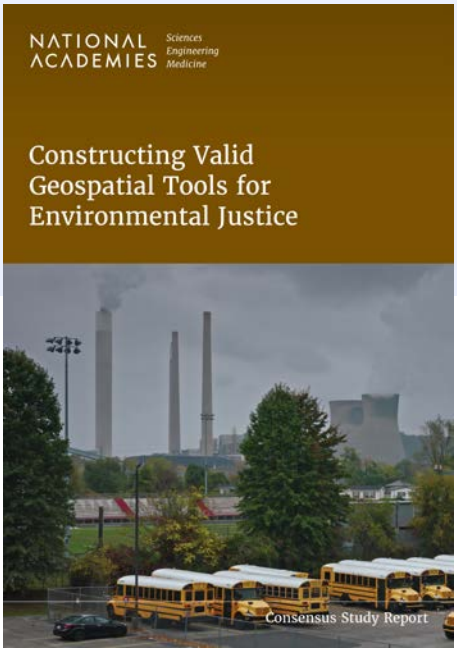
Constructing Valid Geospatial Tools for Environmental Justice



The White House Council on Environmental Quality (CEQ) created the Climate and Economic Justice Screening Tool (CEJST) in 2022—the first geospatial environmental justice (EJ) screening tool developed at the federal level to identify disadvantaged communities for the purpose of guiding federal investment.[1] Federal agencies, states, territories, tribal governments, and other organizations are expected to use this tool to help prioritize infrastructure spending.

Mapping and geographical information systems have been crucial for analyzing the environmental burdens of marginalized communities since the 1980s, and several federal and state geospatial tools have emerged to address a variety of EJ concerns. Decades of research have shown that disadvantaged communities exist at the intersection of high levels of hazard exposure and poverty. EJ tools such as CEJST aid policy decisions that address the pervasive, persistent, and largely unaddressed problems associated with environmental injustice in the United States.

ENVIRONMENTAL JUSTICE TOOLS AND THE CLIMATE AND ECONOMIC JUSTICE SCREENING TOOL

CEJST and similar geospatial tools output a single value intended to reflect the burden being measured for a given geographic location. The heart of many of those tools is a multidimensional model—a composite indicator. For example, CEJST is based on a composite indicator intended to identify if a community is disadvantaged. It includes 30 different indicators (e.g., datasets) that each fall into one of eight burden categories: climate change, energy, health, housing, legacy pollution, transportation, water and wastewater, and

[1] A 2021 Presidential Executive Order (EO) established the Justice40 Initiative, which sets the goal that disadvantaged communities will reap 40 percent of federal investment benefits in key areas relevant to addressing the climate crisis. The EO required the creation of a tool that identifies disadvantaged communities eligible for additional consideration for such investments.

workforce development. CEJST identifies communities as disadvantaged if they meet a low-income threshold as well as a specified threshold in any burden category.

There are published, systematic methodologies following interrelated systems of steps for developing composite indicators and for evaluating construction decisions, internal and external robustness, and validity. Sound models and tools are based on careful conceptualization and rigorous model construction and will reflect the real-world conditions. Valid EJ tools are founded on sound science, involve meaningful and sustained input from interested and affected parties, are transparent, and are accepted by government agencies, communities, and other tool users.

The report's authoring committee considered multiple EJ tools to identify the types of data and data availability and evaluate different data integration approaches. Recommendations regarding an overall data strategy for geospatial EJ tools such as those developed by CEQ are provided. The interrelated components of a data strategy are visualized in Figure 1. The goal is to develop a tool that is grounded in trust, transparency, and legitimacy

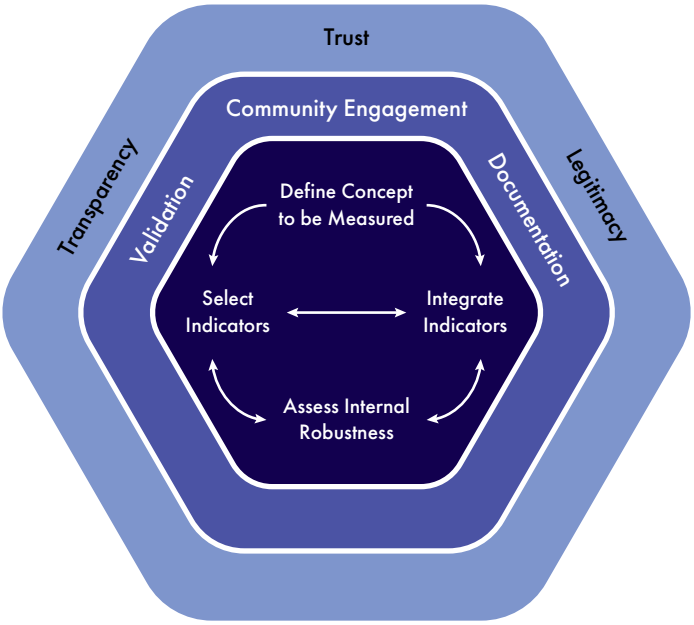


FIGURE 1 This conceptual framework visualizes the iterative processes needed to build an effective EJ tool that embodies trust, transparency, and legitimacy (the outer ring). The inner ring represents activities related to constructing composite indicators. The middle ring represents the communication activities necessary to move from the inside out to encompass validation, community engagement and documentation.

achieved through iterative and meaningful community engagement; validation of tool indicators, data, processes, and results; and complete documentation.

RECOMMENDATIONS TO INFORM A DATA STRATEGY

The committee formulated a set of science-based recommendations to inform a data strategy for geospatial EJ tool development based on current research. These recommendations are not intended to advocate for changes in legal policy, but rather represent the committee's conclusions regarding how data may be used to achieve model results that reflect reality.

Community Engagement

Recommendation 1: Create and sustain community partnerships that provide forums and opportunities to identify local EJ issues, identify the indicators and datasets for measuring them, and determine whether tool results reflect community lived experiences. Choosing appropriate indicators, datasets, and integration approaches requires more than statistical robustness to achieve valid results. Community engagement helps bring local issues into context—especially important when a national-level tool such as CEJST is intended to define diverse populations, be responsive to potentially opposing priorities, and inform decisions in multiple sectors. Community engagement helps to identify and validate options in tool development, allows developers to understand the types of errors that are likely, why and where they occur, and how they might be overcome.

Documentation

Recommendation 2: Provide thorough and accessible documentation of indicator design processes and decisions, including descriptions and rationale for all major indicator construction components. Documentation is the means for a tool developer to describe tool components and explain the rationale behind decisions related to indicator and data selection, data integration and analysis approaches chosen, and about all aspects of robustness and validation analyses. Good documentation makes the strengths and weaknesses of the tool clear to a variety of technical and non-technical users or community members and

provides guidance regarding the best use of the tool for decision making.

Validation

Recommendation 3: Validate tool development and evaluative processes throughout the construction of an EJ tool using approaches such as ground truthing, convergent validation, and community validation to ensure that the tool's indicators and results reflect lived experiences. Validation of every component of a composite indicator is necessary to determine that all processes and information reflect real-world conditions and lived experience of communities. Composite indicator construction requires a certain amount of compromise given data limitations and availability. Validation, through a combination of technical, statistical, and community engagement activities, can check those compromises and helps ensure a tool and its findings are rooted in the realities and lived experiences of communities, even with the necessary compromises. Because communities and their burdens are dynamic, repeated validation of indicators and tool results is necessary.

Using a Structured Development Process

Recommendation 4: Initiate EJ tool and indicator construction with the development of clear objectives and definitions for the concept(s) to be measured. Follow a structured composite indicator development process that requires explicit consideration and robustness analysis of all major decisions involved with indicator selection and integration; assessment of uncertainties; and validation and visualization of results. A good data strategy requires an explicit, systematic structure. Using a methodological framework will ensure that all composite indicator construction decisions are considered explicitly, support the stated tool objective, and are documented thoroughly and transparently.

Selecting and Assessing Indicators

Recommendation 5: Adopt systematic, transparent, and inclusive processes to identify and select indicators and datasets that consider technical criteria (validity, sensitivity, specificity, robustness, reproducibility, and scale) and practicality (measurability, availability, simplicity, affordability, credibility, and relevance). Selecting indicators and datasets is part of the structured approach described above and requires a systematic scan of all available data—perhaps in collaboration with public agencies, technical experts, and community partners—to identify potential indicators, organize them into categories, and identify those most appropriate for inclusion in the model.

Selecting Economic Indicators

Recommendation 6: Choose measures of economic burden beyond the federal poverty level that reflect lived experiences, attend to other dimensions of wealth, and consider geographic variations in cost of living. Metrics of income do not necessarily measure wealth, and the wealth gap between high-income and low-income households is larger than the income gap. Income-based measures deserve scrutiny because of the effects of income on all aspects of a person's or household's quality of life (e.g., nutrition, health care, and education). Tool developers should work alongside communities to identify other dimensions of wealth that accurately reflect economic burdens, and then conduct sensitivity analyses on those indicators and their thresholds.

Consideration of Racism and Race

Recommendation 7: Use indicators that measure the impacts of racism in policies and practices that have led to the disparities observed today. If indicators of racism are not used, explicitly factor race and ethnicity as indicators when measuring community disadvantage. The enduring effects of historical race-based policies on housing, transportation, and urban development continue to shape contemporary environmental inequalities, and ample research demonstrates racism is a fundamental cause of disadvantage and inequalities in the United States. Research also demonstrates that race and ethnicity—more so than economic indicators—are reliable predictors of disparity.

Integrating Indicators and Cumulative Impact Scoring

Recommendation 8: Designate communities as disadvantaged based on cumulative impact scoring approaches that are informed by the state of science; the knowledge, needs, and experiences of agencies, tool developers, and users; and validation efforts conducted in partnership with affected communities. Choose an approach to represent cumulative impacts, such as threshold approaches or aggregation-based approaches for composite indicator construction. The interplay of multiple concurrent stressors interacting with sociodemographic, environmental, and public health factors leads to the possibility of the total burdens on a community being greater than the sum of the individual stressors. Cumulative impact scoring is an established practice applied in various EJ tools that enables clearer comparison of communities and prioritization of investment based on the severity of the burden.

Assessing Internal Robustness

Recommendation 9: Perform and document uncertainty and sensitivity analyses to evaluate how decisions made during tool development affect tool results. Decisions to be assessed may relate to, for example, the selection of indicators and indicator thresholds; model structure; processes related to the normalization, weighting, and aggregation of indicators; and the criteria used for the final designation or classification of communities. Uncertainty and sensitivity analyses are core best practices for quality assurance in composite indicator construction and should be a part of a data strategy for any EJ tool. Uncertainty analyses quantify the variability in model outputs based on changes in model inputs. Sensitivity analyses apportion variability in model outputs to different input parameters or model structures. The ultimate goals are reducing statistical fragility and increasing the transparency of the modeling process.

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FOR MORE INFORMATION

This Consensus Study Report Highlights was prepared by the Board on Environmental Studies and Toxicology, the Board on Earth Sciences and Resources, and the Board on Mathematical Sciences and Analytics based on the Consensus Study Report *Constructing Valid Geospatial Tools for Environmental Justice* (2024).

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