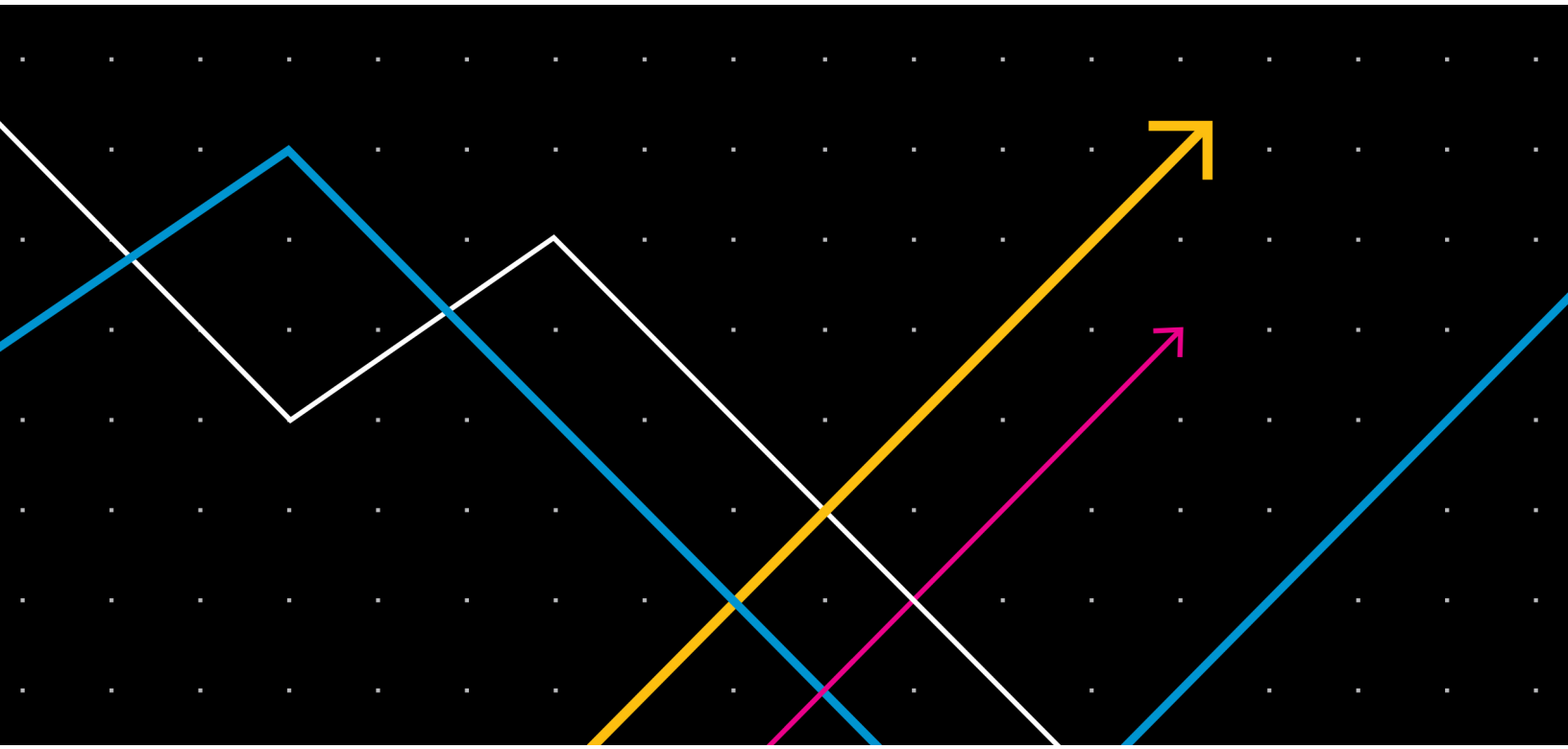

RESEARCH REPORT

Screening for Environmental Justice

A Framework for Comparing National, State, and Local Data Tools

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Screening for Environmental Justice

By many accounts, the modern environmental justice movement was born in the 1980s, sparked by community opposition to a proposed toxic waste site in Warren County, North Carolina.[1] At the time, Warren County had the highest proportion of Black residents in the entire state. Many assumed the siting was no coincidence, but not until the release of the landmark *Toxic Wastes and Race in the United States* report in 1987 were these suspicions confirmed on a grander scale—nationwide, the report found that three out of five Black and Hispanic residents lived in communities with uncontrolled toxic waste sites (United Church of Christ 1987).

The report sparked increased attention from both policymakers and the public, leading to the establishment of the Office of Environmental Justice at the US Environmental Protection Agency (EPA) in 1992. Two years later, President Clinton issued Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," directing federal agencies to develop strategies for implementing environmental justice and to "identify and address the disproportionately high and adverse human health or environmental effects of their actions on minority and low-income populations."[2]

But disparities in exposure to environmental hazards continue to persist today. Black residents are exposed to disproportionate amounts of air pollution (Tessum et al. 2021), Hispanic communities are more likely than predominantly white communities to experience natural gas flaring events at fracking sites (Johnston et al. 2020), and communities of color nationwide are more likely to live near hazardous brownfield sites.[3]

To remedy these disparities and renew the federal government's commitment to environmental justice, in January 2021, President Biden issued Executive Order 14008, "Tackling the Climate Crisis at Home and Abroad." The order called for a "government-wide approach" to tackling the climate crisis and directed federal agencies to "make achieving environmental justice part of their missions." It also established the Justice40 Initiative, an effort to direct 40 percent of the overall benefits from federal investments in climate, clean energy, and related areas to communities identified as "disadvantaged" on the basis of not only exposure to pollution and other environmental hazards but also levels of socioeconomic distress, vulnerability to the impacts of climate change, and other related factors.[4] In addition, the order directed the Council on Environmental Quality to create the geospatial Climate and Economic Justice Screening Tool (CEJST) to aid federal agencies in identifying communities to prioritize. A beta version of the tool was released in February 2022.[5]

CEJST is the latest in a long line of environmental justice data tools, following the general trend of increased usage of data dashboards and other information management and visualization tools for policymaking (Matheus, Janssen, and Maheshwari 2020). In this report, we provide a comprehensive review of existing national, state, and local screening tools as well as propose an analytical framework through which they can be compared. In doing so, we aim to highlight best practices and offer recommendations on how screening tools can be improved to equitably advance environmental justice goals. The remainder of the report is structured as follows:

- Part 1 traces the history of environmental justice data tools and their usage.
- Part 2 describes our analytical framework for comparing the tools based on their ability to advance environmental justice.
- Part 3 reviews the main findings from our analysis.
- Part 4 provides recommendations on ways that current and future tools can be improved and makes suggestions for future research.

A Brief History of Environmental Justice Data Tools

Research and data have been integral to the environmental justice movement since its early years. In 1982, Warren County protester Walter Fauntroy, the then-chair of the Black Congressional Caucus, requested the General Accounting Office (GAO) study the effects of hazardous waste landfill construction on communities of color.[6] A year later, the GAO published a study revealing that three of the four primary hazardous waste landfill sites in the eight southeastern states constituting the EPA's region IV were located in communities in which a majority of individuals were Black and more than one-quarter had incomes below the federal poverty level (GAO 1983). Combined with the United Church of Christ's report, this research confirmed the prevalence of environmental racism, which results in communities of color being disproportionately harmed by pollution and other environmental hazards (see box 1).

While region- and industry-specific studies are crucial to determining the extent of environmental harm, the federal government is also uniquely suited to provide nationally consistent data that can reveal areas of environmental injustice. The EPA made its first attempt to gather such a dataset in 2015, when it publicly released the Environmental Justice Screening and Mapping Tool, or EJScreen.[7] The EPA refers to EJScreen as a "pre-decisional screening tool" and discourages its use for definitively designating environmental justice communities, recommending instead that users supplement the tool

with local knowledge and additional data sources and analysis (EPA 2019). EJScreen assigns communities several "EJ indexes," which it calculates by combining each of its 12 environmental indicators with a demographic index that measures how a community's low-income and minority populations differ from the national average. The tool divides communities according to census block groups, which are divisions of census tracts that contain between 600 to 3,000 people.

Although the development of EJScreen marked the largest aggregation of national environmental hazard data to date, many have recognized the tool's data limitations. Because the EPA aimed to create a tool with consistency in data quality throughout the country, EJScreen does not include information on some key environmental justice indicators that are only available for certain geographies or lack the appropriate granularity, such as the quality of local drinking water (EPA 2019). Furthermore, the Facilities Registry Service environmental records database, which powers EJScreen, lacks records for all states and completeness for some states that do report to it, including information that is crucial to local actors, such as voluntary cleanup sites and state Superfund sites.[8]

Some states and localities have responded to the need for robust environmental justice data by developing their own tools with more granular data that speak to their unique environmental issues. The California Environmental Protection Agency (CalEPA) has led this effort, creating CalEnviroScreen in 2013 as part of its environmental justice program. The tool assigns each census tract an overall score, which it calculates by aggregating subscores for "Pollution Burden" and "Population Characteristics." Although the tool itself does not include race, it is accompanied by a supplemental race analysis that demonstrates how communities of color disproportionately reside in highly impacted communities (CalEPA 2018, 2021).

Unlike EJScreen, CalEnviroScreen is explicitly designed to inform agency action by "identify[ing] communities that face multiple burdens of pollution and socioeconomic disadvantage." In May 2022, CalEPA designated certain communities to receive a legislatively determined amount of proceeds from California's cap and trade program. The communities included census tracts falling within the highest quartile of CalEnviroScreen scores, which reflects communities most burdened by environmental and other harms. Multiple agencies and programs in California now use CalEnviroScreen,[9] and CalEnviroScreen has also influenced many other state- and local-level environmental justice (EJ) tools.[10]

CEJST, developed by the White House Council on Environmental Quality, marks a new chapter in the federal government's use of environmental justice tools because it will serve as the basis for allocating billions of dollars in federal investments through the Justice40 Initiative. The current version

of the tool, which is still in beta as of this report's publication, does not score census tracts but instead makes a binary determination of whether or not tracts are considered "disadvantaged." To qualify as "disadvantaged," a tract must meet thresholds for socioeconomic indicators as well as thresholds for at least one of eight environmental and climate indicators.

One of the most common criticisms of CEJST is its omission of race, which results in the failure to recognize how racially disparate environmental impacts are at the core of environmental justice concerns (McTarnaghan et al. 2022). Other critiques focus on additional omissions, such as the tool's lack of forward-looking indicators (which may downplay effects of climate change), indicators on industrial facility compliance with federal environmental protection laws, and indicators on the presence of fossil fuel–related industries.[11] Finally, given CEJST's binary designation of disadvantaged communities, there is concern that the tool does not recognize cumulative harms, and thus does not prioritize severity for communities that suffer from the highest levels of exposure to environmental hazards and possess the greatest economic and public health burdens (McTarnaghan et al. 2022).

In the past several years, many more states, localities, and community-based organizations have started to create their own environmental justice tools and maps. To date, at least 12 state governments have created their own tools, and several more have been created by localities, environmental justice organizers, universities, and research organizations. While tools range in complexity and functionality, a typical tool includes data on a combination of environmental risks and other socioeconomic and health information for a set of geographic areas, often accompanied by calculated scores or indexes derived from those data.

In addition to the measures that explicitly factor into the identification of EJ communities, some tools also provide additional information (often referred to as *context information* or *context layers*) that is overlaid or presented alongside what is used in calculations, such as transit access, housing conditions, and other details that might help decisionmakers prioritize investments. Tools are being developed at a rapid pace; at least eight tools analyzing state-level environmental data have been published since 2021, and at least three other state governments are in the process of developing tools.[12]

BOX 1

Defining Key Terms

Bryant (1995) defines **environmental justice (EJ)** as "refer[ring] to those cultural norms and values, rules, regulations, behaviors, policies, and decisions to support sustainable communities, where people

can interact with confidence that their environment is safe, nurturing, and productive. Environmental justice is served when people can realize their highest potential . . . Environmental justice is supported by decent paying and safe jobs; quality schools and recreation; decent housing and adequate health care; democratic decision-making and personal empowerment; and communities free of violence, drugs, and poverty. These are communities where both cultural and biological diversity are respected and highly revered and where distributed justice prevails." This definition of EJ goes beyond the EPA's definition[13] and emphasizes the need for legal and policy remedies addressing historical and systemic harms of **environmental racism**, which Bullard (1993, 23) defines as "any policy, practice, or directive that differentially affects or disadvantages (whether intended or unintended) individuals, groups, or communities based on race or color."

We use the term **EJ community** to refer to the communities that tools designate as being communities of interest, whether because they are most at risk of being impacted by environmental harms or because they are overburdened and underserved. These communities stand to benefit most from EJ-focused remedies. Because of systemic and environmental racism, these communities are generally more likely to be communities with low incomes or communities of color. However, the specific definitions vary across tools, and the tools employ a variety of terms for these communities, including "environmental justice population" (Massachusetts), "overburdened communities" (New Jersey), and "potential EJ areas" (New York).

Our working definition of an **EJ data tool** or **EJ screening tool** is an interface that combines environmental, health, socioeconomic, and/or demographic information, often overlaid in an interactive mapping format, to assist policymakers, researchers, and communities with decisionmaking in pursuit of environmental justice. Many of these tools perform screening functions; these tools explicitly identify EJ communities and the specific vulnerabilities those communities face according to criteria and indicators that are visible in the tool. Other tools provide decisionmakers with descriptive or contextual information, rather than making specific EJ designations.

A Proposed Framework for Comparing Environmental Justice Data Tools

The creation of tools that help identify environmentally burdened communities to prioritize for resource allocation is a fundamental first step to incorporating environmental considerations in place-based decisionmaking. Place-based policy takes into account local context and aims to improve quality of life and access to opportunity for people who live in neighborhoods, cities, and rural communities experiencing disinvestment. As many more states, localities, and community-based organizations seek to improve or create their own environmental justice tools and maps, it is important to understand

how different aspects of tool development can impact outcomes for overburdened groups that are disproportionately composed of people with low incomes and people of color.

Existing studies have offered different approaches for comparing national and state EJ data tools, focusing variously on the development process and how tools have been used in practice. Researchers at the University of Michigan, for example, reviewed state-level EJ screening tools and conducted in-depth interviews with nearly 30 stakeholders across the US to learn about the utility of employing such tools to advance environmental justice goals (Zrzavy et al. 2022). The New School has compiled a table that includes proposed and enacted environmental justice legislation at the local, state, and federal levels, as well as the definitions for EJ communities under each policy or law.[14] In addition to descriptive and qualitative research focused on the development process, existing work also touches on best practices in incorporating such tools to improve government decisionmaking based on insights from a handful of state and national tools (Arriens, Schlesinger, and Wilson 2020).

However, there does not yet exist a comprehensive review of all existing EJ data tools that encompasses development, the data used, and how environmental burdens are quantified and communities are prioritized. Hence, in this report, we develop a framework to compare and assess 31 national, state, and local EJ data tools across a number of dimensions. We explore the specific data sources used, the tools' methodologies for identifying EJ communities, the development process, and the intended uses. We compile most of this information in an accompanying Airtable. Our aim in doing so is to identify current limitations and opportunities for future investment in new or existing national, state, and local EJ tools to promote data-driven decisionmaking that advances environmental justice.

Research Methods

For data tools to be both useful in identifying the full spectrum of environmental burdens that communities face and actionable for policymakers and other decisionmakers, they need to take into account exposure to chemical and nonchemical environmental stressors as well as how these stressors impact the lives of individuals and communities. We considered five key themes that are crucial to accurately identify the environmental burdens faced by different communities as well as the need to prioritize community input and expertise in identifying and quantifying those burdens. The five themes emerged from our scan of national, state, and local tools and illustrate our proposed framework for comparing EJ data or screening tools.

Data Sources

As the foundation for any type of data tool, underlying data should accurately reflect the current state of communities. Information that is outdated, not easily accessible, or of low granularity hinders the identification of risks and possible actions to mitigate those risks. We compared the specific data sources used to present various environmental, socioeconomic, and health indicators; where they come from; how frequently they are updated; and the geographic units associated with the data. In addition, we considered whether tools were subject to possible bias against rural and tribal communities in their choices of what data to collect and how to present it. We discuss these matters in more detail in the following analysis section.

Race and Ethnicity

President Biden's Justice40 Initiative, along with EJ legislation in some states, specifically acknowledges the environmental burdens in marginalized, overburdened, and underserved communities, which are disproportionately communities of color due to systemic environmental racism. It is important for EJ data tools to acknowledge the link between race and environmental injustice. The first step toward documenting this correlation is to explicitly factor in race when identifying communities to prioritize. We assessed each tool for whether it includes data on race and ethnicity, either as context information or as an indicator used in the identification of EJ communities. We also noted whether a tool breaks down race and ethnicity beyond a basic "minority/nonminority" binary.

Quantifying Burdens

Data tools often identify EJ communities using multiple indicators capable of reflecting the various burdens these communities experience. We grouped these indicators in three main categories: environmental, socioeconomic and access to opportunity, and physical health. We categorized environmental indicators into air quality, water quality, climate vulnerabilities and natural hazards, and other pollutants. The indicators contained in each category are not meant to be comprehensive of all major environmental metrics that may be of relevance; instead, we sought to catalog the most commonly used areas of measurement among the tools that we scanned.

Further, our groupings do not necessarily correspond to the way tools have categorized their data for the purpose of identifying EJ communities. For example, CEJST groups together an environmental indicator (lead paint) with socioeconomic indicators (median home value and housing cost burden)

under its "affordable and sustainable housing" category. CalEnviroScreen divides environmental indicators into potential environmental exposures (from pollutants such as ozone and drinking water contaminants) and the effects caused by those pollutants (such as the presence of impaired water bodies).

All the tools that we scanned relied on multiple indicators to identify EJ communities, ranging from just two indicators to upwards of 45. We classified the tools' methodologies for aggregating data across indicators into two general approaches: "composite" and "not composite." We consider a tool's approach to be composite if it considers multiple indicators in conjunction with one another, by, for example, taking the average of values across indicators. Conversely, we consider a tool's approach to be not composite if it considers indicators individually without a method of aggregation.

For example, New Jersey's EJMAP tool identifies "overburdened communities" as census block groups that have a significant proportion of low-income households *or* a significant proportion of "minority" or tribal residents *or* a significant proportion of households with limited English proficiency.[15] In contrast, California's CalEnviroScreen tool identifies EJ communities based on a score calculated by taking the weighted average of 21 environmental, health, and socioeconomic indicators. We classify the former as not composite and the latter as composite.

Differentiating between methods of quantifying burdens in this way is necessary to understand how a tool might assess cumulative burdens, which acknowledges that environmental, economic, health, and other stressors are often interdependent and so often coexist if not compound.[16] Some argue that the composite approach can more effectively account for the cumulative burdens that some communities bear (Fu, Williams, and Shipp 2022).

Prioritization among EJ communities

Many tools generate scores or rankings based on the types of indicators discussed earlier, whether through a composite approach that aggregates the indicators or a noncomposite approach that considers them separately. In some cases, thresholds are imposed on those scores or rankings to identify communities as either EJ communities or not EJ communities. We consider this a "binary" approach. For example, CEJST falls under this category because it designates communities as "disadvantaged" if they are in census tracts that are at or above the thresholds in one or more of eight criteria, and it does not attempt to distinguish between varying levels of environmental and other burdens for these communities—census tracts are either designated as "disadvantaged" or "not disadvantaged."

In other cases, rankings are used after the quantification phase to prioritize among EJ communities. We consider this to be a "tiered" approach. Given limited available resources, prioritization is key to ensuring that resources and investments are directed to the communities most in need, and a lack of prioritization could mean that communities with comparatively fewer burdens may receive funding and resources ahead of communities that need it most. The tool created by the University of Michigan and the Michigan Environmental Justice Coalition, for instance, uses a tiered approach by assigning each community a percentile ranking relative to other communities in the state. Box 2 reviews our categorization of tools based on how they quantify harms to and prioritize among different EJ communities.

BOX 2

Categories for Quantifying Burdens to and Prioritizing among EJ Communities

Quantifying Burdens

- **Composite:** Tool aggregates multiple indicators together in identifying EJ communities.
- **Not composite**: Tool considers individual indicators separately in identifying EJ communities.

Prioritization

- **Binary:** Tool assigns a yes/no (binary) threshold and does not attempt to compare EJ communities (Is a community an EJ community?).
- **Tiered:** Tool ranks communities relative to other communities in the area covered by the tool (To what degree does a community face EJ issues?).

Development Process

We initially sought to describe the purpose of each tool in the Airtable to better contextualize tool methodology and usage. However, we observed that few tools had defined purposes and that programmatic uses for the tools were sometimes only determined after the tool had been published. We decided instead to note the policy context that prompted creation of the tools as well as any connections the tools have to specific programs or funding sources.

It is critical to collaborate with the communities that are being classified by EJ data tools to ensure the tools accurately reflect community members' perspectives and priorities and are useful for communities in planning and advocating for EJ-related investments. This practice is called community engagement, and it is based on the understanding that community members bring unique expertise to research, policymaking, and decisionmaking. The core tenet of community engagement is that projects concerning a community are not complete without involving community members in decisionmaking.

We reviewed materials on each tool's website to determine how creators approached community engagement in the development of their tools. We sought to capture a range of activities along the spectrum of community engagement, as tool creators' community engagement processes can incorporate varying degrees of rigor—from informing community members on tool usage through webinars and fact sheets (and not truly collaborating with them) to sharing decisionmaking power through community-based participatory research where community members are cocreators of tools (González 2019). The information we have captured is not comprehensive, however, and extensions of this work could involve speaking directly with tool creators or community groups involved with tool creation.

Table 1 provides a more detailed overview of the various dimensions we consider in our analysis.

TABLE 1
Tool Dimensions Assessed in Airtable

Dimension	Definition
Tool information	
Name of area	Geographic area the tool represents (e.g., New York City)
Name of tool	Name of tool as it appears on website
Link to tool	Link to tool website
Coverage	Indicates what area the tool covers (national, state, county, metro, or city)
Notes	Includes any other relevant information about the tool
Process	
Published	Original publication year of tool
Last updated	Year of last known update, as well as any clearly defined plans for regularly updating the data
Connection to legislation/program	Notes explicitly defined purposes for the tool (mandated by legislation, agency using tool to direct certain investments, etc.)[a]
Community engagement and resources	Notes community engagement activities across different stages of tool development and usage, categorized into the following options: unspecified collaboration with community, public comment, surveys, community forums/public meetings, focus groups, one-on-one interviews, interactive workshops, community self-designation, cocreation of tool with community, and community-driven

	engagement. Also notes publicly accessible resources that provide information about tool usage (fact sheet, user guide, and training/webinar).[17]
Data sources	
Federal government data sources	Identifies any data sources the tool utilizes from the federal government.
State government data sources	Identifies any data sources the tool utilizes from state governments.
Local government data sources	Identifies any data sources the tool utilizes from local governments (including municipal governments, county governments, and metropolitan planning organizations).
Third-party data sources	Identifies any data sources the tool utilizes from nongovernment sources (including universities, nonprofit research organizations, and community-based organizations).
Race and ethnicity	
Race and ethnicity-related language	Describes any information the tool includes on the race and ethnicity of individuals in a given community.
Race and ethnicity as an indicator	Denotes whether the tool utilizes an indicator on race and ethnicity to identify EJ communities.
Breakdown of race and ethnicity	Denotes whether the tool provides further disaggregation of racial and ethnic identities in a community beyond terms like "minority" or "people of color."
Identifying disadvantage	
Definition of EJ community	Outlines tool's designation for communities that are most impacted (or are at higher risk of being impacted). Tools employ a variety of terms for such communities, including "environmental justice population" (Massachusetts), "overburdened communities" (New Jersey), and "potential EJ areas" (New York).
Binary versus tiered	Indicates whether the tool assigns a yes/no threshold and it does not attempt to compare EJ communities (binary) or it ranks communities relative to other communities in the area covered by the tool (tiered).
Composite versus not composite	Indicates whether the tool aggregates multiple indicators together in quantifying EJ burdens (composite) or if it considers individual indicators separately in doing so (not composite).
Explanation of formula	Brief summary of formula associated with definition of EJ community
Geographic granularity	Geographic unit by which tool classifies communities (census tract, census block group, or custom). If tool does not classify communities, then we list the smallest unit of geography displayed by an indicator.
Environmental indicators	
Air quality	Denotes which, if any, of the following air quality indicators are measured by the tool: ozone concentration, fine particulate matter level (PM 2.5), diesel particulate matter level (diesel PM), air toxics respiratory hazard level, lead paint indicator, and traffic proximity.[18]
Water quality	Denotes which, if any, of the following water quality indicators are measured by the tool: wastewater discharge, impaired water bodies, and drinking water contaminants.
Climate vulnerabilities and natural hazards	Denotes which, if any, of the following indicators of climate vulnerabilities and natural hazards are measured by the tool: heat/drought, flood/floodplain, wildfire, and lack of tree canopy.[19]
Other pollutants	Denotes whether tool measures proximity to several types of legacy pollution sites: Superfund (National Priorities List) sites, hazardous waste facilities, and Risk Management Program (RMP) facilities.

Other environmental indicators/notes	Lists other environmental indicators measured by the tool that are not included above, as well as any relevant notes about the tool's environmental indicators.
Nonenvironmental indicators	
Socioeconomic and access to opportunity	Denotes which, if any, of the following socioeconomic indicators are measured by the tool: low income, unemployment, educational attainment, linguistic isolation (limited English proficiency), disability, housing burden, and age (younger than 5 years and/or 65 years or older).[20]
Physical health	Denotes which, if any, of the following physical health indicators are measured by the tool: asthma, cardiovascular disease, low birthweight, cancer, life expectancy, and diabetes.[21]
Other nonenvironmental indicators/notes	Lists other socioeconomic, access to opportunity, and physical health indicators measured by the tool that are not included above. Also includes any other relevant notes about these indicators.

Note:

[a] Sources include tool websites; "EJ Community Definitions Chart," The New School Tishman Environment and Design Center, April 2021, https://docs.google.com/spreadsheets/d/1TgwZAAlmLIBYJciXSpUfOOZifuk8MJUU4_NagVnulU8/edit#gid=0; and Lindborg et al. (2021).

Key Findings

We conducted a scan of national, state, and local tools publicly available as of July 2022, excluding tools that were outdated, lacked clear attribution of data sources or explanation of the EJ community identification process, or presented only one or two environmental indicators. Of the 31 tools we analyzed, 24 tools were created by government agencies and planning commissions including metropolitan planning organizations (MPOs), and 7 were created by research and/or community-based organizations. The geographic coverage of the tools varied—2 contain data for the entire nation; 23 are state-level tools spanning 17 different states; and 6 are county, metro, and city-level tools. State and local tools cover geographic areas throughout the country: of the tools we analyzed, 10 are based in the Northeast, 9 in the Midwest, 6 in the West, and 4 in the South. In the following sections, we synthesize the key findings from our comparative analysis into five themes.

Screening Tools Often Rely on Data That Lack Local Context and Are Out of Date

Among the tools we analyzed, national and state-level data sources are more commonly used than are local sources for environmental and socioeconomic measures. Almost all tools use data from the US Census Bureau for demographic information, and many use data from the EPA for environmental indicators such as water quality and air quality. This is not surprising given that federal agencies generally have the authority and capacity to collect and publish data that are standardized and

comparable across the country. A drawback of only relying on national-level data sources, however, is that smaller or rural areas can face issues such as undercounting, undersampling, and higher margins of error that can lead to inaccurate reflections of local-level realities (Scally, Burnstein, and Gerken 2020).

In addition to national sources, more than half of the tools pull data from state and local government agencies related to health, economic development, the environment, and natural resources. For example, many of the sensitive population indicators in Michigan's MiEJScreen were prepared by the Michigan Department of Health and Human Services using the Michigan Outpatient Database and the Michigan Inpatient Database. The Center for Earth, Energy and Democracy's Twin Cities Environmental Justice Mapping Tool used local Hennepin County and Ramsey County parcel data to calculate the percentage of renter-occupied housing instead of the commonly used census indicator. Data compiled and calculated by third-party sources such as research organizations are sometimes used, although they are used more frequently for tools developed by such organizations themselves. For example, Maryland's MD EJScreen includes food access data from the Johns Hopkins Center for a Livable Future.

Up-to-date data are needed to accurately identify EJ communities and reflect the current issues relevant to these communities. However, few tools receive regular updates when new data become available or are explicit about the plan for updates, which creates a challenge for communities to incorporate the latest information in their planning and advocacy work. Some examples of tools that have led the way in updating their underlying data include EJSCREEN, which was first published in 2015 and is updated annually, and CalEnviroScreen, which was first published in 2013 and was updated to version 4.0 in 2021. MiEJScreen, published in March 2022, already includes a plan for updates in its technical appendix, which notes that "the tool will be updated every three to four years as new data become available and to provide the most current data. In addition, we continue to explore additional indicators and seek input from stakeholders. We welcome opportunities to partner with others in continuing this work."

Current environmental data are less widely available across data sources. Unlike demographic data that are regularly updated, such as the American Community Survey, the collection period for environmental data varies to a greater degree. For example, many tools include toxic air exposure indicators (such as Air Toxics Cancer Risk and Diesel Particulate Matter) from EJScreen, which uses data from the National Air Toxics Assessment (NATA). Although EJScreen is regularly updated, the most recent NATA indicators are based on emissions data from 2014, which means the toxic air exposure information used by EJScreen omits newly emergent environmental risks. Furthermore, the

EPA specifically notes in the technical documentation of EJScreen that NATA-based indicators should be referenced with the knowledge that the data may be a less-than-accurate portrayal of current conditions, given recent decreases in air toxics (EPA 2019). Some states compile and calculate their own data as an alternative; for example, the New Jersey overburdened communities tool calculates air quality data based on daily air monitor data from the EPA's ambient air quality monitoring program.

The issue of measurement error surfaces for other sources of environmental data as well. For example, air pollution monitoring sensors are placed away from communities most at risk of the harms caused by pollutants, and they may be improperly maintained and/or unable to track industrial emissions events that threaten public health (Reed, Lugo-Martinez, and Kalman 2021). There are also significant rates of reporting noncompliance on the part of companies for violations that pose serious health consequences (Giles 2020).

Tools Often Lack Disaggregated Race and Ethnicity Data and Acknowledgement of the Role of Environmental Racism

As many researchers have pointed out, race is the most important predictor of the distribution of environmental hazards (Crowder and Downey 2010). By explicitly including data on race and ethnicity, tools can account for how environmental racism has resulted in disproportionate economic and health burdens for communities of color. Disaggregating environmental data by race and ethnicity is also critical to better understand impacted populations.

We found that all but two tools include data on race and ethnicity in some way. More than 80 percent of tools factor race and ethnicity into their methods for identifying EJ communities, and the remaining three tools include race and ethnicity as context layers. However, the majority of tools present this information in a binary way—for example, using indicators such as the share of the population that is nonwhite and/or Hispanic. Only six tools include a more detailed breakdown of race and ethnicity. Furthermore, Indigenous populations are rarely accounted for as separate population groups, making it a challenge to identify specific environmental concerns for subgroups within the nonwhite population. Providing more detailed data on race and ethnicity promotes the ability to identify community-specific issues, make data-driven decisions, and advocate for the equitable distribution of resources. The Twin Cities Environmental Justice Mapping Tool presents a rare instance of disaggregation: the tool provides breakdowns by each of the major race and ethnicity groups, as well as the percentages of individuals who are Black, Indigenous, and people of color and who are younger than 5, older than 65, or between the ages of 18 and 44.

Some tools implicitly acknowledge the role of environmental racism in their framing language. Michigan's MiEJSCREEN includes the following in its justification of its race/ethnicity indicator: "Ultimately, the causes of racial and ethnic disparities in health status associated with environmental pollutants are still not completely understood and very complex. However, the experience of racism in the form of segregation and reduced access to healthcare, social goods and resources acts as a barrier to health and well-being. Additionally, research has implicated chronic stress due to the experience of racism for the negative health outcomes of minority groups" (Michigan EGLE 2022, 38). Tools with the strongest language on the topic are similarly framed, naming racial disparities and typically including references to the existence of environmental racism; however, most tools we surveyed did not draw more causal links between environmental racism and present-day disparities highlighted by the tool. Although it is possible for a tool to pursue EJ without explicitly calling out environmental racism, this framing language can indicate that tool creators intend not only to recognize EJ communities' environmental harms and associated needs, but also to enact solutions that will mitigate environmental racism through justice-oriented remedies.

Methods for Identifying EJ Communities Vary with the Intended Uses of Screening Tools

As discussed, composite approaches recognize that some communities face multiple, interlinked burdens and these approaches consider those burdens in aggregate rather than in isolation. The composite method offers a more holistic approach than noncomposite methods, but depending on the manner by which indicators are aggregated, certain communities may be deprioritized or overlooked. For example, a community that is extremely burdened by pollution but is relatively wealthy compared with other communities in the region may not qualify as an EJ community if income is given a large weight in a tool's aggregation methodology. This effect can be amplified by tools like EJScreen that provide both positive and negative values for index scores based on how communities fare in relation to a national average. Hammer and others (2021) found that many of the communities most exposed to fine particulate matter (PM 2.5) and lead paint rank very low on EJScreen's scoring system because their share of low-income individuals and/or people of color is below the national average.

Most tools use various combinations of the methods for quantifying burdens and prioritizing among EJ communities that we highlighted in the previous section. For example, Colorado EnviroScreen first uses a composite approach to separately calculate the socioeconomic and environmental burdens for communities in the state, and it then combines the two to calculate the relative environmental burden for all communities in the state using a tiered approach. In contrast,

CEJST uses a composite approach to first calculate each of the eight criteria for identifying disadvantaged communities, but from there, areas that meet the threshold in any one of the eight categories are designated in a binary fashion as disadvantaged or not.

Some states' definitions of EJ communities are established before tool creation, whereas others are created during or after tool development; this context is important for understanding the functions of various EJ tools. Many definitions of EJ communities are established in state or local statute prior to the tool's development; these definitions often only rely on a few simple demographic thresholds, such as the percentage of nonwhite or Hispanic individuals and the share of households below the federal poverty level. These definitions are more commonly termed "potential" EJ areas, and their uses tend to be preliminary and less clearly defined (e.g., a government requiring potential permitters to hold a public hearing if the proposed facility site falls within a potential EJ area).

Other tools take a different approach: they employ definitions of EJ communities that were developed alongside the tool, or they are succeeded by legislation that introduces a definition. The resulting definitions are often much more complex, relying on many environmental, health, and socioeconomic indicators. These definitions are more likely to have been refined by environmental experts and affected community members, depending on the nature of the tool development process. We find that the tools with these more complex identification strategies are likelier to explicitly guide agency actions like investment. For example, the Colorado Department of Public Health and Environment's Environmental Justice Advisory Board will be using Colorado EnviroScreen's statutory definition of an EJ community to determine grant eligibility in 2023.[22]

Most Screening Tools Include Specific Environmental Indicators, but Many Key Topics Are Still Overlooked

A majority of the tools we scanned include at least one category of environmental indicators that corresponds to certain legislative requirements or is deemed relevant to environmental and public health factors affecting overburdened communities. The few tools that do not include any environmental indicators use socioeconomic characteristics—such as poverty status, income, race, and ethnicity—to identify communities that may face other sources of disadvantage that make them more vulnerable to environmental burdens.

More than half of the tools include air quality and water quality measures, though the specific measures within these topic areas can vary by jurisdiction. This is not surprising given the prevalence of air pollution, water pollution, and water shortage issues across the nation.[23] Other important

environmental hazards such as extreme heat, flooding, natural hazards, toxic chemicals, and waste are less commonly included, despite the well-documented negative health and social impacts they pose to exposed communities (Crimmins et al. 2016). In addition, only two of the tools include projected hazards resulting from climate change, although this is crucial information for communities to plan ahead for long-term resilience as the climate crisis continues to escalate.

The effect of environmental issues on physical and mental health is well documented. Adverse health outcomes can be an indication of undue environmental impacts and a preexisting condition that makes certain groups more vulnerable to exposure in the first place. For both reasons, it is crucial that health-related measures are presented alongside environmental risks. A growing body of research has shown that higher rates of asthma among Black and Hispanic children are associated with traffic-related pollutants. Evidence also suggests that environmental hazards can be linked to mental illness, such as depression (Roberts et al. 2019). However, only about one-half of the tools we analyzed include health-related measures, and only one included an indicator related to mental health.

Many Tools Insufficiently Reflect Real Community Data and Needs

Bias toward urban issues and areas presents a continued challenge across tools because of a lack of data on rural and tribal communities. Many of the environmental measures commonly included in tools, such as proximity to traffic, predominantly affect urban communities. One of the challenges involved with capturing rural environmental impacts is that these impacts differ depending on the regions and industries specific to a given state or locality. For example, pollution and climate change effects on a rural farming community will differ widely from the effects on a rural mining community.

State and local tools are uniquely suited to capture region-specific issues and incorporate demonstrated community concerns. Mapping for Environmental Justice, for example, accounts for geographic variation in environmental issues by providing an “oil and gas” indicator for its Colorado map and a “mining” indicator for its Virginia map to reflect the dominant industries in those areas. Other tools, such as MD EJSCREEN, include information on concentrated animal feeding operations, which often negatively impact air quality while also releasing large amounts of animal waste and other pollutants into rural waterways. However, tools rarely include such metrics in their methodologies for identifying EJ communities and generally opt to display these data via context layers.

In addition to omission of rural-specific measures, demographic data in rural areas may have a higher risk of inaccuracies than in urban areas. The American Community Survey does not update its estimates as frequently for geographies with populations less than 65,000, and rural communities are

also at risk of being undercounted in the decennial Census, since residents often live in areas that are difficult to reach (Miller 2012).[24] Similarly, the more than 9 million Indigenous people who live in the United States face census undercounting and they are often misclassified or lumped into broader demographic categories. A lack of a centralized data system for tribal communities presents further data collection and analysis challenges for EJ screening tools (Schwabish, Feng, and Jenkins 2022). New York's Climate Justice Working Group recognized instances of unreliable sociodemographic data in low-population census tracts and in some cases scored these tracts based on environmental burden alone (CJWG 2022).

The gap in rural-specific considerations is one of many instances where EJ data tools may not appropriately reflect lived experience; this problem affects both rural and urban communities. Engagement with impacted community members is essential to understanding how tools can be best positioned to benefit residents. The city of Seattle's Environmental Equity Assessment Pilot specifically notes that many of its environmental programs "do not collect demographic data sufficient to identify who does and does not benefit." Given this information deficit, the creators of this tool acknowledge they "cannot take a solely data-driven approach to policy or program changes in our city. Instead, we can lift up the stories and experiences of Seattle residents, especially those most burdened, to begin understanding where we need to change how we do our work."[25] The tool thus juxtaposes data on environmental impacts with brief profiles of affected Seattle residents encountering the issues in question.

Community perspectives are especially important given that tools are limited in their use of environmental data to capture environmental and other issues. For example, the wastewater discharge indicator used in EJScreen, CEJST, and many other state and local tools is regarded as a proxy for clean water, but this indicator does not incorporate dangers associated with lead pipes (Baptista et al. 2022). Community organizers have historically provided their own evidence of environmental harm in response to the inaction of government. This practice began as early as 1969, when the Young Lords administered their own lead poisoning surveys in East Harlem and pressured the city to address the issue until city leaders passed legislation requiring lead removal.[26] Tool creators who rely on data that are not sufficiently granular and who do not interface with community members may not properly account for these often-localized harms.

By using community-engaged methods, tool creators can equip communities with the knowledge and resources to identify and organize around environmental issues. Unlike organizers and advocates in other sectors, EJ groups are uniquely expected to become well-versed in scientific and technical subject matter to characterize environmental problems, and to carry the burden of proof in

demonstrating both historical and present-day injustices (Martín 2021). The MD EJScreen tool provides an exemplary case of empowering community members to collaborate on every step of the tool development process. The map was created by the Center for Community Engagement, Environmental Justice, and Health (CEEJH), a group that uses community-engaged research methods (including community-based participatory research, citizen science, and community-owned and managed research principles) to develop partnerships between the University of Maryland and local communities. Tool creators ensured that the initial version was vetted by local community activists, planning organizations, and environmental justice coalitions through conferences, local town hall meetings, and other outlets. As CEEJH sought to expand this initial tool, it collaborated with MD Environmental Health Network, an advocacy organization of community leaders and experts.

Community engagement can occur during multiple stages of the tool development process, including initial brainstorming, indicator selection, vetting of beta versions, and post publication. Although inclusion of these stages is beyond the scope of our accompanying table, it is important to note that community engagement earlier in the process allows community members to more significantly shape the trajectory of the tool by sharing input on tool indicators and data sources as well as the tool's overall goals and priorities. Meaningful engagement of community members earlier in the tool development process should ultimately result in a more contextualized, useful, and accurate tool.

Recommendations and Suggestions for Future Research

Based on our analysis of EJ screening tools, we propose several recommendations for improving new and existing tools to promote data-driven decisionmaking that advances environmental justice. Our recommendations speak to the content, development process, and purpose of tools.

Tool Creators Should Be Explicit about the Intended Use of Tools and Allow for Communities to Self-Identify

As noted, we found that few of the tools had defined purposes. In many situations, use cases for the tools were determined only after a tool had been created. This is problematic because a tool's intended use should inform both how it is developed and what factors and features are included. A tool that will be used to direct significant portions of public funds should be developed in conjunction with the communities it intends to benefit; it should account for the cumulative environmental,

economic, and public health burdens that communities might face; and it should allow for effective prioritization between communities facing varying levels of burdens. Thus, tool creators—whether state or local governments, research institutions, or community-based organizations—should be explicit about the intended use of their tools from the start; and they should allow the use case to guide decisions on both which indicators and which data sources to include, as well as the extent to which members of the community and other experts are involved in the development process.

While most of the tools we analyzed incorporated race and ethnicity directly in EJ indexes or identification methods, we noticed two patterns of associated limitations. First, where possible without risk of reidentification, race and ethnicity information should be broken down with more granularity than "percentage of minority residents," which is by far the most commonly appearing indicator. The experiences of different communities of color around environmental issues deserve more nuance than a simple binary measure, but only a few tools avoided treating these communities as a monolith. Second, many of the tools that do include race and ethnicity do not provide much, if any, motivating language to provide tool users with an understanding of why a race indicator is included in calculations or of the intersection between environmental issues and racial equity more generally. Treating this information as implied or simply citing the legal requirement for its inclusion fails to adequately tell the full story. In addition to addressing these limitations, it is important to recognize how the implementation of tools furthers EJ goals. A tool can contain robust language and indicators on the intersection of race and EJ, but if it is only used to measure harms, then it is not working toward environmental justice. Tool creators should follow the examples of Colorado EnviroScreen and CalEnviroScreen, both of which recognize the impacts of environmental racism and are also being used to target investments toward EJ communities.

But although data tools can be helpful in prioritizing between communities facing intersecting environmental, economic, and health burdens, no tool can comprehensively reflect the circumstances of any given community, especially when data are systematically lacking or communities face burdens that cannot be easily quantified. As such, data tools should not be the final arbiter of whether communities receive public funding and resources. Instead, policymakers and administrators can allow communities to self-identify as communities in need of environmental justice resources, as the Illinois Solar for All initiative does. The Solar for All program allows communities to use a variety of data sources to demonstrate eligibility for funding, including expert testimony, community organizing, and news articles. Historical events are also eligible data sources, which is important given that EJScreen indicators—which the tool relies on for initial identification—are limited in their ability to assess prior environmental damage. Allowing communities to self-identify, or, at the very least, to petition their

designations, ensures that communities are not excluded because the existing identification tools or methods are unable to capture localized harms.

Tools Should Be Developed in Conjunction with Community Members and Account for Local Context to the Extent Possible

Community engagement throughout the tool development process is necessary to generate a clear and shared understanding of a tool's purpose, inclusions, and priorities. The most equitable toolmaking partnerships are ones in which community members' lived experiences are valued and viewed as a legitimate source of knowledge, on par with academic research (Davies and Mah 2020, 109). Governments seeking to create EJ data tools can learn from third-party tool developers, who we found were more likely to engage with impacted community members as peers in tool creation. Tool creators should seek to understand community members' ideas of success so that their priorities are reflected in the implementation of the tools they helped to create.[27]

It is also important for tools to reflect residents' own perceptions of their communities (Shakesprere et al. 2021). Many of the tools we surveyed define communities as census block groups or tracts, yet members of the public may not be aware of how these geographies map to their own communities. In addition, as pointed out previously, measurement inaccuracies, especially in areas with smaller population, may not reflect local-level realities if taken at face value. Direct engagement with community members is necessary to ensure that tools reflect how communities themselves define geographic boundaries, which may involve adding features to tools that allow users to combine selections of block groups or tracts to resemble geographies that impacted individuals associate with vulnerabilities in their communities. A model to look to is Native Land Digital's interactive map of Indigenous territories, languages, and treaties that depicts geospatial boundaries, with an option to compare with overlaid "settler labels." The map draws from sources including oral history, written documents, and hand-sketched maps, emphasizing Indigenous knowledge and history over contemporary geographic borders.

Tools should also include indicators that speak to a region's specific environmental challenges. For this reason, nationally available data should only serve as a starting point. State and local tools that use the same indicators as national tools may not appropriately depict or prioritize environmental issues that are connected to that region's major industries, historical injustices, and organizing movements. Tools should consider how to incorporate data gathered by community organizers, especially in circumstances when those data are the only available documentation of an environmental issue. When

data for certain indicators are not available across all geographies represented in the tool's jurisdiction with the same level of granularity, agencies and other groups creating tools should consider including such data where possible rather than omitting the indicator altogether. One easy way to present this information is via context layers, but this could also be accomplished by adding new avenues of eligibility for EJ communities, such as by providing simpler pathways for tribal and unincorporated communities to qualify as EJ communities.

Tools Should Include More Indicators across Diverse Topic Areas and They Should Be Regularly Updated

We found systematic limitations in what kinds of indicators screening tools tended to include. Tools should account for the intersectionality of environmental justice issues by drawing on not just environmental indicators but also socioeconomic, health (both physical and mental), and climate indicators. If not as part of calculations to identify EJ communities directly, then at the very least, tool developers should strive to include maximal information in context layers or other accompanying information. When these indicators are missing from calculations, communities are at risk of being wrongly passed over, not due to a lack of need, but due to a lack of data that quantifies that need. Zooming in on climate information in particular, in a joint Urban Institute and Resources for the Future webinar, panelists called for the inclusion of indicators including, but not limited to, heat index, sea-level rise, severe climate events and resulting damage, social vulnerability indexes from both the Hazards Vulnerability & Resilience Institute and the Centers for Disease Control and Prevention/Agency for Toxic Substances and Disease Registry, and resilience measures such as the National Oceanic and Atmospheric Administration's Coastal Resilience Index (Baptista et al. 2022). Tools should also incorporate climate projections to the extent they are available.

While including indicators that capture a diversity of topic areas is necessary, so too is developing methodologies and calculations that consider the interactions of these indicators. Cumulative impacts are difficult to quantify, but we did not see many tools even attempt to do so. One approach would be to explicitly include interaction terms or weights in calculations. For example, a tool might determine EJ communities by including weights from data on both asthma rates and air pollution, and it could also add a third weight that multiplies the asthma rate and levels of PM 2.5 together, given the negative effects of PM 2.5 on human respiration (Xing et al. 2016). In other words, by considering the dynamics of indicators beyond their individual effects, tools can acknowledge the cumulative burdens of overlapping EJ issues.

To maximize utility to both communities and policymakers and accurately capture current circumstances, tools should be updated as frequently as is feasible, ideally corresponding with the update frequency of the underlying data sources. For example, for socioeconomic data that commonly comes from the American Community Survey, updates should occur annually. Tool creators should also clearly communicate when and how often tools will be updated, so that users can incorporate this information into their planning processes. If a tool is meant to be static, with no planned updates, this information should be made explicit. For data sources that are updated infrequently (particularly environmental indicators, as noted in the previous section), tool creators should look to supplement gaps with data collected at the state and local levels, including surveys, administrative data sources, and community-generated data.

Extensions and Next Steps

This research represents a first step toward a comprehensive comparative framework for environmental justice screening tools, and in some dimensions we have only begun to scratch the surface. In this section we suggest a few areas of extension for future research and analysis.

We tried to be as inclusive as possible in determining the universe of EJ screening tools to consider. In addition to the prominent national and state tools, we also included contributions from MPOs, research, and community organizations. But our working definition of EJ screening tools highlighted in box 1 leaves room to consider even more tools under this umbrella. Other regional planning organizations, government agencies, and research and community organizations have published tools for tangential issues, such as infrastructure, that may not be centered as explicitly around environmental justice but include overlapping indicators and themes. To that end, the EPA lists other national screening tools, such as the Department of Energy's Energy Justice Dashboard (in beta) and the Department of Transportation's Screening Tool for Equity Analysis of Projects, that are beyond the scope of this initial analysis. Future research should explore the universe of related tools and resources beyond the 31 that we analyzed, which can further equip communities and decisionmakers with valuable information.

Our categorization of the common ways in which screening tools quantify burdens for and prioritize between EJ communities is an important step toward assessing how tools engage with the severity of need for certain communities and the cumulative impacts those communities face. However, even within those categories, nuances exist that are worth further exploration. For instance, we commonly labeled tools as *binary* and *not composite* when communities had to meet one or more

criteria to qualify as EJ communities. However, for some tools, such as Rhode Island's Environmental Resource Map, one individual criterion might be built from multiple inputs (e.g., a certain percentage of minority residents *and* a certain median income level). For such cases where the line between composite and noncomposite indicators blurred, additional specificity is needed.

Furthermore, Maryland's MD EJScreen tool was labeled as *binary* and *composite* because tracts are given a socioeconomic EJ score, with areas above a certain threshold identified as having potential EJ concerns. However, the scores for all communities are also displayed as percentiles, indicating elements of both binary and tiered approaches. Future research could zoom in on how specific types of indicators are used in calculations to identify and prioritize EJ communities, particularly for tools labeled as *composite*. For instance, developing a better understanding of which tools not only include health and environmental indicators in their methodologies but also account for the interaction between those factors, would move us closer to measuring the extent to which tools capture cumulative impacts and burdens.

Although our analysis of race and ethnicity in EJ data tools was mainly limited to whether race and ethnicity indicators were part of tools' methodologies, there are many opportunities for future research to analyze how tools can advance racial equity as a central objective. We could not have assessed tools' adherence to racial equity principles in a single column in our Airtable; instead, a racial equity analysis would introduce a new dimension to the data we have collected. Many of the indicators found in tools that we assessed have unique implications for communities of color, such as the disproportionate risk of lead exposure faced by Black children (Yeter, Banks, and Aschner 2020), the importance of environmental self-determination for Indigenous communities (Sproat 2016), and the linguistic isolation that can hinder Latino community members' ability to access environmental data.[28] Racial equity analysis could be accelerated by government assessments of the impacts of environmental, health, and socioeconomic issues on different racial and ethnic groups in specific EJ tool coverage areas.

While we acknowledge throughout this brief the importance of building tools in direct collaboration with affected communities, we were not able to conduct stakeholder interviews with community members who may be vulnerable to environmental justice issues or who have utilized one or more of these data tools. Comprehensively detailing the rigor and nature of community engagement and community-based participatory research undertaken by tool creators is a separate analysis entirely, and certainly not one that can be summarized in the column of a table. Researchers could look to the Spectrum of Community Engagement to Ownership tool, which is outlined by Facilitating Power (González 2019) as a framework that could, in tandem with stakeholder interviews,

shed light on this outstanding question of whether tools appropriately highlight community need, address community input, and reflect residents' lived experiences. Tool creators demonstrating the most robust and collaborative engagement processes would also offer valuable examples of best practices to lift up.

Appendix

The table below displays frequencies of various tool dimensions based on data from our Airtable.

TABLE A.1

Characteristics of Surveyed Environmental Justice Tools

	# Tools	Percent
Coverage		
National	2	6%
State	23	74%
Local	6	19%
Process		
Last updated in 2022	14	45%
Created by government	24	77%
Created by third-party	7	23%
Community engagement and resources	21	68%
Data sources		
Federal government data sources	31	100%
State government data sources	19	61%
Local government data sources	4	13%
Third-party data sources	10	32%
Race and ethnicity		
Race and ethnicity-related language	29	94%
Race and ethnicity as an indicator	26	84%
Breakdown of race and ethnicity	6	19%
Identifying disadvantage		
Definition of EJ community	17	55%
Binary	12	39%
Tiered	19	61%
Composite	17	55%
Not composite	14	45%
Block group-level granularity	12	39%
Tract-level granularity	17	55%
Environmental indicators*		
Any environmental indicators	24	77%
Air quality	20	65%
Water quality	18	58%
Climate vulnerabilities and natural hazards	16	52%
Other pollutants	20	65%
Other indicators*		
Socioeconomic and access to opportunity	31	100%
Physical health	19	61%

Note:

[a] These totals include indicators that are presented as context layers, in addition to those that are used in calculation.

Notes

[1] See, for instance, Alejandra Borunda, "The Origins of Environmental Justice—and Why It's Finally Getting the Attention It Deserves," National Geographic, February 24, 2021, https://www.nationalgeographic.com/environment/article/environmental-justice-origins-why-finally-getting-the-attention-it-deserves.

[2] "Summary of Executive Order 12898 – Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," US Environmental Protection Agency, accessed September 26, 2022, https://www.epa.gov/laws-regulations/summary-executive-order-12898-federal-actions-address-environmental-justice.

[3] "Population Surrounding 32,366 Brownfield Sites That Received EPA Funding," US Environmental Protection Agency, October 12, 2022, https://www.epa.gov/brownfields/population-surrounding-32366-brownfield-sites-received-epa-funding.

[4] "Executive Order on Tackling the Climate Crisis at Home and Abroad," The White House, January 27, 2021, https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/27/executive-order-on-tackling-the-climate-crisis-at-home-and-abroad/.

[5] CEJST version 1.0 was launched on November 22, 2022. This update incorporates new climate projection data and identifies tribal nations as disadvantaged communities, among other improvements. See "Biden-Harris Administration Launches Version 1.0 of Climate and Economic Justice Screening Tool, Key Step in Implementing President Biden's Justice40 Initiative," The White House, November 22, 2022, https://www.whitehouse.gov/ceq/news-updates/2022/11/22/biden-harris-administration-launches-version-1-0-of-climate-and-economic-justice-screening-tool-key-step-in-implementing-president-bidens-justice40-initiative/ .

[6] Renee Skelton and Vernice Miller, "The Environmental Justice Movement," Natural Resources Defense Council, March 17, 2016, https://www.nrdc.org/stories/environmental-justice-movement.

[7] US Environmental Protection Agency, "EJScreen: Environmental Justice Screening and Mapping Tool," updated April 1, 2022.

[8] "Community Lattice Builds Environmental Screening Tool to Empower Community-Led Redevelopment," Data.org, accessed October 4, 2022, https://data.org/stories/community-lattice.

[9] "Uses of CalEnviroScreen," California Office of Environmental Health Hazard Assessment, accessed October 17, 2022, https://oehha.ca.gov/calenviroscreen/how-use.

[10] Several tools have explicitly noted that they adapted their tool from CalEnviroScreen. A few examples include Michigan's MiEJScreen and Mapping for Environmental Justice's EJ Demo Maps for Colorado and Virginia.

[11] Rajat Shrestha, Jillian Neuberger, Sujata Rajpurohit, and Devashree Saha, "6 Takeaways from the CEQ Climate and Economic Justice Screening Tool," World Resources Institute, March 30, 2022, https://www.wri.org/insights/6-takeaways-ceq-climate-and-economic-justice-screening-tool. Eric Nost, Leah Horgan, and Sara Wylie, "Refining CEJST By Including Compliance and Inspection Data and Analysis by Industrial Sector," Environmental Data & Governance Initiative, April 25, 2022, https://envirodatagov.org/wp-content/uploads/2022/04/CEQ-CEJST-Public-Comment-by-EDGI.pdf.

[12] "The Wisconsin Environmental Equity Tool," Wisconsin Department of Health Services, August 26, 2022, https://www.dhs.wisconsin.gov/climate/env-equity-tool.htm. "HB 4077 Passes, Solidifying Oregon's Environmental Justice Council," *My Oregon News*, March 10, 2022, https://www.myoregon.gov/2022/03/10/solidifying-oregons-environmental-justice-council/. "Vermont Governor Signs Law Establishing Environmental Justice Policy," Environmental Council of the States, June 3,

2022, https://www.ecos.org/news-and-updates/vermont-governor-signs-law-establishing-environmental-justice-policy/.

[13] See "Environmental Justice," US Environmental Protection Agency, September 30, 2022, https://www.epa.gov/environmentaljustice.

[14] See "EJ Community Definitions Chart April 2021," The New School, accessed October 17, 2022, https://docs.google.com/spreadsheets/d/1TgwZAAlmLlBYJciXSpUfOOZifuk8MJUU4_NagVnulU8/edit.

[15] New Jersey Department of Environmental Protection, "Environmental Justice Mapping, Assessment and Protection Tool (EJMAP)," accessed October 17, 2022.

[16] See "Cumulative Impacts Research," US Environmental Protection Agency, October 11, 2022, https://www.epa.gov/healthresearch/cumulative-impacts-research.

[17] Our standardization of community engagement activity terms is modeled from Facilitating Power's Spectrum of Community Engagement to Ownership (González 2019), as well as resources from Urban's Community-Engaged Methods group. Given our limited access to information on tool design/development, we list a standardized set of community engagement options along a spectrum from least to most engagement.

[18] Though we may have classified several tools as having a given environmental, socioeconomic, or physical indicator, please note these indicators may have been measured differently across tools. For example, EJScreen's lead paint indicator measures the percentage of housing units built before 1960, whereas CalEnviroScreen calculates "children's lead exposure from housing" by using a weighted average for lead exposure risk based on age of housing that is combined, in a weighted sum, with low-income households with children.

[19] Some indicators measure the occurrence of hazards, whereas others measure vulnerability to a hazard or risk of a hazard occurring.

[20] There is also great variation in measurement of these indicators across tools. For instance, low-income indicators range from measuring the percentage of households below the poverty line to descriptively displaying the median household income in the community.

[21] This category includes some of the greatest variation in measurement; tools may measure the number of deaths resulting from a certain condition, the number of emergency room discharges associated with the condition, or the risk of developing the condition.

[22] "Colorado EnviroScreen," Colorado Department of Public Health and Environment, accessed October 17, 2022, https://cdphe.colorado.gov/enviroscreen.

[23] According to the EPA, in 2021, about 67 million tons of pollution were emitted into the atmosphere in the United States that contributes to the formation of ozone and particles, the deposition of acids, and visibility impairment (see "Air Quality – National Summary," US Environmental Protection Agency, June 1, 2022, https://www.epa.gov/air-trends/air-quality-national-summary). A report published in 2022 by the Environmental Integrity Project (EIP) also found that more than half of river and stream miles across the US remain impaired with pollution (Kelderman et al. 2022).

[24] Amanda Gold and Yipeng Su, "Rural Communities Aren't Immune from a Census Undercount. Here's How They Can Prepare for 2020," *UrbanWire* (blog), October 31, 2019, https://www.urban.org/urban-wire/rural-communities-arent-immune-census-undercount-heres-how-they-can-prepare-2020.

[25] City of Seattle, "Environmental Equity Assessment Pilot," accessed October 17, 2022, https://www.arcgis.com/apps/MapSeries/index.html?appid=4c14645fec154ae8978dc642c94b76ba.

[26] Erik Wallenberg, "The Young Lords' Fight for Environmental Justice in NYC," *Edge Effects*, July 29, 2021, https://edgeeffects.net/young-lords/.

[27] Lack of alignment on metrics of success appears to be a consistent issue for EJ data tools. Blondell et al. (2020) interviewed individuals from state agencies, universities, and grassroots organizations who were involved with and/or affected by EJ data tool development in five different states. None of the interviewees could name concrete metrics of success, such as timelines and goals, for tool implementation.

[28] "Environmental Justice for Whom? The Inaccessibility of Environmental Data for Latinx Communities," Environmental Data & Governance Initiative, June 21, 2021, https://envirodatagov.org/environmental-justice-for-whom-the-inaccessibility-of-environmental-data-for-latinx-communities/.

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