



Tracking urban health policies: a conceptual framework with special focus on air pollution in African cities

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CLIMATE &
CLEAN AIR
COALITION
TO REDUCE SHORT-LIVED
CLIMATE POLLUTANTS

Abstract

To enhance health co-benefits across urban policies which tackle air pollution and climate change, WHO, in cooperation with various international, national, and local partners, implemented the Urban Health Initiative (UHI) pilot project in Accra, Ghana. The Initiative prompted the health sector to use its influential position to demonstrate to decision-makers and the public the full range of health, environmental and economic benefits that can be achieved from implementing local emission reduction and energy access policies and strategies. Policy tracking, although not always considered, is a fundamental component of this procedure. It assesses the planning, implementation and progress of a policy to refine or adjust policies with the final objective of increasing the likelihood of the policy being successful. This report is an outcome of the last component of the UHI model process, Policy tracking and monitoring outcomes. The report proposes a framework for tracking urban health policies, with a special focus on the impacts of air quality and energy access on human health and well-being in African countries, giving some examples from the pilot project in Accra. The report also provides resources to survey air quality in cities and other tools to assess public health and the environmental impacts of urban policies and monitor or track their effects.

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Foreword

African cities are among the most dynamic places on earth. While the energy and vitality of urban life are largely positive, there are also negative externalities – and dealing with the problem of air pollution is one of the most serious for African residents and leaders in the twenty-first century. Increased population, sprawling settlements, poor transport linkages within and between, places and generally weak urban enforcement capacity underpin the rapid rise of air pollution-based impediments to Africans' health and well-being.

Household and ambient air pollution are directly linked to a range of poor health outcomes, from respiratory disease to obesity, placing a significant burden on locally fragile health systems and making air pollution a critical issue for Africa. A population's health and well-being can be dramatically improved with better settlement design, construction, and management. So a wider perspective on urban governance is essential. Tackling the hazard of air pollution is not a simple task and it demands coordinated actions across scales, actors, and sectors – as well as strong political will.

Drawing on the most current thinking about African urbanization and the urban–rural continuum, the varied ways of approaching health and well-being as well as identifying the multiple challenges that air pollution presents to places in Africa, *Tracking Urban Health Policies: A Conceptual Framework with Special Focus on Air Pollution in African Cities* helps lay a path for how we can do more, do better and work together more effectively.

Readers of the document are taken through a clear exposition of the health and well-being risks of air pollution as well as a carefully detailed and informed account of the drivers of change that ensure the systemic shifts needed to set a different course for urban air pollution in Africa. Alongside the recognition that the African settlement continuum is varied, that local and national parties must be included in change, and a realistic profile of what things could be adjusted and who is responsible for those changes, this is an invaluable resource.



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Abbreviations

AAP	ambient air pollution
AQ	air quality
AQM	air quality management
BAU	business-as-usual
CBI	commercial, business, and industrial
CDC	Centers for Disease Control and Prevention
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency
GAPH-TAG	Global Air Pollution and Health – Technical Advisory Group
GIS	Geographical Information System
GHG	greenhouse gas
HIA	Health Impact Assessment
HRA	Health Risk Assessment
HAP	household air pollution
ISThAT	Integrated Sustainable Transport Health Assessment Tool
LCSs	low-cost sensors
LMICs	low- and middle-income countries
NCD	non-communicable diseases
NGOs	non-governmental organizations
NA	Not Applicable
NO₂	nitrogen dioxide
NYC	New York City
O₃	ozone
PM	particulate matter
SDG	Sustainable Development Goal
SLCPs	short-lived climate pollutants
UHI	Urban Health Initiative
US	United States
WHO	World Health Organization

Executive summary

At the core of every policy is a set of rules, regulations, or plans meant to govern, regulate, and possibly improve a particular issue or system when implemented. However, in many low- and middle-income countries (LMICs) policies are often implemented without institutional mechanisms to monitor or track their effects. Not all policies are created similarly, and in some cases, the implementation of a policy could unintentionally undermine the system it was meant to enhance. To avoid this, WHO is proposing a policy tracking mechanism to accompany all urban and environmental policies that have health impacts. Such policy tracking will enable policy-makers and stakeholders across sectors to identify potential setbacks, delays, and negative impacts of policies and develop corrective measures promptly, increasing the likelihood of the policy being successful. However, in many LMICs policies are implemented without institutional mechanisms to monitor or track their effects.

This report, and accompanying policy tracking framework, were developed by WHO staff with the support of the University of Cape Town and the University of Ghana. Experts from universities and the WHO Global Air Pollution and Health – Technical Advisory Group (GAPH–TAG) were involved in the review. In this report, we propose a framework for policy tracking mechanisms that can be adapted for air quality policies, with a special focus on African countries. Cognizant of the intersections between air pollution and other urban policies such as land use management, mobility, energy, and housing infrastructure, we identify various health impacts that can result from urban systems and design, behavioural, social, environmental, metabolic, and individual risks that are associated with multiple urban policies. Fundamental to all policies are objectives and their accompanying process and performance indicators that measure how well these objectives are achieved. This document provides a conceptual framework for understanding and tracking the multi-scale and multi-actor linkages between policies and health outcomes in urban environments. The report might be of interest to different stakeholders and decision-makers that work toward public health promotion and advocacy.

We highlight generic steps required to develop a policy tracking system [(i) policy identification; (ii) policy impact; (iii) policy monitoring; (iv) data collection; and (v) policy quality]. In addition, we discuss air quality policy tracking mechanisms for ambient and household air pollution. The following points address the question: why and how decision-makers should carry out policy tracking for policies or programmes impacting air quality and health?

To implement any policy and to quantify its impacts, decision-makers need to:

- know the exposure to risks and their trends;
- examine the relationship between the changes in risks and related health outcomes after implementing policies;
- understand the capacity for detecting and evaluating trends in, for example, air quality levels; and
- verify changes for the expected health outcome of identified populations at risk.

Policy tracking offers a clear and essential mechanism to:

- assess the impacts of policies on changes in exposures and health outcomes;
- track progress towards the intended and unintended outcomes of the policy (e.g. inequity);
- plan for subsequent policy cycles;
- refine or adjust implemented policies;
- enhance public health surveillance; and
- improve access to quality data.

Policy tracking can:

- stimulate the development of systems, infrastructure, and expertise for public health and environmental data surveillance (for people, data, and health system scales);
- offer new information that can inform and improve policies, programmes, and initiatives; and
- provide an educational role to a broader range of stakeholders, the public, and communities

The case of air pollution illustrates the need to consider several dimensions of information required to set up a policy tracking mechanism. As an example, in this report we describe the dimensions of information required for the AQM indicator. This requires a hybrid mechanism that incorporates policy surveillance and policy tracking, which can provide crucial information about decisions taken and current trends. The hybrid mechanism suggested in this report allows the measurement and collection of qualitative and quantitative data to assess policy changes and impacts across space and time.

The dimensions of information required for a policy tracking mechanism include:

- functional focus (case studies, project reports, data collection);
- type of information (quantitative and/or qualitative);
- research and/or advocacy orientation;
- credibility of information (e.g. external validation);
- engagement of peers;
- tools for policy learning (regular and standardized or irregular methods and reporting); and
- openness and transparency.

We conclude the report by providing a discussion and information on how to consider, in broad terms, urban health and issues on setting up policy tracking systems in cities in LMICs. The report also highlights the role of policy tracking, which is a crucial component of any intervention or policy. The outcomes of policy tracking should be used as input for decision-making about priority areas for further action.

1. Introduction

This document provides a conceptual framework for understanding and tracking the multi-scale and multi-actor linkages between policies and health outcomes in urban environments. While the framework is designed for the urban environment, such as peri-urban areas, cities, or towns, the core concepts detailed in this report can be adapted for other types of human settlements, such as rural areas and villages. Likewise, the framework proposed in this document is given within the African context. It derives examples from policies and city initiatives to address air pollution in line with the World Health Organization's (WHO) Urban Health Initiative (UHI) pilot project in Accra, Ghana. However, the principles presented are valid beyond African cities and applicable to all populations in different regions of the world and settings. The discussion is based on a critical review of relevant literature on urban health and urban policies.

The Initiative aimed to demonstrate the health benefits and co-benefits of implementing policies for reducing air pollution and short-lived climate pollutants (SLCPs) in urban areas and has gathered much of its experiences from pilot projects in Accra as well as Kathmandu (Nepal). The broader linkages between urban policies, urban health outcomes and the methods to map and track policies are a fundamental component of the work carried out in the pilot projects. Working with experts in Accra, the UHI assessed and identified policy interventions by measuring health impact co-benefits and the costs of inaction to develop city-level strategies for addressing air pollution and climate change and maximize health outcomes. The results of these analyses are available in six different reports previously published¹. The current report is an outcome of the last component of the UHI model process, Policy tracking and monitoring outcomes.

The UHI addresses critical aspects of the Sustainable Development Goals (SDGs)² for three targets which WHO is the custodial agency: SDG indicator 3.9.1 on substantially reducing the number of deaths and illnesses from air pollution by 2030; SDG indicator 7.1.2 on the proportion of the population with primary reliance on clean fuels and technologies; and SDG indicator 11.6.2 on annual mean levels of fine particulate matter in cities. The work is also relevant for the target 11.7 of the SDG on cities to "provide universal access to safe, inclusive and accessible, green and public spaces, particularly for women and children, older persons and persons with disabilities." And other SDGs, such as SDG 12 (sustainable production and consumption patterns) and SDG 9 (sustainable and resilient infrastructure, innovation, and research), have also been linked to the overall concept of urban health (Ramirez-Rubio et al., 2019).

The rationale for policy tracking includes to:

- track progress towards the intended and unintended outcomes of the policy;
- refine or adjust implemented policies;
- better understand the public health impacts of a given policy;
- evaluate the distributive impacts of a policy to ensure that it does not deepen existing inequalities;

¹ The reports are by Edwards and Agbevivi (2021), Essel and Spadaro (2021), Mudu (2021), Mudu et al. (2021), Santos et al. (2021). A report is forthcoming on Land-use Green Spaces and Health in Accra, Ghana.

² See the "The Sustainable Development Goals Report 2022" at: <https://unstats.un.org/sdgs/report/2022/>

- gather perspectives of different stakeholders to better understand the impacts on health, social development, and environment of past and current policies; and
- expand the evidence base related to policy tracking for public health impacts.

Tracking policies, programmes, projects, interventions, and initiatives that affect our environment and health should be done before, during, and after their implementation. Setting up mechanisms to conduct policy tracking may be difficult and requires clarification of the available frameworks, indicators, and tools. Resources required for policy tracking and data collection should be incorporated into the cost assigned for policy development.

This report includes different sections. First, a broad overview is given of urbanization patterns in Africa. Second, key environmental risk factors for health in cities are discussed, with particular attention to air pollution. Air pollution is the second leading cause of deaths from noncommunicable diseases (NCDs) after tobacco-smoking and is a pivotal risk factor to address several interrelated urban and rural health conditions (Prüss-Ustün et al., 2019). Third, the main areas of urban policies that impact health are examined. And fourth, a conceptual framework for policy tracking is suggested. The annex of this document offers an overview of urban policies such as housing/household infrastructure, transport, and social development and highlights its interconnectivity with environmental and health impacts through case studies conducted in Ghana. Also, it provides tools that policy-makers and stakeholders can use to track public health and environmental impacts of urban policies, as is the case of air pollution.

2. Urbanization patterns in Africa

Urbanization is a global phenomenon with both positive and negative consequences for the environment and the health of the population. Since the beginning of the 21st century, the world's population has shifted from a predominantly rural to an urban setting, with more than half of the population living in cities (UNDESA, 2019). This demographic shift has positioned cities in a new role to guarantee countries' development and the population's well-being. However, this role is contested, and the political implications of accepting the rhetoric of unavoidable urbanization, or an irreversible "urban age," cannot be ignored (Brenner and Schmid, 2014).

Currently, Africa is experiencing the fastest urbanization rate in the world, with around 43% of its population living in urban areas (UNDESA, 2018), an average of 5.1% annual change in urban extent, and an average of 4.2% annual urban population change between 2000-2015 (UN-Habitat, 2020). The urban population of Africa has been growing rapidly, from an estimated 237 million in 1995 to an estimated 472 million in 2015, an average growth rate of 3.44% per year (UN-Habitat, 2020). The continent already accommodates three megacities (Lagos, Cairo, and Kinshasa), and this number is expected to grow dramatically (UNDESA, 2018; OECD/SWAC, 2020).

Africa is characterized by rapid, uneven urbanization. It is important to note that there are considerable differences in levels of urbanization and rates of urban growth across the continent. Unlike urbanization in many other parts of the world, urban population growth in most of Africa has generally not been accompanied by a commensurate increase in formal employment or other livelihood opportunities, services and infrastructure, resulting in growing urban poverty and increased urban vulnerability (Bryceson and Potts, 2006; Fox, 2012; UN-Habitat, 2020). The net result of rapid urbanization and inadequate capacity for planning or managing cities is the rise of inequality, the increasing prevalence of informality, precarity, and increased health risks. Nearly three quarters of African cities have high levels of inequality, with South African cities being the most unequal in the region and the world (Gini coefficient=0.63) (UN-Habitat, 2020).³

The growth of 'slums' (i.e. areas lacking adequate housing and services, including inadequate access to potable water, poor sanitation, overcrowding, poor-quality housing in hazardous locations, and insecure tenure and risk of eviction) in African cities is the most tangible manifestation of these issues (UN-Habitat, 2020). Poverty and slums are affecting huge populations. Sub-Saharan Africa has the world's second highest level of income inequality after Latin America. In 2014, an estimated 56% of the population in sub-Saharan African cities lived in informal settlements or other types of slums. The number of households living in slums in sub-Saharan Africa has been growing steadily—from an estimated 131 million in 2000 to 237 million in 2018 (Table 2.1) (UN-Habitat, 2020).

³ There is an ongoing debate among scholars about the existence of a relationship between urbanization and the worsening of inequalities (Liddle, 2017). A recent analysis of a panel dataset for 48 Sub-Saharan African countries over the period 1996–2016 found evidence that urbanization is correlated with income inequality (Sulemana et al., 2019).

Table 2.1 Urban population living in slums in Sub-Saharan Africa (millions)

Year	2000	2014	2016	2018
Population	131.716	202.042	228.936	237.840

Source: UN-Habitat, 2020

Although our focus is on urban areas, we acknowledge a dearth of focus on rural areas. This lack of attention has led to the need to manage environmental and health problems with a multi-scalar perspective and to thoroughly consider the challenges of separating the interconnected “urban” and “rural” areas.

2.1. Considerations on urban and rural health and beyond

It is difficult to define the terms “urban” and “health,” and putting them together creates an even more difficult term to define: “urban health”. Though often questioned and discussed, health is usually positioned around the famous definition elaborated by WHO in 1946: “Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity”. Health is a positive entity, something to be promoted and not an absence to be regretted (Hancock and Duhl, 1988). Though in the end, we are still measuring the absence of disease, health is a dynamic quality and condition.

The rural-to-urban transition is more fluid than official statistics or analysis can indicate, and the idea of a discrete urban “unit” is problematic (Brenner and Schmid, 2014). It is also problematic considering the narrative of a completely urbanized world where the “urban” loses any specificity. It is clearly more important to focus on the relationships between a particular society and the construction and use of their spaces and the consequences on public health rather than the term itself. On top of that, there is no single definition for cities and urban areas (they can be mega-cities, city-regions, urban corridors, densely populated areas, etc.). However, there are regular attempts to define it. The most recent definition by international organizations proposes a method to classify the entire territory into levels of urbanisation.

“This new methodology allows statistics to be compiled by degree of urbanisation, identifying cities, towns and semi-dense areas, and rural areas at level 1 of the classification. By using three classes instead of only two (urban and rural), it captures the urban-rural continuum. [...] The first level of the degree of urbanisation classification may be extended in two ways. The first extension, called level 2 of the degree of urbanisation classification, is a more detailed territorial typology: it identifies cities, towns, suburban or peri-urban areas, villages, dispersed rural areas and mostly uninhabited areas. The second extension defines functional urban areas (otherwise referred to as metropolitan areas), covering cities and the commuting zones around them.” (European Commission, FAO, OECD, UN-Habitat, World Bank: 2021: 7)

Even though this approach of defining urban areas using standardized population densities is commendable, it still presents the challenge of defining the terminology in precise terms due to social, cultural, and economic differences across countries. For new projects it is helpful to reconsider all those concepts that limit and orient the analysis as just a description of a succession of events following one and the same organizing principle, that is urbanization.



Internationally, there is a growing interest and related work on the role of the urban environment in shaping human health and disease, giving rise to the new interdisciplinary field of “urban health” (Vlahov and Galea, 2002). Although the impact of services such as water supply and sanitation on health has long been appreciated, it is only in recent decades that some scholars have recognized the multifaceted ways in which urban environments impact health (Frank and Engelke, 2001; Harpham and Molyneux, 2001; Diez Roux, 2003; Jackson, 2003; Montgomery and Hewett, 2005; Baker and Nieuwenhuijsen, 2008; CSDH, 2008; Leon, 2008; Frank et al., 2006; Galea and Vlahov, 2005; Vlahov et al., 2007; Harpham, 2009; Diez Roux and Mair, 2010; Smit and Parnell, 2012; Oppong et al., 2014; Agyei-Mensah et al., 2015; Nieuwenhuijsen and Khreis, 2019). Nevertheless, there is not yet an accepted definition of urban health.

Likewise, while “rural health” is typically described in terms of poorer health status among rural inhabitants and lack of access to health care (Farmer, Munoz, and Threlkeld, 2012), there is no agreement on the definition. Furthermore, the characteristics of rural areas vary widely, making the definition even more challenging (Hart, Larson and Lishner, 2005). There is also a long tradition of projects to improve the health of rural communities and the type of information and approaches for promoting healthier villages (Howard, 2002).

However, even without an accepted definition for either of the terms, given the interconnected nature of urban and rural areas, we know that they both experience a triple health burden, albeit to different extents: infectious diseases, noncommunicable diseases, and violence and injuries. Due to the changeable nature of the rural and urban areas, and the fact that they face similar types of health burdens, it is essential to account for the often ignored rural areas, focus on the possibility of building multi-scalar approaches that are applicable to all human settlements, and to take into consideration the key risk factors that influence health and well-being (WHO, 1976; Tabibzadeh et al. 1989; WHO, 1993; UN-Habitat and World Health Organization, 2020). The need for integrated policies in urban areas requires a constant reflection on the spatial systems that also include rural areas that are institutionally, socially or functionally related, and all the power relations that shape them. We acknowledge that while the “rural–urban” transition is fluid, we use the term “urban” in this document with the understanding that the urban space will need to be further defined, and this policy tracking framework adapted according to the specific context and the nature of projects.

3. Key risk factors for health in cities

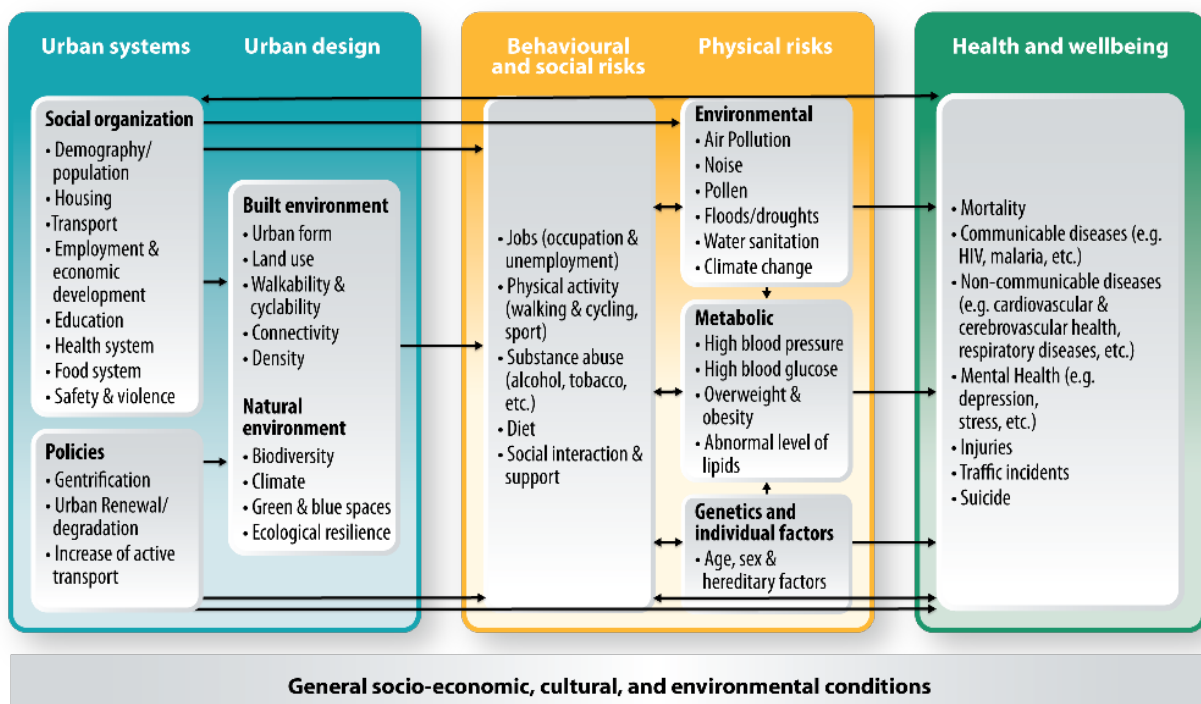
3.1. Overview of the main risk factors for health

There are various pathways, characterized by different interrelated risk factors, through which urban environments can impact human health and well-being (Fig. 3.1). The main interrelated risk factors, that are determined by urban policies and design, which affect the health and well-being of a population are:

- Behavioural and social risks
 - Environmental risks
 - Metabolic risks.
 - Genetics and individual factors
- Physical risks

Behavioural and social risks, such as tobacco and alcohol use, unhealthy diets, and physical inactivity may lead to metabolic risks and various adverse health outcomes. Many of the behavioural and social risks may impact as well as be influenced by physical risks, such as air pollution (Fig 3.1). Urban design, in particular the built environment, can have an enormous impact on ecosystems, which are fundamental for human health. The functions of ecosystems to promote human health include: the provision of food, clean water, clean air, and clean soils, and protective services, such as protection

Fig. 3.1 **Main risk factors and pathways for the impact of the urban environment on health**





against flooding; and their contribution to the promotion of mental health, for example, through providing opportunities for play, recreation, relaxation, and contemplation (WHO and Secretariat of the Convention on Biological Diversity, 2015).

All these risk factors and pathways are interrelated and can be associated with both positive and negative impacts on human health. However, risk factors generally increase the chances of negative health outcomes. This happens as downstream injury and disease outcomes, such as respiratory disease, can conceptually be connected in a causal pathway to upstream urban system policies that shape urban design and transport planning interventions (Giles-Corti, Lowe and Arundel, 2020). The social organization of the population and policies within the urban systems shape risks such as social (e.g. physical activity and social interactions) and physical risks (e.g. air pollution and pollen) which impact metabolic risks (e.g. obesity and high blood pressure), and ultimately long-term health outcomes and well-being (Giles-Corti, Lowe and Arundel, 2020). Considering the relationship between environmental and metabolic risks, one example is the existing adverse association between ambient air pollution and noise with increased blood pressure and hypertension (WHO Regional Office for Europe, 2018; Yang et al., 2018).

It is difficult to isolate and categorize the different risk factors into groups. We must consider that various risk factors precede and influence other risks, and are embedded in the wider socio-economic, cultural, and environmental context. There are two important additional considerations. First, the health outcomes are unevenly distributed across populations and cities, and individual and area-level socioeconomic disadvantages underly determinants of mortality and morbidity, and affect health inequities (Giles-Corti, Lowe and Arundel, 2020). Second, the risk factors for urban health are related to conditions and policies that are usually tackled outside the health sector.

A positive perspective on health should accompany risk reduction strategies because the promotion of public health is not just a matter of developing better epidemiological and medical surveillance of pathologies and improving health systems, but it is also a matter of identifying the social and environmental determinants of health and the behavioural and social dimensions of well-being. This allows broadening of the responsibilities of the decision-makers and the health professionals and their relationship to the larger society's desired well-being. A positive perspective on health, including a focus on prevention, is necessary to build wider viewpoints (Hancock and Duhl, 1988).⁴

The synergistic and potentially aggravating effect of multiple risk factors makes it even more important to consider health holistically. Despite the intersection of behavioural, social, metabolic, individual and environmental risks, the policies and programmes required to reduce these health risks are usually overseen by different governing bodies. Recognizing and developing strategies to facilitate cross-governmental collaborations are pivotal to managing the multifactorial risks that influence urban health and providing adequate solutions (WHO, 2021a).

⁴ Hancock and Duhl (1988) lay out 11 qualities of a healthy city.

1. A clean, safe, high quality physical environment (including housing quality).
2. An ecosystem which is stable now and sustainable in the long term.
3. A strong, mutually supportive, and non-exploitive community.
4. A high degree of public participation in and control over the decisions affecting one's life, health and well-being.
5. The meeting of basic needs (food, water, shelter, income, safety and work) for all the city's people.
6. Access to a wide variety of experiences and resources with the possibility of multiple contacts, interaction and communication.
7. A diverse, vital and innovative city economy.
8. Encouragement of connectedness with the past, with the cultural and biological heritage and with other groups and individuals.
9. A city form that is compatible with and enhances the above parameters and behaviours.
10. An optimum level of appropriate public health and sick care services accessible to all.
11. High health status (both high positive health status and low disease status).

3.2. Risk factors for health in Africa

Cities in LMICs are characterized by particularly large and complex burdens of disease, including: infectious diseases; non-communicable diseases (also known as chronic diseases); injuries; mental health-related conditions (such as psychosocial stress and depression); and substance abuse (which is linked to a number of other types of ill health) (Adeloye et al., 2016; Gouda et al., 2019; WHO, 2017). Particularly in Africa, an estimated 28% of premature deaths are attributable to unhealthy environments, and environmental risks account for 23% of the burden of disease (WHO Regional Office for Africa, 2019).

Infectious diseases are highly prevalent in most African cities and they can be related to poor environmental conditions (e.g. diarrhoea, respiratory illnesses and malaria), or to person-to-person transmission (e.g. tuberculosis and HIV/AIDS), which are particularly prevalent in the eastern and southern African countries (WHO Regional Office for Africa, 2019).

The urbanization process is related to new health threats in Africa due to the increased exposure to risk factors for chronic diseases, such as unhealthier diets and reduced levels of physical activity, which are associated with medical conditions such as obesity or diabetes (Allender et al., 2008; Leon, 2008; Eckert and Kohler 2014; NCD Risk Factor Collaboration – Africa Working Group, 2017). Changing geopolitical, social, and economic conditions have resulted in both increased levels of food insecurity and a shift towards unhealthier diets, resulting in a double burden of malnutrition and obesity for the urban poor (Doak et al., 2004; Ford et al., 2017). In addition, due to inadequate land use planning for children's play spaces, there has been a reduction in physical activity among children and youth in African countries as urbanization increases (Ocansey et al., 2014; Aubrey et al., 2018; Guthold et al., 2020).

Injury rates (for example, from violence, traffic accidents and natural disasters), psychosocial stress and depression are also high in African cities (WHO, 2016). Furthermore, climate change is projected to increase the burden of disease in cities, for example, through increased heat stress and the increased frequency and intensity of extreme weather events (Friel et al., 2011; Harlan & Ruddell, 2011; Ramin & McMichael, 2009, WHO, 2022). The severity of urban health inequalities and inequities makes the burden of disease in LMICs even more complex (CSDH, 2008; Mitlin and Satterthwaite, 2012). Given the presence of slums, it is challenging to enumerate the population size as residents in slums precludes the development of any significant basic statistic (Amegah, 2021; Fischer et al., 2021).

Although we acknowledge that several risk factors can impact human health (e.g. social, behavioural, metabolic, individual, and environmental risk factors), the main analysis developed in this report is on air pollution. Other risk factors are briefly mentioned within the report, and the main literature references are given in the Annex.

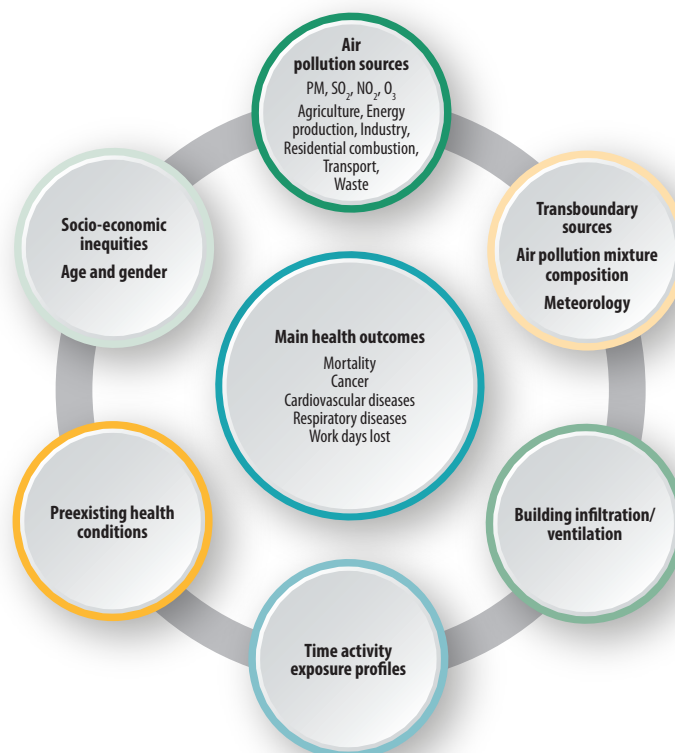
3.3. Focus on air pollution

Air pollution is a mixture of hazardous substances from both human-made and natural sources that modify the natural characteristics of the air and make it detrimental to health. Air pollution is one of the major threats to health – and to the environment – and is associated with an increased risk of mortality and morbidity (Chen and Hoek, 2020; Huangfu and Atkinson, 2020). It is important to note that air pollution levels are typically higher in cities than in rural areas. It is also an actionable



risk factor. The effects of air pollution on human health are influenced by different factors, including air pollution sources, the time-activity exposure patterns, and the intrinsic and socioeconomic characteristics of the population (see Fig 3.2).

Fig. 3.2 Pathways that modify air pollution exposure risk on human health



Source: Authors.

Air pollutants can be directly emitted from sources and interact to form secondary pollutants. Some of the major pollutants in the air include fine particulate matter with a diameter smaller than 2.5 micrometres (PM_{2.5}), nitrogen dioxide (NO₂) and ozone (O₃). All of them have a detrimental impact on human health, as well as on the environment. These major air pollutants are common proxies for air pollution exposure, due to their long lifetimes in the environment and impact on health. However, there are many other pollutants whose effects should not be ignored.

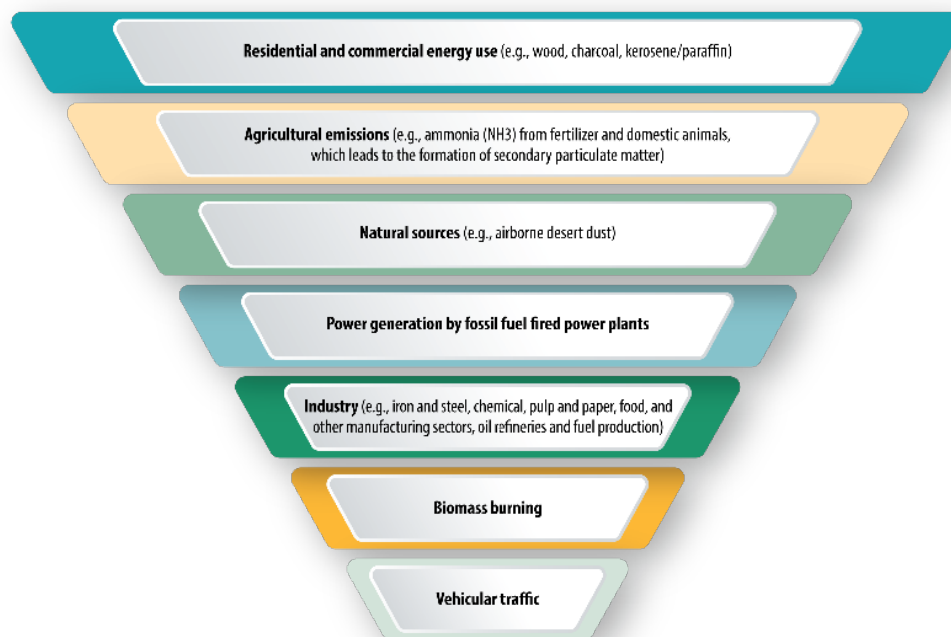
We can distinguish between ambient air pollution (AAP) and household air pollution (HAP). AAP is a broader term used to describe air pollution in outdoor environments. HAP was previously described as indoor air pollution, but acknowledging that human exposure from the air pollution created by the household combustion of solid fuels and kerosene is not limited to the indoor environment, this risk factor has been renamed as HAP to more fully capture the health-based risks associated with it (see Table 3.1). Nevertheless, whatever the type of air pollution, the burden of diseases and the impact on health are globally significant, although having a higher effect on LMICs (Table 3.1).

Table 3.1 Air pollution as a risk factor for urban health

	Impact of air pollution	
	Global	Africa ⁵
Ambient air pollution (AAP)	Globally, 4.2 million deaths were attributable to AAP in 2016 and this number remained unchanged in 2019. About 91% of these deaths occur in LMICs in 2016.	About 426 000 deaths attributable to AAP occurred in the WHO African region in 2016 and this number decreased to 338 000 in 2019.
Household air pollution (HAP)	Globally, 3.8 million deaths were attributable to HAP in 2016 and this number decreased to 3.2 million in 2019, almost all in LMICs.	About 739 000 deaths attributable to HAP occurred in the WHO African region in 2016 and this number decreased to 639 000 in 2019.

Globally, the main sources of air pollution (Fig. 3.3) are, in descending order of importance: (i) residential and commercial energy use; (ii) agricultural emissions; (iii) natural sources; (iv) power generation by fossil fuel fired power plants; (v) industries; (vi) biomass burning; and (vii) vehicular traffic (Lelieveld et al.; HEI, 2021). This connects air pollution and its health impacts to a wide range of sectors in the urban setting.

Fig. 3.3 Main sources of air pollution globally (in descending order)



Source: Authors, adapted from Lelieveld et al. (2015) and HEI (2021).

The global picture offers a broad overview of air pollution. Still, the situation can be very different according to the local contexts where cities can have vehicular traffic representing the main source of air pollution, for example. In Africa, the picture that illustrates the contribution of the different sources of air pollution varies considerably (Fig. 3.4). In North and West Africa, natural sources are the primary contributor to air pollution – although this is being exacerbated by climate change and short-lived climate pollutants (an example of this can be seen in the West African monsoon analysis by Knippertz et al., 2015). In contrast, over most of central Africa, biomass burning is the leading

⁵ The attributable burden of diseases is 10-15% for air pollution (ambient particulate matter, HAP, and ambient ozone pollution) in western and eastern sub-Saharan Africa (Murray et al., 2020).



source (Bauer et al., 2019) (see Fig 3.4). Power generation (mainly from coal power plants in South Africa) is the main source of air pollution over part of Southern Africa. At the same time, residential and commercial energy use is the predominant source in parts of east Africa (e.g. in the countries surrounding Lake Victoria). Nevertheless, the largest proportion of outdoor air pollution in cities in Africa is attributed to emissions from motor vehicles. This is due to the high number of old vehicles, poor maintenance, inadequate infrastructure, and low fuel quality (Clancy, 2008; Alli et al., 2021).

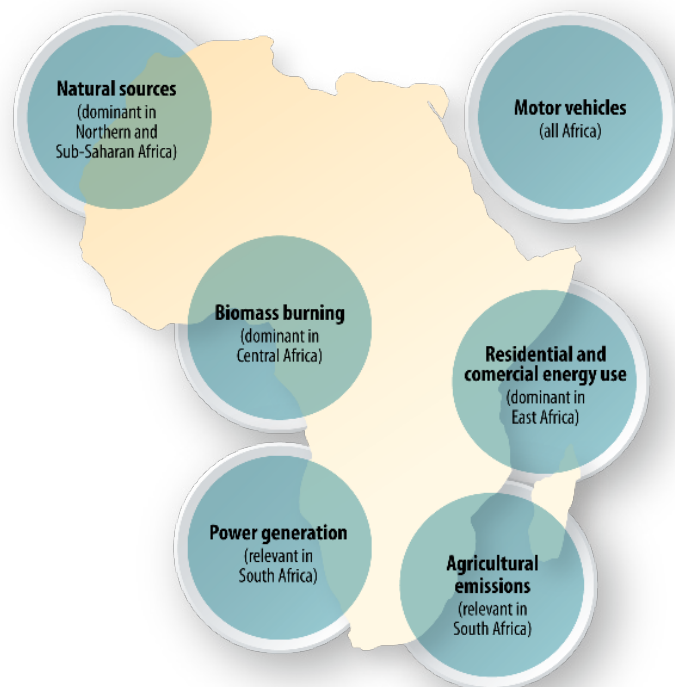
A critical overarching issue is the large variability of air pollution levels across geographic regions of the world – with areas that have reached relatively low levels, and areas with constant extreme high levels which may be due to a combination of emission sources (combustion of fossil fuels, transport, desert, waste, agriculture), population, social and cultural resources. Such variability does not allow for a “one solution fits all” approach, and general principles and advice should consider local variations and resources.

3.3.1. Household air pollution

HAP, highly related to residential energy use, is caused by using polluting fuels (e.g. wood, charcoal) in inefficient devices for cooking, space heating and lighting. HAP accounts for a substantial number of premature deaths, mainly through acute lower respiratory infections (in children under 5 years of age) and cardiovascular and respiratory diseases in adults (Prüss-Üstün et al. 2006). An estimated 3.2 million deaths per year and 7.7% of the global mortality are caused by HAP due to use of solid fuels for cooking and heating (WHO 2022c). In 2019, the proportion of population in the African region that live with primary reliance on clean fuels and technologies for cooking was only 19.3%. During the period 2010–2019, the rate of access to clean cooking fuels and technologies increased at annual rate of 1.0% per year, and deaths from HAP declined, but the overall number of deaths is still very high – at about 639 000 in Africa in 2020 (WHO, 2022c; UNICEF, 2019).

For example, in Nigeria in 2016, 218 400 deaths attributable to HAP were reported⁶. Likewise, a study conducted in Accra found high levels of air pollution, resulting from the fact that approximately 80% of households in the neighbourhoods studied used charcoal and/or wood as their primary source of energy and that cooking of street food by vendors commonly used biomass fuels (Arku et al., 2008). Recent estimates confirm still high values (GBD, 2020). A detailed case study on the health risks associated with exposure to household air pollution in Ghana is presented in Box 3.1.

Fig. 3.4 Main sources of air pollution in Africa



Source: Authors, adapted from Bauer et al. (2019), Lelieveld et al. (2015).

⁶ 218 362 (183 330 – 245 722) were the attributable deaths according to the estimates from 2016 published in 2018 in the indicators for the Global Health Observatory, see: Household air pollution attributable deaths (who.int).

Box 3.1 Notes from Ghana

It is estimated that 28 000 deaths were attributed to both AAP and HAP in Ghana in 2016 (WHO, 2018) and there's an indication of a growing poor air quality and its health implications (Odonkor and Mahami, 2020). In Ghana, a proportion of the population continues to rely on solid fuels and kerosene for cooking at the household level, and this contributes significantly not only to HAP but also a major source of ambient or outdoor air pollution with significant consequences (HEI Household Air pollution – Ghana Working Group, 2019).

Women and children are the most affected by the adverse health effects of HAP (causing, for example, respiratory tract cancers and chronic lung diseases such as bronchiectasis (Gordon et al. 2014)). Given that women are more likely to be involved in household or domestic chores, and they are more likely to cook with polluting energy systems and manage household waste, especially in low-resource settings where they may be more exposed directly to the pollution sources at the household level, their HAP exposure tends to be higher than men (Gordon et al. 2014). The use of biomass fuels for cooking at the household level also has consequences for pregnancy and child health outcomes. Adjei-Mantey and Takeuchi (2021) study in Ghana found that children born in households that use firewood or charcoal as a main cooking source are shorter on average after birth. In addition, boys were found to be more affected by in-utero exposures as compared to girls.

Studies in Ghana have shown that HAP is also linked to the housing type and quality (type of roofing, flooring and exterior materials) as these are all associated with self-reported exposure to household smoke and its consequent health effects (Armah et al. 2013). It is also associated with access and affordability (Gordon et al., 2014) as the cost of intermittent shortages of liquefied petroleum gas (LPG) has implications for the poor to shift to its use (Armah et al. 2013). The irregular access to clean fuels is a major hindrance to fuel transition in low-income communities thus, the provision of equitable energy infrastructure can help address HAP to some extent (Zhou et al. 2011). The impacts on health from exposure to HAP in Accra has been the focus of a dedicated report of the WHO-UHI that presented the health outcomes expected from different scenarios based on various fuel combinations in the household (Edwards and Agbevi, 2021).

3.3.2. Ambient air pollution

AAP results in an estimated 4.2 million premature deaths per year worldwide (WHO 2022c). Exposure to AAP not only causes an impact on the respiratory system (e.g. increased risk of chronic obstructive pulmonary disease, acute lower respiratory illness, lung cancer), but it is also associated with many other health effects, including cerebrovascular disease, ischaemic heart disease, effects on the nervous system, and metabolic effects (US-EPA, 2019). The health risks associated with exposure to AAP in Accra are highlighted in Box 3.2.

Box 3.2 Case study notes from Accra

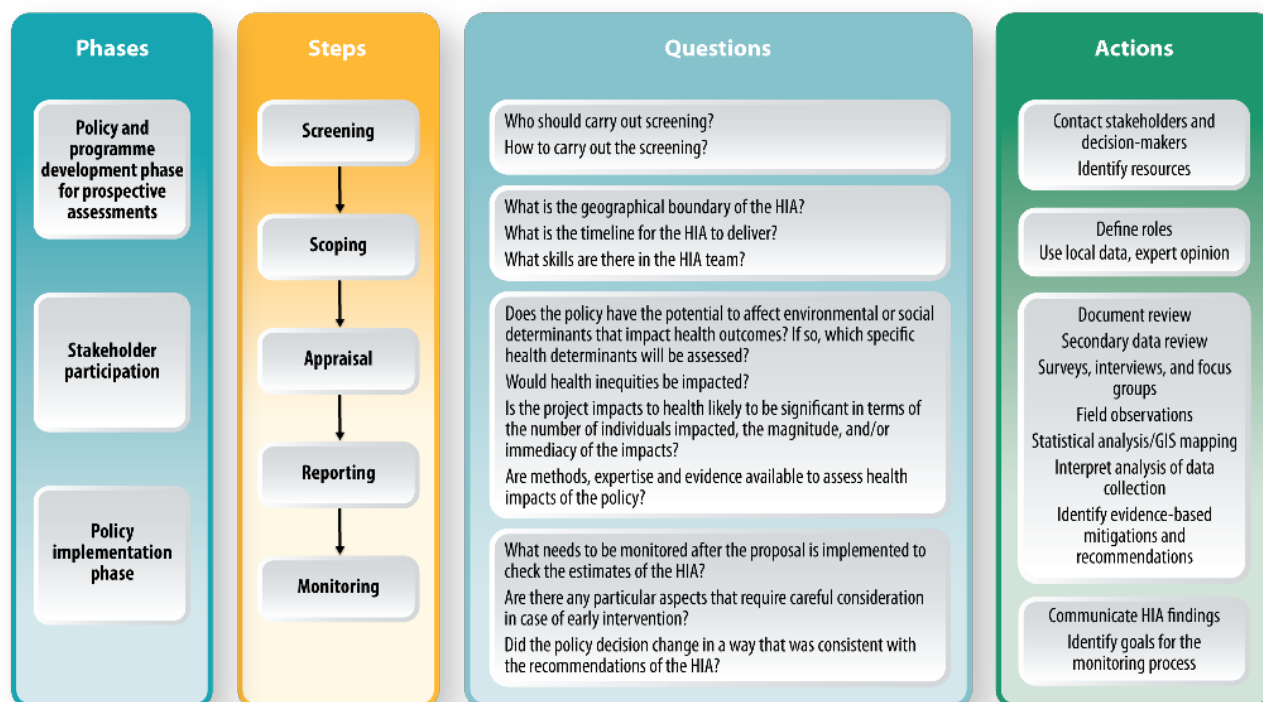
The Environmental Protection Agency (EPA) Ghana has been monitoring air pollution for several years and the impacts of air pollution on health have been quantified based on the 2015 data (see dedicated WHO report (Mudu, 2021)).

A more recent air pollution field monitoring campaign in Accra, conducted between April 2019 and June 2020, confirms the UHI estimates and provides an interesting perspective on AAP in the city and its environs (Alli et al. 2021). The study measured weekly gravimetric (filter-based) and minute-by-minute $PM_{2.5}$ concentrations at 146 unique locations, comprising of 10 fixed (~1-year) and 136 rotating (7-day) sites covering a range of land-use and emission sources and also measures for black carbon (BC) concentration. Results of the study showed that the mean annual $PM_{2.5}$ across the fixed sites ranged from 26 $\mu g/m^3$ at a peri-urban site to 43 $\mu g/m^3$ at commercial, business, and industrial (CBI) areas. CBI areas had the highest $PM_{2.5}$ levels (mean: 37 $\mu g/m^3$), followed by high-density residential neighborhoods (mean: 36 $\mu g/m^3$), while peri-urban areas recorded the lowest (mean: 26 $\mu g/m^3$). Both $PM_{2.5}$ and BC levels were highest during the dry dusty Harmattan period (mean $PM_{2.5}$: 89 $\mu g/m^3$) compared to the non-Harmattan season (mean $PM_{2.5}$: 23 $\mu g/m^3$). $PM_{2.5}$ at all sites peaked at dawn and dusk, coinciding with morning and evening heavy traffic. The study found about a 50% reduction (71 vs 37 $\mu g/m^3$) in mean annual $PM_{2.5}$ concentrations compared to measurements in 2006–2007 in Accra. They concluded that ambient $PM_{2.5}$ concentrations in Accra may have plateaued lower than those in large Asian megacities. However, levels of PM are still 4- to 8-fold higher than the WHO guidelines.

3.3.3. Assessment of health effects of air pollution

Health Impact Assessment (HIA) and Health Risk Assessment (HRA) calculations can be conducted once data on air pollution exposure is collected and/or estimated. HIA is a combination of procedures, methods and tools by which a policy or an intervention may be evaluated to estimate its potential effects on the health of the population and encompasses a broader analysis of policy impacts than HRA (Fig. 3.5). It typically involves the screening, scoping, appraisal, reporting and monitoring of a policy or programme. HIA can be retrospective, concurrent, or prospective (Fehr et al., 2014). For LMICs, depending on when the HIA is undertaken, for example, if the HIA is conducted prospective to the policy implementation, the data collected for the monitoring and evaluation can also be used in the policy tracking. On the other hand, if the HIA is undertaken retrospectively, the data collected for the policy tracking can also be used to develop the HIA reporting. HRA estimates the human health consequences of a particular hazard to which the population may have been exposed (Fig 3.6), for example, air pollution (WHO – Regional Office for Europe, 2016). HRA can be undertaken if air pollution is identified as a potential risk under the appraisal step of the HIA, and an AP-HRA aims to estimate the health risk associated with the exposure to air pollution using concentration–response functions (CRFs).

Fig. 3.5 Steps of a Health Impact Assessment



Source: Based on WHO Health Impact Assessment (HIA) tools and methods⁷.

Long-term health effects of air pollution are the most important to be modelled, but regular data collection of mortality, morbidity, and hospitalizations also allows short-term assessments. The health outcomes and other indicators for which the evidence is the strongest (Schraufnagel et al., 2019; WHO, 2021b) are detailed in table 3.2.

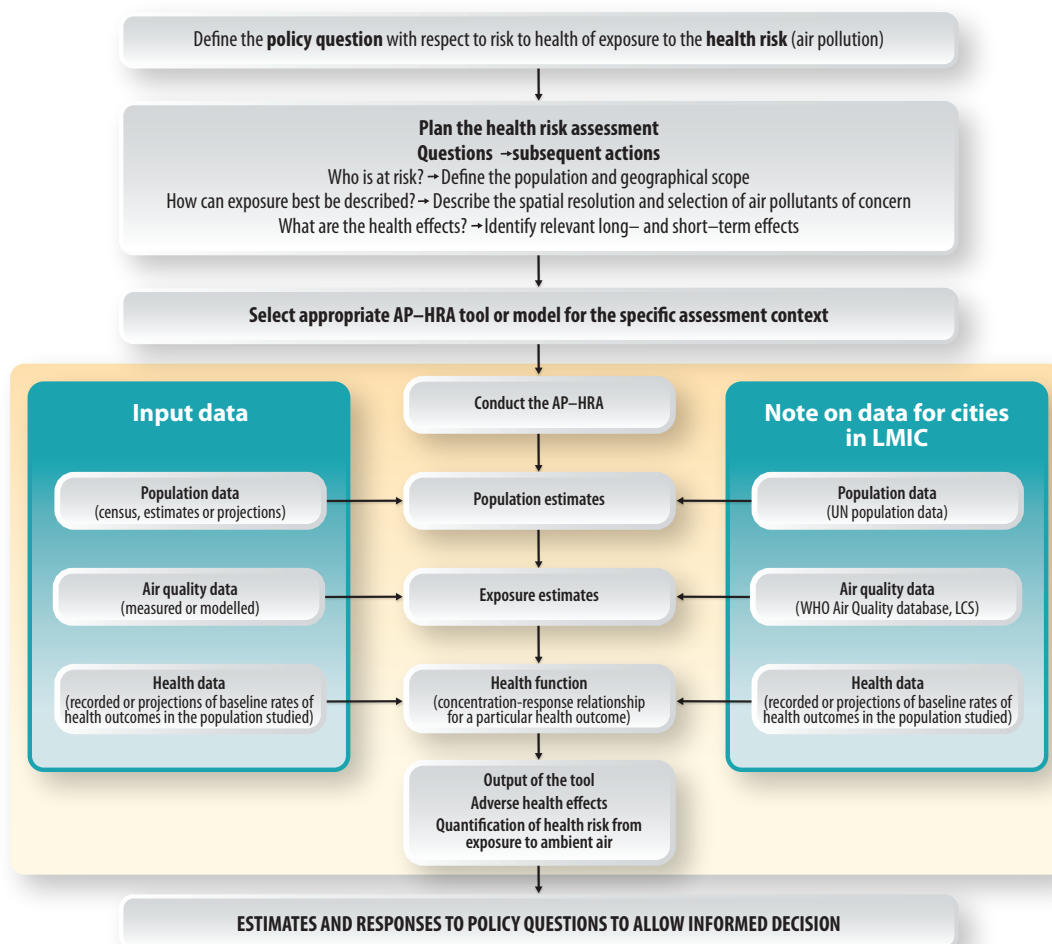
⁷ <https://www.who.int/tools/health-impact-assessments>

Table 3.2 Health outcomes of air pollution exposure

Health outcome	Example of data
Mortality	The total number of deaths due to natural causes and cause-specific mortality, including infant mortality.
Morbidity	Prevalence of bronchitis symptoms in children, incidence of chronic bronchitis in adults, acute respiratory infections in children (0–5 years old), and incidence of asthma symptoms in asthmatic children.
Hospitalizations	Hospital admissions for cardiovascular and respiratory illness.
Workdays lost	The number of days not able to work due to respiratory and cardiovascular illness within the last month and restricted activity days (RADs).

WHO conducted a detailed analysis of the health impacts of ambient air pollution in Accra and presented health outcomes related to different scenarios (Mudu, 2021). One example of the scenario analyses that can be conducted in HIA, using the WHO AirQ+⁸ for HRA, is the number of premature deaths that could be avoided if air pollution is reduced. In the Accra case study, 1790 deaths per year could be avoided if annual PM_{2.5} estimates were reduced to the WHO 2015 AQG value (10 ug/m³).

Fig. 3.6 Framework of a Health Risk Assessment



Source: based on WHO (2016: 4)^{9,10}

⁸ For more information on AirQ+ see: <https://www.who.int/europe/tools-and-toolkits/airq---software-tool-for-health-risk-assessment-of-air-pollution>.

⁹ UN 2019 population data: <https://population.un.org/wpp/Publications/Files/WPP2019-Wallchart.pdf>.

¹⁰ WHO Air quality Database: <https://www.who.int/publications/m/item/who-air-quality-database-2022>.

4. Urban policies and health

Knowing the key risk factors for health in cities is a fundamental step to developing effective and timely interventions, projects and programmes and articulating policies for better urban health. Urban policies are essentially all policies that significantly impact urban environments. Most policies are made mainly at a national scale by national governments. However, sub-national governments (e.g. provinces, states, counties, districts) often also have their own policies, plans, programmes and interventions on specific issues.

Governance often takes the form of horizontal association of networks of private (market), civil society, and state actors which disperses in rule making, rule setting and rule implementation at different geographical scales (urban, regional and transnational). (Swyngedouw 2009). This form of governance does not diminish or reduce state sovereignty and planning capacities, but it displaces techniques of government from formal to informal and places more responsibility on new actors in governance, including market institutions, NGOs, and individual members of the public. This indicates a fundamental transformation in statehood and a renewed relation between state and civil society actors (Swyngedouw 2009). The partial decentralization process, with the allocation of responsibilities to local government but without the distribution of commensurate resources, has exacerbated the challenges faced by local government (Smit and Pieterse, 2014). In addition, high levels of political, jurisdictional, and fiscal conflict, e.g. between national and local governments, can also weaken the ability of local governments to address urban problems (Resnick, 2014). Furthermore, the overbearing control of local governments by national/central governments (including, in some cases, the appointment of city mayors) weaken the capacity and incentives of local governments to be responsive to urban challenges. The policy tracking framework presented in this report is also susceptible to this shifting dynamic of urbanism and governance.

It is important to note that policies are not single documents rather complex bundles of laws, by-laws, regulations, rules, discussion papers, strategies, programmes, interventions, and funding priorities. It is also critical to recognize that policies cut across multiple scales of government and that different levels of government often have overlapping mandates. Similarly, while policies are divided by sectors, the policies of different sectoral departments usually overlap, as many urban issues are multi-sectoral. One should not look at policies on their own since they are informed by other initiatives (such as global agreements and international socio-economic rights) and are actioned through laws, strategies, regulations, practices, etc. (some of which are publicly accessible and some of which are not). Also, policies vary considerably in importance from those which have enormous reach to those which are not implemented. To further complicate the policy framework, policies from different sectors or levels of government may sometimes be contradictory.

In the last decade, and especially since the adoption of the New Urban Agenda in 2016, many countries have introduced national urban policies, which are intended to provide a broad framework for state involvement in urban areas (e.g. the 2012 Ghana's National Urban Policy Framework and Action Plan and the 2016 South Africa's Integrated Urban Development Framework). In practice, however, policies driven by local sectoral departments still have a pivotal role. Some examples of the relationship between these main urban policy areas and policies on air pollution are listed in Table 4.1.

Table 4.1 Examples of the relationship between air pollution policies and other urban policy areas

Main urban policy areas	Urban policy subareas	Air pollution policies	
		Ambient air pollution (AAP)	Household air pollution (HAP)
Urban governance	Governance	<ul style="list-style-type: none"> • Legislation for air quality (AQ) control that integrates accountability, enforceability, transparency, and public participation. • Policies to reduce air pollution through interventions in other sectors such as housing/household infrastructure or transport (multi-sector approach) • Incorporation of potential health impacts into local government decision-making to guide decisions that reduce air pollution exposure. • Fiscal incentives include charges on polluting vehicles entering a city centre and subsidies for cleaner vehicles. 	<ul style="list-style-type: none"> • Existence of policies to provide clean fuel and technologies for cooking, heating and lighting.
	Environmental management	<ul style="list-style-type: none"> • Studies on air pollution sources and trends. • Policies, plans or programmes that develop emission inventories and regulate specific sectors that can affect AQ. 	<ul style="list-style-type: none"> • Policies on specific sectors (e.g. waste management) to reduce negative impacts on air pollution derived from, for example, the open burning of garbage.
Spatial sustainability	Spatial planning and land use management	<ul style="list-style-type: none"> • Existence of a master plan that addresses AQ issues, for example, on infrastructures that promote mixed-uses and compactness, connects destinations and facilitate active mobility, reduces air pollution, and increases equitable access to quality green or blue spaces and recreational areas. • Land use and planning policies that consider the environmental and health risks when defining the location of industrial or commercial establishments (to reduce health risks related to exposure to air pollution). • Policies that consider agricultural sources of air pollution as an environmental and health risk (e.g. by increasing the risk of toxicity in vegetation and the negative effects on crop yield) when determining the location of agricultural land. • Knowledge of measurements of air pollutants in local production and information on crop burning practices. 	<ul style="list-style-type: none"> • Sources and structure of the energy grid. • Policies to regulate and reduce the collection of fuelwood. • Promotion of renewable energy.
	Housing/household infrastructure	<ul style="list-style-type: none"> • Assessment and communications of the potential impacts on air quality due to the construction industry. • Policies that promote efficient and safe thermal insulation in household infrastructure (to reduce the use of heating systems and air conditioning). • Government incentives and subsidies to replace wood burning with clean and sustainable residential heating and cooking options. • Determine emission limits for residential heating/cooking with coal and wood. 	<ul style="list-style-type: none"> • Availability of data describing the types of energy and technology available for cooking, heating, and lighting. • Policies that provide alternatives to the use of cooking and lighting practices that use kerosene lamps, which increases exposure to harmful emissions and long-term health risks, particularly among women and children.

Table 4.1 *continued*

Main urban policy areas	Urban policy subareas	Air pollution policies	
		Ambient air pollution (AAP)	Household air pollution (HAP)
Spatial sustainability	Mobility	<ul style="list-style-type: none"> • Availability of quality, safe, affordable and efficient public transport. • Infrastructure that promotes active mobility (e.g. adequate sidewalks, bicycle lanes, proper connectivity). • Enforcement of regulations regarding vehicle emissions. • Reduction of the development of infrastructures for motorized vehicles (e.g. highways) next to residential areas. • Strategies to mitigate the high exposure to air pollution in areas exposed to high volumes of traffic (e.g. green walls in highly trafficked areas next to residential areas, hospitals or schools). 	
	Health system	<ul style="list-style-type: none"> • Availability of data on critical health outcomes allows quantification of pollution's health burden from mortality and morbidity. • Location of healthcare facilities (avoiding locations with high exposure to air pollution). • Safe and environmentally sound management of health care wastes. 	
	Safety/security	<ul style="list-style-type: none"> • Provision of safe paths for all the population to move between places. • Regulation to guarantee the safety of public transport users (in particular for women). 	
Social sustainability	Education/social development	<ul style="list-style-type: none"> • Existence of curricula that include information on air pollution and health at the higher education grades. • Presence of non-governmental organizations (NGOs) and community organizations against air pollution. • Support for citizen science projects. • Availability of information that raises awareness of the detrimental health effects of AAP, HAP and second-hand smoking. 	
Economic sustainability	Economic development	<ul style="list-style-type: none"> • Availability of data, split by sectors of the economy, showing the contribution of different sources of air pollution. • Type and location of promoted and subsidised industries in a region. 	<ul style="list-style-type: none"> • Availability of affordable clean cooking fuels and technologies.

Given the interconnectedness of urban systems, it is essential subnational governments be cognizant of the overlap between multiple urban policies (e.g. environmental management policies and mobility policies) and the need to track individual policies holistically.

5. Analysing and tracking urban health policies for selected indicators

It is essential to define the methodology to track policies, which can be done by policy tracking and surveillance. Tracking policies can be operationalized by following various steps that can include stakeholder engagement and the use of tools.

This chapter includes four sections. First, the definition and steps for policy tracking. Second, a discussion on the indicators for tracking the impact of urban policies on air pollution and urban health. Third, a section that describes the importance of engaging stakeholders in the policy tracking process. And the fourth section concludes the chapter by highlighting the importance of considering media coverage on policy tracking activities to raise awareness (and therefore action) among the population.

5.1. Defining policy tracking

Two main questions are addressed in this section: what is policy tracking? And how is policy tracking usually framed?

To outline policy tracking, it is useful to first consider some definitions as there are several approaches to the terminology. Policy is commonly used "...as a catch-all term to describe any form of government action including formal laws, acts, decrees and regulations as well as state-supported programmes, schemes, plans and other activities" (WHO, 2021b: 2). In fact, measures and laws are usually needed to support a policy. Once a policy is developed with its measures, a programme is created to achieve the aims of the policy, and interventions are implemented (Table 5.1). Policies have also been defined as "government-driven processes happening over time or events occurring at specific time points, which cause changes in urban infrastructure and/or human behaviour and, as a consequence, impact environmental pathways and health outcomes at street, street network, neighbourhood, city, or metropolitan region levels" (Benavides et al., 2022). According to the UNFCCC: "A 'policy' is a statement of intent to achieve certain goal(s) by local, regional or national governments of a country. A policy could be documented in a legislation or other official documents."

Table 5.1 **Definitions and terms related to policy**

	Definition	Clarifications
Policies	Policies are “. . . any form of government action including formal laws, acts, decrees and regulations as well as state-supported programmes, schemes, plans and other activities” (WHO, 2021b: 2).	Policies are related to the process that gives the direction to be taken to orient decisions and use of funds, and are usually articulated in legislative measures and regulation, that produce programmes. A useful way of understanding ‘policy’ is in terms of context, content, process and power (Walt 1994 quoted by Exworthy, 2008).
Programmes	Programmes are usually a set of official steps (e.g. measures) to execute a policy.	Programmes can be projects or activities that have an identifiable purpose within a specific policy.
Interventions	Actions taken to modify and improve a situation.	Interventions can be taken without a policy or an official act requesting them (e.g. a standard).
Law	A rule of conduct or action formally adopted as binding or enforced by a controlling authority.	The definitions of law are usually broad and include a whole body of rules and regulations.
Measures	An official action (law, regulation, act, decree, directive, resolution, guideline, programme) that is put in place to achieve the particular aim of a policy.	Measure is defined by the United States (US) Congress as “A legislative vehicle: a bill, joint resolution, concurrent resolution, or simple resolution.” (https://www.congress.gov/help/legislative-glossary#p)

Source: Authors.

Policy tracking is the development and application of systematic approaches to identifying and evaluating the planning, implementation and progress of a policy, programme or intervention (rather than laws or measures) over time and space, and between and across populations and sectors. Policy tracking can be formal or informal and its goal is to evaluate the policy status, whether and how it has been implemented, changed, achieved, or suspended. The outcomes of policy tracking can be assessed at different stages of the policy process, from the identification of the need of having a policy, to its implementation (Benavides et al., 2022). The system would ideally help to gain insight into adapting suboptimal policies and identifying the potentially best policy strategies going forward (Francesco et al., 2020). “Policy tracking systems provide a snapshot of the policies and actions in place, and is usually based on descriptive accounts of the quality of projects and how they fit with the specific policy objectives established within a given network (Chriqui et al., 2011, p. 23, Chriqui & Eyler, 2016).” In addition, policy tracking systems aim to showcase local initiatives and mutual learning and are usually not subjected to rigorous peer review and validation process which may increase the accuracy of the data collected. While policy tracking cannot be performed retrospectively, other methodologies such as an HIA (described in section 3.3.3. of this report) can be complementary and a useful process to assess the impacts of existing implemented policies and programmes.

In contrast to policy tracking, **policy surveillance** has traditionally been used to identify non-compliant administrative units and exert pressure on policymakers. Its quantitative reporting requirements enable transparent benchmarking and comparative assessment of multiple cities across time. A comparative assessment of the scope of work involved in policy tracking vs surveillance is illustrated in Table 5.2 for the proposed Ambient Air Pollution Reduction indicator also referred to as the Air Quality Management (AQM) indicator (see section 5.2.1 for more details on the indicator framework).

Table 5.2 **Summary of the dimensions of information systems required for the Air Quality Management (AQM) indicator if using a policy surveillance vs policy tracking approach**

Dimensions of information system	Policy tracking	Policy surveillance	Considerations/challenges/limitations
Functional focus	<ul style="list-style-type: none"> Collection of projects, reports, news and case studies from activities and action plans; No commitment to any specific targets. 	<ul style="list-style-type: none"> An action plan and data on how well countries, regions or cities perform in achieving their targets; Website with accessible information on targets and progress. 	While the AQM does not require a commitment to specific targets, an action plan and data collection strategy will increase the likelihood of fully achieving the policy.
Type of information	<ul style="list-style-type: none"> Predominantly qualitative; Few reports provide numbers on how effective air pollution reduction initiatives were; No comparative data. 	<ul style="list-style-type: none"> Website with quantitative and comparative data on, e.g. number and location of monitoring stations, presence of source apportionment data; national and regional coordination; considerations on population health protection; existence of regular monitoring of air pollution; population weighted exposure measurements; inclusion in the master plan of air pollution issues and identification of hotspots. 	The policy tracking approach only allows users to partially assess the achievement criteria for the AQM indicator, but elements of the policy surveillance approach can be used to fully assess the achievement criteria.
Research vs advocacy orientation	<ul style="list-style-type: none"> Oriented towards advocacy and reporting; Reports and case studies are mostly designed to stimulate learning and discussions. 	<ul style="list-style-type: none"> Oriented towards research and evaluation; Website compares current data against baseline values to motivate research. 	Lack of awareness of the health impacts of air pollution can generate indifference to track policies and measures to improve air quality.
Credibility of information	<ul style="list-style-type: none"> Reports on air quality (for example from dedicated surveys) policies are available but no external validation. 	<ul style="list-style-type: none"> Reports and input data for surveys are available so external validation is feasible; Methodology for compiling 1) the measurement capacity, 2) data assessment and availability, 3) emissions estimates and 4) the air quality management capability are standardized. 	Using the policy tracking approach can lead to the full achievement of the AQM policy, but elements of the policy surveillance approach will be beneficial to include.
Engagement of peers	<ul style="list-style-type: none"> No broad engagement of peers. 	<ul style="list-style-type: none"> Engagement of peers from academia and institutions. 	Peer collaboration and the ability to create positive interaction can be beneficial to strengthening policy tracking activities along medium- and long-term periods.
Tools for policy learning	<ul style="list-style-type: none"> The authorities decide on what they report with no obligation to report periodically. 	<ul style="list-style-type: none"> Comparative measures with standardized methodology and periodic reporting (for example, every two years). 	While the AQM does not include a standardized reporting method, it specifies regular reporting (i.e. two years).
Openness and transparency	<ul style="list-style-type: none"> Public access to original data sources but not comparative assessment and benchmarking. 	<ul style="list-style-type: none"> Data available on websites for easy dissemination of comparative assessment and benchmarking of local data and surveys. 	Open access to data sources and trends is necessary to achieve the AQM policy.

Source: Authors based on Chriqui et al. (2011), Francesco et al. (2020).

All countries should strengthen their institutional capacities and data to implement comprehensive policy surveillance systems. However, this is not always possible, especially in LMICs, where challenges such as data availability, methods and tools adaptation, or convening of different sectors are usually faced. Therefore, although policy tracking and policy surveillance represent two approaches to assessing policies, an alternative system may lie in the middle and depend heavily upon the country's capabilities and data availability. The framework for policy tracking suggested in this report consists of a **hybrid of policy tracking and policy surveillance** that includes collecting both quantitative and qualitative data to assess policy impacts to enable public engagement and mutual learning. The framework is an assertion that a lack of data should not prevent countries and local authorities from enacting policies, for example to address air pollution and energy access, with clear policy tracking mechanisms. From now on, for this report, when we use the term policy tracking, we are referring to the hybrid model described above.

Tracking policies has social and political implications: it can be done for public policy, and/or it can be done with the purpose of evaluation, research, and/or advocacy (Chriqui and Eyler, 2016). It can also be done to understand how international policy ideas are transferred to national policy arenas (Gilson and Raphaely, 2008). Policy actions operate across jurisdictions, and they are often implemented with a multi-level governance (Wälti, 2004; Chriqui and Eyler, 2016). In most countries, policy tracking is a formal institutionalized process,¹¹ and large and important interventions that have consequences for the environment go through a formal process of assessment, including mandatory Environmental Impact Assessment (EIA) for projects. In high-income countries, there are dedicated units to monitor and evaluate policies within governments in ministries or specialized agencies. EIA is a process that evaluates the potential environmental impacts of specific interventions/projects, and it is the decision tool most widely legislated globally (Fehr et al., 2014). One of the strengths of EIA is its specific and detailed structure which makes it easier to monitor the planning and implementation of specific actions throughout the life cycle of the project. However, EIAs are appraisal tools that are used before the intervention's implementation, and additional tools should be employed to track the intervention's progress both during and after implementation. Furthermore, EIA estimates the impacts of a specific intervention on the environment but does not include a human health assessment. See the Annex for additional tools to track the public health impact of air pollution.

Policy tracking systems can be institutionalized using a conference of the parties, specific agencies, or official databases (Chriqui and Eyler, 2016). It is important to note that the policy tracking system required would depend on the type of policy being monitored. Regional and national measures such as treaties and laws which are broader and more aspirational in their objectives are more feasible to be tracked using qualitative methods that examine the absence or presence of specific policy statements. "Most policy tracking systems that are qualitative systems rely on keywords and basic search schemes to enable end-users to search for policy actions within the jurisdictions of interest and on the topics of interest. Typically, policy tracking systems are updated on a regular basis to enable users to monitor changes in policy status and/or actions" (Chriqui and Eyler, 2016: 292).

¹¹ Examples of institutionalized health policy tracking system is in Chriqui and Eyler (2016: 293).

5.1.1. Steps for policy tracking

National and local policies containing specific goals and milestones should be monitored by both qualitative and quantitative policy-tracking methods. The steps needed to conceptualize a framework for policy tracking that are presented in this report (Figure 5.1) rely on a few hypotheses: 1) there is currently weak institutional capacity to track policies; 2) data are not always available; 3) policies can be determined in their development within a more or less precise time frame;¹² 4) it is likely that there are health consequences as a result of the policies.

The **first step** to track the progress of a policy is **policy identification**. This step aims to identify the policy's purpose, related interventions and programmes determine how they fit into a larger picture of national strategies. Most times, an intervention is connected to a national policy or measure. In such scenarios, it's important to distinguish the policy to which the intervention is connected to accurately identify the intervention's milestones. In the first step, "users identify and characterize the policy to be tracked in specific, concrete terms" (Barua, Fransen and Wood, 2014: 1).

Since observed policies are still difficult to assess for significant association with the expected health benefits and there is still limited evidence from LMICs, it is pivotal to assess the **policy impacts** as the **second step** of policy tracking (Burns et al., 2019). As new policies are introduced, the effectiveness of interventions in terms of improved air quality or health needs to consider a built in the evaluation component, which could facilitate more systematic and comprehensive evaluations of the magnitude and quality of the impact on the public in the short- and long-term. However, the complexity and difficulty associated with evaluating impacts and outcomes should be recognized and validated protocols should be followed

In an ideal world, long-term regulatory programmes and policy frameworks benefit from an accountability component built into them. This provides a consistent, recurring framework for evaluation that encourages a more systematic assessment and facilitates comparisons across regulatory programmes and research studies. This requires further insight into how regulatory bodies accomplish long term, strategic, evidence-based policy measures, and how academic researchers may be involved. A system for reliable tracking of air quality and health outcomes data over the long term, including quality assurance of the data and making them publicly available is therefore vital.

Once the policy framework has been characterized, a **third step**, crucial to identify specific objectives and milestones, is required for the policy life cycle i.e. **policy monitoring**. When monitoring the progress of a policy, it is useful to identify key performance indicators for each milestone. Key performance indicators allow us to determine what data needs to be collected for a specific objective. They are most effective if they are specific, measurable and have an end time. The monitoring procedures for each intervention should be well defined and could contain information on:

- Objectives and milestones
- Expected completion dates
- Key performance indicators
- Institutions responsible for tracking
- Sources of data collected
- Status and date at last tracking
- Frequency of tracking

For each milestone, it is crucial to identify the expected date by which the milestone should be completed. Often, the progress of each outcome will impact another. For example, the initiation of

¹² A policy process has often no start or end point, only a middle (Exworth, 2008).



the intervention requires specific input indicators such as financial resources. If financial input is not timely, human resources cannot be acquired and the baseline assessment of the policy could be delayed. Expenses incurred during implementation should also be compared against the benefits as well as the estimated expenditures that were projected during the planning process.

The **fourth step** in tracking the progress of a policy is **data collection** for each key performance indicator to monitor and evaluate the implementation of specific objectives. This allows “identifying trends, comparative analysis, and measuring outcomes” (Chriqui and Eyler, 2016: 297) and also informs advocacy and research actions. Data sources can be indirect (e.g. via media reports or government publications) or direct (e.g. from polls, surveys, interviews, focus groups or direct observations). Data sources that are publicly available, either online or in print, are usually preferred as it can be collected and assessed more quickly. When such data sources are not readily available, conducting periodic surveys, interviews and even focus groups with government officials, public health officials and most importantly, the general public may be useful. Data should be collected before the intervention to determine a baseline value for the indicator to assess the change from an intervention. While tracking the progress of policies, programmes and interventions is essential, it is also critical to understand the public’s risk perception throughout the policy’s life cycle. For example, “does the public see the benefits associated with this intervention or would they prefer to see another intervention implemented?” When implementing interventions that seek to change behaviour or practices, public perception indicators should also be monitored. This information allows us to compare projected outcomes with observed outcomes, and in scenarios where the projected benefits were not actualized, this feedback can be used to modify the intervention and enhance its probability of success. To set up policy tracking mechanisms, new skills are needed in data collection and selection, scanning of communication information, transdisciplinary practices, and applying tools from the science of economic evaluation (Brownson and Eyler, 2016).

In the **fifth step**, it is important to focus on the **policy quality** by evaluating changes in both health and environmental outcomes. This includes interventions that aim to reduce air pollution that positively affect respiratory and cardiovascular health. In such an intervention, it would be useful to conduct interviews with public health officials or hospital personnel to monitor changes in hospitalization rates due to asthma, chronic obstructive pulmonary disease and ischemic heart disease. However, it might be difficult to detect the efficacy of an intervention over a short period of time, and in this case, interviews can be conducted as a first step prior to in-depth analysis. The development and implementation of a validation protocol is crucial given the complexity of the evaluation process. The data collected should aim to be disaggregated by age, sex, district. Additionally, the time period should allow stakeholders, citizens and donors to assess any inequities in the benefits of the intervention. Within the policies and the associated actions, one must keep in mind a nested series of considerations to include the dimensions of inequality, as there are relevant indicators of health and appropriate criteria for subgroup disaggregation, and always explore the possibility of preparing, analysing and reporting disaggregated data that allows evaluations of inequality.

It is important to recognize that in urban design, populations and behaviour change over time. As a result, the impact of a policy is not static. While Benavides et al. (2022) observed that most policy impacts were examined at a single stage or point in time, they highlighted the benefit of impact evaluations at multiple stages to develop a comprehensive evaluation of the policy. Experience implementing the Initiative in Accra confirmed that policy processes for environmental health are neither completely linear nor iterative, presenting new challenges with ongoing implementation. The Policy tracking steps (Fig. 5.1) outlines a more complex but likely process.

Fig. 5.1 Policy tracking steps

Steps for policy tracking



Step 1. Policy identification

Identify which policies exist, which authorities are involved, and the main goals of the policies.



Step 2. Policy impact

Conduct evaluations to determine the impact of a policy.



Step 3. Policy monitoring

Understand how the policies have changed over time.



Step 4. Data collection

Identify information and data sources through qualitative and quantitative methods.



Step 5. Policy quality

Understand which policy solutions use the best available evidence, and if different demographic groups are considered.

Key considerations

- What is the impact of historic policies on present day urban design, environmental pathways, and health?
 - Has the current policy been adopted and implemented?
 - What is the geographical boundary of the policy?
 - What is the timeframe for policy?
-
- Is the policy impact to health likely to be significant along the next years in terms of the number of individual affected, the magnitude, and/or immediacy of impacts?
 - What are the potential health impacts and tradeoffs of different policy scenarios or objectives?
 - What are the costs and benefits of a proposed policy?
 - What are the health and climate mitigation co-benefits of a proposed policy?
-
- Is there a monitoring/surveillance process on-going?
 - who was in charge of the monitoring/surveillance process?
 - how was screening carried out?
 - what are the objectives and expected completion dates?
 - If not: which policy monitoring system can be implemented?
 - What is the public perception or acceptability of the policy?
-
- Which qualitative or quantitative methods can be used to collect useful data for assessing policy quality and impacts?
 - What are the impacts of the policy on urban design, behaviour, pathways, and/or health?
 - Are the impacts of the policy on exposures or health distributed in an equitable manner?
 - What is the cost-effectiveness of the policy?
-
- Were the potential health impacts outcomes evaluated?
 - Which specific health determinants will be assessed?
 - Were health inequities considered?
 - Are the health burdens from exceeding international, national, or local exposure guidelines for an environmental pollutant distributed equitably by social factors (e.g. race/ethnicity, economic income, etc.)?

5.2. Indicators to track air pollution policies

An essential part of the policy tracking framework is the development or identification of indicators that are relevant and measurable for the policy being implemented and monitored. This is part of the third step of the policy tracking framework described in the previous section (i.e. policy monitoring), and it deserves a more in-depth discussion as this represents an intersection with policy surveillance activities. In this section there is a detailed discussion on the adoption of existing indicators from the SDG framework to track the impact of urban policies/strategies that impact health and air pollution.

5.2.1. Air pollution indicators

Given the significant public health costs of air pollution, many countries have put in place more measures, laws, regulations, monitoring programmes and public awareness campaigns to improve air quality (e.g. unep.org/airquality/; and breathelife2030.org). Following these efforts, the 2030 Sustainable Development Goals include global targets that aim to reduce air pollution and its related mortality.

Therefore, the policy area chosen in this report is the reduction of air pollution,¹³ and specific indicators for policy tracking are suggested, considering the steps introduced before.

Two SDG indicators, with urban and rural data for all the countries, are currently available and well-suited to monitor health benefits from policies that aim to reduce air pollution:

- 1) Annual PM_{2.5} mean concentrations for AAP exposure (SDG 11.6.2) and
- 2) Percentage of population with primary reliance on clean fuels and technologies at the household level (SDG 7.1.2).

These indicators are currently used for the SDG reporting at the national level¹⁴.

To support the development of these SDG indicators, WHO manages global databases on AAP, HAP and household energy use to track and monitor both exposure and disease burden due to air pollution. This data is collected at the city level within the Ambient Air quality Database¹⁵ and the Household Energy Database¹⁶. When taking into account indicators, a balance is to be found between the unavailability of data and the promotion of specific policies. The availability of indicators to track the general air quality status supports more specific policy tracking activities, knowing that the key challenge for the evaluation of an intervention is the capacity to directly attribute the changes in air pollution and health to a single intervention among many regulatory actions.

Two indicators can be envisaged: one for AAP reduction policy objectives "Ambient Air Pollution Reduction", and a second one for HAP reduction policy objectives "Clean Household Energy".

¹³ There are examples of analysis and discussions on other environmental policies, for example on climate change see Barua, Fransen and Wood (2014).

¹⁴ On the SDGs indicators see: <https://unstats.un.org/sdgs/indicators/indicators-list/>.

¹⁵ The WHO air quality database compiles data on ground measurements of annual mean concentrations of PM_{2.5}, PM₁₀, NO₂ for the city or town as a whole, rather than for individual stations. The latest version (fifth update) of the database was released in April 2022 and currently hosts data on air quality for over 6000 human settlements in more than 100 countries. The database is used to derive the Sustainable Development Goal Indicator 11.6.2, Air quality in cities, for which WHO is custodial agency. See: <https://www.who.int/publications/m/item/who-air-quality-database-2022>.

¹⁶ The Household energy database contains nationally representative data from surveys and censuses on cooking, heating and lighting fuels. The database is used to calculate national, rural and urban estimates for use of clean fuels and technologies which WHO reports for Sustainable Development Goal Indicator 7.1.2. See: <https://www.who.int/data/gho/data/themes/air-pollution/who-household-energy-db>.

1. Ambient Air Pollution Reduction: (also referred as Air quality management) given the heterogeneity of air pollution levels, an indicator for AAP in cities can only be conceived in relation to air quality management including the entire set of actions that national or local regulatory authority undertakes to help protect human health and the environment from the effects of air pollution (see Annex). In fact, population weighted exposure, taking into account spatial distribution of both the pollution and of the population, should be the indicator that leads the intervention, and continuous outdoor air quality monitoring should be encouraged for regulatory purposes and tracking the effectiveness of interventions¹⁷.

2. Clean Household Energy: the indicator for HAP is related to inefficient combustion of different cooking technologies and the varying toxicity of the combustion products from clean vs polluting fuels. Since HAP is primarily from cooking-related emissions, technologies for cooking should be the primary indicator to monitor its progress.

Table 5.4 **Ambient air pollution reduction**

Name abbreviated	Air quality management
Indicator name	Ambient Air Pollution Reduction
Policy area	Air Pollution reduction
Policy action	This indicator is used to assess policy actions, implementation and monitoring. Policy action constitutes the development or existence of policies, legislations and standards. Implementation involves configuring the environment, infrastructure or setting to comply with policies/legislation and standards, which may include provision of services, or redesign of the built environment. Policy monitoring refers to existing actions to assess implementation, understand policy changes over time, and ensure compliance with policies, legislation and standards.
Rationale	Air pollution is a major risk factor for health and it is the single largest environmental health risk, causing more preventable disease and death than any other environmental risk factor (e.g. heart disease, stroke, chronic obstructive pulmonary disease, lung cancer and respiratory infections like childhood pneumonia). In some areas of the world, air quality has improved over the last decades due to targeted policies and technological improvements. However, a significant proportion of the urban population is still exposed to concentrations of certain air pollutants above WHO AQG or interim target values set for the protection of human health. Policies to improve air quality across urban sectors have many potential co-benefits for health, the environment and economic development.
Definition	Cities follow different policies according to local and national legislation, and two main mechanisms define their Air Quality management framework: <ul style="list-style-type: none"> • Implementation of national legislation; • Specific local air quality monitoring programmes (e.g. measurements and models).
Numerator	NA A simple indicator with a numerator and denominator is not of much use at a local level, and it is better to consider a composite indicator. Individual indicators need to be compiled into an overall single index, not just a ratio or proportion. The preferred option is to use a five levels scale (minimal, limited, moderate, good, excellent) that can be combined into three achievement levels: 'Achieved', 'Partially achieved' and 'Not achieved'. Minimal means no implementation of national legislation, no knowledge of the source of emissions, no availability of population weighted exposure to air pollution (PM _{2.5}), decreasing trends of air pollution are not proved. Reference to PM _{2.5} is necessary to start a process of work on all air pollutants.
Denominator	NA
Unit of measure	NA

¹⁷ Since modelling requires validation by high quality air pollution monitoring, it is possible to combine modelling with passive sampling to support continuous monitoring to get a better picture of exposure and its trends.

Name abbreviated	Air quality management	
Disaggregation	If local specific measures are in place, check if relevant subgroups by age or sex are specified. Ideally, breakdown in terms of individual and area-level socioeconomic realities should be looked for.	
Achievement criteria	These indicators are proposed to have the following level of achievements:	
	Achieved	1) Legislation (national/subnational) to monitor Air Quality and reduce air pollution is implemented and at the selected scale (e.g. city) 2) data on sources of emissions and 3) population weighted exposure to air pollution (PM _{2.5}) are available AND policies are fully enforced AND decreasing trends of air pollution are proved.
	Partially achieved	1) Legislation (national/subnational) to monitor Air Quality is implemented and at the selected scale (e.g. city) 2) data on source of emissions and 3) population weighted exposure to air pollution (PM _{2.5}) are available BUT policies are still not fully enforced AND trends of air pollution do not show significant changes.
	Not achieved	1) Legislation (national/subnational) to monitor Air Quality is adopted BUT policies are absent or ineffective AND 2) city level data on source of emissions or 3) population weighted exposure to air pollution (PM _{2.5}) or trends of air pollution are not available and likely increasing.
Method of estimation/ calculation	Elaboration of data based on: A) Air Quality Management and Monitoring, B) population weighted exposure, taking into account both spatial distribution of the pollution and of the population, should be the indicator that leads the interventions, C) ambient air levels and trends, identifying emission sources.	
Data collection	Three potential sources: 1. collection of official city data (e.g. use of the WHO Ambient Air Quality database); 2. availability of public local data 3. Survey on the Air Quality management including approximately 30 questions (or a short version, see the Annex) on: (i) the measurement capacity, (ii) data assessment and availability, (iii) modelling of emissions estimates and (iv) the air quality management capability. Some important aspects of the survey are to gather information on number and location of stations, presence of source apportionment data; national and regional coordination; considerations on population health protection; existence of regular monitoring of air pollution; population weighted exposure measurements; inclusion in the master plan of air pollution issues and identification of hotspots (see Annex).	
Expected frequency of data collection	It might be: i. Continuous and regular ii. Regular iii. Periodic: for example, once every three years	
Related links	https://www.who.int/airpollution/data/cities/en/	
Other information		
Tier	SDG Indicator 11.6 Tier 1 ¹⁸	
Target outcome	Local air quality data that is available globally	
Stage of development	The indicator is currently not being used.	
Data availability	There are existing data for potential sources (see above data collection row of this table). For data source (1) data at city level is regularly collected. For data sources (2) and (3) ad-hoc surveys are needed.	
Data collection feasibility	It depends on the context	

See the survey proposed in the Annex.

¹⁸ Tier 1 means that the "Indicator is conceptually clear, has an internationally established methodology and standards are available, and data are regularly produced by countries for at least 50 per cent of countries and of the population in every region where the indicator is relevant" (<https://unstats.un.org/sdgs/iaeg-sdgs/tier-classification/>).

Table 5.5 Household air pollution reduction

Name abbreviated	Household Air Pollution Reduction	
Indicator name	Clean Household Energy Use	
Policy area	Household Air Pollution reduction	
Policy action	This indicator provides a mechanism for tracking the effectiveness of policies and programmes to achieve universal access to clean cooking. The types of policies (e.g. subsidies, national cookstove standards) and programmes (e.g. fuel/tech pay-as-you go) implemented for clean cooking vary based on local context, available resources, infrastructure and cultural factors. Evidence-based normative guidance from the WHO (i.e. WHO Guidelines for indoor air quality: household fuel combustion) provide a benchmark via technical recommendations (i.e. emissions targets for what fuels and technology (stove and fuel) combinations in the home are clean for health and environmentally sustainable). They also provide specific recommendations against or discouraging the use of some fuel types (e.g. unprocessed coal and kerosene) in the home. These Guidelines currently serve as the benchmark for policy-makers to track their progress towards universal access to clean cooking (i.e. SDG 7 indicator).	
Rationale	Cooking represents a large share of household energy use across LMICs and in some cities it accounts for up to 50% of AAP. Globally some 40% of households typically rely on solid fuels (such as wood, charcoal, biomass) or kerosene paired with inefficient technologies (e.g. open fires, stoves). It is well known that reliance on such inefficient energy for cooking is associated with high levels of household (indoor) air pollution. The use of inefficient fuels for cooking alone is estimated to cause over 3.8 million deaths annually, mainly from noncommunicable diseases. In many countries, a much larger fraction of the urban population has access to clean fuels and technologies for cooking. However, this is not universal with some countries, particularly in Sub-Saharan Africa and South-east Asia reporting less than 75% clean cooking use. Further in some cities, HAP leaking outdoors can account for up to half of AAP. Thus, policies targeting clean cooking access in cities could substantially reduce the morbidity and mortality associated with AAP.	
Definition	Primary reliance on clean fuels and technologies for cooking	
Numerator	Number of people using clean fuels and technologies for cooking	
Denominator	Total population reporting any cooking	
Unit of measure	Percentage	
Disaggregation	Urban, rural	
Achievement criteria	These indicators are proposed to have the following level of achievements:	
	Achieved	Universal reliance on clean fuels and technologies for cooking
	Partially achieved	At least 75% of the population relies on clean fuels and technologies for cooking
	Not achieved	Less than 75% of the population relies on clean fuels and technologies for cooking
Method of estimation/calculation	Household surveys routinely collect this information, which is then collated in WHO's Household Energy Database. The resulting database is used to inform a multi-level hierarchical statistical model to derive estimates at country, urban and rural levels of individual fuel and technology use, as well as aggregated levels (i.e. population with primary reliance on clean fuels and technology). This modelling method can be applied at a local level as well.	
Data collection	WHO, in cooperation with other UN and survey agencies have developed a set of robust and piloted questions on household energy use. These questions have been designed in a way to better estimate health impacts of household energy use.	
Expected frequency of data collection	1–2 years	
Related links	https://www.who.int/data/gho/data/indicators/indicator-details/GHO/gho-phe-primary-reliance-on-clean-fuels-and-technologies-proportion ; https://trackingsdg7.esmap.org/countries	

Name abbreviated	Household Air Pollution Reduction
Other information	
Tier	SDG 7 Tier I indicator
Target outcome	Universal access to clean cooking
Stage of development	Advanced, official indicator for SDG monitoring (7.1.2)
Data availability	The indicator is modelled with household survey data compiled by WHO. ¹⁹ The information on cooking fuel use and cooking practices comes from about 1300 nationally representative survey and censuses. Estimates of primary cooking energy for the total, urban and rural population for a given country and year are obtained together using a single multivariate hierarchical model. Using household survey data as inputs, the model jointly estimates primary reliance on 6 specific fuel types: 1. unprocessed biomass (e.g. wood), 2. charcoal, 3. coal, 4. kerosene, 5. gaseous fuels (e.g. LPG), and 6. electricity; and a final category including other clean fuels (e.g. alcohol). Estimates of the proportion of the population with primary reliance on clean fuels and technology (SDG indicator 7.1.2) are then derived by aggregating the estimates for primary reliance on clean fuel types from the model. Details on the model are published in Stoner et al. (2019).
Data collection feasibility	Data is collected routinely on household surveys and censuses (1–3 years), and WHO derives country, regional and global level estimates annually for SDG 7 reporting.

WHO has been preparing a repository of policies for the use of clean fuels to reduce HAP (<https://www.who.int/tools/household-energy-policy-repository>).

Unfortunately, efforts at monitoring and research are uneven across the globe. In sub-Saharan Africa, air quality data often do not exist, and regulations and laws are often not in place to curb air pollution; or if in place, policies are not implemented, even though existing research shows that the annual mean fine particulate matter in these cities often exceeds WHO standards (Njee et al., 2016; Petkova et al., 2013). Few African cities operate air monitoring systems, and most cities lack any air quality monitoring capabilities (Schwela, 2012a; Njee et al., 2016). Currently, only Ghana, Senegal and South Africa operate comprehensive and well-organized air quality monitoring programmes (Amegah and Agyei-Mensah, 2017). Recent updates to the WHO Ambient Air Quality database in 2022 reported ground measurements for PM and NO₂ in 12 African countries, covering 59 human settlements (WHO, 2022b). In addition, existing air quality data is not always made public or communicated effectively, limiting public awareness and effective policy (Petkova et al., 2013). For many countries, the only available data originates from global model estimates, such as the ones produced by DIMAQ, used in the Burden of Disease assessment (Shaddick et al., 2018). Recently, source-specific estimates are available at national and sub-national levels (Hopke et al., 2020, McDuffie et al., 2021). Data originating from global modelling at a spatial scale of 10 km do not represent a replacement for local monitoring, but can constitute a starting point to guide policies.

¹⁹ Core questions for household energy use are available at: <https://www.who.int/tools/core-questions-for-household-energy-use>.

5.3. Engaging stakeholders at all levels in policy-making and policy tracking

The process of focusing on understanding the relationship between people and their environmental exposures should theoretically accompany any relevant environmental policy. Participation of communities is a fundamental aspect and can happen in different ways. Since the late twentieth century, “**citizen science**” has become increasingly used to define various participatory research activities (Strasser et al., 2019). Citizen science enables persons outside of the scientific domain (e.g. NGOs, community groups and the general public) to use technical tools to answer research questions that concern these groups (Froeling et al., 2021). There is “limited but growing evidence that citizen science projects achieve participant gains in scientific knowledge, increase public awareness of the diversity of scientific research, and provide deeper meaning to participants’ hobbies... [and] evidence that citizen science can contribute positively to social well-being by influencing the questions that are being addressed and by giving people a voice in local environmental decision-making” (Bonney et al., 2016: 1).

Air pollution provides several examples where networks for action were created and citizen science dynamics have allowed the possibility to review the scientific practices and influence policies (Van Brussel and Huyse, 2019). Participatory Geographical Information System (GIS) can represent a useful method to generate risk mapping by communities and individuals, and local spatial knowledge can provide considerable value-added for understanding risk situations and designing community-based amelioration (Cinderby and Forrester, 2005; López-Aparicio et al., 2017). One of the more popular tools that is being used to facilitate citizen science in the air quality field is low-cost sensor systems (LCSs). The political and social direction is going toward an increased use of LCSs, although currently and for the next years the use of ground monitoring stations will be fundamental (Karagulian et al., 2019). According to a recent report by the European Environmental Agency:

In the near future, the increasing number of citizen science initiatives focused on air pollution, coupled with new data digitalisation approaches, may represent a paradigm shift in the way that air quality is monitored [...]. A large network of LCSs, combined with statistical analysis or machine learning, could complement the quality of the current official data and provide new pathways to obtain accurate, real-time information²⁰.

The main strength of citizen science is that participants tend to develop a sense of ownership and vested interest in the concern which motivates them to participate in public discussions on the matter (Froeling et al., 2021). This in turn can help raise public awareness of air quality issues, bolster public policies or interventions to reduce air pollution, or modify personal behaviour such as switching from driving to walking or cycling.

Another benefit of citizen science initiatives is that the data collected by LCS systems can be used to complement regulatory monitoring networks as well as improve national air quality models. Although citizen science can have many benefits, care must be taken to ensure that citizen science does not exacerbate existing inequalities. The lack of access to LCSs in vulnerable communities may hamper their ability to respond to pollution in comparison to wealthier communities who are likely to be able to afford such devices (deSouza and Kinney, 2021). Another relevant challenge of citizen science is data quality, considering the potential lack of experience and formal scientific training among citizens. However, it has been found that the data quality depends more on the study design and how the data is managed, analysed and interpreted (Froeling et al., 2021).

²⁰ <https://www.eea.europa.eu/publications/assessing-air-quality-through-citizen-science>.



Citizen science might play a fundamental role in the policy tracking procedure because it empowers citizens to raise awareness of the health and environmental impact of the policy that is being monitored. Also, citizens are more motivated to share the results to influence local decisions and advocate for social change. At the same time, citizens might provide valuable data to be used by policy-makers for policy tracking. Thus, it could be considered a win-win factor in policy tracking (Froeling et al., 2021; Haklay, 2015; EC, 2020; Gignac et al., 2022).

5.4. Tracking communications and media coverage

Communications and media play an essential role in increasing awareness, engaging citizens' interest, and influencing the political agenda for clean air (Chen, Tu and Zheng, 2017). Available media like radio, television, newspapers, social media, public speeches, town hall meetings, and community engagement activities play different roles in providing information to people.

Organizing policy tracking activities for air pollution issues in the specific area of communications and media include a variety of methods: media content analysis, dedicated surveys, interviews with stakeholders, and focus groups (Sapkota et al., 2023).

Media coverage of key events, workshops and press conferences are important to promote environmental health messages and gain insights into public opinion. Media encounters and educational events targeting reporters, editors and publishers to follow the air pollution and health story can move public opinion and raise the issue on the policy-making stage.

Box 5.1 Notes from Accra

In Accra, for the UHI, a large number of communication materials and presentations have been created to disseminate the evidence basis for policy action as the Initiative was ongoing. Health and environmental sectors, technical experts, policy-makers and community members were the main target audiences. In addition, campaigns in Ghana and Accra, such as the Clean Cooking Metropolitan Authority's campaigns to stop waste burning, have all contributed to the general awareness of air pollution as a health issue.

The UHI-Accra communications task team developed strong partnerships with communications stakeholders in key agencies and organizations. Health workers' outreach, along with outreach to community schools and town hall meetings, have been priorities of the communications campaign. Participatory research approaches including key informant surveys have been used to engage informal sector workers including street vendors, fish smokers and waste collectors. The impact of such activities on the consequent behaviour of community members should be taken into account to understand public attitudes and their impact on policy-making and enforcement.

Within policy tracking activities implemented in Accra for the Urban Health Initiative a qualitative analysis of selected newspapers was carried out between the periods 2016 and 2021, along with a focus group with key media informants. The analysis highlighted how articles on air pollution have been increasing, with more reportage on impact and policy issues compared to causes of air pollution (Agyei-Mensah et al., 2022).

6. Conclusion

There is growing awareness of the importance of tracking policies with good health performance across sectors and exploring the conditions and relations that enable urban policies to be effective and sustained over time. Policy tracking is a crucial component of any intervention or policy. Not only does it inform the progress of the policy implementation, but more importantly, it allows the evaluation of the success of the policy and improves the process where necessary. Another benefit of policy tracking is that it can support HIA activities and take advantage of the output from HIA already being conducted.

Given the significant public health costs of air pollution, many countries and cities are implementing more measures to improve air quality, including laws, regulations, monitoring programmes and public awareness campaigns. In this report we have presented concepts and methodologies for appraising policies, in particular policy tracking of environmental and health risks at the urban level, with a specific focus on air pollution in African countries, but the framework discussed can be used in high-income countries as well. Although restricted to urban areas, we have also been postulating a broad trajectory to be followed in the future when considering policies that influence human settlements and health, and accounting for current trends in governance beyond government. This is based on the knowledge of the rural-to-urban socio-spatial continuum that exist not only in Africa but also in many other parts of the world. Populations should be considered in holistic terms within a variety of territorial, socio-cultural systems, and a diverse biosphere. The policy tracking framework proposed in this report can be adapted to track the impact of any urban or rural policy on health.

African cities present particularities that make policy tracking difficult but highly needed and valuable. Indeed, the complexity of interrelated factors – rapid urbanization, extensive household use of poor fuel sources, weak institutional capacities, limited systems for measuring and monitoring – all exacerbate air pollution in African cities but at the same time serve as an impetus for a call to action.

Cities are facing problems that are difficult to address with the tools developed in the past. This report provides conceptualizations and tools that can be used by different stakeholders and decision-makers for public health promotion and advocacy. Although policy tracking is a strategic tool for the evaluation of policies and preventative actions, there are different ways to operationalize it - according to specific contexts and populations - and to make it effective to change policies and protect the most sensitive and vulnerable populations.

The conclusion is organized into four subsections: the first includes general and specific considerations on policy tracking; the second provides a discussion on policy tracking of air pollution policies; the third describes the key messages of this document; and the fourth section includes a list of suggestions for conducting policy tracking.



Conceptualizing policy tracking

The main areas of urban policy and the main risk factors for urban health intersect in complex ways. Clear methods and tools for the performance of measurement and evaluation of city action plans/strategies, as well as policy changes, should inform and support the development of a framework for policy tracking. While policy tracking systems have traditionally provided descriptive information of the quality of the policy projects and how they achieve the policy objective, the policy tracking framework described in this report suggests a **hybrid model of policy tracking and policy surveillance** with a recommendation to measure or collect qualitative and quantitative data to assess policy changes and impacts across space and time. This hybrid model facilitates the **monitoring policies when data is scarce or absent**, given that policy tracking and policy surveillance can complement each other. This framework is relevant not only for LMICs, but also for local authorities of high-income countries who might also face challenges related to scarcity of data. As policy tracking is developed, cities are urged to build a long-term strategy for the surveillance and evaluation of policies. The final goal is to be able to move from this hybrid policy tracking to policy surveillance – from more qualitative evidence (e.g. periodic opinion polls or surveys) to collect quantitative evidence (e.g. factual, objective observations). Countries should aspire to have a system and data to integrate a more comprehensive policy surveillance model.

An important condition for the hybrid policy tracking framework described in this report is **information-sharing and mutual learning** between cities and countries with similar circumstances/conditions. Open access to data is a fundamental aspect to consider given the fact that, although more measuring stations are available to monitoring air pollution, many publicly funded agencies still do not provide access to this data. Pivotal to this policy tracking framework is the **collection of quantitative and qualitative data** on a regular basis to track the progress of the policy through **comparative and trend analyses**. The results generated from policy tracking can be used as input to decision-making about priority areas for further action. Conceptual models can help policy-makers and stakeholders to understand and intervene better, despite significant obstacles for environmental policies. Thus, a benefit of policy tracking is its ability to enable the balancing of negative feedback and knowledge translation through regular policy evaluations.

Air pollution policies do not exist in a vacuum, but they are implemented while other policies are operating and there are several sectors that impact air quality (as described in section 4 of this document). It is important to keep in mind a framework to identify the items that belong to both, air quality policy and other urban policies. A framework for identifying linkages allows policy-makers to specify the most important issues that can be highlighted and prioritized. The inclusion of cost–benefit economic assessments within the policy tracking framework for an intervention vs no intervention can also guide the decision-making process. Likewise, the local situation and context can influence the policy tracking framework, and this suggests that the tracking should include a quick review of all other policies to assess their relevance (positive, negative or neutral) to the air quality policies (see the Annex for further details).

Tracking air pollution policies

Air pollution continues to be a major concern in LMICs, particularly in African cities where the rate of urbanization tends to be faster than the creation and implementation of urban development policies. While air pollution in parts of Africa may be declining, the anticipated population growth is expected to increase air pollution levels through increased motorization, solid waste production and household fuel consumption (Edwards and Agbevivi, 2021; Essel, 2021; Mudu et al., 2021). **If we are to abate future emissions increases, innovative and effective interventions or policies will need to be implemented, monitored and evaluated through cross-governmental collaborations.**

The identification and monitoring of indicators are relevant steps to be considered in the hybrid policy tracking framework suggested in this report, as it represents an intersection with policy surveillance activities. In this report we explored air pollution reduction policies and identified two indicator frameworks to enable policy tracking (i.e. Ambient Air Pollution Reduction and Clean Household Energy Use).

Key messages

The work on policy tracking should promote the design of policies that include a framework for their regular surveillance and periodic review process, such as indicators for measuring the impacts and implementation progress. It should also promote actions to improve or adjust the tracked policy as needed.

Active monitoring of air pollution, as well as health indicators, is vital to understand the effectiveness of policies and allows consideration of different policy perspectives to check the sustainability of ongoing and future interventions, including in economic terms.

The policy tracking framework suggested in this report can be considered a tool to understand which decisions are producing the most effective results. It includes the use of indicators, engagement with multi-sector stakeholders and media communications.

A strategy that includes surveys, expert opinion, use of indicators and media analysis should be seriously considered for policy tracking due to its relatively low costs and capacity to offer a wide overview of the situations, trends and directions in policy making.

Good urban health cannot be achieved if exposure to air pollutants is not reduced, and this can only happen with a strategic vision that accompanies each relevant policy with measuring and tracking mechanisms. Policy surveillance and tracking have different roles.

Policy surveillance aims to:

- 1) collect data that cover various aspects, e.g. number and location of monitoring stations, presence of source apportionment data; national and regional coordination; considerations on population health protection; existence of regular monitoring of air pollution; population-weighted exposure measurements; inclusion in the master plan of air pollution issues and identification of hotspots;



- 2) use the data collected for quantitative estimates, that in broad terms can be supportive of air quality SDG indicators and comparative data analysis;
- 3) orient towards research and comparative evaluations/benchmarking against baseline local data; and
- 4) engage peers from academia and institutions.

Policy tracking is predominantly qualitative and it aims to:

- 1) check reports on how effective air pollution reduction initiatives were;
- 2) use dedicated surveys to collect information;
- 3) be oriented towards advocacy and reporting of case studies;
- 4) stimulate learning and collaboration with stakeholders;
- 5) track the role of the media in offering information on air pollution.

Policy tracking can be implemented without policy surveillance, but it can offer an added value when coupled with policy surveillance activities, as suggested in this report. It is important to recognize that the policy tracking approach can lead to the partial achievement of air quality management policies, but elements of the policy surveillance approach will be needed to fully achieve the comprehensive evaluation of the policy.

Suggestions

To operationalize the conceptual framework for tracking urban policies proposed in this report, a few suggestions are important for consideration in LMICs.

In general terms:

- Urban policies should be examined using a holistic approach due to their complexity and inter-sectoral characteristics.
- All urban policies that may have positive or negative impacts on human health should be accompanied by a policy tracking mechanism.
- Using a hybrid framework of policy tracking and policy surveillance allows for more comprehensive monitoring and evaluation of urban policies, and enables countries and local authorities to take action even with limited data.
- The outputs of policy tracking should be employed to identify potential setbacks, delays and negative impacts of policies and develop corrective measures in a timely manner. This would increase the likelihood of the policy being successful.

- Policy-makers should use the outputs of policy tracking to define priority areas for future action.
- Reliable (accurate and timely) data are essential both for policy tracking and surveillance. Improvements to data collection need to be substantial, and activities on this offer significant opportunities to promote the use of statistical concepts and methods for data assessments.
- Data should be transparent and accessible, and the main information should be shared and communicated to a wider set of stakeholders and relevant communities.
- The complexity and difficulty associated with the evaluation of the impacts and outcomes of a policy should be recognized, and validation protocols should also be developed and implemented.
- In tracking policies, priority should be given to empowering individuals and communities to set long-term goals and medium- and short-term objectives for public health improvements. Such active participation will encourage changes of existing policies and formulation of new and inclusive policies.

For public health:

- The identification of the determinants of health and its interrelated risk factors is key for identifying priority areas for action, developing effective and timely interventions, projects and programmes and articulating policies for better urban health.
- Consider multi-scalar approaches that apply to all human settlements, including urban and rural areas that are both affected by similar health burdens.

It is important to consider that different risk factors need integrated approaches and dedicated suggestions. For example, for air pollution:

- It is not possible to apply a “one solution fits all” approach because air pollution sources and exposure varies across geographical regions, and depends on the socio-cultural context.
- Tracking air pollution policies should also consider other urban policies (e.g. transport, energy, land-use management, waste etc.) given the interconnectivity between them.
- There are tools available for air quality monitoring, such as long or short surveys already employed in many cities.
- There are tools that allow participatory processes to orient and provide information for the policy tracking.
- It is important to identify trends that can be useful to examine the effectiveness of air quality management.

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Annex

This Annex includes brief fact sheets on the main areas of urban policies that have an impact on urban health and that might be of interest for the readers when considering policy tracking for air quality changes, taking into account the need for a multi-sector approach. Case studies are also presented for some urban policies in the context of African cities, specifically Accra. Additionally, this annex also includes some tools and indicators, as well as an air quality management survey, that can be used for tracking policies on air quality and health.

A) Urban policies and health

Governance

Governance is fundamental to the tracking of air pollution and urban health policies and programmes. It entails devolution or decentralization governance, or multilevel governance. Decentralisation/devolution of government refers to the transfer of political, fiscal and administrative authority from a central government to subnational tiers or spheres of the state. The exact form of decentralisation/devolution is regulated by the allocation of powers and functions to city and regional governments. This allocation of functions results in multilevel governance is often embedded in a political process that externalises functions in a rather vague, unnamed and uncounted way which makes it difficult to account for the intended and unintended consequences (Swyngedouw, 2009). Multilevel governance refers to the configuration of roles and responsibilities for international, national, state and local authorities and it recognizes that power should be shared depending on the most appropriate scale of decision-making and implementation. Issues like urban and/or air pollution policy tracking need action across sectors and at multiple scales (Parnell 2021). Thus, effective air pollution policy and practice works best when the powers and functions of government are clearly delineated, funded and sanctioned, and people collaborate and work across the different sectors and government institutions (Henneman et al., 2016).

Governance related policies include legislation and regulations on the powers, responsibilities and funding of different levels of government, and how citizens are involved in the development and implementation of policies. Policies about governance impact on the capacity of government to develop and implement policies/ programmes and the extent to which policies/programmes respond to the needs of citizens (Yang et al., 2019).

Policies relating to governance therefore do not directly impact on risk factors for urban health, but they have an impact on the ability of government and other stakeholders to deal with issues that impact on health. Therefore, there is an indirect correlation between democratic governance processes (e.g. free and fair elections, accountable politicians) and levels of health (Franco et al. 2004).

For the governance aspects that are relevant for air pollution, see **Table 4.1**.

Spatial planning and land use management

Spatial planning and land use management (i.e. land use zoning, planning/building approvals) determines the land use of specific regions, what areas of a specific region are developed or not, how dense neighbourhoods are, whether streets are suitable for walking and/or cycling, whether there are recreational facilities, etc. Spatial planning and land use management are critical in promoting efficient and effective use of urban spaces and the prevention and exposure of urban population to injuries, pollution and other urban hazards (UN-Habitat and World Health Organization, 2020).

Spatial planning and land use management policies usually consist of:

- National/sub-national laws on spatial planning processes.
- Building regulations (usually national) for the minimum standards for different types of buildings (and the materials used to construct them) and prevention of fire.
- Spatial plans for cities and specific areas within cities (these can take the form of rigid master plans or more flexible spatial development frameworks, showing where future development will occur).
- Planning/design guidelines may exist for specific developments or precincts with detailed design requirements/suggestions.
- Infrastructure plans that show where future investment in infrastructure will go (some countries may also have housing plans for the provision of government-subsidized housing).
- Land use zoning schemes showing the allowable activities on each plot.

Spatial planning and land use management policies and plans can impact on:

- Location of industrial establishments that contribute to increased environmental risks such as outdoor air pollution/ noise pollution.
- Location and type of food/alcohol outlets, that influence behavioural and social risks which can have an impact on diet/nutrition and access to alcohol (and certain types of alcohol establishments, such as bars and nightclubs can also impact on noise pollution). This is related to metabolic risks such as obesity, which can exacerbate these urban health risk factors.
- Location and extent of urban agriculture, which can impact on food security and public health, environmental and economic costs related to transport.
- Location and availability of natural environments such as green and blue spaces which can minimize social and health risks while contributing to reduced air pollution and urban heat islands.
- Walkability/cyclability/playability of areas (e.g. street connectivity, sidewalks, cycle paths), which can impact on levels of physical activity and vehicle usage of both adults, youth and children and consequently modify behavioural, social and environmental risks.
- Density/compactness (and mix of land uses) of urban areas, which can impact on levels of physical activity and vehicle usage (dense/compact urban areas with a high mix of land uses are likely to be easier to get around on foot/bicycle, while low-density sprawling urban areas with segregated land uses are likely to have much higher levels of vehicle use) and potentially increase emergency response times.
- Availability of land for affordable housing – high planning and buildings standards can result in a lack of affordable housing (and thus in the growth of informal settlements with inadequate housing).
- Reduce or heighten crime and security of households and communities. Studies suggest that spatial planning and the resultant-built environment can either prevent or reduce

opportunities for crime, fear of crime and residents' concerns about the safety of their neighbourhoods (Owusu et al., 2015; Cisneros, 1995).

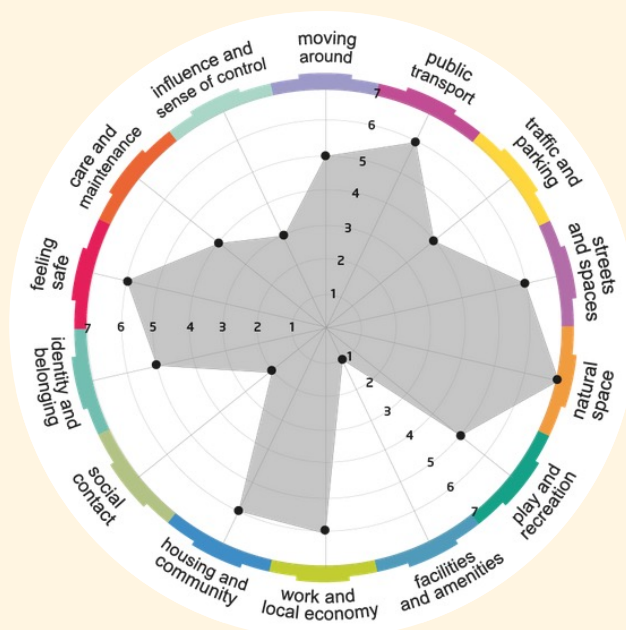
- Levels of social interactions and social cohesion of communities.

For land use management and air pollution there are several aspects of particular relevance, see **Table 4.1**.

The implications of planning for health are huge, and tools to facilitate the design and monitoring of policies and plans on spatial planning and land use management are important (UN-Habitat and World Health Organization, 2020). Tools such as the Place Standard (Box A1) can enable conversations about how healthy your physical environment is for you.

Box A1 The Place Standard Tool

The Place Standard tool provides a simple framework to structure conversations about place. It allows you to think about the physical elements of a place (e.g. its buildings, spaces, and transport links) as well as the social aspects (e.g. whether people feel they have a say in decision-making), consisting of 14 questions covering both aspects. The tool is simple and free to use.



The tool provides prompts for discussions, allowing you to methodically consider all the elements of a place. The tool pinpoints the assets of a place as well as areas where it could be improved.

Source: <https://www.placestandard.scot/>

Spatial planning is one of the main determinants of the extent of urban agriculture. Another important determinant is the support for urban agriculture in terms of inputs (seeds, fertilizers, equipment), access to markets and subsidies. Urban agriculture policies can be either national or local, or a combination, and can ultimately impact food availability, and air/ground/water pollution from agricultural activities in urban areas. In particular, the use of unclean or drainage water and pesticides due to the intensive nature of urban agriculture in an unregulated manner can adversely impact adversely both consumers and urban farmers, and pose environmental and metabolic risks (Abdulai

et al., 2011). In the international and national agendas there has been emphasis on promoting urban agriculture at all levels (Taguchi and Santini, 2019). For example, community and school gardens can be leveraged to increase the accessibility and affordability of fresh fruits and vegetables while enabling social connections and physical activity.

Box A2 Urban agriculture in Ghana

In Ghana, it is argued that urban agriculture contributes significantly to the socio-economic lives and well-being of both male and female urban farmers. It also provides food security and nutrition within cities such as Accra and Kumasi. However, this sector faces both environmental and health challenges (Lydecker and Drechsel 2010; Adeoti et al. 2014). Studies have shown that poorly treated wastewater is a main source of irrigation for these farms. Lydecker and Drechsel (2010) estimates that urban vegetable farmers in Accra alone use up to 11 250 000L out of the approximately 80 000 000L of wastewater that Accra generates per day. Antwi-Agyei and Ensink (2016) study on wastewater use and agriculture in Accra found that over 80% of the produce were contaminated with *E.coli*, with street food salad found to be the most contaminated (4.23 log *E. coli*/g). Farm soil, wastewater use and poor food and environmental hygiene were found to be some of the risk factors associated with produce contamination. Ackerson and Awuah's (2010) study in Kumasi similarly showed that farmers mostly use water from shallow wells that were mixed with contaminated stream, which led to serious health consequences.

These practices contribute to severe health implications for both farmers and consumers. Nyantakyi-Frimpong et al., (2016) study in Ashiaman in the Greater Accra region of Ghana showed that both male and female urban farmer experience health risks through the use of agro-chemicals such as blurred vision, dizziness, skin rash, cough and vomiting. Whilst agro-chemicals use affect both male and female farmers, females were more likely to be affected as a result of the early and extended contact with pesticide treated crops (Nyantakyi-Frimpong et al., 2016). Other studies have shown reported cases of pesticide residue in the breast milk of women farmers (see Northern Presbyterian Agricultural Service, 2012 in Nyantakyi-Frimpong et al., 2016). Similarly, Ackerson and Awuah's (2010) study in Kumasi revealed that schistosomiasis, cholera, nematode infections, malaria, and headaches were common diseases among urban farmers.

Yet farmers' awareness of health risk does not influence their adoption of safer farming practices and there also appears to be low awareness of the source of irrigation water among consumers and street food vendors (Antwi-Agyei et al. 2016). Their study recommends the multi-barrier approach by the WHO which recommends health protective measures at different entry points along the food chain. This includes hygiene education and enforcement of food safety bylaws to influence behaviour change (Antwi-Agyei et al. 2016).

Housing/household infrastructure

Though all constituents of the environment have some impact on human health, the component that exerts possibly the greatest and most immediate influence on the health of households is the intimate environment of their homes and neighbourhoods WHO, 2018a. Therefore, access to decent and affordable housing has several health benefits for occupants and the wider society including fewer behavioural problems especially among children (Newman, 2008). Most African countries do not have large, subsidized housing programmes for low-income households. In these cases, housing policy provides a framework in which there may be specific programmes and projects for particular groups and locations, e.g. slum upgrading, projects in particular slums, and comprehensive housing programme are necessary, including:

- Detailed reports on housing/housing infrastructure.
- National and local acts.
- A national housing code and national building regulations.
- National and provincial regulations on norms and standards, and on procurement processes, which determine the nature of the end product that is delivered (minimum house size, minimum requirements such as ceilings, minimum plot size, minimum levels of services).



- Provincial and Municipal housing strategies that effectively determine where housing and household infrastructure are provided and when.

While the acceptability of the housing developments is essential, it is also vital to ensure that housing is equally affordable and accessible to individuals from high and low socio-economic strata.

Countries such as Ghana have comprehensive housing policy, but the challenge has been the lack of political will and financial resources for policy implementation (Songsore and McGranahan, 1993). Consequently, private and informal operators have stepped into the urban housing sector and, driven by profit motives, housing supply has largely neglected poor and low-income households (ISSER, 2019). The housing situation in Accra is a major public health and wellbeing problem (Arku et al., 2011; Addo, 2016).

For the housing/household infrastructure aspects related to air pollution, see **Table 4.1**.

Mobility

Transport infrastructure and services are a core basic demand of city dwellers to enable individuals' access to basic urban services. The fast, constant urban sprawl in most African cities makes it difficult for adequate provisioning of crucial transport infrastructure and services.

Transport policies can have a significant impact on health in terms of:

Transport policies can have a significant impact on health in terms of:

- Provision of public transport – lack of effective, reliable, and affordable public transport can mean that levels of private motorized vehicle usage are higher, which increases environmental risks such as air pollution or noise; that commuting times are longer, and that people have to spend a larger proportion of their income on transport (thus leaving less for expenditure on food and health care which can aggravate behavioural and social risks).
- Provision of infrastructure for pedestrians and cyclists (e.g. sidewalks, pedestrian crossings and cycle paths) – lack of infrastructure for pedestrians and cyclists may result in more traffic accidents and also may result in higher levels of vehicle usage. This can also increase behavioural and metabolic risks by limiting physical activity and social interactions.
- Enforcement of regulations regarding roadworthiness, road safety and vehicle emissions, which can impact the number of traffic accidents and air pollution.

For the mobility aspects that are relevant for air pollution, see **Table 4.1**.

Box A3 Notes on mobility from Accra

The city of Accra has 7591 km of total road length serving the 3.5 million residents in the city (KOICA & MOT, 2016). This road network is highly dense in the Central Business District (CBD) and less dense as one moves away from the CBD. This results in reduced access to transport services and infrastructure needed for basic services. It has been estimated by Korean International Cooperation Agency (KOICA) and the Ghana Ministry of Transport (MOT) (2016) that there are about 2.5 million daily commuters to the city of Accra. The high cost of accommodation in the CBD causes people to often reside in the periphery of the city and commute daily to the CBD for work, economic services and other governmental services. This results in residents living in locations that are without the needed transport infrastructure and services. The provision of public mass transport is one that is missing in most African country cities, except for Nigeria which has implemented the bus rapid transit (BRT) in West Africa. Ghana tried implementing the Accra BRT but met with challenges, ultimately leading to its failure. The BRT did not get dedicated lanes to make it a fast mass transit service. The transport service space in Accra is largely dominated by private and individual players that have to meet the transport demand of residents. Popular among these private players is the Ghana Private Road Transport Union, whose members provide most of the transport services in the city of Accra. However there is a sterling example of how the city of Kigali has regulated and operationalized motorcycle taxi services to enhance access to transport (Goodfellow, 2015).

There is also the emerging trend of individuals using motorcycle taxis and tricycles to provide transport services in the city of Accra. This however is one which has policy challenges as discussed in the research of Oteng-Ababio and Agyemang (2015). The poor public transport service and infrastructure have resulted in longer travel time as found in studies by Abane (2011) and Agyemang (2017) in Accra. There is also a loss of productive time and income as time used in travel increases. The high level of congestion in Accra also causes commuters to be exposed to harmful air pollutants, which can cause respiratory diseases and asthma.

An example of a WHO tool that was used to systematically evaluate the impact of mobility interventions in Accra is the Integrated Sustainable Transport Health Assessment Tool (iSThAT). iSThAT uses health, environmental and mobility data to quantify the health benefits of reduce air pollution and increased physical mobility as well as the economic valuations of the interventions (Essel and Spadaro, 2020). The input data included: background concentration, health and socio-economic data, modal share (private, public, active travel), fleet specifics and emission factors). In Accra, it was estimated that if there is a significant shift from use of passenger cars to electrified public transport, walking and cycling by 2050, US\$ 1 to 2.6 billion health benefit could be achieved, a 159 million tonnes of carbon emissions and 1800 to 5500 deaths could be avoided. For more details on this analysis please refer the published report (Essel and Spadaro, 2020).

Transport scenarios for the Greater Accra Metropolitan Area have indicated that the number of postponed premature deaths from reduced air pollution over the period 2015–2050 ranges between 1800 and 5500 deaths plus an additional health benefit of 33 000 avoided deaths attributable to increased physical activity (Essel and Spadaro, 2020).

All the recent studies highlighted the need for safe walking and cycling to reduce road injury and enhance the physical health of city residents. The development of public-led mass transit services and a strong policy to regulate them will result in health and environmental benefits.

Health system

Health policies are primarily focused on the provision of health care, with health promotion as a secondary focus. Health policies are generally not urban-specific, but the aspect of health policy that intersects most with the urban environment is the location of different types of health care facilities (e.g. clinics and hospitals) within cities. The location of healthcare facilities can influence access to health care (e.g. consultations, medicine) and thus potentially have an impact on health outcomes (Verter and LaPierre, 2002). Health policy can also determine the availability and effectiveness of emergency response vehicles. At a local government scale, health policies also play a big role with regard to the enforcement of health and safety regulations (e.g. the regular inspection of food preparation and retail facilities to ensure compliance with food safety standards). About 1 billion people worldwide are served by health-care facilities without reliable electricity. It is estimated that



1 in 4 health-care facilities in sub-Saharan Africa has no electricity. Even in cases when electricity connection exists, power supply is not reliable because it depends on poor grid infrastructures or polluting diesel generators. Inadequate and unreliable access to electricity in healthcare facilities also impact the accessibility and quality of healthcare services.

After COVID-19, health policies have to strengthen the capacity to deal with the risk of epidemics.

For the health system aspects that are relevant for air pollution, see **Table 4.1**.

Education/social development

The provision of education and social development services and facilities can have a significant impact on health, for example, through education about healthy behaviour and through opportunities for physical activity (e.g. at school sports fields and community recreation facilities).

The educational setting is also an ideal location for the implementation of health programmes such as initiatives to prevent alcohol and substance abuse, or tobacco use, and to promote healthy diets. Integration of these programmes and policies in the formative years of young people can lead to lower behavioural, social and metabolic risks in the long-term. In addition, education enhances reproductive healthcare among women and girls, as well as contributing positively to better household sanitation conditions and the intake of nutritional meals. Without education there is no possibility for a community's right-to-know about their environmental conditions and raise awareness of the potential risks to health.

For the education/social development aspects that are relevant for air pollution, see **Table 4.1**.

Box A4 Notes from Accra

In Ghana, rapid urbanization and globalization and the associated behavioural changes are exposing many urban dwellers to the risk of chronic NCDs such as obesity (Tagoe and Dake, 2011). Sedentary lifestyles, reduced physical activity levels, decreased hours of rest and increasing levels of stress are all linked to such diseases (Dake et al. 2010; Wrigley-Asante et al. 2017). The National Health Policy has been put in place and aims at ensuring healthy living for all by addressing the complex disease burden influenced by risk factors such as the physical environment, education, socio-economic situation, population lifestyle and demographic characteristics whilst strengthening the healthcare delivery system (Ministry of Health, 2020). The School Health Education Programme (SHEP) has also been put in place with the overall goal of ensuring the provision of comprehensive health and nutrition education and related support services in schools to equip children with basic life skills for healthy living (Ghana Education Service, 2019). Tagoe and Dake's study (2011) among Ghanaians after the introduction of the national health policy showed that while the prevalence of some negative lifestyle behaviours like smoking has reduced, others like alcohol consumption has increased and relatively few people adhere to consuming recommended fruits and vegetables servings per day. However, there's a significant improvement in healthy lifestyle behaviour among adults, particularly women. This calls for the intensification of education on healthy lifestyle behaviours.

Safety and security

Safety and security policies are generally about policing and law enforcement. Most African countries have national police forces and justice systems, but at the urban scale, safety/security policy impacts on the location of policing facilities/activities and also the type of policing (e.g. top-down or grassroots bottom-up). This can have an impact on levels of violence and can represent a difficult framework to promote measures to reduce air pollution from traffic, promoting walking and cycling for example. Additionally,

the relation between air pollution and violence and aggressive behaviours are under investigation for the different implications that may exist (Burkhardt et al., 2020). Neighborhood security deterioration and violence exposure associated to higher levels of air pollution, may lead to synergistic health effects of social and physical environmental conditions (Clougherty et al., 2007). For example, studies suggest an association between traffic-related pollution and asthma diagnosis among children with elevated exposure to violence such as witnessing hitting, slapping, punching, a shooting, a stabbing, hearing gunshots, and domestic verbal abuse (Clougherty et al., 2007; Sullivan and Thakur, 2020).

For the safety and security aspects that are relevant for air pollution, see **Table 4.1**.

Box A5 Notes from Accra

The absence of effective policing has implications for the safety and security issues of the citizenry as it impacts on all facets of urban life at the individual, household and community levels (Owusu et al. 2015). The urban crime and poverty study in Ghana revealed that there has been an increasing rate of crimes in Accra and other Ghanaian cities with crimes such as robbery, murder and sexual assault (defilement and rape) all on the rise (Oteng-Ababio et al. 2016). For example, Accra's robbery rate was 32 per 100 000 people in 2010 representing a 17% increase over that of 2000 (13 per 100 000). Defilement also increased significantly from 3 cases per 100 000 in 2000 to 7 per 100 000 in 2010 indicating an increase of 197% (Oteng-Ababio et al. 2016).

It's been argued that inadequate location of policing and its activities contribute to increased crime levels in cities, particularly in Accra. However, the Ghana urban crime and poverty study revealed that several other interrelated factors – such as increasing urbanization process and its associated unemployment rate amongst the youth, poverty, weak criminal justice system, poor basic urban infrastructure (such as proper lighting systems), poor housing/household infrastructure, breakdown of family structures and political vigilantism – all contribute to violence and crime and its related safety and security concerns in cities (Owusu et al. 2016; Oteng-Ababio et al. 2016; Wrigley-Asante et al. 2016).

The increasing nature of crime and violence in urban spaces threatens the security and safety of many residents particularly the vulnerable groups, which have been identified to include, the aged, women, people with disabilities and, children (Ajayi, 2013; Wrigley-Asante et al. 2016). Studies in Accra have shown greater feelings of vulnerability to crime in urban public spaces such as in markets, public transport systems and parks and a greater feeling of insecurity among females than males. Females living in slums are also more vulnerable and feel unsafe walking alone particularly at night (Wrigley-Asante et al. 2016; Owusu et al. 2019). Crime and violence result in serious health consequences on victims, which range from physical, psychological, emotional and mental health (Wrigley-Asante et al. 2016).

An increasing response to the rising crime rates and fear of crime in major cities in Ghana have led to the adoption of targeted protection measures such as high walls, metal burglar-proofed windows and doors, use of security doors and reliance on private security companies to provide security in the absence formal policing (Owusu et al. 2016). However, the formal regulations of the private security sectors also remain weak and limited to the growing urban upper and middle class. As argued by Owusu et al. (2016), the urbanization process in Ghana which remains unplanned has resulted in uncontrolled sprawl, stretching urban infrastructure and services, including police services, which contributes significantly to rising crime incidences and safety and security concerns. This calls for integrating crime preventive measures into urban planning to ensure the safety and well-being of the citizenry.

Economic development

Economic development policy can impact on the type (and location) of industries that are promoted and subsidized. The types of industries that are encouraged can impact on air, water and noise pollution, e.g. oil refineries, steelworks. Economic development policies often involve a range of national, sub-national and local incentives (e.g. company tax or property tax rebates) and support mechanisms (land and infrastructure provision, support from an economic development agency, special customs and migration arrangements), often spatially targeted at specific areas in the form of special economic zones (SEZs) or free trade zones (FTZs).



At a broader scale, economic development policies (or the lack thereof) may also impact on levels of unemployment and poverty, which indirectly affects health. In particular, in many cities in Africa, the informal sector is the largest employer, and provides urban citizens with shelter (housing), services and any claims on consumption of goods in the city. Yet, it is the sector which often neglected in city planning and land use management (Owusu & Wrigley-Asante, 2020).

The different development of the service, agriculture and industrial sectors affect the health and well-being of people.

For the economic development aspects that are relevant for air pollution, see **Table 4.1**.

Environmental management

Environmental management policies aim to minimize environmental risks from all domains of the biosphere: land, water and air. Environmental management policies, plans and programmes generally include the following issues:

- The collection, management and disposal or recycling of waste. Inadequately managed waste (e.g. uncollected garbage and the incineration of garbage) can result in severe pollution of the air, ground and water.
- The protection of undeveloped land within and around cities (especially sensitive environmental areas such as wetlands, lagoons, and river floodplains, which are prone to flooding; or mountainous areas, which are prone to landslides).
- Monitoring and prevention of air, ground and water pollution from natural and human origins.
- Climate change adaptation, closely linked to disaster risk management strategies, to cope with increased risk of flooding, drought, wildfires and sand/dust storms.

Several countries in Africa have well-defined structures for the management of the environment.

For the environmental management aspects that are relevant for air pollution, see **Table 4.1**.

Box A6 Notes from Ghana, Rwanda and Tanzania

Tanzania has a number of legal, regulatory and institutional frameworks that support air quality management in the country. The National Environmental Management Council (NEMC) was established with the responsibility of advising government and the international community on environmental issues in Tanzania. Its key function includes: i) undertaking enforcement and compliance; ii) reviewing and monitoring EIAs; iii) facilitating public participation in environmental decision-making; and iv) supervising and coordinating environmental management issues within the country.

Air quality management in Rwanda is the overall responsibility of the Rwanda Environmental Management Authority (REMA). It is mandated by the new Air Quality Law No. 18/2016, Law N°18/2016 of 18/05/2016 which sets out the framework for the regulation and prevention of air pollution in Rwanda, to monitor and provide air quality data for six common air pollutants from both natural and man-made sources in the country. The two pollutants of high priority concern are however, particulate matter (PM_{2.5}) and nitrogen oxides.

In Ghana, the EPA has the overarching responsibility of governing the preservation of air quality and prevention of air pollution. The institution works within several relevant policy, legal and regulatory frameworks to address air pollution including the EPA Act 1994, Act 490 (Integrated Digital Monitoring and Management of Air Pollution in African Cities (DIDA) (2021).

B) Examples of tools to track public health impacts in urban environments

In this section, we will focus on tools for tracking environmental management and public health impacts, specifically air pollution. Tools can include models and frameworks, interactive websites, templates, toolkits and software. We show a non-exhaustive overview of tools and schemes for policy tracking, considering potential health impacts as well as specific aspects of policies (e.g, financing to health sectors) that were not covered in our discussion. Additional tools can be found in the “sourcebook directory for integrating health in urban and territorial planning”²¹, an online repository with more than 100 tools and resources for health integration into urban policies. Most of the available tools are dedicated to monitoring public health, not policies. They can certainly be used to support tracking the results of policies, but not to track the performance of the policies themselves.

Box A7 CDC: National Environmental Public Health Tracking Network

The National Environmental Public Health Tracking Network (Tracking Network) by the US Centers for Disease Control and Prevention (CDC) brings together health data and environment data from national, state, and city sources and provides supporting information to make the data easier to understand. The Tracking Network has data and information on environments and hazards, health effects, and population health.

Moreover, it has a data explorer that allows the monitoring of asthma, biomonitoring, community design, outdoor air and population characteristics, to name a few.

Source: based on US CDC information from <https://ephtracking.cdc.gov/>

²¹ <https://www.who.int/publications/m/item/sourcebook-directory--integrating-health-in-urban-and-territorial-planning>



The National Environmental Public Health Tracking Network provides data from the US. Examples of policy surveillance and policy tracking are readily available in high income countries and cities. Another example is shown below (Box A8).

Box A8 **New York City Tracking Program Bureau of Environmental Surveillance & Policy**

The Environment & Health Data Portal is run by the New York City (NYC) Environmental Public Health Tracking Program, a programme of the NYC Department of Health and Mental Hygiene. This programme is part of the National Environmental Public Health Tracking Network, an effort led by the US CDC to share data and analyze trends in environmental public health across the nation. The NYC Environment & Health Data Portal is used by public health professionals, community-based organizations, community boards, city agencies, elected officials, health workers, advocates, and everyday New Yorkers to get information that they need to do their jobs and make important, informed decisions about health.

Source: based on New York City Department of Health and Mental Hygiene information from <https://a816-dohbesp.nyc.gov/IndicatorPublic/>

The richness of data and information on air pollution and health indicators pose different challenges in terms of policy tracking. At the core of all policy tracking systems is the collection of available data. For this reason, air pollution data are a fundamental resource.

Two more examples that can be useful to consider for the tracking of air pollution data are OpenAQ (Box A9) and the Air Visual project (Box A10).

Box A9 **OpenAQ**

The non-profit organization OpenAQ has built the data infrastructure to track publicly available, air pollution data from regulatory monitors and LCSs around the world. Such data can allow the public to survey the effects of various policy endeavours.

Besides contributing to promote cleaner air, OpenAQ aims to reduce inequalities by empowering communities around the globe by sharing air quality data. The availability of harmonized data across the world might be used by different sectors to promote actions towards improving the quality of the air.

However, for the data to be collated by OpenAQ, they must be publicly available. If open data policies are not in place, even if data has been gathered in a particular location, this data will not be actionable.

Source: <https://openaq.org/#/>

Box A10 **Air Visual**

Since 2020, the Air Visual project by UNEP provides world population real-time exposure to PM2.5 and the percentage of people exposed to polluted air worse than the WHO recommended values. Exposure is estimated according to air quality data from ground-based monitors and satellites, along with estimated world population data provided by WorldPop (www.worldpop.org).

Air Visual provides data from around the world. It also informs about active fires, humidity, wind, or pressure, factors that can impact the air quality.

Source: <https://wesr.unep.org/airvisual>

The challenge that we face is double. On the one side, we need complex data infrastructures to track open data policies. And on the other side, real-time data are just giving short-term information.

Using AQ data to track air pollution policies

Although systematic, long-term monitoring is missing in most African cities, existing studies show a serious and growing problem in urban AQ due to rapid urbanization coupled with industrialization, increasing motorization and the continued use of biomass fuel as the household energy source (UNEP, 2016; Lindén et al., 2012; Schwela, 2012b). The most concerning urban air pollution is in sub-Saharan African countries and cities (Schwela, 2012a; Shaddick et al., 2020; WHO Ambient air pollution data website: <https://www.who.int/data/gho/data/themes/air-pollution/ambient-air-pollution>). Thus, an urgent need is to monitor urban AQ in this region so that the health effects of pollutants can be better understood and quantified, leading to cost-effective abatement strategies and greater public awareness and pressure.

Several projects have been implemented to assist African governments involving international organizations and NGOs to fill the gaps in air quality data and governance. Although the funding currently invested by organizations in African countries is small compared to the rest of the world, a lot of efforts has been devoted to LCSs because of their lower costs (Box A11). A report by the Clean Air Fund²² found that only 0.2% of all funding went to projects in African countries. It is essential to track the outcomes from such projects and coordinate across the various actors involved to avoid the duplication of efforts. One of the ways the effects of these projects can be tracked is by building data infrastructure to assess outcomes, infrastructure and processes.

Box A11 Cost applications for different air pollution monitors

For a single chemical component monitor, the capital cost of reference monitors that meet US EPA Federal Equivalent Methods range from US\$ 15 000 to US\$ 40 000 (Clements and Vanderpool, 2019). These devices usually have an average life of 10 years. The capital cost of LCSs are approximately US\$ 1000 (Peltier et al., 2020), though this can vary across sensor manufacturer, measurement technology, and the number of chemical component measurements included in the sensor product. To follow best measurement practices, high operating costs for maintenance, software management and quality control/quality assurance should be considered. A single low-cost sensor can be an additional US\$ 14 000 over a five-year period. However, several sensors are usually required for a monitoring network and this can incur significant costs, even if economies of scale can be achieved with multiple sensors. For example, in India, a monitoring network of 200 LCSs operating and a single advanced station was estimated to require US\$ 135 000 (Brauer et al., 2019).

Air pollution data from ground-based monitors, as well as from satellite instruments, can reveal if specific policy interventions have resulted in improvements in AQ. Ground-based monitors can reveal fine-scaled improvements in air pollution locally. Satellite derived estimates of air pollution can reveal long-term trends in air pollution in a given location. The methodology of deriving air pollution estimates from satellite data is progressing quite quickly but it is still complicated. There is often a lag between the measurements made by satellite instruments and the production of estimates of air pollution from such data which can make tracking short-term initiatives difficult. Various research groups around the world are producing publicly available air pollution datasets for different time periods using satellite data and have built the data infrastructure to make these estimates accessible by the public. However, the data format of such estimates can be difficult to work with, which has limited their use by policy-makers. There are several initiatives on the way (for e.g. from the US NASA:

²² https://www.cleanaifund.org/wp-content/uploads/2020/09/EMBARGOED-7-Sept_State-of-Global-AQ-Funding-2020_Clean-Air-Fund_Final.pdf, Last accessed April 9, 2021



<https://haqast.org/> or from the EU Copernicus: <https://atmosphere.copernicus.eu/air-quality>) to facilitate the wide use of such critical data which are promising.

Many projects leave behind critical infrastructure such as air pollution monitoring devices which should be able to be used by local communities. There is a need to build data infrastructures to track such devices to ensure that they can be used and made accessible by local groups. There is also a need to track the infrastructure and scientific needs of local groups to ensure that locally-specific, locally-relevant projects can be facilitated, which are more likely to have an impact in the given context. Current funding opportunities are typically available in North America and Europe. The lack of funding which has its roots in structural adjustment programmes in LMICs has made it difficult for local researchers to implement many important experiments and projects. It is also the case that in many African countries, air pollution in cities has not been given priority attention against other pressing competing needs, in terms of funding and other resources (World Health Organization, 2018b). Many policy projects do the critical work of building expertise in the Global South. However, many of these events are one-offs. To track the effects of training and to allow new projects to build on previous initiatives, it is also important to make the data infrastructure track the various initiatives that have already been implemented and the officials who were involved. For such data infrastructure to be built, air pollution and urban health concerns need to be integrated into the indicators of the success of a project. The need to report on these outcomes can facilitate proper integration of such indicators into the design of various initiatives.

Ambient air pollution survey

Based on WHO and UNEP's previous work on air quality management capability that use indicators to assess each component of capability, the suggested survey on the urban AQM is designed to be short and includes 33 questions covering four main components: 1) measurement capacity, 2) data assessment and availability, 3) emissions estimates and 4) the air quality management capability (UNEP/WHO, 1996; EEA, 1998; Schwela et al., 2006)²³ "Each of the four component indices consists of a number of indicators, which are designed to determine whether a city has useful capacity with respect to a particular element of the air quality management capability."

Questions gather specific information on:

- national and regional coordination for the implementation and enforcement of laws and standards;
- considerations on population health protection;
- existence of regular monitoring of air pollution (only monitoring which is currently taking place regularly, at least once a week, should be considered);
- emissions inventories data;
- availability of source apportionment data;
- inspection activities on source of emission;
- population weighted exposure measurements;
- coordination with the master plan;
- identification of hotspots;
- use of census data;
- communication and public awareness of current and forecasted air quality levels.

²³ UNEP has also prepared an extensive questionnaire to Member States on Actions on Air Quality (<https://wedocs.unep.org/bitstream/handle/20.500.11822/32833/AQQ.pdf?sequence=1&isAllowed=y>).

Adapting already published surveys by UNEP/WHO (1996) and EEA (1998) used in several studies (Peterson, 1999; Schwela et al., 2006), we describe a survey with a structured questionnaire on urban AQ (see below). The questionnaire can provide the tool for a survey that produces an index that can be used to produce an indicator for Ambient Air Pollution Reduction (see section 5.4).²⁴ The indicator questions adapted and developed in this report generally represent the minimum capability required to generate air quality information useful for decision-makers.

Many LMICs have developed some form of AQM system involving regulations and standards, but the extent of the system may not always be adequate to effectively address urban air pollution problems. Integral to the development of an effective AQM programme is the assessment of factors such as air quality monitoring, emission inventories and source apportionment and Health and Environmental Impact Assessment. "Monitoring at least one site in a residential area for one year or more is considered as an indicator of the capacity to assess chronic health effects (this does not mean that chronic health effects due to air pollution are assessed in the city). Provision of daily or hourly mean values for each day of a year or more, at least one site in a residential area, is considered as an indicator of the capacity to assess acute health effects." (Schwela et al., 2006: 57).

It is also important to recognize that the design and implementation of an integrate AQM programme requires cross-collaboration between national, regional and local authorities as well as the different stakeholders that are impacted. A benefit of the AQM survey is that the index score allows countries to identify the areas of their AQM systems that could be enhanced. In addition, lessons can be learnt from other countries that have similar or different levels of capabilities (Schwela et al., 2006).

Technical note on the index calculation of the air pollution indicator

The index that is calculated with the survey is a composite indicator. Individual indexes (measurement of air quality, data assessment and availability, emissions inventory, air quality management) capability need to be compiled into an overall single indicator not just a ratio or proportion. The preferred option is to use a five levels scale (minimal, limited, moderate, good, excellent) that can be combined in three achievement levels (not achieved, partially achieved, achieved).

Each question was allocated a score (Table A1). The subtotal maximum score value is equal to 25 for the Measurement Capacity Index, Data assessment and Availability Index, Emissions Estimates Index and Air Quality Management Capability Index. The more questions answered positively, the greater the management capability of that city. The original questionnaire was modified, taking into consideration the importance that some issues have reached and technological developments.

²⁴ This survey has been tested and used in the WHO City indicators project by the WHO Department of Noncommunicable Diseases.

Table A1 Questions scores

Section 1		Section 2		Section 3		Section 4	
Question	Score	Question	Score	Question	Score	Question	Score
1a	0.5	13a	1	17a	1	21	2
1b	0.5	13b	1	17b	1	21a	0.5
1c	0.5	13c	1	17c	1	22a	1
1d	0.5	13d	1	17d	0.5	22b	1
1e	0.5	13e	2	17e	0.5	22c	1
2a	0.5	13f	1	17f	1	23	2
2b	0.5	13g	1	17g	1	24	0.5
2c	0.5	13h	1	17h	1.5	25	0.5
2d	0.5	13i	2	17i	1	26a	1
2e	0.5	13j	1	17j	0.5	26b	1
3a	0.5	13k	1	18a	0.5	27	2
3b	0.5	13l	1	18b	0.5	28	2
3c	0.5	14a	1	18c	0.5	29	1
3d	0.5	14b	1	18d	0.5	30ai	0.5
3e	0.5	14c	1	18e	0.5	30bi	0.5
4a	0.5	14d	1	18f	0.5	30ci	0.5
4b	0.5	14e	1	18g	0.5	30di	0.5
4c	0.5	14f	1	19a	2	30ei	0.5
4d	0.5	14g	1	19b	1	30fi	0.5
4e	0.5	15	2.5	19c	2	30aii	0.5
5a	0.5	16	1.5	19d	2	30bii	0.5
5b	0.5			19e	1	30cii	0.5
5c	0.5			19f	1	30dii	0.5
5d	0.5			19g	1.5	30eii	0.5
5e	0.5			20a	2	30fii	0.5
6	2			20b	1	31a	0
7	2					31b	3
8	1.5					31c	1
9	1					32	2
10	2						
11	2						
12	2						

The scores have been adapted to reflect the greater importance of some indicators in relation to others (Schwela, 2006). For example, data assessments for exceedances and epidemiological studies (13e and 13i) were identified as being of greater importance, so those questions were assigned a score of 2 rather than 1. Higher importance was assigned to positive trends (31b), as in fact shifting attention to trends and rates of change, rather than compliance, would provide a better connection between policy measures and outcomes (Fuller and Font, 2019; Shaddick et al., 2020).

The overall capability index score ranges between 0 and 100 (Table A2). An equal weighting of each component index has been given to the overall assessment (Schwela et al., 2006).

Table A2 **Bandings for the component and overall capability indexes**

Effectiveness	Index score	Overall index score
Minimal	0–5	0–20
Limited	6–10	21–40
Moderate	11–15	41–60
Good	16–20	61–80
Excellent	21–25	81–100

Source: based on UNEP/WHO (1997).

Minimal means there is no regular monitoring of air quality, no assessment of measured or modelled data, no emission inventories have been derived, and the existence of standards and regulations such as Environmental Impact Assessments are unknown. A minimal rating from the AAP survey will likely result in an achievement level of “Weak” for the Ambient Air Pollution Reduction indicator, which means there is no implementation of national legislation, no knowledge of the source of emissions, no availability of population-weighted exposure to air pollution ($PM_{2.5}$), decreasing trends of air pollution are proved (see Table 5.4).



Questionnaire on Air Quality Management

For each question answer YES or NO (Either/Or – please underline correct response), and specify more details as requested.

Section 1: indicators of measurement capacity

1. For which of the following pollutants does your city have at least one site monitoring central urban background²⁵ concentrations, which has been operating continuously²⁶ for at least one year (and therefore provides data from which evaluation of possible chronic, long-term, health effects is possible)?

		Answer
a	PM _{2.5}	Yes <input type="checkbox"/> No <input type="checkbox"/>
b	PM ₁₀	Yes <input type="checkbox"/> No <input type="checkbox"/>
c	NO ₂	Yes <input type="checkbox"/> No <input type="checkbox"/>
d	O ₃	Yes <input type="checkbox"/> No <input type="checkbox"/>
e	Other pollutants	Please specify: 1) 2) 3) 4)

2. For which of the following pollutants does your city have at least one site monitoring central urban background concentrations, which has been operating for at least one year and provides daily or hourly mean values (and therefore provides data from which evaluation of acute, short-term, health effects is possible)?

		Answer
a	PM _{2.5}	Yes <input type="checkbox"/> No <input type="checkbox"/>
b	PM ₁₀	Yes <input type="checkbox"/> No <input type="checkbox"/>
c	NO ₂	Yes <input type="checkbox"/> No <input type="checkbox"/>
d	O ₃	Yes <input type="checkbox"/> No <input type="checkbox"/>
e	Other pollutants	Please specify: 1) 2) 3) 4)

²⁵ Background concentrations refer to concentrations of air pollutants that are generated by sources that cannot be modified by local actions. Background concentration of a pollutant is the concentration resulting from natural primary and precursor sources everywhere in the world plus anthropogenic sources outside of the selected area (US-EPA: 2019)..

²⁶ Air quality monitoring is continuous when data are produced for at least 274 days/year.

3. For which of the following pollutants does your city have at least one site monitoring central urban background concentrations, which has been operating for at least five years (and therefore provides data from which evaluation of trends is possible)?

		Answer
a	PM _{2.5}	Yes <input type="checkbox"/> No <input type="checkbox"/>
b	PM ₁₀	Yes <input type="checkbox"/> No <input type="checkbox"/>
c	NO ₂	Yes <input type="checkbox"/> No <input type="checkbox"/>
d	O ₃	Yes <input type="checkbox"/> No <input type="checkbox"/>
e	Other pollutants	Please specify: 1) 2) 3) 4)

4. For which of the following pollutants does your city have monitors operating for at least one year (and therefore provide data from which evaluation of spatial distribution is possible)?

		Residential area	Traffic	Commercial area	Industrial area	Background ²⁷	Answer
a	PM _{2.5}						Yes <input type="checkbox"/> No <input type="checkbox"/>
b	PM ₁₀						Yes <input type="checkbox"/> No <input type="checkbox"/>
c	NO ₂						Yes <input type="checkbox"/> No <input type="checkbox"/>
d	O ₃						Yes <input type="checkbox"/> No <input type="checkbox"/>
e	Other pollutants, please specify: 1) 2) 3) 4)						Yes <input type="checkbox"/> No <input type="checkbox"/>

²⁷ A background station is located remote from major emission sources.



5. For which of the following pollutants does your city have at least one site monitoring at the roadside or kerb (and therefore provides data from which evaluation of the importance of vehicle emissions is possible)?

		Answer
a	PM _{2.5}	Yes <input type="checkbox"/> No <input type="checkbox"/>
b	PM ₁₀	Yes <input type="checkbox"/> No <input type="checkbox"/>
c	NO ₂	Yes <input type="checkbox"/> No <input type="checkbox"/>
d	O ₃	Yes <input type="checkbox"/> No <input type="checkbox"/>
e	Other pollutants	Please specify: 1) 2) 3) 4)

The following questions are indicators of the quality control and assurance procedures operated by the air quality monitoring network in your city:

6. Are the instruments calibrated at least every two weeks?

Yes No

7. Are site audits conducted to compare measurements from different instruments in the network, (intercomparisons) at least once a year?

Yes No

8. Are analysis and audits performed by a laboratory with an accreditation certificate?

Yes No

9. Are audits conducted by an independent body?

Yes No

10. Are the sites reviewed at least every five years to ensure they still meet the objectives of the network and hence are appropriate?

Yes No

11. Is a quality control procedure applied to the data before it is finally released?

Yes No

12. Are there guidelines regarding the location of each monitoring site according to its purpose (background/hot spot site)?

Yes No

Section 2: indicators of Data assessment and Availability

The following questions are indicators of the procedures used, and extent to which, data assessment and dissemination is conducted.

13. Which of the following data assessments are conducted? Determination of:

		Answer
a	Means (daily, monthly, annual, etc.)	Yes <input type="checkbox"/> No <input type="checkbox"/>
b	Maximum values (Daily, monthly, annual, etc.)	Yes <input type="checkbox"/> No <input type="checkbox"/>
c	Daily variations	Yes <input type="checkbox"/> No <input type="checkbox"/>
d	Percentiles	Yes <input type="checkbox"/> No <input type="checkbox"/>
e	Exceedances of national or WHO air quality standards	Yes <input type="checkbox"/> No <input type="checkbox"/>
f	Trends	Yes <input type="checkbox"/> No <input type="checkbox"/>
g	Spatial distribution (mapping)	Yes <input type="checkbox"/> No <input type="checkbox"/>
h	Predictions of air pollution episodes	Yes <input type="checkbox"/> No <input type="checkbox"/>
i	Epidemiological (health) studies	Yes <input type="checkbox"/> No <input type="checkbox"/>
j	Modelling with meteorological measurements	Yes <input type="checkbox"/> No <input type="checkbox"/>
k	Modelling with emissions	Yes <input type="checkbox"/> No <input type="checkbox"/>
l	Exposure assessments (determining the exposure of different population groups to air pollution)	Yes <input type="checkbox"/> No <input type="checkbox"/>

14. Is air quality information available?

		Answer
a	As raw data	Yes <input type="checkbox"/> No <input type="checkbox"/>
b	As aggregated data	Yes <input type="checkbox"/> No <input type="checkbox"/>
c	As air pollution index	Yes <input type="checkbox"/> No <input type="checkbox"/>
d	In public reports	Yes <input type="checkbox"/> No <input type="checkbox"/>
e	On the internet	Yes <input type="checkbox"/> No <input type="checkbox"/>
f	On information boards in the city centre	Yes <input type="checkbox"/> No <input type="checkbox"/>
g	Only in internal reports/bulletins not readily available to the general public	Yes <input type="checkbox"/> No <input type="checkbox"/>

15. Are warnings to the public issued during or before forecasted periods of poor air quality?

Yes No

16. Has there been in the last three years any mass media education and awareness campaign on air pollution?

Yes No

Section 3: Indicators of Emissions Estimates

17. For which of the following emissions sources have estimates of emissions been made in your city in the past five years?

		Answer
a	Household emissions	Yes <input type="checkbox"/> No <input type="checkbox"/>
b	Power generating facility emissions	Yes <input type="checkbox"/> No <input type="checkbox"/>
c	Industrial emissions	Yes <input type="checkbox"/> No <input type="checkbox"/>
d	Total traffic only	Yes <input type="checkbox"/> No <input type="checkbox"/>
e	Cars	Yes <input type="checkbox"/> No <input type="checkbox"/>
f	Motorcycles	Yes <input type="checkbox"/> No <input type="checkbox"/>
g	LGV (light goods vehicles)	Yes <input type="checkbox"/> No <input type="checkbox"/>
h	HGV (heavy goods vehicles)/buses	Yes <input type="checkbox"/> No <input type="checkbox"/>
i	Agriculture	Yes <input type="checkbox"/> No <input type="checkbox"/>
j	Others, e.g. ships, aircraft	Yes <input type="checkbox"/> No <input type="checkbox"/>

18. For which of the following primary/secondary pollutants have estimates of emissions/ generation been made in your city in the past five years?

		Answer
a	Nitrogen oxides	Yes <input type="checkbox"/> No <input type="checkbox"/>
b	Sulphur dioxide	Yes <input type="checkbox"/> No <input type="checkbox"/>
c	Particulate matter	Yes <input type="checkbox"/> No <input type="checkbox"/>
d	Carbon monoxide	Yes <input type="checkbox"/> No <input type="checkbox"/>
e	Lead	Yes <input type="checkbox"/> No <input type="checkbox"/>
f	Ozone	Yes <input type="checkbox"/> No <input type="checkbox"/>
g	Hydrocarbons	Yes <input type="checkbox"/> No <input type="checkbox"/>

19. The following questions refer to how the inventory was produced:

		Answer
a	Estimates including some actual measurements of emissions?	Yes <input type="checkbox"/> No <input type="checkbox"/>
b	Estimates based upon fuel consumption statistics and emissions estimates only?	Yes <input type="checkbox"/> No <input type="checkbox"/>
c	Are emissions from non-combustion processes included?	Yes <input type="checkbox"/> No <input type="checkbox"/>
d	Is the inventory cross-checked (validated)?	Yes <input type="checkbox"/> No <input type="checkbox"/>
e	Are inventories conducted at least every 2 years?	Yes <input type="checkbox"/> No <input type="checkbox"/>
f	Are future inventories planned?	Yes <input type="checkbox"/> No <input type="checkbox"/>
g	Spatial distribution of emission sources included?	Yes <input type="checkbox"/> No <input type="checkbox"/>

20. How are details of the inventory available?

- a. Published in full and available to the general public. Yes No
- b. Partially available. Yes No

Section 4: Indicators of Air Quality Standards and Management Capability

21. Are there air quality standards?

Yes No

21a. If yes, please specify which level:

national from year ...

subnational from year ...

city level from year ...

22. Which of the following sources of emissions have emissions limits been set, and for which are these enforced and penalties imposed for exceeding this limit:

		Answer
a	Transport (emissions from road vehicles)	Yes <input type="checkbox"/> No <input type="checkbox"/>
b	Industry (emissions from industrial sources)	Yes <input type="checkbox"/> No <input type="checkbox"/>
c	Other. If 'Yes' please specify:	Yes <input type="checkbox"/> No <input type="checkbox"/>

23. Are Environmental Impact Assessments conducted before the construction of major new projects such as roads or industrial facilities?

Yes No

24. Is unleaded petrol available?

Yes No

25. What is the allowed sulfur content in diesel fuel for road vehicles:

1) below 15 ppm (ultra low)

2) below 500 ppm (low)

3) above 500 ppm

26. Are there quality norms imposed on solid fuels to be used by households?

1) for coal? Yes No

2) for wood/biomass? Yes No

27. Are additional emission controls imposed on industry, or vehicle use restricted during episodes of particularly poor air quality?

Yes No

28. Are there enforced regulations to ensure compliance with air quality standards (if an area exceeds an air quality standard are additional measures enforced to control emissions and ensure this is not repeated)?

Yes No



29. Are there local air quality standards to take account of sensitive environments, such as nature parks, residential areas, etc.?

Yes No

30. For which of the following pollutants have short-term and long-term ambient air quality standards (such as limit values) been set? (Short-term is for averaging times shorter than 24 hours; long-term for averaging time longer than 24 hours, such as month or year).

	Pollutant	i. Short-term	ii. Long-term
a	PM _{2.5}	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
b	PM ₁₀	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
c	NO ₂	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
d	SO ₂	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
e	CO	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
f	Other	Please specify: 1) 2) 3) 4)	Please specify: 1) 2) 3) 4)

31. In the last 5 years, the city -level trend of air pollution for PM_{2.5} are:

- a) Increasing
- b) Decreasing
- c) Stable

32. Is there city-level data on population weighted exposure to air pollution (PM_{2.5}) calculated?

Yes No

33. Any additional comment you may want to add?

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Thank you very much for completing this questionnaire.

Short version of the questionnaire

This survey has also been adapted for the NCDs City Indicator project. The adapted AP indicator is a reduced set of questions from the complete survey. While the complete survey includes 33 questions that are organized in four main sections, the short version contains 19 questions and has four sections on AAP and one on HAP. The short version contains only one HAP question related to the proportion of the population with primary reliance on clean fuels and technologies for cooking.

The four sections of the short questionnaire include: Availability of monitoring sites for air pollution data collection (sourced from the main section on Measurement capacity); Availability of air quality information and trends (indicators of Data assessment and Availability); Indicators of Emissions Estimates; Indicators of Air Quality Standards and enforcement of air pollution reduction policies.

Similar to the complete survey, each subsection in the reduced survey is evaluated separately, then combined to provide one a score in terms of achievement of air quality policies (strong, developing, weak).

For the short version, “Weak” would mean air quality legislation may or may not exist; but no enforcement of air pollution reduction policies; no availability of monitoring sites for air pollution data collection; no data available on for sources of emission inventory; no information on air quality information and trends available.

For “Developing” in the complete survey air quality legislation exists and knowledge of source of emissions, or population weighted exposure to air pollution ($PM_{2.5}$) are available but trends of air pollution do not show significant changes and policies are not fully enforced. For the reduced survey, “Partially Achieved” would mean that air quality legislation exists but either the enforcement of air pollution reduction policies; monitoring sites for air pollution data collection; data on for sources of emission inventory; or air quality information and trends is not available.

To earn a score of “Achieved”, air quality legislation must exist and policies are not fully enforced, knowledge of source of emissions, and population weighted exposure to air pollution ($PM_{2.5}$) must be available and trends of air pollution must show decreases. For the reduced survey, “Strong” would mean that air quality legislation exists, air pollution reduction policies are enforced; monitoring sites for air pollution data collection are available; data is available for inventory of sources of emission; and air quality information and decreasing trends are available



C) Other resources to track environmental policies that have relations with air pollution

The following is not an exhaustive list, but just an indication of some publications or reports that may be of interest.

Climate change

Despite its importance, limited publications have suggested systematic approaches to tracking climate adaptation policies (Ford and Berrang-Ford, 2016). A description of a process for applying the climate policy tracking framework is available from Barua, Fransen and Wood (2014) and Lesnikowski et al. (2019).

Green spaces

One source of information on how to track interventions for green spaces can be found in the WHO (2017) report on urban green spaces that includes a section on “How to monitor and evaluate urban green space interventions”. Also, a recent review of tree planting projects in African cities was published by Lobe Ekamby and Mudu (2022). Of support can also be the discussion on hypothesized causal pathways between green infrastructure (GI) projects and their initial, intermediate, and long-term outcomes for human health and social well-being by Nieuwenhuijsen (2020).

Transport

The work on policy tracking in the transport sector has a longer tradition compared to other issues. Among many examples, see the work of the UN-ESCAP for Asian cities (<https://www.unescap.org/blog/tracking-the-progress-of-urban-mobility-in-asian-cities-using-the-sustainable-urban-transport-index>).

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