Fighting for Clean Air Around the Globe

Air Quality Workshop Outcome Document

Elizabeth Moses

Executive Summary

From April 11–13, 2018, WRI's Ross Center for Sustainable Cities, OpenAQ, and WRI's Governance Center, in its role as secretariat of The Access Initiative, hosted a workshop on air quality with 15 civil society experts from across the globe who have implemented successful strategies in the fight for clean air. The workshop was designed to collectively investigate the different air quality challenges and entry points in policy, public-sector administration, and private-sector priorities and unpack the key drivers of successful work.

This document synthesizes key insights and entry points for action from the workshop and provides recommendations to WRI as we develop our strategy to address air pollution and the range of environmental, public health, and socioeconomic impacts in partnership with OpenAQ. Based on our lively discussion, we found the following key lessons for building a global movement for clean air:

April 11–13, 2018

WORKSHOP ON AIR QUALITY

Washington, DC

The contents of this report reflect the views of the workshop participants and do not necessarily reflect the views of the World Resources Institute or other conference partners. The content of this report aims to faithfully reflect the conversations and content generated at the workshops, but for ease of readability some wording has been edited.

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1. **Collective action requires more effective coordination among the diverse set of air quality actors working across different scales and in different scientific, policy, legal, and data silos.** The workshop highlighted the different strategies being used to achieve regulatory reform as well as the gap between air quality data generators and the way data are used to address policy questions and approaches. Connections between air quality and health impacts and other social issues in particular was repeatedly emphasized as an important example of where multi-sector collaboration was needed. Workshop participants suggested that WRI, in close partnership with OpenAQ, is well positioned to facilitate the necessary bridge building and should prioritize strategies that bring these communities together for effective, collective action.

2. **Civil society actors are using a wide range of accountability strategies to address air pollution policy failures.** These include the use of social media, public art, strategic litigation, advocacy campaigns, generating and leveraging new sources of data, and fostering multistakeholder coalitions. This variety points to the need for deeper evaluation of these strategies and tactics and better opportunities to share and adapt successful strategies across countries.

3. **Unintended consequences or incomplete policy action point to the need to mainstream air quality goals across multiple policy and planning frameworks.** Pollution mitigation proposals often focus on the most visible or politically expedient sources of air pollution and don't address the multifaceted drivers of the problem or address the social consequences of the policy response. This often leads to unintended problems like shifting the air pollution problem from mega-cities to smaller cities or from one country to another. Addressing these challenges requires development and implementation of system-based policies and practices that holistically address the wide range of environmental, health, and socioeconomic impacts of air pollution.

4. **Poor implementation and enforcement of existing laws and regulations significantly impedes air pollutant reductions in practice. Often this was attributed to poor political will of government actors,** but workshop participants cited multiple institutional challenges, including the lack of experts and capacity especially at the municipal or local level, inadequate agency budgets, poor guidance laws and regulations, and poor interministerial coordination. Creating an enabling environment that builds the capacity of government to address these challenges must be prioritized as part of clean air initiatives.

5. **Language and communication strategies are critical for reaching the broad range of stakeholders needed for action.** Translating technical data into forms that can be understood and used by a diverse range of nontechnical stakeholders, including local community members, journalists, judges, and city-level officials, will be essential if the goal is to align the efforts of different stakeholders toward a shared, effective, lasting solution and build political momentum.

6. **Air quality data and better science around air pollution sources is needed to help transform growing awareness of the air pollution problem into focused demand for action and the development of targeted solutions that can be implemented and enforced.** Access to reliable, timely, and understandable data is still a significant challenge, especially at the municipal and subnational level. Achieving this pathway for change—awareness through action—requires development of different models that help ensure that air quality sensors, source identification, and other data innovations can be tailored and used to address the technical, institutional, and political barriers across different scales and geographies. At the same time, air quality actors must develop a deeper understanding of the data needs of different policy, civil society, and scientific actors.

7. **Solutions that overcome political barriers are critical for mobilizing clean air action.** Air quality actors must work together to develop new approaches that change the political dialogue and foster sustaining coordinated action across sectors and geographies.

As the outcomes from this workshop demonstrate, the complexities for tackling air pollution are huge, but so are the potential benefits of interdisciplinary technical, scientific, and policy innovation. Based on feedback to WRI's air quality strategy moving forward, we will be working with partners to use these important lessons to foster a stronger global movement for air quality action. This includes:

- Developing a global platform for making data and monitoring technologies more accessible and replicable and expanding their use to new stakeholders outside the regulatory and scientific community;
- Fostering innovations in science and technology, including approaches to data modeling and source allocation that can be effectively implemented at scale and communicated and used by a diverse range of air quality experts;
- Convening multi-sector dialogues among different stakeholders to bridge stronger connections among different air quality actors and investigate how to align efforts to collective action;
- Amplifying policymaking at the national and local scale that brings civil society, government, and private sector actors together to drive innovation;
- Analyzing more deeply the obstacles preventing effective policy implementation and capacity-building initiatives that help governments, the private sector, and civil society work collectively to improve compliance and enforcement in practice; and
- Identifying government and private-sector champions who can work to address the political obstacles hampering change and open the political space for cutting-edge solutions at the subnational, national, and regional scale across different geographies.

Introduction

From April 11–13, 2018, WRI's Ross Center for Sustainable Cities, OpenAQ, and WRI's Governance Center, in its role as secretariat of The Access Initiative, hosted a workshop on air quality. The workshop brought together 15 civil society experts from across the globe who have implemented successful strategies in the fight for clean air. The goal of the workshop was to explore the range of actions and tactics being used to address air pollution and deepen our understanding of the air pollution landscape and its dynamics for change. The insights revealed during the event will help shape WRI's air quality strategy moving forward. A list of workshop participants is provided at the end of the document.

The workshop was designed to collectively investigate the different air quality challenges and entry points in policy, public-sector administration, and private-sector priorities. We hoped to unpack the key drivers of successful work, including where opportunities exist and how best to leverage them across the spectrum of governance and political contexts. Specifically, we wanted to answer the following questions:

1. What are key elements of success among the groups' different approaches to air quality advocacy? How do contexts with varying socioeconomic, legal, and political frameworks affect their work?
2. What obstacles do the participants identify that are preventing further success in their sectors or other sectors? And where are the key entry points to explore?
3. What new innovations in open data, institutional action, technologies, or other efforts to build movements are needed to advance participants' work and better address broader social and economic goals of reduced air pollution across diverse levels of scale and sectors?

The Air Pollution Challenge

WRI and OpenAQ believe this is an opportune time to foster a strategic dialogue on global air quality. Awareness of the global air pollution crisis and its impacts on public health, food supplies, the economy, and the environment is growing around the world. Key champions are stepping up at the international, national, regional, and local level to propose better solutions for cleaner air.

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At the same time, the following critical obstacles are preventing this awareness from transforming into concrete and sustained action:

- Often, the locally specific nature of the direct causes, impacts, and solutions to air pollution drive the landscape of advocacy, science, policy networks, and funding efforts. This results in the development of globally oriented approaches that are geographically disaggregated and less connected.
- Successfully addressing air pollution in a city or region often involves multi-year to decadal-scale efforts, requiring sustained political will at local and national levels.
- Because successfully addressing air pollution requires mobilizing multiple disciplines, it can be challenging to coordinate and communicate across sector and policy field silos.

WRI's international offices, Governance Center, and Cities team have taken multiple steps to directly address these intersecting challenges through our project work, partner collaborations, and data analysis. OpenAQ focuses on opening up near real-time, government-grade, station-level air quality data and connecting a diverse global, grassroots, multi-sectoral community with data generators and users. Yet to adequately address the complex obstacles and build a global movement for improving air quality, new innovations in open data, institutional action, and strategic applications of technologies to leverage social and economic goals are needed.

To that end, WRI and OpenAQ are interested in fostering a faster, more robust cycle of awareness to action. To help frame this goal, WRI has captured a pathway for change and the potential obstacles that prevent action on air pollution in the figure below. The fragile cycle begins with building awareness and captures the growing concern over air pollution. For example, global media coverage on the topic has seen more than 100,000 news articles published in the last year, with the largest spikes occurring in China and India, according to the media analytics company Cision. Google Trends shows an increasing number of people searching for air pollution-related queries. The Lancet report on pollution and health impacts was the most downloaded report in the journal's history.

The next cycle, organizing demand, focuses on leveraging this growing awareness for action. It calls on scientists and cities to help cut through the noise of scapegoat politics and refocus the dialogue on systematically breaking down the complexity of the air pollution problem into concrete, targeted issues.

Figure 1 | Pathways for Change: A Fragile Cycle

Source: WRI Ross Center for Sustainable Cities

This demand is then used to foster a focus on sources, which takes a forensics approach to identify the culprits and contributors to air pollution through scientifically credible techniques. Once source attribution is complete, only then will effective actions and laws be identified at the city level as presented in the phase that involves updating policy and planning. Finally, to avoid short-lived results that do not reduce air pollution, the cycle pertaining to enforcing and adopting solutions closes out the pathway for change by ensuring that the identified actions and laws are implemented and enforced in a timely, cost-effective, and practical manner.

Workshop Outcomes

This document synthesizes key insights and entry points for action from the workshop and provides recommendations to WRI moving forward. The workshop helped identify the important data gaps and analysis needed for sustained and targeted momentum. More importantly, it represents the beginning of an important new initiative to build bridges among the diverse set of science, government, policy, private sector and civil society air quality actors that must work together to create the next generation of strategies to reduce air pollution.

Key Lessons and Entry Points for Action

1. **Collective action requires more effective coordination among the diverse set of air quality actors working across different scales and in different scientific, policy, legal, and data silos.**

Air quality work spans multiple disciplines, including energy, governance, climate change, and health, and uses a diverse set of policy, legal, scientific, and technology strategies. While this interdisciplinary approach offers opportunities to synergize comprehensive solutions, it also results in significant integration and communication challenges. Too often, air quality activists are not able to learn from the success or failure of attempted approaches in other countries and operate alone in their own sector silo.

Bringing together a diverse set of air quality actors during the workshop highlighted many different stories of change. It helped demonstrate the need to more strategically connect the scientific, open data, and legal communities with the policy and civil-society actors using data to achieve regulatory reform. Also evident at the workshop was the mismatch between the research and technical questions around air quality data that were presented and the policy questions and approaches being applied.

Connections between air quality and health impacts and other social issues in particular was repeatedly emphasized as an important example of where multi-sector collaboration was needed. In Mongolia, workshop participants believe the lack of understanding about the health impacts of dangerous air pollution levels in Ulaanbaatar is exacerbated by the lack of information about air quality. In Israel, applying air quality data to a municipal socioeconomic framework allowed civil society experts to highlight air quality as an indicator of environmental injustice. In this case better air quality indicated areas far away from public transportation access and the lack of industrial economic zones in Arab population-dominated locations. This kind of insight was a result of an integrated policy, open data, and a social approach to pollution.

ENTRY POINTS FOR ACTION: Developing interdisciplinary networks of air quality expertise is essential for fostering cross-sector collaboration at each phase of the action cycle. Faster, more effective communication channels should be developed and analytical approaches that disentangle different sources, impacts, and solutions to complex air pollution problems should be enhanced. Workshop participants suggested that WRI, in close partnership with OpenAQ, is well positioned to facilitate the necessary bridge building and should prioritize strategies that bring these communities together for effective, collective action.

2. Civil society actors are using a wide range of accountability strategies to address air pollution policy failures.

Workshop participants highlighted the successful use of a variety of transparency, legal, and advocacy strategies to specifically address the policy and political failures affecting air quality. Examples mentioned in the workshop include:

- Using publicly available data and social media to increase public awareness and focus public pressure and political support for better air quality regulatory enforcement and compliance in China;
- Using public art as a public awareness tool to showcase the danger and impacts of air pollution in Ulaanbaatar, Mongolia;
- Winning cases in court and using strategic litigation to enforce air emission limits and ambient air standards in India, South Africa, and Europe;
- Using targeted advocacy campaigns that counter-balance grassroots, bottom-up pressure with government engagement to leverage opportunities for dialogue around revisions to emission standards for coal-fired power plants in Indonesia;
- Sharing government, real-time air quality data publicly and creating new sources of data using citizen monitoring techniques to forecast air quality and contribute to air quality management plans in Delhi and Bangalore in India; and
- Creating multistakeholder coalitions and networks at the national, regional, and local scale to improve the development and implementation of air quality management plans in Medellin, Colombia, and Mexico City, Mexico.

ENTRY POINTS FOR ACTION: The range of approaches highlight the need to tailor strategies to the country's specific regulatory, judiciary, and political context. Many of the suggested approaches focused on tactics that brought together different groups and leveraged opportunities to use social pressure and social support.

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The variety of civil society actors using data, policy, and legal strategies at different scales points to the need to map the broader air quality stakeholder community and unpack the strategies and tactics they use to address air quality policy failures. This deeper understanding will help air quality experts share and adapt successful strategies across countries.

3. **Unintended consequences or incomplete policy action point to the need to mainstream air quality goals across multiple policy and planning frameworks.**

Because of poor source attribution and implementation of partial, narrow policy solutions, pollution mitigation proposals often focus on the most visible or politically expedient sources of air pollution. These solutions do not comprehensively address the multifaceted drivers of the problem or address the social consequences of the policy response. Also, shifting of the air pollution problem from mega-cities to smaller cities or from one country to another can be an unintended consequence of overlooking the entire life-cycle and supply-chain nature of policy solutions and mitigation proposals.

Workshop participants cited multiple examples of this problem. In India, where the burning of coal is a major source of air pollution, the continued focus on air pollution in big cities like Delhi has resulted in proposals to shift the location of power plants to other smaller cities, thereby just shifting the location of the problem to new geographical areas. Media attention has also caused significant public and government focus on the role of crop burning as a source of air pollution while ignoring the contribution from everyday use of cars and the role of the building and construction industry. In Hungary, an air pollution problem was exacerbated when a company stopped using air filters as it switched to using wood as a new fuel source because the air quality regulations allow this exception as wood is defined as a clean biomass fuel source. In Mongolia, a successful cook stove project significantly reduced air pollution in Ulaanbaatar by 15 percent by replacing coal burning stoves in more than 120,000 households. However, this success was not sustained because no training or public

education was provided to citizens on how to maintain the stove or the public health and environmental improvement goals behind the initiative. A large number of stoves were also sold because of the high subsidy provided and the fact that they were considered a gift and not a critical public health tool.

ENTRY POINTS FOR ACTION: These examples point to the need to adopt a systems approach that acknowledges and deals with the complexity of the regulatory process required to reduce air pollution that goes beyond one agency's responsibility to encompass the environment, city planners, agriculture, and health. A systems approach allows policymakers and other stakeholders to incorporate different analysis at different scales, both in strategy design and policy implementation, while simultaneously making progress on specific objectives. The approach can help identify potential conflicts areas and emergent problems before development, while helping to clarify the diverse range of interests and actors across relevant sectors.

4. Poor implementation and enforcement of existing laws and regulations significantly impedes air pollutant reductions in practice.

In many countries ambitious and enforceable ambient air quality and pollution control regulations have been passed. But workshop participants pointed to numerous examples of poor enforcement and weak implementation of existing air quality laws and regulations. Often this was attributed to the poor political will of government actors, but other institutional challenges cited include the lack of experts and capacity especially at the municipal or local level, inadequate agency budgets, poor guidance on how to implement and enforce laws and regulations, and poor inter-ministerial coordination especially between health and environmental ministries. For example, in South Africa, 23 states have exceeded air quality standards, and implementation of the emissions standards for SOx and NOx has been postponed until 2020, in part due to a lack of political support for strong implementation and enforcement. In Delhi, the Greater Response Action Plan was initially seen as a groundbreaking achievement in the war on air pollution because, when air quality levels in the city reach a certain hazardous threshold, an alert triggers a set of actions that are supposed to have immediate impact. But in reality, a number of obstacles prevented implementation:

- A shortage of 18,000 buses prevented implementation of a mandate for increased use of public buses on the roadways.
- A requirement for increase parking charges was not enforced because the owners of the lots feared a backlash from the drivers.
- The stoppage of all construction was not enforced because there was no easy way to inform daily wage workers not to show up for work.

ENTRY POINTS FOR ACTION: These implementation obstacles point to the need to identify appropriate and practical entry points for better governance as part of any air pollution initiative. Capacity building that identifies and focuses on specific deficiencies within the regulatory air quality framework is also needed, especially within the local airshed context. Ensuring that air quality regulations are transformed into action will require an enabling environment that supports the government's ability to address specific outcomes, use of the right delivery mechanisms over appropriate time frames, and incorporation of strategies to build implementation capacity.

5. Language and communication strategies are critical for reaching the broad range of stakeholders needed for action.

Proper framing of issues can allow prospective strategies to resonate with different audiences and actors. Translating technical data into forms that can be understood and used by a diverse range of nontechnical stakeholders, including local community members, journalists, judges, and city-level officials, will be essential if the goal is to align the efforts of different stakeholders toward a shared, effective, lasting solution and build political momentum.

But paying close attention to the mechanisms of communication must be carefully considered to ensure that marginalized and poor voices are not lost in the complexity and urgency of the problem. In India, lack of access to air quality data was exacerbated by existing barriers to access smartphones and apps because air quality experts do not employ traditional forms of communication that are used by most people, like radios or newspapers. The citizen science monitoring momentum in China is also limited to people who can afford smartphones and have the education to understand the meaning of different air quality measurement values.

Working across silos can also amplify the potential for misunderstanding. This was illustrated in the workshop where the civil-society representatives, public-interest lawyers, data modelers, and academic experts used common terms differently and expressed critical knowledge gaps about the other air quality arenas outside their field of expertise. These challenges can have real world implications. In one example mentioned, different Delhi interest groups used the same data to create different messages around both the success and failure of the odd/even car rationing plan to reduce air pollution.

ENTRY POINTS FOR ACTION: These challenges point to the need to understand how to convey complex issues to different audiences, create methods for filtering the compatibility of data across sectors and countries, and work collectively to develop a common air quality language. It also suggests that time and resources are needed to align diverse groups around a unified vision outside formal government regulatory processes and build broader alliance initiatives.

The wealth of information and proposed solution sets will be more robust when engaging a broader range of air quality actors. To that end, WRI and OpenAQ incorporated a resource-sharing session into the workshop. This exercise resulted in the development of a strategic list of resources that air quality experts can use in their work. These resources can be found in Appendix B.

6. Air quality data and better science around air pollution sources is needed throughout the pathway for change (awareness through action).

Improving air quality will require coordinated top-down and bottom-up approaches that expand the access and use of air quality data to accelerate and sustain action across different scales and political contexts. But access to reliable, timely, and understandable data is still a significant challenge, especially at the municipal and subnational level. Examples were mentioned by nearly all the workshop participants. In Mongolia, the lack of hospital data on persons affected by asthma or deaths attributable to air quality prevented research from capturing indicators to document the true extent of the problems related to indoor cooking. In Colombia, government authorities do not recognize data from low-cost sensors or other citizen collection methods, thereby creating a significant gap for localized datasets.

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Workshop participants also discussed how they are addressing this data gap and using data across the pathway for change. OpenAQ is leading the effort to make government data publicly available and provided numerous examples of how its community of open data advocates are using data in air quality management plans, air quality communication platforms, and policy-relevant analysis. Participants also highlighted how new citizen monitoring techniques have greatly expanded the number and types of nonscientist citizens working to monitor and address air pollution in their communities in China, Colombia, Mexico, and Mongolia.

The range of ways that data are applied in different judicial, policy, and scientific settings throughout the entire regulatory framework was also highlighted. For example, in India, air quality data are incorporated into monitoring and analytical tools to support pollution control boards' and other regulators' abilities to identify sources and to regulate pollutants. In China, the collection and disclosure of facility-specific violation records is being used not only to improve public participation but to help increase government enforcement capacity and private-sector action. While in the Latin America region, regional approaches are linking air quality data with health assessment and air quality management plans across multiple cities.

ENTRY POINTS FOR ACTION: The expanded use and strategic placement of low-cost sensors and other air quality monitoring technologies can help fill in data gaps. The wide range of data applications suggests the need to build different models that help ensure that air quality sensors, source identification, and data innovations can be tailored and used to address the technical, institutional, and political barriers across different scales and geographies. At the same time, data required for action in different spheres (legal, policy, science) and sectors must be clarified and incorporated into open data platforms and monitoring systems. To start, a global technical advisory committee could be formulated to include a range of air quality data experts and applied scientists to evaluate and recommend data formats and quality assurance methodologies for low-cost and reference-grade air quality monitoring.

7. Solutions that overcome political barriers are critical for mobilizing clean air action.

Many politicians still believe that air pollution is an adequate price to pay for economic development. Throughout the three-day workshop, the lack of political will to address air pollution was raised by virtually all workshop participants. Whether it was around accurately identifying the sources of air pollution, sharing government air quality data with the public, actively monitoring air quality, developing air quality management plans, enforcing ambient and pollution control laws and regulations through the courts, or proposing new "smart cities" solutions to address transportation and energy systems, the need to engage leaders to overcome political barriers and foster new entry points for change was highlighted.

Clearly more articulated, politically focused demand for clean air is needed. The multi-sector and complexity of source allocation across different scales creates a challenging political environment. Workshop participants also recognized that this environment is compounded by the turnover rate of elected officials and the need to develop context-specific solutions that respect cultural traditions. And while growing awareness over the health and social impacts of air pollution offers the potential to help overcome political obstacles, workshop participants discussed the need for behavior change motivators that expand the number of people actively engaged in the fight for clean air.

Finally, despite the global nature of the problem, local variations in air quality sources, economic, and political structures mean that the starting points for catalyzing change, however, will vary across airsheds. A number of participants suggested that cities are more responsive to citizens than other levels of government and should be the focal point for implementation of new strategies and technologies.

ENTRY POINTS FOR ACTION: Clean air experts must develop new approaches that change the political dialogue and foster sustaining coordinated action across sectors and geographies. Overcoming these political barriers will require new research and political economy analysis that moves beyond recommendations for improving laws and implementation to illuminate the drivers of inaction and evasion of responsibility.

These challenges also point to the need to identify multi-sector, collaborative strategies that change the political narrative and improve the trust and credibility of government and political actors attempting to address air pollution challenges. Making the economic case for improving health and cleaning the environment and more effective engagement with the private sector are also essential elements. As is the development of phased solutions that directly recognize the costly transition to new technologies and practices and the distribution of the costs and benefits.

Recommendations for WRI

The workshop ended with participants providing feedback on WRI's pathway for change ideas and suggested a number of areas where WRI was well placed to help shape air quality moving forward. These ideas included:

- Capturing and sharing interactive and meaningful stories of change;
- Fostering more strategic institutionalization at the international level;
- Working together to address the quality of air quality management parameters, while harmonizing a standard for air quality indexes that allows for compatibility and comparison between countries;
- Synthesizing air quality research for policymakers, such as an "IPCC for air," while promoting better coordination and integration among the different air quality networks and platforms across local, national, regional, and international scales;
- Helping address the gaps and needs of international and regional institutions and supporting the creation of a better political climate that pushes national action and increased visibility of the impact of air pollution;
- Engaging the public health community around the impacts of air pollution and climate change; and
- Fostering more pathways for funding local efforts for change on a global scale and from organizations that are actually targeting air pollution.

Next Steps

The workshop's central goal was to foster a dialogue around three central questions to help identify the key elements of success that drive air quality advocacy, the obstacles preventing action, and new innovation that can help create a global movement for clean air. As the outcomes from this workshop demonstrate, the complexities for tackling air pollution are huge, but so are the potential benefits of interdisciplinary technical, scientific, and policy innovation. WRI will be working with its partners to implement a multi-pronged strategy grounded in moving to a faster, more robust cycle of awareness to action and building a global movement for air quality action through city-level engagement and solutions. This includes:

- Developing a global platform for making data and monitoring technologies more accessible and replicable and expanding their use to new stakeholders outside the regulatory and scientific community;
- Fostering innovations in science and technology, including approaches to data modeling and source allocation that can be effectively implemented at scale and communicated and used by the diverse range of air quality experts;

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- Convening multi-sector dialogues among different stakeholders to bridge stronger connections between different air quality actors and discuss how to align efforts to collective action;
- Amplifying policymaking at the national and local scale that brings civil society, government, and private-sector actors together to drive innovation;
- More deeply analyzing the obstacles preventing effective policy implementation and capacity-building initiatives that help governments, the private sector, and civil society work collectively to improve compliance and enforcement in practice; and
- Identifying government and private-sector champions who can work to address the political obstacles hampering change and open the political space for cutting-edge solutions at the subnational, national, and regional scale across different geographies.

Overall, to ensure the creation of successful, effective pathways for change, the workshop reinforced a number of technology, policy, and institutional strategies that should be implemented in air quality work moving forward. These entry points for action have already helped enhance WRI's air quality work, but everyone agreed there is much more to learn from each other; and we need more opportunities for the network to come together. Together WRI, OpenAQ, and our air quality partners are well positioned to build a network to advance a new global agenda for air quality from awareness to action.

Appendix A

Air Quality Workshop Participants

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C**arlos Gonzalez,** National University of Colombia, executive director, MAKAIA, Colombia

Carmit Lubanov, Association of the Environmental Justice in Israel (AEJI), Israel

Carole Excel, Acting director, environmental democracy practice, Governance Center, World Resources Institute, United States

Chris Hasenkopf, Executive director, OpenAQ, United States

Delgerzul Lodoisamba, Local scientist and public health advocate, Mongolia

Fajri Fadhillah, Public interest lawyer, Indonesia Center For Environmental Law, Indonesia

Elizabeth Moses, Associate, environmental democracy practice, Governance Center, World Resources Institute, United States

Jessica Seddon, Director of integrated urban strategy, WRI Ross Center For Sustainable Cities, World Resources Institute, United States

Jing Jing Zhang, Open Society Foundations fellow and partner, Beijing Huanzhu Environmental Public Interest Law Firm, China United States and China

Kate Logan, (former) Green Choice outreach director, Institute of Public and Environmental Affairs, China

Katja Dzepina, Assistant professor, University of Rijeka, Dept. of Biotech: Sarajevo Campaign 2017, Croatia

Pallavi Pant, Post-Doc research associate, University of Massachusetts, former WRI India consultant, India

Ritwick Dutta, Lawyer, TAI partner and director of Legal Initiative for Forest and Environment, India

Sandor Fülöp, President and lawyer, Environmental Management and Law Association, Hungary

Sarath Guttikunda, Founder and director, Urbanemissions.info initiative, India

Sergio Sanchez, CEO and executive director, Clean Air Institute in DC, Latin America

Seth Contreras, Air quality and road safety associate, WRI Ross Center For Sustainable Cities, World Resources Institute, United States

Timothy Lloyd, Attorney, Centre for Environmental Rights, TAI partner, South Africa

Ugo Taddei, Lawyer, Client Earth, Belgium

Appendix B

Resources Referenced at Workshop

China

- Blue Map App download page: http://wwwen.ipe.org.cn/appdownload30_en/pc/index.html
- Blue Map online database: http://wwwen.ipe.org.cn/index.html
- Environmental Maps: http://wwwen.ipe.org.cn/AirMap_fxy/AirMap.aspx?q=1
- Air Quality Transparency Index (AQTI) reports: http://wwwen.ipe.org.cn/reports/Reports.aspx?cid=18333
- The Crowd and the Cloud documentary series: http://crowdandcloud.org/
- "Environment China": http://environmentchinapod.libsyn.com/. There are two episodes focusing specifically on air quality
- Air Pollution Solutions: An End to China's Smog: http://environmentchinapod.libsyn.com/air-pollution-solutions-an-end-to-chinas-smog
- Air Quality Innovations: Finding Data in the Smog: http://environmentchinapod.libsyn.com/air-quality-innovations-finding-data-in-the-smog
- China GBD-MAPS program: https://www.healtheffects.org/publication/burden-disease-attributable-coal-burning-and-other-air-pollution-sources-china

Croatia

- Organizing field campaigns to characterize air pollution/do source apportionment Example: SaFiCa Campaign: https://sites.google.com/view/dzepinagroup/sarajevo-canton-field-campaign-2017

Eurpean Union

- Air Pollution Publications: https://www.eea.europa.eu/publications#c7=en&c11=5&c14=&c12=&b_start=0&c5=air
- ClientEarth's Clean Air Handbook: http://www.cleanair-europe.org/fileadmin/user_upload/redaktion/downloads/DUH/CleanAirHandbook_Vol_2_final_2015_EN.pdf
- European Environment Agency's Air Quality Report 2017 (updated every year; lots of useful information on air quality status in Europe, health impacts, and economic costs): https://www.eea.europa.eu/publications/air-quality-in-europe-2017
- European Environment Agency's Air Quality Index (real-time data from across Europe): http://www.eea.europa.eu/themes/air/air-quality-index
- UK laboratory for diffusion tubes monitoring campaigns: http://www.gradko.com/
- WHO/OECD Report on Economic costs of the health impact of air pollution in Europe: http://www.euro.who.int/__data/assets/pdf_file/0004/276772/Economic-cost-health-impact-air-pollution-en.pdf?ua=1

India

- Air Quality in India: https://indiaaq.blog (media database)
- If you are interested in finding air quality data for your city on Twitter, check out @SmokeyBot
- Air Pollution Visual Map: https://www.airvisual.com/earth
- High resolution air quality forecasts (for 72 hours) Delhi, India: http://delhiairquality.info/
- High resolution air quality forecasts (for 72 hours) all of India, including district and state-level summaries: http://indiaairquality.info/
- India GBD-MAPS program: https://www.healtheffects.org/publication/gbd-air-pollution-india

UrbanEmissions

- UrbanEmissions.Info: http://www.urbanemissions.info/resources/infographs/ (Good infographics)
- Air pollution monitoring 101 notes including doodles for some easy understanding: http://www.urbanemissions.info/air-monitoring-101/
- Primer on air quality management: http://www.urbanemissions.info/primer-on-air-quality-management/
- Primer on particulate source apportionment: http://www.urbanemissions.info/primer-on-pollution-source-apportionment/
- Air Pollution knowledge Assessments (APnA) city program in India: http://www.urbanemissions.info/india-apna/
- Status of air quality monitoring in India: http://www.urbanemissions.info/india-ambient-monitoring-data/

Global

- State of the Global Air: http://stateofglobalair.org/
- Global Burden of Disease (GBD) — A great resource for data to compare health risks across countries: https://vizhub.healthdata.org/gbd-compare/
- A great list of resources for low-cost sensors and how to use them: https://developer.epa.gov/air-quality-sensors/
- IHME Global burden of disease — visualization portal: https://vizhub.healthdata.org/gbd-compare/
- SIM-air working paper series: http://www.urbanemissions.info/publications/simair-wp-series/
- GEIA: Global emissions initiative: http://www.geiacenter.org/
- IIASA — GAINS modeling system: http://www.iiasa.ac.at/web/home/research/researchPrograms/air/GAINS.html
- WRF — Meteorological modeling system: https://www.mmm.ucar.edu/weather-research-and-forecasting-model
- Real-time open fire emissions — satellite feeds: https://earthdata.nasa.gov/earth-observation-data/near-real-time/firms
- Global fire emissions database: http://www.globalfiredata.org/ar6historic.html
- Breathe Life Campaign: http://breathelife2030.org/
- ICCT reports
- Cost and benefit assessments for air pollution's impact on health
- Union of Concerned Scientists: https://www.ucsusa.org/
- ISEE — International Society of Environmental Epidemiology: https://www.iseepi.org/

Latin America

- Example of training at community centers: https://www.youtube.com/watch?v=k5FBOVdkhsg&feature=youtu.be
- PurpleAir low-cost sensors and data maps for citizen scientists
- Clean Air Institute: https://www.cleanairinstitute.org/

Mongolia

- Breathe Mongolia: https://breathemongolia.org/
- Breathe Mongolia Facebook page: https://www.facebook.com/breathemongolia/
- Breathe Mongolia LinkedIn page: https://www.linkedin.com/company/breathe-mongolia/
- Air quality art: http://www.abc.net.au/news/2018-02-15/melbourne-mongolia-mural-making-of-video-tells-smog-story/9445614
- Air pollution analysis for Ulaanbaatar, Mongolia: http://www.urbanemissions.info/cities/ulaanbataar-mongolia/

OpenAQ Resources

- From 64 countries: OpenAQ.org Open/free platform to download or programmatically access government and research-level air quality (PM10, PM2.5, O3, CO, SO2, NO2, BC)
- Global OpenAQ Community on Slack: https://openaq-slackin.herokuapp.com/
- OpenAQ on Twitter: https://twitter.com/Open_AQ

South Africa

- CER (website includes a virtual library, materials and information for programs and campaigns): https://cer.org.za/
- Pollution and Climate Change Programme: https://cer.org.za/programmes/pollution-climate-change. Includes information and documentation on litigation/submissions on laws, regulations and policies/ and key correspondence.
- Life After Coal campaign: https://lifeaftercoal.org.za/
- Highveld Priority Area (HPA) and the Broken Promises Report (October 2017), which investigates and exposes the current failure of the HPA: https://cer.org.za/programmes/pollution-climate-change/publications/broken-promises-the-failure-of-the-highveld-priority-area

United States

- US Environmental Protection Agency's Health Impact Calculation Tool: BenMAP (Domestic and International versions)
- EPA's Toxics Release Inventory (TRI) Program includes industrial facility specific point source air emission data estimates and the ability to cross-reference with other data sets such as Risk-Screening Environmental Indicators (RSEI) Model.

World Resources Institute Resources

- Resource Watch: https://resourcewatch.org/
- The Access Initiative: https://accessinitiative.org/resources
- Environmental Democracy Index: https://environmentaldemocracyindex.org/

ABOUT THE WRI GOVERNANCE CENTER OF EXCELLENCE

WRI Governance Center of Excellence helps empower people and strengthen institutions to foster environmentally sound and socially equitable decision-making. It prioritizes the rights of poor, vulnerable, and marginalized citizens who most sharply experience the brunt of resource constraints and environmental degradation. As a global leader on environmental governance, the Center works with civil society, governments, development agencies, businesses, and other institutions to create transparent, inclusive, accountable decision-making processes and legal frameworks to ensure that development benefits people and the planet. The Center is divided into five practice areas—climate resilience, environmental democracy, energy governance, natural resource governance, and urban governance—and supports WRI's seven priority issues: climate, energy, food, forests, water, cities, and oceans. The Center also acts as secretariat for The Access Initiative (TAI), the largest civil society network in the world dedicated to ensuring that citizens have the right and ability to influence decisions about the natural resources that sustain their communities.

More information at **www.wri.org/our-work/topics/governance**.

ABOUT WRI ROSS CENTER FOR SUSTAINABLE CITIES

WRI Ross Center for Sustainable Cities helps create accessible, equitable, healthy and resilient urban areas for people, businesses and the environment to thrive. Together with partners, it enables more connected, compact and coordinated cities. The Center expands the transport and urban development expertise of the EMBARQ network to catalyze innovative solutions in other sectors, including water, buildings, land use and energy. It combines the research excellence of WRI with 15 years of on-the-ground impact through a network of more than 250 experts working from Brazil, China, Ethiopia, India, Mexico and Turkey to make cities around the world better places to live.

More information can be found at **www.wrirosscities.org .**

ABOUT OPENAQ

OpenAQ is a global, yet grassroots community that is sparking an open air quality movement to fight air inequality - the unequal distribution of healthy air around the world that affects the lives of millions. The OpenAQ Community has built the only open, transparent, and free real-time air pollution global data platform that provides programmatic and historical air quality data access to the public. The goal of the platform is to enable communities around the world to do previously impossible science, impact policy and empower the public to fight air pollution. To date, community members across four continents have opened up more than 250 million data points in 67 countries.

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