Abt Associates Inc.

Analytical Methods for Assessing the Environmental Justice Implications of Environmental Regulations: Seminar Summary Report

U.S. EPA Contract # EP-W-05-022

Work Assignment # 4-106

FINAL
September 1, 2010

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List of Abbreviations and Acronyms

Abbreviation	Description
BART	Bay Area Rapid Transit
BCA	Benefit-Cost Analysis
CAA	Clean Air Act
C-FERST	Community-Focused Exposure and Risk Screening Tool
DOT	Department of Transportation
ECHO	Enforcement and Compliance History Online
EJ	Environmental Justice
EJSEAT	EJ Strategic Enforcement Assessment Tool
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
HUD	Housing and Urban Development
IEUBK	Integrated Exposure Uptake Biokinetic
IGEMS	Internet Geographical Exposure Modeling System
NAAQS	National Ambient Air Quality Standards
NATA	National-Scale Air Toxics Assessment
NEPA	National Environmental Policy Act
NHANES	National Health and Nutrition Examination Survey
NPL	National Priorities List
OAQPS	Office of Air Quality Planning and Standards
OAR	Office of Air and Radiation
OCSPP	Office of Chemical Safety and Pollution Prevention
OECA	Office of Enforcement and Compliance Assurance
OPEI	Office of Policy, Economics, and Innovation
OPPT	Office of Pollution Prevention and Toxics
OSWER	Office of Solid Waste and Emergency Response
RCRA	Resource Conservation and Recovery Act
RIA	Regulatory Impact Analysis
RSEI	Risk-Screening Environmental Indicators
SIP	State Implementation Plan
SWF	Social Welfare Function
TRI	Toxics Release Inventory
TSCA	Toxic Substance Control Act
VSL	Value of Statistical Life

Executive Summary

While tools used for conducting an efficiency analysis of environmental regulations are rigorous and well understood among economists, those for carrying out an equity analysis are not as well developed. The US EPA has committed to incorporating environmental justice (EJ) analyses into Agency decision making processes. There is thus a strong need to devise appropriate analytical tools to conduct an analysis of the equity, or EJ, implications of regulatory activities.

The purpose of this workshop was to gather a small group of economists, regulatory experts, and EJ community leaders to discuss methods for incorporating EJ analyses into EPA's regulatory process. Each session of the workshop consisted of an overview of EJ activities within an EPA program (e.g., Air, Water, Solid Waste, etc.) and a technical presentation on an EJ methodology appropriate to that program, followed by an evaluation of that methodology. Each session concluded with a moderated open discussion of the technical details of the methodology presented, appropriate uses, data needs, analytical requirements, and merits and limitations. The workshop also included a panel discussion with EJ community leaders in which they outlined the types of questions they would like to see addressed by the EJ analyses.

The workshop began with opening remarks by Lisa Heinzerling, the Associate Administrator of EPA's Office of Policy, Economics and Innovation, highlighting the importance of EJ and the challenge of addressing it in EPA's rulemaking activities. Addressing EJ concerns has officially been required of federal agencies since 1994 (i.e., Executive Order 12898), but has for the most part been handled relatively superficially with boilerplate language. Addressing EJ concerns in broad national level rulemaking is particularly challenging, because EJ concerns developed historically from site-specific decisions and analyses of impacts on nearby communities. Nevertheless, EPA is committed to change along three fronts: substantive changes in the rules being adopted to address EJ concerns, procedural changes that allow greater participation by EJ communities, and institutional changes to ensure that EJ concerns are incorporated into all stages of the rulemaking process.

Session 1 of the workshop provided a broad overview of the evidence for EJ concerns and the issues and challenges facing EJ analysts, and explored how EJ might be incorporated into benefit-cost analyses. The overview (by Manuel Pastor) presented both quantitative analyses and graphs that showed associations between vulnerable communities (poor, minority, linguistically isolated, rapidly transitioning demographics) and greater exposure to environmental hazards. In the discussion of how EJ concerns might be incorporated into benefit-cost analyses, the participants discussed the social welfare function (SWF), which provides a theoretical framework for asking how society might choose between different distributions of environmental quality, with differences in both inequality and overall levels. Although the technical issues concerning such social decisions can be quite complex, a useful analogy is a "leaky bucket," and we can ask, at what level of leakage (costs of redistribution) would society decide that an improvement in equality is no longer worth pursuing? Answering this question is difficult, but "social weights" of some sort applied to a SWF might be used to incorporate EJ concerns into the standard benefit-cost analysis (BCA). Focus group research suggests that it may be possible to develop valuations of distributional outcomes, but we are just at the beginning stages of such development to derive valuations for actual decision-making.

Sessions 2 through 5 of the workshop addressed approaches for EJ analyses of rulemakings for different media or EPA programs: water, air, waste, and toxics. The EPA participants charged with providing an

Agency perspective on EJ concerns noted that their respective offices are committed to incorporating EJ analysis, but that there is considerable uncertainty about what that analysis should include, so better guidelines are needed. Without guidelines, different teams, even within the same office, may devote very different resources to EJ analysis, follow different approaches, and sometimes rely on the earlier boilerplate EJ language.

Researchers presented and discussed papers covering a range of EJ analyses of environmental hazards. Some of these were proximity-based analyses, focusing on the characteristics of the populations living near hazards, to see if vulnerable populations were disproportionately exposed to hazards, but without an explicit model of how people were exposed. Others were exposure and health risk analyses. The paper on air pollution, for example, presented an exposure-based analysis using a GIS-based model for air pollution benefits analysis to estimate population exposures to air pollutants by EJ groups. The analysis of lead dust exposures incorporated a model of the effects of lead exposures on cognition.

The open discussions following the presentations yielded several useful observations. It was noted that it may not be appropriate to extend the exposure modeling to modeling personal exposures, since people taking "averting actions" to avoid exposure (e.g., staying indoors or using filtered air or water) would not count as "exposed" but would nevertheless have had the costs of the potential for exposure imposed upon them. It was also noted that bioaccumulative hazards, interactions among multiple chemical exposures, and/or variations in dose-response relationships across EJ groups will complicate many EJ analyses. For many hazards, the existing data and exposure modeling tools are insufficient to carry out a quantitative EJ analysis of exposures, so proximity-based tools will continue to be used, and in many cases provide reasonable identification of differences in exposures across groups; however, improvements in data and models would be helpful.

The importance of developing EJ screening tools that can help identify EJ concerns early in the rulemaking process was also noted, both to allocate more resources to EJ analyses for those rules and to assess whether some modification of the rule or its options is warranted on the basis of EJ concerns. Combining demographic information on vulnerable populations with data on exposures to a range of environmental hazards, these tools could help to identify "hotspots" – areas with both high hazard levels and vulnerable populations. Some of these tools might therefore be more generally applicable in benefits analyses. The EJ Strategic Enforcement Assessment Tool (EJSEAT) developed by Office of Enforcement and Compliance Assurance (OECA) provided an example of such a screening tool with national coverage; in Session 1 Manuel Pastor showed a more detailed screening tool covering one city. It was noted that, because of the level of detail required, these tools may be most applicable to rules or activities whose effects are relatively localized, to see if the affected location is a vulnerable one (an EJ hotspot). For national rules, tools such as the Environmental Benefits Mapping and Analysis Program (BenMAP), which focus on a particular pollutant, could assess how the aggregate impacts of a rule would affect people from different vulnerable groups. These tools could also be made available to EJ communities to help them participate in the process.

The participation by EJ community leaders, both in their panel discussion and in their comments on other sessions, contributed an important perspective. The EJ community leaders suggested that EJ considerations should be included in the rulemaking process, rather than being "tacked on" at the end. They noted too that involvement of EJ communities in the rulemaking process has implications for EJ analyses. Adopting quantitative EJ analyses that are too complex to be understood by non-experts, for example, will tend to discourage participation of EJ communities in the rulemaking process and reduce their acceptance of analysis results. The EJ community leaders also noted that EJ concerns arise from exposures to multiple environmental hazards (in conjunction with other disadvantages) over a long period of time, so incorporating EJ concerns into a rulemaking on a particular hazard may require addressing exposures to other hazards and other sources of vulnerability.

Session 6 of the workshop discussed the importance of addressing EJ concerns when implementing EPA regulations. It was noted that concerns about implementation are increased by the federalism of the U.S. regulatory system, since most rules are set at the federal level but implementation and enforcement typically take place at the state or local level. This could in theory improve responsiveness to EJ concerns, with decisions happening closer to local communities; in practice, however, it may frustrate EJ concerns if local decision makers are not responsive to the concerns of EJ communities. In the open discussion following the presentation in this session, ways in which the Federal EPA could play a greater role in encouraging and/or mandating greater responsiveness to EJ concerns by state regulators were discussed. It was suggested that creative implementation of rules could help address long-standing EJ concerns -- for example, firms seeking to locate new emissions sources within non-attainment counties could be required to buy all their offsets from existing sources in EJ communities, thus ensuring gradual reductions in emissions at EJ hotspots. In this way, the rulemaking process could incorporate considerations of implementation into the rule's design, helping ensure that EJ concerns are addressed in ways that are both substantive and procedural.

The workshop concluded that, moving forward, a combination of clearer definitions and guidelines for EJ analyses and "demonstration" examples would make it easier to ensure consistency across rule-writers in the types of EJ analyses being applied to final rules. Development of better EJ screening methods would allow better targeting of analytical effort to rules that raise particular EJ concerns, and doing this earlier in the rulemaking process to influence options and rule selection would be advisable. While various EJ analysis methods were discussed during the workshop, data challenges and model choice issues were identified. Creative application of EJ concerns to new rulemaking could help reduce the existing burden of exposures faced by some EJ communities. The participants in the workshop agreed that these are important issues to be considered in the rulemaking process.

1. Summary of the Workshop Sessions

1.1. Opening Session by Lisa Heinzerling

Lisa Heinzerling, the Associate Administrator of EPA's Office of Policy, Economics and Innovation, opened the workshop by noting that environmental justice is one of Administrator Lisa Jackson's top priorities and that she intends to incorporate it into every step of the rulemaking process. She mentioned two challenges facing EJ analysis. First, EJ arose from a concern about site-specific decisions, specifically the siting of a hazardous waste facility in NC. This presents a challenge for extending EJ analytical methods to national-level rules. Second, although federal agencies have been required to address EJ concerns since 1994 (E.O. 12898), this has, for the most part, been done relatively superficially, with boilerplate language ("everyone benefits from this rule, so there cannot be any EJ problem"). The challenge is to change the expectations of rule-makers and get them to incorporate EJ concerns at all stages of the decision-making process. In addition, EJ advocates have high expectations, which generates pressure on EPA to make progress quickly.

Associate Administrator Heinzerling identified three types of changes to be incorporated in EPA's rulemaking:

1. *Substantive.* EJ concerns may affect the rules that have been adopted. For example, in the NO_X National Ambient Air Quality Standards (NAAQS) Regulatory Impact Analysis (RIA), there were EJ concerns about the impact of the rule on particular communities. It was decided to "set aside" 40 of the air monitoring stations to be placed in the EJ communities of critical importance. However, in general it may be challenging to incorporate EJ concerns in a national rulemaking process for a specific pollutant, especially given the holistic, community-focused approach that generally characterizes EJ concerns.

2. *Procedural.* EPA is committed to improving transparency and collaboration in the rulemaking process to encourage greater participation by EJ communities and outside experts. For example, EPA has developed a portal – the EPA Rulemaking Gateway – where anyone can look up the status of various rules (starting from the proposal stage).[1] This will allow "outsiders" to see what rules are upcoming, and identify whether they have EJ implications, before the rules reach the final comment stage.

3. *Institutional.* EPA is in the process of revising the guidance for rule development in the agency. This will require that EJ questions be asked at the various stages of the rule making (initiation, option selection, and final agency review). This may sound bureaucratic, but the effect will be to make EJ considerations pervasive in the agency. Every office will need EJ experts, and they will become accustomed to incorporating EJ concerns in all their processes. This will serve to make the changes durable within the institution. A useful example is National Environmental Policy Act (NEPA) which requires environmental impact statements. To comply with NEPA, federal agencies hired environmental experts and considered the environmental effects of their decisions during their planning processes, and this has had a major impact.

[1] http://yosemite.epa.gov/opei/RuleGate.nsf/

Associate Administrator Heinzerling asserted that EPA is committed to taking action on EJ concerns. There is a need for more analytical help, she noted, to examine whether economic analysis (which is as important as ever) is adequately taking equity concerns into account. She said she is eager to get started.

1.1.1. Questions to Lisa Heinzerling and Answers:

Q1: Through interactions at your level, have you seen evidence that other agencies are focusing on EJ concerns?

Lisa: Not specifically – There have been lots of interagency projects, but none of them focus on EJ, although some address EJ issues. [Charles Lee: Department of Transportation (DOT) does have an EJ policy, and even revoked a $50 million grant to bay area rapid transit (BART) for lack of an appropriate EJ analysis.]

Q2: Has the new Rulemaking Gateway been successful in collecting more comments from a wider range of participants?

Lisa: They do not have any data on that yet. They are trying to measure its impact on comments received. Currently the comments they get are very predictable - industry wants weaker standards, environmental groups want stricter standards, and few others respond. EPA hopes that the Gateway will expand the diversity of comments they receive during the rulemaking process.

Q3: Are there intra-agency definitions of EJ?

Lisa: There has been a general discussion of how to define EJ, but there is no consistency across (or even within) agencies.

1.2. Session 1: Environmental Justice and Equity

1.2.1. Al McGartland

Dr. McGartland observed that the current situation with EJ analysis is similar to the situation with BCA when it was first introduced in rulemaking. EPA has become familiar with BCA, and uses it extensively in RIAs. An EJ analysis presents its own complications, he noted, but we have better data and better tools for measuring environmental impacts, and a substantial EJ literature to work with. Therefore he expressed cautious optimism. He noted that it may be desirable to think about how to best leverage methods developed for BCA for EJ analyses. He added that it is worthwhile to think about ways of incorporating EJ analyses into the existing BCA framework (or at least to try not to depart from it too much).

1.2.2. Manuel Pastor

Dr. Pastor noted that there is not much doubt that poor and minority communities face disproportionately greater risks along many dimensions, but there is some doubt about the cause(s). Explanations include clustered land uses, markets for labor and housing, and the effects of politics and power on facility location. Dr. Pastor is currently working on a more nuanced view of EJ for a project in the San Francisco Bay area, considering factors including linguistic ability and political power, and using a combination of maps, regressions, and spatial autocorrelations. He noted that properly accounting for distance is important, since facilities are often sited on Census boundaries and affect neighboring blocks. He found major effects for being linguistically isolated as well as "ethnic churning" (rapid demographic transition, which could weaken social cohesion).

Dr. Pastor emphasized that definitions of EJ communities should go beyond residential location to include school, hospital, and work exposures, and should consider all hazards faced by the community – i.e., we should focus on the analysis of the cumulative risks faced by communities. He presented his new method, environmental justice screening method, where he used block-level data weighted by exposure, aggregated up to the Census tract level, and looked for the combination of high exposures and vulnerable populations. The results show the expected EJ communities (i.e., this is, in principle, a screening analysis for the San Francisco Bay area). Interestingly, the results also show locations where the community faces substantial cumulative risks, but has not yet organized to take action. He noted that the kind of analysis he undertook may be useful for encouraging those communities to organize to address EJ concerns.

Finally, Dr. Pastor observed that economists tend to focus on multiple regressions, looking at the impact of race or income "holding all else equal," but that may not be appropriate for an EJ analysis. People of color have disadvantages along many dimensions which can interact with each other, and a "causal" analysis that identifies income rather than race as the causal variable does not negate the disproportionate risks. Returning to the influence of political power, he suggested that the inequality of risks may reduce the pressure to clean up pollution if the risks do not affect those with political power.

1.2.3. Maureen Cropper

Dr. Cropper addressed the following question: Is it appropriate to include in a benefit-cost analysis individuals' willingness-to-pay for changes in the distribution of risks in a population? Her answer: Yes, if altruistic values are allowed in a benefit-cost analysis, and if people are paternalistically altruistic – i.e., if they value risk reductions for others rather than simply increases in others' utilities. Buying a protective device for somebody, rather than giving that person money (presumably to buy such a device), is an example of paternalistic altruism.

Dr. Cropper then described a focus group she conducted with Dr. Alan Krupnick to see if they could operationalize the process of eliciting values for changes in risk to others. This turned out to be tricky, especially communicating the difference between baseline risk and changes in risk due to a policy. She noted, however, that the focus group participants seemed to understand the questions and were generally more willing to contribute to reduce others' environmental risks than simply to provide money. This is just a first step, she said, but suggests this sort of analysis is possible. She identified a benefit-cost analysis of water quality improvements, which has some of the same aspects of evaluating a public good, as a likely candidate for incorporating this approach. Finally, she expressed the opinion that people should be asked to value the change in the overall distribution of risks, rather than valuing the change in a measure of the inequality of risk, because welfare depends on *absolute* risk levels in a population and inequality measures only describe the distribution of risks (or incomes) *relative* to the mean, so they cannot capture changes in overall welfare.

1.2.4. Matt Adler

Social welfare functions (SWF) provide a theoretical way of approaching social decision-making and can be connected to inequality measures. After reviewing different SWFs and their properties, Dr. Adler discussed ways that the SWF approach could provide insights for practical applications. The utilitarian SWF is similar to the usual benefit-cost analysis approach of adding up everyone's benefits and costs, while an "equity regarding" SWF places greater weight on those who are worse off, tilting society's decisions in favor of more equitable results. Dr. Adler noted that implementing SWFs would require solving some difficult problems (e.g., deriving interpersonally comparable measures of individual utility, using lifetime utility vs. slices of time, and dealing with uncertainty in policy outcomes). He suggested that a less demanding approach may be to normalize by income, after setting non-income attributes at a specific level. (Basically, this would mean putting normalized incomes into the income-utility function.)

He proposed a "leaky bucket" analogy – moving dollars from rich to poor could be worth doing, even if some are lost in the transfer. A measure of society's preferences for equality is how much leakage has to happen before the transfer is undesirable. He noted that inequality metrics can be used to decompose the SWF into two pieces, one for the total utility and the other for the inequality component, which is similar to doing benefit-cost analysis with distributional weights. We could use the leaky budget example to identify the strength of people's preferences for equality, and use those preferences to develop the appropriate distributional weights.

1.2.5. Open Discussion

The open discussion among workshop participants focused on both of the approaches described by Drs. Cropper and Adler, as well as the interface between analysis approaches and EJ communities. Below is a synopsis of the thread of the conversation:

Inequality analysis could be done on survival rates, perhaps decomposing them into the mean survival rate times an inequality measure (e.g., Atkinson index), avoiding the need to assign dollar values to risks, and focusing on tradeoffs between mean risk reduction and improvements in risk equality. The SWF approach suggests that we should also consider inequality in individual exposures within groups as well as between groups.

However, given the fact that some population groups face not only multiple survival risks but also poorer quality of life in general, a more holistic/integrated approach would be to work in the space of individual utilities rather than individual attributes. The SWF approach allows balancing equality and overall change brought about by various policy options, without the need for gathering paternally altruistic WTPs for inclusion in benefit-cost analysis. Nevertheless, eliciting paternally altruistic WTPs may be a more practical approach for including equity considerations in benefit-cost analysis.

The focus on SWFs could address EJ concerns with distributive justice (by defining an appropriate inequality metric, but would not address procedural justice. In fact, the more sophisticated models preferred by academics may be incomprehensible to EJ community groups, and could raise concerns that the experts are trying to "cover up" the true situation with fancy techniques. There is thus a tradeoff researchers should be aware of between (analysis) complexity and communication. It was also noted that an aspect of procedural justice could be captured by multiple regressions in a retrospective analysis (asking, e.g., whether minorities have been exposed to greater risks than others, even after controlling for lower income or less political clout).

EJ methodologies were originally developed to address site-specific issues, which may be difficult to connect to national rulemaking, and concerned with group and community actions, rather than summing up individual utilities. On the other hand, the EPA Office of Environmental Justice was originally called the "environmental equity" office, and changing the name did not change what they did. There is also the possibility that experts should be trying to change society's valuation of equity issues by providing EJ information in a way that community leaders can use to raise awareness of EJ issues.

1.3. Session 2: Methods for Analyzing Environmental Justice for Disperse Pollutants: Application to Water

1.3.1. Kelly Maguire

Dr. Maguire introduced this session, the first of the four sessions looking at different EJ methodologies and their connections to particular media or EPA programs. She is co-chairing an EPA workgroup charged with developing technical guidance on how to conduct EJ analyses, for which these topics are quite relevant.

1.3.2. William Swietlik

Mr. Swietlik gave an overview of EJ activities in EPA's Office of Water and office's perspective on the challenges they face in incorporating EJ concerns in their rulemaking process. Most major rulemaking in the past, he said, did not pay much attention to EJ issues, but they do more now. A review of the EJ sections in past rulemaking efforts finds a wide range of approaches, from qualitative statements to site-specific analysis using EJ indices. The Office of Water's current action plan includes two programs with major EJ components – "water safe to drink" and "fish and shellfish safe to eat" – and they are doing EJ analysis for all priority actions. They need data for this analysis, he noted, including data on plant location, hydrology, drinking water sources, and subsistence fishing, as well as demographic data. Finally, he noted that they also need a better screening methodology to determine where EJ analysis is needed, better guidance on EJ analysis to ensure that different teams apply similar standards, and guidance on what constitutes "disproportionate impact," the appropriate scope of the community, and how extensive an EJ analysis is needed in different settings.

1.3.3. Spencer Banzhaf

Like some other speakers, Dr. Banzhaf noted that the history of EJ analysis started in specific sites, often connected with hazardous waste, with a second wave connected with toxics release inventory (TRI) facilities. EPA's response has also been site-specific, related to brownfields and permitting. It is less clear, he observed, how to address EJ issues for diffuse pollutants such as pollutants in water.

He noted that the traditional approach to EJ analysis is to define a "community" around a "site" and a "reference community" and look at the groups who live in each. He expressed his sense that EJ analysis at EPA is mostly focused on this approach of examining sites and communities, and that it typically offers "negative assurance" – i.e., it is more likely to assert that there is no reason to think a policy will harm EJ communities disproportionately, rather than trying to craft policies to positively benefit EJ communities.

Instead, he suggested, for diffuse pollutants it makes sense to start with the groups of interest and look at the effect of a regulatory action on them, regardless of where they may live – i.e., to reverse the categories. Essentially, then, EJ analysis becomes a special case of distributional analysis. That is, in addition to computing the aggregate benefits and costs of an action, RIAs should compute the benefits and costs of the action for specific demographic groups. While the importance of adopting this approach is most obvious for dispersed pollutants, he noted, it is applicable to the environmental justice considerations in any RIA.

Dr. Banzhaf then asked: If EPA sought to positively promote equity through EJ activity, what would it be promoting equity of? One could use policy to try to equalize cancer risk from arsenic, for example, or total environmental risks, or overall well-being. Dr. Banzhaf expressed his preference for the latter approach, which suggests the possibility of using environmental policy to improve the relative position of EJ communities (noting that such a policy would not necessarily be "equitable" in isolation, since it gives preference to the EJ community, but could still be equitable in terms of overall well-being). He noted too that it is important in this process to think about the costs of a policy as well as its benefits, since costs can also disproportionately impact an EJ community. Also important are "general equilibrium" effects (e.g., environmental gentrification in an EJ community raising rents and forcing out current residents).

Dr. Banzhaf suggested that the best analysis would incorporate heterogeneity in willingness to pay (WTP) across groups as well as distributional effects. He observed that differences in WTP across groups could be offset (or more than offset) by using distributional weights or an inequality index to favor disadvantaged groups. This approach would be more flexible than simply imposing the same WTP.

Finally, he noted that even simple tabulations of the distributional effects of a rulemaking in a benefit-cost analysis may facilitate equity considerations and inform the policy makers about the existing tradeoffs.

1.3.4. Tauhidur Rahman

Dr. Rahman, who was asked to be a discussant for Dr. Banzhaf's paper, observed that while the paper does provide a way to think about incorporating distributional effects in RIA, the approach seems to be mostly theoretical, and may be intractable. Many of the potential costs and benefits are difficult to quantify, indirect effects such as market effects may be important, group-specific heterogeneity in responses would be difficult to measure, and non-use or existence values could complicate the process. The incorporation of the distributional objective into the efficiency objective of a benefit-cost analysis by using distributional weights on net benefits requires deciding on the appropriate distributional weights for different groups, which could be quite complicated. Moreover, he added, the proposed method may work for observable dispersed pollutants, but not for unobservable dispersed pollutants.

1.3.5. Open Discussion

The open discussion among workshop participants focused on differential values of statistical life as well as overall versus constrained optima in achieving environmental justice. Below is a synopsis of the thread of the conversation:

Several workshop participants commented on the political pitfalls associated with assigning different value of statistical life (VSL) to groups based on differences in willingness to pay (based on differences in income levels), however theoretically appealing the combination of heterogeneous VSLs and distributional weights might be, since any such attempt could easily be defeated by sound bites (e.g., "the lives of the rich are twice as important as the lives of the poor"). The data requirements would be high (even without different VSLs), but perhaps not much higher than doing a good benefit-cost analysis. The distributional EJ analysis suggested by Dr. Banzhaf needs to be supplemented with a procedural analysis that looks for possible failures of institutions to provide equal protection in EJ communities.

Some "theoretical" first-best analyses of policy changes assume that it would be possible to change the tax code to offset any adverse distributional effects of the policy, so that policy makers can focus on maximizing efficiency. However, since EPA does not have the power to change the tax code, it must make policy decisions in a "second-best" world, where it needs to consider distributional issues. This suggests that EPA could try to incorporate extra benefits for disadvantaged communities when making new rules, as partial compensation for their higher overall baseline risks. We should also be concerned about possible inequity in the implementation of regulations, although this could go both ways. One concern is that facilities in EJ communities might receive less enforcement activity, reducing the benefits of the regulation (so more enforcement would be better). Alternatively, if the cost of compliance differs greatly across facilities, it might be socially optimal to have incomplete implementation at high-cost facilities (i.e., the older facilities located in older industrial areas which are often near EJ communities). In the long run, we need to see whether there is any connection between EJ concerns and EPA's decisions – i.e., what difference does considering EJ make in the final rules being adopted?

There is a sense that examination of the distributional effects of a rule may not be equivalent to an EJ analysis. An EJ analysis is about multiple environmental risks that burden specific communities, whereas distributional analysis is about how (net) benefits of a certain rule are divided up across various socio-demographic groups. Can one inform the other? Also, if inequalities are detected in a distributional analysis, what kinds and/or magnitudes would imply disproportionate impact (i.e., injustice)?

1.4. Discussion with Panel of EJ Community Leaders

1.4.1. Mark Mitchell

Dr. Mitchell is the founder and president of the Connecticut Coalition for Environmental Justice. He noted that a map of Connecticut clearly shows a strong correlation between percent minority and numbers of air pollution sources. The EJ notion of "disproportionate impact" is clearly met in the aggregate, he said, but may be missed by regulators who treat each facility as a separate case or fail to recognize that EJ communities may be more susceptible because they are exposed to more pollutants or because of unique pathways (e.g., subsistence fishing). Dr. Mitchell highlighted the importance of multiple and cumulative exposures to environmental hazards, pointing to public health research on multiple stressors in the environment that make people in EJ communities disproportionately more vulnerable. He also noted the importance of institutional issues, such as the inability to participate in the decision making process or failure to coordinate across agencies (e.g., building a public school on top of a brownfield).

1.4.2. Jose Bravo

Jose Bravo, Executive Director for the Just Transition Alliance, noted that EJ communities are commonly defined by race and income but can also be affected by education and political clout. He observed that while economic analyses often focus on willingness to pay, EJ communities have been "paying" in terms of higher environmental risks for many years, and these higher risks have sometimes been driven by government decisions. Most EJ communities, he noted, have mixed (industrial + residential) zoning; in the case of San Diego, EJ groups were "encouraged" to live near jobs (i.e., in industrial areas) by city ordinances until the 1960s. Even recent decisions, he said, have shown adverse EJ consequences. He gave several examples: (1) California is moving from methyl bromide to methyl iodide to reduce greenhouse gas emissions, but this increases health risks for the farm workers who apply it. (2) A floor stripper was given a “Green Seal” because less water was used in its production, despite higher risks for the cleaning people using it. (3) Lead-containing toys are banned in the mainstream stores and instead end up in dollar stores (more likely to be frequented by low income individuals). He suggested that rulemaking could help reverse this history of greater (legacy) risks in EJ communities. This is not just “NIMBY” (“not in my backyard”), he said; the idea is not to just push the risks to other areas, but to get them cleaned up everywhere.

1.4.3. Cecil Corbin-Mark

Mr. Corbin-Mark, Deputy Director of WE ACT, noted that his organization is concerned about several environmental issues, including global warming and the potential impacts on native populations (e.g., Alaska), cap-and-trade systems that allow higher emissions at high-cost plants, which tend to be older plants in EJ areas, and the longer term issue of avoiding the perpetuation of past pollution differentials due to the concentration of multiple polluters and pollutants in EJ areas. As others before him had observed, Mr. Corbin-Mark noted that benefit-cost analyses focus on effects of individual policies and ignores the cumulative and multiple-risk setting that is always been the basis for EJ concerns (the “hot spot” concept). EJ activists, he said, hope to influence policy in a way that stops “escalation of the ecological debt” – i.e., stops the “piling up” of the environmental stressors on specific communities. They recognize, however, that the EJ movement has to move out of the “local” and “site-specific” activities and start working at a broader level. There is also an idea, he said, that an arbiter for what happens in society should be the community rather than the individual.

1.4.4. Open Discussion

The open discussion among workshop participants focused on the tradeoffs EJ communities may face as well as the rulemakers’ tradeoff between producing more rules versus addressing EJ concerns in every rule. Below is a synopsis of the thread of the conversation:

EJ communities are aware of the tradeoffs affecting them, but often they have not participated in the decision-making process, and the final outcomes often involve costs to EJ communities and benefits to others. They are also aware of the possibility of environmental gentrification - a proposed waterfront park in one community, for example, was opposed by an EJ community for that reason. Can we identify which rules raise particular EJ concerns with some type of screening analysis, given the large number of rules being proposed and the limited resources to process them? It might be possible to structure the communication – i.e., to develop a decision matrix to help with the planning and scoping of rules – to see which need EJ attention. However, this question raises the larger question of EPA’s mission and priorities. Is it more important to produce many rules, or to address EJ concerns fully in every rule? Consideration also needs to be given to the time line and the resources that EJ communities need to participate in the regulatory process. Perhaps EPA should try to identify existing hotspots, based on cumulative exposures to multiple pollutants, and then put effort into cleaning up those areas. Workshop participants liked the idea of hotspot cleanup, since they do not want to simply shift pollution to other areas. In considering the benefits of jobs versus community health, health appeared to be the key concern. There is also an understanding that not every job is a good job. In fact, in many cases community was first and then came the industry. Some of these issues may be addressed through proper re-zoning.

1.5. Session 3: An Exposure and Health Risk Environmental Justice Analysis Method: Application to a National Air Quality Rule

1.5.1. Neal Fann

Dr. Fann leads the Office of Air and Radiation health benefits team and is the project manager for the Environmental Benefits Mapping and Analysis Program (BenMAP). He noted that EPA has had practice doing the aggregate analysis required in benefit-cost analysis, but less practice doing distributional analysis. He noted too that air rules cover a wide range of scales, from local or regional to national and that the air office's experience so far suggests that the resolution and scale of a distributional analysis can make a difference, but there is no clear sense as to what are the appropriate resolution and scale.

1.5.2. Tamara Saltman

Ms. Saltman, a policy analyst in the Office of Policy Analysis and Review (OPAR) in EPA's Office of Air and Radiation (OAR), noted that OAR is experimenting with different approaches to addressing EJ issues in rulemaking, that it is very much "a work in progress." OAR can see some communities facing problems, she said, but regulators have a limited toolset to work with, and air pollution comes from many different sources. Given that agency resources are limited, there is an interest in understanding how the existing tools can be used (perhaps, with modifications) to carry out distributional analyses. She noted that the Clean Air Act (CAA) emphasizes a national approach, with minimum standards for air quality to be met everywhere. OAR also deals with a range of different types of rules: standard-based vs. technology-based, sector-based vs. broad rules, rules targeting mobile vs. stationary sources, rules for new vs. existing sources. All of this, she said, implies varying degrees of relationships with the affected communities. EJ concerns could be helpful, she noted, in laying out the agenda, prioritizing rules based on their impact, encouraging multi-pollutant analyses, collecting data on affected communities, thinking about enforcement, and holding meetings with people from affected EJ communities. She identified the current basic concerns as a terminology gap, effective outreach to EJ communities, data for carrying out vulnerability analysis, and a lack of opportunities for the EJ communities to participate in the regulatory process.

1.5.3. Ellen Post

Dr. Post described an individual-based method that Abt Associates developed to carry out EJ analyses of national air rules using BenMap. BenMAP is the tool used by EPA's Office of Air Quality Planning and Standards (OAQPS) to carry out benefits analyses for NAAQS and other national and regional criteria air pollution rules and regulations. It combines data on ambient air pollution concentrations with Census data on location-specific populations, health impact functions, baseline mortality and morbidity incidence rates, and valuation of morbidity and mortality health endpoints to derive estimates of monetized health benefits. Dr. Post noted that an EJ analysis would use EJ group-specific inputs (e.g., EJ group-specific baseline incidence rates) where they are available. Baseline air quality (in the absence of a regulation) and control scenario air quality (in the presence of the regulation) are inputs to BenMAP. In benefit-cost analysis, BenMAP is typically run for the entire population. In the method Dr. Post described for EJ analysis, a BenMAP analysis is effectively carried out separately for each of the population sub-groups of interest. The results of the BenMap runs are then post-processed to derive, for each population sub-group of interest, distributions of individual-level air quality exposures in the baseline and in the control scenario, as well as distributions of air pollution-related health effects. These EJ group-specific distributions can then be compared.

Dr. Post also described how decomposable inequality indices (such as the Atkinson index) can be used to examine the extent to which an EJ factor (e.g., race or ethnicity) explains the inequality (e.g., in baseline exposures) observed across individuals, in the same way that an analysis of variance decomposes total variability into within-group versus between-group variability. She noted that inequality indices can be used to estimate whether an air pollution rule or regulation will increase or decrease the inequality in exposures and/or air pollution-related health effects across EJ groups. In a case study of the Heavy Duty Diesel Rule she presented, decompositions of inequality indices showed that most inequality in exposures to particulate matter air pollution in the US population is due to within-group rather then between-group heterogeneity in exposures.

Dr. Post noted some issues and challenges. She noted that the method she presented attempts to answer whether there are differences (e.g., in baseline exposures) among EJ groups, but not why there are differences. Perhaps the biggest challenge, she said, is that we cannot really get individual-specific exposures. The case study analysis, for example, used an air quality grid with 36 km x 36 km grid cells, which is much coarser than the usual definition of EJ communities. In contrast, she noted, a recent OAQPS analysis in Detroit used 1 km x 1 km grid cells, which may be too fine a resolution, since people move around rather than staying at their residence. She concluded that it is not clear what the optimal grid cell size is. A next step could be performing a comparative analysis with different air quality modeling resolutions, to determine how sensitive the results of the distributional analysis are to the chosen grid size. The grid structure in general could be problematic for mobile source rules, she said, since a grid would not adequately capture the higher air pollution levels near transportation corridors.

Finally, Dr. Post noted that there will always be some differences across groups. The relevant question, she said, is: Are observed differences between EJ groups *worthy of concern*? That is, we need to be able to decide which differences are large enough to be meaningful.

1.5.4. Chris Timmins

Dr. Timmins, who was asked to be a discussant for Dr. Post's paper, observed that BenMap is comprehensive and relatively easy to use, with the Census data providing highly detailed population information and allowing us to talk about the distribution of effects across population groups for different policy options. He noted, however, that it does not have a way to capture lifetime exposures and that we do not know where individuals spent their childhoods. He noted also that different groups have different degrees of mobility (for example, 80% of high school graduates are living in the same region where they grew up, but this is true of only 50% of college graduates).

He also brought up the broader question of people's locations representing optimizing behavior, and asked, what do people give up to live in a nicer area? While this is easier to think about when the effects do not include mortality, he observed, still we can think about hedonic valuation of non-market characteristics such as environmental quality, perhaps adding heterogeneity in WTP across groups, or inter-urban hedonics including wages and labor markets as well as housing markets, or equilibrium sorting models with endogenous prices. These are complicated models, he acknowledged, but non-optimizing models are equivalent to assuming that people do not know about - or do not value - pollution risks.

1.5.5. Open Discussion

The open discussion among workshop participants focused largely on one of the main challenges of the proposed method: estimating individual-level exposures. Below is a synopsis of the thread of the conversation:

It was noted that some of the challenges identified for the proposed EJ method using BenMAP are challenges for the broader benefit analysis method as well – most notably, air pollution benefit analyses estimate average ambient pollutant concentrations within each cell of a grid, and these average ambient pollutant concentrations get assigned to all individuals living within the grid cell. We do not know the true exposures for individuals, just the ambient air quality within grid cells, which may obscure intra-cell heterogeneity of exposures.

The possibility that averting behavior varies across populations, with more educated people presumably being more able to avoid pollution, was also noted. However, as noted above, the problem is that we do not know true exposures, just the ambient air quality. If different people spend different amounts of time outdoors, they could have different exposures, depending on their access to air conditioning.

It was also noted that, if we are going to apply an inequality metric in BenMap, it is important that it be decomposable, and that it be applied to the levels of pollution before and after the policy change (not just applied to the changes in pollution, which would ignore the differences in baseline exposures which are important in identifying inequities).

Workshop participants discussed whether we should consider differences across other groups, such as gender. It is possible with BenMap, but it would involve moving away from traditional EJ concerns, since gender is not a characteristic that is traditionally associated with environmental justice. It may be more important to provide information to EJ communities based on the groups with which they are already identified. One workshop participant suggested that EJ analysis at EPA is clearly focused on race, class, and power, although there can also be specific groups being defined for particular EJ issues (e.g., substance fishermen in South Florida).

1.6. Recap of Day 1 and Opening Remarks by Wayne Gray

Wayne Gray recapped the main themes that emerged during the first day of the seminar:

- EJ communities experience cumulative exposures to multiple environmental hazards, while the rulemaking process tends to focus on exposures to a single hazard in isolation.
- There seem to be a few different approaches that various EPA offices (or analysts within offices) take to analyze EJ issues.
- There is already a range of tools available (BenMAP, Manuel Pastor's environmental justice screening method, etc.) that can be successfully used for EJ/distributional analyses. There may be other tools that would need to be developed for other analytical contexts.
- There are procedural rulemaking issues: EJ communities for various reasons are unable to fully represent their interests. There is also a problem of clear communication of the modeling/analysis results to the wider public.

- There is a sense that, given the many rules EPA has to produce each year, there may be a need for a screening mechanism for the rules to identify the ones where EJ concerns may be the greatest. Rules with very large net benefits may fall into this category.
- There is a sense of optimism, however, because benefit-cost analysis, which once seemed impossible to do well, is now standard (although analyzing distributions may be somewhat harder).

1.7. Session 4: Proximity-Based Approaches to Analyzing Environmental Justice: Application to Waste

1.7.1. Mark Corrales

Mr. Mark Corrales, of EPA's Office of Policy, Economics and Innovation (OPEI), said that OPEI reviews all proposed rules, so they see a variety of EJ analysis methods early in the rulemaking process. Not many of the methods are quantitative, he noted, nor is it clear what constitutes a quantitative EJ analysis. A number of these rules, he said, come from EPA's Office of Solid Waste and Emergency Response (OSWER), and a lot of the analyses use proximity to hazard as a surrogate for risk in lieu of an exposure analysis using air quality or other modeling. Often enough, air quality modeling is not available and the question is whether proximity analyses may provide useful insights. Problems with modeling exposures, he noted, are not specific to EJ analysis.

Picking up on Manuel Pastor's talk, Mr. Corrales asked whether EJ analyses should focus on trying to explain inequalities (e.g., using multivariate regression) or just document them. A conceptual concern is whether the analysis should focus on the community or individual level. He asked whether EJ analysis should look at impacts (exposure) or also at (health) effects or overall well-being (mentioned by Dr. Banzhaf).

Finally, Mr. Corrales noted that there are at least a dozen upcoming rules with plans for quantitative EJ analysis, yet analysts are not clear about what exactly needs to be done.

1.7.2. Lyn Luben

Mr. Lyn Luben, of EPA's Office of Solid Waste and Emergency Response (OSWER) said that in OSWER they are looking for a measurable benefit to the life of impacted communities, and that they are seeking to incorporate EJ into all aspects of their rulemaking in a meaningful and understandable way, which requires life-cycle assessment. They have been tracking EJ since 1995, he said, and have seen four approaches: boilerplate text, text with speculation on EJ effects, analysis of community demographics, and analysis of community health risks. The only quantitative risk analysis they are aware of, he said, happened in 1992; it looked at the impact of wood treatment runoff on subsistence fishers. For upcoming rules, he noted, they will be using a variety of methods: looking at minority and low-income populations within 1-3 miles, calculating ratios between local and national population percentages (with 1.0 = no differential effect), and looking at other stressors of the community.

He cited several issues which make EJ analyses difficult: (1) there is no overall guidance, including definitions of key terms, e.g., "disproportionate impact" (in one rulemaking they said the impact was "disproportionate" but then realized they could not support the assertion without a definition), "susceptible populations," "low income," and "proximity"; (2) issues of data availability and appropriate methods; and (3) the waste management hierarchy sometimes conflicts with EJ priorities.

1.7.3. Doug Noonan

Dr. Noonan reported on a literature review of 110 EJ studies, as well as their own analysis, that he and his co-authors conducted. He found that there is considerable "room for guidance" in the way EJ analyses are conducted, both in the scale (unit of analysis) and the scope (geographic study area) chosen for the study, as well as the measured outcome, which can be either discrete (site location) or continuous (emissions or ambient exposures). Typical scopes include national, state, and municipality; typical scales include block, block group, tract, zip code, or county. He reported that the recommendations in the literature are widely varying, as are the "intuitions" about how scale should matter for the results; when different scales are used within the same study, he noted, it often affects the results. Researchers have tried many combinations, he said; something is usually significant, but studies using finer scales tend to have more significant results.

Dr. Noonan reported that, for their own analysis, he and his co-authors looked at 1633 national priority list (NPL) sites, with the dependent variable being a binary variable for whether or not an areal unit has an NPL site. When using national data, he said, it is important to modify the definition of an "area of concern" to something like "an area that has at least 50% within 6 miles of a site," because otherwise the much larger block groups in the West skew the results. He reported that hedonic analysis helped them choose the 6 mile distance as providing the strongest results. In their analysis, the results varied considerably, he said, depending on the scale and the presence of control variables. They also identified issues with assuming linear effects, but while there was evidence of spatial dependence, it did not seem to greatly affect the results. He cited some underlying questions still remaining – for example, disproportionate impact "of what, on what?" The NPL rule did not cause the sites to exist, so it is not obvious how EJ considerations would affect the rulemaking. He noted that E.O. 12898 says that EJ analysis should not "artificially" dilute or inflate the effects, but with so much opportunity for choices to affect the results, and no benchmark for the "true" effects, these are difficult and important issues.

1.7.4. Hilary Sigman

Dr. Sigman, who was asked to be a discussant for Dr. Noonan's paper, observed that it is difficult to get standardized guidance on EJ analyses, given the number of different issues involved. She noted that there has been substantial technological progress over time in EJ analyses, so there may be some "vintage" effects in the range of studies being examined in Dr. Noonan's paper. Newer studies used faster computers, so they include better spatial analysis, more complex models, and better matching to Census data. She said that the scale of the analysis should depend on the rule being examined -- e.g., is it a case of direct contact, surface or groundwater, air pollutants, or urban blight? In addition, community boundaries can be an important part of the analysis, which suggests that Census units (which tend to follow neighborhood boundaries) are preferable to zip codes (which were designed for the convenience of mail delivery). If a larger area is needed for the analysis, Census tracts can be aggregated into larger units. She noted that we might expect smaller areas to give bigger point estimates and more statistical significance. Proximity-based measures are better than point locations, since polluting facilities are often located on or near boundaries.

Finally, she addressed the issue of causality. She suggested that the more sophisticated EJ models that include many controls and test for causality may not be the best choice for rulemaking. We want to give as much scope as possible for the explanatory variables (race and income) to have an effect, she noted, thus parsimony of controls is essential. We also want the models to be understandable to those in EJ communities, so that they can fully participate in the rulemaking process, which may argue in favor of proximity analysis, which is simpler to explain. The problem, she added, is that peer review pushes researchers towards complicated and novel analyses.

1.7.5. Open Discussion

The open discussion among workshop participants focused on the location versus proximity measures as well as more general issues facing EJ analysis. Below is a synopsis of the thread of the conversation:

It is important to recognize the big variation in the size of Census units across the country, which makes a proximity measure (e.g., all Census block groups which have the majority of their land area within 5 miles of a hazard) better than a location measure (e.g., only those Census block groups which have a hazard within their boundaries) for a national analysis. In a remote rural area, with very large block groups, a location-based measure would count everyone in the block group as being exposed to a hazard located within the block group, even if most of them are many miles away, while in an urban area, with much smaller block groups, a location-based measure would ignore many people located quite close to the hazard, because they happened to be in another nearby block group.

If polluters differ widely in size, that should be considered in the analysis. However, it may be hard to make sense out of (and policy decisions based on) a large number of sensitivity analyses using various proximity measures (multiple buffer sizes, various boundary definitions, etc.). In that sense, a site-specific risk assessment may be a better choice (unless there are too many sites, which would make risk analysis for the rule very expensive).

Looking at community demographics in specific communities may be of value for rulemaking. It may make sense to screen for communities with certain demographic compositions first. We might also consider the cumulative exposures in an area, not just exposures from each polluter in isolation, perhaps by counting the number of polluters or total emissions within a circle around the area. The precise calculations should depend on the pollutant and risk involved. We could focus regulatory attention on those areas with both high exposures and especially vulnerable populations, and perhaps try to write the rules in a way that will provide those populations with greater protection, rather than simply reducing exposures equally from all sources. This may be easier to apply to permitting and implementation decisions than it is to a national rule.

It is not clear how the EJ analysis is supposed to affect the rule. Would an EJ analysis simply justify an existing decision, if the analysis is done too late in the process to affect the number or type of options being considered? (It was noted that this concern about the timing of the analysis also exists for benefit-cost analysis.) We may need screening methods to identify which rules raise the greatest EJ concerns, and try to put more effort into the EJ analysis for those rules (and do the EJ analysis earlier in the rulemaking process). The forthcoming EPA guidance on rulemaking will address these issues.

Another concern is the incentives faced by those making the rules – if they are rewarded based on the number of rules they complete, they will not want to spend extra time doing EJ analysis, so the incentive structure may need modification.

1.8. Session 5: Methods for Analyzing EJ Associated with Pollutants in Household Products: Application to Toxics and Pesticides

1.8.1. Glenn Sheriff

Dr. Sheriff, of EPA's Office of Policy, Economics and Innovation, noted that for household products there is not a perfect overlap between geography and community, so there is a question of the proper unit of analysis. The pollution occurs at the individual household level, e.g., from pesticides or lead paint. He cited formaldehyde as an interesting example of the practical difficulty involved in incorporating EJ in regulatory design for toxics. Much of the EJ pressure for developing the formaldehyde rule came from exposures to formaldehyde of Katrina evacuees living in Federal Emergency Management Agency (FEMA) trailers. It would be impractical for EPA to conduct the monitoring required to enforce regulations on indoor air quality for individual homes. Instead they are regulating the sources of household formaldehyde, specifically the ingredients in the pressed-wood products used in furniture and cabinets. Risk of household formaldehyde exposure is likely to be highest in new, tightly sealed homes with new furniture rather than older drafty homes with old furniture. If EJ populations are concentrated in the latter, they may not be the ones most benefiting from the regulation.

1.8.2. Kaitlin Rienzo-Stack

Ms. Rienzo-Stack, of EPA's Office of Chemical Safety and Pollution Prevention's (OCSPP), Office of Pesticide Programs, noted that pesticide exposures cover a variety of scales, moving from production to field application to processing and transport to consumption; there is therefore some direct exposure, some proximity exposure, and some disperse pollutants. In principle, she said, this calls for a life cycle analysis-inspired EJ analysis. She also raised the issue of multiple exposures – a farmer might use five different pesticides in a season, but the rules are written one pesticide at a time. Much of the EJ effort at EPA's Office of Pollution Prevention and Toxics (OPPT), she said, now focuses on mitigation rather than rulemaking – e.g., outreach to EJ communities and funding of doctors in farm worker areas. She noted that some of their rules are developed for EJ reasons, especially those for worker protection when all the workers are from sensitive/disadvantaged communities. Benefit-cost analysis, she said, could consider the distributions of both costs and benefits – i.e., how both costs and benefits are distributed across large vs. small farmers as well as workers and consumers. She noted, however, that they face serious data issues. Their pesticide data measures applications in particular areas, but workers may move across areas over the course of a year and get multiple exposures. It is also often unclear who would be affected by a particular pesticide. Finally, there is limited information on human health and environmental toxicology for all the different pesticides. Given the lack of guidance, she concluded, it is not surprising that different rulemaking teams make different choices.

1.8.3. Stephanie Suazo

Ms. Suazo, also from OCSPP in the Office of Pollution Prevention and Toxics, briefly discussed the challenges that EPA/OCSPP faces in dealing with the wide range of chemicals on the market. For new chemicals, EPA receives pre-manufacture notice and information on exposure, so they can limit uses or the production process. There are so many existing chemicals, however, that it is difficult for EPA to cover everything. Like pesticides, she said, there are many potential channels of exposure, and it is not known how consumers respond to changes in the market. There are also jurisdictional issues and statutory limitations related to downstream uses of the chemical and imports. She said they are developing the internet geographical exposure modeling system (IGEMS), combining TRI and geographic data, to produce analyses of exposures to specific chemicals.

1.8.4. Matt LaPenta

Mr. LaPenta reported on a method for estimating the EJ implications of revising the Section 403 residential lead dust hazard standards. He noted that EPA is revising these standards after being petitioned to lower the permitted levels. The benefits include cognitive effects (IQ loss avoided), and the affected population tends to be in the EJ community. He considered household poverty status as the "EJ variable," although he noted that his method could be applied to other EJ factors as well. Finally, he focused only on floor dust.

In his method, he estimated baseline levels of lead dust (using data from national health and nutrition examination survey [NHANES]), as well as the dust levels expected if the policy were imposed, separately in each EJ group. He then converted the lead dust levels ($\mu g/ft^2$) in each scenario (baseline and control scenario) to concentrations ($\mu g/g$) to predict lifetime average blood lead levels using the integrated exposure uptake biokinetic (IEUBK) model. Blood lead levels were then translated into an estimate of IQ loss using a relationship estimated in an epidemiological study. Like the baseline levels, these health effects were estimated separately for the high-income population and the low-income population.

Mr. LaPenta said that both the baseline exposure levels and the policy effectiveness (i.e., the likelihood that the hazard will be mitigated if the policy is implemented) should be considered. The latter, he said, will be attempted in a future draft. The current analysis compared baseline exposure levels in the two income-level groups and, assuming full compliance (an unrealistic assumption, Mr. LaPenta acknowledged, for a variety of reasons), compared the impact (in terms of IQ loss avoided) of going from the current standard of 40 $\mu g/m^3$ lead in floor dust to a standard of 10 $\mu g/m^3$. He found a reduction in mean IQ loss for all children, especially for those in low-income households; he noted, however, that the sample size is small (94 individuals) and he has not conducted tests of statistical significance.

Mr. LaPenta emphasized that there are several different reasons why lead dust hazards get mitigated in specific households. Sometimes lead blood level screening identifies exposures and some Housing and Urban Development (HUD)-funded housing requires lead tests. There are, in addition, geographic differences in screening frequency – some states require screening at age one, while other states require annual screening. Medicaid requires screening at ages one and two. The proposed rule would require that lead dust tests be conducted after renovations. If all children were subject to the same screening rules, Mr. LaPenta said, he could use the NHANES data directly to identify differences in lead exposures across different groups for an EJ analysis. Unfortunately, as noted above, blood lead screening requirements affect older children in some states but not in others, and there are different screening requirements for Medicaid recipients; moreover, screening frequency may also differ with the household's access to medical care.

1.8.5. Robin Saha

Dr. Saha, who was asked to be a discussant for Mr. LaPenta's paper, acknowledged that lead exposures are an important EJ concern and noted that it is helpful that the steps in the analysis are clearly explained, using good data and a sensible chronic exposure model. He noted, however, that the sample was small and poverty level is a questionable EJ variable (observing that, although poverty level is convenient, even households at twice the poverty level might be resource-constrained). He observed that better tests and statistical analyses would require more and better data. For example, to improve modeling of hazard mitigation in accordance with the rule considered, one could conduct a survey of compliance rates, with a stratified sample (both owners and renters), including local agency implementation capacity and policy advocacy to help explain hazard reductions. Questions remain, however, about the quantitative importance of the reductions achieved, other neuro-developmental effects, and effects below threshold levels.

He added that risk communication to the community and involving the community in the rulemaking process are important, and suggested that we should distinguish between predictive analysis (for rulemaking) and retrospective analysis (to evaluate existing policies and the distribution of risks).

1.8.6. Open Discussion

The open discussion among workshop participants focused on some of the difficulties of dealing with the great number of chemicals that EPA regulates, each of which may have its own exposure profile idiosyncrasies. Below is a synopsis of the thread of the conversation:

Dealing with all the legacy chemicals (tens of thousands of them) is difficult. There are blood biomarker testing data in NHANES for about 200 chemicals that could help identify which chemicals are most present in the population, and perhaps also which chemicals show the most inequality in presence across different groups, focusing EJ attention on overlaps between quantity and inequality of exposure. EPA could provide input about which (legacy) chemicals to include in the biomarker testing, and NHANES has been good about responding to such requests. This information could help with priority-setting for which chemicals to regulate next. Pesticides are reviewed every 15 years, along with coverage of specific groups of chemicals. EPA tries to address all chemicals in a product group together (e.g., soil fumigants), so that any restrictions on using one will not simply drive users to switch to an unregulated substitute.

Any given chemical will have idiosyncrasies in its exposure profile that need to be taken into account. EJ communities may be exposed to more sources of lead (e.g., in cookware, medicines, older toys, candy wrappers from Mexico). Higher blood lead levels may affect the EJ analysis if there are nonlinearities in the effects. (These effects may sometimes occur in surprising ways -- e.g., a simulation of lead exposures in children at home and in daycare using a threshold dose-response function found more benefit from reducing exposures in daycare, despite greater exposure levels in the home. This occurred because the home exposure levels were so high that they still exceeded the upper threshold levels for IQ effects even after the rule was adopted, so those exposure reductions were not predicted to result in IQ improvements).

Chemicals can affect distant EJ groups, such as Arctic and Native American tribal groups who do not use the chemicals but are affected by long-range transport and bioaccumulation. We could put more of the burden on industry to gather the information on hazards. Europe follows a different approach to regulation of chemicals which is more precautionary – the regulators must approve a new chemical before it can be used, and manufacturers must provide evidence on hazards as part of that process. Bioaccumulation can affect EJ analyses, if EJ populations have long histories of high exposures.

There is also considerable uncertainty about the information going into EJ analysis of chemicals, which may affect our confidence about the significance of observed disparities. Some sources of uncertainty, however, may not affect the relative impacts of the chemical on different groups (e.g., a dose-response function could be uncertain, but be the same across groups, so it would not affect the relative impacts of exposures). Finally, a technical point was raised: if a dose-response function comes from a study that controls for EJ variables (e.g., demographics, income), the EJ analysis may need to adjust for those variables.

1.9. Session 6: Environmental Justice Considerations in the Implementation of Regulations

1.9.1. Ann Wolverton

Dr. Wolverton, of EPA's Office of Policy, Economics and Innovation, introduced this last session looking at EJ considerations in the implementation of regulations.

1.9.2. Loan Nguyen

Ms. Nguyen, of EPA's Office of Enforcement and Compliance Assurance (OECA), gave a brief overview of how OECA has addressed EJ concerns in implementation and enforcement of regulations: They have emphasized EJ concerns when working on the Toxic Substance Control Act (TSCA). They have developed a training course in writing enforceable regulations, which provides draft guidance on the rulemaking process incorporating EJ concerns on topics such as record keeping and community monitoring (which aids enforcement). They are working on improving transparency of the implementation process. She mentioned Enforcement and Compliance History Online (ECHO), an online information system that provides information on compliance and enforcement action at specific sites. They have also developed tools, she said, to screen EJ populations, helping inform enforcement activity and communicate EJ benefits.

1.9.3. Andrew Schulman

Mr. Schulman, also of OECA, gave a brief overview of EJSEAT, which is designed to provide a nationally-consistent tool for EJ screening assessments. He said that EJSEAT was originally developed in 2005-2006 and incorporates 18 indicators in 4 areas: social demographics, environmental exposures, baseline health, and enforcement. It uses only nationally available and federally managed data sources. The indicators are scaled from 0-100 and are combined across the 4 areas, with the scales calculated separately for each state, allowing state program independence, while looking at the allocation of resources across facilities within the same state. Because of privacy concerns, he noted, the health indicators are available only at the county level (he noted that some reviewers had suggested removing the health indicators from the model for that reason). He said that the model only goes down to the Census tract level and may not be measured well in tribal areas, but it can be a useful screening tool to see where "environmentally disadvantaged" populations might be located. Its relative simplicity, he noted, can also make it a useful tool for EJ communities to participate more in the rulemaking process. Testing in Region 3 and Region 5 showed that EJSEAT does reasonably well in prioritization of the communities according to EJ concerns. He said, however, that EJSEAT is not yet available to the general public.

1.9.4. Ron Shadbegian

Dr. Shadbegian, of EPA's National Center for Environmental Economics, provided some general thoughts on environmental justice and the implementation of regulations. He first observed that EPA's RIAs do not always consider implementation issues, which can raise EJ concerns. There is not much academic literature addressing this area, he noted, so there are no firm conclusions to point to, and EPA is also just getting started in this area.

He identified several issues of EJ concern regarding implementation. One of the key issues is regulatory federalism, with federal EPA rules typically being implemented and enforced by state and local regulators, so that the stringency of enforcement activity may affect the overall regulatory stringency applied in different areas. He noted that EPA generally assumes that all states will achieve 100% compliance, adding that there is fairly good data available on compliance and enforcement activity for air and water pollution, so we could conduct some retrospective assessments of enforcement activity of existing rules to see whether an assumption of equal enforcement across different communities is reasonable.

Another EJ issue he discussed is the permitting process, which tends to focus on single plants but could consider existing vulnerabilities due to multiple and cumulative impacts, and engage the EJ community more fully in permit writing.

He noted that most rulemakings are national in scope, but some include regional features and some have geographic variability (the most widely studied being county non-attainment status for enforcement stringency on air pollution), so the results could differ across groups. While rules incorporating allowance trading have enabled more efficient reductions in emissions, he observed that there may be local hotspots and an inequitable distribution of benefits if there is a local impact of the pollution.

He also acknowledged a “lack of voice” for EJ communities in the allocation of pollution reductions across sources, since the allocations are driven by market outcomes, not by negotiations over permit conditions. He suggested that we could try an ex-post analysis of actual trades, to see whether they tended to shift pollution towards or away from EJ communities. Given the long time needed for implementation of new rules, however, the socioeconomic characteristics of particular areas can change before the rules take effect (and such changes could be affected by the rules).

Finally, he observed that technological change can result in long-run reductions in pollution, so if plants in different areas have different rates of adoption of technological change – and if these differences are related to location near EJ communities -- this could affect the long-run exposure trends for different groups.

1.9.5. Randy Walsh

Dr. Walsh discussed two kinds of equity relevant to EJ concerns: (1) process equity (i.e., are all communities treated equally, are regulators “demographically blind” in their decisions, and do all communities have equal access to the process?) and (2) exposure equity. He said that regulatory behavior and implementation of rules get at the heart of process equity – e.g., is there sufficient auditing and oversight of those allocating enforcement activity to ensure equal treatment of all groups? This is a complicated analysis, he said, because if regulators are less stringent in some areas in an absolute sense, but companies take advantage of that lower stringency to lower their compliance efforts, this may induce additional enforcement activity (based on non-compliance), offsetting the initially lower enforcement activity in those areas. EPA could help encourage process equity, and allow EJ communities to play a greater role in influencing state and local decisions, he said, by creating EJ analytical tools (such as EJSEAT) and training communities in their use.

Even if there is process equity, he noted, there could still be exposure inequity. Suppose, for example, that there is generally a spatial pattern to the location of air polluters, so that some areas have higher exposures than others. Air regulations seek to ensure some baseline level of air quality, he said, but that just moves up the air quality at the lower part of the distribution – it does not completely catch up with the higher air quality in some areas before regulation. This unequal distribution of exposures is likely to lead to hotspots and to EJ correlations –lower environmental quality in an area results in lower land rents, attracting polluting facilities and poor renters. This can be exacerbated by a combination of housing discrimination and a taste for living with similar people to increase the tendency for poor and minority communities to exist where there is lower environmental quality.

These EJ concerns could be addressed, he said, by incorporating cumulative exposures into regulatory implementation, including crediting the community for its past exposures. He suggested that there could be increased enforcement, tighter standards, and other creative approaches for facilities located in hotspots. For example, people in Alleghany County, PA (an EJ area where he does some work) could require new facilities to buy offsets from plants located in EJ communities, ensuring that the cleanup would be targeted spatially to reduce hotspots. The ways to reduce the correlation between EJ communities and poor environmental quality, he noted, are to move the pollution or move the people. One possibility would be to allow local hotspots, but not allow people to live nearby (although displacing current residents might not be considered an appropriate outcome by the community).

Finally, he identified environmental gentrification as a concern. If environmental quality in an area improves, among the chief beneficiaries will be the owners of land in the area. If most of the residents are renters, they would tend to be left out – i.e., displaced when rents rise to reflect the quality improvement. He suggested that perhaps it would be possible to work with other government agencies in areas like low income housing and zoning rules to try to give low-income renters a stake in the benefits of environmental quality improvements. He acknowledged, however, that this will be difficult, because market forces will tend to push in the other direction.

1.9.6. Open Discussion

The open discussion among workshop participants focused on the difficulties in addressing EJ concerns when it comes to the implementation and enforcement of environmental regulations. Below is a synopsis of the thread of the conversation:

Analyzing differences in compliance or enforcement across areas can be very difficult. Observing bigger penalties for violations in a minority community could be interpreted as good ("regulators being especially protective of the EJ community") or bad ("violations being much worse in the EJ community"). This could be addressed, at least in part, by controlling for the seriousness of violations, although there could also be variation across areas in how compliance is measured.

Environmental federalism raises some EJ concerns. It does not have to in theory – it allows the decision-making process to be "closer to" the affected community – but in practice state-level regulatory decisions tend to be driven more by the unequal distribution of power and resources within the state (except for a few unusually progressive states). Despite its practical drawbacks, however, there is no escaping federalism. For example, under Resource Conservation and Recovery Act (RCRA) legislation, implementation must devolve to the states. The implementation is paid for with grants to the states, which could in theory be taken back if the state did not properly implement the rules (but no grant has ever been taken back). Similarly, achievement of air quality regulations is supposed to happen through

State Implementation Plans (SIP), where EPA can review the plans to either accept or reject them, but the state regulators have the primary role of designating which facilities are making the largest emissions reductions. EPA also has oversight responsibility for enforcement activity and can conduct its own inspections, which can help support state regulators facing local political opposition. There needs to be enough federal oversight, however, to ensure reasonably equitable implementation at the state level – if not, all the good EJ intentions during rulemaking could be undone at the implementation stage. This is important if the goal is protecting EJ communities rather than just writing nice-sounding regulations. It was suggested that perhaps state agencies could be evaluated based on the "EJ-friendliness" of their regulatory activity, in either a retrospective study or in ongoing oversight. One workshop participant noted that some of these concerns about federalism call to mind the difference between state and federal responses to implementing civil rights legislation, with the federal government taking a much more active role in enforcing regulations despite state reluctance.

EJSEAT, or some other screening program, could be quite useful for EJ communities to gather information and participate in the rulemaking process. The concern about health data being available only at the county level may not matter so much if it is designed to capture local vulnerabilities, rather than being a direct measure of differences in environmental hazards. It might also be possible to get some health data with more spatial detail, but such data tend to show that most of the geographic variation in health outcomes occurs within the county, rather than between counties. EJSEAT also includes information on compliance levels and inspection rates, which can be subject to the concerns about controlling for differences in regulatory attention across areas.

It would be helpful to conduct a "litmus test" on EJSEAT or other screening models. We could begin by identifying 20 well-known EJ communities, based on existing qualitative information and feedback from EJ community leaders. We could then see if those communities are near the top as ranked by the screening model. If the model identifies other communities as being of high EJ concern, we could look carefully at those communities to see whether they are worthy of consideration (i.e., can we believe the model's results and learn something from them?). It can be difficult to test the model quantitatively, since we do not have an existing "true" measure of EJ communities to compare it with. In fact, OECA did a validation study of EJSEAT in EPA Region 3, and the tool seemed to get pretty close to what was known about the EJ communities.

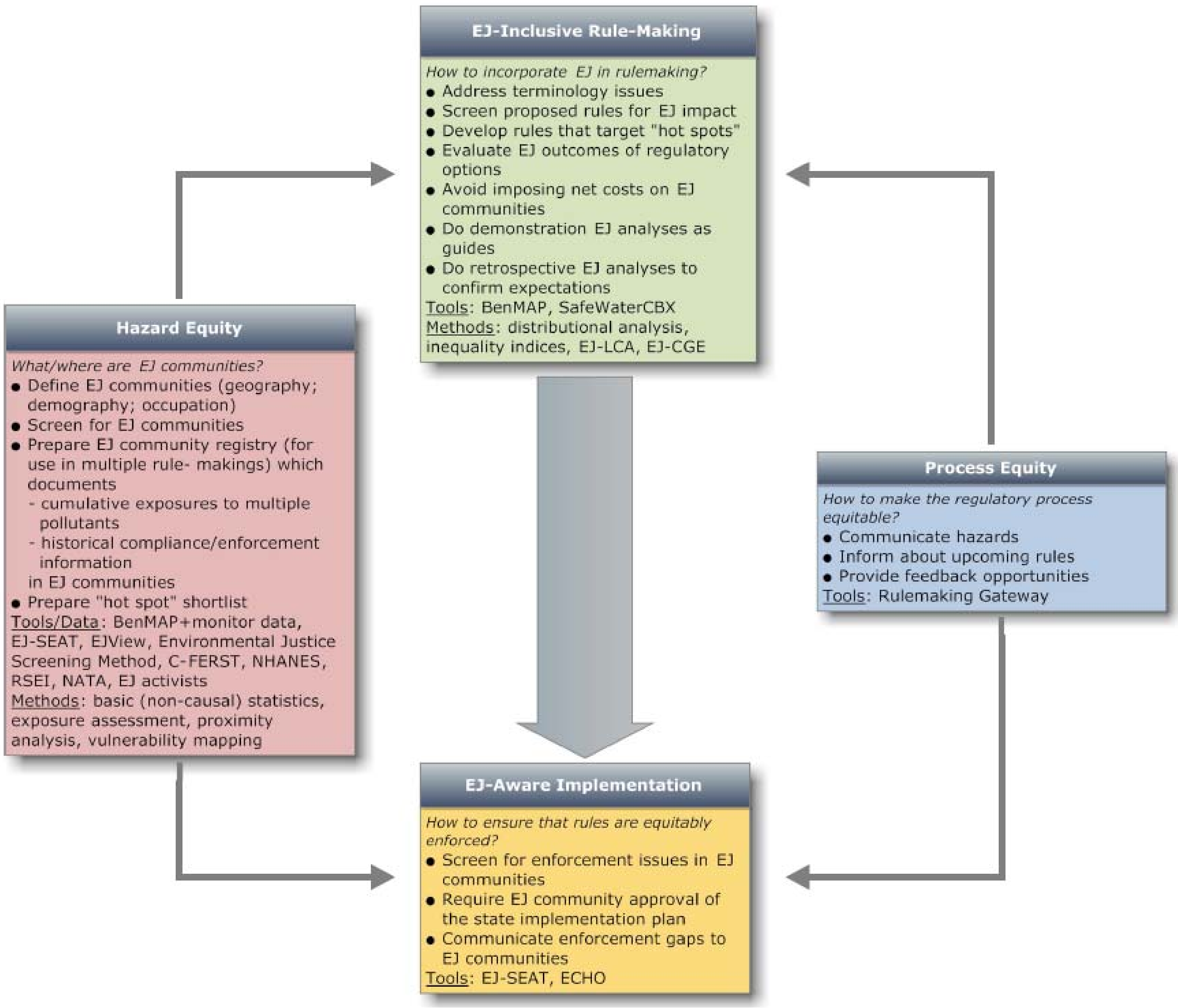
One problem with any analysis of compliance and enforcement is that it depends on datasets that focus on the large and well-known polluters found in EPA regulatory databases. The worst cases of violations are often found at small plants operating without permits (e.g., small metal-plating shops), either because they are exempt from reporting due to their size, or because they are concealing their existence from regulators. Enforcement is technically possible at such plants, but their absence from regulatory datasets makes them difficult targets.

On the housing decision, EPA has been working with HUD in siting low-income housing. To hold down the costs of building such housing, developers often use inexpensive land, which has sometimes led to the housing being built out in the middle of nowhere, far from the jobs and transportation networks available near the city center. The only inexpensive land available in the central city might be remediated brownfield sites, which, according to HUD regulations, cannot be used for such housing. Housing could be an efficient use of brownfield land, assuming the cleanup was effective, but it would be a difficult decision to justify politically.

1.10. Closing Session

The six sessions described above were followed by a "closing session" in which Dr. Gray and other workshop participants synthesized the various strands of the 2-day discussion. The many issues discussed in the course of the 2-day workshop are outlined below. The basic questions the workshop addressed, the suggested approaches to answering these questions, and how they relate to each other, are shown diagrammatically in Figure 1.

Figure 1. **A Summary of the EJ Workshop Discussion**



1.10.1. What is an EJ Analysis?

Perhaps the most fundamental question that arose in the workshop was: What is an EJ analysis? Most participants considered an "EJ analysis" to be a distributional analysis – i.e., an analysis of how benefits and costs are distributed among different groups in the population. It was repeatedly pointed out, however, that there are communities whose members tend to be disadvantaged in multiple ways and who experience multiple cumulative environmental exposures. These "EJ communities" are "hot spots" – places with both vulnerable populations and multiple exposures. An alternative answer to the question was, then, that EJ analysis should focus specifically on these "EJ communities." It was not clear, however, how a national rule would do this. It was also noted that, while these EJ communities experience multiple environmental exposures, environmental rulemaking has traditionally focused on one pollutant at a time. The discussion of how to define EJ analysis was acknowledged to be ongoing.

The following key concepts need to be better understood and defined:

- "EJ analysis" vs. "distributional analysis"
- "Disproportionate impact" (how much difference constitutes a "disproportionate impact"?)
- "EJ community" vs. "demographic group" (i.e., is adding up individuals okay, or must they only be considered as a part of a community (which would include some mix of demographics)?)

1.10.2. Suggestions for how EPA could be more proactive/prioritize/screen:

- Identify burdened EJ communities and hotspots (EJ baseline analysis) to provide a baseline of current exposures to identify most vulnerable populations; analyses could also include bioaccumulation of persistent hazards and increased sensitivities; we could identify communities that, more generally, face more stressors.
- Perhaps also consider ways to provide extra help to EJ communities in the rulemaking process (e.g., require offsets for new plants to be bought from facilities in EJ communities).
- Screen upcoming regulations to identify those rules with potential EJ concerns or implications to improve the current EJ baseline.
- Consider the relative magnitudes of effects – for example, $PM_{2.5}$ has huge mortality effects (relative to other air pollutants), so even a small variation in benefits across groups with respect to exposure to $PM_{2.5}$ could have larger consequences than larger variations with respect to other pollutants.
- Use EJ communities themselves as a resource to help test any numerical screening methods.

1.10.3. Benefits from EJ Analyses

- They help EPA in setting overall priorities for rulemaking.
- They help EPA in choosing regulatory options within a given rulemaking.
- They help provide credible measures of benefits of regulation to EJ communities, and communicate those measures to those communities. Even if results do not show disparity, they still provide a "positive assurance" (so that is also a benefit).
- They help to document the current burden faced by EJ communities and support community action to address this burden.

1.10.4. EJ Methodology – Toolkit

Screening tools: [2]

[2] Note that this list is not necessarily comprehensive.

- Proximity analysis – for specific sites, examine characteristics of "nearby populations;" we could use a binary (0/1) metric of EJ community or percentage minority/poor.

- EJSEAT – a national multi-component indicator for EJ assessment; uses socio-demographic, health, environmental, and compliance/enforcement tract-level data (except health, which is at the county level), normalized within state; used for strategic targeting of enforcement.

- Environmental Justice Screening Method – presented by Manuel Pastor. His method can include multiple dimensions of community characteristics (see Section 1.2.2).

- C-FERST (Community-Focused Exposure and Risk Screening Tool) – a user-friendly, web-based tool designed as a "one-stop shop" to help identify and prioritize community environmental issues and to assess human exposures and health risks, using the best available information and science (http://www.epa.gov/heasd/c-ferst/).

- RSEI (the Risk Screening Environmental Indicators) – described by EPA as "a computer tool that analyzes risk factors to put TRI release data into a chronic health context." (see http://www.epa.gov/oppt/rsei/)

- NATA (EPA's National-Scale Air Toxics Assessment) – described by EPA as "a state-of-the-science screening tool for State/Local/Tribal Agencies to prioritize pollutants, emission sources and locations of interest for further study in order to gain a better understanding of risks." (see http://www.epa.gov/ttn/atw/natamain/)

- EJView -- formerly known as the Environmental Justice Geographic Assessment Tool, is a mapping tool that allows users to create maps and generate detailed reports based on the geographic areas and data sets they choose (see http://epamap14.epa.gov/ejmap/entry.html).

Distributional analysis tools:

- BenMap – combines detailed Census block-level socio-demographic information with concentration-response functions for criteria air pollutants estimated in epidemiology studies, baseline incidence rates (for mortality and morbidity endpoints), and modeled or/and monitoring air quality data. BenMAP generates counts of deaths and illnesses avoided as a result of specified changes in ambient air pollutant concentrations and calculates total dollar benefits (using VSL, willingness to pay, and cost of illness estimates of value).

- SafeWater CBX – estimates the costs and benefits of alternative maximum contaminant levels (MCLs) for water contaminants (e.g., arsenic) in drinking water, using test sample data from public water suppliers and information on populations served. (Although it is not currently in the model, more detailed demographic population data could be added.)

In addition to the tools discussed above, workshop participants also mentioned some datasets that are potentially useful for conducting screening and distributional analyses. For example, the NHANES database contains biomarkers for chemicals, which could possibly be used to screen for differential exposures across population groups. (This database contains direct measures of blood concentrations, but for a relatively small selection of chemicals, although EPA can request that specific chemicals be tested.)

1.10.5. Data Challenges

Data availability has been recognized as one of the biggest challenges for conducting EJ analysis. The challenges include:[3]

Lack of data on sources of pollution

- Mobile sources
- Small stationary sources (RCRA), exempt from permit requirements (so not in existing datasets).

Estimation of exposures (given pollution)

- Better models of pollution flows/pathways are needed
- Some media have relatively sophisticated models already (e.g., air pollution with air quality modeling) while others are less well developed (e.g., water pollution, where there are some models of stream flow, but groundwater aquifers are less well modeled). For air, everyone breathes so ambient concentrations provide a reasonable starting point – it is harder to model exposure for water, since that often involves choices (swim/boat/fish).
- Occupational exposures of different groups -- e.g., farm workers for pesticide regulation, subsistence fishing for bioaccumulative toxins – are needed.
- For some contaminants, a life-cycle approach may be needed – e.g., for pesticides, we may need exposures from production and application to consumption; there may also be "trickle-down" exposures – e.g., toys with lead paint removed from shelves at toy store, sent to dollar store.

Issue of personal exposures vs. ambient concentrations

- Although subject to argument, ambient concentration represents a hazard to communities even if people engage in averting behavior to avoid it (therefore it is not clear whether personal exposures or ambient concentrations are the more appropriate metric).
- Epidemiological concentration-response functions (e.g., describing the relationships between criteria air pollutants and population health effects) are based on ambient concentrations rather than personal exposures.

Data on sensitivity for vulnerable populations

- We lack dose-response functions for specific hazards stratified by population groups – or, alternatively, evidence that the response is similar across groups. (It was mentioned that CDC may be working on this.)
- More work is needed to identify data on disease incidence for different EJ groups to establish baseline risk levels.
- We need to take into account the interactions among multiple pollutants, non-linearity and bioaccumulation.

Costs and unintended consequences

- Environmental gentrification is a possible unintended consequence of environmental cleanup in EJ communities; while this could impose costs on EJ communities, this is currently not considered in EJ analysis.

[3] Note that the following list of challenges is not necessarily comprehensive.

- There are sometimes mixed effects of product substitution (e.g., the change of pesticides to reduce greenhouse gases increases hazards to farm workers).

1.10.6. Modeling choices

- In any policy-related analysis that needs to be communicated to non-specialists (in this case, those without expertise in economics or statistics), there is a tradeoff between using sophisticated models and analytical techniques to estimate distributional consequences, on the one hand, and being able to easily explain the methods and results of the analysis to the target audience, on the other hand. The experts doing the analysis prefer using more sophisticated techniques because those techniques are considered superior, and studies using those techniques are far more likely to get published in scholarly journals. This generates a natural research bias towards more complex approaches that are unfortunately more difficult to communicate to others. While they should not sacrifice analytical rigor, researchers should be encouraged to consider whether, in some cases, simpler models might capture the same results as the more complex ones. Whatever analytical approach is used, researchers should also be encouraged to make the effort to explain their results in non-technical language so that others who do not happen to be experts in economics and/or statistics can more easily understand the analyses and participate in the rule-making process.
- Trying to estimate causality, rather than simply correlation – the standard approaches for trying to get at causality may not be appropriate if our focus is on the "excess burden" faced by the EJ community (e.g., even if greater pollution exposure is "explained" by income differentials across groups, that does not make it any less burdensome). The causality analysis may be helpful for something like the analysis of rule implementation, where we are trying to see whether the regulatory activity was distributed equitably among groups, or was lower (or higher) for plants located in EJ communities.

1.10.7. Rulemaking

Current rulemaking

- Consider multiple stressors in vulnerable communities, interactions among pollutants.
- Consider non-linearity in effects, if different baseline exposures.
- Consider implementation effectiveness – will EJ communities see equal enforcement?
- In cases where EJ analysis shows negative distributional consequences, seek to modify rule to avoid EJ problems – or at least be willing to make the negative results public.
- Perhaps add requirements for state implementation plans to "favor" EJ communities (provide extra protection where possible).
- Perhaps require demonstration of "at least equal" enforcement activity.
- Perhaps require consultation with local EJ communities on SIPs, with sufficient time to provide meaningful response.

Retrospective analysis of rules

- Try to discern any differences in implementation of rules across EJ groups
- Examine consequences of rules after adoption to see whether EJ communities show similar outcomes (exposures, costs, etc.)
- Collect information on possible unintended consequences

1.10.8. Possible next steps

- Develop and test screening models to identify EJ communities and characterize the environmental risks they face.
- Do detailed EJ analyses of some rules as "demonstration projects," even if the analysis takes too long to be incorporated in the rulemaking (to learn how to do the analysis for the next time, to describe the baseline risks, and to show it can be done). Alternatively, we could apply EJ analysis to an existing rule, which would remove the time pressure, allow selection of a rule that raises EJ concern, and enable us to compare "*ex ante*" expectations of impact with "*ex post*" resulting impacts.
- Develop capacity for rapid deployment of EJ screening and distributional analysis tools (a "matrix of solutions"), apply it to upcoming rules, and modify as necessary (learning process).
- Possibly consider larger changes in rulemaking, such as requiring companies to get regulatory approval before introducing a new chemical on the market, which is already required for new drugs and is required more generally for new chemicals in Europe. That would put the burden of proof on the company to show the chemical's safety, at the cost of greatly slowing down the introduction of new chemicals.
- Take a more proactive approach to helping EJ communities –e.g., a systematic examination of all the problems they face (community by community) and attempt to address environmental problems simultaneously. This might be similar to current "small business" protections (e.g., create a register of EJ communities to focus attention on them). Use of offsets targeted to EJ communities to improve conditions.

Appendix A: List of the Participants

Participant	Affiliation
Matt Adler	University of Pennsylvania
Tracy Atagi	U.S. EPA, Office of Solid Waste and Emergency Response
Spencer Banzhaf	Georgia State University
Randy Becker	U.S. Census Bureau
Anna Belova	Abt Associates
Tracy Bone	U.S. EPA, Office of Water
Jennifer Bowen	U.S. EPA, Office of Policy, Economics, and Innovation
Jose Bravo	Just Transition Alliance
Heather Case	U.S. EPA, Office of Environmental Justice
Cecil Corbin-Mark	WE ACT
Mark Corrales	U.S. EPA, Office of Policy, Economics, and Innovation
Jeneva Craig	U.S. EPA, Office of Air and Radiation
Maureen Cropper	Resources for the Future
Bridgid Curry	U.S. EPA, Office of Policy, Economics, and Innovation
Ken Davidson	U.S. EPA, Office of Air and Radiation
Brooks Depro	Rearch Triangle Institute
Neal Fann	U.S. EPA, Office of Air and Radiation
Michael Firestone	U.S. EPA, Office of Children's Health Protection
Lisa Garcia	U.S. EPA, Office of Environmental Justice
Wayne Gray	Clark University
David Guinnup	U.S. EPA, Office of Air and Radiation
Kevin Haninger	U.S. EPA, Office of Solid Waste and Emergency Response
Lisa Heinzerling	U.S. EPA, Office of Policy, Economics, and Innovation
Jin Huang	Abt Associates
Debbie Kemp	Abt Associates
Gerry Kraus	U.S. EPA, Office of Enforcement and Compliance Assurance
Matt Lapenta	Abt Associates
Amanda Lee	Office of Management and Budget
Charles Lee	U.S. EPA, Office of Environmental Justice
Lyn Luben	U.S. EPA, Office of Solid Waste and Emergency Response
Kelly Maguire	U.S. EPA, Office of Policy, Economics, and Innovation
Sarah Mazur	U.S. EPA, Office of Research and Development
Al McGartland	U.S. EPA, Office of Policy, Economics, and Innovation
Mark Mitchell	Connecticut Coalition for Environmental Justice
Loan Ngnyen	U.S. EPA, Office of Enforcement and Compliance Assurance
Doug Noonan	Georgia Institute of Technology
Onyemaechi Nweke	U.S. EPA, Office of Environmental Justice
Manuel Pastor (on phone)	University of Southern California
Ellen Post	Abt Associates
Tauhid Rahman	University of Arizona
Kaitlin Rienzo-Stack	U.S. EPA, Office of Chemical Safety and Pollution Prevention
Robin Saha	University of Montana
Tamara Saltman	U.S. EPA, Office of Air and Radiation

Participant	**Affiliation**
Andrew Schulman	U.S. EPA, Office of Enforcement and Compliance Assurance
Ron Shadbegian	U.S. EPA, Office of Policy, Economics, and Innovation
Glenn Sheriff	U.S. EPA, Office of Policy, Economics, and Innovation
Hilary Sigman	Rutgers University
Stephanie Suazo	U.S. EPA, Office of Chemical Safety and Pollution Prevention
William Swietlik	U.S. EPA, Office of Water
Chris Timmins	Duke University
Randy Walsh	University of Pittsburgh
James White	U.S. EPA, Office of Air Quality Planning and Standards
Ann Wolverton	U.S. EPA, Office of Policy, Economics, and Innovation

Appendix B: Workshop Agenda

Day 1 – Wednesday	
8:00	Registration, coffee/tea and light refreshments
Opening Session	
8:30	Welcome and Administrative Remarks *Workshop Chairperson – Wayne Gray, Clark University*
8:45	Opening Remarks *Lisa Heinzerling, Associate Administrator, USEPA, Office of Policy, Economics and Innovation*
9:00	Q&A following the Opening Remarks
Session 1: Environmental Justice and Equity	
9:15	Introduction and Overview *Moderator – Al McGartland, USEPA, Office of Policy, Economics and Innovation*
9:20	Environmental Justice: Evidence, Issues and Challenges *Manuel Pastor, University of Southern California*
9:40	Incorporating Willingness-to-pay for Equity into Health Benefits Analysis *Maureen Cropper, University of Maryland and Resources for the Future*
10:00	Equity and Social Welfare Functions *Matt Adler, University of Pennsylvania*
10:20	Open Discussion
11:00	**Break**
Session 2: Methods for Analyzing Environmental Justice for Disperse Pollutants: Application to Water	
11:15	Overview of Theme *Moderator – Kelly Maguire, USEPA, Office of Policy, Economics and Innovation*
11:20	Highlighted Regulatory Activity (EPA perspective) *William Swietlik, USEPA, Office of Water*
11:35	Methods for Analyzing Environmental Justice Effects with Disperse Pollutants *Spencer Banzhaf, Georgia State University*
11:55	Remarks on presentation *Discussant – Tauhidur Rahman, University of Arizona*
12:10	**Lunch (on your own, Panel discussion will begin at 12:45)** *Panel of EJ Community Leaders* *Moderator, Lisa Garcia, USEPA, Senior Advisor to the Administrator for Environmental Justice* *Jose Bravo, Just Transition Alliance* *Cecil Corbin-Mark, WEACT for Environmental Justice* *Mark Mitchell, Connecticut Coalition for Environmental Justice*
1:50	Open Discussion – Disperse Pollutants
2:35	**Break**
Session 3: An Exposure and Health Risk Environmental Justice Analysis Method: Application to a National Air Quality Rule	
2:50	Overview of Theme *Moderator – Neal Fann, USEPA, Office of Air and Radiation*

2:55	Highlighted Regulatory Activity (EPA perspective) *Tamara Saltman, USEPA, Office of Air and Radiation*
3:10	Methodology for Distributional Benefit Analysis of a National Air Quality Rule *Ellen Post, Abt Associates*
3:30	Prepared Remarks on Presentations *Discussant – Chris Timmins, Duke University*
3:45	Open Discussion
4:30	**Adjourn**
5:00	**Group Dinner – Lauriol Plaza, Dupont Circle (participants responsible for own tab)**

Day 2 – Thursday	
8:00	Coffee/tea and light refreshments
8:15	Recap of Day 1 and Opening Remarks *Workshop Chairperson – Wayne Gray, Clark University*
Session 4: Proximity Based Approaches to Analyzing Environmental Justice: Application to Waste	
8:30	Overview of Theme *Moderator – Mark Corrales, USEPA, Office of Policy, Economics and Innovation*
8:35	Highlighted Regulatory Activity *Lyn Luben, Office of Solid Waste and Emergency Response*
8:50	Scales of Justice: A Geographic Bias in Environmental Equity Analysis *Doug Noonan, Georgia Institute of Technology*
9:10	Prepared Remarks on Presentations *Discussant – Hilary Sigman, Rutgers University*
9:25	Open Discussion
10:10	**Break**
Session 5: Methods for Analyzing EJ Associated with Pollutants in Household Products: Application to Toxics and Pesticides	
10:25	Overview of Theme *Moderator – Glenn Sheriff, USEPA, Office of Policy, Economics and Innovation*
10:30	Highlighted Regulatory Activity (EPA perspective) *Kaitlin Rienzo-Stack and Stephanie Suazo, USEPA, Office of Chemical Safety and Pollution Prevention*
10:45	A Proposed Method for Evaluating the Environmental Justice Implications of Revising the Section 403 Lead Dust Hazard Standards *Matt LaPenta, Abt Associates*
11:05	Prepared Remarks on Presentation *Discussant – Robin Saha, University of Montana*
11:20	Open Discussion
12:00	**Lunch** (on your own)
Session 6: Environmental Justice Considerations in the Implementation of Regulations	
1:00	Overview of Theme *Moderator – Ann Wolverton, USEPA, Office of Policy, Economics and Innovation*
1:05	Highlighted Regulatory Activity (EPA Perspective) *Loan Ngnyen and Andrew Schulman – USEPA, Office of Enforcement and Compliance Assurance*
1:20	Implementation and Environmental Justice Considerations

	Ron Shadbegian, USEPA, Office of Policy, Economics and Innovation
1:35	Heterogeneity in Environmental Quality: Environmental Justice Considerations *Randy Walsh, University of Pittsburgh*
1:50	Open Discussion
2:30	**Break**
Closing Session	
2:45	Facilitated session on significant issues, summary points and next steps. *Chairperson and others*
4:30	**Adjourn**

Appendix C: Discussion Questions

The questions and points of guidance below are intended to help inform the workshop discussions and focus the presentations in order to meet the workshop objectives as outlined on the agenda. They are grouped according to the intended recipients and the purpose they are intended to serve.

<u>All Participants:</u>
Questions for all workshop participants to consider throughout the workshop
Purpose: Provide a basic foundation for workshop discussions

1. What is "environmental justice"?
    a. Are there differences between environmental justice, equity, and equality and how should they be treated in an analytical framework?
2. What questions should environmental justice (EJ) analyses try to answer?
    a. Are all questions equally appropriate in all scenarios (e.g., if the pollutant travels in certain media; if the scope of the environmental regulation is relatively local vs. regional or national)?
    b. What are the appropriate baseline(s) to consider?

Questions for participants to bear in mind during each of the methodology sessions
Purpose: Provide guidance to participants during open discussions

1. What EJ questions does the methodology attempt to answer?
2. Are these appropriate questions given the scenario being considered (e.g., the medium in which the pollutants travel; the scope of the regulation)?
3. Does the methodology succeed in answering these questions? If not, what are the limitations of the methodology? Can the methodology be improved so that it is better able to answer the questions?
4. Is the methodology empirically feasible?
5. Is the methodology useful for national environmental regulatory decision-making?

<u>All Presenters and Discussants:</u>
Guidance for presenters and discussants in methodology sessions
Purpose: Provide guidance to presenters on areas to focus on in their presentations

- Paper Presenters:
  1. Please clearly identify the question(s) your analysis is trying to answer.
  2. Please highlight the methodology (rather than specific results).
  3. Discuss advantages and limitations of the methodology, including other approaches that could be used to address your question(s).
  4. Discuss data needs and access.
  5. Identify the timeframe needed to conduct the analysis.

- Discussants:
  1. Please focus on the extent to which the methodology is able to answer the question(s) it was intended to address.
  2. Discuss the strengths and weaknesses of the methodology.
  3. What, if any, other methodology could be used to address these question(s)?

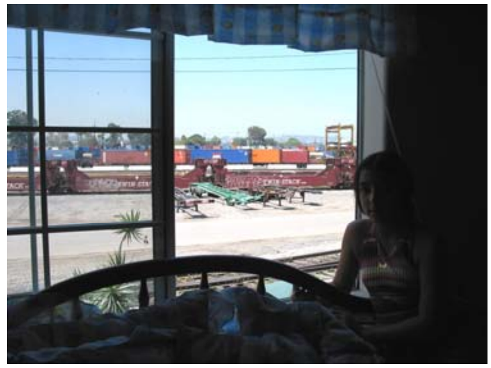
- EPA Highlighted Regulatory Activity Presenters:
    1. Please provide an overview of the EJ activities in your program
    2. Try to address the following questions:
        a. How is EJ being applied in your program?
        b. What are the challenges your program faces in incorporating EJ into regulatory analysis?
        c. What plans does your program have to incorporate EJ into future regulatory analysis?

Session 1 (Environmental Justice and Equity) Presenters:

1. Are there differences between equity, from an economist's perspective, and environmental justice? If so, please elaborate.
2. Please provide thoughts on how to incorporate equity concerns into national environmental regulatory decision-making.

Lunch-time Panelists:

1. What is environmental justice and how is it achieved?
2. What are the most important questions EPA should address by equity or EJ analyses?
3. What are the advantages of quantitative assessment of EJ for national, environmental rule-makings? What are the limitations?



PERE
USC Program for Environmental & Regional Equity

ENVIRONMENTAL JUSTICE:

EVIDENCE, ISSUES AND CHALLENGES

June 2010

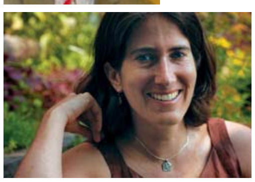
MANUEL PASTOR

Science to the Rescue . . .

- Studies emerge questioning general applicability of the environmental justice argument, complete with multivariate analysis and discussion of appropriate geographic units

- Issues raised regarding risk assessment, cost-benefit analysis, action in the face of unknowns, and the difficulties of policy implementation

Our Research Team



- Manuel Pastor, Ph.D. in Economics, responsible for project coordination, statistical analyses, including multivariate and spatial modeling, and popularization
- James Sadd, Ph.D. in Geology, responsible for developing and maintaining geographic information systems (GIS), including location of site and sophisticated geo-processing
- Rachel Morello-Frosch, Ph.D. in Environmental Health Science, responsible for statistical analysis, health end-points, and estimates of risk.

Arc of Our Research
Environmental Justice & Community Health

- Demonstrating Disparities in Exposure to Hazards and Risk
- Analyzing Determinants of these Disparities using Multivariate Statistics
- Understanding Evolution of Present Pattern
- Documenting Health Risks and Outcomes
  - Other Consequences
    - Children’s School Performance
  - Mapping Cumulative Exposure
  - Work done throughout California
    - regional and statewide
    - three Census generations

Explaining the Pattern

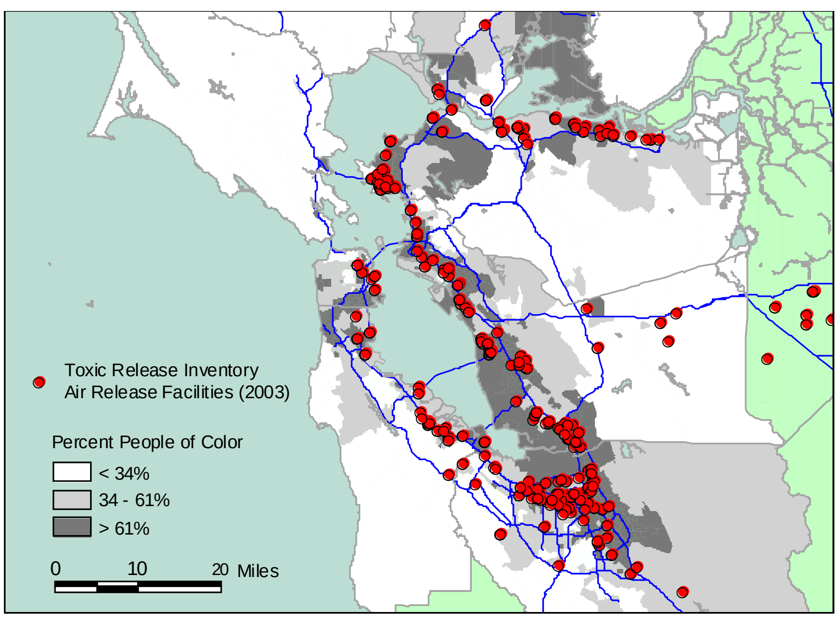
- Rational land use – it's just clustered uses
  - Magic of the market – it's income and land value
    - Politics and power – it's discrimination and unequal leverage/ influence

Teasing Out Causes Requires Multivariate and Other Analysis

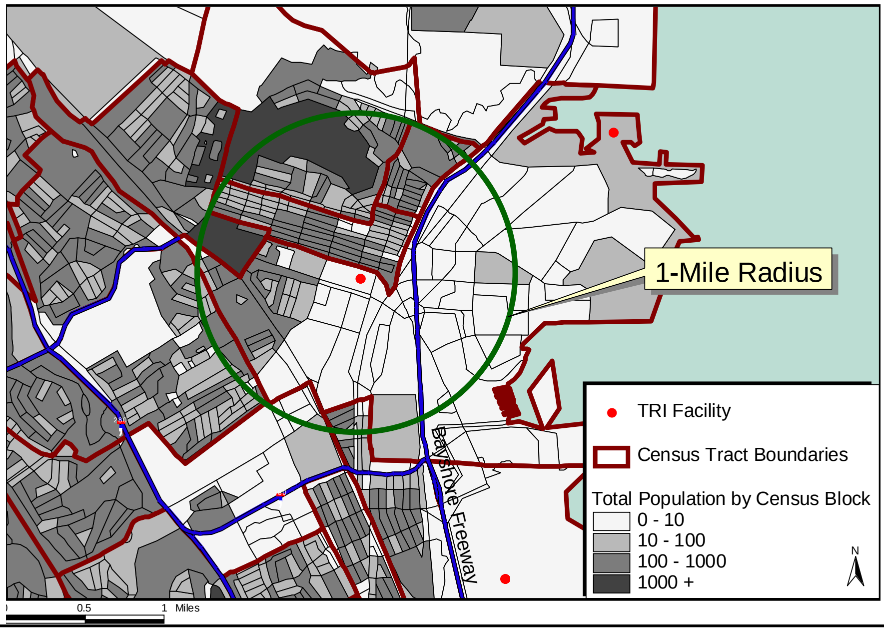
- Need to control for multiple factors
- Need to consider longitudinal issues
- Need to consider issues of spatial autocorrelation
- An illustration below of one set of these exercises in a regional usually thought of as pristine and green . . .

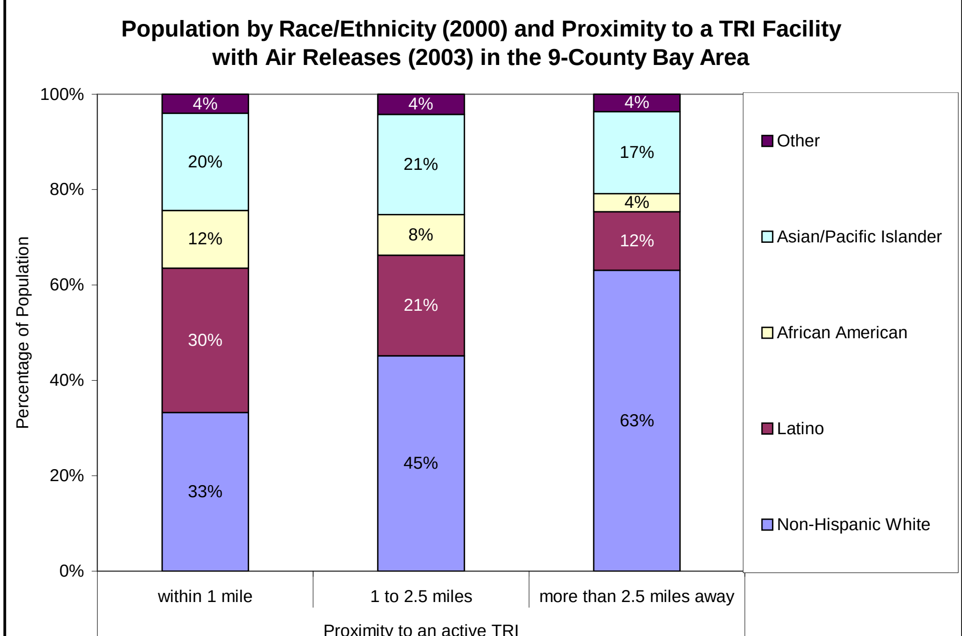
SF Bay Area

Drilling in . . .
TRI Facilities Relative to Neighborhood Demographics

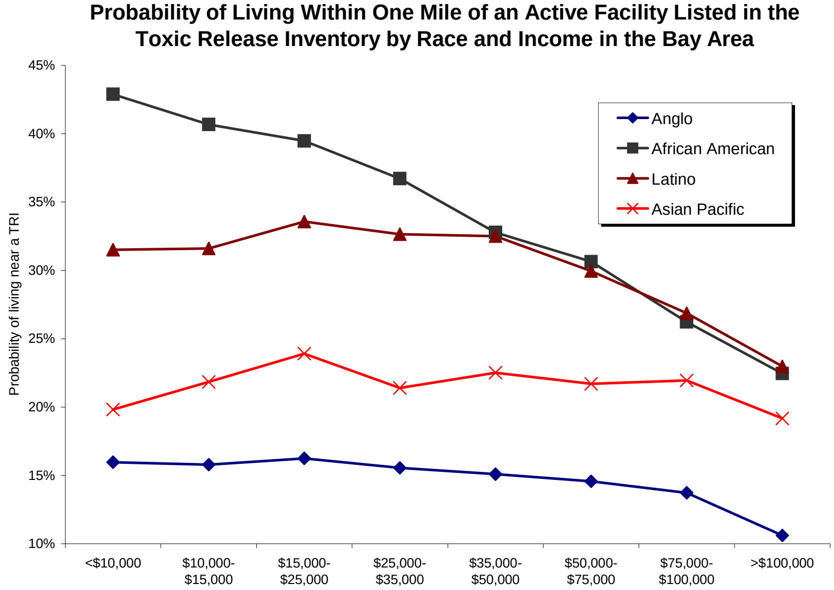


How do we determine TRI proximity?
The one-mile case

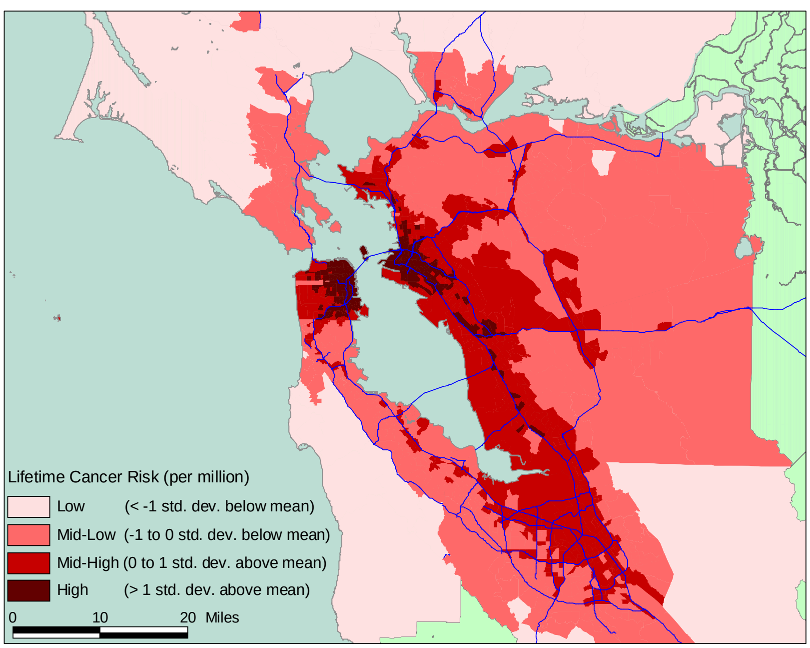




It's Not Just Income . . .



1999 NATA Estimated Cancer Risk (All Sources) by 2000 Census Tracts, Nine-County Bay Area



Linear Model on Risk

Multivariate Correlates of Estimated Cancer and Non-Cancer Risk from Air Toxics, Traditional Linear Model

	Cancer Risk				Respiratory Hazard			
Model variables	*Coeff. Est.*	*Std. Err.*	*Coeff. Est.*	*Std. Err.*	*Coeff. Est.*	*Std. Err.*	*Coeff. Est.*	*Std. Err.*
Intercept	3.230***	0.110	3.205***	0.110	-0.115	0.095	-0.115	0.095
% owner occupied housing units	-0.457***	0.045	-0.408***	0.047	-0.230***	0.039	-0.232***	0.041
relative per capita income (tract/region)	0.588***	0.080	0.619***	0.080	0.661***	0.068	0.660***	0.069
relative per capita income squared	-0.001***	0.000	-0.001***	0.000	-0.001***	0.000	-0.001***	0.000
ln(population density)	0.152***	0.008	0.150***	0.008	0.133***	0.006	0.133***	0.006
% industrial/commercial/transportation land use	0.854***	0.079	0.823***	0.079	0.791***	0.068	0.792***	0.068
% African American	1.257***	0.086	1.277***	0.086	1.119***	0.073	1.118***	0.074
% Latino	0.373***	0.086	0.232**	0.096	0.610***	0.074	0.614***	0.083
% Asian/Pacific Islander	0.646***	0.065	0.461***	0.086	0.731***	0.056	0.737***	0.074
% linguistically isolated households			0.643***	0.198			-0.021	0.171
Adj. r-squared	0.5692		0.5721		0.5635		0.5632	
Log likelihood	-465.9250		-460.6600		-251.9300		-251.9250	
N	1403		1403		1403		1403	

****P < 0.01; **P < 0.05; *P < 0.10.*

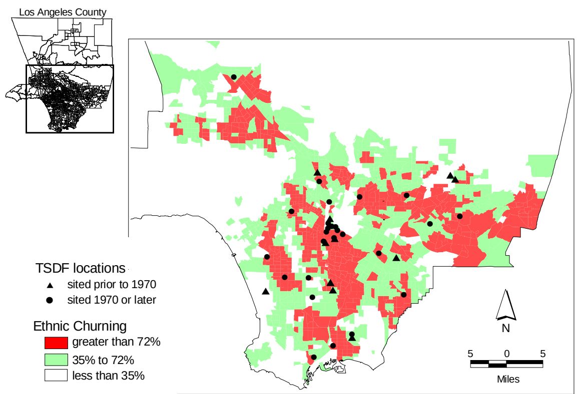
Controlling for Spatial Autocorrelation

Multivariate Correlates of Estimated Cancer and Non-Cancer Risk from Air Toxics, Spatial Error Model

	Cancer Risk				Respiratory Hazard			
Model variables	*Coeff. Est.*	*Std. Err.*	*Coeff. Est.*	*Std. Err.*	*Coeff. Est.*	*Std. Err.*	*Coeff. Est.*	*Std. Err.*
intercept	3.284***	0.269	3.287***	0.268	-0.166	0.358	-0.172	0.360
% owner occupied housing units	-0.126***	0.034	-0.112***	0.035	-0.060**	0.026	-0.055**	0.027
relative per capita income (tract/region)	0.171***	0.061	0.184***	0.062	0.067	0.047	0.072	0.048
relative per capita income squared	-0.000*	0.000	-0.000*	0.000	-0.000	0.000	-0.000	0.000
ln(population density)	0.087***	0.006	0.087***	0.006	0.068***	0.004	0.068***	0.004
% industrial/commercial/transportation land use	0.696***	0.053	0.686***	0.054	0.561***	0.041	0.557***	0.041
% African American	0.382***	0.072	0.392***	0.072	0.147***	0.055	0.150***	0.055
% Latino	0.297***	0.071	0.235***	0.079	0.239***	0.055	0.218***	0.061
% Asian/Pacific Islander	0.115*	0.060	0.034	0.074	0.018	0.046	-0.009	0.057
% linguistically isolated households			0.254*	0.139			0.085	0.107
lambda	0.978***	0.008	0.978***	0.008	0.987***	0.005	0.988***	0.005
Log likelihood	133.088		134.759		496.588		496.903	
N	1403		1403		1403		1403	

****P < 0.01; **P < 0.05; *P < 0.10.*

Also Have Considered Which Came First . .



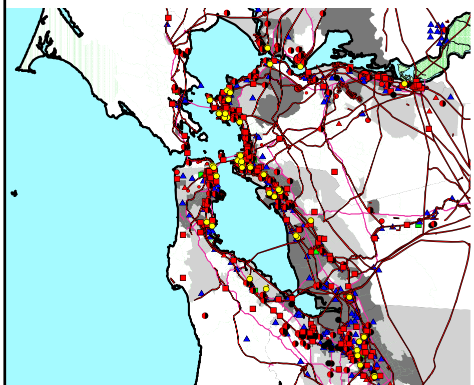
- Found out in our analysis that siting dominated move-in, even in a simultaneous modeling approach
- Also found out that "ethnic churning" – the rate of demographic change – was associated with a higher probability of receiving a facility. . .

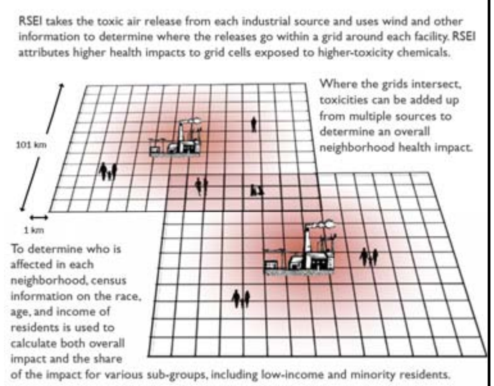
Who's Minding the Kids?

- Found disparities by ethnicity in exposure at schools
- Found statistically significant impacts or respiratory hazard measures on academic performance of schools even controlling for the factors typically used in educational production functions

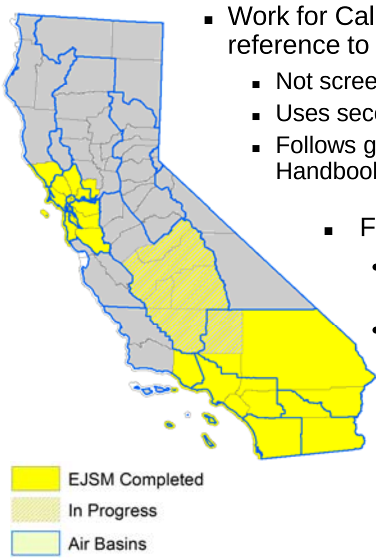
Issues: How Do We Regulate?

- We need to both model and regulate based on cumulative impacts – neighborhood-by-neighborhood not facility-by-facility





Issues: Can We Identify EJ Communities?



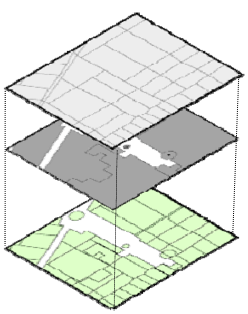
- Work for California Air Resources Board (ARB) with reference to ambient air quality
  - Not screening for occupational, indoor, water, pesticides.
  - Uses secondary databases (<u>screening,</u> not assessment)
  - Follows guidance of CARB Air Quality and Land Use Handbook (2005)
- First applied in So. California
  - Completed for Southern California and the Bay Area (16 counties; 76% of population)
  - In process in 5 southern Central Valley counties.
- Screen and map where people are exposed
  - Residential land use
  - Sensitive land use categories (California ARB land use guidelines, 2005)

Three Categories



- Proximity to hazards & sensitive land uses
  - Based on EJ literature
  - CARB land use guidelines (sensitive receptors)
  - State data on air quality hazards
- Health risk & exposure
  - Based on EJ and public health literature
  - Available state and national data
  - Modeling from emissions inventories
- Social & health vulnerability
  - Based on epidemiological literature on social determinants of health
  - Based on EJ literature on area-level measures of community vulnerability

GIS Spatial Base



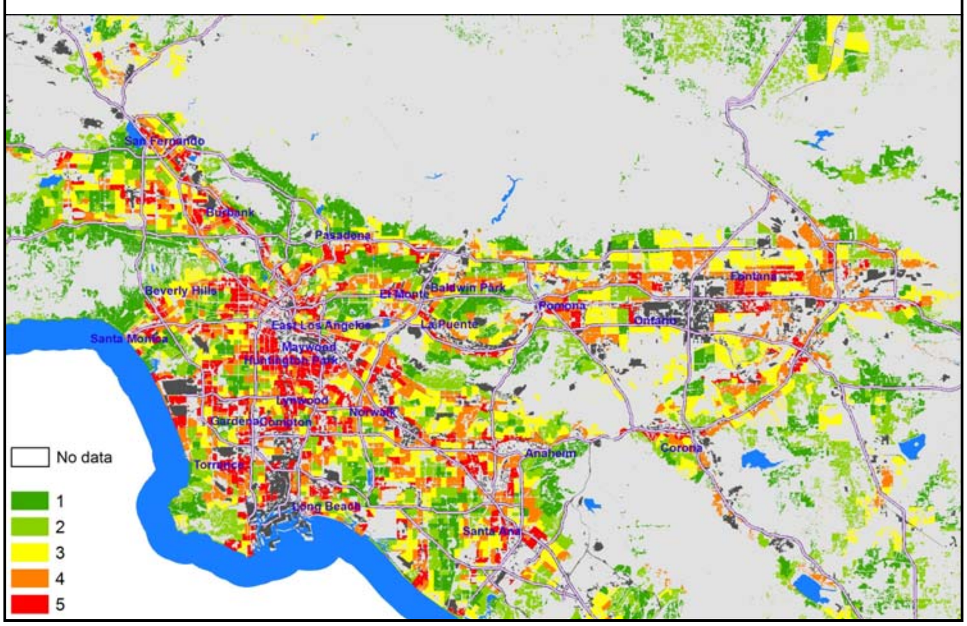
1. Create land use layer by isolating specific land uses
   - "Sensitive land uses" – daycare, schools, medical facilities, urban parks and playgrounds (CARB, 2005)
   - Residential
2. Intersect land use polygons with census blocks
3. Resulting Base Map - CI Polygons
   - Scoring System – each polygon receives "points" related to indicators
   - Final mapping done using census tracts (with weighting procedures)

Scoring – Land Use and Hazard Proximity

- Land use polygons receive a score of 1 if they contain at least one sensitive land use category
- Calculate hazard proximity metrics
  - ❑ CHAPIS (Priority emitters from California emissions inventories)
  - ❑ Chrome Platers
  - ❑ Hazardous Waste TSDs
  - ❑ Land Uses associated with high levels of air pollution (ARB Handbook)
    - ❑ Rail, Ports, Airports, Refineries, Intermodal Distribution Facilities
- Proximity analysis using CI polygons
  - – Number of sites within distance of CI polygon boundary
  - – Distance-weighted approach to address locational inaccuracy

- Transfer values to census tracts using a population-weighting procedure

Hazard Proximity & Sensitive Land Use Score at the Tract Level
Mapped on CI Polygons (quintile distribution)



Scoring for Health Risk & Exposure
(Tract Level)

Five indicator metrics, all at tract level

- RSEI - Toxic conc. hazard scores from TRI facilities (2005)
- NATA - Respiratory hazard from mobile/stationary sources (1999)
- CARB Estimated Inhalation Cancer Risk 2001
- CARB estimated $PM_{2.5}$ concentration (2004-06)
- CARB estimated Ozone concentration (2004-06)

Scoring:

- Each indicator is ranked into quintiles (1-5) across all tracts in the region
- Quintile rank values are summed for each tract
- Tract-level sum is ranked into quintiles (1-5) across all tracts in the region
- The resulting quintile rank is the final health risk and exposure score for each tract

Social & Health Vulnerability Indicators

Census Tract Level Metrics (2000)

- % residents of color (non-White)
- % residents below twice national poverty level
- Home ownership - % living in rented households
- Housing value – median housing value
- Educational attainment – % population > age 24 with less than high school education
- Age of residents (% <5)
- Age of residents (% >60)
- Linguistic isolation - % pop. >age 4 in households where no one >age 15 speaks English well
- Voter turnout - % votes cast among all registered voters in 2000 general election
- Birth outcomes – % preterm or SGA infants 1996-03

Final Cumulative Impact Scores

Combine three categories of impact and vulnerability to derive final Cumulative Impact Score

Cumulative Impact Score =

Hazard Proximity and Sensitive Land Use Score (1-5) +

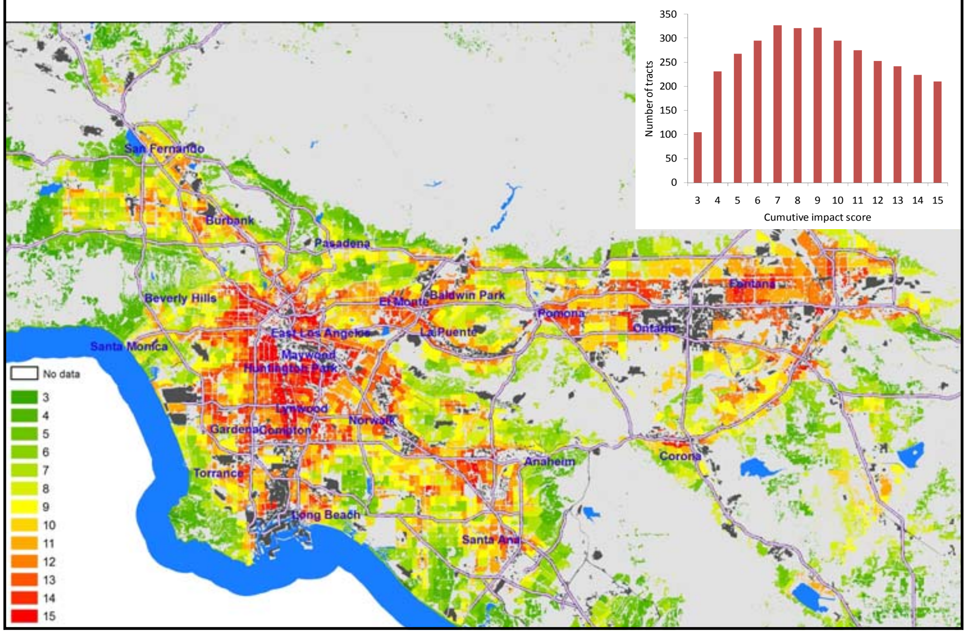
Health Risk and Exposure Score (1-5) +

Social and Health Vulnerability Score (1-5)

- *Final Cumulative Impact Score Ranges from 3-15*

Tract Level Cumulative Impact Score

Distance weighted hazard proximity, mapped on CI Polygons



Notes for a New Approach

- Note that this approach considers a wide variety of social disadvantages that may impact health as well as some of the actual environmental determinants of risk – it is not reducible to race or income, a criticism Matt Adler offers about "environmental justice" approaches

- At the same time, the literature does demonstrate persistent patterns by race and other non-market measures that indicate that may be significant problems of environmental inequity that are rooted in social structures, and this is important.

Notes for a New Approach

- Economists – I'm one – are mostly taught to explain away inequality. We try to find every other factor that could possibly account for a differential in income or other outcomes, hoping to expand explanatory power and focus on the direct role of discrimination.

- People of color – I'm one – tend to contemplate lived experience and the ways in which disadvantages (from differences in education, neighborhood characteristics, and mobility constraints as well as any role of direct discrimination) interact to produce differentials.

Notes for a New Approach

- Importance of thinking about scale – not just unit of analysis as in Doug Noonan – but the finding (Ash and Fetter) that fixed effects by region matter. That is, it may not be the national distribution but the distribution of risk within any regional industrial cluster and land use configuration.
- How does that complicate – and it does – considerations of equity?

Notes for a New Approach

- Some of the work we are considering here starts from a notion that there is a given level of risk and the issues is how it should be distributed.
- Research by James Boyce (UMass Amherst) and Rachel Morello-Frosch (UC Berkeley) and their various co-authors asks a different question: if the risk is unequal, is there more of it overall?

- The authors generally find that there is, suggesting that inequality of outcomes has an impact on perceptions and maybe policy preferences.

Notes for a New Approach

- One strategy could be to "do no harm" – to consider at a minimum whether regulatory changes are likely to worsen any patterns of inequality in exposure and prefer those strategies that both reduce overall exposure and equalize risk (by this standard, "cap-and-trade" strategies need careful analysis).

- Equally important is considering the role of participation and voice. Approaches that are purely technical miss the empowerment element and the role of community (and not just individual) capacity, including the importance of community-based participatory research.

Challenges for the Future

- How can you take a cumulative approach?
- How do we develop effective screening mechanisms?
- How do we secure new partnerships with communities?
- How do we provide agencies with tools to make decisions even when situations are so specific?

Incorporating Equity Concerns into Benefit Cost Analysis

Maureen L. Cropper
U. of Maryland and Resources for the Future
June 9, 2010

The Context

- Distributional considerations are usually incorporated into BCA by presenting benefits for specific groups of concern
  - Health benefits are based on WTP to reduce risks to oneself
  - Decision maker is free to attach “welfare weights” to different groups
- Concerns for the health and safety of others—in the form of willingness to pay—are usually not incorporated into a BCA
  - Altruistic WTP not used by EPA when monetizing health benefits
- Can/Should this be done?

Policy Questions

- Is it appropriate to include individuals' WTP for changes in the distribution of risks in a population?
  - Yes, if altruistic values are allowed in a BCA
  - And, if people are paternalistically altruistic
- If so, what should people value—a change in the distribution of risks or a change in a risk equity measure?
  - Social welfare depends on risk levels rather that the distribution of risks relative to mean risk
  - Ask people to value changes in the distribution of risks
- Can people value changes in risk distributions?

Outline of Talk

- Arguments for including altruistic values in a BCA
- How should equity be represented?
  - Using an inequality index or a distribution of risks?
- Preliminary attempts at measuring WTP for changes in risk distributions
- Questions that remain

Altruism and BCA

- Jones-Lee (1991): Altruistic values should be incorporated into a BCA if and only if per people are paternalistically altruistic.

- Assume person 1 receives utility from his own wealth (w_1) and survival probability (π_1) and everyone else's:
- $SWF_1 = SWF_1(\pi_1, w_1, \pi_2, w_2, \pi_3, w_3, ... \pi_n, w_n)$. (1)

- Problem: How strictly to regulate HAPs?
  – More stringent regulation will increase $\{\pi_i\}$ but will cost people money - alter $\{w_i\}$

What Benefit Measure to Use? Case of Pure Altruism

- Suppose each person is a "pure" altruist
  - He respects people's preferences, e.g., SWF_1 is the sum of individuals' private utility functions
  - $SWF_1 = \sum u_i (\pi_i, w_i)$
- This means person 1 cares about the benefits of the program to each person but also the cost
- Each person's private WTP already captures this tradeoff
- The correct BCA criterion is to compare the sum of private WTPs for a change in survival probability with program cost

What Benefit Measure to Use? Paternalistic Altruism

- Suppose each person is a "paternalistic" altruist
  - He cares about people's safety but not about their wealth
  - $SWF_1 = v(w_1) + W(\pi_1, \pi_2, \pi_3, \ldots \pi_n)$ (2)
- The correct BCA criterion is to compare the sum of each individual's WTP for a change in $\{\pi_i\}$ with program cost
- So . . . We can measure WTP for a change in the distribution of risks and use it in a BCA if people are paternalistically altruistic

Measuring Distributional Preferences

- Borrowing from the income distribution literature, order people in the population from those with the lowest survival probability to those with the highest
- Each person's SWF can be written as:
- $SWF_1 = v(w_1) + \Sigma_p U(\pi_p)\omega(p)$ (3)
- Where p is the pth quantile of the distribution, π_p is the average survival probability in the quantile and $\omega(p)$ is a welfare weight

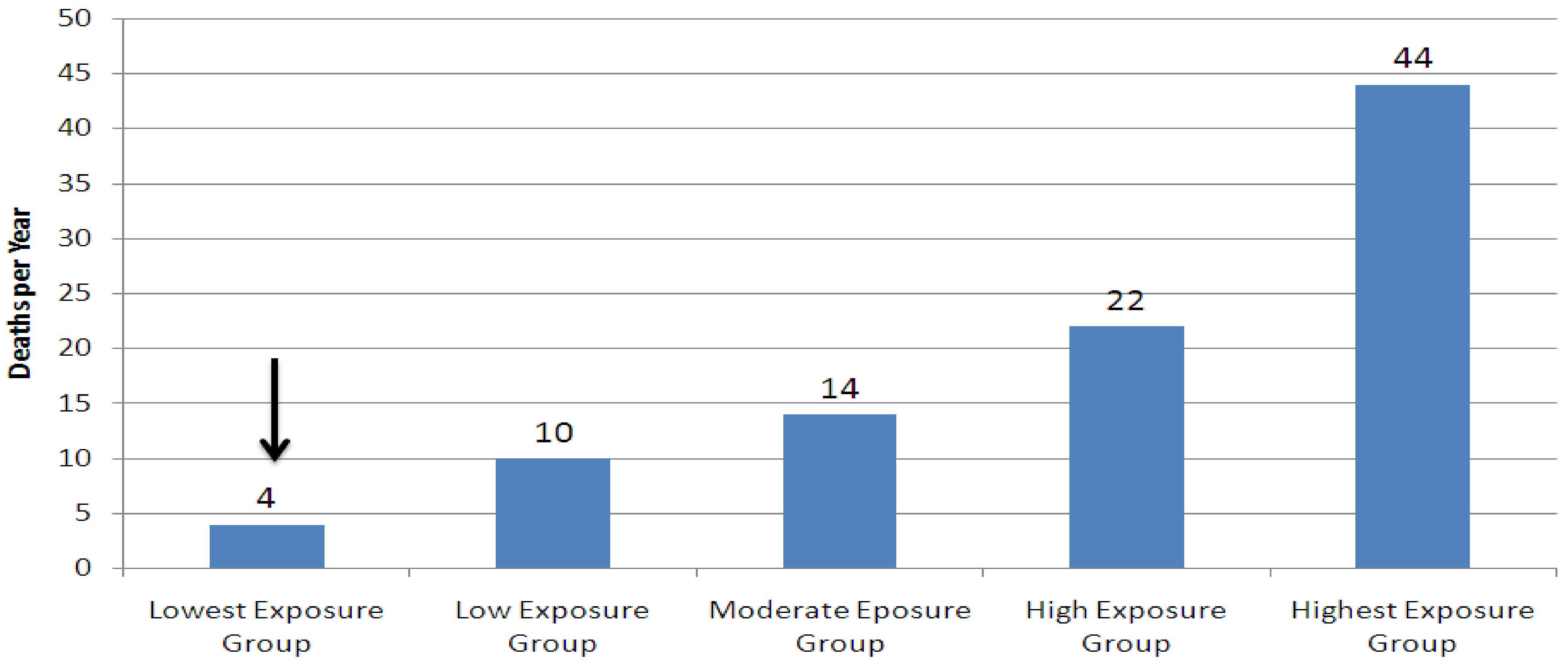
How Do We Value Changes in the Risk Distribution?

- Our goal here is to estimate WTP for a change in the risk distribution
- $WTP = \Sigma_p (\partial W/\partial \pi_p)/(\partial v_1/\partial w_1)$
- How to communicate baseline risks and changes in the risk distribution?
- In ongoing research we are:
  - Describing the population in quintiles
  - Using bars to describe annual cancer deaths in each quintile
  - Using bars to represent deaths after the policy
  - Focus on risk reductions that make all quintiles better off
  - Varying how the policy affects the respondent

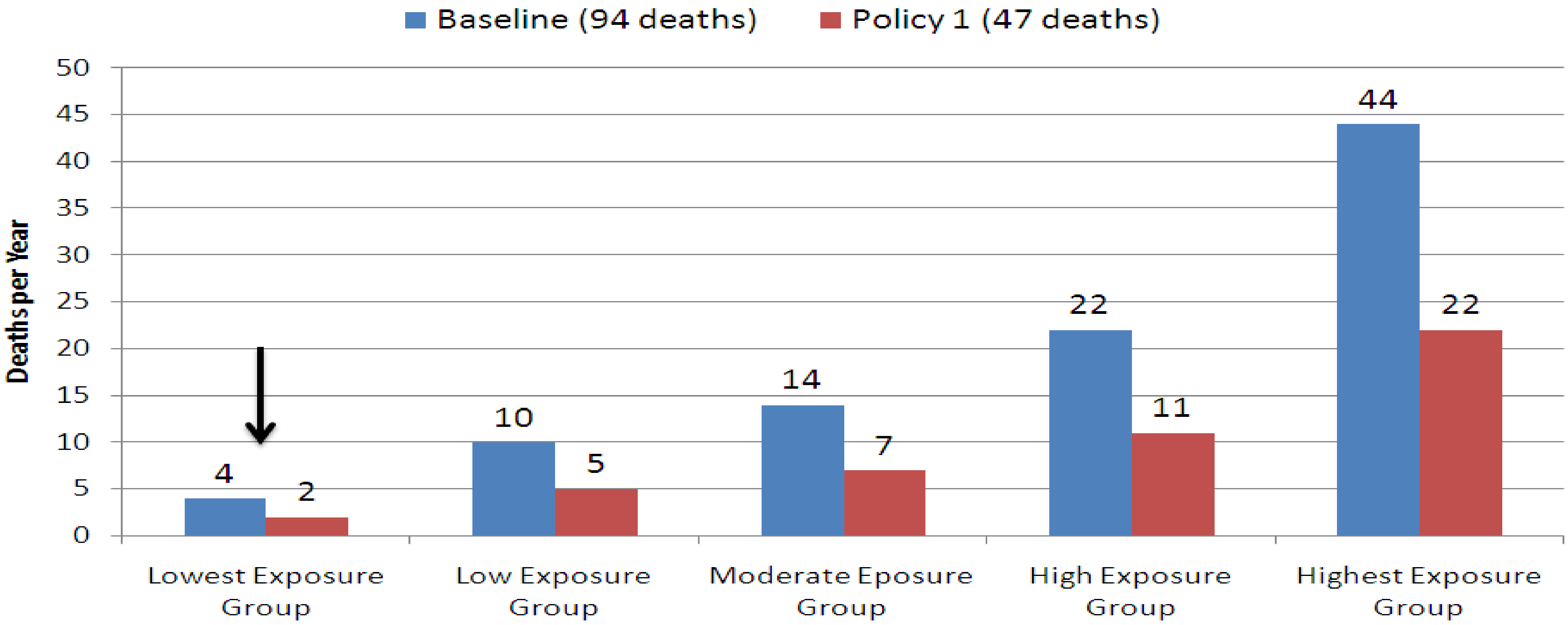
Baseline Benzene Cancer Deaths per Year in the United States: You are in the Lowest Group (represented by the arrow)

Divided into equal groups of 60 million people

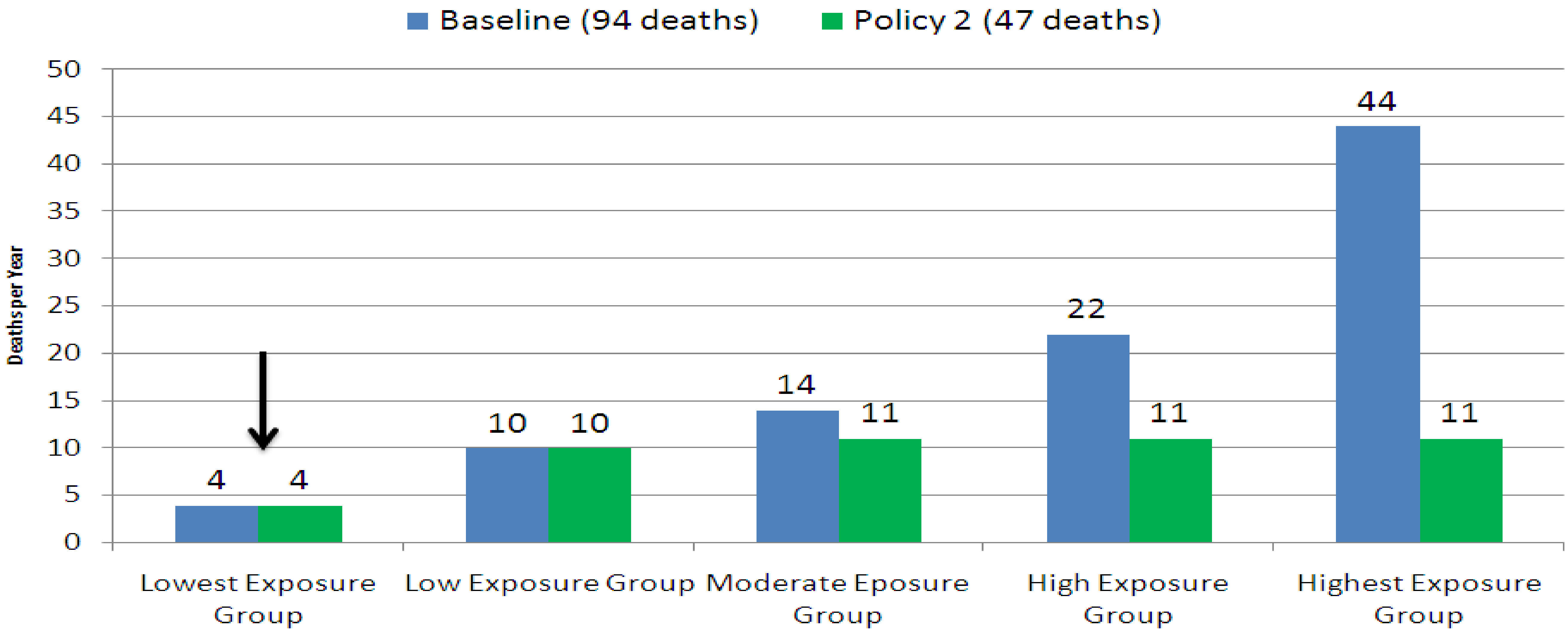
Baseline Benzene Cancer Deaths per Year, (You are in the Lowest Group (shown with the arrow))



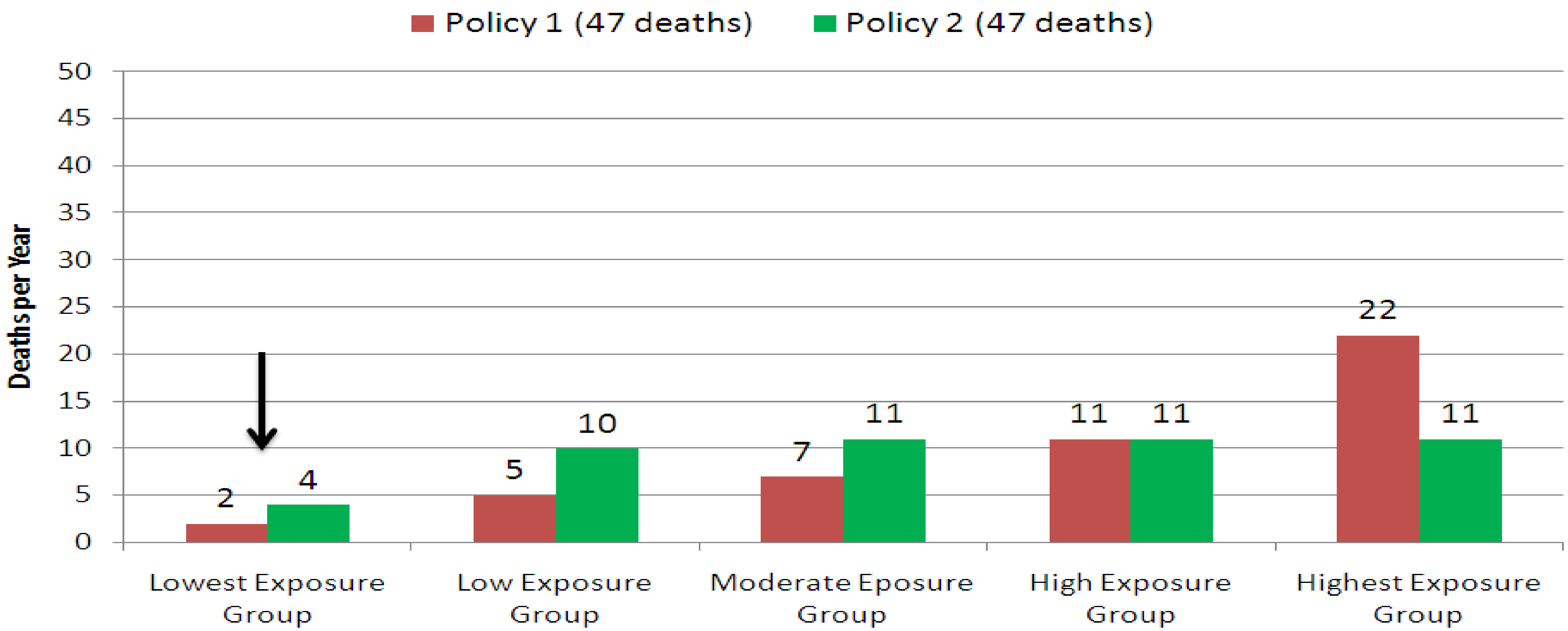
Policy 1 Comparison to the Baseline: You are in the Lowest Group (shown with the arrow)



Policy 2 Comparison to the Baseline: You are in the Lowest Group (shown with the arrow)



Policy 1 Comparison to Policy 2:You are in the Lowest Group (shown with the arrow)



Issues in Valuing Changes in Risk Distributions

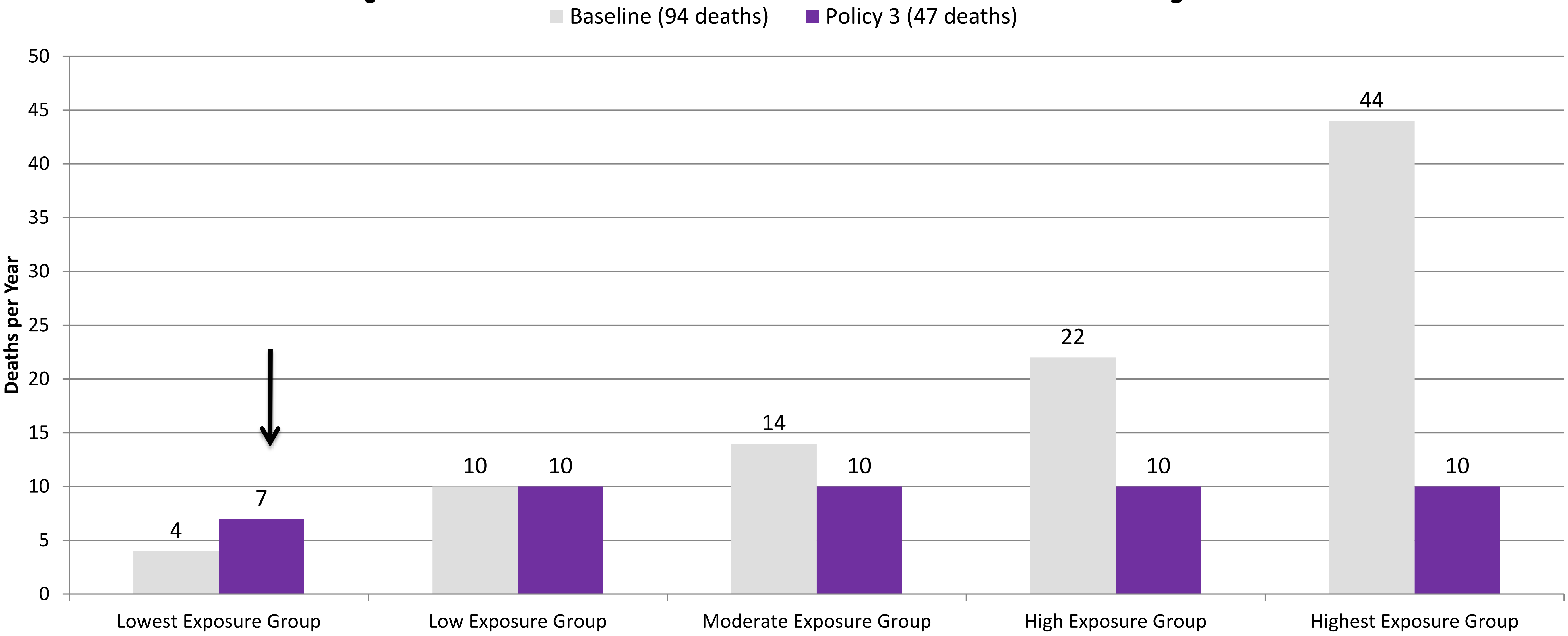
- How would WTP for a change in the risk distribution be used in a policy context?
  - When respondent is affected by the policy, WTP for a change in the risk distribution includes impact on respondent (don't add individual VSL)
  - Would sum WTP for a change in the risk distribution across all individuals, both those affected by the policy and those who are not
- Are people paternalistically altruistic?
- Have altruistic values been allowed in regulatory impact analyses?
  - BCAs of the Clean Water Act use WTP for improvements in a public good (improving water quality in a lake or stream)
  - This could include altruistic values (others benefit from improved water quality)

Additional Slides

Aside on the Income Inequality Literature

- A key result from the Income Inequality literature:
- Social welfare -- $\Sigma_p U(\pi_p)\omega(p)$ can be factored into the product of mean risk (μ) and an inequality index
- The form of the inequality index depends on the form of U( ) and $\omega(p)$
  - The Atkinson Index results if $U(\pi_p) = (1-\varepsilon)^{-1}(\pi_p)^{1-\varepsilon}$
- In this case: $\Sigma_p U(\pi_p)\omega(p) = \mu(1-A)$, where A is the Atkinson Index.
- Inequality indices DO NOT MEASURE WELFARE – they measure the distribution of income (or risk) relative to the mean.
- What we want people to value is a change in $\Sigma_p U(\pi_p)\omega(p)$

Scenario 1- Policy 3 Comparison to the Baseline: You are in the lowest group (shown with the arrow)



Equity and Social Welfare Functions

Matthew Adler, Leon Meltzer Professor
University of Pennsylvania Law School

EJ Workshop, June 2010

Overview of Presentation

- The Social Welfare Function (SWF) Approach
- SWFs and Inequality Metrics
- SWFs and CBA
- Comparing SWFs to other Equity Metrics

The SWF Approach

- Theoretical literature on SWFs begins in 1970s, in response to Arrow's theorem
- SWFs now used in a variety of economic literatures, including optimal tax, environmental economics, and growth theory
- Related to CBA with distributive weights, which have been used by governments and NGOs

The SWF Approach

- SWFs rank outcomes as a function of interpersonally comparable utilities

  $x = (\mathbf{a}_1, \mathbf{a}_2, \ldots, \mathbf{a}_N)$, $y = (\mathbf{a}_1{}^*, \mathbf{a}_2{}^*, \ldots, \mathbf{a}_N{}^*)$, etc.

  $u(x) = (u_1(x), u_2(x), \ldots, u_N(x))$

  $x \succcurlyeq y$ iff

  $w(u_1(x),\ldots, u_N(x)) \geq w(u_1(x),\ldots, u_N(x))$

  Note: There are some SWFs, such as the leximin SWF, that do not take the form of a real-valued function.

- Policies correspond to outcomes or probability distributions over outcomes

Axioms for an SWF

- Pareto principle: (3, 4, 10, 13) $\succ$ (3, 4, 10, 12)
- Pigou-Dalton (hallmark of equity): (3, 6, 8, 12) $\succ$ (3, 4, 10, 12)
- Separability:

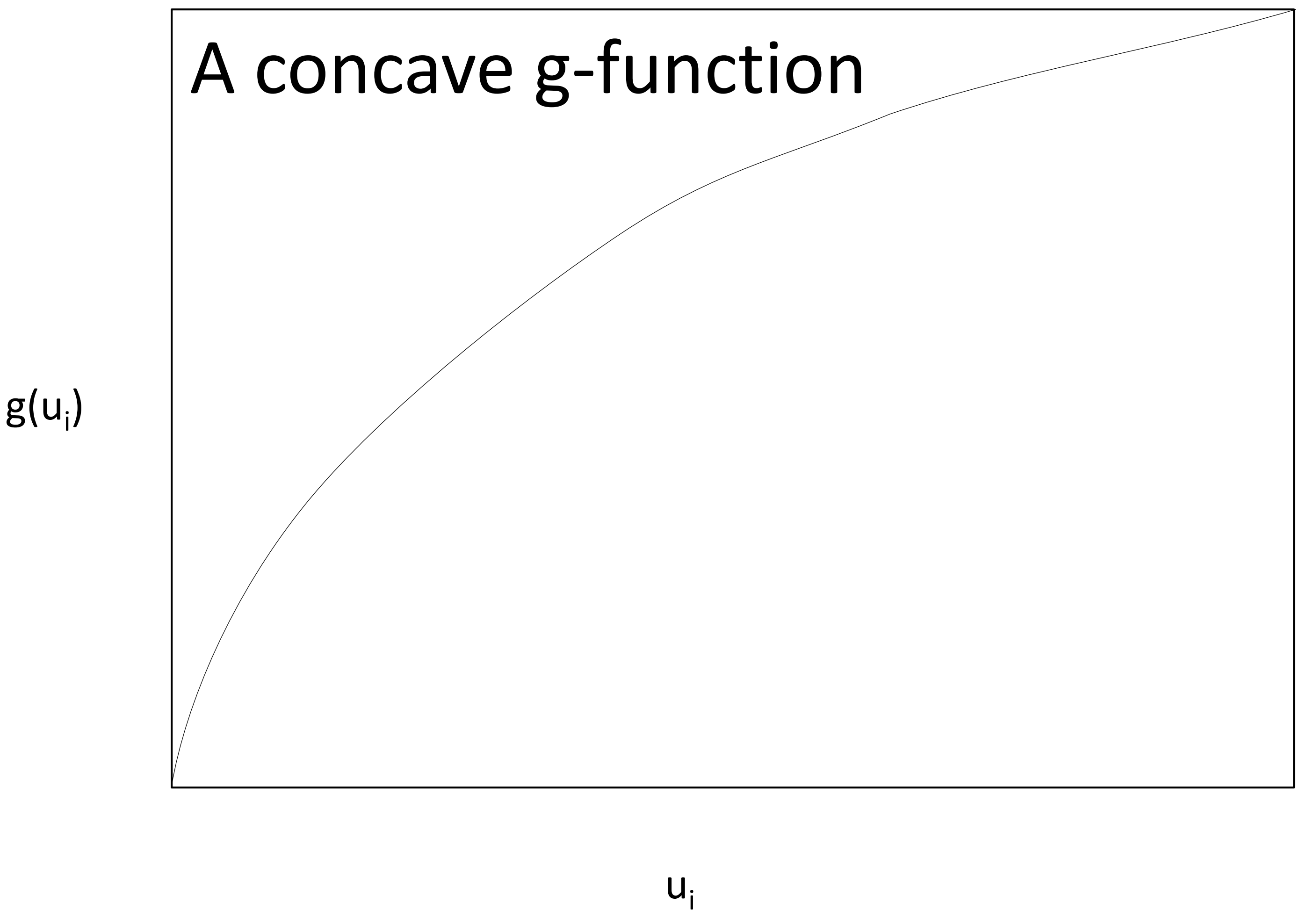
  (7, 100, 100, 7) $\succ$ (4, 100, 100, 12) iff

  (7, 7, 7, 7) $\succ$ (4, 7, 7, 12)
- Continuity:If (1, 3, 50000, 50000) $\succ$ (1, 3, 6, 8), then (1, 3±ε, 50000, 50000) $\succ$ (1, 3, 6, 8) for ε sufficiently small

Utilitarian versus Equity-Regarding (Pigou-Dalton) SWFs

- Utilitarian SWF, $w(u(x)) = \sum u_i(x)$, does not satisfy Pigou-Dalton
- The widely used SWF, $w(u(x)) = \sum g(u_i(x))$, with g strictly increasing and concave, satisfies Pigou-Dalton as well as separability and continuity
- The Atkinson SWF: $g(u_i) = 1/(1-\gamma)\ u_i^{1-\gamma}$, $\gamma > 0$
- There can be equity-regarding SWFs that do not satisfy separability or continuity, e.g., rank weighted SWF, leximin SWF

Equity Regarding SWFs



Where do Interpersonally Comparable Utilities Come From?

- Social judgment: $u_i(x) \geq u_j(y)$ iff being i in x is judged to be at least as good for well-being as being j in y
- Extended preferences (Harsanyi): Individuals have preferences over life-histories. With certain assumptions, we can estimate extended preferences from ordinary preferences. Assume $u^k_i(x) = u^k(\mathbf{a}_i(x))$. We can estimate $u^k(\mathbf{a}_i(x))$ by looking to k's ordinary preferences for his own attributes, i.e., $u^k(\mathbf{a}_k(x))$
- Extended preferences: "life history" surveys
- Sensitivity analysis

A Less Demanding Approach?

- Map each outcome onto an "equivalent" outcome with normalized incomes. If $\mathbf{a}_i=(c_i, \mathbf{b}_i)$, then $x = (\mathbf{a}_1, \mathbf{a}_2, \ldots, \mathbf{a}_N)$ is mapped onto $x^{norm} = (c_1^{norm}, c_2^{norm}, \ldots c_N^{norm}; \mathbf{b}_1^{ref}, \mathbf{b}_2^{ref}, \ldots, \mathbf{b}_N^{ref})$, where each i is indifferent between x and x^{norm}.
- Map each vector of normalized incomes onto a utility vector. CRRA utility function can be used here.
- Use an equity regarding SWF to rank outcomes as a function of these utility vectors.

Calibrating the degree of Inequality Aversion of the Atkinson SWF

- Leaky bucket question. Poor is at utility level U, while Rich is at level KU. If we reduce Rich's well-being by Δu, and increase Poor's by f Δu, $0<f<1$, what is the smallest value of f such that this remains a social improvement? For given γ, $f = (1/K)^{\gamma}$
- Equalization question. Is it an improvement to move from

  (U, U^*) to (U^{+}, U^{+}), where $U + U^* > 2U^{+}$?
- Some surveys have tried to estimate
- Sensitivity analysis

The Time-Slice Question

Period:	1	2	3	4	*Lifetime Utility*
Phil	9	16	9	16	50
Sam	12.5	12.5	12.5	12.5	50
Phil	12.4	12.4	12.4	12.4	49.6
Sam	12.5	12.5	12.5	12.5	50

- Note that $\sum \surd u_i$ applied to sublifetime utilities says that the second outcome is better, but applied to lifetime utilities says that the first is better.

The Time Slice Question

	Period:	1	2	*Lifetime Utility*
Outcome x	Phil	40	90	130
	Sam	60	10	70
Outcome y	Phil	20	100	120
	Sam	80	0	80

- Any equity-regarding SWF, if applied on a lifetime basis, says that y is better – but if applied on a sublifetime basis says that x is better

Equity-Regarding SWFs under Uncertainty

$w = \sum \sqrt{u_i}$

A and B are equiprobable states

	Status Quo			Policy		
	A	*B*	*EU*	*A*	*B*	*EU*
Jim	4	9	6.5	3.5	3.5	3.5
June	0	4	2	3.5	3.5	3.5
w	*2*	5		3.74	3.74	

Expected *w* = 3.5

w applied to the vector of expected utilities = 3.96

Expected *w*= 3.74

w applied to the vector of expected utilities = 3.74

Equity-Regarding SWFs under Uncertainty

	Status Quo			Policy		
	A	*B*	*EU*	*A*	*B*	*EU*
Jim	20	200	110	0	210	105
June	20	100	60	40	90	65

As in the prior slide, A and B are equiprobable states.

For any equity-regarding SWF, if we calculate the expectation the status quo is preferred, but if we apply the SWF to expected utilities the policy is preferred

Inequality Metrics

- Inequality metrics are applied to a distribution of some item ($s_1, s_2, \ldots., s_N$). $I(s_1, s_2, \ldots., s_N) > I(s_1^*, s_2^*, \ldots., s_N^*)$ means that the degree of inequality in the first distribution is greater.
- The item s can be income, some other attribute, or utility.
- Standard inequality metrics: Atkinson, Gini, coefficient of variation, Theil index
- Inequality metrics satisfy Pigou-Dalton principle (w/respect to s) and equality-as-lower-bound.

SWFs and Inequality Metrics

- If w is a continuous equity-regarding SWF, then $w(u(x)) \geq w(u(y))$ iff

  $[1- I^w(u_1(x), \ldots, u_N(x))] \sum u_i(x) \geq$

  $[1- I^w(u_1(y), \ldots, u_N(y))] \sum u_i(y)$
- If w is the Atkinson SWF, then I^w is the Atkinson inequality metric
- If w is the rank weighted SWF, then I^w is the Gini coefficient

SWFs and CBA

- CBA: If x is a baseline outcome, then assign any other outcome y a net benefits amount, $\sum \Delta c_i(y)$, where $\Delta c_i(y)$ = individual i's equivalent variation. $X = (c_1, \ldots, c_N; \mathbf{b}_1, \ldots, \mathbf{b}_N)$, $y = (c_1^*, \ldots, c_N^*; \mathbf{b}_1^*; \ldots, \mathbf{b}_N^*)$. Individual i is indifferent between y and $(c_1, \ldots, c_i + \Delta c_i(y), \ldots, c_N; \mathbf{b}_1, \ldots, \mathbf{b}_N)$
- Most SWFs (utilitarian or equity-regarding) can be "mimicked" by CBA with distributive weights. Now assign each outcome y a weighted net benefits amount $\sum m_i(y)\Delta c_i(y)$.

Advantages of SWFs as an inequality metric

- Sensitive to both overall well-being and the distribution of well-being
- Utilities are an inclusive measure of individual attainment (a function of individual income, health, and all other individual attributes)
- Sensitive to inequalities both within and between population subgroups
- Closely related to current tools that are widely used (CBA and inequality metrics)
- Atkinson SWF has simple functional form and is amenable to sensitivity analysis

Methods for Analyzing Environmental Justice for Disperse Pollutants: Application to Water

"Highlighted Regulatory Activity- An EPA Office of Water Perspective"

William Swietlik, USEPA, Office of Water, Office of Science and Technology

substituting for

Julie Hewitt, USEPA, Office of Water, Office of Science and Technology

June 09, 2010

Overview:

1. **Office of Water EJ Policies/Strategy/Guidance**

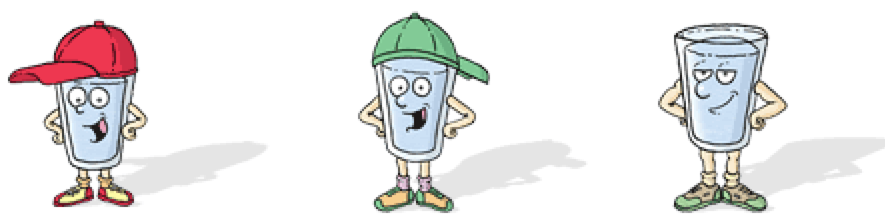
2. **Examples of EJ activities in Office of Water - Office of Science and Technology (OW-OST)**

3. **Challenges**

Background:

EPA Office of Water (OW):

- Office of Science and Technology (OST)
- Office of Wastewater Management (OWM)
- Office of Wetlands, Oceans and Watersheds (OWOW)
- Office of Ground Water and Drinking Water (OGWDW)



Office of Water-OST EJ Policies/Strategy/Guidance

OFFICE OF WATER FISCAL YEAR 2009 ACTION PLAN TO INTEGRATE ENVIRONMENTAL JUSTICE:

- Integrate environmental justice principles as appropriate into policies, programs, and activities to ensure that no segment of the population is disproportionately burdened from adverse human health or environmental effects.
  http://www.epa.gov/compliance/ej/resources/reports/actionplans/ow-ej-actionplan-2009.pdf

FY 2010 National Water Program Guidance:

EJ Priority: Water Safe to Drink-

- *Reliable delivery of safe water in small and disadvantaged communities, Tribal and territorial public water systems, schools and child-care centers through operator certification programs, State capacity building and assistance programs.*

EJ Priority: Fish and Shellfish Safe to Eat-

- *Reducing risk of exposure to contaminants in fish through contaminant monitoring, risk communication to minority populations, and assessment of waters used by minority populations and Tribes.*
  http://www.epa.gov/water/waterplan/

Office of Water-OST EJ Policies/Strategy/Guidance

- **FY 2010 National Water Program Guidance:**
  - **EJ analyses for all Priority Actions:**
    1. Rules
    2. Policy statements
    3. Risk assessments
    4. Guidance documents
    5. Models
    6. Analytical blueprints

OW-OST Regulatory Activities with EJ Analyses

– **Upcoming water rules:**

1. **316(b) Proposed Rule:** (Existing electric utilities and manufacturers with cooling water intakes)

2. **Recreational Water Quality Criteria Guidance**: (Safe levels of pathogens in surface waters)

3. **304(m) Plan:** (OW's Plan for regulating new/existing industries)

4. **Steam Electric Proposed Rule:** (Coal fired steam electric generators)

Specific Example

➢ **Steam Electric Proposed Rule:** (Coal fired steam electric generators)

- 500 coal fired plants in US
- Pollution sources:
  - -- FGD wastewater
  - -- Ash handling water
  - -- Ash pond runoff
  - -- Coal pile runoff
  - -- Ash pond and coal pile leachate
- Selenium, arsenic, mercury, cadmium, etc.
- Surface water/ground water contamination
- Bioaccumulation in fish/humans/wildlife

Examples of EJ in OW-OST Regulatory Activity

Steam Electric Proposed Rule :

- **Could the rule distribute benefits among population sub-groups in a way that is significantly unfavorable to low income and minority populations?**
- **Data necessary to conduct the analysis will include:**
  - (1) Coordinates of each plant,
  - (2) Publicly available geographic data such as political subdivisions,
  - (3) Hydrologic network,
  - (4) Groundwater, drinking water source/usage
  - (5) Demographic statistics (e.g., annual household income and race); and
  - (6) Exposure pathway-specific data such as the distribution of recreational anglers, fish consumption, etc.
  - (7) Other.
- **Tools such as NEPAssist, EJSEAT, etc**.

Challenges for EJ in OW- OST

- **Inconsistent EJ analyses**
- **Adequate data-**
  - Better and consistent data on dependence on subsistence fishing
  - Data on private individual water wells
- **Methods-**
  - Screening OW actions for potential EJ concerns
  - Determining scope of “existing disproportionate impacts”
  - Operational boundaries, i.e., how extensive an EJ analysis should be?

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Environmental Justice Effects with Dispersed Pollutants

Spencer Banzhaf
Georgia State Univ., NBER, PERC

Workshop on Analytical Methods for Assessing the Environmental Justice Implications of Environmental Regulations

EPA-NCEE and Abt Assoc.

June 9-10, 2010

Traditional EJ Perspective

- 1982: hazardous waste facility in Warren Co., NC
- Early research focused on hazardous waste
  - US GAO (1983)
  - United Church of Christ (1987)
  - Second wave: TRI facilities (Arora & Cason 1996, Brooks & Sethi 1997, Ringquist 1997, Sadd et al. 1999).
- EPA responses – brownfields, permitting
  - EPA's *Environmental Justice Strategy* (1995)
  - EPA's *Toolkit for Assessing Potential Allegations of Environmental Injustice* (2004)
- Traditional focus on "sites."

What about Diffuse Pollutants?

- Point sources with diffused emissions
  - Municipal water supplies
  - Power plants
- Dispersed sources
  - Agricultural runoff
  - Arsenic in groundwater
  - Mobile-source air pollution
- Examples range from historical priorities (criteria air pollutants, pathogen-free drinking water) to recent concerns (arsenic, disinfectants, cooling water intake structures)

A Conceptual Framework

- Concentration-response function:

$$Y_{gi} = f_g(Q_i, Z_i) + \varepsilon.$$

$$E[dY_g] = \sum_i \frac{\partial f_g(Q_i, Z_i)}{\partial Q_i} \frac{\partial Q_i}{\partial A} \frac{N_{gi}}{\sum_i N_{gi}}$$

Group *g*, location *i*.

Environmental quality *Q*, technologies *Z*, policy *A*.

Outcome *Y*

Sources of Group-Level Variation

1. Spatial variation in effect of policy on environmental quality: $\partial Q_i/\partial A$
2. Spatial variation in available substitute technologies or, if concentration-response function is non-linear, in background levels of environmental quality: $f(Q_i, Z_i)$.
3. Group-level variation in response to pollution: $f_g(.)$

EPA’s approach to including environmental justice considerations in RIAs has been too limited

- Focus on “sites” and “communities”.
- Focus only on distribution of environmental effects: $\partial Q_i/\partial A$
- Stance of providing *negative assurance* that programs do not exacerbate environmental justice concerns.

Reverse the Categories

- Traditional approach: Define a “community” around a “site” and a “reference community” and look at the groups who live there.
- Instead: Start with the groups of interest and look at the effect on them of a regulatory action, regardless of where they may live.
- Essentially, EJ analyses becomes a special case of distributional analysis.

Distributional Analysis

- Long precedent in academic research
  - Banzhaf (2009)
- Also federal benefit-cost analysis
  - US Water Resource Council
  - OMB Budget Circulars A-4, A-94
  - EO 12866
- HM Treasury's "Green Book"

Advantage I: More Information for Public

- EO 12898:

  *[*agencies should*] at a minimum*, (1) promote enforcement of all health and environmental statutes in areas with minority populations and low-income populations: (2) ensure greater public participation; (3) improve research and data collection relating to the health of and environment of minority populations and low-income populations; and (4) identify differential patterns of consumption of natural resources among minority populations and low-income populations. (§1-103, emphasis added).

- EPA's Environmental Justice Strategy:

  An informed and involved community is a necessary and integral part of the process to protect the environment.

  EPA will work with affected communities, State, Tribal, and local governments, and others to have the best possible information available to identify and address disproportionately high and adverse human health or environmental effects on minority populations and low-income populations.

Advantage II: Fits Underlying Objective

- One goal is to improve equity.
- Show effects of policy on that goal.
- Begs question: Equity of *what*?
  - A specific environmental impact?
  - Environmental health generally?
  - Over-all welfare?

Equity of over-all welfare is most natural choice

- Most fundamental: We care about environment *because* it affects welfare.
- Encompasses all important effects.
  - Distribution of costs as well as benefits.
  - General equilibrium effects.
- Avoids perverse decision rules. Thought experiment:
  - What if a policy especially benefited a minority group?
  - Would it contribute to, or detract from, the equity objective?
- Consistent with benefit-cost paradigm.
- Again, sanctioned by OMB and EPA.

Heterogeneity in WTP

- Average VSL is $6m.
- Rich-person's VSL is $8m.
- Poor-person's VSL is $4m.

Heterogeneity in WTP

Table 1A. Benefit-Cost Analyses for Policy A

Group	Costs	Lives Saved	Benefits without Heterogeneity	Benefits with Heterogeneity	Net Benefits without Heterogeneity	Net Benefits with Heterogeneity
Rich	$1700m	100	$600m	$800m	-$1100m	-$900m
Poor	0	200	$1200m	$800m	$1200m	$800m
Total	$1700m	300	$1800m	$1600m	**$100m**	**-$100m**

Table 1B. Benefit-Cost Analyses for Policy B

Group	Costs	Lives Saved	Benefits without Heterogeneity	Benefits with Heterogeneity	Net Benefits without Heterogeneity	Net Benefits with Heterogeneity
Rich	$1700m	200	$1200m	$1600m	-$500m	-$100m
Poor	0	50	$300m	$200m	$300m	$200m
Total	$1700m	250	$1500m	$1800m	**-$200m**	**$100m**

Heterogeneity in WTP

Table 1C. Benefit-Cost Analyses for Policy C

Group	Costs	Lives Saved	Benefits without Heterogeneity	Benefits with Heterogeneity	Net Benefits without Heterogeneity	Net Benefits with Heterogeneity
Rich	$350m	50	$300m	$400m	-$50m	$50m
Poor	$350m	100	$600m	$400m	$250m	$50m
Total	$700m	150	$900m	$800m	**$200m**	**$100m**

Table 1D. Benefit-Cost Analyses for Policy D

Group	Costs	Lives Saved	Benefits without Heterogeneity	Benefits with Heterogeneity	Net Benefits without Heterogeneity	Net Benefits with Heterogeneity
Rich	$600m	100	$600m	$800m	$0	$200m
Poor	$100m	50	$300m	$200m	$200m	$100m
Total	$700m	150	$900m	$1000m	**$200m**	**$300m**

Heterogeneity in WTP

- Best analysis includes heterogeneity in WTP…
- …AND distributional effects.

How to Incorporate Distributional Effects

- Distributional Weights
  - Most approaches give extreme, counter-intuitive weights.
  - Arrogates too much power to analyst?
- Effect on a distributional index
  - E.g. Levy et al. (2009)
  - Hard to tell which groups are affected, and details are lost in the index.
- Display distributional effects in a table by group.
  - For economically significant rules, net benefits by group.

Recent examples

- EPA
  - Arsenic rule: Effects on children
  - Stage 2 rule: Distribution of costs by size of treatment system
  - 316b rule: Subsistence fishing benefits by groups
- Shadbegian, Gray and Morgan (2006).
  - Acid rain trading program
  - Costs by state (no group-level variation)
  - Health effects by county
  - Group-level benefit-cost ratios based on spatial variation in residential patterns

Conclusion

- Traditional approach to environmental justice considerations has been discrete and local.
  - Difficult to envision how to apply this approach to dispersed pollutants.
- But environmental justice considerations are a special case of distributional effects.
- Viewed in this light, dispersed pollutants pose no unique challenge.

COMMENTS ON "METHODS FOR ANALYZING ENVIRONMENTAL JUSTICE EFFECTS WITH DISPERSE POLLUTANTS"

Tauhidur Rahman, University of Arizona

June 9, 2010

Outline

- Limitations of EPA's current EJ approach
- Contributions of the paper
  - Strengths
  - Limitations
- Is there an alternative approach?

Limitations of the current approach

- A “local” perspective
- Emphasizes “do not exacerbate environmental concerns”
- Limits EJ analysis of diffuse pollutants

How this paper contributes?

- Proposes a method of EJ analysis with dispersed pollutants
- Considers how EJ considerations can be incorporated into the RIAs for dispersed pollutants
  - Think in terms of distributional impacts of an action, beyond "do no harm" approach
  - Compute the benefits and costs of an action on specific demographic groups, as well as aggregate benefits and costs
  - Fundamental distributional objective is equity in overall-all welfare, and NOT either exposure to particular contaminant or environmental health, this objective should guide our thinking about incorporating EJ considerations into RIAs

How this paper contributes?

- What “over-all” welfare?
  - Identify potential impacts of an action that need to be analyzed
  - It include costs as well as benefits. Distribution of net benefits
  - Indirect effects through market should be considered in RIAs of dispersed pollutants
  - Consider group-level heterogeneity in willingness to pay for health and environmental improvements
  - Consider the role of nonuse or existence values in distributional benefits

How this paper contributes?

- How to incorporate distributional effects into an RIA?

1. Incorporate distributional objective into the efficiency objective, using distributional weights on net benefits
2. Document the change in an index that reflects the degree of equity, e.g. Gini of health distribution
3. Display the effects on different groups, whether monetized as net benefits or not.

Strengths of the proposed approach

- An excellent paper: excellent discussion of what is wrong with current practices
- Permits EJ analysis with diffuse pollutants
- Facilitates informed citizen involvement and comment

Issues with proposed approach

- It is mostly a theoretical approach
  - Empirically intractable
- "Net benefits" of an action is not necessarily the ultimate distributional interest
- It depends on kinds of "dispersed" pollutants
  - It will work for observable dispersed pollutants, but not for unobservable dispersed pollutants

Issues with proposed approach

- Argument that "narrow" types of equity could result in counter-intuitive, even perverse, decision rules for policy is somewhat misplaced
  - Example of arsenic concentration: why should we care about "equity" if there is complete compliance?
- How should the "weights" be determined if EJ analysis is for race/ethnicity instead of poor versus rich?

Abt Associates

Methodology for Distributional Benefit Analysis of a National Air Quality Rule

Ellen Post, Abt Associates Inc.

June 9, 2010

From Insight to Impact – Worldwide

Abt Associates Inc.

Two types of “Environmental Justice” (EJ) research:

- Proximity-to-hazards studies
- Exposure and health risk analyses*

EJ Questions of Interest

- Baseline exposures: Are different socio-demographic subpopulations being exposed to different pollution levels?

- Changes in exposures due to a rule or regulation: When a given rule is implemented, do different socio-demographic subpopulations benefit differentially?

EJ Questions of Interest (cont'd)

- Changes in health risks due to a rule or regulation: Do some groups enjoy greater reductions in health risks as a result of a given rule or regulation?

- Control scenario exposures: Are pollutant exposures (and associated health risks) experienced by different groups less unequal as a result of the rule or regulation?

Abt

EJ issues are often framed in terms of "EJ communities"

- Define communities (geographically)
- Estimate level of pollution in each community
- Classify communities into EJ and non-EJ
- Compare pollution levels between EJ and non-EJ communities

Abt

Problems with Community-Based Approach:

- Defining a community is non-trivial and subjective
- Classification depends on arbitrary thresholds
- Lends itself most readily to a comparison of only two groups

Abt

The Individual-Based Method of EJ Analysis for National Air Pollution Rules

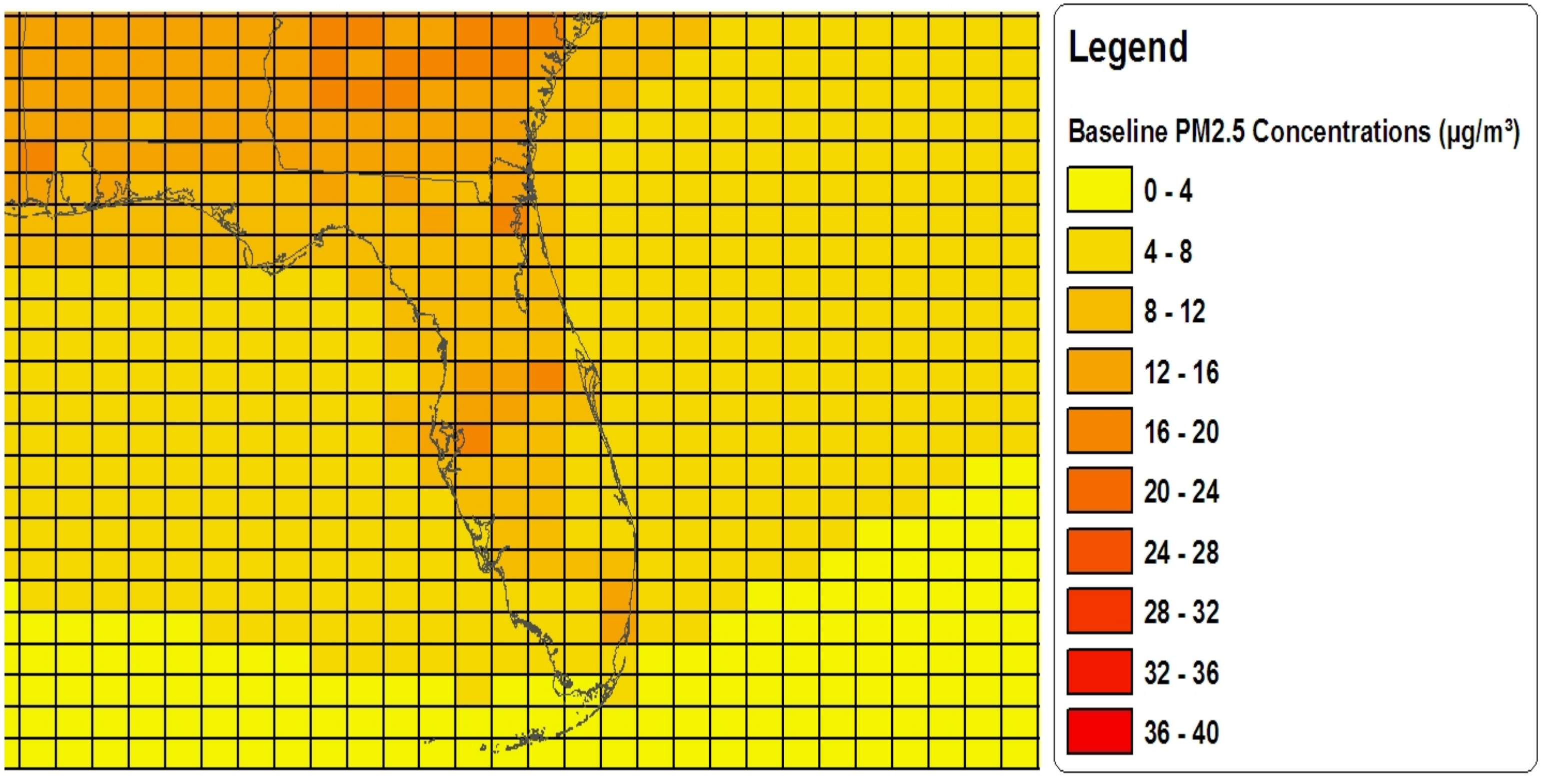
- Define EJ group
- Estimate exposures (Δ exposures) of all individuals in an EJ group, for each group
  - results in a distribution of exposures (Δ exposures) for each EJ group.
- Compare EJ group-specific distributions
- Individual-based approach used by Levy et al. (2007)
  - applied inequality indices to pre-control and post-control risk distributions to measure changes in inequality across individuals in hypothetical control scenarios for power plants in the U.S.

Estimating Individual-Level Exposures in the Baseline

- Air quality model divides U.S. into grid cells; estimates pollutant concentration within each cell – input to BenMAP
- BenMAP
  - configures Census block data - calculates populations of each EJ group in each grid cell
  - assigns grid cell's pollutant concentration to EJ-group-identified individuals.
- We derive EJ group-specific distributions of exposures in baseline

Example: $PM_{2.5}$ Concentrations in 36 km x 36 km grid cells in Florida

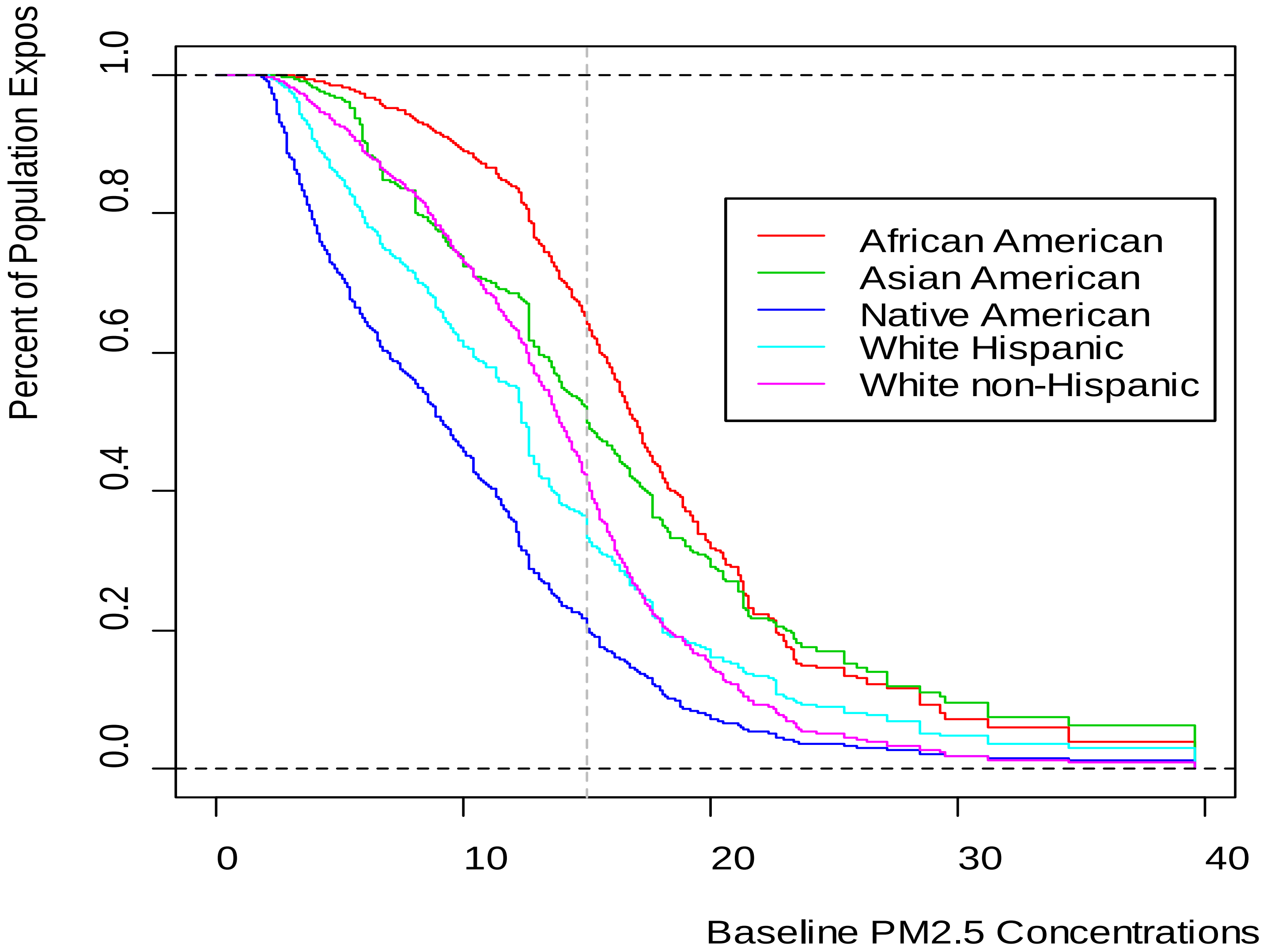
(from Nonroad Diesel RIA (U.S. EPA, 2004))



Example: Assigning Pollutant Concentrations to EJ-Identified Individuals

- BenMAP calculates 3,500 African-Americans and 1,400 whites in a grid cell.
- Annual average $PM_{2.5}$ concentration in grid cell is 17 $\mu g/m^3$.
- Those 3,500 African-Americans and 1,400 whites are each assigned an annual average $PM_{2.5}$ concentration of 17 $\mu g/m^3$.

Example: Racial and Ethnic Group-Specific Distributions of Baseline $PM_{2.5}$ Concentrations in 2030



To Estimate Individual-Level Changes in Exposures Resulting From a Rule:

- BenMAP
  - estimates pollutant concentration in each grid cell in baseline and control scenario
  - calculates Δ exposure (baseline – control scenario) in each grid cell
  - assigns Δ exposure to each EJ-group-identified individual in grid cell
- We derive EJ group-specific distributions of Δ exposure

To estimate individual-level changes in health risks:

- BenMAP
  - has concentration-response functions (usually not EJ group-specific)
  - has grid cell- and EJ group-specific populations
  - has EJ group-specific baseline incidence rates
  - combines these to estimate EJ group- and grid cell-specific Δ health risk associated with grid cell-specific Δ exposure
- We derive EJ group-specific distributions of Δ health risk.

Summary of Individual-Based Method of EJ Analysis for National Air Pollution Rules

- Define EJ groups

- Effectively carry out a benefit analysis separately for each EJ group

- Compare the EJ group-specific results

Characterizing Inequality Using Inequality Indices

- Provides a single number to characterize degree of inequality.
- Different indices – e.g., Atkinson, Generalized Entropy (GE) indicator
- Some have property of decomposability
  - total inequality can be divided into constituent parts of the distribution.
  - can be used to assess within- and between-group inequalities (like an ANOVA)

Case Study: EPA's Heavy Duty Diesel (HDD) Rule in 2030

- Used a 36 km x 36 km grid

- Defined racial EJ groups:
  - Asian-American,
  - African-American,
  - Native American, and
  - White

- Defined ethnic EJ groups
  - Hispanic
  - non-Hispanic

Case Study: EPA's Heavy Duty Diesel (HDD) Rule in 2030 (Cont'd)

- For each EJ group, we examined:
  - $PM_{2.5}$ concentrations in 2030 in baseline
  - reductions in $PM_{2.5}$ concentrations in 2030 as a result of the rule
  - corresponding reductions in health effects
    - Mortality
    - Hospitalization for cardiovascular and respiratory illnesses
    - Asthma-related ER visits among children
    - Non-fatal heart attacks

Case Study: EPA's Heavy Duty Diesel (HDD) Rule in 2030: Key Results

- EJ groups disproportionately exposed will enjoy greater reductions in $PM_{2.5}$ concentrations as a result of the HDD rule
- Exposure reductions do not necessarily translate into equivalent health risk reductions – because of different baseline incidence rates
- Inequality Indices: Much more inequality within groups than between groups

Case Study: EPA's Heavy Duty Diesel (HDD) Rule in 2030: Key Results

Absolute and Relative Reduction in Mean $PM_{2.5}$ Concentrations and Incidence of All-Cause Mortality (per Million Population)

Age / Race	Baseline Incidence per Million Pop.	Absolute Reduction in $PM_{2.5}$ Level (ug/m^3)	Relative Reduction in $PM_{2.5}$ Level (ug/m^3)	Absolute Reduction in Incidence per Million Pop.	Relative Reduction in Incidence per Million Pop.
Infants (Age 0)					
Asian-American	2,907	0.71	1.2	13.6	0.7
African-American	9,543	0.74	1.2	46.9	2.3
Native American	4,166	0.38	0.6	9.0	0.4
White	4,005	0.57	0.9	15.3	0.8
Total Population	*4,816*	*0.61*	--	*20.2*	--
Adults (30-64)					
Asian-American	1,771	0.69	1.2	6.6	0.6
African-American	5,183	0.73	1.2	21.6	2.0
Native American	2,587	0.40	0.7	4.6	0.4
White	3,027	0.55	0.9	9.7	0.9
Total Population	*3,225*	*0.58*	--	*11.1*	--
Elderly (65+)					
Asian-American	20,411	0.67	1.2	77.6	0.6
African-American	39,783	0.74	1.3	170.1	1.4
Native American	25,344	0.39	0.7	52.8	0.4
White	37,945	0.54	1.0	119.6	1.0
Total Population	*36,863*	*0.57*	--	*121.3*	--

Issues and Challenges

- Equality vs. equity: Asking, “Are there differences?” vs “*Why* are there differences?”
  - This method attempts to answer the first question; cannot answer the second
  - Endogeneity
  - historical patterns of settlement of different ethnic groups coming to the United States

Issues and Challenges

- We cannot really get individual-specific exposures
  - Grids currently being used (e.g., 36 km or 12 km) are not of sufficiently high resolution
    - Possible obscured intra-grid cell heterogeneity (e.g., Jerrett et al. (2005)
    - Problem if intra-grid cell exposures correlated with EJ factor
  - The higher the grid resolution, the better the individual-specific exposure estimates – up to a point
    - Detroit study by OAQPS used 1 km grid
  - People are mobile; they don't just stay at their residence
  - What is the optimal resolution?
  - Matching what was done in epi study to estimate C-R function

Issues and Challenges

- Mobile source rules may pose a particular challenge – a grid structure doesn't capture pollutant levels near transportation corridors

Abt

Issues and Challenges

- There will always be some differences. What is a *meaningful* difference?
- Relevant question is: Are observed differences between EJ groups *worthy of concern*?

Abt

Abt Associates Inc.

"Methodology for Distributional Benefit Analysis of a National Air Quality Rule"

by

Ellen Post
Don McCubbin
Anna Belova
Jin Juang
Nate Frey

Discussion Notes by
Christopher Timmins

Discussion: *Advantages*

(1) Extremely practical – "simple enough to be used after a short tutorial", "results can be mapped for ease of presentation".

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Achieving (2) and (3) do require that we give-up a lot in terms of how individual agents' decisions are modeled (relative to non-market valuation models). When is this trade-off most justified? Policies with wide-reach and detailed impact.

Discussion: *Advantages*

(4) Conducive to application of inequality measures (within and across groups).

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(5) Conducive to describing entire *distribution* of change in exposure (e.g., within racial groups).

What percentage of African-Americans see a 0.5 reduction in PM2.5? What percentage see a 2.0 reduction? Looking only at mean reductions can be misleading. E.g., a group may have a high mean reduction being driven by a few outliers. This would exacerbate within-group inequality.

Discussion: *Critiques*

(1) Makes the point that choice of unit of analysis (e.g., county, census tract, etc.) will impact results.

Suppose a pollution source is in a predominantly minority tract in a mostly-white county. Defining exposure at the tract level would lead to a much higher measure of inequality than defining it at the county level.

Suggests that ideal unit of analysis is the individual. This turns out to be impractical.

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<u>Question</u>: How does the pseudo-individual method differ from just defining the grid-cell as the unit of analysis? The grid-cell is a composite individual (e.g., 20% African-American, 80% white). Depending upon how the grid-cell is defined, the same problem described above will arise.

Discussion: *Critiques*

(2) C-R Function – Different abilities of different types of individuals to adapt to changing pollution levels? Likely some heterogeneity in resources to be devoted to avoidance activities across subgroups.

Model will work better for pollutants that can't be avoided, or that people don't know they should avoid.

PM2.5 better than ground-level ozone?

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(4) Do health effects take into account where people spend their childhood?

Mobility Matrix, High School Graduates
2000 US Census, 5% IPUMS Random Sample

	Destination Region									
		New England	Mid-Atlantic	E North Central	W North Central	South Atlantic	E South Central	W South Central	Mountain	Pacific
Birth Region	New England	0.806	0.035	0.011	0.005	0.083	0.008	0.012	0.017	0.024
	Mid-Atlantic	0.016	0.809	0.011	0.005	0.100	0.008	0.012	0.019	0.020
	E North Central	0.004	0.013	0.766	0.024	0.072	0.034	0.026	0.031	0.031
	W North Central	0.002	0.006	0.053	0.770	0.028	0.011	0.034	0.053	0.043
	South Atlantic	0.008	0.036	0.016	0.007	0.863	0.029	0.017	0.010	0.015
	E South Central	0.003	0.009	0.065	0.009	0.082	0.776	0.032	0.008	0.015
	W South Central	0.002	0.007	0.022	0.025	0.035	0.022	0.814	0.030	0.043
	Mountain	0.004	0.009	0.017	0.032	0.027	0.010	0.049	0.747	0.105
	Pacific	0.006	0.011	0.021	0.027	0.035	0.012	0.040	0.097	0.750

Mobility Matrix, College Graduates
2000 US Census, 5% IPUMS Random Sample

		Destination Region								
Birth Region		New England	Mid-Atlantic	E North Central	W North Central	South Atlantic	E South Central	W South Central	Mountain	Pacific
	New England	0.619	0.073	0.033	0.012	0.129	0.012	0.024	0.029	0.070
	Mid-Atlantic	0.060	0.546	0.053	0.012	0.182	0.014	0.030	0.035	0.070
	E North Central	0.017	0.033	0.600	0.040	0.112	0.028	0.043	0.051	0.077
	W North Central	0.010	0.020	0.091	0.537	0.074	0.018	0.075	0.085	0.090
	South Atlantic	0.020	0.049	0.046	0.014	0.709	0.043	0.043	0.028	0.049
	E South Central	0.009	0.019	0.068	0.017	0.189	0.560	0.076	0.024	0.038
	W South Central	0.008	0.016	0.032	0.028	0.078	0.032	0.696	0.047	0.064
	Mountain	0.012	0.021	0.037	0.040	0.062	0.014	0.074	0.562	0.179
	Pacific	0.014	0.021	0.032	0.022	0.061	0.012	0.042	0.091	0.706

Discussion: *Critiques*

(5) Equilibrium Effects – Poor and minorities are expected to see the biggest reductions in pollution. What will happen to housing prices as a result? Will they get priced out of their current residences?

Discussion: *Critiques*

(5) Equilibrium Effects – Poor and minorities are expected to see the biggest reductions in pollution. What will happen to housing prices as a result? Will they get priced out of their current residences?

(6) Is there sampling error introduced through the estimation of population prediction functions? No talk of standard errors. Woods and Poole (2007) is cited but not referenced.

Discussion: *Broader Questions*

Is there a role for optimizing behavior in these models?

Discussion: *Broader Questions*

Is there a role for optimizing behavior in these models?

- EPA defines Environmental Justice as "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies."

- EPA defines "fair treatment" to mean that "no group of people should bear a disproportionate share of the negative environmental consequences resulting from industrial, governmental, and commercial operations or policies."

- Are these *net* consequences? What about the things people need to give up in order to avoid living near pollution (e.g., lower commute time, cheaper housing, urban amenities)?

Not all negative welfare effects of pollution are associated with mortality, and there may be correlated amenities.

Discussion: *Broader Questions*

Should we be deriving *utility-based* measures of welfare that account for *individual heterogeneity* and the ability to *re-optimize* in response to non-marginal changes.

Need to be able to monetize impacts in order to be able to add up pros and cons. Requires utility based measure in order to compare to marginal utility of income.

Should environmental justice be about net welfare effects, not simply different exposure rates.

Non-Market Valuation Technique	What it brings to the table…	What would this add to the simulations…
(1) Simple Hedonics (Constant MWTP) Recover coefficient on disamenity in linear hedonic price function. - Parsons (1992) - Davis (2004) - Chay and Greenstone (2005) - Kiel and Williams (2007) - Pope (2008)	Common MWTP estimates.	Not much. Predicted change in number of bad health outcomes is proportional to the predicted welfare measure. One just needs to know the MWTP to multiply by.

Non-Market Valuation Technique	What it brings to the table…	What would this add to the simulations…
(2) Hedonics with heterogeneous MWTP - Bajari & Benkard (2005) - Bajari & Kahn (2005) - Koster, Van Ommeren, and Rietveld (2010)	Heterogeneity in MWTP across individuals, but places strong restrictions on shape of MWTP function.	Simulations ignore the possibility that people have heterogeneous tastes (based on observed or unobservable attributes) that could affect distributional conclusions. Do people living near pollution have a lower willingness to sacrifice other amenities to avoid it?

Non-Market Valuation Technique	What it brings to the table…	What would this add to the simulations…
(3) Inter-Urban Hedonics Estimate two hedonic gradients (one for housing prices and one for wages). - Roback (1982) - Blomquist, Berger, and Hoehn (1988) - Albouy (2008)	Two dimensions on which people make tradeoffs. No explicit individual preference heterogeneity, but heterogeneity introduced job opportunities. Some individuals may "choose" to take on more pollution in exchange for better labor market opportunities.	Particularly when analyzing pollutants that vary across cities (as opposed to neighborhoods), this provides another dimension of "heterogeneity" in welfare effects.

Non-Market Valuation Technique	What it brings to the table…	What would this add to the simulations…
(4) Non-Marginal Hedonics Recover MWTP functions that vary with individual attributes, or by individuals. - Palmquist (1984) - Boyle, Poor, and Taylor (1999) - Ekeland, Heckman, and Nesheim (2004) - Bishop and Timmins (2010)	Heterogeneity both across individuals and in the welfare effect of a non-marginal change.	Simply knowing change in exposure for different people may not reveal differences in welfare effects. 10 x's larger change in exposure does not have to have 10 x's the welfare effect – depends upon the shape fo the MWTP curve.

Non-Market Valuation Technique	What it brings to the table…	What would this add to the simulations…
(5) Equilibrium Sorting Models Allow individuals the chance to re-sort in response to non-marginal policy changes. Re-equilibration in labor and housing markets. - Sieg, Smith, Banzhaf, and Walsh (2004) - Bayer, MacMillan, and Rueben (2009) - Timmins (2007) - Kuminoff (2008) - Bayer, Keohane, and Timmins (2009)	Heterogeneity in utility parameters and employment opportunities across locations. Stickyness and imperfect mobility. Re-optimization in response to large changes.	Differences in distributional effects owing to: - heterogeneous preferences - different job opportunities - different initial conditions & moving costs - re-optimization in response to non-marginal changes - re-equilibrating prices and wages.

Discussion: *Broader Questions*

Improving environmental conditions could make those choosing to live in poor environmental quality neighborhood worse-off if house prices rise and they don't have anywhere else to go with poor environment and cheap housing.

Re-equilibrating wages in response to climate change induced migration mean those least directly affected by climate change in south of Brazil will suffer quite a bit. Changes distributional conclusions.

Discussion: *Broader Questions*

There is an internal inconsistency in any model where we don't explicitly model optimizing choices.

If people aren't making optimizing choices with respect to pollution, then either:

(1) they don't value it (so it shouldn't enter into welfare calculations)
(2) they don't know about it

Hedonic estimates suggest (2) isn't true (i.e., people do seem to take pollution into account when making decisions in related markets).

Discussion: *Conclusions*

These non-market valuation approaches require assumptions:

- functional forms for MWTP
- functional forms for utility
- preference homogeneity across markets
- additively separable utility
- distributional assumptions
- information and ability of individuals to optimize

All of these may make estimating utility-based welfare measures seem less attractive.

Discussion: *Conclusions*

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- functional forms for MWTP
- functional forms for utility
- preference homogeneity across markets
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- information and ability of individuals to optimize

All of these may make estimating utility-based welfare measures seem less attractive.

But, the simulation approach requires a lot of assumptions as well:

- population growth rates and migration behavior
- within grid-cell exposure homogeneity
- avoidance behavior
- preference heterogeneity

Environmental Justice
in the
Office of Solid Waste and Emergency Response (OSWER)

Lyn D Luben, Economist
Economics and Risk Analysis Staff
Office of Solid Waste and Emergency Response
U.S. Environmental Protection Agency

June 10, 2010

Presentation Outline

- OSWER, Environmental Justice, and the EPA Strategic Plan;
- Goal, Policy, and Leadership
- Importance of Environmental Justice (EJ) in OSWER
- Four Common Approaches to EJ Assessment
- EJ Assessments in OSWER - Representative Examples
- Key General Issues-Challenges
- Key Analytical Issues-Challenges
- Improving EJ Rulemaking Assessments: Current OSWER Focus
- Conclusions

EPA Strategic Plan: OSWER and Environmental Justice

- **Improvements to human health and the environment for all communities:**
  - **Goal 1: Clean Air and Global Climate Change**
  - **Goal 2: Clean and Safe Water**
  - **Goal 3: Land Preservation and Restoration**
  - **Goal 4: Healthy Communities and Ecosystems**
  - **Goal 5: Compliance and Environmental Stewardship**

OSWER Goal and Policy

- Goal:
  - To *effectively* integrate environmental justice into *all* strategic planning, program policies, and *daily operational activities,* resulting in a *measurable* benefit to the life of impacted communities.
- Policy:
  - Programs administered by OSWER must demonstrate the fair treatment and meaningful involvement of people from all cultures, races, and incomes;
  - Environmental justice must be considered as an integral part in the development of all OSWER policies, guidance, and regulations.

OSWER Leadership

- OSWER Assistant Administrator, Mathy Stanislaus - strongly committed to ensuring Environmental Justice for all communities:
  - EJ considerations must be incorporated into all aspects and stages of our actions,
  - EJ analyses must be *meaningful* and *understandable,*
  - EJ analyses should, as feasible, incorporate Life Cycle Assessment (LCA)

Importance of Environmental Justice in OSWER

Community Engagement Initiative

- Goals/Objectives:
  - Create transparent and accessible decision making processes:
  - Present information and analyses to ensure community stakeholders better understand environmental issues and can participate in an informed way;
  - Plan decision making processes with stakeholders;
  - Evaluate and measure effectiveness of community engagement activities;
  - Promote a community centered culture within OSWER

Importance of Environmental Justice in OSWER

Community Engagement Initiative (continued)

- Results
  - More involved communities;
  - Outcomes that are responsive to stakeholder concerns;
  - Outcomes that are aligned with community needs and long-term goals;
  - More attention to EJ analyses in rule development

Importance of Environmental Justice in OSWER

Documentation, Training, and Guidance

- Tracking and documentation of Environmental Justice activities:
  - Environmental Justice activities tracked/documented since 1995
    - Waste Program Accomplishments
    - Success Stories
    - Partnerships, benefits, and lessons learned
- Ongoing and Expanded Training on Environmental Justice Issues:
  - OSWER Offices and Regions
  - Non governmental stakeholders
- Significant OSWER contribution to the ongoing development of Agency guidance document

Recognition

- OSWER-Based Recognition Programs:
  - Recognition of EJ accomplishments through the issuance of awards to staff
  - Recognition of stakeholder and community accomplishments
- Outside Recognition
  - OSWER recognized as an Environmental Justice leader by federal advisory committee members

Four Common Approaches to EJ Assessment in OSWER

- Boilerplate text only
- Boilerplate plus speculation text
- Community focused demographics assessment
- Community focused human health risk assessment

Representative Assessments

- **F033 Surface Protection Listing Determination – Proposed Rule**
  - Risk Assessment:
    - Impacts to subsistence fishers (largely minority)
- **Hazardous Waste Combustion MACT Standards - Final Rule**
  - Demographics Assessment:
    - "significant number" of combustion facilities located in areas where the nearby populations are "disproportionately" minority or low-income
    - *Total* minority and low-income numbers of potentially exposed people near combustion facilities

Representative Assessments

- **Exclusion for Gasification of Petroleum Oil-Bearing Secondary Materials - Final Rule**
  - Demographics Assessment:
    - Minority and low income populations living within a one-mile of refineries with gasification systems.
- **Identification of Non-Hazardous Secondary Materials (NHSM) That Are Solid Waste – Proposed Rule**
  - Demographics Assessment: (non incineration management of solid waste materials):
    - Minority and low income populations within one and three miles of waste management or recycling facilities;
    - No determination of "disproportionate"

Representative Assessments

- **Identification of Non-Hazardous Secondary Materials (NHSM) That Are Solid Waste – Proposed Rule (continued)**
  - Qualitative Assessment:
    - Potential impacts associated with increased transportation and other activities at recycling facilities;
    - Potential impacts associated with solid waste diversion to municipal waste combustors or landfills;
    - Possible impacts from potential slowdown in abatement of scrap tire stockpiles;
    - Potential for increased accumulation of secondary materials in stockpiles;
    - Potential for dumping of used oil

Representative Assessments

- **Disposal of Coal Combustion Residuals (CCR Proposal)**
  - Demographic Assessment:
    - Minority and low income populations near affected facilities;
    - Comparisons to state and national averages;
    - Numerical ratio applied to demographic analysis;
    - No determination of “disproportionate”

Representative Assessments

- **Definition of Solid Waste (hazardous) – Final Rule**
  - Comprehensive community-based approach:
    - Hazard characterization
      - Soils, groundwater, surface water, air releases, accidents
    - Identification of potentially affected communities
      - Facility based
    - Demographics of potentially affected communities;
    - Identifying other stress factors that may affect vulnerability in communities;
    - Information synthesis: assessment of “disproportional” impact;
    - Identification of potential preventive and mitigation strategies

Key General Issues-Challenges

- No standardized OSWER, Agency, or OMB guidance for EJ assessments in support of rule development;
- No clear determination of what represents a “disproportionate” impact;
- No clear determination of “susceptible populations”;
- No clearly established definition of “low income” (poverty level and below, 1.5 poverty level?)

Key General Issues-Challenges

- No clear determination of “proximity”;
- Community perceptions;
- Impacts to communities of concern and the waste management hierarchy: Reduce, Reuse, Recycle (WTE), and Disposal

Key Analytical Issues-Challenges

- Data quality and availability;
- Spatial and Temporal effects;
- Jurisdictional (RCRA v. CAA) conflicts and analytical consistency;
- Consideration of cost and benefit distributions across affected EJ communities;
- Accounting for population growth patterns;

Key Analytical Issues-Challenges

- Accounting for existing disproportionate impacts unique to communities of concern:
  - Chronic stress and multiple stress factors;
  - Cumulative risk, synergistic effects, and multimedia pathways
- Accrual of benefits v. costs, and discounting;
- Incorporation of LCA into EJ assessments

Improving EJ Rulemaking Assessments: Current OSWER Focus

- EJ community focused risk analyses:
  - Recognizing cumulative impacts, synergistic effects, and multiple sources;
- More comprehensive demographics analysis
  - Application of ratio analysis to demographics assessment;
    - Effective measure without defining disproportionate
- Marginal utility value of costs-benefits;
  - Costs-benefits adjusted for inequality aversion

Improving EJ Rulemaking Assessments: Current OSWER Focus

- Consideration of economic (e.g., jobs) vs. human health and environmental benefits;
- Consideration of cost-benefit distributions among minority and low-income communities (winners and losers within the EJ communities);
- Incorporating LCA findings into EJ rulemaking assessments;
- Improving analytical transparency and clarity

Conclusions

- OSWER responsibilities and corresponding EJ implications cut across all Agency Goals, and Program Offices;
- OSWER has a long history of EJ focus and EJ analyses in support of rulemakings;
- OSWER has a strong record of EJ accomplishments in support of rulemakings

Conclusions

- Current AA has a strong commitment to community outreach, communication, and improved EJ analyses in support of rulemakings;
- OSWER recognizes multiple issues and challenges affecting EJ assessments for rulemakings and is working to address these issues;
- Focused approach to improving analyses in the short term.

“Scales of Justice”

Scale, Scope, Specification, and Superfund

Douglas S. Noonan

School of Public Policy

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Research support was provided under National Science Foundation award #0433165, “Ecological Boundary-Setting in Mental and Geophysical Models.” All views (and errors) expressed are my own.

Outline

- Literature review
  - Overview
  - Meta analysis
- A demonstrative example (NPL siting)
- Methodological choices
  - Scale
  - Scope
  - Specification
    - Control variables
    - Linearity, spatial dependence
- Others issues
  - Proximity: areal concentration, hedonics
  - Data: micro-level, heterogeneity,

Summary of “Scales of Justice”

- Baden, Noonan, and Turaga. *Jrnl Env Plan Mgt* 2007.
  - EJ lit varies widely choice of scale, scope, hazard … and results
  - Results vary *across* & *within* studies
    - Demonstrate across using 110 empirical EJ studies
    - Demonstrate within using logits predicting NPL sites
  - Room for theoretical and regulatory guidance in conducting ‘conventional’ EJ analyses

Literature review

- In the large and varied EJ literature
  - We're interested in "conventional" empirical EJ analyses
    - Correlations of environmental hazards and 'special' groups
      - Sometimes correlations with amenities
      - Often partial correlations, with varying controls
      - Almost never at the micro-level or using actual exposures
      - Varying inferential techniques
    - Typically comparing means of Census variables near and far from hazards

Literature review

- Much attention paid in the literature to
  - scale (‘unit of analysis’ or ‘resolution’)
  - scope (‘geographic bounds’ or ‘scale’)
  - the **MAUP** (modifiable areal unit problem)
    - *Scale* (level of aggregation)
    - *Zoning* (gerrymandering)
- Researcher has a lot of latitude to make defensible choices
  - literature offers mixed recommendations

Literature review

- **Recommendations**:
  - Cutter et al. (1996), Dolinoy & Miranda (2004): use small scales
  - Hockman & Morris (1998): use larger zip-code scale
  - Krieg (1998b): use municipality scale to correct for tract size variance
  - Taquino et al. (2002): construct community areas (larger than zip code areas)
  - Bowen (2001): use smaller scales of analysis
  - Ringquist (2005): use disaggregated units or those matching sites' impact areas
    - the magnitude of inequity coefficients should increase with the level of aggregation

Table 1 (Noonan, *SSQ* 2008)

Panel A: Identified from Intuition or Theory		
Author	**Effect as Scale Increases**	**Comment**
Fotheringham & Wong (1991)	Correlations ↑	Bivariate only, with stable covariance
Fotheringham & Wong (1991)	? (uncertain)	Multivariate
Cutter et al. (1996)	Correlations ↑	
Hockman and Morris (1998)	Correlations ↑	
Sui (1999)	Correlations ↓	Due to scale effects
Sui (1999)	? (uncertain)	Due to zoning effects
Maantay (2002)	Reliability ↓	
Maantay (2002)	Accuracy ↓	
Dolinoy and Miranda (2004)	Exposures ↑	
Ringquist (2005)	Correlations ↑	Aggregation bias

Table 1 (Noonan, *SSQ* 2008)

Panel B: Identified from Empirical Analysis		
Author	**Effect as Scale Increases**	**Comment**
Ringquist (2005)	Mixed for race, no effect for income, effects ↓ for poverty	Meta-analysis of EJ studies
Anderton et al. (1994)	Correlations ↑	Multi-scale study (only tract vs. tract-plus-adjacent-tracts)
Glickman (1994)	Race correlations ↑, income correlations ↓	Multi-scale study
Cutter et al. (1996)	Correlations ↑	Multi-scale study
Sui (1999)	Race correlations ↑, income correlations ↓	Multi-scale study
Sheppard et al. (1999)	Income correlations ↑	Multi-scale study
Taquino et al. (2002)	Income correlations ↑, no effect for race	Multi-scale study
Dolinoy and Miranda (2004)	Mixed for income, race correlations ↓	Multi-scale study
Glickman (2004)	Race correlations ↑, income correlations ↑	Multi-scale study
Baden et al. (2007)	Mixed; generally race and income correlations ↓	Multi-scale, multi-scope study

Literature review

- Meta analysis: 110 empirical EJ studies
  - Chosen from highly cited (ISI) studies
  - Filtered for 'conventional' EJ studies with inferential statistics
  - Few studies show scale/scope sensitivities
- Much variation in scale, scope, and findings
  - Most scopes are national, state, or metropolitan
  - Most scales are Census units
  - Hazard types: (a) site location & (b) emissions, ambient, risk measures

Table 1A Physical Hazard Locations

	Scale	County		Zip Code		Tract+		Tract		Blockgroup	
		Significant?		Significant?		Significant?		Significant?		Significant?	
		Y	N	Y	N	Y	N	Y	N	Y	N
	National										
	% Black	36,45,52, 53,110	31,47,102	26,43,47, 64,87	46,48	3,4,33, 103	44	***5***,12,13,***32***, ***51***	2,3,4,44,80	8,49	33
	% Hispanic	45,52,53	31,102	26,43,87		3,4,33,44, 103		12,13,32, 44	2,3,4,5,51, 80	8	33
	Income	***31***,***36***,45, ***52***, ***53***	102,110	26,43,***48***,87	46,47	3,***4***,33,44, 103		2,***3***,***4***,***5***,12, ***13***,44	32,80	8,33	49
	State or Region										
	% Black	11,27,***28***, 68,74,85, 100,101	30,98,102	35,37,55, 61,87	45,98	82,85,93		85,93	3,28,32,98, 108	79,84,106, 107	28,98
	% Hispanic	68,100,101	102	55,61,87	45	82,93		93	3,32,108	79	
CERCLIS, CERLCIS NPL, RCRA TSDF or other hzds. site	Income	11,27,***28***, 30,74,***98***, 100,101	68,102	***35***,37,45, 61,87,***98***	55	82,93		93,108	3,28,32,98	28,79,84, 106,107	98
	City or Metro										
	% Black			58,60,***89***, 95,105	35,65	14,81,95	9,66,88,91	11,19,20, ***32***,42,56, ***57***, 70,81, 82,95,96	9,29,14,63, 88,91,94	29,54,56,57, 70,71,95	50,91
	% Hispanic			58,60,65, 95	89	9,81,88,***95***	14,91	9,20,32,57, 81,82,95	14,88,91, 94	57,71,95	50,91
	Income			35,58,60, 65,89,95		***9***,***88***,91,95	14,66,81	11,20,42, ***57***,***81***,82, ***88***,91,***94***, 95,96	9,14,29,32, 63	29,***54***,***57***,70, 71,91,95	

Table 1B Environmental Quality

	Scale	County		Zip Code		Tract+		Tract		Blockgroup	
		Significant?		Significant?		Significant?		Significant?		Significant?	
		Y	N	Y	N	Y	N	Y	N	Y	N
Emissions and ambient levels	National										
	% Black	1,31,***41***,53, 92	7	6,18,86,87		90					
	% Hispanic	***31***,53		86,87		***90***					
	Income	7,***31***,***41***,***53***, 92	1	***6***,***18***,86	87	90					
	State or Region										
	% Black	15,21,67,99, ***109***	16	87	6	17,69,72,83, 88	78	75	72	62,***86***	22,79
	% Hispanic	15	16,99	87		17,69,72,83, 88	78	72,75		62,86	22,79
	Income	21,25	15,16,67,99	87	6	17,69,***78***,83, 88		***75***	72	22,86	62,79
	City or Metro										
	% Black	38		34	59		15,39,97	23,24,73,76, 77,88,104	7,10,34,39, 42,82,99	24,34,***40***	
	% Hispanic				59	39	15,97	39,76,77,88	10,82,99		
	Income	38		***34***,59		39,97	15	7,10,23,24, 73,***77***,82,***88***, 104	34,39,42,76, 99	24	34,40

Meta analysis

- Many combinations
  - 35 of 110 had at least 1 national-level analysis
  - most are along main diagonal
- Injustice *usually* found (96 of 110)
  - smaller scales tend to show more insignificance
  - scale & significance are not independent in Table 1a

Meta analysis

- Mostly reduced-form models
- Mostly static models (92 of 110)
- Mostly single-scale estimates (91 of 110)
  - Only 1 study did dynamic, multi-scale
- Mostly noxious sites or their emissions, not broader enviro quality (94 of 110)
- Most use control variables (86 of 110)

An example

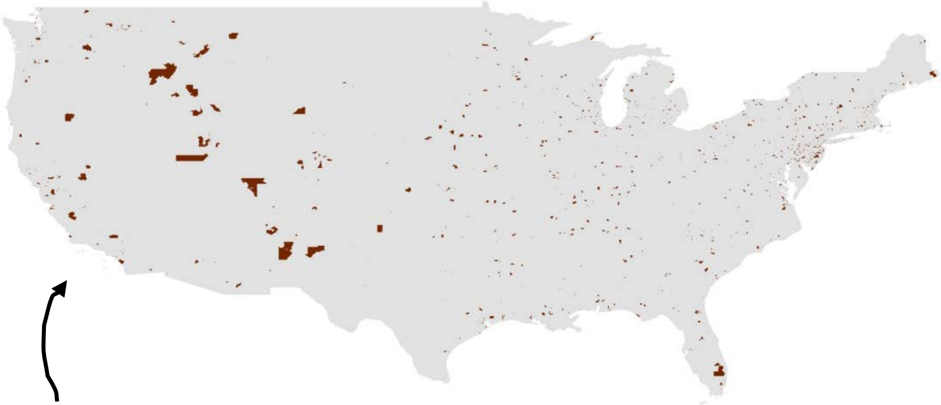
- A ‘conventional’ example, using National Priorities List
  - 1,633 sites on NPL circa 2002
- Use only publicly available data
  - Census*
  - CERCLIS
- logit predicting proximity to NPL sites using demographic factors
  - does areal unit “contain” a site?

Methodological choices

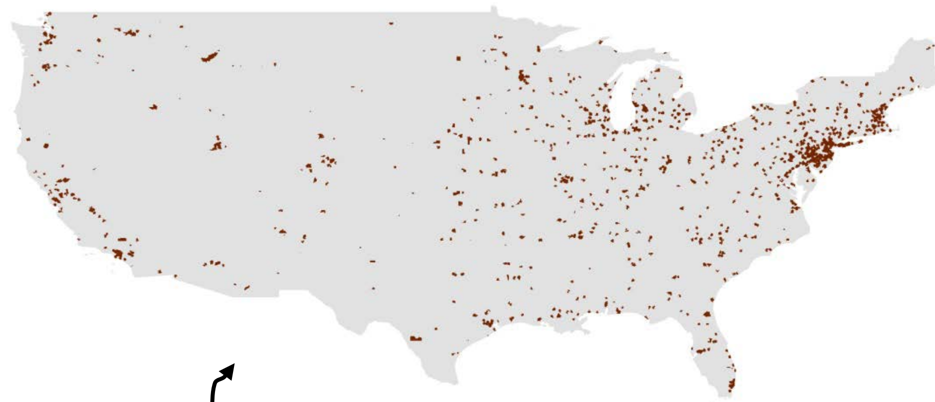
- **Scale**
  - County
  - Zip code
  - Tract
  - Block group

  - Others?
    - “tract+”, communities, etc.
    - individual or household

Proximity definitions

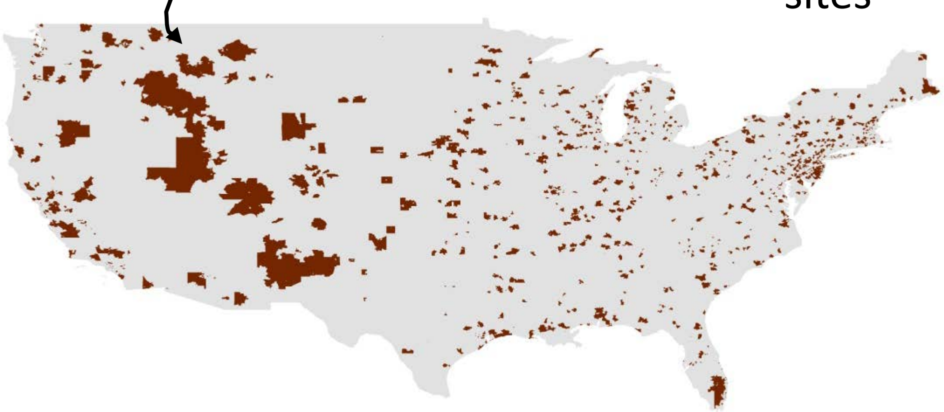


block-groups containing sites



50%+ of block-group's area within 6 miles of site

block-groups or adjacent ones containing sites



Methodological choices

- **Scope**
  - National
  - State
  - County
  - Others?
    - MSA, region, etc.
    - temporal scope

Methodological choices

- **Specification**
  1. Control variables
     - No controls (bivariate)

	Unit of analysis:							
	County		Zip Code		Tract		Block Group	
with NPL site?	Y	N	Y	N	Y	N	Y	N
% black	8.9	8.7	9.1	7.1*	10.0	13.7*	10.0	13.2*
% Hispanic	7.9	8.5	9.3	6.4*	9.4	12.7*	9.0	12.3*
Income ($1000s)	39.7	33.4*	45.5	39.8*	44.6	43.8	44.7	44.3

* significant at 1%

Methodological choices

- Specification
  1. Control variables
     - No controls (bivariate)
     - “standard” controls
       - density, population, urbanicity
       - state FEs?
       - employment? industry?

Methodological choices

- Specification
  1. Control variables
     - No controls (bivariate)
     - “standard” controls
       - density, population, urbanicity
       - state FEs?
       - employment? industry? (see Noonan et al. *EM* 2009)

National-scope results

	County Coef.	Zip Code Coef.	Tract Coef.	Block Group Coef.
Black	0.9554*	0.7307***	0.7417***	0.8349***
	(1.67)	(3.15)	(4.27)	(5.44)
Hispanic	-1.2679*	0.834***	1.2804***	1.2103***
	(1.75)	(2.86)	(5.66)	(5.91)
Income	0.0098	-0.0015	-0.0099***	-0.0102***
	(1.25)	(0.72)	(5.55)	(6.61)
Density	-491.2545***	-580.4366***	-1045.179***	-1318.672***
	(3.41)	(11.16)	(20.37)	(23.77)
Population	0.0008***	0.0318***	0.1044***	0.2268***
	(2.82)	(12.35)	(9.04)	(11.85)
Urbanicity	2.6761***	1.2516***	0.3749***	0.4447***
	(11.1)	(10.82)	(4.25)	(5.69)
MSA	0.3883***	0.3614***	0.2885***	0.4372***
	(2.97)	(3.75)	(3.76)	(6.06)
N	3178	31627	65744	209648
LR $\chi^2(7)$	375.9	694.01	1032.91	1559.05
Prob > χ^2	0	0	0	0
State fixed-effects	48	51	51	51

Summary results

Table 6 Summary of Scale and Scope Effects on EJ Variables

		County	Zip Code	Tract	Block Group
Nation	% Black	+*	+***	+***	+***
	% Hispanic	–*	+***	+***	+***
	Income	0	0	–***	–***
California	% Black	0	0	+***	+***
	% Hispanic	0	0	+***	+***
	Income	0	0	0	0
L.A. County	% Black	n/a	0	0	0
	% Hispanic	n/a	0	+*	+***
	Income	n/a	0	–**	–**

* significant at 10%; ** significant at 5%; *** significant at 1%

Methodological choices

- Specification
  1. Control variables
     - No controls (bivariate)
     - "standard" controls
       - density, population, urbanicity
       - state FEs?
       - employment? industry? (see Noonan et al. *EM* 2009)
     - BG scale, national scope, alternative controls (*SSQ*)

Sensitivity to controls

model	dependent variable	% White coeff.	Income coeff.	controls included	N
1.	in BG	0.8934***	-0.0022*		205633
2.	in BG	-0.6280***	0.0016	density, population, MSAdum	205625
3.	in BG	-1.1691***	-0.0079***	density, population, MSAdum, State FE	205625
4.	in BG	-0.8129***	0.0005	density, population, MSA FE	187705
5.	in BG	-1.1132***	-0.0093***	density, population, State FE, MSA FE	187705

Methodological choices

- Specification
  2. Linearity, spatial dependence
     - Looked at an SAR LPM for state/local scopes
       - (computationally) infeasible for national scope
     - significant spatial correlation in errors (at non-county scales) for CA scope
     - controlling for this via SAR minimally affects results
       - typically, we might expect clustering to bias standard errors down
       - models incorporating spatial dependence in EJ analysis are increasingly common; still the exception

Sidebar: "Appropriate" scale

Sample	Variable	County	Zip Code	Tract	Block Group
	Black	.901	.846***	.891***	.870***
Full	Hispanic	-1.393*	.845***	1.297***	1.158***
	Income	.015	-.002	-.010***	-.010***
	Black	.623	.336	1.058***	.692**
Air	Hispanic	-3.049**	1.459***	1.816***	.872*
	Income	.010	.001	-.008**	-.005
	Black	.761	.743***	.943***	.627***
Water	Hispanic	-1.739**	.882***	1.215***	.367
	Income	.010	-.002	-.011***	-.007***
	Black	.598	0.904***	.939***	.670***
Soil	Hispanic	-2.336**	.864***	1.272***	.451*
	Income	.007	-0.002	-.011***	-.006***
	Black	1.906**	.952**	1.081***	.795***
Other	Hispanic	-1.287	1.859***	1.679***	1.029**
	Income	.024**	.002	-.010***	-.001

* significant at 10%; ** significant at 5%; *** significant at 1%

Noonan et al. (*EM* 2009)

Other issues

- Proximity:
  1. areal concentration
     - unit's centroid within *x*-mile buffer
     - 50%+ of unit's area within *x*-mile buffer
  2. Hedonics
     - review of NPL hedonics suggests a 6-mile buffer as upper-bound

     - examples from *SSQ* 2008

model	dependent variable	% White coeff.	Income coeff.	controls included	N
6.	BG within 1 mi.	-0.6600***	-0.0072***	density, population, MSAdum, State FE	204582
7.	BG within 6 mi.	-1.3695***	0.0039***	density, population, MSAdum, State FE	205625
8.	50% of BG area within 1 mi.	-0.6650***	-0.0079***	density, population, MSAdum, State FE	204582
9.	50% of BG area within 6 mi.	-1.0865***	-0.0000	density, population, MSAdum, State FE	205625
10.	50% of BG area within 1 mi. of deletion	-0.3787	-0.0125***	density in 1990, population in 1990, MSAdum, State FE	1902
11.	50% of BG area within 6 mi. of deletion	-0.4565***	-0.0169***	density in 1990, population in 1990, MSAdum, State FE	31371

Other issues

- Data
  - micro-level studies rare
  - heterogeneity, spatial regimes rarely addressed
  - exposure, trade-offs rarely incorporated into analysis
- Counterfactual … identifying impact of what?
  - just states or just policies?
- Generalizable ‘*process*’ EJ studies still rare

Conclusions

- Ample room for arbitrary choices by EJ analysts
  - Sensitivity checks are rare
  - Spatial problems (MAUP, SAR, etc.) common
  - Typically reduced-form with various controls

    - Sophistication is improving…

- Limited guidance on scale, scope, specification, counterfactuals
  - *appropriate* "unit that is to be chosen so as to not artificially dilute or inflate the affected minority population" (EO 12898)

Comments on Baden, Noonan, and Turaga and on Proximity Based Approaches to measuring EJ

Hilary Sigman

Rutgers, The State University of New Jersey

EPA Workshop on Analysis of Environmental Justice

June 9-10, 2010

"If you can read this, you're too close"

Baden, Noonan, and Turaga (BNT)

- Interesting, multifaceted approach
- Compare analysis of EJ that uses as "unit of observation" the county, zipcode, Census tract and Census block group
- Survey of prior literature
  - Paper concludes that larger areas have a higher frequency of statistically significant EJ effects
  - Vintage effects possible --- now easier to map to finer Census-defined areas, so these studies are more recent
- Own analysis on location of NPL sites
  - Concludes that finer categories yield more statistically significant coefficients on race/ethnicity/income variables

Area should depend interests

- Health effects of exposure
  - Direct contact
    - Depends on social patterns
  - Contact through contaminated ground or surface water (or costs of avoidance)
    - Depends on hydrology
- Other harms
  - Urban blight (externalities for communities)
    - Depends on perceived association of community with site
- Questions of procedural justice

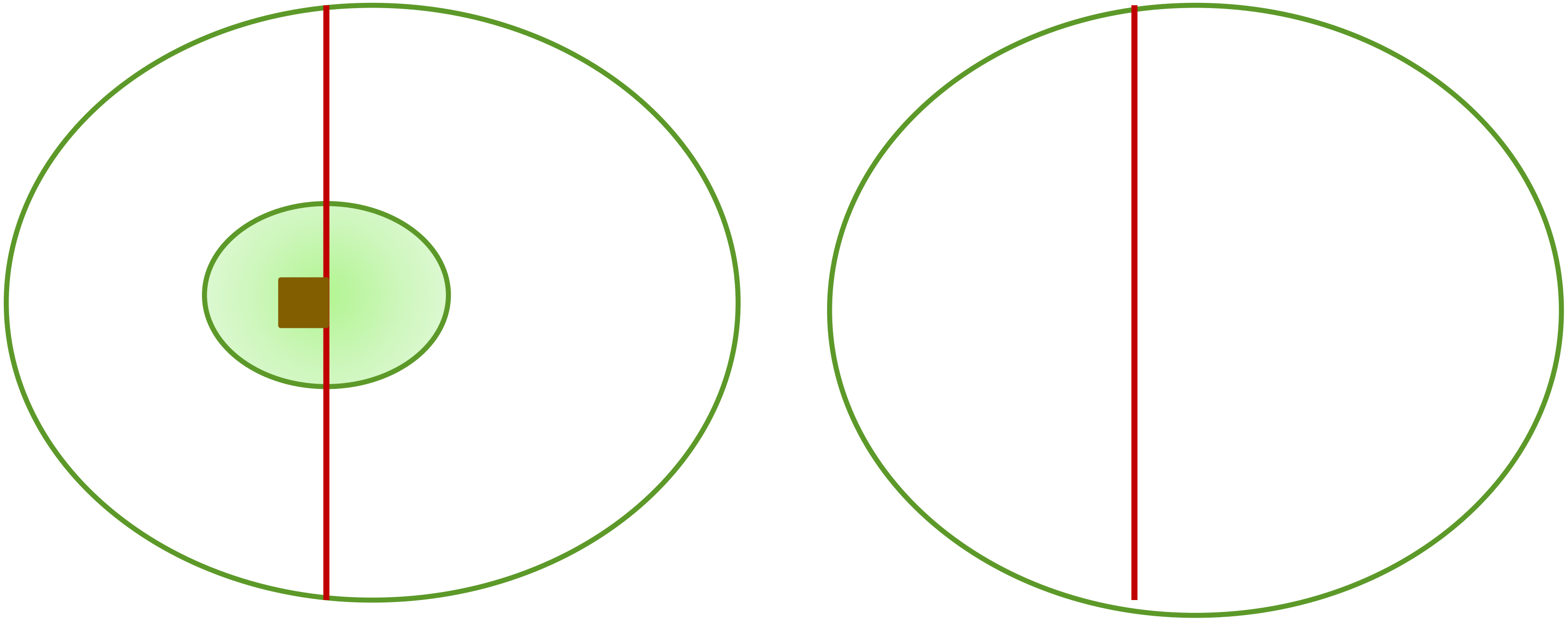
Area for analysis

- Not only a comparison between large and small areas:
  - County, zipcode defined administratively and historically
  - Census units are designed to reflect communities and geographically meaningful boundaries

Area for analysis

- Smaller areas likely to produce higher point estimates and thus greater statistical significance
  - When likely exposure in increasing in proximity, effects are stronger nearby
- BNT's analysis of NPL sites is consistent with this view
- Border effects are a potential problem
  - Probably best solved with a true proximity approach (throw in the adjacent Census tract), rather than moving to zipcode or county

Contaminated site on border. Consider as 4 observations or 2?



Too many controls?

- Econometric literature has focused on looking for "causal" relationships, thus conditional expectations
  - Many explanatory variables
  - Fixed effects
- For many distributional questions, just need differences in means or distributions across groups
  - Fixed effects especially suspect

USES OF OTHER EXPLANATORY VARIABLES

1. Looking at effects of policy may require some controls to address pre-policy "baseline"
   - E.g., to assess effects of NPL listing, need to control for eligible sites
   - None of the other explanatory variables would be socioeconomic
2. Establish some procedural problem
   - E.g., if NPL listing process doesn't some communities adequate voice

Translating proximity into welfare

Several hard steps to determine impacts of proximity to a site with reduced contamination.

- From proximity to exposure
- From exposure to health and other effects
- Valuation of effects
  - E.g., harms from lost work days
- Other economic adjustments
  - Response of rents

Thinking about full distribution

- Most proximity research treats exposure as discrete
  - Is household within the same census tract?
- Can look at differences in distribution, not just central tendency
  - E.g., likelihood of living with 100 m, 1 km, 10 km, etc. by income or race
- Might allow different sorts of "exposures" to be considered for same analysis (e.g., direct contact likely very local, "blight" broader)
- Use hedonic models to derive boundary or weight distances? (approaches valuation)

Some Thoughts

- Proximity-based methods are convenient and transparent
  - Valuable to avoid black box exposure models
  - Peer-review process may push toward complexity
  - Technology (GIS) likely to make this ever more attractive
- Almost all the literature suggests that EJ communities are situated to benefit from cleanup programs
  - Caveat would be gentrification problem
  - Valuable to document this distribution
  - But not a fundamental conflict between EPA's goals in this area and EJ

Office of Chemical Safety and Pollution Prevention (OCSPP)

Highlighted Regulatory Activity: The Office of Pollution Prevention and Toxics (OPPT) Perspective

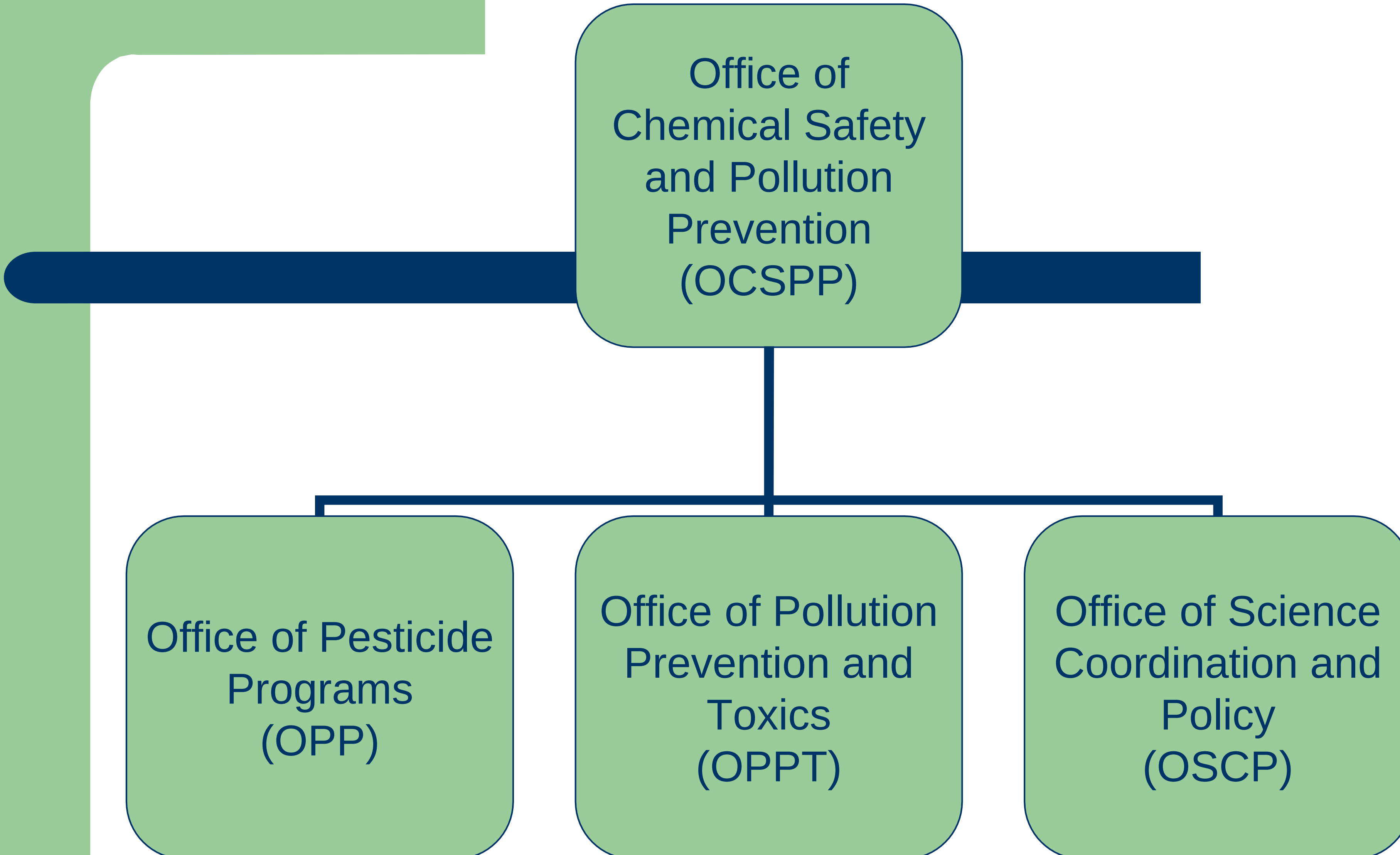
By Stephanie Suazo

Workshop on Analytical Methods for Assessing the Environmental Justice Implications of Environmental Regulations

Mathematical Association of America Carriage House Conference Center

Washington, D.C.

June 9-10, 2010



U.S. EPA, Office of Pollution Prevention and Toxics (OPPT)

Office of Pollution Prevention and Toxics (OPPT)

- Manages programs under the Toxic Substances Control Act (TSCA) of 1976 and the Pollution Prevention Act (PPA) of 1990.
- Evaluates new chemicals and their risks, and finds ways to prevent or reduce pollution before it gets into the environment.
- Addresses pollution prevention, risk assessment, hazard and exposure assessment and characterization, and risk management for existing chemicals and mixtures already listed on the TSCA Inventory.
- Manages variety of environmental stewardship programs that encourage companies to reduce and prevent pollution.

Goals

- Promoting pollution prevention as the guiding principle for controlling industrial pollution.
- Promoting safer chemicals through a combination of regulatory and voluntary efforts.
- Promoting risk reduction to minimize exposure to existing substances such as lead, asbestos, dioxin, and polychlorinated biphenyls (PCBs).
- Promoting public understanding of risks by providing understandable, accessible and complete information on chemical risks to the broadest audience possible.

Toxic Substances Control Act (TSCA)

- Goal is to ensure that chemicals manufactured, imported, processed, or distributed in commerce, or used or disposed of in the United States do not pose any unreasonable risks to human health or the environment.
- Covers production and distribution of commercial and industrial chemicals.
- Under TSCA, EPA has established reporting, record-keeping, testing, and control-related requirements for new and existing chemicals.
- TSCA Chemical Substance Inventory first established in 1979 and lists all existing chemicals produced, processed or imported for commercial purposes in the U.S.

Pollution Prevention Act (PPA)

- Addresses Pollution Prevention (P2) – ‘source reduction’ and other practices that reduce or eliminate the creation of pollutants through:
  – Increased efficiency in the use of raw materials, energy, water, or other resources;
  – Protection of natural resources by conservation.

Programs

- New chemicals:
  - Assess, test, and manage identified potential risks from chemicals new to commerce.
- Existing chemicals:
  - Collect data, assess chemicals, and conduct risk management actions for chemicals identified as posing a risk to human health or the environment.
- National Chemicals Program:
  - Lead, mercury, asbestos, and polychlorinated biphenyls (PCBs) risk management programs.
- Pollution Prevention:
  - Design for the Environment (DfE), Green Chemistry, Green Suppliers Network, and Environmentally Preferable Purchasing (EPP) programs.

Enhancing EPA's Chemical Management Program

- Administrator Priority:
  - "More than 30 years after Congress enacted the Toxic Substances Control Act, it is clear that we are not doing an adequate job of assessing and managing the risks of chemicals in consumer products, the workplace and the environment. It is now time to revise and strengthen EPA's chemicals management and risk assessment programs."

EPA Administrator Lisa P. Jackson, January 23, 2009

Chemical Management Program: Chemical Action Plans

- Range of possible actions for chemicals in the Action Plans include:
  - Section 5(b)(4) - Authority to list chemicals of concern.
  - Section 6 - Actions to limit manufacture/import/use of chemicals.
  - Section 5 - Significant New Use Rules (SNURs).
  - Section 4 - Test rules.
  - Design for the Environment (DfE)/Voluntary efforts.

Environmental Justice Analysis in Actions

- Multimedia exposure:
  - Consumer exposure through products usage.
  - Worker/occupational exposure.
  - General population exposure through environmental releases.
  - Routes: Air, water, land, household products.
  - Coordination across Agency and across disciplines.

EJ Analysis and Consumer Products

- Represents the biggest gap in knowledge.
  - Need to identify the chemicals used in products and the consumption patterns.
- Example – which products contain isocyanates and which uses may result in exposure?
  - Spray foams, adhesives, personal care products – all have different exposure scenarios.

EJ Analysis and Occupational Exposure

- New Chemicals Program estimates the potential exposure to workers and may require exposure controls when appropriate.

EJ Analysis and General Population Exposure

- Releases of chemicals to air, water, and land modeled through the Internet Geographic Exposure Model (IGEMS).
  - Data sources include the Toxics Release Inventory (TRI) and other types of monitoring data.
- Example – application of sludge containing PFCs in Decatur, GA.

Challenges for EJ Analysis

- Scale of regulations:
  - National vs. Regional.
- Data gaps:
  - Chemicals in consumer products.
  - Existing chemicals vs. New chemicals.
- Statute limitations and jurisdictional issues:
  - Downstream processors and end users of manufactured chemicals.
  - Imports.
  - TSCA Reform.

Contact Information

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Abt Associates

Environmental Justice Implications of Revising the Section 403 Residential Lead Dust Hazard Standards:

A focus on methods with EJ considerations

Matt LaPenta, Abt Associates Inc.

June 10, 2010

From Insight to Impact – Worldwide

Abt Associates Inc.

Background

- EPA petitioned to lower lead dust hazard standards
  - 40 µg/ft^2 to 10 µg/ft^2 for floors*
  - 250 µg/ft^2 to 100 µg/ft^2 for window sills
- Even low exposures have negative cognitive effects

Purpose of Paper

- Method for evaluating EJ implications of revising lead dust hazard standards
- IQ loss avoided is metric for comparison
- Paper considers populations by poverty status
- Methods applicable to other EJ populations

Summary of Analysis Steps

1. Determine baseline and policy floor dust levels (µg/ft^2)
2. Convert lead dust levels (µg/ft^2) to concentrations (µg/g)
3. Predict lifetime average blood lead levels using IEUBK model
4. Estimate IQ changes using piecewise linear concentration response function developed by Lanphear et al. (2005)
5. Define intervention scenarios and estimate results by EJ population

Components of an EJ Analysis

- Baseline: percentage of EJ population living where hazards are present
  - Preliminary estimates in current draft
  - Estimated using NHANES data
- Policy Effects: likelihood that a hazard is mitigated for a given EJ population
  - Analysis for future draft
  - Will consider some common EJ factors

Baseline Scenario

- Paper presents preliminary results for scenario where floor dust levels meet standard in **ALL** households
- Scenario not realistic because testing for hazards not performed regularly
- Frequency of testing for hazards and hazard elimination varies by EJ population

Some Preliminary Baseline Results

- Compare Scenarios: 10 µg/ft^2 versus 40 µg/ft^2 standard achieved in **ALL** households
  - Mean IQ loss avoided for **ALL** children:
    - 0.027 for children near poverty
    - 0.005 for children above poverty
- Selected limitations:
  - Survey representative of population, not housing stock
  - Sample sizes of affected populations are small

Policy Effects: Reasons Why Hazards are Mitigated

- Response to elevated blood lead
- HUD Lead Safe Housing Rule compliance
- Result of EPA LRRP Program (assuming Clearance Rule becomes a final rule)

Some Common EJ Factors

- EJ populations may differ according to:
  - Geography
  - Consumer behavior and economic factors
  - Physical behaviors affecting exposure risk (e.g., more hand to mouth activity in children)
  - Physiology (e.g., age can affect susceptibility to adverse health effects)

Geographic Variation

- Blood lead screening varies by state
- Estimate frequency of required screening by EJ population:
  - Estimate EJ populations by state
  - Apply state requirements for screening

Consumer Behaviors and Economic Factors

- Account for additional factors in blood lead screening frequencies:
  - Medicaid has specific screening requirements
  - Health care access my vary
    - Frequency of missing required screenings
    - Frequency of screenings where not required

Example: Geographic Variation

- 80% live where screening required at age one
  - 50% have Medicaid (screening at age one and two)
- 20% live where annual screening is required
- Estimate:
  - 100% screened at age one
  - 60% screened at age two
  - 20% screened annually after age two

Highlights

- Baseline effects:
  - Used household level survey data
- Policy effects:
  - Can use geographic factors to estimate how blood lead screening varies by EJ population
  - Can use household level survey data to estimate frequency of Lead Safe Housing Rule and Clearance Rule events by EJ population

Abt

Abt Associates Inc.

Overview

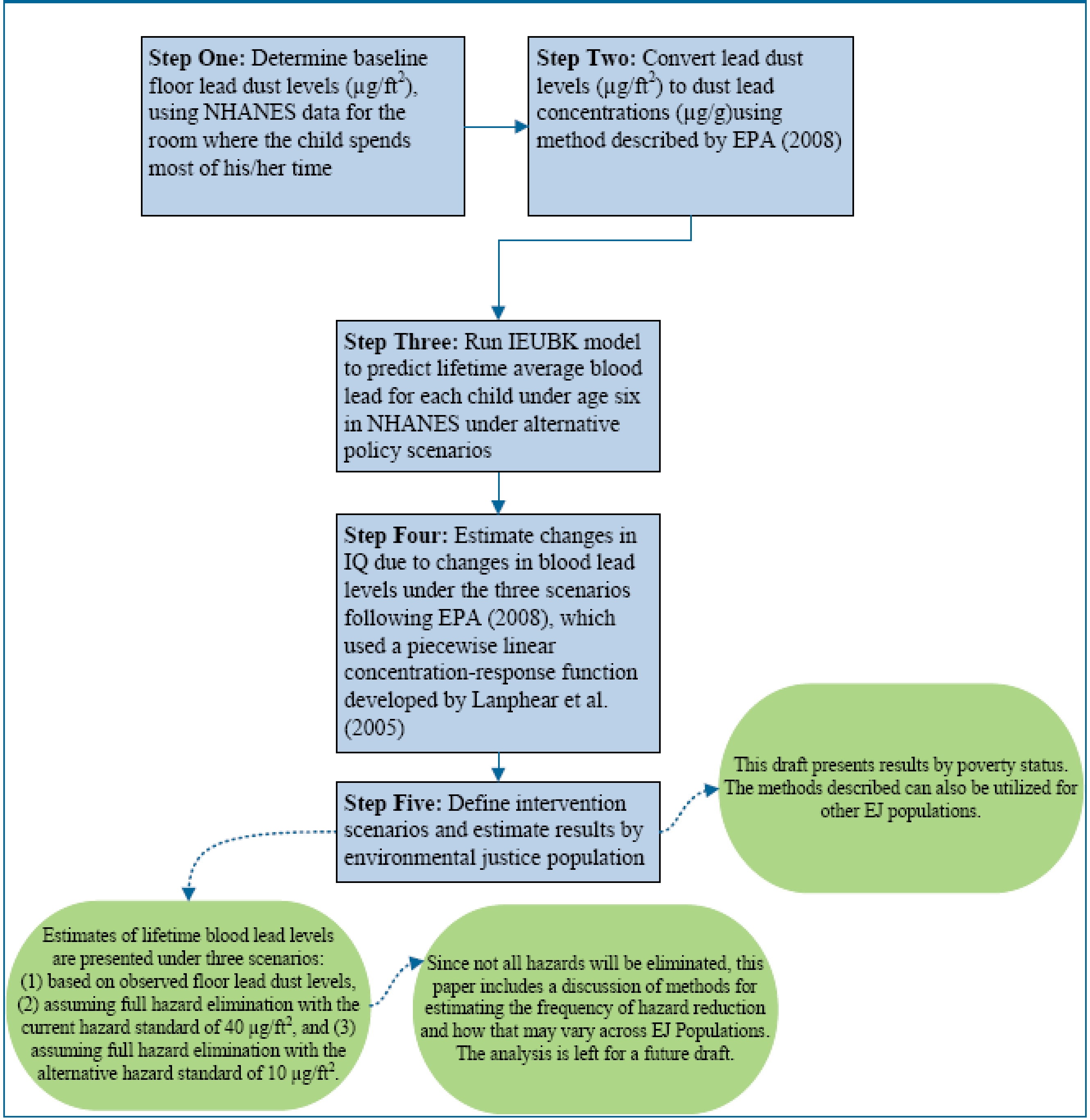
- Analytic questions
- The Method
- Advantages
- Limitations
- Data needs and access
- Alternative approaches
- Other questions

Stated analytic questions

- How will the revised household lead dust standards under TSCA affect the blood lead levels of children under the age of six in different EJ populations (or the extent to which exposure to lead dust hazards varies across EJ populations)
- How will those reductions on blood lead levels (from >40 μg/g to <40 μg/g and from >10 μg/g to <10 μg/g) affect the children's cognitive abilities?

The Method

Figure 1: Primary Analysis Steps



Advantages

- NHANES is robust sample for converting floor dust lead levels (µg/sq-ft) to dust lead concentrations (µg/g), and in turn, to blood lead concentrations (µg/g)
- Integrated Exposure Uptake Biokinetic (IEUBK) Model appears to be appropriate to consideration of chronic exposures (and appropriately sensitive to modeling exposure reductions over time (avoids "noise" of acute exposures)
- Utilizes multinational, pooled sample of 7 studies (n=1,333) to estimate health impacts in relation to blood lead concentrations (Lanphear et al. 2005)
- Utilizes multiple data sources

Disadvantages/Limitations

- Utilizes multiple data sources – adds uncertainty
- Complexity adds potential for error (µg/g vs. µg/L)
- Robustness and significance (n=94)
- EJ populations of concern not identified
- Near poverty cut-off at ≤125% of poverty level (n=64 and 18 at near poverty and above poverty, respectively)

Data and research needs

- Is the relationship between floor dust levels and blood concentrations from the NHANES sample (n=5,000) consistent with those of EPA's *The Approach Used for Estimating Changes in Children's IQ from Lead Dust Generated during Renovation, Repair, and Painting in Residences and Child-occupied Facilities* (based on U.S. Department of Housing and Urban Development's (HUD) National Survey of Lead-Based Paint in Housing (stratified n=400)
- Improving data quality more generally

Alternative approaches

- Examine non-compliance in stratified sample (owner- and renter-occupied housing)
- Consider local agency implementation capacity
- Support policy advocacy for hazard reduction – guidance, technical assistance, empowerment, community-based research

Other questions and points

- Following Post et al. (2010), do the reductions matter?
- Are there other neuro-developmental concerns not assessed?
- Do reductions in households with baseline below standard matter?
- Standards are protective but do not equate to zero risk
- How to capture lead exposure risks that matter to parents and community members?
- Distinguishing between predictive (prospective) vs. retrospective (evaluatory) distributive benefit analyses

Other questions and points

- Following Post et al. (2010), do the reductions matter?
- Is the assumption of EPA (2008)* of a linear dose-response appropriate?
- What about the Pb levels <10 µg/sq-ft? Quoting the EPA's 2006 Air Quality Criteria Document (AQCD) for Lead, Lapenta notes "that recent studies examining the Pb associations with intellectual attainment and academic performance in children with low Pb exposures have consistently observed effects at blood Pb concentrations below 10 µg/dL.
- Are there other developmental concerns not captured?
- Standards are protective but may not equate to zero risk
- Do reductions in households with baseline below standard matter?

** The Approach Used for Estimating Changes in Children's IQ from Lead Dust Generated during Renovation, Repair, and Painting in Residences and Child-occupied Facilities*

EJSEAT:
A Screening Tool for EJ Concerns

Analytical Methods for Assessing the Environmental Justice Implications of National Environmental Regulations

June 10, 2010

Andrew Schulman, Office of Enforcement and Compliance Assurance
US EPA

Outline

- What is EJSEAT?
- Data and Scoring
- Strengths and Limitations
- Current Status
- NEJAC Recommendations

United States Environmental Protection Agency

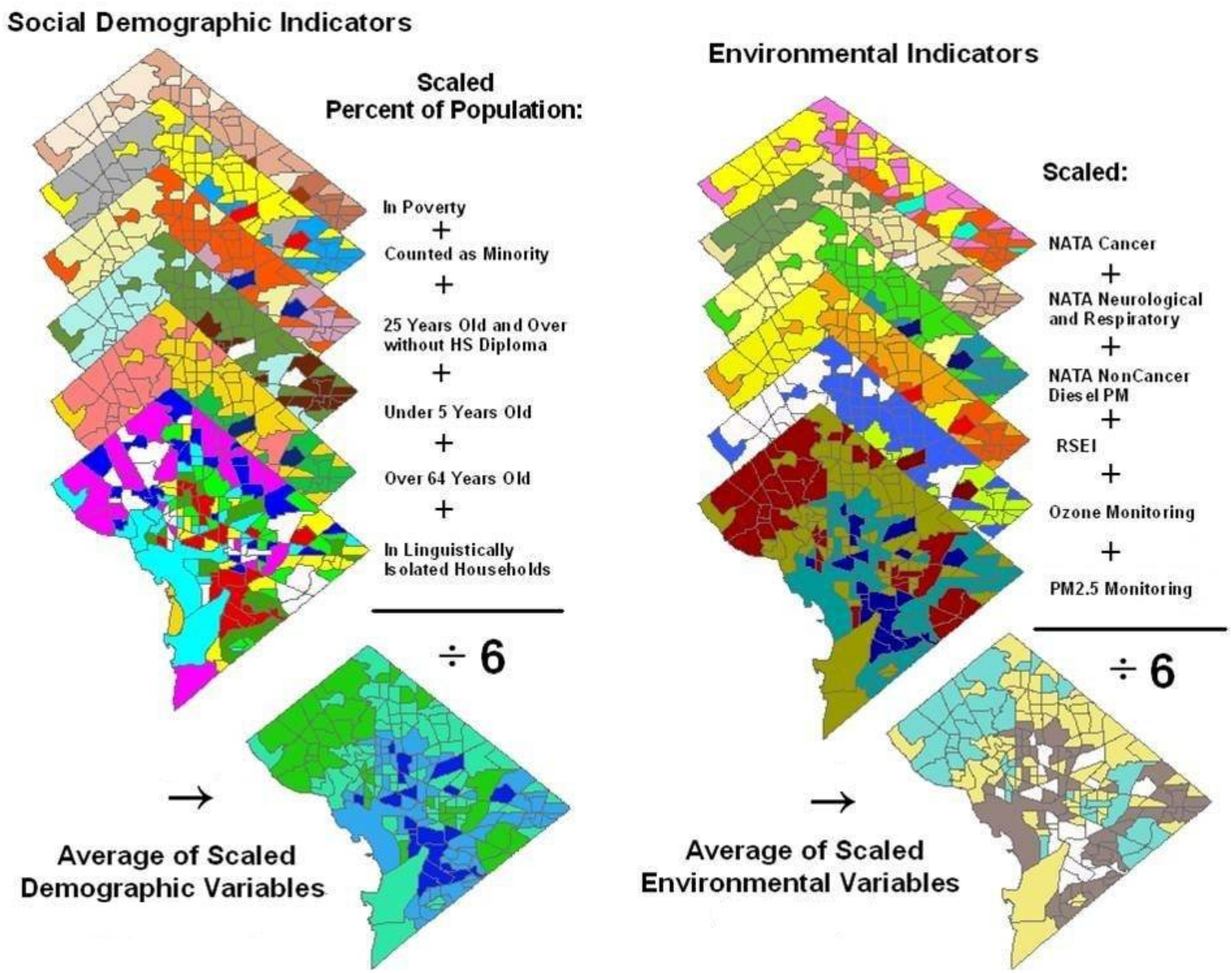
What is EJSEAT?

Environmental Justice Strategic Enforcement Assessment Tool

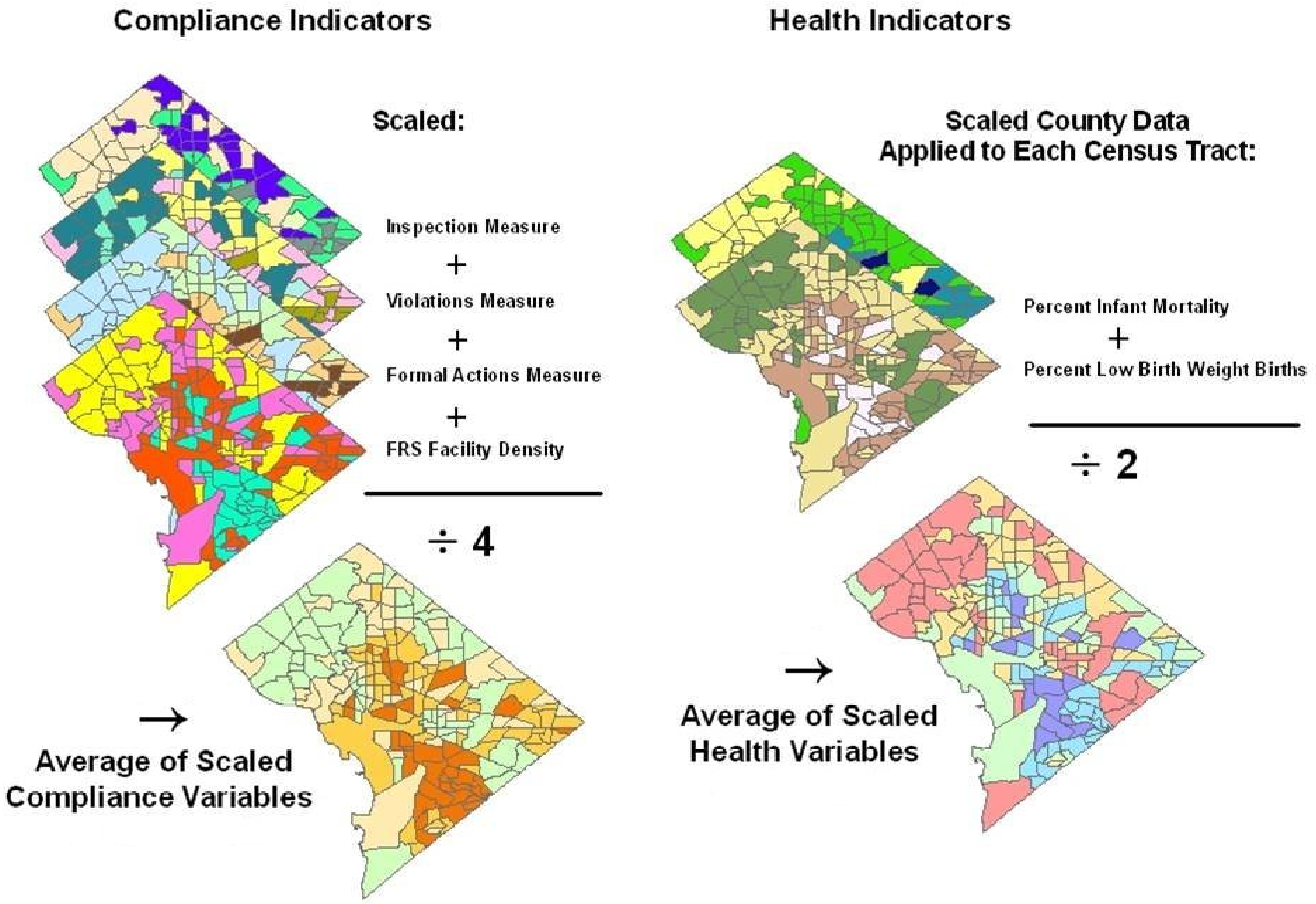
A screening level measure that:

- quantitatively identifies areas with potential EJ concerns
- uses environmental, health, demographic and enforcement indicators
- provides national consistency when prioritizing and reporting on enforcement activities with respect to EJ concerns

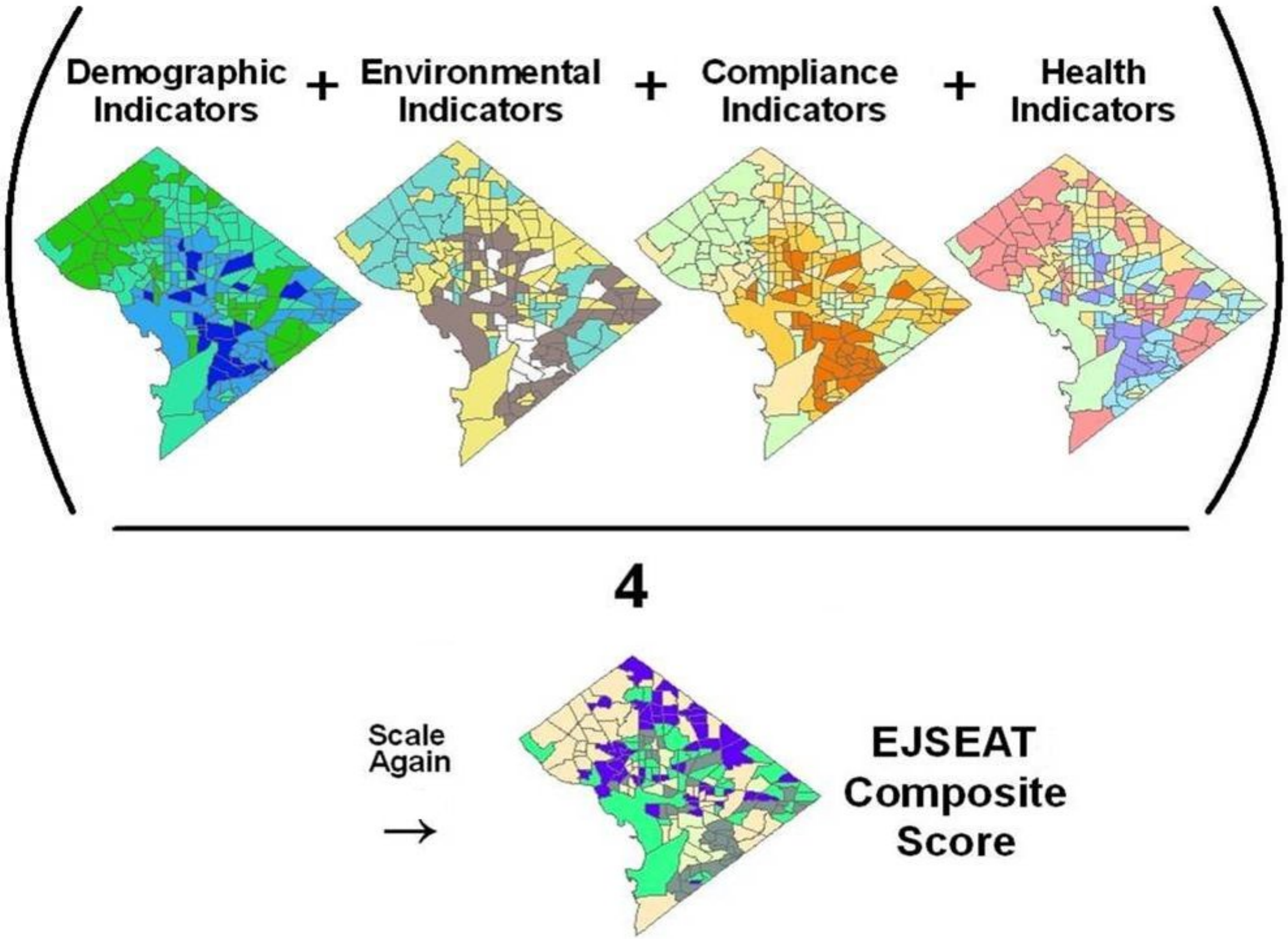
Data and Scoring



Data and Scoring



Data and Scoring



Strengths

- Nationally consistent screening tool
- Combines a wider range of data than EPA has traditionally used for EJ analyses
- Useful for retrospective reporting and prioritization of enforcement efforts, within its limitations

Limitations

For prioritizing enforcement efforts, EJSEAT should only be used in combination with other available data:

- Doesn't capture communities smaller than Census tracts (about 4,000 people)
- May not capture tribal communities
- Environmental indicators are mostly air-related
- Health data are only available at County level

United States Environmental Protection Agency

Status

- Available in draft for OECA internal use only
- Internal and external peer reviews completed
- Regional testing completed
- NEJAC draft evaluation delivered Jan 2010
- Being piloted for prioritizing enforcement activities in Region 3, Region 5, hazardous waste (OSRE)
- Further development and deployment is under OECA review

United States Environmental Protection Agency

NEJAC Recommendations - Technical

- Modify and improve some of existing indicators
- Modify categorization of indicators from 4 to 2 categories to address overweighting
- Modify scoring method
- Add more indicators of environmental burden and social vulnerability

NEJAC Recommendations - Policy

- Improve clarity in planned uses and transparency through demonstration projects with public participation and stakeholder input
  - If EJSEAT will be used for prospective planning, include a public comment step
  - Publish maps of EJSEAT scores by state
- Develop training program to avoid overemphasis on scores and enable EPA staff to proactively avoid/address false positives and false negatives

Environmental Justice and the Implementation of Regulations: Thoughts for Discussion

Ron Shadbegian, USEPA

National Center for Environmental Economics

Implementation of Regulations

- Many considerations
- Not always fully addressed in an RIA
- Some standard assumptions may not always hold (e.g. 100% compliance)
- Implementation is likely to have significant effects on vulnerable communities
- Not a lot of academic literature on the subject

Implementation considerations

- Environmental Federalism:
  - Federal, state, local authority
- Permitting
- Compliance
- Enforcement
- Spatial dimension
- Permit Trading
- Timing of Implementation
- Technological change

EJ and implementation

- For each implementation consideration there may be things which we can and should give special attention to
- Intended to stimulate discussion
- EPA is just beginning to think about some of these issues
- Often we hear that EJ is not an issue when benefits are large

Environmental Federalism

- Implementation, including enforcement, of regulations often happens at the state or local level.
- Some states implement stricter regulations than imposed at the federal level
- What is the evidence on the “strictness” of regulations across states or other levels of government? Are there predictable patterns?

Permitting

- Does the permitting process consider existing facilities?
  - Can be important if we consider multiple and cumulative impacts
- Would the permitting process create new disparities (e.g., placement in vulnerable communities)?
- What is the process of engaging communities in the permitting process?

Compliance

- In RIAs EPA typically assumes 100% compliance with regulations
- Are other assumptions more reasonable?
- What are the implications of assuming less than perfect compliance?
- Is compliance determined by the characteristics of communities?

Enforcement

- Most enforcement decisions are made at the state rather than the Federal-level.
- Existing research demonstrates the connection between enforcement and plant characteristics, including past compliance.
- A fruitful area of research is examining the relationship between enforcement and the characteristics of communities.

Spatial issues

- Rules can be limited with specific geographic focus
  - Non-attainment areas
  - Regional dimensions

- Consideration of the characteristics of communities is important

Permit Trading

- Many potential EJ issues can arise with regard to permit trading
- Inequitable distribution of benefits
- Hot spots
- Lack of a voice at the table

Timing of Implementation

- Many EPA rules and regulations do not become effective for many years after they are promulgated
- Especially true with NAAQS (5-10 years)
- EPA needs to be aware that the socioeconomic characteristics of communities evolve over time

Technological change

- Many argue that technological change is an important source of emission reductions in the long-run
- The determinants of induced technological change are not well known
- We are not sure if EJ plays a role here, but it may be worth studying the relationship between induced technological change and the characteristics of communities it occurs in

Concluding Thoughts

- Like most of the issues discussed at this workshop EPA is working hard to determine the most appropriate analytical tools and making sure we are asking the right questions
- EJ and implementation is in the nascent stages
- However we know that much of the concerns at the community level surround the implementation of rules
- Welcome your thoughts and comments

Heterogeneity in Environmental Quality: Environmental Justice Concerns

Randall Walsh
University of Pittsburgh

Framework

Process Equity (current regs)

Vs.

Exposure Equity

Small Print:

The vast majority of you understand far more about the regulatory process than do I.

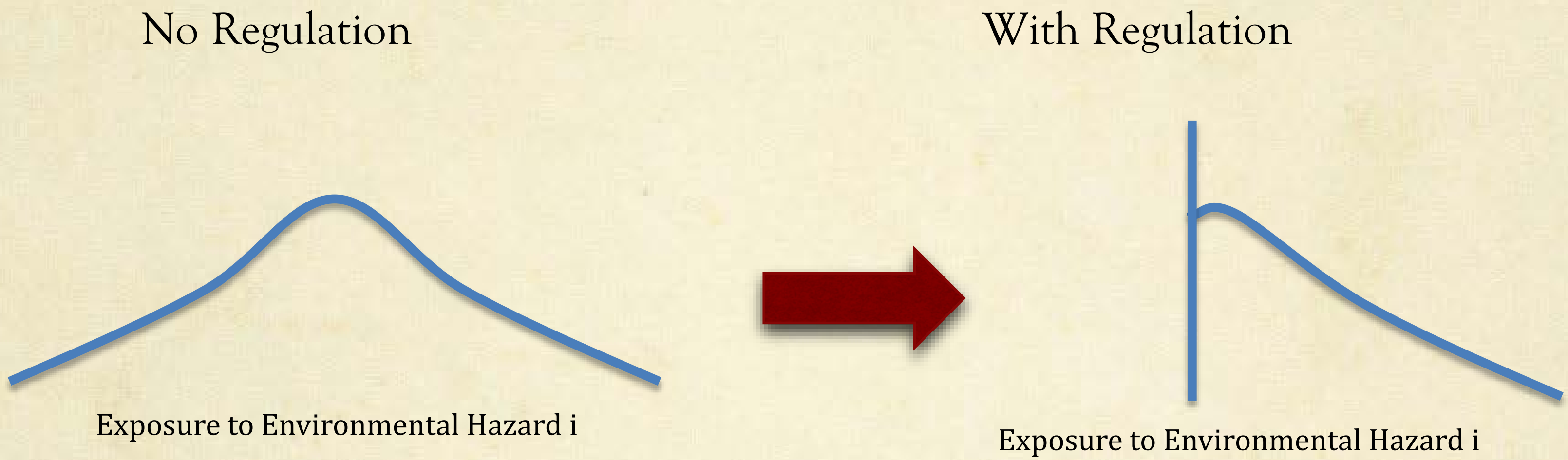
Process Equity

- All communities (choose your definition) are treated equally by the process
  - Regulators are demographics blind in the application of the law
  - All communities have equal access AND resources relative to the regulatory process

Process Equity -- Policy

- Regulator Behavior
  - Audits/Oversight
  - Empirical Evaluation (i.e. Shadbegian and Gray, 2010)
    - Identify plant-level deviations from "appropriate" oversight
    - What is the appropriate definition of community
- Community Access & Resources
  - Access to regulators
  - Information
  - Resources (money)
    - Experts
    - Lawyers/lobbyists

A World With Process Equity



Heterogeneity Remains (just truncated)

Clustering of emitters x-cross pollutants → greater heterogeneity & hot spots

A World With Process Equity

- Poor Communities Exposed to Lower Environmental Quality
    - Lower Land Rents Attract:
        - Lower income residents
        - Industrial Land Uses
    - Lower Environmental Quality Lowers Residential Land Rents
        - You don't see expensive subdivisions neighboring oil refineries
    - Empirical Evidence - Banzhaf & Walsh (2009)

A World With Process Equity

- Minority communities exposed to lower environmental quality
    - Driven in part by differences in income distributions.
    - Exacerbated by forces that lead to clustering of minority populations
        - Housing Discrimination
        - Tastes for Demographic Composition
    - Banzhaf & Walsh (2010)

Process Equity – Bottom Line

If we achieve process equity under current regulations:

-- EJ Concerns Will Still Exist

Exposure Equity

Can be decomposed:

- Spatial heterogeneity in environmental quality
- Correlation between demographic communities & environmental quality

Policies can push at either dimension

Exposure Heterogeneity

- In a world with uniform environmental quality, EJ concerns disappear
- Current policy not only allows variation in environmental quality – but allows for significant variation – Hot Spots
- Eliminating Hot Spots would markedly attenuate EJ concerns

Exposure Heterogeneity – Policy

- Move to Regulating Cumulative Effects
- Focus on policies that improve environmental quality in Hot Spot areas (as opposed to just do no harm)
  - Increased enforcement
  - Ratchet up standards
  - Leverage new sources through offsets?
- Issues
  - How do we aggregate to develop "environmental index"
  - Doesn't directly address existence of Environmental Injustice
  - Maybe hot spots are efficiency enhancing

Correlated Exposure

- Significant spatial variation in environmental quality is likely to be a persistent reality
- Reducing correlations with EJ populations will require either:
  1. Moving Pollution
  2. Moving People
- Either approach will need to overcome market forces that work to reinforce correlations

Moving Pollution

- Build measures of susceptibility into cumulative effects regulations
- Incorporate “credit” for past burdens in prioritizing locations for accelerated clean-up
- Empower EJ communities in their efforts to influence state and local implementation of regulations
  - Document EJ implications of policies
  - Incorporate distributional concerns into Cost-Benefit analysis

Moving People

- Market forces will push poor populations toward low environmental quality
- Work with other government agencies to incorporate EJ concerns into policies that impact housing outcomes
  - Section 8
  - LIHTC
  - Zoning
- Develop policy options that offset "Environmental Gentrification"
  - i.e. give low-income renters "equity" stake in communities/properties that experience appreciation as environmental quality increases

If I were Administrator…

If I were Administrator...

<fortunately this will never happen>

If I were Administrator…

- Continue to work towards process equity
  - Take significant guidance from EJ communities
- Move to policies that account for cumulative effects and accelerate environmental improvements in Hot Spots
  - accounting for variation in susceptibility across communities
- Develop analyses that empower EJ communities in their efforts to influence state and local regulators
- Work to see EJ concerns reflected in government policies that impact housing outcomes