CHARITY ENTREPRENEURSHIP

Strengthening Air Quality Monitoring and Advocacy in LMICs

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RECOMMENDED

Strengthening Air Quality Monitoring and Advocacy in Low- and Middle-Income Countries

Ambitious Impact Research Report

August, 2025

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Contributions: *The primary authors for this report were Hubert Thieriot (AIM Research Program fellow) and Filip Murár (Senior Research Manager), with contributions from Morgan Fairless (Research Director).*

Ambitious Impact (AIM) *exists to enable more effective charities to exist worldwide. We strive to achieve this goal through our extensive research process and Incubator Program. We give talented potential entrepreneurs two months of cost-covered, intensive training designed by founders for founders. Our talented researchers and entrepreneurs identify evidence-based, high-impact interventions and help founders find a co-founder to launch the idea and reach scale.*

Note to readers: *Our research is geared toward AIM decision-makers and program participants. We attempt to find the best ideas for our incubation programs through these reports. Given our commitment to focusing on recommended ideas, reports on those not recommended for incubation can often be less polished.*

For questions *about the content of this research, please contact Filip at filip@charityentrepreneurship.com. For questions about the research process, please contact Morgan Fairless at morgan@charityentrepreneurship.com.*

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Strengthening Air Quality Monitoring and Advocacy in Low- and Middle-Income Countries / Summary

Description

Ambient air pollution is a leading risk factor for poor health and mortality, responsible for nearly five million premature deaths each year. Compared to its severity, air pollution remains a neglected topic in many places, especially low- and middle-income countries (LMICs). This neglect is partly due to a lack of high-quality, transparent, local data on the severity and sources of air pollution. While a growing number of local actors have been setting up air quality monitoring functionality and advocating for stronger regulations, many of these local actors are undertrained and undersupported, limiting their effectiveness and chance of success. This report explores the idea of incubating a meta-charity that would help fill this gap by providing targeted support to local air quality (AQ) monitoring and advocacy teams, consisting of training, knowledge exchange, monitoring, evaluation, and learning (MEL), and other services.

Counterfactual impact

Cost-effectiveness analysis: We estimate this charity's potential cost-effectiveness as USD 42 per DALY averted. The model is highly uncertain and reliant on assumptions we made about the scale, the counterfactual effect this charity would have on the local teams' success, the effect successful local teams would have on local $PM_{2.5}$ levels, and how much credit this charity should take for local teams' success. See our model here.

We also created a simple "back-of-the-envelope" calculation to estimate that this intervention may reduce greenhouse gas emissions with a cost-effectiveness of USD 13 per ton of CO_2 averted.

Scale this charity could reach: We roughly estimate that this charity could avert 12,400 DALYs per year at scale and avert around 23,000 tons of CO_2.

Potential for success

Robustness of evidence: High-quality causal evidence linking transparent AQ monitoring with AQ improvements is limited to three studies: one randomized controlled trial and two natural experiments (two of which are from China). However, there is a growing set of case studies from places where newly collected local data was used to successfully support government advocacy and the development and implementation of new standards and regulations. See section 3.2 for details.

Theory of Change: The theory of change of this charity is somewhat uncertain. It would likely be multi-faceted and may change over time. The most promising activities we have identified are: (i) Designing and running an online AQ bootcamp for aspiring local teams, (ii) supporting teams with developing ToCs for policy advocacy activities, (iii) conducting MEL activities for existing teams, (iv) researching the cost-effectiveness of different advocacy interventions, (v) facilitating knowledge exchange between local teams, (vi) helping teams calibrate their sensors, and (vii) conducting source apportionment studies. We expect these activities to strengthen local teams' capacity and speed up the successful implementation of air pollution mitigation strategies.

Neglectedness

Neglectedness: We have some concerns about neglectedness. While major international institutions have neglected AQ monitoring, a few existing organizations are offering different kinds of support to local AQ monitoring teams in LMICs. However, these organizations are small and have limited remits, so there still seems to be a lot of space for a new actor. This has been confirmed in conversations with multiple experts.

Geographic assessment: We think this organization will have a global focus. However, the country teams it will work with will likely roughly follow our geographic mapping or any prioritization conducted by other research organizations.

Relevance

Strategic value to AIM: We expect this charity to have a default level of strategic value for AIM.

Fit for the Charity Entrepreneurship Incubation Program (CEIP): We expect that this idea will be attractive to many incubatees, as much of it can be done remotely (though likely involving travel to different LMICs) and relies on implementing various concepts CEIP focuses on, such as theories of change and MEL. We also expect the work to be highly collaborative and involve working with highly motivated teams across the globe.

Other

Expert views: The experts we spoke with were generally supportive of additional global "meta" efforts in the AQ monitoring space. They had slightly varying views on the exact most promising activities for this charity, based on what they perceive as the most pressing needs and on the comparative tractability of different activities.

Implementation factors: We don't anticipate significant challenges with implementation. The AQ space seems highly collaborative, so a new actor could likely quickly get up to speed, identify the most promising and neglected activities, and learn how to do them.

Strengthening Air Quality Monitoring and Advocacy in Low- and Middle-Income Countries / Crucial considerations

Will AQ monitoring be followed up by mitigation activities?

A key uncertainty of this charity idea is whether setting up transparent AQ monitoring actually leads to ultimate impact. For that to happen, it needs to cause (or increase the likelihood of) follow-up mitigation activities, such as governments introducing new standards or enforcing existing regulations, the general public pressuring local governments (or businesses) to reduce air pollution, governments or businesses being successfully sued over unaddressed air pollution, etc. Whether or not these will happen is highly uncertain in any particular case.

What makes us more confident about the overall ToC of this charity is the fact that the local teams this charity would be working with (who would likely – though not necessarily – be the grantees of the EPIC Clean Air Fund) can be preselected based on the strength of their plans and strategies for engaging in such follow-up activities. Moreover, a key part of this charity's ToC would be to increase the capacity of these local teams to follow through with these plans. In other words, this charity would not be "just measuring air quality" – its key focus would be to maximize the chances that AQ data is used to enable reductions in air pollution.

What exact activities should this charity focus on?

We are quite uncertain about which exact activities would be most impactful for this charity to focus on. While we have identified a promising shortlist, we have not been able to narrow it down to a confident set of key activities. The charity may need to do its own research post-incubation and possibly experiment with different activities before settling on a clear ToC.

That being said, it is plausible that the most impactful charity in this space does not focus on a single activity and instead provides a suite of services to local groups. Being a meta-charity, this kind of multi-pronged ToC seems relatively feasible. However, it may be at odds with AIM's general preference for focused charities with narrow ToCs.

Counterfactual benefit of this meta-charity

We have some concerns about the additionality of a new actor in this space. While AQ monitoring seems generally neglected by major international institutions, there already are several meta-organizations in this space, including EPIC's Clean Air Program, OpenAQ, CAMS-Net, and Afri-SET. Our conversations with experts, however, suggest that there is a whole range of potential activities that aren't being pursued by existing organizations. The experts we spoke with indicated that a new charity would be unlikely to duplicate existing efforts.

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Glossary

Air quality sensor: A hardware component that detects specific pollutants in the air.

Air quality monitor: A complete device that includes sensors plus electronics, software, display/interface, and often connectivity (e.g. Wi-Fi).

Air quality management: A regulatory authority's activities to manage air pollution, ranging from policy planning and program implementation to air quality monitoring and impact assessment.

DALY: Disability-adjusted life year. Losing one DALY can either mean dying prematurely by one year (i.e., losing one year of life) or living with a disability for several years. Disability weights used in DALY calculations are developed by the Institute for Health Metrics and Evaluation.

Loss of life expectancy (LLE): The total number of years of life by which one's life is estimated to have been shortened as a result of a condition or a health risk factor. In our context, the estimated number of years of life lost as a result of exposure to air pollution.

PM pollution: Particulate matter pollution.

Source apportionment: The practice of deriving information about pollution sources and the amount they contribute to ambient air pollution levels.

1 Background

1.1 Context

Ambitious Impact (AIM) exists to increase the number and quality of effective nonprofits working to improve human and animal wellbeing. AIM connects talented individuals with high-impact ideas. We give potential entrepreneurs intensive training and ongoing support to launch ideas to scale. Our research team focuses on finding impactful opportunities.

As part of our 2024–2025 research agenda, we researched the idea of improving air quality monitoring as a way of reducing the harms of air pollution. This report provides an overview of our findings.

1.2 Introduction to the idea and problem

The health burden of air pollution

Air pollution kills an estimated eight million people annually (Ritchie & Rosado, 2025). Its total estimated health burden is 236 million disability-adjusted life years (DALYs) lost – more than, for instance, unsafe sex, dietary risks, or tobacco use (Institute for Health Metrics and Evaluation, 2024a). It is the second-highest risk factor globally for lost years of healthy life (Figure 1).

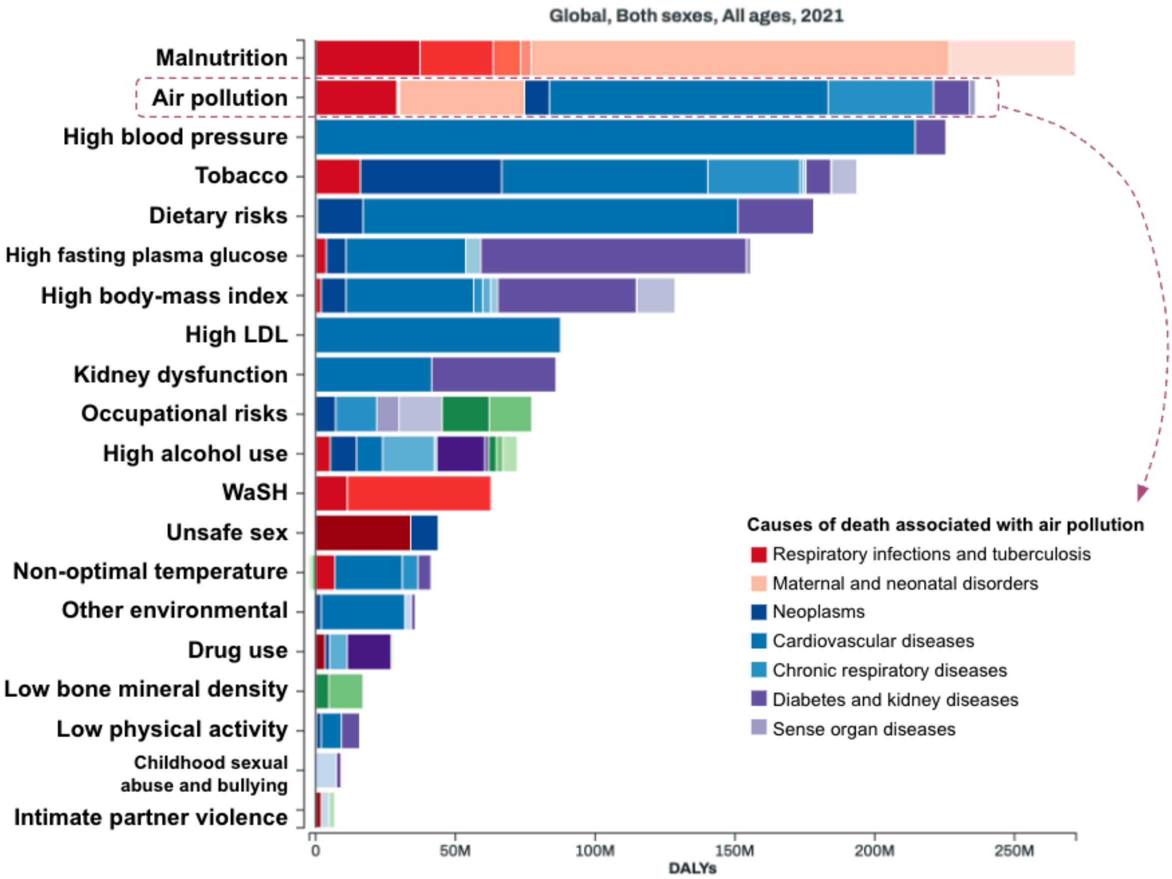

Figure 1: Global DALYs attributable to different level 2 Global Burden of Disease risks[1] (Institute for Health Metrics and Evaluation, 2024a).

There are many kinds of air pollution that are harmful to human health, including particulate air pollution, nitrogen oxides, ozone, sulfur dioxide, and others (Ritchie & Rosado, 2025). The focus of this report is particulate matter (PM) pollution. PM air pollution refers to the presence of "small solid particles and liquid droplet mixtures [in the air]" (U.S. EPA, 2016, para. 1). Inhaling them increases the risk of several diseases, including cardiovascular conditions and respiratory infections (Institute for Health Metrics and Evaluation, 2024b). Of the different subtypes of PM pollution, $PM_{2.5}$ – i.e., particles smaller than 2.5 micrometers – is considered the most hazardous to human health, due to its ability to penetrate deep into the lung tissue and enter the bloodstream (Brook et al., 2010).

[1] The Global Burden of Disease (GBD) study uses a hierarchical structure to categorize risk factors, with four levels of increasing specificity. Level 1 includes broad categories like behavioral, environmental/occupational, and metabolic risks. These are then disaggregated into 20 Level 2 risk factors, followed by 52 Level 3 risk factors, and finally, 69 Level 4 risk factors.

This report specifically focuses on ambient PM pollution—air pollution originating outdoors (rather than within the household, such as from cooking). Ambient air pollution alone caused an estimated 120 million DALYs and 4.7 million premature deaths in 2021, i.e., about half of the total burden (Institute for Health Metrics and Evaluation, 2024b).

Ambient air pollution exposure and impact vary across regions, with average loss of life expectancy (LLE) reaching 3.9 years in East Asia, 3.1 years in Africa, 2.2 years in Europe, and 1.5 years in North America, with a global average of 2.9 years (Lelieveld et al., 2020).[2] According to Lelieveld et al., removing all potentially preventable anthropogenic emissions could reduce the global LLE of 2.9 years by 1.7 years (i.e., by ~60%).

The World Health Organization (WHO) suggests that the annual average $PM_{2.5}$ concentration should not exceed 5 μg/m³ (WHO, 2021). However, as shown in Figure 2, many regions around the world exceed these levels, sometimes by more than a factor of 10.

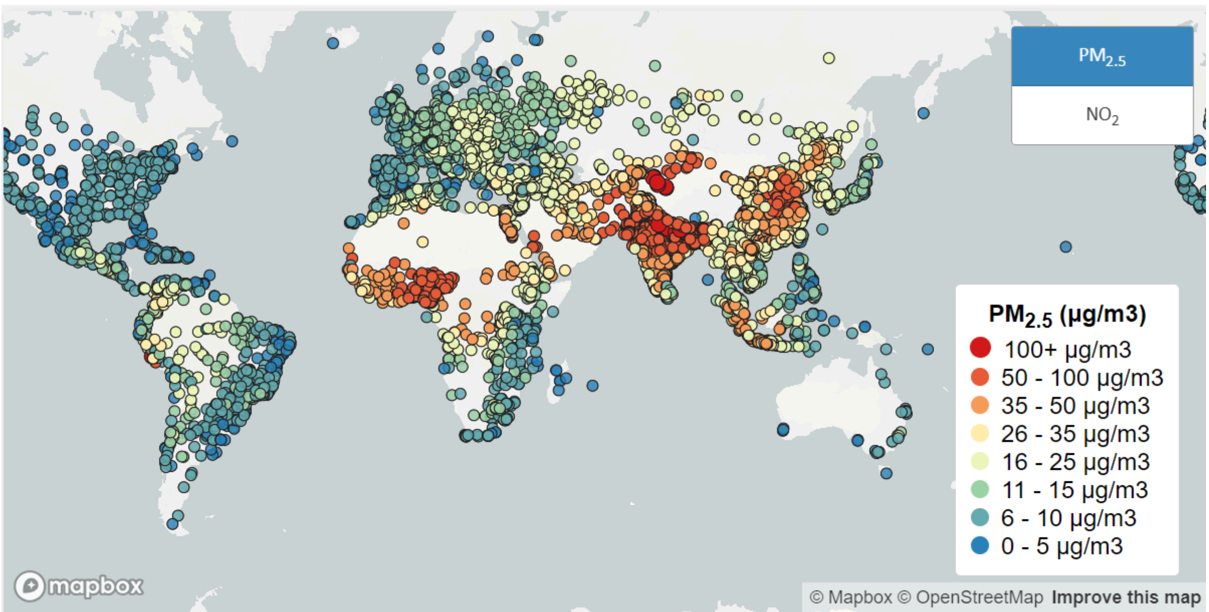

Figure 2: Population-weighted annual average pollutant concentration in cities in 2019 (Source: State of Global Air, n.d.).

[2] In the rest of this report, air pollution will refer to ambient (i.e., outdoor) air pollution alone, unless otherwise specified.

Air quality monitoring

This report explores the idea of starting a charity that would contribute to monitoring air quality (AQ) in low- and middle-income countries (LMICs). The central sustaining premise is that to make progress on reducing air pollution, we need to know where it happens, how bad it is, what sources it comes from, and to be able to track progress on addressing it (Hasenkopf et al., 2023).

Current global coverage of $PM_{2.5}$ monitoring is very unequal. Many regions most affected by air pollution—South Asia, Africa, and Latin America—also collect the least data (Figure 3). This leaves populations in those regions "in the dark" about the severity of local air pollution, and does not give their governments and citizens a reliable basis for tackling the problem.

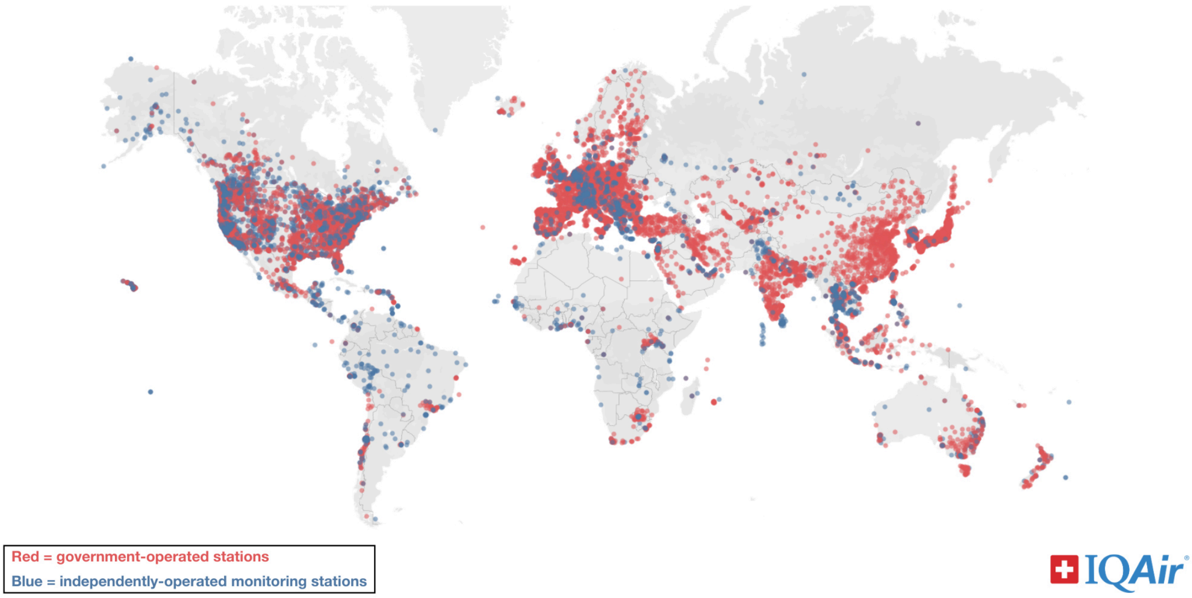

Figure 3: Global distribution of $PM_{2.5}$ air quality monitors in 2023 (IQAir, 2024, p.12).

AQ monitor installations in LMICs have been growing in recent years. A major development has been the setup of the Clean Air Program by the Energy Policy Institute at the University of Chicago (EPIC). The Program manages the EPIC Air Quality Fund, a regranting initiative with at least USD 2.9 million from Open Philanthropy, Amazon Web Services, and other funders (EPIC, 2025). The fund solicits applications for USD 50,000–75,000 grants to set up AQ monitoring in “high-opportunity countries”, i.e., countries where new AQ data has a good chance of impacting national policy. In about a year of its official existence, the fund has awarded 31 grants (selected from a pool of over 300 applications), and it is expected to double this number in the coming year at least (based on our interview with Christa Hasenkopf, the Director of the Clean Air Program at EPIC).

While the setup of this fund is changing the landscape and reducing the neglectedness of AQ monitoring per se, it has also created new opportunities for impact. As highlighted in a conversation with Christa Hasenkopf, many applicants to the fund lack basic knowledge of AQ monitoring (including its technical and regulatory aspects). There also aren’t sufficient channels for sharing information and lessons across teams and countries. Plugging these gaps requires various kinds of “meta” activities (explored in more detail in section 2.2), which are the focus of this report.

Types of air quality sensors

The report will refer to different types of air quality sensors:

- **Reference-grade monitors** typically refer to either Federal Reference Method (FRM) monitors or their less expensive version, the Federal Equivalent Method (FEM) monitors. FRM monitors are those approved by the U.S. Environmental Protection Agency to measure pollutants in a way that meets legally defined, highly standardized procedures. FEM monitors are designed and demonstrated to produce equivalent results to FRM at a significantly lower price tag.

- **Low-cost sensors (LCSs)**, which are around 100x cheaper than reference-grade monitors, are significantly more affordable but offer much less accuracy and granularity (see Appendix 1). LCSs “do not directly measure size-partitioned mass concentrations but rely, instead, on basic a priori assumptions of particle size and distribution to derive their estimations” (Alfano et al., 2020, p.25). An important consequence of this is that calibration is a crucial aspect of operating LCSs. This is typically done by co-locating them with reference-grade monitors (US EPA, 2016).

- **"Medium-cost sensors"** aim to strike a balance between cost and accuracy. They are about 10x cheaper than reference-grade monitors while providing granular data and not requiring calibration.
- Finally, **remote sensing** (typically satellite-based sensors) is another way to estimate ambient air pollution. It is often combined with models and ground-based monitoring data to provide global maps of ambient air pollution. The most widely used source is van Donkelaar et al. (2021). Such data sources can prove useful in estimating ambient pollution in regions deprived of sensors or monitors. However, their accuracy is limited in the absence of calibration using land-based sensors. Perhaps more importantly, their spatial resolution is limited – about 3.5 km x 7 km for Sentinel 5P, which is often insufficient to provide accurate, local data in urban areas (Apte et al., 2017). Finally, in most regions, only one value is available daily (around noon) – though new geosynchronous instruments, which provide hourly data, are becoming available (GEMS over Asia, TEMPO over North America, and Sentinel 4 over Europe).

Appendix 1 provides more information on types of sensors available, their benefits, and drawbacks.

2 Theories of change

2.1 Barriers to better AQ monitoring

The main barriers we have identified to improved AQ monitoring are varied and will depend on the context. One central assumption underlying the intervention is that AQ monitoring is a critical element in addressing air pollution as both a trigger and an enabler of subsequent mitigation activities. We therefore focused on barriers that have prevented the widespread adoption of transparent AQ monitoring in LMICs.

These barriers are presented in no particular order and are largely informed by the main author's experience working in the field and our conversations with experts.[3]

- **Funding**: Reference-grade monitors are prohibitively expensive for many countries. Even a network of low-cost sensors can represent a significant expense in many LMICs.
- **Technical expertise:** AQ monitoring systems require trained personnel for installation, calibration, maintenance, and appropriate data sharing. Without external intervention, this expertise may be lacking.
- **Technical challenges**: Intermittent access to electricity and limited internet connectivity can limit the deployment of sensors in certain regions. New instruments are being developed that combine solar panels with cellular LTE connections. Other technical challenges pertain to the rough conditions where sensors operate (e.g., heat, humidity, or dust).
- **Misperception of air pollution**: While air pollution is noticeable with human senses, people may not realize its severity unless real data is shown. People may also be underinformed about the health risks air pollution causes, especially if they're used to it as the status quo.

[3] See also Hasenkopf et al. (2023).

- **Lack of incentives for governments**: Unless motivated by external factors (e.g., local citizen groups, journalists, or international agencies), there is little incentive for governments to start monitoring air quality in the first place. This intervention is precisely about facilitating that pressure.
- **Limited institutional coordination**: Air quality monitoring often falls between agencies (health, environment, and transport) with unclear mandates and weak coordination.
- **Weak regulatory and policy frameworks**: Many LMICs lack national air quality standards or enforcement mechanisms.
- **Weak international ambition:** AQ monitoring is not strongly mentioned in frameworks developed by multilateral organizations, such as the Sustainable Development Goals. As such, the topic has attracted comparatively little attention.

2.2 Options for a charity working in this space

We believe that the most promising version of this charity focuses on a range of “meta” activities to support and strengthen the global AQ infrastructure capacity.

Options for AQ data collection

The charity team will need to make decisions about the nature of AQ data collection, including questions about:

1. How & where to deploy the sensors/monitors
2. What kind of sensors to use
3. Who will operate the sensors and publish data in the long run

The second and third questions can be summarized in the matrix below (Table 1), with the following criteria:

- **Scalability**: How easy would it be for a charity to expand coverage geographically (either within a country or across countries)
- **Cost**: How costly is it either to purchase or operate equipment
- **Insights**: What quality and quantity of information can the charity produce

Table 1: Potential types of direct air quality monitoring interventions

		Sensor operator		
		AIM-incubated charity	**Institutions, e.g., universities or hospitals**	**Citizens or grassroots organizations**
Type of sensor	**Low-cost sensors (LCSs)**	Scalability - Cost + Insights ±	Scalability ++ Cost ++ Insights ±	Scalability + Cost ++ Insights ±
	Medium-cost sensors	Scalability ± Cost ± Insights +	Scalability + Cost ± Insights +	Scalability ± Cost - Insights +
	Reference-grade monitors	Scalability - Cost -- Insights ++	Scalability - Cost -- Insights ++	Too complex

Given the success of EPIC's Clean Air Program in identifying high-capability local teams, we don't think that the charity should operate sensors directly. The focus should instead be on supporting such local groups. These can either be grassroots citizens' organizations or institutions, such as universities, hospitals, or schools. Based on our conversations with representatives of existing groups, we believe that institutions are likely a better target, as they are less likely to suffer from electricity and internet connectivity issues. However, not all countries may have networks of local institutions that are interested in collaborating, so working with grassroots organizations may still make sense in those places.

The two cases where directly operating AQ sensors does seem promising are for the purposes of calibrating LCSs and conducting apportionment studies.

- As previously discussed, LCSs need to be calibrated to local conditions using reference-grade monitors.[4] However, reference-grade monitors are often prohibitively expensive for local groups to purchase and run. As such, it may prove impactful and cost-effective for a charity to purchase one (or a small number of them) and use it to calibrate LCSs for local teams. This type of work is successfully being done by AfriSET who calibrate LCSs for teams in West Africa, using a reference-grade monitor in Accra, Ghana.
- In order to identify the sources of PM pollution, it may be necessary to undertake careful apportionment studies, which again require the use of high-quality monitors. An AIM-incubated charity may be in a good position to help local teams run such studies using a portable high-quality monitor it purchases and operates.

Potential charity activities beyond direct monitoring

1. **Online AQ bootcamp for aspiring local teams**: As mentioned by Christa Hasenkopf, many applicants to the EPIC Clean Air Fund lack basic knowledge of AQ and AQ monitoring, even though their applications are otherwise competitive. In her estimate, the number of grants could almost double if such applicants had gone through a dedicated program aimed at upskilling them. However, such a program does not currently exist.
2. **Support with developing ToCs for follow-up activities**: The ultimate impact of AQ monitoring depends on how the data is used (see the next section). However, many local groups may not be experienced in designing strong, ambitious strategies with clear ToCs. An AIM-incubated charity may be in a good place to provide this support with developing such ToCs.[5]
3. **Supporting local teams with translating data into easy-to-understand stories:** Turning data into clear stories that audiences such as policymakers

[4] To our understanding, medium-cost monitors may also be sufficient for this task, though we are not fully knowledgeable of their potential limitations.
[5] Our sense is that support with follow-up activities is currently a more neglected niche compared to technical support with setting up AQ monitoring, which multiple existing organizations focus on (see section 5.1).

or the wider public can understand is a specialist skill that not all local groups may have. This charity could support groups in this process, e.g., by helping craft strong arguments or create attractive visualizations.

4. **Monitoring, evaluation, and learning (MEL) for existing teams:** Once plans have been put in place, progress against them should be tracked and evaluated. This is so that the teams themselves spot weaknesses early on, receive targeted feedback and advice, and their eligibility for follow-up grants can be better assessed.

5. **Sharing lessons on what works:** A dedicated MEL function could also help collect systematic evidence on what kinds of strategies—both for monitoring itself and for follow-up activities—work vs. don't work, so that different local groups can efficiently learn from each other. To our understanding, such lesson sharing is currently often done on an ad hoc basis and is based on low-quality anecdotal evidence (as opposed to evidence collected following rigorous, prespecified plans).

6. **Researching the cost-effectiveness of different follow-up interventions**: Following on from MEL, the charity may be able to do in-house research on the relative cost-effectiveness of different follow-up activities, which could increase the impact of the whole international AQ monitoring space.

7. **LCS calibration and source apportionment studies:** As discussed in the previous section, it may be impactful for this charity to purchase one (or a small number of) medium-cost or reference-grade monitors and use it to support local teams in calibrating their LCSs and/or in running source apportionment studies.

8. **Developing air quality forecasting models and alerts:** A separate causal pathway through which the harms of air pollution can be mitigated—other than directly reducing PM pollution levels—is notifying citizens when AQ levels are particularly high, to allow them to practice protective behaviors (e.g., staying indoors, not exercising outside, or wearing a facemask). The charity could collaborate with researchers, governments, or other third parties to develop local AQ forecasting models and set up a system of alerts

to make sure citizens and the media are appropriately notified of unusually high PM levels.

9. **Publishing progress reports:** The air pollution space is currently missing a unified place where progress is tracked and summarized on a regular basis. Diseases such as malaria, tuberculosis, or AIDS receive annual update reports by the Global Fund. These reports help galvanize support and create a sense of progress. A meta-charity in the AQ space may be able to fill this gap and thereby create a greater global momentum (Our Common Air Commission, 2024).

10. **Convening**: To further build support and momentum for AQ monitoring and for addressing air pollution, the charity could collaborate with other actors (such as EPIC) on convening annual or biannual conferences. These would have multiple aims: (i) bringing together different local teams to facilitate collaboration and knowledge exchange; (ii) bringing together relevant government staff from priority countries and trying to get them to commit to specific follow-up actions; and (iii) bringing together new potential funders for the AQ space who have historically been hesitant to fund AQ work in certain LMICs (Christa Hasenkopf interview).

We are currently not very confident in our understanding of the relative tractability, counterfactual impact, and cost-effectiveness of these different activities. We also anticipate that these will change over time as the AQ monitoring space develops and its needs change over time. However, we see it as promising that there is such a long list of plausibly impactful activities a meta-charity in this space could undertake.

Options for follow-up mitigation activities

The ToC for this charity requires follow-on actions to convert increases in monitoring to improvements in air pollution. These follow-on actions could include, but are not limited to:[6]

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[6] See Appendix 2 for a more detailed list.

1. Actions led by grassroots organizations, such as:
    - Pressuring local governments or businesses to reduce air pollution in identifiable areas (e.g., power stations, brick kilns, transport, etc.)
    - Petitioning central, state, and local governments to implement air quality regulations
    - Pressurizing media outlets to report on the topic more
    - Organizing public protests
    - Suing governments for failing to regulate air pollution
    - Suing businesses for failing to comply with regulations
2. Actions led by governments, such as:
    - Setting national targets for $PM_{2.5}$ levels
    - Tracking progress against these targets
    - Introducing new standards and regulations (e.g., for car emissions, industrial emissions, power plant emissions, stubble burning, etc.)
    - Enforcing existing regulations
    - Setting up new bodies dedicated to tackling air pollution.

2.3 Theory of change of this intervention

This section discusses the theory of change (ToC) linking the activities of this potential new charity to outcomes and ultimate impact. We are less certain about the precise activities this organization will undertake, relative to other organization ideas we normally recommend. We strongly expect the organization to ultimately coordinate with allied actors, such as EPIC and air quality funders.

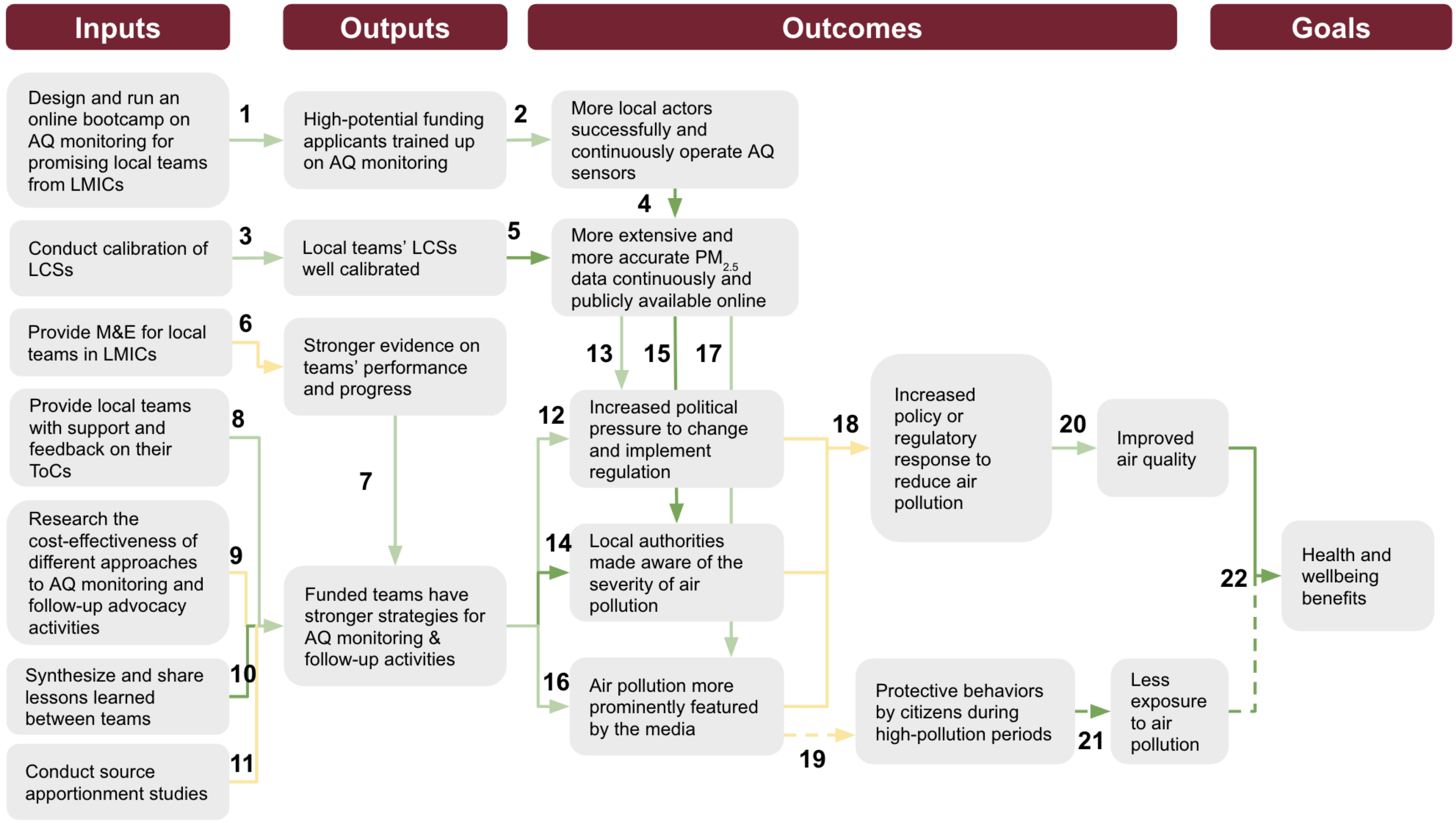


Figure 8: Theory of change of this charity. Note that we don't expect the charity to undertake all of the activities listed in the Input column, and it may conduct activities not listed here.

2.4 Assumptions within the ToC

Table 2 provides a breakdown of the assumptions underpinning the causal connections in the ToC. Color-coding in the first column indicates our confidence that this assumption holds: Very high confidence (>85%), high confidence (65–85%), medium confidence (35–65%), low confidence (15–35%), very low confidence (<15%).

Table 2: ToC assumptions.

#	Assumption	Evidence/reasoning
1	The charity can design a course/ bootcamp that will successfully train up promising applicants	All the necessary information is available in existing resources, and we believe that AIM incubatees can design an engaging and comprehensive course that successfully conveys the necessary knowledge.
2	More trained funding applicants results in a larger number of funded teams	Christa Hasenkopf (Director of the Clean Air Program at EPIC) told us that a lack of knowledge is a key barrier to accepting grant applications. Note that this assumption will cease to be met if the EPIC Clean Air Fund (or other similar funding opportunities for local teams) runs out of money.
3	Calibration using reference-grade or medium-cost sensors results in well-calibrated LCSs used by local teams	There is extensive evidence that calibration of LCSs is tractable. However, there is also evidence that LCSs may become less accurate over time if the composition of local $PM_{2.5}$ changes. Therefore, the charity may need to recalibrate teams' LCSs with some regularity.
4	A greater number of local actors successfully operating AQ monitors results in richer publicly available data	This is very likely to be true as long as these local teams are well trained and supported.
5	Better-calibrated LCSs will provide more accurate data	We believe this is self-evidently true.

#	Assumption	Evidence/reasoning
6	The charity will be able to provide meaningful and informative MEL services	While we think it is highly likely that an AIM-incubated charity would be able to provide high-quality MEL (especially in comparison with the likely counterfactual of local groups evaluating themselves), we worry that this may prove expensive, especially if some of the evaluation practices necessitate in-person visits. As such, budgeting constraints or cost-effectiveness considerations may limit the kind of MEL data the charity generates. Moreover, if engaging in MEL is not linked to incentives for the local groups, they may be unwilling to share their data or agree to be evaluated.
7	Stronger evidence on teams' performance allows teams to develop stronger strategies	We believe it is more likely than not that data generated by MEL activities will be informative for designing stronger strategies.
8	Providing support with developing ToCs results in stronger strategies	We think it is highly likely that ToC training and feedback will strengthen local teams' strategies – though we are somewhat concerned that, without incentives, teams may not take this advice on board.
9	The charity can conduct meaningful and informative research on the cost-effectiveness of different follow-up activities	We are somewhat unsure about the feasibility of collecting enough information about the costs and benefits of different follow-up activities and being able to generate internationally (or at least regionally) meaningful comparisons of activities based on their expected cost-effectiveness.
10	Synthesizing and sharing information between different teams helps them develop stronger strategies	We believe that facilitating knowledge sharing between different local teams is highly likely to lead to better strategies being developed.
11	The charity can conduct source apportionment studies that will be informative for local groups	We are unsure whether or not the charity will be able to conduct source apportionment studies. We believe this work is feasible but requires highly specific expertise, either among the founders or senior hires.
12 & 13	Better AQ data and better strategies translate into	See the evidence review (section 3.2).

#	Assumption	Evidence/reasoning
	increased political pressure	
14 & 15	Better AQ data and better strategies translate into greater awareness of air pollution by local authorities	We believe it is highly likely that, at the very least, local authorities' awareness of air pollution will increase.
16 & 17	Better AQ data and better strategies translate into more media coverage	We believe that this is highly likely, based on the available evidence (see e.g. Barwick et al., 2024). However, this may not be true in all locations – e.g. if the state has a strong control of the media and is not on board with publicizing information on poor AQ.
18	Increased political pressure, local authority awareness, and media coverage increase the chances of policy or regulatory responses	This is a key assumption behind this ToC. While there is a growing set of case studies demonstrating that well-designed AQ-monitoring programs (with strong follow-up activities) can lead to policy or regulatory changes, rigorous quantitative evidence is missing. As such, we are highly uncertain of the likelihood and strength of this causal relationship.
19	Increased media coverage results in more protective behaviors	We think that protective behavioral responses are likely, based on the available evidence (see e.g. Barwick et al., 2024). However, citizens' capability to alter their behavior may vary between places (e.g., poorer people may not afford not to go to work or to buy face masks).
20	Government response results in improved AQ	We think it is likely that successfully passed policies and regulations will translate into meaningful improvements in AQ. However, this may turn out not to be true in countries with low state capacity and weak enforcement.
21	Improved AQ translates into improved health outcomes	We are confident that this change would benefit people's health. See section 3.3 for details.
22	Protective behaviors translate into improved health outcomes	If people are exposed to less PM pollution, even if the ambient levels are unchanged, we are confident that they will benefit in terms of their health outcomes.

3 Quality of evidence

3.1 Evidence that charities can contribute to increased monitoring

We think it is likely that a charity can contribute to increased monitoring by providing technical assistance to individuals or organizations setting up monitoring stations. We largely rely on expert views and thinking by analogy to understand what a charity could plausibly do. As such, we note the relative weakness in the quality of evidence pertaining to this question.

Many AIM-incubated charities have successfully designed learning modules, including HealthLearn, which has built an online learning platform. This charity's work should be easier because the participants are presumably highly motivated to learn, as it may result in higher chances receiving funding from entities such as EPIC, and being able to join the community of grantees. In our interview, Christa Hasenkopf said she believed strong incubatees could get up to speed with the technical details of AQ monitoring fairly quickly.

AIM also has good resources and a track record of teaching potential founders strong ToC-development skills. MEL skills are more complex to teach quickly—there may be a substantial benefit in at least one of the cofounders already having those skills. As long as it is feasible to collect the necessary data, we are confident that the charity founders would either be able to do cost-effectiveness analyses themselves or find hires/contractors in the AIM community who would be able to conduct such analyses. Examples of past AIM-incubated charities engaged in similar activities include The Mission Motor (which provides M&E services to organizations working in the animal welfare space) and CEARCH (which conducts research and cost-effectiveness analyses of grantmaking opportunities).

Lesson sharing on what works also seems highly tractable. Other non-profits in this space are already doing this, for instance, OpenAQ, EPIC, and CAMS-Net.

Learning groups and communities of practice abound in development. We think that the challenge here won't be the ease with which an organization can set up learning environments, but rather the difficulties involved in ensuring those environments are productive.

Some organizations already calibrate LCSs, such as AfriSET. We are confident an AIM-incubated charity could do it, too. However, transporting sensors over long distances or across borders may turn out to be complicated, so the charity may need to adopt a more localized approach (similar to AfriSET's) or procure a greater number of sensors – which could affect the charity's overall cost-effectiveness.

Source apportionment has been performed by academic researchers many times before, so we are confident that this is a tractable type of activity (see e.g. Li et al., 2020; Anwar et al., 2024; Fakhri et al., 2024). However, we are concerned about the required level of expertise and the likely need to have this expertise in-house. A lack of this kind of expertise among the founders or senior hires would very likely make systematically conducting apportionment studies infeasible for this charity.

Co-founders (or their hires) with strong organizational skills should be able to convene international meetings—we are not too concerned about the technical feasibility. However, it may prove costly and be outside the charity's budget. Christa Hasenkopf estimates a conference may cost ~USD 250,000 to organize.

3.2 Evidence that the change has the expected effects

***Summary**: A growing evidence base suggests that increasing AQ monitoring (and/or increased transparency) leads to improvements in air quality. Evidence also indicates that when publicizing air pollution information, citizens increase protective behaviors, such as avoiding the outdoors. However, the evidence base is overall limited: We were only able to find three high-quality causal studies: one assessing the effect of transparent air quality monitor installations on $PM_{2.5}$ levels; one assessing the impact of transparent air quality monitoring on behavioral* *responses; and one studying the effect of disclosing non-compliance with air-pollution regulations on $PM_{2.5}$ levels. Two of these were done in China, limiting the external validity of the available evidence. There is, however, a growing set of anecdotal case studies of countries or cities that experienced promising developments following the installation of AQ monitors.*

In Figure 6 below, we map out the potential causal pathways we have identified that may link increased AQ monitoring to reduced exposure to air pollution.

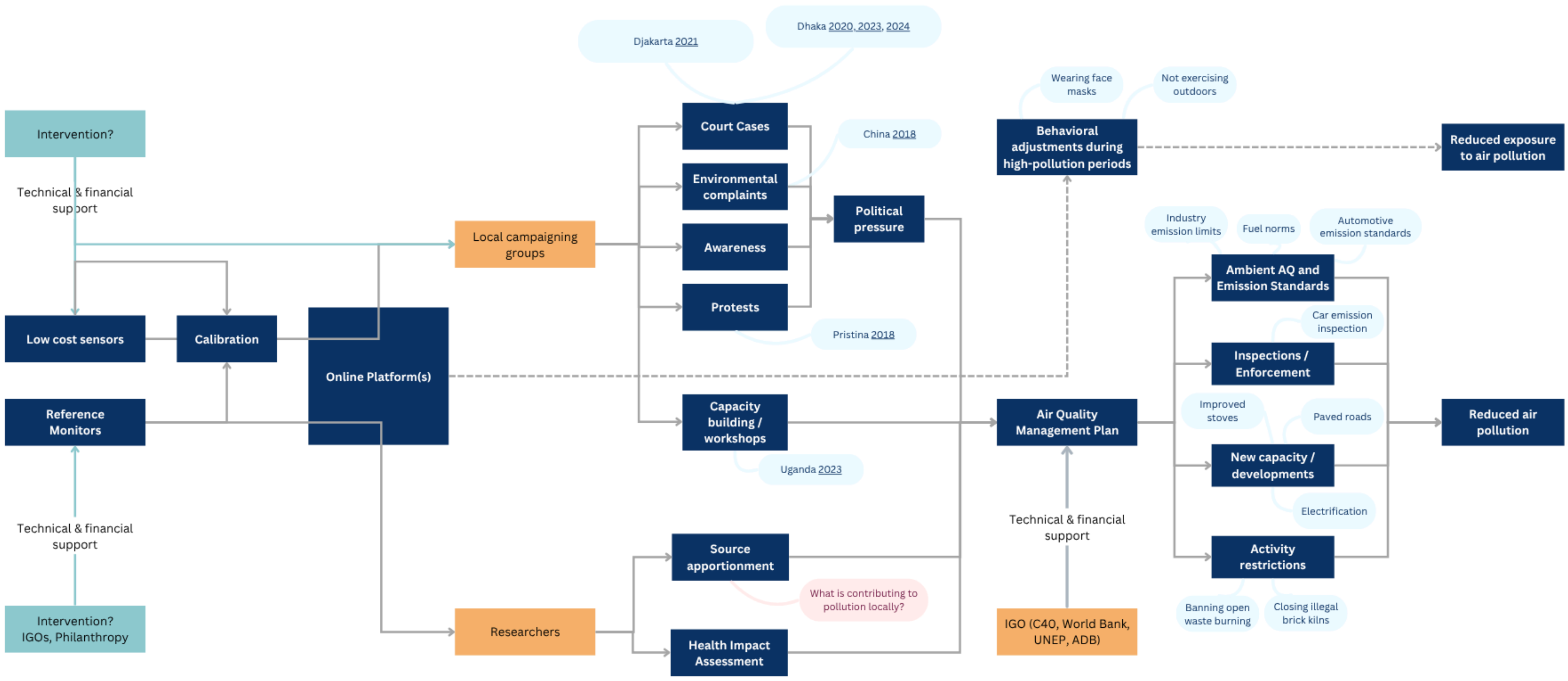


Figure 6: Potential causal pathway(s) from air pollution monitoring to reduced air pollution (diagram with hyperlinks).

Causal evidence

We found three causal studies analyzing the effects of transparent air quality monitoring, all finding significant effects on air pollution levels and/or exposure to air pollution.

Firstly, Jha and La Nauze (2022) found that reductions in local $PM_{2.5}$ levels followed installations of AQ monitors on the roofs of US embassies. The authors analyzed data from 50 such embassies (in 36 non-OECD countries), which all installed monitors in the period since 2008 and then started publicly sharing their data.[7] By looking at air pollution levels before and after air quality monitors were installed and comparing these 50 locations with 400+ cities around the world, the authors obtained a plausibly causal estimate of the effect of this program on AQ levels. They concluded that the program resulted in an average reduction of $PM_{2.5}$ levels of 2 to 4 $\mu g/m^3$ per year (i.e., a cumulative effect size) for at least six years after monitor installation (see Figure 9 below).

A significant limitation of this study is that it doesn't present the causal mechanism underlying this effect, i.e., how exactly the additional monitoring led to reduced levels of ambient $PM_{2.5}$. The authors are working on better understanding the exact causal chain; however, it is uncertain whether or when they will publish their findings.

[7] Under the current administration, the US government has now effectively stopped this program (Air Quality News, 2025). If the program is permanently discontinued, the neglectedness of AQ monitoring will significantly increase. As of writing (12/08/2025), we could not find any evidence that the program has restarted.

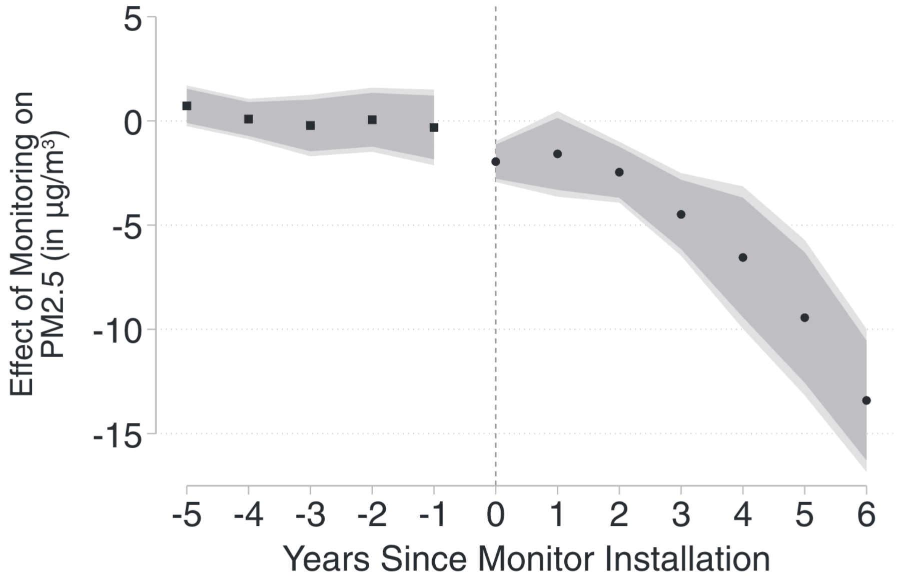
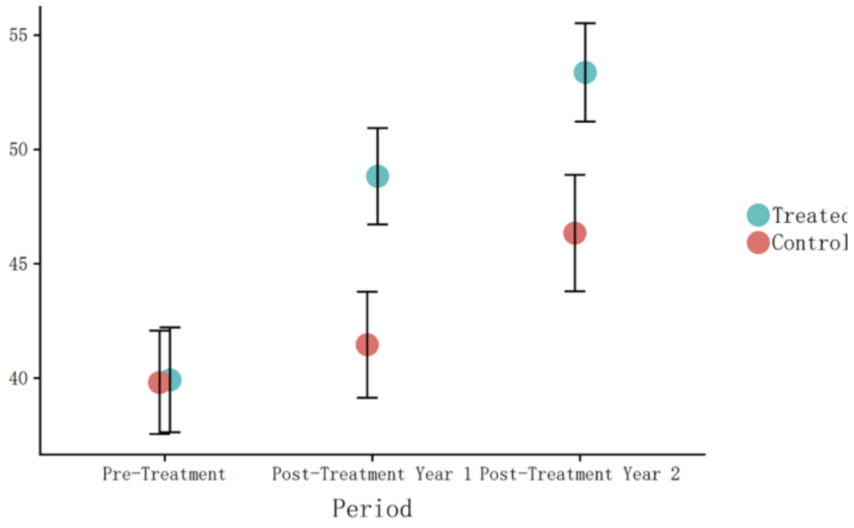


Figure 9: Figure from Jha & La Nauze (2022) representing the estimated contribution of US consulate $PM_{2.5}$ monitoring on local $PM_{2.5}$ levels

Secondly, using a randomized controlled trial, Liu et al. (2025a) found that increasing transparency directly resulted in improved air quality in China. The authors worked with the Institute for Public and Environmental Affairs to publicly rate 25 municipal governments in China based on their compliance with national rules to disclose information about topics such as local firms' emissions, inspections, and environmental impact assessments. First, they found that releasing these ratings increased cities' transparency (see Figure 10, top). Next, they found that treated cities experienced a reduction in ambient air pollution of 8–10% relative to control cities (i.e., around 4 $\mu g/m^3$; Figure 10, bottom).



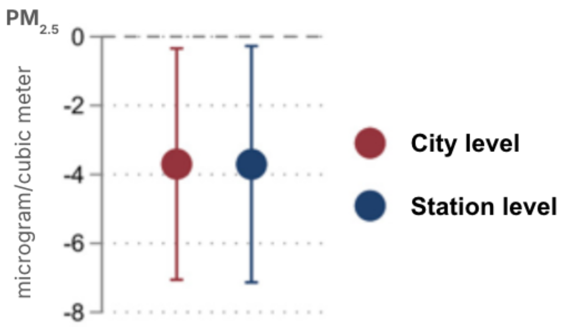


Figure 10: Effect of the intervention on city transparency ratings (left) and $PM_{2.5}$ levels (right). From Liu et al. (2025b).

The authors also found evidence that improved regulatory efforts by local governments and by reduced pollution violations by industrial firms mediated this change. They did not, however, find evidence of increased public or media attention, suggesting that "bottom-up" citizen pressure may only have played a limited role.

A potential limitation of this study is its focus on China, a country with centralized governance and relatively strong government capacity. As such, results may not translate to countries where local governments are less accountable to higher authorities or the public.

Another limitation to external validity is that the study focuses on transparency around emission, inspections, and violations – rather than transparency about $PM_{2.5}$ levels per se. This type of information is very targeted, specifically saying which firms are failing to meet their legal obligations, which may make it more conducive to being followed by mitigating measures than information on overall $PM_{2.5}$ levels.

Lastly, Barwick et al. (2024) analyzed the effect of China's 2013–2014 nationwide rollout of a real-time air quality monitoring and disclosure program, finding that the "program triggered cascading behavioral changes such as stronger avoidance of outdoor pollution exposure and increased spending on protective products" (abstract). The study exploits the staggered introduction of this national program across 337 cities as a natural experiment. It uses data from credit card transactions as a proxy for outdoor consumption activities and data on air purifier sales as a proxy for spending on defensive technologies. They found that people's avoidance of outdoor activities and defensive spending rose almost immediately after the program's rollout.

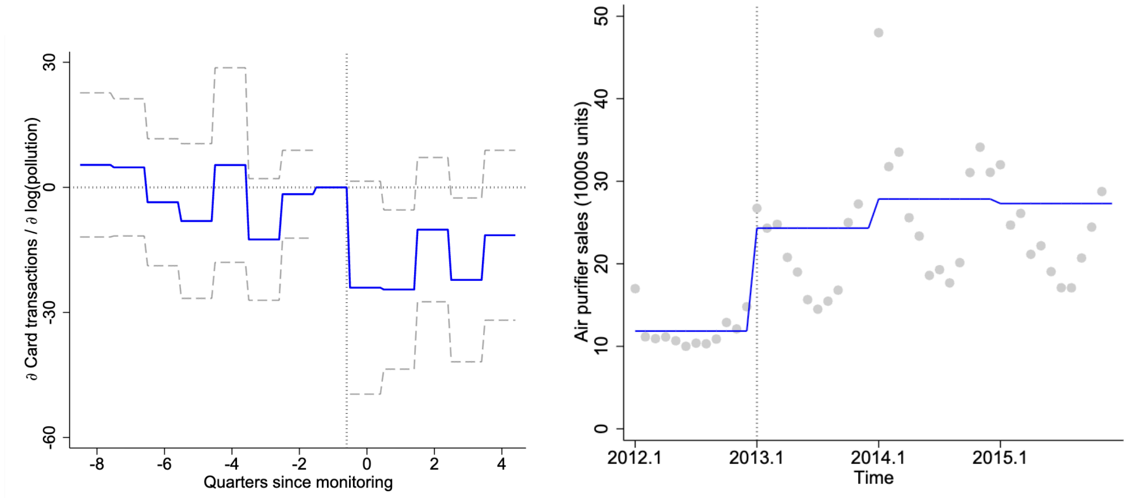


Figure 10: Left – Change in card transactions (a proxy for avoidance behaviors); Right – change in national purifier sales (proxy for defensive behaviors). From Barwick et al. (2024, figures 6 and 7).

The study additionally provided some insights into the mechanisms of these effects. The authors found that, by one year after the program's rollout, mentions of smog and air pollution in the local media increased significantly (by 0.60 standard deviations), as did web searches for information about smog and air pollution (by 0.75 standard deviations). Survey data show that respondents' environmental concerns, uncorrelated with their cities' air pollution levels prior to the program, became strongly correlated after the program's rollout.

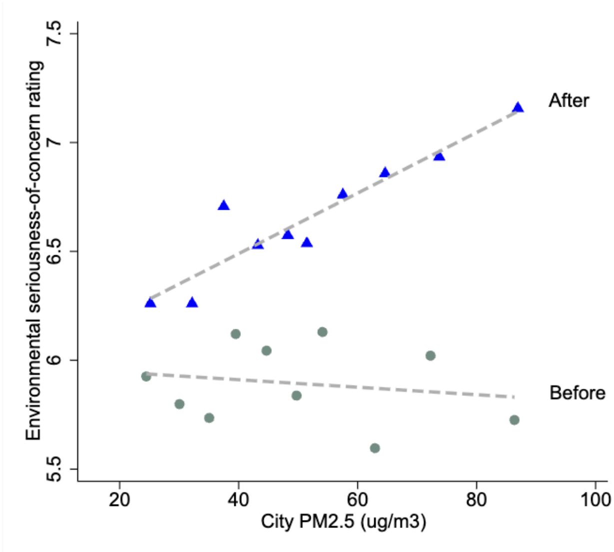


Figure 11: Survey-reported environmental by city pollution levels before and after program rollout. From Barwick et al. (2024 figure 5b).

Same as Jha and La Nauze (2022), this paper focuses on a natural experiment—not a true experiment—and, therefore, its conclusions rely on a set of assumptions; for example, that there were no other major policies that coincided with the program that could affect its outcomes. While they employ sensible analytic approaches to minimize the risk of bias, it should be noted that the risk cannot be fully removed.

Anecdotal evidence

This section includes a small selection of anecdotal case studies showing a likely relationship between the installation of AQ monitors and subsequent citizen or government action.

There are ample case studies of countries or cities where AQ data was used to bring about (or speed up) mitigation activities. For instance, local AQ data has been used to (successfully) support a court case against the government in Pakistan (Shaikh & Tunio, 2018) and Indonesia (BBC, 2021); it has been used to draft new legislation in the Gambia (Christa Hasenkopf interview); it led to public protests in Kosovo (Morina, 2018); and it has informed the standards in Uganda’s national air quality regulations (AirQo Blogs, 2023).

Pristina, Kosovo

In January 2018, protests in Pristina about air pollution seemed to have been directly related to the availability of $PM_{2.5}$ data offered by the US consulate monitor: "Hundreds of citizens of Kosovo's capital staged a protest on Wednesday in reaction to data provided by the US consulate's Pristina Air Quality Monitor, which showed Pristina was the most polluted city in the world during the last few days" (Morina, 2018, para.1). The US consulate monitor started publishing $PM_{2.5}$ concentration records in 2016 and the Hydrometeorological Institute of Kosovo started publicly sharing their AQ data in 2017 (Shala et al., 2022). This short succession of events suggests a plausible causal relationship between transparent data availability and the subsequent protests.

Kampala, Uganda

In Kampala, local authorities initiated AQ monitoring efforts in 2018, with actual measurements commencing in December 2019 (Clean Air Fund, & Vital Strategies, n.d.) – roughly one year after the US embassy started publishing their $PM_{2.5}$ data. In a 2022 bulletin, the Kampala Capital City Authority (KCCA) mentions two studies (conducted 2014 and 2015 respectively), as well as the US Consulate monitoring data, as a potential trigger: "It became clear to KCCA that poor air quality posed a serious risk to the health of Kampala residents and should be prioritized in the city's five-year strategy" (KCCA, 2022, pp. 6–7).[8] Far from trying to hide worsening air quality, the authorities seem to have been fairly proactive at sharing numbers and raising awareness around air pollution issues (KCCA, 2018).

Pakistan

The Pakistan Air Quality Initiative installed a network of low-cost sensors to demonstrate the severity of air pollution in the country. Based on our expert interviews, these sensor readings were instrumental in helping win an AQ court case in which the government was ordered to monitor AQ.

[8] The two studies are Schwander et al. (2014) and Kirenga et al. (2015).

The Gambia

In the Gambia, EPIC Clean Air Fund grantee Permian Health has made rapid progress on the policy front in approximately the last two years. They have managed to source and set up a reference-grade monitor for the country in collaboration with the government. As a result of this collaboration, the national environmental agency has drafted a landmark environmental policy that is designed to address clean air policy and specific enforcement plans. The draft legislation is moving through the Gambian legislative process (Christa Hasenkopf interview). While the policies have yet to go through parliament, this experience suggests that rapid progress is possible after high-quality, transparent AQ monitoring is set up.

Argument from analogy

In many domains of global health and development, we are accustomed to using quantitative data to inform our strategies. Data from sources such as the Global Burden of Disease (GBD) study or the Demographic and Health Surveys (DHS) has proved indispensable in past AIM decisions to incubate new charities. Compared to data on many diseases, however, air pollution information is often too scarce for us—or other actors— to pinpoint the highest-burden areas and design effective interventions. There is a level of similarity between air pollution and lead exposure: Lead exposure, too, is significantly under-researched, which has slowed down global progress on addressing it. AIM has already incubated two charities whose primary activities involve collecting data on lead exposure, with the explicit aim of using the data to enable mitigation activities (lead paint studies in the case of LEEP and market surveys in the case of LeRA).

Is AQ monitoring necessary?

One may wonder if air quality monitoring is even required in the first place. There are indeed activities that seem to robustly reduce air pollution without the need for increasing monitoring capacity. In Table 3, we summarize a few arguments in favor and against the necessity of continuous air quality monitoring to reduce air pollution.

Table 3: Is monitoring required in the first place?

Is monitoring required?	
Yes	**No**
• Is required for governments to set air quality standards and track progress. A lack of data may prevent policy introduction or effective enforcement • Allows for source apportionment, which allows government to prioritize interventions and policies	• Existence of well-evidenced solutions to ambient air pollution that a government could enact without the data; e.g., banning open waste burning; banning mandating catalytic converters and particulate filters on cars; promoting public transportation; etc.

Is monitoring required?	
• Can lead to public attention/outcry, upping pressure • Necessary in court cases • Allows for alerts and enactment of temporary measures (e.g. temporary closure of factories, adoption of protective behavior, adapted schooling) • Allows the global philanthropic community to identify the high-burden where interventions could have the greatest impact • Ground-based monitoring may be required by regulators who may dismiss satellite-based data as unreliable	• Existence of satellite data, soon to be hourly in many areas, reduces uncertainty created by data gaps • Air pollution can be seen and felt. We don't need to measure it to know it is there

Overall, our view is that, while AQ monitoring is not strictly necessary in order for us to tackle air pollution in some parts of the world, it can be a significant enabler of action in many other parts of the world – especially action that is driven by local governments and communities.

Is AQ monitoring sufficient?

The other important question is whether AQ monitoring alone is sufficient to stimulate mitigation activities. Our view is that it is not, and that the installation of AQ monitors should be paired with two more elements in order to maximize the chance of subsequent impact:

1. **Transparency**: Data on air pollution will only be impactful if it is shared in an open and easy-to-access format with anyone who wants to use it. This may sometimes require bypassing third parties, such as domestic or foreign governments, who may have the ability to withhold or tamper with the data. Websites such as IQAir and OpenAQ make it their explicit focus to encourage and enable easy and transparent AQ information sharing.

2. Explicitly pairing monitoring capacity with **follow-up activities**: Setting up AQ monitors without any plans for follow-up steps raises the risk that no mitigation activities take place. As such, a charity can maximize its chances of success by creating plans for how the data will be used to generate government or civil society interest—or work with existing local groups that already have promising follow-up plans and provide them with the necessary support to turn those plans into reality.

3.3 Evidence that reduced ambient $PM_{2.5}$ exposure leads to reduced health burden

***Summary**: There is strong evidence that exposure to $PM_{2.5}$ harms human health. However, there are significant disagreements about the strength and shape of the relationship between $PM_{2.5}$ exposure and health effects (such as mortality risk). This is largely due to the difficulty of studying these effects, because estimates rely on longitudinal observational data. There is also uncertainty in the literature about the relative toxicity of different particulate matter (e.g., inorganic vs carbonaceous), which indicates that certain sources may be significantly more harmful than others for the same amount of emission.*

Strength of evidence rating

In its most recent edition of the Global Burden of Disease, the Institute for Health Metrics and Evaluation (IHME) included a Burden of Proof section that explores the "strength of evidence between health risks and outcomes, indicating the likelihood that certain behaviors have an impact on health" (IHME, 2024). **Particulate matter pollution consistently reached three out of five points in their rating regarding the robustness of results.**

Risk A variable associated with an increased risk of disease or infection.	Outcome A health outcome or modification of health that results from exposure to a given agent, or risk factor. Usually reported as a relative risk of the outcome occurring.	RO Score A score metric that indicates the strength of the evidence for an association for a given risk-outcome pair. Negative scores suggest there may be no association once between-study heterogeneity is accounted for. Positive scores indicate evidence of an association, with higher scores indicating a stronger association.	Star rating A five-star scale representing the robustness of results. Higher star ratings signify greater strength of evidence for and magnitude of an association between risk and outcome.	Data type The type of data associated with each Risk/Outcome pair. Click the buttons in this column to view a visualization of the detailed results for each pair.
Particulate matter pollution	Chronic obstructive pulmonary disease	0.44	4	Continuous
Particulate matter pollution	Tracheal, bronchus, and lung cancer	0.34	3	Continuous
Particulate matter pollution	Ischemic heart disease	0.26	3	Continuous
Particulate matter pollution	Diabetes mellitus type 2	0.19	3	Continuous
Particulate matter pollution	Stroke	0.17	3	Continuous
Particulate matter pollution	Lower respiratory infections	0.15	3	Continuous

Figure 12: IHME's Burden of Proof ratings for particulate matter pollution.

An ambient air pollution mortality model

The relationship between ambient air pollution and mortality risk has been captured by multiple quantitative models, such as the Global Exposure Mortality Model (GEMM) (Burnett et al., 2018)**.** As shown in Figure 13, this model estimates a strong relationship between air pollution and the risk of noncommunicable diseases and lower respiratory infections. For instance, those living in an area with ambient $PM_{2.5}$ levels of 32.9 µg/m^3 (i.e., the global urban average; WHO, 2024) have a hazard ratio of about 1.25 compared to those living in areas with $PM_{2.5}$ levels below 3.0 µg/m^3, implying they're expected to die from noncommunicable diseases or lower respiratory infections at a 25% higher rate.

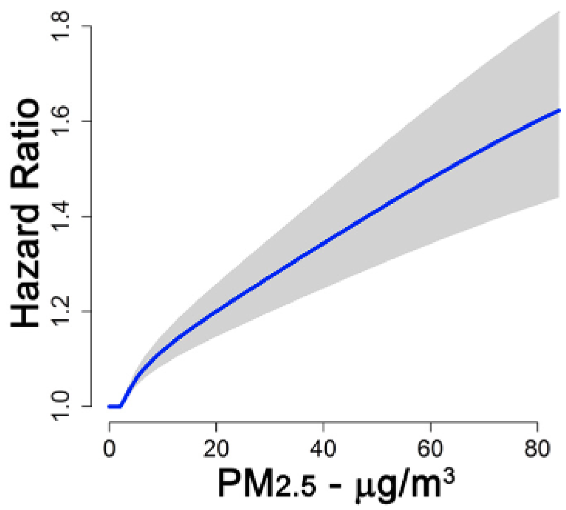


Figure 13: The relationship between ambient $PM_{2.5}$ levels and the hazard ratio of noncommunicable diseases and lower respiratory infections (Burnett et al., 2018).[9]

The curve is steepest at very low levels of exposure and roughly linear after that (until at least 80 µg/m^3). The grey area highlights the 95% confidence interval. However, Lelieveld et al. (2020) note that the level of uncertainty may be underestimated by about 50%.

[9] Note that this particular model is now considered relatively outdated. We encourage readers and potential founders of this charity to instead use the FUSION model by Burnett et al. (2022) or the latest Global Burden of Disease model (i.e., GBD 2023).

Assumption of equal toxicity

Lelieveld et al. (2020) also warn of key limitations: "The harmfulness of different types of particles, individually and in mixtures, is not well understood. The GEMM assumes that $PM_{2.5}$ toxicity does not significantly depend on the sources and chemical composition, which is a simplification that requires further investigation" (p.1915). This implies that the impact of AQ monitoring—and the subsequent assumed reductions in $PM_{2.5}$ exposure—may vary between different regions of the world, depending on the local sources of $PM_{2.5}$ pollution. While some emerging evidence seems to point toward certain sources being more harmful than others—for instance, diesel engine exhaust particles being worse than gasoline engine exhaust particles or coal combustion particles, and road dust being the least harmful (Park et al., 2018)—there doesn't seem to be a strong consensus yet on which particles are the most toxic.

3.4 Evidence of externalities and second-order effects

We expect that this intervention may cause a reduction in greenhouse gas (GHGs) emissions and therefore contribute to slowing down global warming. Emissions of some types of $PM_{2.5}$, such as emissions from coal power plants or brick kilns, are highly correlated with the emissions of GHGs, including carbon dioxide, methane, and black carbon. Therefore, at least in some places, this intervention should reduce total GHG emissions, on top of the health gains from reduced $PM_{2.5}$ pollution.

We also believe that it is likely that interest in air pollution spreads somewhat organically, so that supporting groups in certain cities may create positive spillovers to interest and activity in other cities. Lastly, we believe there may be broader societal benefits by nurturing citizen science and building the capacity of local actors to address their countries' health and environmental problems (in contrast to charities that deliver their interventions more directly, with less local involvement).

There is also some risk of negative second-order effects. If AQ monitoring is rolled out in some areas and not others, there is some risk of negative spillovers whereby polluting firms move to areas that are less well monitored. This was observed in China, where some polluting firms relocated to less developed regions with lower environmental standards (Fang et al., 2019).

4 Expert views

As part of our investigation, we consulted eight people who are familiar with this space.[10] Our findings from these conversations have influenced our understanding of this topic and our decision-making.

Several of the experts were consulted for an earlier version of this report, which considered a ToC based around developing AQ monitoring capacity in specific countries – as opposed to the "meta" ToC considered in this version of the report.

Three experts were explicitly asked about their views on the value of having a new meta-charity in this space. They were all supportive, saying that there is a whole range of potential activities that aren't being pursued by existing organizations. However, their views somewhat varied on where exactly a new organization may be most helpful:

- One expert expressed strong support for developing **high-quality online training modules** for new local teams to get them up to speed with the practicalities of AQ monitoring.
- One expert said that many groups may benefit from support with follow-up activities once data collection has been set up, such as **turning the data into convincing stories for the public and for relevant stakeholders**. Training or support with policy advocacy may be part of this as well.
- Two of the experts highlighted the value in different kinds of **convening** that would bring together policymakers, implementers (i.e., local groups), and funders. Firstly, policymakers are often under-informed about air pollution and ways to address it, so may benefit from attending workshops and interacting with implementers. Secondly, the AQ space is currently significantly underfunded, and exposing funders to successful implementers could be a promising way of getting them on board. Lastly, conventions would bring together implementers from different countries and allow them to share lessons they have learned.

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[10] This section has been anonymized and redacted as we had not received permission to speak about them publicly as of the date of publication. We may update a new version of the report if this changes.

- Two experts agreed that **MEL** is currently weak in the AQ space, with groups tending to share their wins but not their losses, meaning we don't have an accurate picture of what works. One expert noted, however, that MEL activities need to be linked to incentives (such as funding); otherwise, they may be seen as burdensome, without providing a clear benefit to the groups.
- Experts said that conducting **source apportionment** studies could be impactful and that it is something many groups could use support with. However, they also highlighted that specific expertise is needed for this and that, for the charity to do this well, it should have in-house expertise/experience with this type of research.
- One expert highlighted that a regional, rather than global, focus may be preferable. Smaller regions are more likely to share similar needs and be better able to learn from each others' successes.

5 Additionality and geographic assessment

This section discusses our considerations of additionality and our review of locations where this idea could be delivered in light of the burden, tractability and potential additionality.

5.1 Neglectedness

Neglectedness

We are moderately concerned about the neglectedness of this idea.

There are several organizations focused on enhancing regional or global AQ monitoring infrastructure:

- **Energy Policy Institute at the University of Chicago (EPIC):** EPIC (specifically, its Clean Air Program) focuses on providing USD$50–75,000 grants to promising local groups that plan to set up AQ monitoring capacity and have plans to use the data generated for national-level impacts, like the creation of new air quality standards. EPIC has some capacity to support grantees with technical assistance, such as on how to set up monitors so that they are sharing data correctly. They've awarded grants to 31 groups[11] and are expecting to support even more teams in further funding rounds.
- **OpenAQ:** A major NGO in the AQ space which collects and shares real-time and historical AQ data from around the world, including government monitors and low-cost sensors, and standardizes the data into a uniform database. It also runs the Community Ambassador Program, which trains local leaders in polluted regions to use data for grassroots action.
- **Clean Air Monitoring and Solutions Network (CAMS-Net):** CAMS-Net is a network of partner networks, based at Columbia University, focusing on

[11] Their grantees are based in Bhutan, Nepal, Pakistan, Lebanon, Honduras, Cameroon, Ghana, Nigeria, Uganda, Burkina Faso, Zambia, Côte d'Ivoire, Liberia, Malawi, Mozambique, Zimbabwe, the Gambia (and the list keeps growing).

improving the use and impact of low-cost air quality sensors (LCSs) globally. They help calibrate LCSs and build research capacity by training scientists and early-career researchers through student exchanges, workshops, and conferences. Based on our conversation with Daniel Westervelt in June 2024, it is our understanding that CAMS-Net has funding to operate until December 2025.

- **AirQo:** Based at Makerere University, AirQo's mission is to bring AQ monitoring to cities in Africa. It develops its own low-cost sensors and runs an online platform for data sharing. They also organize workshops, seminars and international forums, such as the CLEAN-Air Forum in 2024 in Lagos, Nigeria and in 2025 in Nairobi, Kenya. These have brought together communities of practice in Africa to promote knowledge sharing and collaborations.
- **African Sensor Evaluation and Training Centre (Afri-SET):** Afri-SET is a Ghana-based initiative focused on enabling accurate, reliable, and locally relevant air quality monitoring across Africa, especially in West Africa. They provide testing, training and calibration services on low-cost sensors.

Our sense is that the primary focus of most of these actors is on the technical and data side of AQ monitoring, with less of a focus on follow-up activities. EPIC is an exception here, as it specifically selects and supports grantees who have follow-up plans. OpenAQ also provides support to local groups. However, Christa Hasenkopf noted that, to her knowledge, no effort explicitly focuses on building a global infrastructure for AQ monitoring and action.

Major multi-lateral institutions have also focused comparatively little on AQ and its monitoring. For instance, while diseases like AIDS, TB, and malaria get annual reports from The Global Fund,[12] no progress reports like that exist for air pollution – which results in less sense of progress and global momentum around the problem. The WHO has also invested relatively little in AQ infrastructure, having hosted only its second conference in seven years on air pollution & health earlier this year (WHO, 2025) and, as Christa Hasenkopf highlighted, the conference didn't involve

[12] The Global Fund to Fight AIDS, Tuberculosis and Malaria

the majority of as high opportunity countries (i.e., those with high air pollution yet very few financial resources or data to address the issue; Hasenkopf et al., 2023).

5.2 Geographic assessment

The idea behind this charity is for it to be an international meta-charity, working with local teams across a range of countries. As such, a geographic prioritization is somewhat less important for this idea than for other charity ideas AIM explores, which often recommend focusing on specific countries. Nevertheless, a geographic prioritization exercise is useful to help identify a potential list of countries, as well as broader regions, in which this charity may operate.

We approach this assessment in two ways: (1) Building our own simple model and (2) summarizing the results of EPIC's geographical prioritization model.

AIM's geographic prioritization model

We have constructed a geographic prioritization model[13] based on a set of indicators intended to capture the scale/importance of air pollution in each country, the neglectedness of AQ monitoring, and tractability of working in the country. Table 4 below describes the factors/indicators we used to build this model, together with our rationale for using them, the assigned weighting of the variable,[14] and the data source.

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[13] Reported as of 12/08/2025—note the models are live and may be subject to tweaks or (in rare occasions) large changes that may not be reflected in the text if carried out after publication.
[14] The model calculates a final score for each country as a weighted average of the input factors.

Table 4: List of factors considered in our geographic assessment

Category	Name	Definition	Rationale	Weight	Source
Scale	Years of life lost from anthropogenic $PM_{2.5}$	Health burden that is preventable by reducing anthropogenic emissions	We prefer considering anthropogenic emissions, assuming biogenic emissions (such as sea salt and sand) are harder to prevent and given the shared suspicion that these are less toxic.	30%	Lelieveld et al. (2020)
Neglectedness	Monitor density	Measure of proliferation of AQ monitors. Defined as the number of monitors per million people. Lower value indicates bigger opportunity.	We assume a diminishing marginal return of monitors i.e. the first few monitors having more impact than the subsequent ones.	15%	EPIC's Opportunity Score
Neglectedness	Existence of National Air Quality Standards (NAAQS)	Binary variable indicating whether the country has already enacted NAAQS.	The existence of NAAQS in a country indicates that the issue is already on the radar of local authorities, hence potentially less neglected. Note that the existence of NAAQS could also be considered to increase tractability, as it would be easier to campaign and hold government accountable if monitored data can be benchmarked against local targets.	10%	EPIC and Online research
Neglectedness	Existing funding	Available international development funds for air quality infrastructure development. Lower value indicates bigger opportunity.	CE intervention is more likely to be impactful in a country deprived of development funds.	5%	EPIC based on Clean Air Fund report: The State of Global Air Quality Funding 2023, specifically Outdoor Air Quality Funding
Neglectedness	Existence of a monitoring dedicated intervention	Whether a program already exists that aims to increase monitoring in the country	Not yet implemented, will do if have time		

Category	Name	Definition	Rationale	Weight	Source
Tractability	Distance to typical NAAQS GDP	How far is the country GDP per capita (PPP, current intl$) from the value at which NAAQS has historically been introduced in other countries. Expressed in difference between country's GDP per capita and the yardstick value identified (Intl$ 5,900). Value is capped at 0 i.e. this is only used to "penalise" countries that are seemingly too poor to implement NAAQS."	It is assumed that a country with too few resources is unlikely to adopt, let alone enforce, air quality standards. In the other direction, the richer the country, the more likely it is to adopt standards without an additional intervention.	15%	Own research for NAAQS and World Bank for GDP figures. See Appendix 3 for details.
Tractability	FSI - Security apparatus	The Security Apparatus indicator considers the security threats to a state, such as bombings, attacks and battle-related deaths, rebel movements, mutinies, coups, or terrorism.	Representing the risk of operating in the country.	10%	Fragile States Index
Tractability	FSI - State Legitimacy	The State Legitimacy Indicator considers the representativeness and openness of government and its relationship with its citizenry.	I was looking at a factor representing the capacity for a charity to engage with government officials.	5%	Fragile States Index
Tractability	Ranking of $PM_{2.5}$ as a cause/risk of death	Ranking of $PM_{2.5}$ as a cause/risk of death in terms of life-years lost.	Air pollution issue will be more salient and the political pressure/desire to tackle it is assumed to increase as the risk factor is relatively more important.	10%	EPIC: AQLI for $PM_{2.5}$ and Global Burden of Disease tool by IHME for all other risks/causes

Table 5 below lists the top 25 countries based on this model. We can see that the majority (15) are in sub-Saharan Africa while the rest are spread between Southeast Asia (3), South Asia (3), South America (2), North Africa (1), and Eastern Europe (1).

Table 5: Top 25 countries from our geographic assessment.

#	Country	Region	Weighted average	Scale	Neglected-ness	Tractability
1	DR Congo	sub-Saharan Africa (SSA)	0.814	2.00	-0.34	1.05
2	Bhutan	South Asia	0.68	-0.39	0.81	1.35
3	Bangladesh	South Asia	0.66	1.68	-0.42	0.75
4	Rwanda	SSA	0.61	0.27	0.55	0.93
5	Indonesia	Southeast Asia	0.58	1.55	-0.04	0.35
6	Nepal	South Asia	0.57	0.90	-0.33	1.04
7	Myanmar	Southeast Asia	0.55	1.24	0.24	0.30
8	Vietnam	Southeast Asia	0.54	1.34	-0.18	0.50
9	Cameroon	SSA	0.52	0.46	0.61	0.55
10	Zambia	SSA	0.51	0.46	0.72	0.42
11	Burundi	SSA	0.49	0.43	0.72	0.39
12	Tanzania	SSA	0.46	0.76	0.69	0.10
13	Angola	SSA	0.45	1.00	0.76	-0.15
14	Nigeria	SSA	0.45	1.32	0.65	-0.31
15	Rep. of Congo	SSA	0.45	-0.09	0.81	0.61
16	Bolivia	South America	0.44	0.28	0.09	0.86
17	Lesotho	SSA	0.42	-0.02	0.81	0.49
18	Malawi	SSA	0.41	0.46	0.81	0.09
19	Morocco	North Africa	0.39	0.36	0.78	0.16
20	Sierra Leone	SSA	0.38	0.17	0.81	0.25
21	Brazil	South America	0.38	1.38	0.13	-0.17
22	Benin	SSA	0.35	0.32	0.75	0.11
23	Côte d'Ivoire	SSA	0.34	0.66	0.71	-0.12
24	Belarus	Eastern Europe	0.34	0.73	0.81	-0.31
25	Mozambique	SSA	0.35	0.76	0.67	-0.20

The model above is intended to be treated as indicative and preliminary only. Potential charity founders are encouraged to further develop it based on their needs, update based on newer data, or enrich it based on additional variables.

If we had more time, these are the improvements we would prioritize implementing:

- **Scale**: (i) Try to account for transboundary sources of $PM_{2.5}$ pollution, as these are significant in certain countries (e.g. in Bangladesh).
- **Neglectedness**: (i) List existing interventions in specific countries, starting from those with the highest "opportunity score". (ii) Update/validate the monitor density figures from EPIC/OpenAQ. For instance Rwanda seems to have had many more monitors than indicated in the dataset. These numbers are also susceptible to rapid changes. (iii) Try to quantify air pollution salience as a topic of concern (e.g. using Google Trends in various languages). (iv) Capture anecdotal information about neglectedness, such as that Francophone countries in Africa are comparatively more neglected (based on our expert interviews).
- **Tractability**: (i) Consider the existence of networks of hospitals or schools that could be tapped into.

EPIC's Opportunity Map

The EPIC team has constructed their own geographic prioritization model, visualized on the Opportunity Map website. This map is based on the calculation of an "opportunity score", which aims to identify countries where a small, targeted support in setting up AQ monitoring could help catalyze national-level change in air pollution (Hasenkopf et al., 2023).

Similar to our model, this model follows the logic of the ITN framework, combining indicators of Importance, Tractability, and Neglectedness. Specifically, it uses existing data on average $PM_{2.5}$ levels (relying satellite-derived estimates), population size, a measure of the strength of legal frameworks for ambient air quality standards, the quality of government-operated AQ monitoring infrastructure, presence of government-operated open AQ data, and the total number of AQ monitors. See Table A.1 in Hasenkopf et al. (2023) for details.

Using this model, the following countries have been identified as having the highest opportunity for impact:[15]

Table 6: 25 countries with the highest opportunity score in EPIC's model.

#	Country	Region	Opportunity score
1	**Democratic republic of the Congo**	sub-Saharan Africa	13.2
2	**Cameroon**	sub-Saharan Africa	13
3	**Honduras**	Central America	12.6
4	**Equatorial Guinea**	sub-Saharan Africa	12.4
5	**Bhutan**	South Asia	12.4
6	**Lesotho**	sub-Saharan Africa	12.4
7	**Burundi**	sub-Saharan Africa	12.4
8	**Zambia**	sub-Saharan Africa	12.4
9	**Angola**	sub-Saharan Africa	12.4
10	**Central African Republic**	sub-Saharan Africa	12.2
11	**Republic of the Congo**	sub-Saharan Africa	11.8
12	**Bolivia**	South America	11.8
13	**Malawi**	sub-Saharan Africa	11.8
14	**Iraq**	West Asia	11.8
15	**Rwanda**	sub-Saharan Africa	11.8
16	**Zimbabwe**	sub-Saharan Africa	11.6
17	**Côte d'Ivoire**	sub-Saharan Africa	11.6
18	**Afghanistan**	Central Asia	11.4
19	**Gabon**	sub-Saharan Africa	11.2
20	**Djibouti**	sub-Saharan Africa	11
21	**Nicaragua**	Central America	11
22	**Belarus**	Eastern Europe	11
23	**Haiti**	Caribbean	11
24	**Benin**	sub-Saharan Africa	11
25	**Cambodia**	Southeast Asia	10.8

[15] This figures as based on Hasenkopf et al. (2023). For the latest version of the model, see the Opportunity Map website.

Overall, there is both a high degree of overlap with our model but also some differences. As shown in Table 6, the majority (16) of the top 25 countries in EPIC's model are also located in sub-Saharan Africa, though the specific countries and their relative ordering somewhat differs. The other countries are spread between Central America (3), South Asia (1), West Asia (1), Eastern Europe (1), the Caribbean (1), and Southeast Asia (1).

6 Cost-effectiveness analysis

Summary: *We model that this charity can avert a DALY for around USD 42 and avert one ton of CO_2 for around USD 13. View our full model here.*[16]

6.1 Results

We modeled the possible cost-effectiveness of an AQ monitoring meta-charity working on supporting local groups in LMICs. The main result from our health cost-effectiveness analysis (CEA) is an estimate that such a charity may be able to counterfactually avert one DALY for around USD 42.

However, our result is extremely uncertain, and the real cost-effectiveness may be both significantly greater and smaller than this. It wouldn't surprise us if the true cost-effectiveness was an order of magnitude smaller or greater. This unusually high level of uncertainty is primarily due to two factors:

1. **The "meta" nature of this charity and the long ToC from the charity's activities to ultimate impact.** On a high level, the ToC has five stages: (I) This charity's activities, (II) Impact on local group's working on AQ monitoring, (III) Improvement in AQ monitoring, (IV) Increases in follow-up mitigation activities, (V) Improvements in health outcomes. Each of these stages introduces uncertainty in the CEA estimate. The "meta" nature also raises difficult-to-resolve questions about how to attribute impact to this charity, i.e., how much credit this charity should be taking for the successes of the local groups it supports.
2. **Our uncertainty about the exact activities this charity will engage in.** These choices, which will have to be made by the charity's founders, could have a significant impact on the CEA result.
3. **Uncertainty about counterfactual impact**: There is limited empirical data informing some of our key inputs, such as the expected effect of AQ monitoring on $PM_{2.5}$ levels or the counterfactual duration of the impact of

[16] Reported as of 12.08.2025—-note the models are live and may be subject to tweaks or (in rare occasions) large changes that may not be reflected in the text if carried out after publication.

this charity's activities. As such, we have had to guesstimate several of these inputs.

In addition to the health model, we built a rough back-of-the-envelope (BOTEC) calculation to estimate this charity's climate impacts. This BOTEC is based on the assumption that emissions of particulate matter are often correlated with emissions of greenhouse gasses. We estimate that this charity may be able to avert one ton of CO_2 GHGs for around USD 13. See this model here.

This result is, however, again highly uncertain, for the following reasons:

1. **We only built a quick BOTEC**, as opposed to a detailed model. It relies on a highly simplified way of calculating the total weight of averted $PM_{2.5}$ emissions and then uses this to estimate how much CO_2 is averted as well.
2. **The strength of this correlation varies very significantly depending on the sources of air pollution or the mitigation activities**. In our calculation, we use an average figure, but this figure may be highly inaccurate when applied to specific situations. To give an example: If $PM_{2.5}$ reduction in a given country is achieved by reducing the number of cars on the road, this will also reduce CO_2 emissions; if, however, reduction is achieved by mandating the use of catalytic converters, the effect on CO_2 emissions may be negligible.

6.2 Modeling choices

Effects

Given the possible range of activities this charity may engage in, it was infeasible for us to build a detailed CEA that models the effect of each potential activity. Instead, we focused on modeling two high-level effects: (1) The charity causing more funded local AQ teams to come into existence and (2) the charity increasing the chance that local teams are successful in their advocacy efforts. We assume that both of these would happen simultaneously and, as such, add up the results from both models into a single result.

Both of these models shared several modeling assumptions (most of which are highly uncertain):

- Each local team the charity would support operates on the level of a city, with the average target city population roughly 1.6 million.
- The average baseline $PM_{2.5}$ level is 32.9 µg/m^3 (which was the global urban average in 2019).
- Successful local-group activities result in a reduction in $PM_{2.5}$ 3.9 µg/m^3 (based on Jha and La Nauze, 2022), subjectively discounted to 2.3 µg/m^3.
- Each local group has a 20% probability of success.
- The average person in the target cities loses 0.020 DALYs per year.
- The average number of years between the implementation of AQ monitoring and mitigation activities is six years. This is an estimate based on (i) data from Jha and La Nauze (2022) who found effects (of the installation of reference-grade monitors by US embassies) already from year 2 onward and (ii) a Uganda case study, in which the charity AirQo took a total of nine years from advocacy to the enactment of AQ standards.
- Health benefits of $PM_{2.5}$ reduction are delayed by about ten years, on average (as a rough average of some immediate benefits and some very delayed benefits).

ToC 1: More local teams

We assumed that this charity would help more local teams get funding from grantmakers such as the EPIC Clean Air Fund. Based on the fact that, last year, EPIC received 29 “competitive” applications that it rejected, we assumed that there are this many teams per year that could benefit from the charity’s support, primarily in the form of an AQ bootcamp. We then made guesses that 65% of these would take part in the bootcamp and 65% of those would end up getting funded, for a result of 12 additional funded local groups per year.

However, we assumed that each of these local groups only receives a two-year counterfactual speed-up due to our charity’s work. In other words, we assumed that those local teams we help get funded would have got funded anyway two years later.

ToC 2: Stronger local teams

In this model, we assumed that the charity's activities—such as support with follow-up activities, MEL, facilitation of knowledge sharing, apportionment studies, etc.—will increase the chances of successful follow-up mitigation activities. We assumed that this charity would be able to support 15 local teams each year and increase their likelihood of success by 10%, over the baseline of 20% (i.e., by 2 percentage points). We then estimate that this would result in a counterfactual speed-up of mitigation activities by seven years.

Costs

We are highly uncertain about this charity's costs. As such, we kept this part of the model simple and relied on a few simple assumptions:

- The fixed costs in year 1 would be USD 130,000, in line with AIM's default CEA assumptions.
- The fixed costs from year 2 onward would be USD 200,000 per year. This is lower than the AIM default value of USD 280,000, as we expect this charity to be able to run a smaller budget than an average AIM-incubated charity.
- We additionally assumed that there would be four additional staff each paid USD 50,000, for a total of an additional USD 200,000 per year.

7 Implementation

7.1 What does working on this idea look like?

We rate all charity ideas we explore on the explore-exploit continuum. "Explore" ideas are those that require more research and design, and involve riskier bets and wider confidence intervals; "exploit" ideas are characterized by having a strong evidence based, a clear ToC, and may involve partly replicating the work of past academic studies or non-profits.

As shown in Figure 17, we rate this idea as roughly in the middle, but closer to the explore end of the spectrum. On the one hand, transparent AQ monitoring is something that has already been done in many countries, and there are many organizations involved in using AQ data to design and implement mitigation activities. Most of the possible activities for this charity have also been done by others in the past. On the other hand, the evidence base is relatively weak compared to many ideas we research, there is uncertainty about the exact ToC(s) to follow, and there is not a clear playbook to follow. As such, we expect that the founders of this charity will need to be open to a significant level of exploration, strategic development, and potentially experimenting with different things before finding a charity model that they are satisfied with.

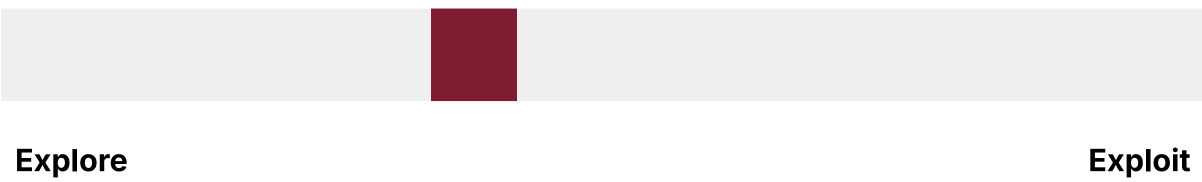

Figure 17: Our subjective rating of where this charity idea lies on the explore-exploit spectrum.

7.2 Key factors

This section summarizes our concerns (or lack thereof) about different aspects of a new charity putting this idea into practice.

Table 8: Implementation concerns

Factor	How concerning is this?
Talent	Low-moderate concern
Access to information	Low concern
Access to relevant stakeholders	Low concern
Feedback loops	Moderate concern
Obtaining funding	Moderate concern
Complexity of scaling	Low concern
Execution difficulty/Tractability	Moderate concern
Risk of harm	Low concern

Talent

Overall, we have a low-moderate level of concern about founder talent being a limiting factor for this charity. For many of the potential activities of this charity, we believe that a large percentage of the typical participants of the Charity Entrepreneurship Incubation Program (CEIP) could be a good fit for this charity idea. This is captured in Table 9 below.

We think that it would be preferable for at least one founder to have good experience with quantitative research (to be able to engage with the technical aspects of AQ monitoring and translate numbers into easy-to-understand stories), to have experience conducting M&E activities (if that's one of the founders' chosen focus activities), and to be a strong networker. While we don't believe that background in the AQ space is a must-have, having a cofounder with this background could be a significant advantage for the charity. Lastly, if the charity founders wanted to work and engage in source apportionment studies, we suspect that it would be highly advantageous – and possibly a necessity – for one of them to have some experience with this type of research. However, it may be the case that this could be achieved via a combination of strong senior hires and collaborations with third party (likely university) teams.

Table 9: Founder requirements and nice-to-haves

Must have	Preferable (offsets a 10% diff in incubatee strength)	Preferable, all else equal
No strict must-haves Experience conducting source apportionment studies (for that specific ToC)	Experience with quantitative research Experience with monitoring and evaluation (M&E) Strong networker Experience in the AQ space	Experience working in LMICs

Access

Information

We do not anticipate that access to necessary information would slow down this charity's progress. Where information on AQ is limited, it is actually a sign that the charity needs to focus its efforts there.

Relevant stakeholders

The existence and identification of local actors to empower and leverage is a critical factor of the intervention. Our sense is that gaining access to these actors – typically, NGOs, universities or other local institutions – should be relatively easy, as these groups often want more support in their activities. A strong relationship with existing meta-organizations in the AQ space will further improve access to these teams.

Feedback loops

As a meta-charity whose impact depends on the actions of others, it may be somewhat challenging for the charity to create good feedback mechanisms. It may have to carefully design M&E plans to assess the impact its programs are creating for the teams it works with. Finding a fair counterfactual may be difficult and may require special attention from the outset.

Funding

Funding from funders in the CE network

The Energy Policy Institute at the University of Chicago (EPIC) has received USD 1.5 million from **Open Philanthropy** (OP)[17], indicating the foundation's interest in supporting AQ infrastructure projects (EPIC, 2025). Abid Omar, the founder of the Pakistan Air Quality Initiative, also received a grant from OP.

Founders Pledge has also explored the topic of air pollution and made grants to at least two charities in this space: Clean Air Asia and Vital Strategies (Barnes, 2022; Founders Pledge 2022a; Founders Pledge 2022b). This suggests they may be interested in this topic – though their priorities may have shifted since 2022.

We are less certain about other funders' interest in this space, but believe that the idea would be attractive to other impact- and cost-effectiveness-focused funders.

Broader funding sources

The **Clean Air Fund** (CAF) is a major funder in this space. For instance, Afri-SET – whose representatives we spoke with – received $1 million from CAF. See the CAF grants page for details.

More broadly, the topic of air pollution in LMICs seems to be underfunded – something that several of our expert interviewees have highlighted. AQ monitoring is not part of the Sustainable Development Goals (SDGs), which has made it harder

[17] It has also received an additional USD 1.4 million from other sources.

to attract funder attention to it. As such, we are somewhat concerned about this charity's ability to attract funding.

Tractability

We are moderately concerned about the tractability of this charity idea. While doing *some* useful work in the AQ monitoring space doesn't seem too difficult, building a world-class charity that achieves highly cost-effective counterfactual impact may be challenging. Firstly, the impact of this charity strongly depends on the work of third-party actors, so developing strong relationships and trust is a must. Secondly, due to the charity's distance from end-line impact, it may be difficult to know what counterfactual impact it is having – and potentially easy to fool oneself that this impact is greater than it truly is. As such, founders should have a strong inclination toward skepticism and lean toward over- rather than under-investing in M&E. Lastly, the charity founders will likely have to engage in extensive strategic planning and potentially experiment with focusing on several different types of activities – which makes this charity idea more difficult to implement than those with very clear and simple ToCs.

Complexity of scaling

Once the charity founders have found a tractable model, we believe that scaling may be relatively easy. There are many countries/cities around the world where there is a need for strengthening AQ monitoring & transparency capacity, and there is a growing number of local teams that may benefit from support. As such, we are optimistic about this charity's ability to scale its impact.

Risk of harm

We do not anticipate any significant risks of harm.

8 Conclusion

Air pollution is one of the greatest global contributors to poor health and lost years of life. Transparent AQ monitoring is a strong prerequisite for effectively reducing the harms of air pollution. However, many countries around the world are currently lacking a robust AQ monitoring infrastructure. We believe that an impact-oriented meta-charity in this space could significantly contribute to speeding up progress toward cleaner air and better lives. As such, we see this idea as worth recommending for the Charity Entrepreneurship Incubation Program.

Appendix 1: Sensor types and more information

According to an expert interviewee, most low-cost $PM_{2.5}$ sensors rely on the same sensor, Plantower, which can only capture particles between 200 and 800nm. Diesel particles, for instance, wouldn't be captured by such sensors. This limitation makes such sensors unable to discriminate between different sources of particles. Calibration is a way to mitigate such limitations and needs to be done regularly, especially when the sources of air pollutants are changing.

Table A1: Types of instruments to measure particulate matter and gaseous air pollutants

Category	Cost	Pros	Cons
Ambient air pollution			
Reference Federal Reference Method (FRM) monitors	USD 15–50k + high maintenance costs (link, link)	**Allows for:** Air quality regulations Source apportionment studies Epidemiological studies Calibration of low-cost sensors Respected by regulators who demand high-quality data.	High capital and operating costs Requires technical capacity to operate and share data
Reference Federal Equivalent Method (FEM) Monitors	USD ~20k (link)	Demonstrated ability to produce results equivalent to FRM for measuring specific pollutants.	High capital and operating cost
Medium-cost sensors	QuantaAQ Modulair USD 2.5–10k (link)	Allows for source apportionment studies[18] Easy to operate Includes gases and particulate matter of different sizes	May not meet some regulators' requirements.

[18] Source apportionment study: analysis of the air pollution sources and their respective contribution to ambient air pollution levels. See Westervelt et al., (2024) for one example of such study with medium-cost sensors.

Category	Cost	Pros	Cons
Low-cost sensors (stationary)	USD 100s (link)	Low cost Ease of installation and use Comes with a digital dashboard, mobile app Better geographical coverage (network)	Inconsistency Inaccuracy Apportionment studies with low-cost sensors are still experimental[19] Short lifetime (especially for gas sensors)
Low-cost sensors (wearable)	USD ~200 (link)	Give a closer estimate of individual exposure Highlight exposure to inequality	Low accuracy Not systematic
Emission monitoring/measuring			
Industry Continuous Emission Monitoring Systems (CEMS)	USD 100k – 1M+	High accuracy Real-time monitoring Essential for regulatory compliance	Very high cost Complex maintenance Requires specialized technical expertise
Automobile Portable Exhaust Gas Analyzers	USD 2k – 20k	Portable Real-time data Useful for on-site testing	Limited to specific gases Regular calibration needed
Remote sensing			
$PM_{2.5}$ satellite-based	Free	- Global coverage - Free of charge	Limited accuracy (Alvarado et al., 2019) and granularity

There is a growing trend of combining the data from different sensors to obtain a "best of all worlds" solution (low cost, high precision, large coverage, etc.). For instance, a single reference-grade monitor (or a small number of them) can be combined with a network of low-cost sensors and satellite data in order to generate an AQ map of a whole city that is reasonably well calibrated and granular while keeping the overall cost down (Hoffmann & Milusheva, 2024).

[19] Bousiotis et al., (2022) is an example of these.

Appendix 2: Potential policies to mitigate PM emissions

Table A2 outlines an overview of potential actions that a government could take and what our assessment is on how effective those strategies are.

- Regulation enforcing cleaner fuels – low sulfur diesel (& ban high oil mix gasoline, etc)
- Requirements on new vehicles to have better engines
- Think tank advocating for supporting government on market-based approaches to air quality policy
- Better waste collection and management and bans on burning waste
- Promotion and subsidies for solar lighting
- Paving roads or road dust binding (in SSA/ Sahel where there is lots of dessert / mineral dust)
- Promotion and subsidies for clean cookstoves
- Improve use of renewable energy sources rather than coal etc. End coal subsidies. Etc

Appendix 3: Additional information for the geographic prioritization model

Economic stage as a tractability criterion

Development stage is likely to be a critical factor for both tractability and neglectedness: too early and the country probably won't have resources to act on the monitoring data; too late and the charity might not accelerate the monitoring of air quality by a significant margin.

To leverage that assumption, we manually collected the date of the first air quality standard for a selection of countries in various continents (a subset of those indicated as having National Air Quality Standards in EPIC Opportunity Score). According to this sample, the GDP per capita, PPP at the time of the first introduction of air quality standards was on average $8,429 (constant 2021 intl $). The 25th and 75th percentile were respectively $4,858 and $11,202. We use the distance to this window as a tractability indicator (negatively weighted). In other words, the model will favor countries that are within or close to this window of GDP per capita.

Table A3: GDP per capita, PPP at which first air quality standards were issued

Country	Year of first air quality standard	GDP per capita, PPP (constant 2021 international $)	Source
Argentina	1973	-	link
Sri Lanka	1994	$5,136	link
Paraguay	2014	$14,171	link
Bangladesh	1997	$2,580	link
Thailand	1992	$9,811	link
Indonesia	1999	$5,911	link
South Africa	2004	$12,447	link
Jamaica	1996	$9,957	link
Kenya	2014	$4,580	link
Chile	1978	(omitted)	link
Colombia	1982	(omitted)	link
Mexico	1994	$18,863	link
Ghana	2019	$6,454	link
Uganda	2024	$2,811	link

Country	Year of first air quality standard	GDP per capita, PPP (constant 2021 international $)	Source
	Median	$6,454	
	Mean	$8,429	
	25th percentile	$4,858	
	75th percentile	$11,202	

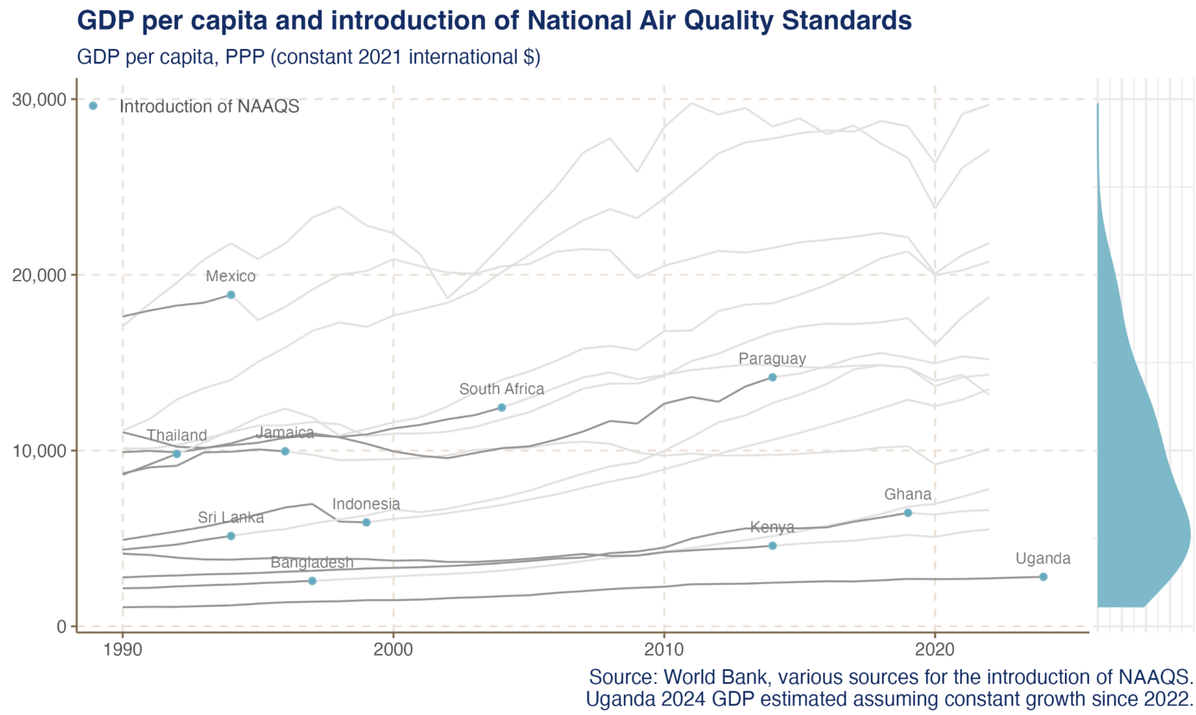

Figure A1: GDP per capita and introduction of National Air Quality Standards (own research)

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