

A statistical note:

Proposal for air pollution as an indicator for tracking progress toward SDGs on health (3), energy (7) and cities (11)

Summary:

Air pollution serves as an important indicator for monitoring progress toward achieving the sustainable, equitable and healthy future we want. Improvements in air quality are a direct indication of achievements in the policies and interventions implemented for sustainable energy (i.e. energy access, energy efficiency), sustainable consumption, urban development, climate and infrastructure. At the same time, exposure to air pollution is a major cause of mortality and morbidity globally, making data on air pollution levels and their spatial and temporal trends an essential and pragmatic indicator of the health impacts of sustainable development.

Statistics on air pollution levels, trends and geographical distribution are available through a number of sources. These are regularly compiled and updated by international organizations and reported in terms of short-term peaks and annual means at the global, national and municipal level.

This statistical note summarizes key linkages between air pollution and the SDGs on health, energy and cities. It describes the WHO-hosted global databases on air quality (both indoors and outdoors) and household energy, which for over a decade have been used for tracking global and national air pollution levels and relevant air pollution proxies (e.g. energy access in households as a surrogate for household air pollution). Also described are continuing global efforts to enhance the quality and methods for data collection on air pollution exposure, involving a number of UN and government agencies as well as other stakeholders, through the WHO-hosted Global Platform on Air Quality and Health¹. Recommendations are made on the articulation of air pollution indicators for the SDGs on health (goal 3) and cities (goal 11), as well as for the indicator to monitor energy access (goal 7), so as to make them more specific, measurable, relevant and achievable. These are complemented by an overview of the available data sources, and ongoing efforts to fill any relevant data gaps.

A new WHO World Health Assembly Resolution “Addressing the health impacts of air pollution”², adopted unanimously by its 194 Member States, calls on WHO to further strengthen its efforts and international cooperation within the UN and other systems to “*compile and analyse data on air quality, with particular emphasis on health related aspects of air quality*”. In light of this resolution and considering WHO’s expertise, leadership and convening power in the area of air pollution and health, WHO is well-placed to serve as the lead technical agency for SDG monitoring of statistics on air pollution and related levels of human exposure. In cooperation with UN partners and other stakeholders, WHO will continue to produce statistics on air pollution and related indicators (e.g. household energy access) on a regular basis for the monitoring of the impacts of the Sustainable Development Goals on 3, 7 and 11.

¹ The Global Platform on Air Quality and Health is an ongoing global cooperation to improve the quality and availability of data on human exposure to air pollution. Partners in this effort include relevant UN agencies and programmes (e.g. WMO, UNEP, UNOOSA); the UNECE Convention on Long Range Transboundary Air Pollution, the World Bank; national institutions (e.g. US Environmental Protection Agency, National Aeronautics and Space Administration (NASA), Japanese Aerospace Exploration Agency (JAXA), Shanghai Environmental Monitoring Centre, Indian Institute of Technology); research institutes (e.g. European Joint Research Committee, International Institute for Applied Systems Analysis, Health Effects Institute, Stockholm Environment Institute), and international experts from relevant disciplines.

² World Health Assembly Resolution: Health and Environment: Addressing the health impact of air pollution. Geneva, 2015. http://apps.who.int/gb/ebwha/pdf_files/WHA68/A68_R8-en.pdf

Background

The greatest single environmental risk for health, climate and sustainable development is air pollution. Outdoor (ambient) and household (indoor) air pollution are responsible for about 7 million premature deaths annually – making air pollution one of the largest single causes of premature mortality and morbidity worldwide. Inefficient energy production, use and distribution of energy services, along with energy inefficient industry, transportation, and housing, as well solid waste management systems are some of the major sources of air pollution emissions. Air pollution sources and exposure are thus closely linked to sustainable development, particularly in relation to the way we produce and use energy at household, community and urban level with direct consequences to health and climate.

As part of its core functions to monitor trends in health risk and disease burden, the World Health Organization (WHO) has been publicly tracking global and national air pollution levels and relevant air pollution proxies (e.g. energy access in homes) and their health impacts for over a decade. WHO's technical capacity, in combination with its global and national databases make important contributions to a number of key global efforts and monitoring frameworks including the Global Tracking Framework of Sustainable Energy for All Initiative³⁴, collaboration with the Global Alliance for Clean Cookstoves on harmonizing indicators for top-down routine monitoring, UNEP Live⁵ and the International Energy Agency's World Energy Outlook⁶.

WHO, in close collaboration with other international organizations and researchers, is strengthening the global tracking capacity for air quality and health by establishing a Global Platform on Air Quality and Health, containing data and information which will be accessible to everyone through the Internet. The Platform's purpose is to facilitate access to evidence on human exposures to outdoor (ambient) air pollution, on the health impacts of the pollutants and on effective interventions for their reduction.

The Global Platform on Air Quality and Health is a cooperative initiative bringing together efforts, expertise and data from many different stakeholders working in UN and other international agencies (e.g. WMO, UNEP, World Bank, UNECE), international initiatives (e.g. Climate and Clean Air Coalition), national agencies (e.g. Japanese Aerospace Exploration Agency, USA Environmental Protection Agency) and researchers (e.g. Health Effects Institute, International Institute for Applied Systems Analysis (IIASA), European Joint Research Centre) to achieve a comprehensive and harmonized ambient air quality monitoring network. This will have the capacity to harness the scientific evidence and advanced tools to monitor the impacts of human exposure to air pollution and its impacts on population health much more effectively than has been the case previously. See Annex 1 for examples of contributions from different UN agencies and Annex 2 for a full list of the organizations represented in the Global Platform on Air Quality and Health.

Measuring air pollution exposure and its impact on health is a measurable and effective indicator for monitoring progress on several sustainable development goals and their associated targets. More specifically, targets on the goals for health, energy and cities can be measured and monitored using indicators on air pollution sources (e.g. cooking with polluting fuels, inefficient energy production) or exposure. The following statistical note provides the conceptual framework, feasibility, and data requirements for using air pollution sources and levels of exposures for monitoring the above-mentioned SDGs. The currently available data sources and the potential data

³ Sustainable Energy for All <http://www.se4all.org/tracking-progress/>

⁴ World Bank; *A Comprehensive Methodology for Defining and Measuring Access to Energy*; (in preparation for publication)

⁵ UNEP Live; www.unep-live.org

⁶ IEA's World Energy Outlook; <http://www.worldenergyoutlook.org/>

gaps are discussed in the context of the respective sustainable development goal and its associated target.

This note responds to concerns by Member States about air pollution and its consequences, manifested not only in the recent World Health Assembly Resolution, but also at United Nations Environment Assembly last year, when governments adopted a decision that encourages the formulation of national action plans, implementation of national air quality standards, and establishment of emissions standards for significant sources of air pollution⁷. Within the UNEA resolution, governments and intergovernmental, regional and international organizations are also encouraged to make air quality data more easily accessible and understandable to the public as well also facilitate the operation of UNEP-supported programmes on the assessment of air quality issues.

Goal 3: Health

Air pollution is the single largest environmental health risk, causing more preventable disease and death than any other environmental pollution (e.g. water, chemical contamination)⁸. Air pollution exposure is a shared risk, affecting populations in both developed and developing countries alike. Accounting for around 7 million deaths each year, (more than Tuberculosis, malaria and HIV/AIDS combined), exposure to air pollution is a major risk factor for noncommunicable diseases like heart disease, stroke, chronic obstructive pulmonary disease, lung cancer and respiratory infections like childhood pneumonia.⁹

Reducing air pollution requires addressing the main sources, including inefficient fossil fuel combustion from motor vehicle transport, power generation and improving energy efficiency in homes, buildings and manufacturing, all of which are central to sustainable development and the post-2015 Sustainable Development agenda.

Considering its universality and its close connections to sustainability, ambient (outdoor) air pollution exposure is a well-suited and measurable indicator to monitor health benefits from a more sustainable future with less pollution (Table 1).

Table 1. Proposed OWG Goal 3 on health and air pollution relevant target

Goal 3	Ensure healthy lives and promote well-being for all at all ages
Target 3.9	By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution from contamination.

Indicators to monitor mortality attributable to pollution

Systems to monitor ambient air quality are well-established and growing. WHO has been leading a cooperative effort through its Global Platform on Air Quality and Health and global databases on ambient air pollution, household air pollution and household energy to track and monitor both exposure and disease burden due to ambient air pollution more broadly, and in some cases, ambient air pollution attributed to specific sectors (e.g. household energy use). Table 2 provides a proposal for refinements in the ambient air pollution indicator for health. The suggested changes increase the geographic and population representation of the indicator. In addition, they make the data collected comparable and practical for monitoring the health and environmental impacts of other sustainable

⁷ UNEA resolution 1/7 http://www.unep.org/unea/UNEA_Resolutions.asp

⁸ <http://www.who.int/mediacentre/news/releases/2014/air-pollution/en/>

⁹ WHO Global health observatory: <http://apps.who.int/gho/data/node.main.ENVHEALTHJOINTAAPHAPBoD?lang=en>

goals, either directly (e.g. SDG 11 air quality in cities) or indirectly (e.g. improvements in air quality can serve as a proxy or surrogate for monitoring progress in energy efficiency and/or the uptake of clean renewables).

Following is the detailed description and justification for such refinements, as well as discussion of currently available information resources, data gaps, and opportunities to fill such gaps.

Table 2. Current indicator for 3.9.7 & recommended update

Target	Current Indicator	Recommended update to indicator
3.9	3.9.1 Population in urban areas exposed to outdoor air pollution levels above WHO guideline values	3.9.1. Mean levels of exposure to ambient air pollution (population weighted)

Rationale

Exposure to ambient air pollution, (urban + rural) areas: Ambient air pollution is a problem for both urban and rural areas. Limiting the indicator to just urban areas overlooks a substantial population suffering from the impacts from outdoor air pollution exposure. In many rural areas, brick kilns, household fuel combustion, crop burning and other forms of inefficient energy combustion create substantial levels of health-damaging air pollution. Although, ambient air pollution monitoring has traditionally been limited to urban areas in high-income countries, recently more and more cities in low- and middle-income countries and in some cases rural areas, are beginning to routinely monitor and report on ambient air quality. This rise in monitoring is complemented by new scientific methods to estimate ambient air pollution which combine data collected from satellites, air pollution chemical transport models, and emissions inventories and can facilitate monitoring of ambient air pollution levels globally—in both urban and rural areas, with or without air quality monitoring (see description of Global Platform on Air Quality and Health below). Expanding the indicator to include both urban and rural areas ensures that all human and environmental impacts referred to in target 3.9 are better accounted for.

Mean levels: Levels of air pollution can vary from day to day, in some cases drastically, due to changes in local weather conditions, geography, economic output (e.g. industry) etc. Although there are acute health impacts following peaks of air pollution, the most significant health impacts are due to chronic exposure to air pollution. Articulating the indicator as the annual average or mean is a more specific and reliable indicator for monitoring the health and environmental impacts of sustainable growth and development which is not unduly influenced by daily fluctuations or short-term peaks in air pollution levels.

Achieving the WHO air quality guideline levels will ensure clean air and health protection for all. Presently, a large majority of countries has air pollution levels that far exceed the WHO Air quality guideline levels. Using a binary metric (i.e. whether or not a country achieves WHO AQ guideline value) does not necessarily allow countries to monitor gradual improvements in air quality and related health burden over time. Rather if the indicator is articulated as the annual mean level of air pollution (i.e. fine particulate matter –PM_{2.5}) concentrations, countries will be able to better track improvements in air quality and health as a measure of sustainable development achievements. rather than just whether or not they have attained the WHO guideline level.

WHO is still able to report on the relevant health impacts from any noted reductions in mean levels of fine particulate matter, and will continue to report on those countries that have attained WHO guideline level.

Population-weighted: The size or population of urban and rural areas along with their respective air pollution levels vary significantly within a country. Weighting annual levels of fine PM by the size of the population in urban and rural area increases the specificity of this indicator.

Data Sources

Global Platform on Air Quality and Health:

Traditionally, ambient air pollution monitoring was generally limited to urban areas, mostly in high-income countries where ground level monitoring is more routinely conducted. In 2013, WHO began collaborating with major institutions and agencies worldwide in the development of a global air pollution monitoring platform—the Global Platform on Air Quality and Health. This Platform uses information on air pollution concentrations from satellite monitoring, chemical transport models, ground-level measurements, emission inventories of pollution from key sources in addition to drawing on WHO's other air pollution databases (i.e. WHO Global household energy database, WHO Ambient air pollution database) to estimate ambient air pollution exposure in both rural *and* urban areas and attribute such pollution to their sources. An advantage of this new monitoring system is that it permits estimates of air pollution exposures even in areas where there are no ground level monitoring stations, like in many rural and smaller urban areas of the world. In addition, understanding the sources of air pollutants helps the development and implementation of effective policies to reduce air pollution. A draft meeting report from the WHO Global Platform on Air Quality and Health which outlines the objectives, data sources and outputs for the platform and provides the relative contributions of Platform partners including other UN agencies (e.g. WMO, UNEP, UNDP, UNECE), national agencies (e.g. Japanese Aerospace Exploration Agency, Shanghai Environmental Monitoring Center) and research institutes (e.g. Yonsei University, Tehran University of Medical Science) involved in this global cooperation is available in Annex I.

WHO Guidelines for Air Quality,^{10,11}:

WHO Air quality guidelines synthesize the evidence on the health impacts of air pollution to derive recommendations on what exposure levels of air pollutants can be considered safe for health. The guideline levels or interim targets levels provided in these Guidelines are applicable to all environments, i.e. both outdoors and indoors, can help countries define their own safe levels of exposure and can be used in combination with epidemiological data to track and monitor the avoided air pollution exposure and related health benefits from sustainable development. These guidelines are routinely updated and used by countries and/or municipalities to establish local or national air quality standards. These guidelines draw on global research evidence, including from toxicological, epidemiological and intervention studies about human exposure and the health impacts of air pollution. In developing these recommendations, WHO applies a high level of scrutiny to all the scientific evidence used and ensures there are no conflict of interest from contributing scientists, to guarantee the scientific quality and independence of its guidelines and related recommendations.

WHO's Global Health Observatory¹²:

The WHO Global Health Observatory is a key information source for tracking the health impacts of air pollution. Estimates of the underlying mortality rates, average ambient air pollution exposure in countries and/or cities and the mortality attributable to ambient air pollution for different diseases

¹⁰WHO Air quality guidelines: global update 2005; 2006;

(http://www.who.int/phe/health_topics/outdoorair/outdoorair_agq/en/).

¹¹ WHO guidelines for indoor air quality: household fuel combustion; 2014;

(<http://www.who.int/indoorair/guidelines/hhfc/en/>).

¹² WHO Global health observatory (http://www.who.int/gho/phe/indoor_air_pollution/burden/en/)

are routinely updated and reported within the Observatory. All information in the Observatory is free and publicly available online. The Observatory also provides functionalities for better visualization of information (e.g. maps, graphs) that could be valuable for countries to monitor and report on target 3.9 amongst others.

WHO Ambient Air Pollution Database in cities¹³: As part of its core functions, WHO monitors and assess trends to major health risks including ambient air pollution. The *WHO's Ambient air pollution database* provides annual mean concentrations of particulate matter based on daily air measurements of particulate matter (PM₁₀ or PM_{2.5}) or data which could be aggregated into annual means. Currently the WHO database houses data from 1,628 cities, from 91 countries for the years between 2008 and 2013. This database is updated on a regular basis can be released annually to support monitoring of this SDG target.

The Primary sources of data in this database are official national/subnational reports, national/ subnational web sites containing measurements of PM₁₀ or PM_{2.5} and the relevant national agencies. In addition, measurements reported by the following regional networks are used: the Asian Clean Air Initiative (1) for Asia, and Airbase (2) for Europe. In the absence of data from the previous sources, data from (a) UN Agencies, (b) Development agencies and (c) articles from peer reviewed journals are used. In order to present air quality values that are largely representative for human exposure, only measurements characterized as urban background, residential areas, commercial and mixed areas are used. Stations characterized as particular "hot spots" or exclusively industrial areas are excluded, unless they are contained in reported city means and could not be dissociated. In a few exceptional cases, where annual means could not be calculated, measurements covering a more limited part of the year were used.

Data gaps & opportunities to address such gaps

Geographic coverage:

Air quality ground-level monitoring is not universal. There are some parts of the world where little if any ground-level monitoring of air quality has been put into place. This is particularly the case for some developing countries and/or small urban or rural areas. Drawing on data from various information resources (e.g. satellite remote-sensing, chemical transport models, emission inventories), in combination with the WHO air quality guidelines and underlying disease burden estimates, the Global Platform for Air Quality for Health can provide routinely updated ambient air pollution exposure and attributable disease burden estimates at the global, national and local level (e.g. in urban, rural areas).

Air Pollution Sources:

Understanding the sources of air pollution is critical for decision-makers to design and implement effective policies to tackle air pollution. Currently there are a number of emissions inventories which use statistical modelling and other tools to identify the sources of air pollutants and their respective contributions to the overall air pollution mixture in different regions, countries and/or cities. WHO is collaborating with different agencies (e.g. Joint Research Centre, IIASA) within the context of the Global Platform for Air Quality and Health to better identify the major sources of health-damaging air pollutants to support the development and implementation of focused policies and actions to control air pollution in different economic sectors.

¹³ WHO Ambient air pollution database in cities (http://www.who.int/phe/health_topics/outdoorair/databases/cities/en/)

Goal 7: Energy

Globally, 3 billion people rely on inefficient fuels (e.g. wood, coal, dung, kerosene) and technologies to meet their home energy needs, including energy for cooking, heating and lighting. The lack of access to clean and efficient household energy solutions has significant impacts on the economy, social well-being, gender equality, the environment and public health, accounting for 4.3 million deaths annually¹⁴—all areas of critical importance to the post-2015 Sustainable Development Agenda. Recognizing its importance, a goal dedicated to energy was included in the Open Working Group’s report to the UN General Assembly in preparation for the discussions of the post-2015 Sustainable Development Goals.

Table 3. Proposed OWG Goal 7 on energy and associated access target

Goal 7	Ensure access to affordable, reliable, sustainable, and modern energy for all
Target 7.1	By 2030, ensure universal access to affordable, reliable and modern energy services

As part of WHO’s mandate for monitoring and tracking health impacts from major risk factors, and for reporting on MDG Goal 7, WHO has been monitoring and tracking access to energy and its impacts on health and development using its Global household energy database, and Global health observatory for over a decade. In addition, WHO provides normative guidance to stakeholders working in the health or other sectors on the requisite performance of fuels and technologies that can be considered clean and safe for health. All of which are instrumental to developing and implementing effective policy for the sustained adoption of clean household energy that improves health and the environment.

Indicators to monitor access to modern energy services

Historically, a binary indicator has served as practical surrogate to monitor energy access in homes -- the use of solid fuels for cooking (i.e. Total population – % of population relying on *nonsolid fuels*—the currently proposed indicator). Using binary indicators is pragmatic and is an important mechanism for monitoring the health and development impacts from the lack of access to energy in the home.

Our current knowledge and understanding of the impacts that inefficient household energy use has on the health and well-being of billions around the world, as well as on our climate and environment, suggests an important modification to this binary indicator will allow us to better monitor the impacts from access to modern energy services in the home for sustainable development objectives, including health. Table 4 presents the current proposed indicator as well the suggested reformulation. Following that is a brief summary of the why this modification will allow for more specific and meaningful measurement of the impacts from target 7.1 of the SDG 7 on energy.

The full evidence-base supporting this reformulation of this indicator can be found in the *WHO indoor air quality guidelines: household fuel combustion*¹⁵, an authoritative document that uses both systematic reviews of the evidence base and a panel of scientists to provide normative

¹⁴ WHO Global Health Observatory; <http://apps.who.int/gho/data/node.main.139?lang=en>

¹⁵ WHO guidelines for indoor air quality: household fuel combustion; 2014; (<http://www.who.int/indoorair/guidelines/hhfc/en/>).

recommendations of what fuels and technologies used in the home can be considered clean and safe for health as well as the environment.

Table 4. Proposed Indicator 7.1.2 on energy access and recommended update

Target	Indicator	Recommended update to indicator
7.1	7.1.1 Percentage of population with electricity access	n/a
	7.1.2 Percentage of population with primary reliance on <i>non-solid fuels</i> (%)	Percentage of population with primary reliance on <i>clean fuels and technologies at the household level*</i>

* where the recommendations of the *WHO guidelines for indoor air quality: household fuel combustion*¹⁵ define what can be considered “clean” fuels and technologies

Rationale:

Shift in terminology from “nonsolid fuels” to “clean fuels”: Kerosene, also known as paraffin, is a *liquid* or *nonsolid* fuel that is a **major** source of air pollution, particularly formaldehyde, poly-aromatic hydrocarbons and particulate matter, including black carbon (a major contributor to near-term climate warming). More importantly, in light of the substantial evidence on the health and safety risks of kerosene use in the home, WHO guidelines for indoor air quality: household have a specific recommendation which discourages the use of kerosene in the home for activities like cooking, heating and lighting¹⁶. There are a significant number of scientific studies showing kerosene to substantially put the health and safety of household members at risk. For example, one epidemiological study shows the relative risk for tuberculosis to be 9 times higher amongst households using kerosene for lighting compared to households using electricity . Kerosene is also the leading risk factor for childhood poisonings and is a major cause of fires and burns in low and middle-income countries. A recent systematic review of household kerosene use and its hazards in low and middle-income countries, recommends based on the potential risks of kerosene use that policymaker consider alternatives to kerosene subsidies and shift support to cleaner technologies for lighting, and cooking¹⁷. Rearticulating the indicator to refer to ‘clean fuels and technologies’ in place of ‘nonsolid fuels’ will help direct countries away from a unhealthy and environmentally detrimental solution (i.e. kerosene) to meet the energy access target of SDG 7.

Inclusion of technologies: The normative guidance of the *WHO IAQG*, strongly recommends that all major household energy end uses (e.g. cooking, space heating, lighting) use efficient fuels and technology combinations to ensure health and environmental benefits. Focusing on the fuel itself limits the utility of this indicator to monitor the impacts of sustainable development, as the emissions (i.e. level of pollution) are directly correlated to how well the technology or device (e.g. cookstove, lamp) burns the fuel. Furthermore, understanding the type of technology being used can be used to inform global tracking for energy efficiency and climate impacts. Although currently there are no biomass stoves available in low and middle-income countries that burn efficiently enough to be considered “clean” (i.e. meeting the WHO air quality guideline emission rate target for PM_{2.5}), reformulating this indicator to account for the fuel in combination with technology, allows for future innovations in biomass stove technologies to be positively counted toward achieving the SDG goal 7 and related targets (i.e. 7.2, 7.3) and other SDGs related to sustainability (e.g. Goal 12, 15).

¹⁶ WHO guidelines for indoor air quality: household fuel combustion; 2014; (<http://www.who.int/indoorair/guidelines/hhfc/en/>).

¹⁷ Lam et al., Kerosene: a review of household uses and their hazards in low- and middle-income countries. *J Toxicol Environ Health B Crit Rev*. 2012;15(6):396-432. doi: 10.1080/10937404.2012.710134. <http://www.ncbi.nlm.nih.gov/pubmed/22934567>

Defining the location:

Defining the energy access indicator to refer to as energy access at the *household* level makes this indicator more specific, measurable, comparable (over time and geographically) and requires less resources and capacity for its monitoring. Energy access is an important development issue facing households, the community (e.g. health care facilities, schools, etc.) and the workplace. The Sustainable Energy for All (SE4All) initiative aims to ensure universal access in all of these settings; the current capacity for and level of data collection on energy access in the community and the workplace, however, is far less robust and geographically representative than what is available for households and would require significantly more resources to monitor. Furthermore, the largest health burden from air pollution is in the homes. Accounting for 4.3 million deaths annually, or over half the total global air pollution burden, improving energy access in homes holds some of the greatest and measurable benefits for health.

Data Sources

Six key sources of data and evidence, described below, are integral to effectively tracking access to energy and its associated benefits using the updated indicator. Two of these sources (i.e. WHO's Global household energy database¹⁸, WHO's Global Health Observatory¹⁹) are also essential to monitoring the currently proposed indicator.

WHO's Global household energy database⁸

The WHO's global household energy database has been the primary resource for data on energy access for over a decade. It collates nationally-representative household survey and census data on primary cooking fuel; currently it includes data from over 800 surveys, representing 159 countries, with raw data for some countries dating back to 1970 to 2014. This database also stores information on primary cookstove and other cooking attributes such as ventilation, cooking location and has recently been expanded to include nationally representative survey data on heating and lighting fuels and technologies. WHO is in the process of enhancing the database to allow disaggregation of information (e.g. primary cooking fuel, time loss due to fuel collection) by sex to better capture gender issues associated with household energy use which will help provide better data linkages between SDGs on energy, health, and gender.

WHO's Global Health Observatory⁹

The data on household energy access housed in this global database is used to inform a non-parametric statistical model which estimates primary solid fuel use for cooking globally, regionally and for all countries between 1980 and the present year. The modelled estimates, as presented in the WHO Global Health Observatory are reported annually in the World Health Statistics and have been used for the global monitoring of the SE4All's Global Tracking Framework, the International Energy Agency's World Energy Outlook and the Global Alliance for Clean Cookstoves top-down monitoring framework, and Global Burden of Disease work, amongst others.

WHO guidelines for indoor air quality: household fuel combustion²⁰

In November 2014, WHO published the first-ever normative guidance on household energy use and its associated health impacts. The recommendations within the WHO IAQG provide technical specifications in the form of emission rate targets for the fuels and devices used in the home to protect health and the environment. They also provide specific recommendations against home use of unprocessed coal and discourages the use of kerosene in the home. Guidance on the transition to

¹⁸ WHO Global household energy database (http://www.who.int/indoorair/health_impacts/databases/en/)

¹⁹ WHO Global health observatory (http://www.who.int/gho/phe/indoor_air_pollution/burden/en/)

²⁰ WHO Guidelines for indoor air quality: household fuel combustion ()

wide-scale sustained adoption of the cleanest fuels and technologies, and on securing climate co-benefits, are also included.

Sustainable Energy for All Multi-Tier Tracking Framework

Since its inception in 2011, under the context of the Sustainable Energy for All (SE4All) initiative²¹, there has been an ongoing collaboration amongst SE4All members, led by the World Bank, ESMAP and IEA to develop a more refined method to measuring energy access in the home, community and in the workplace. The currently proposed multi-tier framework to track progress towards attaining the goal for universal access to modern energy services in the home includes both quantitative and qualitative elements to better assess all access to energy for basic home energy needs, including cooking, heating and lighting. The technical health-based recommendations from the WHO IAQG are integrated into the grading of fuels and technologies within the multi-tier tracking framework. The Knowledge Hub of SE4All is currently piloting this tool in a number of countries, and following any necessary further development, this should be rolled more extensively soon.

International Organization for Standardization²²

In 2012, an international effort to develop standards for cookstoves was initiated. Using the ISO mechanism of an international working agreement, IWA 11:2012 provides a voluntary framework for rating cookstoves against tiers of performance for a series of performance indicators, including fuel use, emissions (indoor and overall) and safety. WHO, serving as a Category A Liaison has been actively participating in this process by advocating and providing the technical support to use health impacts as an important benchmark for cookstove and fuel standards and testing protocols. The finalization of these new ISO standards, expected in 2016, will help support the monitoring of this indicator locally, regionally and globally.

Global Alliance for Clean Cookstoves's Clean Cooking Catalogue²³

The Global Alliance for Clean Cookstoves maintains a clean cooking catalogue which documents the testing results of different cookstoves and fuels. This catalogue is updated regularly with new results from various testing centres and studies around the world. This information included in this catalogue is useful resource for monitoring what technologies can be considered clean, based on quantitative measures of performance consistent with the ISO standards development process.

Data gaps & opportunities to address such gaps

Two major data gaps or challenges exist for this updated indicator. Following is a description of each of these gaps along with the current opportunities, resources and ongoing initiatives to address or fill these gaps.

Technologies

Traditionally household surveys and censuses limited their assessment of household energy to primary fuel used for cooking. A few household surveys (e.g. USAID's Demographic Health Survey, UNICEF's World Health Survey) have included questions on the type of cooking device but in very general terms that would not adequately facilitate monitoring this proposed indicator on clean fuels and technologies.

Other household energy-uses:

²¹ Sustainable Energy for All (<http://www.se4all.org/tracking-progress/>)

²² International Organization for Standardization (http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=61975)

²³ Global Alliance for Clean Cookstoves Clean Cooking Catalogue (<http://catalog.cleancookstoves.org/>)

Currently there is a paucity of data collection around other household energy end-uses (i.e. space heating, lighting) other than cooking. It is often assumed that access to electricity equivocates to access to clean lighting, however there are a number of studies and surveys showing that this is often not the case due to issues with the electricity supply like reliability (e.g. electricity available only at times when lighting is not needed), affordability (e.g. electricity more expensive than kerosene for lighting) and/or availability (e.g. inadequate supply).

Addressing data gaps:

In light of these data gaps, WHO in cooperation with the Global Alliance for Clean Cookstoves initiated an ongoing effort with various surveying agencies (including the Knowledge hub of the Sustainable Energy for All Initiative, USAID’s Demographic Health Survey, UNICEF’s Multi-indicator Cluster Survey, World Bank’s Living Standards Measurement Survey, etc.) to enhance and harmonize household survey instruments to assess all the types of fuel and technologies used in the home for cooking, heating and lighting. These questions will be freely available to national statistical agencies, surveying agencies and are expected to be incorporated into the International Household Survey Network’s question bank. To complement this harmonization process, work is underway to develop standardized methods for measuring emissions from household energy devices in a cost-efficient way that is adaptable to local circumstances and technologies. The current work by International Standards Organization (ISO) to develop standards on cookstoves (i.e. ISO /TC 285 Clean cookstoves and clean cooking solutions) is an important asset in this regard and will help to facilitate the monitoring of home energy technologies.

The SE4All initiative (where WHO is a partner organization) and its multi-tier tracking framework is another important source of data collection that can help facilitate monitoring this proposed indicator. The SE4All multi-tier framework accounts for the fuels and technologies used for cooking and heating in alignment with the WHO IAQG. SE4All has also developed a similar metric for assessing household access to electricity, which specifically addresses the limitations of using access to electricity as a proxy for lighting. The SE4All multi-tier tracking framework, currently being piloted and will be rolled out in a number of countries, representing a large majority of the high-burden countries (i.e. highest population levels without access). WHO and GACC have worked closely with the World Bank, the leading agency behind the development of this tracking framework, to ensure that it aligns with the current evidence, ISO standards and the WHO IAQG on household fuel combustion. Data from the SE4All multi-tier tracking framework will be included in the WHO’s global household energy database and will be utilized to better estimate the relative health burden and developmental impacts from household energy access and the associated household (indoor) air pollution.

As collaborative efforts to enrich and harmonize data collection on household energy continue, WHO’s role to build-capacity in countries for the effective monitoring of access to clean household energy and its related health impacts, as well its global public databases will continue to be adapted and enhanced to reflect such developments, making WHO well-placed to support the monitoring of SDG target 7.1

Goal 11: Cities

The world is undergoing a rapid rate of urbanization. Over half of the world’s population now lives in urban areas, providing both risks and opportunities for health. For example, ambient air pollution and its related health risks are often greatest in urban areas. Largely due to the use of inefficient energy for transportation, buildings and industry, ambient (outdoor) air pollution accounts for 3.7 million deaths annually (a majority of which are found in urban areas) and up to 70% of global greenhouse gas emissions. Monitoring air quality serves as an important indicator to monitor the

environmental impacts of sustainable growth in cities and on goal 11 and its associated target 11.6 which relate to the health and well-being of urban populations.

Table 5. Proposed OWG Goal 11 on cities and associated target

Goal 11	Make cities and human settlements inclusive, safe, resilient and sustainable.
Target 11.6	By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management.

Indicators to monitor sustainable cities:

Currently air quality in cities is proposed as an indicator to monitor the progress and impacts of goal 11 and target 11.6 (see Table 6). While overall WHO supports the proposed indicator, some modifications will enhance the specificity and measurability of this indicator. The rationale for such changes are presented below, followed by a description of the available data resources, data gaps and possible resources to address such gaps.

Table 6. Proposed Indicator 11.6 on air quality in cities and recommended update

Target	Current Indicator	Recommended update to indicator
11.6.1	Percentage of urban solid waste regularly collected and recycled (disaggregated by E-waste and non E-waste)	na
11.6.2	Level of ambient particulate matter (PM ₁₀ and PM _{2.5})	Annual mean levels of fine particulate matter (i.e. PM _{2.5}) air pollution in cities (population weighted)

Rationale:

Mean or average: Levels of air pollution can vary drastically from day to day based on local weather conditions, geography, economic output, etc. Articulating the indicator as annual mean is a more specific indicator for monitoring the health and environmental impacts of sustainable growth and development in cities over time. WHO air quality guidelines provide specific recommendations on the mean levels of fine particulate matter which can support measuring the per capita health impacts related to any improvements or degradation in air quality in cities. Incidents of high air pollution levels also have health impacts, but these are less important than longer term exposures, and related statistics are less reliable in view of greater variability due to external factors, we therefore do recommend a more specific articulation of this indicator to as annual means as a way to monitor SDG achievement.

Fine particulate matter: Fine particulate matter (i.e. PM_{2.5}) can be directly linked to estimates of health risks. Coarse particulate matter (i.e. PM₁₀) measurements can be converted to PM_{2.5}, but will inherently introduce additional uncertainty to estimates of impacts (e.g. health). Articulating this indicator to fine particulate matter increases its specificity and its relevance for monitoring the health impacts of sustainable development policies.

Population weighted: The population size of cities vary within a country. Weighting annual mean air quality measurements of fine PM by the city population size relative to other cities in a country increases the suitability and measurability of this indicator at a national scale. Furthermore it makes estimating the related impacts on health and other sustainable development issues (e.g. improvements in energy efficiency from sustainable transport) more feasible and accurate for monitoring progress.

Data sources:

WHO Ambient Air Pollution in Cities Database²⁴: As part of its core functions, WHO monitors and assesses trends in major health risk factors including ambient air pollution. The *WHO's Ambient air pollution database* provides annual mean concentrations of particulate matter based on daily air measurements of particulate matter (PM₁₀ or PM_{2.5}) or data which could be aggregated into annual means. In a few exceptional cases, where annual means could not be calculated, measurements covering a more limited part of the year were used.

The primary source of data are official national/sub-national reports, national/sub-national web sites containing measurements of PM₁₀ or PM_{2.5} and the relevant national agencies. Furthermore, measurements reported by the following regional networks are used: the Asian Clean Air Initiative for Asia²⁵, and Airbase²⁶ for Europe. In the absence of data from the previous sources, data from (a) UN Agencies, (b) Development agencies and (c) articles from peer reviewed journals are used.

In order to present air quality that is largely representative for human exposure, only measurements characterized as urban background, residential areas, commercial and mixed areas are used. Stations characterized as particular "hot spots" or exclusively industrial areas were excluded, unless they were contained in reported city means and could not be dissociated.

Currently the WHO database houses data from over 1,600 cities, from 91 countries for the years 2008 to 2013 inclusive (Figures 1 and 2).

This database is updated on a regular basis can be released annually to support monitoring of this SDG target.

Figure 1: Total number of cities in AAP database, 2014 version, by WHO region

Region	Number of cities	Number of <i>countries</i>
Africa (Sub-Saharan)	16	6
America, LMI	88	13
America, HI	535	4
Eastern Mediterranean, LMI	14	6
Eastern Mediterranean, HI	12	5
Europe, LMI	109	8
Europe, HI	461	29
South-East Asia	167	9
Western Pacific, LMI	133	5

²⁴ WHO Ambient Air Pollution in Cities Database; http://www.who.int/phe/health_topics/outdoorair/databases/cities/en/

²⁵ Clean Air Asia; <http://cleanairasia.org/portal/knowledgebase/cities>

²⁶ AirBase – European Air Quality database; <http://acm.eionet.europa.eu/databases/airbase>

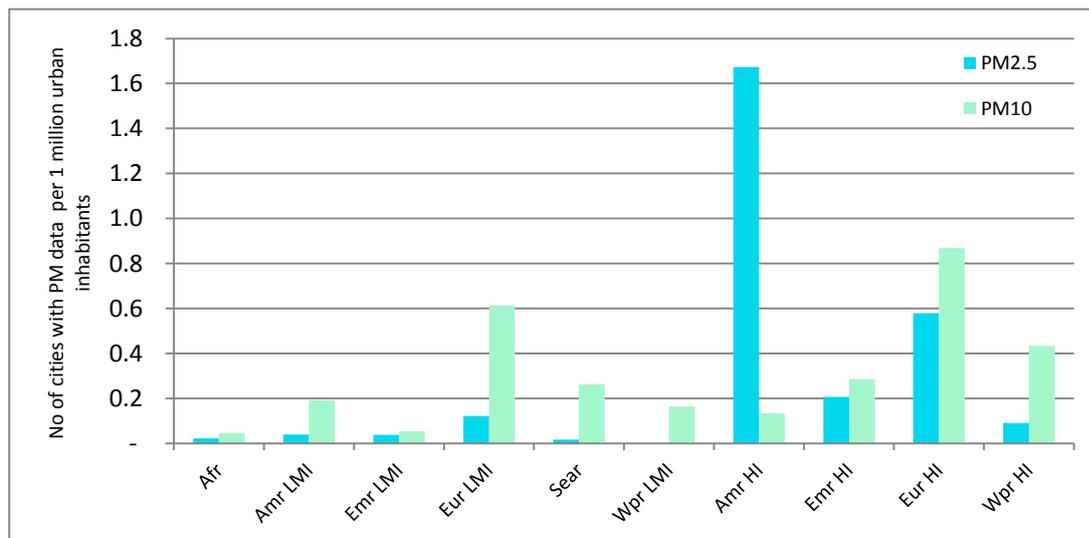


Figure 2: Number of cities with accessible PM₁₀ and PM_{2.5} data in 2014 per urban population
 Amr: America, Afr: Africa; Emr: Eastern Mediterranean, Sear: South-East Asia, Wpr: Western Pacific; LMI: Low- and middle-income; HI: high-income.

WHO Global Health Observatory: The WHO Global Health Observatory (GHO) houses information on both the exposure (i.e. ambient air quality measurements of fine particulate matter) and associated disease burden. In addition, the GHO provides graphs, tables and interactive tools to depict air pollution levels across regions and countries which can support countries in visualizing their situation and in monitoring progress towards SDG11 more readily.

WHO air quality guidelines: global update 2005: WHO air quality guidelines provide normative guidance on pollutant levels that can be considered “healthy”. They also provide information about the sources of air pollution and the health impacts from exposure to different pollutants which serve as an important information resource for countries as they develop and implement plans for sustainable development. The recommendations of specific pollutant levels found in the guidelines serve as the basis for estimating the attributable disease burden to ambient air pollution. These guidelines are updated regularly and publicly available.

Data gaps & opportunities to address such gaps

Several gaps in the currently available data for monitoring target 11.7 along with some recommendations of upcoming opportunities for filling such gaps are provided below.

Measurements of fine particulate matter:

PM_{2.5} measurements can directly be linked to estimates of health risks using an integrated exposure response function, and are therefore of particular interest. PM₁₀ measurements first need to be converted to PM_{2.5} in order to do. In high-income countries, PM_{2.5} measurements are already being widely performed. In low- and middle-income countries, however, while PM_{2.5} measures are increasingly being developed, they are not yet available in many countries. In low- and middle-income countries, annual mean PM_{2.5} measurements could be accessed in 69 cities, but PM₁₀ in 512 cities. In high-income countries, 816 cities with PM_{2.5} measures could be accessed, against 544 cities with PM₁₀ measurements.

For cities with PM₁₀ reported as the only monitored PM parameter, PM_{2.5} concentration can be calculated from PM₁₀ using national conversion factors (PM_{2.5}/PM₁₀ ratio) estimated as population- weighted averages of city-specific conversion factors for the

country. City-specific conversion factors were estimated as the mean ratio of PM_{2.5} to PM₁₀ of stations for the same year, and alternatively as the ratio of city values if the values by station were not provided. If national conversion factors are not available, regional ones can be used, which are obtained by averaging country-specific conversion factors.

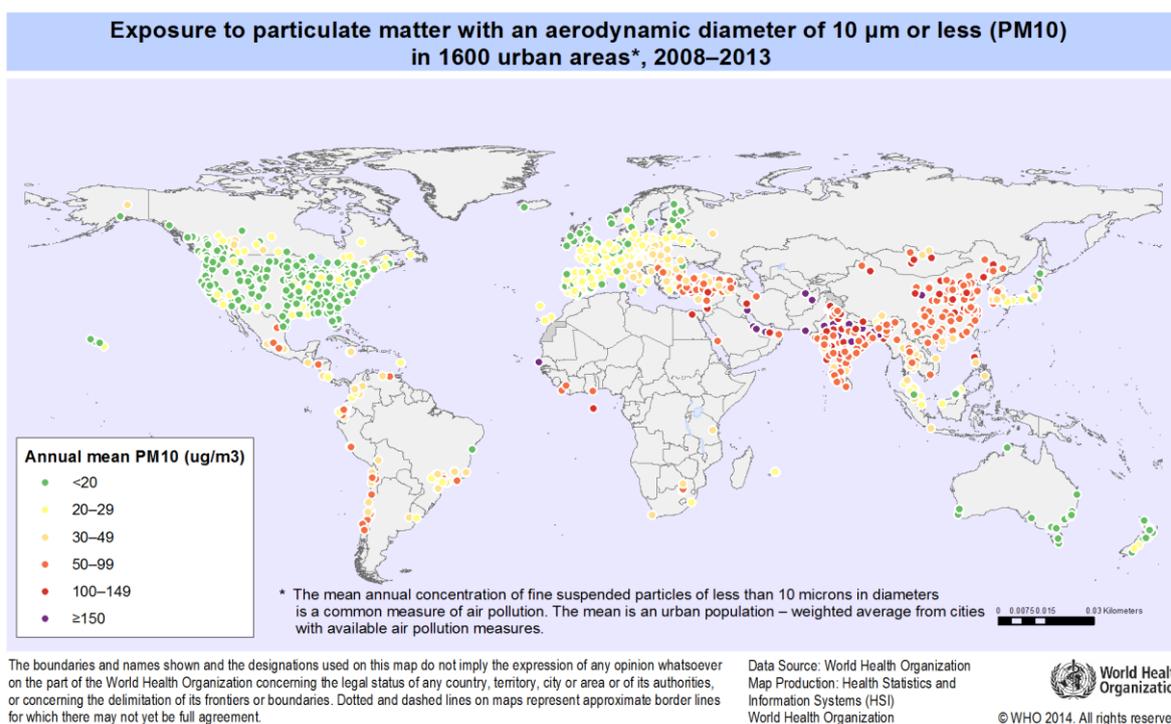
Definition of cities: There is no agreed upon definition of city and/or urban area. Currently the WHO Ambient air pollution database includes information on cities with populations of 100,000 or more. This is partly due to the fact that for some countries ambient air quality information is only available for larger cities whereas for other countries data is available for cities with just a few thousand inhabitants. In general, the inclusion of cities with less than 100,000 inhabitants did usually not significantly modify the country mean as compared to considering only cities larger than 100,000 inhabitants.

WHO is able to update its database and reporting to include cities/urban areas to be in line with the definition agreed upon for the monitoring and tracking of SDG 11 on cities.

Geographic coverage of monitoring:

Measurement of ambient air quality in cities is currently limited to 91 countries. Below is a map of the current sources of ambient air quality monitoring housed in the WHO's Ambient air quality database (Figure 3). Although, as noted, there is a paucity of data from low- and middle-income countries, the level of monitoring and reporting in these areas is rapidly increasing each year. In addition, the Climate and Clean Air Coalition's Urban Health Initiative aims to increase monitoring in urban areas of LMIC and will be providing guidance and resources to increase air quality monitoring capacity.

Figure 3: Data coverage of ambient air quality monitoring of the WHO Ambient Air Pollution in Cities Database



Location of monitoring:

Sampling locations of air quality measurements may change within a period of monitoring, and consequently lead to a variation over time in annual mean PM levels for a city that does not necessarily reflect actual changes in air quality but rather a difference in the pollution levels at the new measurement sites. To address such a challenge, appropriate guidance and/or a protocol can be provided to countries/cities, about the importance of maintaining specific sampling locations to monitor trends and impacts. Through its work within the Climate and Clean Air Coalition's Urban Health Initiative, WHO will be working with a number of cities to develop guidance on how and where to install air quality monitoring systems as well as the importance in consistency in monitoring practices. This information or guidance will be freely available to other cities to use and can be adapted to their local circumstances as appropriate for better monitoring of target 11.7.

Annex 1: Activities of international agencies contributing to the global assessment of air quality

The current status of international activities on air quality assessment is, to a large extent, the result of collaboration under specific conventions or projects facilitated by international organizations or national agencies. Below are some examples of ongoing activities of different UN organizations that would help support the monitoring and tracking of air pollution related SDG indicators through the Global Platform on Air Quality and Health.

World Meteorological Organization (WMO) coordinates the Global Atmospheric Watch (GAW) network. It is responsible for systematic, long-term global monitoring, analysis and assessment of atmospheric chemical and physical parameters, including aerosols. GAW implements a comprehensive quality assurance/quality control (QA/QC) system aiming at ensuring that the data collected are consistent, of known and adequate quality, supported by comprehensive metadata, and sufficiently complete to describe global atmospheric states with respect to spatial and temporal distribution. The system serves both developed and developing countries, and includes training of field personnel. WMO links the work on air pollution with that on climate. Recently, WMO has increased its work on megacities and large urban areas aiming at:

- development of strategies for megacities to deal with weather, climate and environmental problems, and improvement of related services;
- enhancement of environmental monitoring and modelling capabilities; and
- establishment of case studies for understanding air pollution and the connections between health and climate in different types of megacities.

The GAW Urban Research Meteorology and Environment (GURME) network is active worldwide, engaging in a wide range of collaborative projects. The results of WMO's projects are presented in a variety of reports and bulletins addressing diverse audiences, including policy-makers and decision-makers. One recent report is the *Atlas of health and climate* published jointly with WHO in 2012.

United Nations Economic Commission for Europe (UNECE) provides a secretariat to the Convention on Long Range Transboundary Air Pollution. The *European Monitoring and Evaluation Programme (EMEP)* of the Convention, supplies governments with scientific information supporting Convention implementation. Its monitoring programme includes assessment of background concentration of PM₁₀ and PM_{2.5}, ozone and a number of other pollutants. It is run in collaboration with national centres using an advanced QA/QC protocol. Annual EMEP reports document the pollution levels and trends in Europe. Data collected are also used for development and evaluation of atmospheric chemical transport models. New elements of EMEP's monitoring strategy include extension of the monitoring to Eastern Europe, the Caucasus and Central Asia as well as combination of data from multiple platforms (e.g. in situ, satellite and remote sensing), and data assimilation. Much of the work on the global assessment of air pollution is conducted within the framework of the Task Force on Hemispheric Transport of Air Pollution (TF HTAP) of the Convention. UNECE also collaborates with WHO within the framework of the Joint Task Force on Health Aspects of Air Pollution, to which WHO European Centre for Environment and Health provides a secretariat.

United Nations Environmental Programme (UNEP) described its input through the Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants (CCAC). The Coalition's objective is to reduce the pollutants that are affecting both climate and health. It has proposed a set of key actions leading to the most effective reduction of methane, black carbon and hydrofluorocarbons (HFCs),

and using currently available technologies. National assessments and plans of action to reduce short-lived climate pollutants (SLCP) have already been launched in several countries. Many of these assessments and actions are based on very approximate data. Therefore more precise and relevant data are important to support the CCAC's actions both at the planning and the evaluation stages, and both the national and regional scales. The long-term goal is to incorporate the SLCP actions into national planning. The newly created Health Task Force, in collaboration with WHO, aims at targeting the health sector in scaling up its actions and in launching the Urban Health Initiative. UNEP programmes are, to a large extent, implemented by networks of the national collaborating centres. UNEP facilitates intergovernmental processes related to air pollution in all regions outside Europe and North America, runs a joint secretariat with WHO for the Regional Ministerial Forum on Environment and Health in Asia and hosts the secretariat of the Partnership for Clean Fuels and Vehicles. It also provides guidelines, equipment, and training for monitoring and impact assessment.

The mission of the **United Nations Office for Outer Space Affairs (UNOOSA)** is to promote international cooperation on the use of outer space to achieve development goals for the benefit of humankind. Among other responsibilities, the Office implements the UN Programme on Space Application which assists Member States in the use of satellite remote sensing, global positioning, geographical information systems (GIS) and satellite communications in various application areas, including spatial epidemiology, telemedicine and tele-health. The Programme runs conferences, workshops and training courses on various topics, including environmental monitoring, climate change and application of space technologies for global health and disaster management, as well as disseminating information on the use of space tools in various disciplines. UNOOSA also coordinates space-related activities within the United Nations system through the Inter-Agency Meeting on Outer Space Activities, which is organized on an annual basis for harmonization of future plans and programmes of common interest for cooperation and exchange of views on current activities in the practical application of space technology. Outcomes of the Inter-Agency Meetings are presented in the Secretary-General's report on coordination of space-related activities within the United Nations system.

Annex 2: Representatives from the following institutions provide inputs to the Global Platform on Air Quality and Health

University of São Paulo, Brazil

Sri Ramanchandra Medical College and Research Institute, India

The University of British Columbia, Canada

The University of Iowa, USA

Health Effects Institute, USA

Indian Institute of Technology Delhi, India

Shanghai Environmental Monitoring Center, People's Republic of China

Universidad Nacional Autónoma de México, Mexico

Remote Sensing Technology Center of Japan, Japan

Yonsei University, Republic of Korea

US Environmental Protection Agency, USA

Japan Aerospace Exploration Agency, Japan

King's College London, England

Norway

The Hong Kong University of Science and Technology, China, Hong Kong, SAR

Emory University, USA

Environmental Protection Department, China, Hong Kong SAR

Dalhousie University, Canada

Queensland University of Technology, Australia

Norwegian Ministry of Foreign Affairs, Norway

Universidad Andrés Bello, Chile

International Institute for Applied Systems Analysis, Austria

Stockholm Environment Institute, England

India

University of Bath, England

Gwangju Institute of Science and Technology, Republic of Korea

Turkey

Joint Research Centre, Italy

Dalhousie University, Canada

Emory University, USA

University of North Carolina, USA

Tehran University of Medical Science, Islamic Republic of Iran

University of Liverpool, United Kingdom

International organizations

World Meteorological Organization, Switzerland

United Nations Office for Outer Space Affairs, Austria

National Aeronautics and Space Administration, USA

United Nations Economic Commission for Europe, Switzerland

World Meteorological Organization, Switzerland

United Nations Environment Programme, France

United Nations Economic Commission for Europe, Switzerland

The World Bank, USA

United Nations Economic Commission for Europe, Switzerland