

**Program Evaluation:**  
**Needs Assessment for Colorado's Environmental Justice Act**

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## **Introduction**

Colorado has a history of environmental justice issues related to industrial pollution and Superfund sites (Beaty, 2018), oil and gas extraction (Sakas, 2020), refineries (Brasch, 2021), and evidence of redlining through anti-Indigenous, anti-immigrant, anti-Hispanic, or anti-Black laws (Penney, 2020). In 2021, Colorado passed the Environmental Justice Act HB21-1266, referred to as “the Act”, to address environmental injustice for disproportionately impacted communities, referred to as “DICs.” The Act creates an Environmental Justice Task Force within the Department of Public Health and Environment that is responsible for defining, identifying, and engaging with DICs to research environmental remediation projects for these areas, and directs the Air Quality Control Commission to establish new fees to pay for engagement with DICs and remediation efforts (EJDICS, 2021). This needs assessment will examine the inequality that the Act intends to address with an analysis of the types of environmental injustice that exist in Colorado, their reasons for existence, and evaluate the Act’s plan to engage with and remediate DIC areas using a logic model.

## **Literature Review**

For this needs assessment, it is important to understand the geographic distribution and history of environmental injustice. Banzhaf et al. (2019a) describes two ways to approach environmental justice as either distributive or procedural justice. Distributive justice is the analysis of the distribution of environmental pollution according to race, income, and other demographic variables (Banzhaf et al., 2019a). Banzhaf et al. (2019a) notes that the distribution of pollution has been correlated to race and income in many studies but found manufacturing employment to be a confounding variable as manufacturing is often located in low-income areas and employs low-income workers. Procedural justice is the analysis of what policies or

community actions led to the inequitable distribution (Banzhaf et al., 2019a). Procedural justice is often linked to the historical power structures that determine where people live, as well as the political power of communities (Banzhaf et al., 2019a).

In Colorado, it is helpful to understand the economic underpinnings of how people “site and sort” themselves when faced with environmental pollution. Banzhaf et al. (2019b) examined the procedural causes of environmental justice using the Coasean framework, which posits that an economically efficient allocation of pollution in a community is determined by the community’s “willingness to accept” a level of pollution in exchange for compensation. Banzhaf et al. (2019b) found that communities that are unable to effectively organize often accept compensation that is too low and does not capture the full effect of the pollution. Reasons for poor organization include lack of funding, education, or limited political access (Banzhaf et al., 2019b). There is also disparity in the equity outcomes of government actions for communities affected by pollution, where Banzhaf et al. (2019b) found that government action to alleviate unequal distribution has in certain cases had the opposite effect, due to lower-income households typically spending more on pollution-intensive goods, such as fuel and electricity, and working in polluting industries.

One aspect of environmental justice is the geographic distribution of environmental costs versus economic benefits. Mischen & Swim (2020) examined this distribution in the context of hydraulic fracturing, or “fracking”, in Pennsylvania and found that 15 of the 26 public managers explicitly recognized there was distributional benefits-sharing inequity from fracking, with a few members of the community receiving most of the economic benefits, and those closest to the pollution bearing most of the burden. This type of inequity is important for Colorado as there are

over 50,000 fracking wells in the state and the “siting and sorting” (Banzhaf et al., 2019b) of these wells is important for establishing inequitable distribution and identification as a DIC.

Government can respond to environmental justice in several ways, including regulations to protect impacted areas, cleanup and remediation activities, and fining polluters. Liang et al. (2020) studied the policy outputs of the EPA in the context of these independent variables: minority bureaucratic representation, social vulnerability, the environmental policy problem, and found that minority representation in the EPA workforce and public administrators significantly impacts the equity of policy outputs. This finding is relevant to the Act’s Environmental Justice Task Force in terms of who is chosen to be a member and the overall demographic composition of the Task Force.

### **Stakeholders**

Stakeholders that are affected by the Environmental Justice Act include communities labeled as DICs, as well as communities that have experienced environmental injustice but are not captured by the definition of DIC. Industry stakeholders include companies that will pay fines on greenhouse gas emissions and fines for being located near DICs, as well as their employees, who may or may not be a member of a DIC community. Government stakeholders include the newly created Environmental Justice Task Force and the Colorado Air Quality Control Commission, who will administer the new fees.

### **Program Description**

The Act’s primary goal is to alleviate environmental injustice for DICs, and it defines DICs as “A community that is in a census block group where the proportion of households that are low income, that identify as minority, or that are housing cost-burdened is greater than 40%; or any other community as identified or approved by a state agency, if the community: Has a

history of environmental racism perpetuated through redlining, anti-Indigenous, anti-immigrant, anti-Hispanic, or anti-Black laws; or is one where multiple factors may act cumulatively to affect health and the environment and contribute to persistent disparities” (EJDICS, 2021).

The Act has three main directives. First, it creates an Environmental Justice Task Force whose objective is to conduct research and interviews about environmental injustice in DICs, refine the definition of DIC areas, and propose recommendations to the general assembly for remediating environmental inequities (EJDICS, 2021). Second, it requires the Air Quality Control Commission to establish an annual greenhouse gas fee to be applied as part of existing APEN notices and allocates the collected funds to be used for administration of the Task Force (EJDICS, 2021). Third, the Act requires the Air Quality Control Commission to adopt fees that apply to permits for sources of pollutants that cause or contribute to significant health or environmental impacts in DICs (EJDICS, 2021). Since the Act was passed in 2021 and is in the implementation stage, as of the writing of this needs assessment the only actions that have been taken are to appoint members to the Task Force and begin research and engagement with DICs.

### **Evaluation Design**

This needs assessment will evaluate the scope and extent of pollution areas, the distribution of pollution-related risks, and the definition of DICs to assess whether the Act and creation of Environmental Justice Task Force sufficiently addresses environmental injustice in Colorado.

### **Definition of Problem**

The Environmental Justice Act is predicated on the perception that environmental pollution exists in Colorado, is distributed unequally, and is correlated with increased health risks in DICs. The theory of action of the Act is that to address environmental injustice, Colorado

can engage with DICs to remediate environmental pollution and increase the cost of polluting.

The theory of change for the Act is that by engaging with DICs and remediating environmental injustice, health risks linked to pollution can be decreased in DICs.

### **Scope and Extent**

To determine the scope and extent of inequitable pollution distribution and health risks, I will ask these 3 questions using data from the EPA EJScreen database (*EJScreen*, n.d.): 1) Is there evidence of pollution in low-income and minority areas; 2) Are low-income and minority areas more likely to be located near fracking wells and pollution sites; 3) Are there greater pollution-related health risks associated with low-income and minority areas?

### **Target Population**

To assess whether the Act sufficiently targets the appropriate population in their definition of Disproportionately Impacted Community, I will use EJScreen data to compare block groups that qualify as a DIC with block groups that are proximally located to fracking and pollution sites. Block groups that do not fit the definition of DIC but are located near fracking and pollution sites will be identified and investigated.

### **Characteristics of the Problem and Target Population**

To assess characteristics of low-income and minority that have high levels of pollution-related health risks I will examine each block groups' levels of manufacturing employment using Bureau of Labor Statistics data.

### **Evidence**

To answer the questions in the Evaluation Design I will be using data collected from three online sources. *EJScreen* (n.d.) is a database and mapping tool created by the EPA that combines environmental and demographic indicators. It includes variables such as an index

computed from percent low-income and people of color, air, water, and traffic pollution, and proximity to pollution sites. FracTracker.org. (n.d.) is an organization that tracks fracking wells across the U.S. and has created a database of fracking locations with latitude and longitude coordinates. My third data set is taken from the U.S. Bureau of Labor Statistics' Quarterly Census of Employment and Wages yearly average for 2020 (*QCEW Data Files*, n.d.).

There are no common keys between these data sets, so comparison was done by using GIS functions to match latitude/longitude points of fracking wells within census block group polygons in the EJScreen data. To compare BLS data to EJScreen, I calculated the percent DIC for each FIPS in the EJScreen data and joined to BLS FIPS codes.

These three data sets were uploaded to a PostgreSQL PostGIS database and accessed using the sqlalchemy package (Bayer, 2012) from a python Jupyter Notebook as well as QGIS mapping application. These are all public data sets and there is no non-public information in any of the data. Statistics were calculated using the python Pandas package (Pandas, 2010).

### **Justification of Conclusions**

#### **1. Is there evidence of pollution in low-income and minority areas?**

Using data from *EJScreen* (n.d.), I did not find any strong correlations between low-income and minority areas with areas of air, water, or traffic pollution, with the highest R value occurring for levels of diesel particulate matter at 0.25. However, when variable "VULEOPCT," an index based on percent low-income and percent people of color, was binned into quartiles with group-wise averages, I found that diesel particulate matter, PM2.5 concentrations, pollution discharge into water, and traffic pollution had higher averages in the 4<sup>th</sup> quartile. Notably, diesel particulate matter in quartile 4 was 37% higher than quartile 3, and pollution discharge into water in quartile 4 was 127% higher than quartile 3. See Appendix 1 and 2.

## **2. Are low-income and minority areas more likely to be located near pollution sites fracking wells?**

Using data from *EJScreen* (n.d.), I found the highest correlation between proximity to pollution and the VULEOPCT income and people of color index to be the Risk Management Plan facilities variable, with an R value of 0.36. Notably, the fourth quartile group averages for the three proximity to pollution variables were 35% to 90% higher than quartile 3 group averages. See Appendix 3 and 4.

Using data from *EJScreen* (n.d.) joined to fracking well locations provided by FracTracker.org. (n.d.) I found a negative correlation of -0.012 between the low-income and people of color index VULEOPCT and the number of fracking wells in a block group. When VULEOPCT is broken into quartiles, the mean number of wells per block group is highest in quartiles 2 and 3. See Appendix 7.

## **3. Are there greater pollution-related health risks associated with low-income and minority areas?**

Using data from *EJScreen* (n.d.), I found the correlation between the low-income and people of color block area index and the air toxics cancer risk to be 0.13, and correlated to air toxic respiratory hazard at 0.24. When broken down by quartile, the correlation for each quartile was less than the overall correlation. The quartile averages for airborne toxic cancer risk and respiratory hazards were highest in quartile 4 of the low-income and people of color index, but not significantly higher than quartiles 1 to 3. See Appendix 5 and 6.

## **4. Does the definition of DIC capture all the communities that are experiencing environmental injustice?**



Using data from *EJScreen* (n.d.) joined to fracking well locations provided by FracTracker.org. (n.d.) I found 185 block groups that had fracking wells but did not fit the definition of DIC. As expected, none of quartile 4 of VULEOPCT are in this list. Notably, quartile 3 of VULEOPCT did not have the highest average levels of cancer risk or respiratory hazard, but did have the highest average number of fracking wells. See Appendix 8.

### **5. Is the average manufacturing employment for DICs higher than non-DICS?**

To answer this question I joined *EJScreen* (n.d.) data with annual averages of employers and employment from U.S. Bureau of Labor Statistics for 2020 (*QCEW Data Files*, n.d.) on their respective FIPS codes. I found a correlation of 0.25 for number of employers and percent DIC, and a correlation of 0.32 for number of employees and percent DIC.

### **6. Conclusions**

There were some common trends in the data for existence of pollution and proximity to pollution, where a strong correlation could not be obtained from the overall data set, but when binned into quartiles based on the percent low-income and people of color index, the highest quartile (low-income and people of color) also had the highest group average (highest average pollution or proximity). However, while the strength of the correlation in this study was relatively low for all variables, and none broke an R value of 0.50, the cutoff for what is considered a strong correlation should be examined further in these cases. The most notable finding from the proximity analysis was the difference between the averages for quartile 3 and 4, where quartile 4 was 35% to 90% higher. It should also be noted that the existence of fracking wells was not strongly correlated to areas of low income and people of color.

The analysis of the DIC target population compared to counts of fracking wells found that quartile 2 of the low-income and people of color index had the highest number of wells with

some outliers in the thousands of wells per block group. However, since EJScreen only has airborne cancer risk, we cannot evaluate if the high number of wells are contributing to any other health issues in those areas. For average manufacturing employment in Colorado, we found a relatively low correlation of 0.32 between DIC designation and number of manufacturing employees.

To further investigate the likelihood of low-income and people of color areas situated in polluted areas, I would recommend a regression model with demographic and employment data as predictors for location in a polluted area. Also, further study could be done using cancer rate data other than the airborne toxins cancer risks provided by EJScreen to provide a more comprehensive health linkage between pollution sites and demographics.

### **Ensure use and Share Lessons**

To ensure use and share lessons from this needs assessment, a fact sheet will be created and sent to the Environmental Justice Task Force. It will have the statistics listed above, as well as maps designating cancer risk, pollution sites, and fracking wells. The information will not be highly technical and will be in an easy-to-read format. Another way to share this data is through a web app dashboard similar to the EJScreen mapping tool. Since the data is already cleaned and housed in a database, it would only require a front-end design using Tableau or PowerBI, or a web app platform, to create maps with simple controls and reports.

### **Logic Model**

The below logic model describes the Colorado Environmental Justice Act from inputs to impact. The Environmental Justice Task Force's main impact goal is to reduce pollution-related health risks and cancer statistics in DIC areas, as well as reduce inequitable distribution of pollution in DIC areas. It will appoint members and use funds from APEN greenhouse gas fees

and fees for polluting in DIC areas to appoint members and hire a support staff. Their activities and outputs contribute towards identifying polluted DIC areas, presenting the Colorado General Assembly with a cleanup plan for the area, and then monitoring the short-term cleanup work as well as census block group statistics in cleanup areas. The attention given to polluted DIC areas by the Task Force will help keep the cleanup of these areas on the political agenda, as well as providing a formal resource within the Department of Public Health and Environment for addressing environmental justice issues.

The greenhouse gas APEN fees and the fee for polluting in a DIC area will fund the Environmental Justice Task Force efforts, as well as provide long-term funding and economic disincentives for polluting.

Colorado Environmental Justice Act Logic Model					
Objective	Inputs	Activities	Outputs	Outcomes	Impacts
<b>Environmental Justice Task Force</b>	<ul style="list-style-type: none"> <li>- Appoint members</li> <li>- Funds from APEN and DIC industry fees</li> </ul>	<ul style="list-style-type: none"> <li>- Identify Disproportionately Impacted Communities (DICs)</li> <li>- Community Meetings and interviews with DICs</li> <li>- Evaluate EJ research</li> </ul>	<ul style="list-style-type: none"> <li>- Present DIC areas that are in need of remediation to the CO General Assembly</li> <li>- Present cleanup plan for polluted DIC areas</li> <li>- Outcome monitoring for remediation sites</li> </ul>	<ul style="list-style-type: none"> <li>- Short-term cleanup of polluted DIC areas</li> <li>- Awareness and monitoring of polluted DIC areas that have not yet received cleanup activities</li> <li>- Reduced number of polluted DIC sites due to cleanup activities</li> <li>- Educated Env Justice Advocates with a</li> </ul>	<ul style="list-style-type: none"> <li>- Reduced pollution-related health risks and cancer rates for DIC areas.</li> <li>- Reduced environmental pollution inequity in areas defined as DIC</li> </ul>
<b>Greenhouse Gas APEN Fees</b>	<ul style="list-style-type: none"> <li>- Set up system to identify greenhouse gas emissions for APEN notices</li> <li>- Staff and resources to administer fee</li> </ul>	<ul style="list-style-type: none"> <li>- Issue fee for GHGs in APEN Notices</li> </ul>	<ul style="list-style-type: none"> <li>- Fees paid to community impact cash fund</li> </ul>	<ul style="list-style-type: none"> <li>- Long-term funding for Task Force and remediation activities</li> </ul>	<ul style="list-style-type: none"> <li>- Economic incentive to reduce GHG emission</li> <li>- Market failure remediation for GHG polluters</li> </ul>
<b>Fees for polluting industries located in Disproportionately Impacted Communities</b>	<ul style="list-style-type: none"> <li>- Set up system to identify polluting industries in DIC areas</li> <li>- Hire staff and allocate resources to administer fee</li> </ul>	<ul style="list-style-type: none"> <li>- Issue fee for polluting in DIC areas</li> </ul>	<ul style="list-style-type: none"> <li>- Fees paid to community impact cash fund</li> </ul>	<ul style="list-style-type: none"> <li>- Long-term funding for Task Force and remediation activities</li> </ul>	<ul style="list-style-type: none"> <li>- Economic incentive to reduce pollution in DIC areas</li> <li>- Market failure remediation for pollution in DIC areas</li> </ul>

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## Appendix

### 1. Correlation between low-income and minority (VULEOPCT) areas with pollution levels

Metric	R	R-squared
Diesel PM	0.25132381	0.063163660
OZONE	-0.197416	0.038973069
PM25	0.14417288	0.020785819
Water discharge	0.00882052	0.000077801
Traffic	0.18371157	0.033749942

### 2. VULEOPCT quartile averages for air, water and traffic pollution

quartile	Diesel PM	OZONE	PM25	Water Discharge	Traffic
1	0.40442066	54.0447865	6.85962718	0.64919424	397.737035
2	0.41670812	53.0061296	6.79151487	0.78471275	532.947822
3	0.45012378	52.5520966	6.82113928	0.42466444	651.941351
4	0.61801664	52.5149404	7.26606722	0.96632146	847.997237

### 3. Pollution proximity correlated to low-income and minority areas

Metric	R	R-squared
Proximity to National Priorities List (NPL) sites	0.2744749	0.07533647
Proximity to Risk Management Plan (RMP) facilities	0.36447774	0.13284402
Proximity to Treatment Storage and Disposal (TSDF) facilities	0.20771164	0.04314412

### 4. VULEOPCT quartile averages for pollution proximity

quartile	PNPL	PRMP	PTSDF
1	0.08040713	0.4069577	0.84222469
2	0.0884956	0.48853899	0.99547832
3	0.09500036	0.62391493	1.08255638
4	0.18118938	1.16753326	1.46341074

### 5. Health Risk Correlation by VULEOPCT quartile

quartile	CANCER	RESP
1	0.03974623	0.05886157
2	0.00491518	-0.01685054
3	0.02647671	0.08755742
4	0.04764076	0.19779522

### 6. Health risk average by VULEOPCT quartile

quartile	CANCER	RESP
1	24.6731916	0.31071314
2	25.4697833	0.31421568
3	27.2449976	0.33105717
4	30.3423626	0.38428279

### 7. Mean number of wells per block group by VULEOPCT quartile

quartile_label	NUMPOINTS
1	4.17727273
2	15.4391354
3	15.0659841
4	7.51422071

### 8. Non-DIC average health risks, proximity to pollution, and number of fracking wells

quartile	MINORPCT	LOWINCPCT	CANCER	RESP	PNPL	PRMP	PTSDF	numpoints
1	0.12	0.10	25.84	0.39	0.03	0.29	0.30	56.25
2	0.15	0.24	20.52	0.29	0.04	0.35	0.17	156.36
3	0.29	0.29	22.44	0.34	0.02	0.59	0.19	258.58
4	NA	NA	NA	NA	NA	NA	NA	NA