Facility Emissions (2017b).*

Co-Pollutants and Communities Vulnerable to Climate Change

Thirty-one facilities with point source CO_2e emissions greater than 25,000 metric tons (out of a total of 49 facilities) are located within U.S. census tracts identified as vulnerable to climate change. Although the majority of the potentially regulated facilities are located within census tracts identified as most vulnerable to climate change, we find that only eight facilities are located within two miles of densely populated areas or regional population centers. Many of the facilities belong in the industry sectors of frozen food manufacturing, universities and electronics manufacturing, which tend to emit relatively low amounts of harmful co-pollutants such as CO, NO_x, SO_2 and PM according to the most recent DEQ permits held by the facilities.

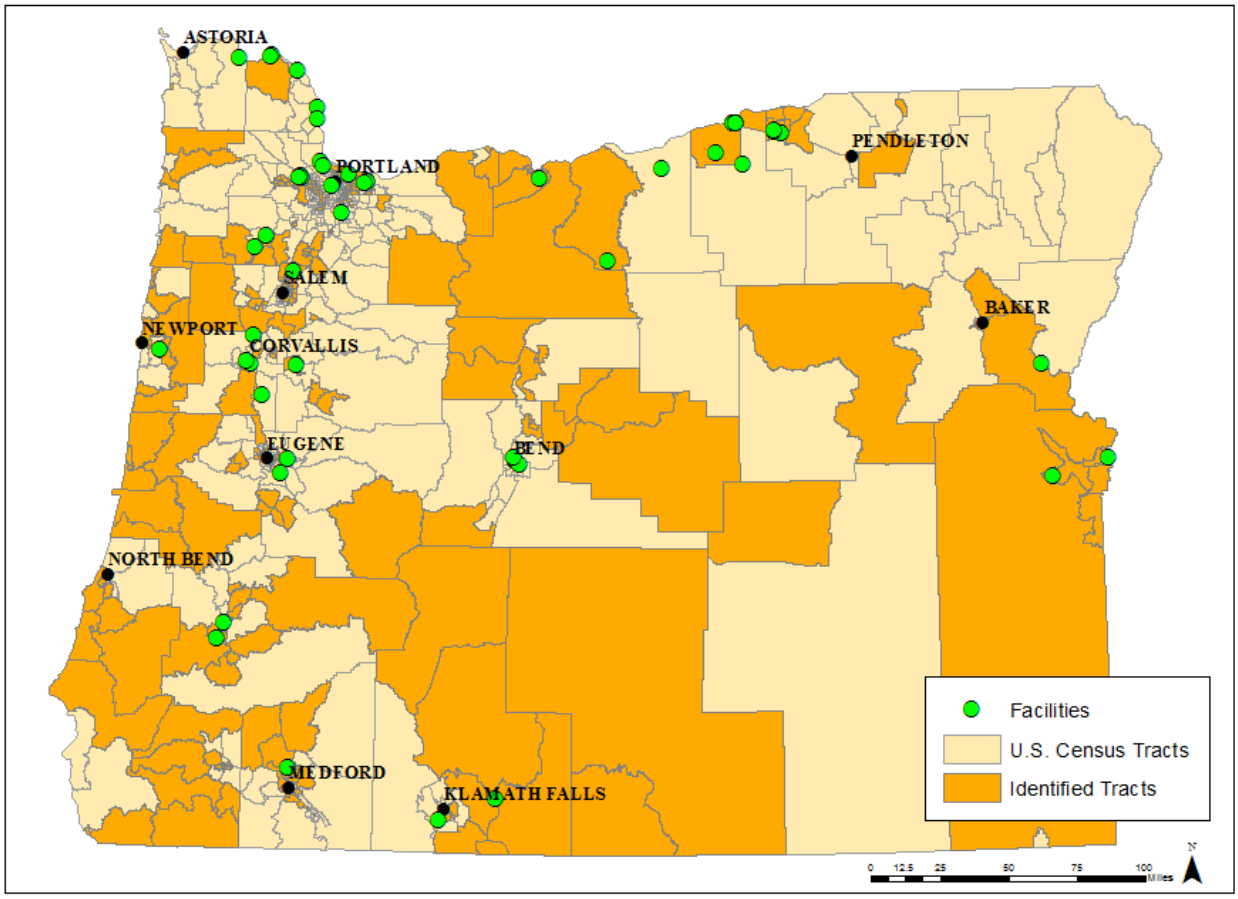

Figure 3: Distribution of Greenhouse Gas Emitting Facilities in Relationship to U.S. Census Tracts Identified as Most Vulnerable to Climate Change. *All facilities with Air Quality Permits from the Oregon Department of Environmental Quality that produced over 25,000 metric tons of CO_2e emissions in 2015. Data source: Oregon Department of Environmental Quality 2015 Greenhouse Gas Facility Emissions (2017b). Most vulnerable to climate change census tracts include the top 50% of census tracts with the highest vulnerability index score.*

Co-Pollutant Hot Spots Recommendations

Current data on existing regulated point source facilities in Oregon do not indicate critical hot spot concerns. However, we strongly recommend that additional co-pollutant data be collected for facilities regulated within the proposed greenhouse gas cap-and-trade policy to properly monitor the potential for localized concentrations (or hot spots) of co-pollutant emissions, particularly in the communities most vulnerable to climate change. In addition, we propose that careful attention be paid to the siting of new facilities as well as the expansions of existing facilities to avoid the future development of co-pollutant hot spots. Finally, while mobile emission sources and smaller emitters (under 25,000 metric tons of CO_2e emissions) are not the focus of this analysis, continued attention should be paid to them to alleviate concentrations of harmful co-pollutants from these sources.

Community Benefits and Distribution

Sharing the benefits accrued through the creation of GHG carbon pricing programs with the communities most vulnerable to impacts of climate change is essential to meeting equity goals in public policy. These co-benefits include the general health benefits associated with reducing co-pollutants associated with GHG emissions as well as distributing revenue accrued through carbon pricing programs to those communities most impacted by climate change. In this section we focus on discussing the types of activities and ways to distribute accrued funding akin to California's plan to distribute cap-and-trade auction proceeds (California Climate Investments 2016).

This study focused on the spatial distribution of people vulnerable to the impacts of climate change. The issues that concentrations of individuals face when responding to economic hardship, severe weather, and natural disasters or when addressing the historic siting of environmental hazards near those communities who are least well off is well documented. However, a spatial approach to understanding equity should not preclude programming or benefits distribution to individuals from backgrounds with low socio-economic profiles. The balance between activities that help places where vulnerable people are living and supporting individuals regardless of where they live should be considered when developing programming.

Identifying Activities

Deciding what types of activities to fund from any revenue generated should be driven by the needs of community members most vulnerable to the effects of climate change. Determining how funds would be allocated should incorporate:

- Dedication of resources specifically to those communities most vulnerable to the effects of climate change.
- Diverse representation on decision-making bodies related to the creation and administration of the funds.
- Community participation in developing and identifying projects for funding.
- Ensuring there is accountability and transparency in program delivery.
- Creation of jobs for community members and technical assistance for women- and people of color-owned businesses.

As a starting point to determine what types of programmatic activities might be applicable in Oregon, we asked community experts which types of activities they would like to see supported through funding generated by cap-and-trade programming via a survey.

Types of activities

Multiple types of activities could be supported through funds generated through carbon pricing programs. From individual household activities such as weatherization programs to community based activities such as job training programs, the types of activities could encompass a wide breadth of programs. Affordable housing, adaptation support for individuals or communities whose economies are severely disrupted by climate change, and workforce development were identified as the top priorities for those people who responded to the survey.

Scale of activities

At this stage, we recommend additional work with community groups to understand the scale and scope of any activities that receive support. In the survey sent to community members, there was not wide agreement about whether fewer, more expensive programs such as job training should be funded instead of more expansive, less costly programs such as individual weatherization programs. While there was clear agreement about the top priorities, without giving community members the ability to weight more concrete trade-offs, we hesitate to strongly advocate for one set of activities at a particular scale over another.

Next Steps for Community Benefits

Additional work should be conducted to determine what types of programs or activities should be supported by generated revenue. In California multiple large workshops were conducted across the state to generate input on community benefits. To reproduce something similar in Oregon, additional resources would need to be set aside to conduct these type of workshops effectively. However, we are concerned that Oregon lacks the number of advocacy, environmental justice, or community development organizations that California has across the state. Previous regional planning level work in California makes it conceptually easier to envision hosting large workshops that are well attended in key geographic areas. In Oregon, there may need to be many more workshops at smaller geographic scales to really obtain the type of turn-out necessary for a decision-making workshop. A more comprehensive survey conducted across the state coupled with key stakeholder interviews or focus groups may yield useful outcomes.

Any work to assess what community groups and members would like to see prioritized should also use realistic estimated GHG cap-and-trade program revenues. Asking people if they would like to support job training programs versus weatherization assistance means something different if there is $100,000 to spend or $1,000,000 to spend. People's decisions about what types of activities to support may also change based on how many people will be served versus how many activities can be supported across how much geography. Forced choice questions will help people understand the trade-offs between activities.

We recommend grounded future research on how to best ensure that any generated revenue be allocated in a way that supports the needs of the most vulnerable communities to climate change in Oregon.

Conclusion and Future Work

In this study we constructed an index to assess who is most likely to experience the disparate impacts of climate change. Our index score draws on social determinants of health, and emphasizes the role of demographic factors in shaping peoples' life outcomes, particularly the role of race and income. Because of the scope of possible GHG cap-and-trade legislation (for point source GHG emissions), we did not incorporate metrics related to environmental hazards such as flooding or economic measures related to local economies likely to be disrupted by climate change. Future work should explore the incorporation of these metrics. Such work takes on increased importance given the unique situation of Native American reservations and Native Americans living off reservation in rural communities, as many of these individuals live a subsistence life-style that will be impacted by climate change but not likely reflected in demographic census metrics related to unemployment or income. Additional metrics related to transportation and housing cost burden could also uncover additional meaningful vulnerability.

We also examined the possible issues related to hot spots. Current data on existing regulated point source facilities in Oregon do not indicate critical hot spot concerns. However, we strongly recommend that additional co-pollutant data be collected for facilities regulated within the proposed greenhouse gas cap-and-trade policy to properly monitor the potential for localized concentrations (or hot spots) of co-pollutant emissions, particularly in the communities most vulnerable to climate change. In addition, we propose that careful attention be paid to the siting of new facilities as well as the expansions of existing facilities to avoid the future development of co-pollutant hot spots. Finally, mobile emission sources and smaller emitters (under 25,000 metric tons of CO_2e emissions) are not the focus of this analysis, and continued attention should be paid to them to alleviate concentrations of harmful co-pollutants from these sources.

Lastly, we researched how to allocate community benefits. While we found broad agreement about the types of activities that community experts would like to see supported (housing and economic development), we found less agreement about the scale of those activities. We recommend that additional research be conducted based on realistic projections of revenues to help community members better understand and envision trade-offs between options.

The framing for this research focused on providing Oregonians an accessible way to understand the disparate impacts of climate change, and how GHG cap-and-trade programming could potentially help address those effects. We believe this work lays the foundation for additional research to ensure that those Oregonians most vulnerable to the effects of climate change receive the support and protection they need and deserve.

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