What's the Equitable Pathways Method Supposed to Do?

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The Baltimore Social-Environmental Collaborative (BSEC) uses the Equitable Pathways method to identify potential futures for Baltimore in light of climate change. Academic researchers and community stakeholders have key roles. Both groups will describe Baltimore now – both its environmental and its equity challenges – and will identify possible actions to improve the city's resilience to climate change. The researchers will take the lead in describing how climate change will affect Baltimore's physical and social systems. The stakeholders will take the lead in describing the future they want to see. This is an iterative process – results will be taken back to the stakeholders and the researchers for refinement. Based on initial consultations, four topics have been selected for the first round of Equitable Pathways analysis: extreme heat, indoor and outdoor air pollution, urban flooding, and greenhouse gas emissions reductions.

This document explains the Equitable Pathways process.

Who Defines the Problem?

The hard problems that face communities (from the local to the national and global levels) are complex. This means:

- They have many stakeholders, and the problem is described differently by each group of stakeholders.
- There are feedback loops – vicious or virtuous cycles that strengthen or relieve behaviors in the problem.
- There is no "silver-bullet" solution that fixes the whole problem.
- The behavior of the system as a whole is very uncertain.

Both climate change and racial equity in Baltimore are complex problems.

In standard policy design, we entrust a relatively small number of people who have relatively narrow knowledge with the job of describing the problem and identifying the solutions. These experts' perspectives (including their conscious or unconscious biases and those of the institutions they work for) get more weight than those of other stakeholders. Once the problem is described and possible solutions outlined, in theory it's relatively straightforward to define a plan to deal with the problem. However, there are several problems with this approach:

- The plan may be weak, because neither the problem nor the potential solutions were well enough described.
- Without strong representation of different viewpoints, the analysis may be too narrow.

- The political will needed to implement the plan is squandered rather than built, because stakeholders are generally apathetic.
- Alternatively, stakeholders may rebel against this system, which can either damage political will or wrest it from the leading institution. Either outcome makes the plan harder to implement.
- This approach generally looks at one possible future state of the world if no action is taken, and one path for moving to build a better future. Such plans rarely include explicit triggers for evaluating the path. That is, standard policy design doesn't build in adaptation to changing conditions.

The Equitable Pathways approach addresses some of these dangers. In this approach, the focus is on broad participation and identifying many possible pathways to good futures rather than determining *the* future. Many people with different expertise (lived neighborhood experience, academic, government experience, non-government organization) can participate in describing the problem and possible solutions, as well as describing the relationships among parts of the problem and parts of the solutions. This is important because in hard problems, there is no single way to describe the problem that satisfies all groups of stakeholders. The goal is for different perspectives to add richness, rather than for one perspective to become dominant.

All of this information is then fed into a computer program that identifies:

- What combinations of goals can likely be met through what combination of solutions.
- Which solutions do and do not meet which stakeholder's goals.
- What conditions make it more likely that stakeholders' goals will or will not be met by specific solutions.

The Equitable Pathways approach democratizes the process of understanding the problem, the possible solutions, and connections between the solutions. Researchers have the responsibility of ensuring that stakeholders' concerns and the context they provide are properly fed to the computer program. Stakeholders and the whole community of researchers play a key role in improving the "black box" of the computer program (described below). A key goal of the Equitable Pathways project is to engage stakeholders and researchers in evaluating and improving the "black box," ideally so that it becomes a trustworthy aid in community decision making.

Who Evaluates the Solutions?

The result of the computer calculations is a collection of many possible pathways. Each pathway represents an educated guess about a possible future based on potential policies or practices the community stakeholders identify; and the correlations between those policies or practices, surrounding conditions like changing climate, and the uncertainty inherent in all of those elements. The pathways can model different scenarios based on questions like: Where and when is money spent? What are the expected benefits for health, or jobs, and for the environment? Which pathways lead to outcomes that communities value? The possible pathways can help stakeholders gain a sense of the trade-offs among policy options, and can inform the choices that Baltimore City and its

communities make to collectively implement equitable solutions.

The computer provides a sense of what outcomes are possible and which might be more likely than others under different conditions. Only a diverse group of stakeholders can effectively discuss and evaluate which of the pathways have the greatest promise for equitable climate adaptation. That group can also identify what's missing, what's unrealistic, what else needs to be considered, and whose perspectives have not yet been included. The feedback from that discussion will inform the next round of BSEC research, with the goal of producing more useful pathways that, over time and through further stakeholder input, will support equitable and broadly supported climate action in Baltimore.

The Equitable Pathways decision tool also requires a broad range of researchers. While we know a lot about how climate change is expected to play out globally, it is much more difficult to understand what will happen in a particular location – and especially an urban location. The density of cities means that the interactions among many natural physical systems (such as the flow of water and the movement of air) are more difficult to predict. And these physical systems interact with multiple human systems (like housing, transportation, land use) in complex ways that affect both the weather and whether different groups thrive or suffer.

For example, to study the impact of heat on cities, researchers developed a model that looked at how three possible investments would influence five objectives: minimize heat-related mortality over time, minimize cost, minimize mortality across neighborhoods, minimize worst-case mortality events, and reduce carbon emissions. The three possible investments identified for the exercise were cool roofs and pavement, planting trees, and providing cooling centers to reduce individual heat exposure. The researchers used existing evidence to come up with the best estimates of the interrelationships between possible investments and objectives by asking questions like "how much does a tree cool its neighborhood in each year of its life?" and "how does mortality increase with heat?" And then questions like "If all this occurs as the weather heats up, how does that affect mortality – and will the trees themselves survive?" They calculated how much each investment would cost initially and to maintain over time. Based on these relationships, the "black box" identified 3,300 possible scenarios for the next twenty years. The results could then be used to examine possible future scenarios and serve as the basis to discuss which scenarios would be preferred among stakeholders, including community members, policymakers, and scientists. The information can also suggest triggers (such as dying trees) that should prompt a decision to reassess the policies that were chosen.

As another example, how does the concentration of an air pollutant affect the air that we breathe inside a typical Baltimore home? How might a reduction in emissions of a pollutant (achieved by shutting down a polluting industry, or reducing traffic flow, for example) affect indoor exposure? How does the home's insulation, air flow system, and the owner's choice to open or close windows influence those exposures? And ultimately, how do all these changes influence the occupant's health and how much they spend to heat or cool their home? In both these cases, place-based science is needed to help us understand whether a set of interventions

will improve community resilience or achieve other community goals.

Who Will Evaluate and Improve the "Black Box"?

As mentioned above, the Equitable Pathways model relies on computers to crunch a lot of data. While the process of determining what data go into the computer algorithm is relatively democratic, it's the job of climate scientists to create the software (the "black box") that produces the pathways the community will evaluate. How do we know if the "black box" does a good job?

And then there's the problem of timescale. The actions we take to adapt to climate change often take a while to create their effects. How can we evaluate these actions in a five-year study?

The BSEC study is funded by the U.S. Department of Energy (DOE). For DOE, evaluating the effectiveness of decision tools like Equitable Pathways is a key goal of the study. We have a few ways to do this:

- One test of the decision tool is whether the parts of it that simulate the physical environment are accurate. For example, is the part of the model that predicts heat accurate when we use it to estimate heat this year, or in past years? And, most importantly, is it accurate for the factors that matter to majority Black neighborhoods in Baltimore? These neighborhoods have been systematically deprived of climate and environment measurements. BSEC will work with communities to get better measurements, and to use those measurements to make sure that the computer model performs well in these neighborhoods.
- It's also important to test whether we can believe the future conditions that the model predicts. We don't have measurements of the future, so one method BSEC can use is to "trade space for time." This means to carefully choose comparisons – one site that is undergoing a change now, with another site that saw the same change in the past. For example, we can look at tree planting that's taken place in Old Goucher to learn how these kinds of efforts might influence the environment in a less green neighborhood like Broadway East.
- An equitable future is about much more than the physical environment. It's vital that the decision tool take other priorities into account, and that it represents these priorities in a meaningful way. For example, if one heat reduction strategy will reduce the energy bills of low-income residents while another will increase those bills, we need to weigh that in our discussion of preferred pathways. Similarly, Baltimore residents might prefer greening strategies that employ local workers, that contribute to food security, or that provide pleasant gathering spaces. The decision tool therefore needs to be evaluated by stakeholders to ensure that it is accounting for the right set of goals and counting progress towards those goals in the right way. And stakeholders need to work with researchers to make sure that the social and economic data and relationships that go into the decision tool are reliable and consistent with lived experience.
- Finally, we will look at whether the use of the tool builds stakeholders' ability to be effective agents and whether it helps communities work together for the policies they need. All the science and sound policy in the world doesn't matter if people

aren't able to create change.

The Researchers Talk about XLRM. What's that?

The XLRM Framework is the "black box" tool that generates millions of potential pathways. It is also an abbreviation for the components that are fed into the "black box." Stakeholder input is a key part of getting this right. Three important questions to evaluate all elements that go into the analysis are:

- Is the information sound? That is, are we confident that the results are correct or the model sound?
- Does the analysis address stakeholders' goals? That is, are we confident that the knowledge created applies to real world problems?
- Was the process to get the information sound? That is, are we confident that all the necessary perspectives are represented?

Name	Definition	Questions	Contributions
X - External Uncertainties	The goal is to get very specific about what we don't know. For example, we know climate change is here, but we don't know exactly how much hotter a city will get than a rural area. We know that power outages are likely, but not how often there could be widespread, lengthy outages. More generally, External Factors of the things that are outside the control of our levers.	What's the level of confidence in general models for a specific factor? What urban factors might change our confidence in a result for a larger area? How does the urban environment add complexity?	**Stakeholders** will often have insight on uncertainties specific to their local environments. **Researchers** will often have a broad and deep understanding of the uncertainties in general. We rely on our decision scientists and our down-to-earth community leaders to help us stay aware of uncertainties related to our process.
L - Levers	These are the actions that can be taken, and the policies that can be put in place. Simple examples are reflective roofs and	What actions and policies can mitigate the local experience of climate	**Stakeholders** can often provide a rich vocabulary of possible levers.

	tree-planting, and laws to protect trees. More complex examples include good public transportation that provides better access to jobs, thus providing households with greater wealth and more options. It's important to be clear about the degree of confidence that a lever will act as expected.	change? What actions and policies can help residents adapt to climate change? What actions and policies reduce the disproportionate vulnerability of some residents and neighborhoods?	**Researchers** may be familiar with levers that are used in other places.
R - Relationships	This is the key area of scientific research. It is a way of describing (whether through a model, a regression, or another tool) the potential effects of introducing one or more levers. It's important to be clear about the degree of confidence that the relationship is correctly modeled.	How do physical and social systems interact with each other? What happens in different scenarios of the uncertainties? What happens when a lever is introduced?	**Stakeholders** may have understandings about relationships that are novel to researchers. **Researchers** know how to investigate hypotheses.
M - Metrics	These are measurable changes we want to see. These outcomes always embody values, such as valuing life, valuing the lives of all equally, and valuing our city as a habitat for plants and animals. It's important to work toward a metric that measures what really matters. This can be challenging due to scientific challenges.	What are our specific goals? What can we measure to see if we are meeting these goals? Which of these measures should we choose?	The metrics need to be built on the goals and values expressed by **stakeholders**. **Researchers** are experts at figuring out what can be measured, and how.