Manual on the Basic Set of Environment Statistics of the FDES 2013

Air Quality

(Topic 1.3.1 Air Quality: Local air quality of the Basic Set of Environment Statistics of the FDES 2013)

Elaborated by the Environment Statistics Section
of the United Nations Statistics Division,
in collaboration with the
Expert Group on Environment Statistics

Version 1.0

06 November 2018

Methodology sheet of the Basic Set of Environment Statistics of the FDES

https://unstats.un.org/unsd/envstats/fdes/manual_bses.cshtml
https://unstats.un.org/unsd/envstats/fdes.cshtml

Contents

1. Statistics in Topic 1.3.1 Air Quality: Local air quality

Component 1: Environmental Conditions and Quality				
Sub-component 1.3: Environmental Quality				
Topic 1.3.1: Air quality				
Statistics and Related Information (**Bold Text - Core Set/Tier 1**; Regular Text - Tier 2; *Italicized Text - Tier 3*)		**Category of Measurement**	**Potential Aggregations and Scales**	**Methodological Guidance**
a.	Local air quality		• By point measurement • Sub-national • Daily maximum • Monthly maximum and average • Yearly maximum and average	• WHO Air Quality Guidelines— Global Update 2005, Particulate matter, ozone, nitrogen dioxide and sulfur dioxide • WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide, Global Update 2005, Summary of risk assessment • UNECE Standard Statistical Classification of Ambient Air Quality (1990)
	1. Concentration level of particulate matter (PM_{10})	Concentration		
	2. Concentration level of particulate matter ($PM_{2.5}$)	Concentration		
	3. Concentration level of tropospheric ozone (O_3)	Concentration		
	4. Concentration level of carbon monoxide (CO)	Concentration		
	5. Concentration level of sulphur[1] (sulfur) dioxide (SO_2)	Concentration		
	6. Concentration levels of nitrogen oxides (NO_X)	Concentration		
	7. Concentration levels of heavy metals	Concentration		
	8. Concentration levels of non-methane volatile organic compounds ($NMVOC_s$)	Concentration		
	9. Concentration levels of dioxins	Concentration		
	10. Concentration levels of furans	Concentration		
	11. Concentration levels of other pollutants	Concentration		
	12. Number of days when maximum allowable levels were exceeded per year	Number	• By pollutant	

[1] The alternate spelling of sulphur is sulfur (as approved by the International Union of Pure and Applied Chemistry (IUPAC). The spelling sulphur is primarily still of use in British contexts. The methodology sheet throughout uses the term sulfur in line with international practice.

2. Introduction/Relevance

The effects of air pollution are recognized worldwide as one of the main problems that threaten the health of the population, with more severe impacts on people who are already ill, children, the elderly and the poor people. The World Health Organization (WHO) estimates that around 4.2 million premature deaths worldwide were attributable to the effects of ambient air in 2016.[2]

Air pollution, both through short and long-term exposure, plays a significant role in cardiovascular illness and death, and there is increased evidence linking air pollution and cardiovascular disease. Links have been established between the concentration level of pollutants such as particulate matter (PM), ozone (O_3), sulfur dioxide (SO_2), carbon monoxide (CO) and nitrogen dioxide (NO_2) and premature deaths and cardiorespiratory diseases in children and adults. Around 58% of outdoor air pollution-related premature deaths were due to ischaemic heart disease and strokes, while 18% of deaths were due to chronic obstructive pulmonary disease and acute lower respiratory infections, and 6% of deaths were due to lung cancer. The WHO reports that the most damaging are particles of 10 micrometres (µm) or less as these can penetrate and lodge in the lungs.[3]

In addition, air pollution can cause widespread environmental damage to forests, soils and waters through acidification of the environment from emissions of sulfur dioxide, nitrogen oxides and other pollutants. Air pollution and acid deposition of excess sulfur and nitrogen damage soils, vegetation, rivers and oceans with resulting negative effects on fish reproduction, soil nutrients, forest health and also results in corrosion of the built environment and heritage. In addition, eutrophication is caused by the input of excessive nutrients into ecosystems caused by excessive atmospheric nitrogen, and crop damage is caused by exposure to high ozone concentrations.

Policies on air pollution address the root causes of pollution from sectors such as industry, energy, transport, urban planning, power generation and municipal and agricultural waste management. Local air quality is determined by the complex relationship of factors such as physical, chemical, meteorological, social, economic and technological variables; therefore, air quality statistics should be considered together with other data such as weather conditions in order to fully understand the impacts of air pollution on health. Air quality statistics are therefore closely tied to other components of the FDES 2013 and provide relevant information for public policies across a wide range of sectors.

International and regional agreements addressing air pollution include the UNECE 1979 Convention on Long-Range Transboundary Air Pollution,[4] covering the 51 parties to the treaty, which aims to reduce air pollution and its effects through international cooperation in monitoring and evaluating long-range transport of air pollutants. Extensions include protocols addressing sulfur emissions and nitrogen oxides.

[2] WHO (2017) *Air pollution* webpage, http://www.who.int/en/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health (accessed 02 October 2018)
[3] WHO (2016) *Ambient air pollution: A global assessment of exposure and burden of disease*, http://apps.who.int/iris/bitstream/handle/10665/250141/9789241511353-eng.pdf?sequence=1 (accessed 02 October 2018)
[4] UNECE (1979) *Convention on Long-Range Transboundary Air Pollution*, https://www.unece.org/fileadmin/DAM/env/lrtap/full%20text/1979.CLRTAP.e.pdf (accessed 02 October 2018)

The impact of household air quality has also been recognized as a leading cause of disease and premature death linked to exposure to smoke from solid fuel cooking and heating fuel and to exposure to pollutants from lighting such as kerosene burning.[5]

The methodology sheet covers FDES 1.3.1.a Local air quality, which addresses ambient air pollution. The statistics of the FDES 2013 are also relevant to major sources of household air pollution from unclean cooking fuels which are addressed in this methodology sheet. Global aspects of air quality (FDES 1.3.1.b Global atmospheric concentrations of greenhouse gases) are covered in a separate methodology sheet.

[5] WHO (2017) *Air pollution* webpage, http://www.who.int/en/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health (accessed 02 October 2018)

3. Definitions and description of the statistics

Air quality is understood as an indicator which gives an account of the presence of substances or compounds in the air which can present a potential risk to the environment and to the health of the population exposed to them. It can be expressed by concentrations of a pollutant or as quality indices referring to a pollutant.

Air pollution is contamination of the indoor or outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere. Household fuel combustion, motor vehicles, industrial facilities and forest fires are common sources of air pollution. Pollutants of major public health concern include particulate matter, carbon monoxide, ozone, nitrogen dioxide and sulfur dioxide.[6]

Primary air pollutants are the pollutants emitted directly into the atmosphere by sources such as factory chimneys or exhaust pipes, or through suspension of contaminated dusts by wind. In principle, therefore, it is possible to measure the amounts emitted at the source itself. This is relatively straightforward in terms of the factory chimney or vehicle exhaust pipe; it becomes more difficult when considering diffuse sources such as wind-blown dusts.[7]

Secondary air pollutants are those formed within the atmosphere itself. They arise from chemical reactions of primary pollutants, possibly involving the natural components of the atmosphere, especially oxygen and water. The most familiar example is ozone, which arises almost entirely from chemical reactions that differ with altitude within the atmosphere. Because of this mode of formation, secondary pollutants cannot readily be included in emissions inventories, although it is possible to estimate formation rates per unit volume of atmosphere per unit of time. Another important distinction must be made in relation to the physical state of a pollutant.[8]

Particulate air pollutants comprise material in solid or liquid phase suspended in the atmosphere. They have very diverse chemical compositions that are highly dependent on their source, can be either primary or secondary, and cover a wide range of sizes.[9] Newly formed secondary particles can be as small as 1–2 nanometres (nm) in diameter (1 nm = $1*10^{-9}$ m), while coarse dust and sea salt particles can be as large as 100 µm (1 µm = $1*10^{-6}$ m) or 0.1 mm in diameter. However, the very large particles have a short atmospheric existence, tending to fall out rapidly through gravity and wind-driven impaction processes. Thus, in practice there are few particles in the atmosphere exceeding 20 µm in diameter, except in areas very close to sources of emission.

[6] WHO (2016) *Programmes: air pollution* webpage, http://www.who.int/topics/air_pollution/en/ (accessed 02 October 2018)
[7] WHO (2005) *Air Quality Guidelines. Global Update 2005. Particulate matter, ozone, nitrogen dioxide and sulfur dioxide*, http://www.euro.who.int/en/health-topics/environment-and-health/air-quality/publications/pre2009/air-quality-guidelines.-global-update-2005.-particulate-matter,-ozone,-nitrogen-dioxide-and-sulfur-dioxide (accessed 02 October 2018)
[8] WHO (2005) *Air Quality Guidelines. Global Update 2005. Particulate matter, ozone, nitrogen dioxide and sulfur dioxide*, http://www.euro.who.int/en/health-topics/environment-and-health/air-quality/publications/pre2009/air-quality-guidelines.-global-update-2005.-particulate-matter,-ozone,-nitrogen-dioxide-and-sulfur-dioxide (accessed 02 October 2018)
[9] WHO (2005) *Air Quality Guidelines. Global Update 2005. Particulate matter, ozone, nitrogen dioxide and sulfur dioxide*, http://www.euro.who.int/en/health-topics/environment-and-health/air-quality/publications/pre2009/air-quality-guidelines.-global-update-2005.-particulate-matter,-ozone,-nitrogen-dioxide-and-sulfur-dioxide (accessed 02 October 2018)

Point sources include emissions for sources that are located at a fixed, stationary location. These are usually significant sources of emissions. Point sources include large industrial facilities and electric power plants, airports, and smaller industrial, non-industrial and commercial facilities.

Non-point sources include line and area sources. Line sources include emissions along roads or railways which are broken up into individual sections for measurement of emissions. Area sources include emissions which are more diffuse and spread over a significant spatial region. In this case, each source is usually too small to make a significant difference individually but in total would generate a large contribution. Examples include residential heating, commercial combustion, asphalt paving, and commercial and consumer solvent use.[10]

3A. Local air quality (FDES 1.3.1.a)

The following statistics are measured in terms of local air quality, as these pollutants, by virtue of their source or of having a very short atmospheric life time, are only encountered in appreciable concentrations close to where they are emitted. This methodology sheet includes examples of target concentration levels for the air pollutants, which are those given by WHO Europe in its Air Quality Guidelines. However, national and regional bodies may well have their own targets or legally acceptable concentration levels.

Concentration level of particulate matter (PM_{10}) (FDES 1.3.1.a.1)

Particulate matter, also known as PM or particle pollution, is a complex mixture of extremely small particles and liquid droplets. Particle pollution is made up of a number of components, including acids (such as nitrates and sulphates), organic chemicals, metals, and soil or dust particles.

The size of particles is directly linked to their potential for causing health problems. Particles that are 10 µm in diameter or smaller generally pass through the throat and nose and enter the lungs. Once inhaled, these particles can affect the heart and lungs and cause serious health effects.

Coarse particles, such as those found near roadways and dusty industries, are larger than 2.5 µm and smaller than 10 µm in diameter.[11]

Remarks:

- PM_{10} measurements are reported as average concentrations of hourly, running 24-hour, daily and annual particulate in the air. However, measurements are usually aggregated to daily or running 24-hour totals for comparison with standards on short-term pollution. Measurements are expressed in micrograms per cubic metre (µg/m^3) at normal pressure and temperature.
- WHO Europe guidelines: for concentrations [12]
  20 µg/m^3 on average for 1 year
  50 µg/m^3 on average for 24 hours at the 99th percentile (i.e., not to be exceed for more than 3 days/year)

[10] WHO (2005) *Air Quality Guidelines. Global Update 2005. Particulate matter, ozone, nitrogen dioxide and sulfur dioxide*, http://www.euro.who.int/en/health-topics/environment-and-health/air-quality/publications/pre2009/air-quality-guidelines.-global-update-2005.-particulate-matter,-ozone,-nitrogen-dioxide-and-sulfur-dioxide (accessed 02 October 2018)

[11] U.S. EPA (2017) *What is Particulate Matter?* webpage, https://www3.epa.gov/region1/eco/uep/particulatematter.html (accessed 02 October 2018)

[12] WHO (2005) *Air Quality Guidelines. Global Update 2005. Particulate matter, ozone, nitrogen dioxide and sulfur dioxide*, http://www.euro.who.int/en/health-topics/environment-and-health/air-quality/publications/pre2009/air-quality-guidelines.-global-update-2005.-particulate-matter,-ozone,-nitrogen-dioxide-and-sulfur-dioxide (accessed 02 October 2018)

Concentration level of particulate matter ($PM_{2.5}$) (FDES 1.3.1.a.2)

Fine particles, such as those found in smoke and haze, are 2.5 µm in diameter and smaller. These particles can be directly emitted from sources such as forest fires, or they can form when gases emitted from power plants, industries and automobiles react in the air.[13]

Remarks:

- $PM_{2.5}$ measurements are reported as average concentrations of hourly, mobile 24-hour, daily and annual particulates in the air, expressed in µg/m^3 at normal pressure and temperature. However, measurements are usually aggregated to daily or running 24-hour totals for comparison with standards on short-term pollution.
- WHO Europe guidelines for concentrations:[14]
  10 µg/m^3 on average for 1 year
  25 µg/m^3 on average for 24 hours at the 99th percentile (i.e., not to be exceed for more than 3 days/year)

Concentration level of tropospheric ozone (O_3) (FDES 1.3.1.a.3)

Ozone (O_3) is a gas that in the troposphere is a secondary pollutant formed by photochemical reactions of precursor gases and is not directly emitted from specific sources. Its origin can be both anthropogenic (i.e., man-made) or natural. Ozone can be formed by photochemical reactions involving sunlight and precursor pollutants, including volatile organic compounds (VOCs), nitrogen oxides (NO_X), and carbon monoxide (CO) which originate from emissions in large urban centres and industrial areas, or from emissions from vegetation, microbes, animals, burning biomass (e.g., forest fires), and lightning.[15]

Ambient ozone concentrations produced by these emissions are directly affected by temperature, solar radiation, wind speed, and other meteorological factors. Tropospheric ozone is present not only in polluted urban air, but across the globe.[16]

Remarks:

- Measurements of ozone are reported as hourly values, aggregated to average concentrations for 8 hours in the air, expressed in µg/m^3.
- WHO Europe guidelines for concentrations:
  100 µg/m^3 on average for a daily maximum 8-hour average[17]

[13] WHO (2005) *Air Quality Guidelines. Global Update 2005. Particulate matter, ozone, nitrogen dioxide and sulfur dioxide*, http://www.euro.who.int/en/health-topics/environment-and-health/air-quality/publications/pre2009/air-quality-guidelines.-global-update-2005.-particulate-matter,-ozone,-nitrogen-dioxide-and-sulfur-dioxide (accessed 02 October 2018)

[14] WHO (2005) *Air Quality Guidelines. Global Update 2005. Particulate matter, ozone, nitrogen dioxide and sulfur dioxide*, http://www.euro.who.int/en/health-topics/environment-and-health/air-quality/publications/pre2009/air-quality-guidelines.-global-update-2005.-particulate-matter,-ozone,-nitrogen-dioxide-and-sulfur-dioxide (accessed 02 October 2018)

[15] WHO (2005) *Air Quality Guidelines. Global Update 2005. Particulate matter, ozone, nitrogen dioxide and sulfur dioxide*, http://www.euro.who.int/en/health-topics/environment-and-health/air-quality/publications/pre2009/air-quality-guidelines.-global-update-2005.-particulate-matter,-ozone,-nitrogen-dioxide-and-sulfur-dioxide (accessed 02 October 2018)

[16] U.S. EPA (2013) *Integrated Science Assessment (ISA) of Ozone and Related Photochemical Oxidants (Final Report, Feb 2013),* U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-10/076F, https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=247492 (accessed 02 October 2018)

[17] WHO (2005) *WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide. Global update 2005. Summary of risk assessment*, http://apps.who.int/iris/bitstream/10665/69477/1/WHO_SDE_PHE_OEH_06.02_eng.pdf (accessed 02 October 2018)

Concentration level of carbon monoxide (CO) (FDES 1.3.1.a.4)

Carbon monoxide (CO) is a colourless, odourless gas that can be harmful when inhaled in large amounts. Carbon monoxide is released when something is burned. The greatest sources of carbon monoxide to outdoor air are cars, trucks and other vehicles or machinery that burn fossil fuels.[18]

Remarks:

- Carbon monoxide measurements are reported as average concentrations over 1 hour or over 8 hours in the air, expressed in milligrams per cubic metre (mg/m^3) at normal pressure and temperature.
- WHO Europe guidelines for concentrations:[19]
  100 mg/m^3 (90 ppm) on average for 15 minutes
  60 mg/m^3 (50 ppm) on average for 30 minutes
  30 mg/m^3 (10ppm) on average for 1 hour
  10 mg/m^3 (25 ppm) on average for 8 hours

Concentration level of sulphur (sulfur) dioxide (SO_2) (FDES 1.3.1.a.5)

Sulfur dioxide (SO_2) is both a primary gas-phase pollutant (when formed during fuel combustion) and a secondary pollutant (the product of atmospheric gas- or droplet-phase oxidation of reduced sulfur compounds) (sulphides).

The main anthropogenic source of primary sulfur dioxide is fossil fuel combustion, while volcanoes and landscape fires (wildfires as well as controlled burns) are the main natural sources of primary sulfur dioxide.[20]

Remarks:

- Measurements of sulfur dioxide are reported over minutes, hours, twenty-four-hour periods, and annual average concentrations in the air, expressed in $\mu g/m^3$ at normal pressure and temperature.
- WHO Europe guidelines for concentrations:
  20 $\mu g/m^3$ on average for 24 hours
  500 $\mu g/m^3$ on average for 10 minutes

Concentration level of nitrogen oxides (NO_X) (FDES 1.3.1.a.6)

Nitrogen oxides (NO_X), along with volatile organic compounds (VOCs), including anthropogenic and biogenic hydrocarbons, aldehydes, and carbon monoxide (CO), serve as precursors in the formation of ozone (O_3) and other elements of photochemical smog.

Emissions of nitrogen oxides are spatially distributed vertically with some occurring at or near ground level (e.g., mobile sources) and others at higher levels (e.g., electric generating utilities). Nitrogen oxides are emitted primarily as nitrogen monoxide (NO) with smaller quantities of nitrogen dioxide (NO_2).[21]

---

[18] U.S. EPA (2017) *Carbon Monoxide (CO) Pollution in Outdoor Air*, https://www.epa.gov/co-pollution/basic-information-about-carbon-monoxide-co-outdoor-air-pollution (accessed 02 October 2018)

[19] WHO Europe (2000) *Air Quality Guidelines for Europe, 2nd edition, WHO Regional Publications, European Series, No.91*, http://www.euro.who.int/__data/assets/pdf_file/0005/74732/E71922.pdf (accessed 02 October 2018)

[20] U.S. EPA (2017) *Integrated Science Assessment (ISA) for Sulfur Oxides – Health Criteria (Final),* U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-17/451, https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=338596 (accessed 02 October 2018)

[21] U.S. EPA (2008) *Integrated Science Assessment for Oxides of Nitrogen-Health criteria*, U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-15/068, https://ofmpub.epa.gov/eims/eimscomm.getfile?p_download_id=526855 (accessed 02 October 2018)

Remarks:

- Experimental studies indicate that NO_2 at short-term concentrations exceeding 200 µg/m^3 is a toxic gas with significant health effects. The WHO Europe air quality guidelines value of 40 µg/m^3 (annual mean) was set to protect the population from the health effects of gaseous NO_2.[22]
- WHO Europe guidelines for concentrations:[23]
  40 µg/m^3 on average for 1 year
  200 µg/m^3 on average for 1 hour

Concentration levels of heavy metals (FDES 1.3.1.a.7)

Heavy metals are naturally occurring elements that have a high atomic weight (e.g., mercury, chromium, cadmium, arsenic and lead). They may be harmful to human beings in small concentrations and tend to accumulate in the food chain. With the assumption that heaviness and toxicity are inter-related, heavy metals also include metalloids, such as arsenic, that are able to induce toxicity at low level of exposure.[24]

Remarks:

- In the WHO Europe air quality guidelines,[25] lead is considered a 'criteria air pollutant'. Average air lead levels are usually below 0.15 µg/m^3 at non-urban sites. Urban air lead levels are typically between 0.15 and 0.5 µg/m^3 in most European cities. For mercury, in areas far from industries, atmospheric levels are about 2–4 nanograms per cubic metre (ng/m^3), and in urban areas about 10 ng/m^3.
- WHO Europe guidelines for concentrations:[26]
  Lead 0.5 µg/m^3 in air on average for 1 year (based on 100 µg/l lead in blood).
  Mercury 1 µg/m^3 in air on average for 1 year

Concentration levels of non-methane volatile organic compounds (NMVOCs) (FDES 1.3.1.a.8)

Volatile organic compounds (VOCs) are any compound of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates and ammonium carbonate, which participate in atmospheric photochemical reactions.[27] VOCs are considered to be important air pollutants, which play a fundamental role in photochemical smog formation. Car exhaust, gasoline-powered lawn and garden equipment, gasoline dispensing stations, industrial coating operations, printing shops, paints, household chemicals are some of the sources of VOCs.

Data are often reported as kilo tonnes (KT) NMVOC, and by sector share of NMVOC (e.g., solvent and product use, commercial, institutional and households, road transport, energy production and distribution, industrial processes, agriculture, energy use in industry, non-road transport, waste, other).[28]

---

[22] WHO (2005) *Air Quality Guidelines. Global Update 2005. Particulate matter, ozone, nitrogen dioxide and sulfur dioxide*, http://www.euro.who.int/en/health-topics/environment-and-health/air-quality/publications/pre2009/air-quality-guidelines.-global-update-2005.-particulate-matter,-ozone,-nitrogen-dioxide-and-sulfur-dioxide (accessed 02 October 2018)

[23] WHO Europe (2000) *Air Quality Guidelines for Europe, 2nd edition, WHO Regional Publications, European Series, No.91*, http://www.euro.who.int/__data/assets/pdf_file/0005/74732/E71922.pdf (accessed 02 October 2018)

[24] Duffus, J.H. (2002) "*Heavy metals"-a meaningless term? Pure and Applied Chemistry*, Vol. 74(5), pgs. 793–807 http://iupac.org/publications/pac/pdf/2002/pdf/7405x0793.pdf (accessed 02 October 2018)

[25] WHO Europe (2000) *Air Quality Guidelines for Europe, 2nd edition, WHO Regional Publications, European Series, No.91*, http://www.euro.who.int/__data/assets/pdf_file/0005/74732/E71922.pdf (accessed 02 October 2018)

[26] WHO Europe (2000) *Air Quality Guidelines for Europe, 2nd edition, WHO Regional Publications, European Series, No.91*, http://www.euro.who.int/__data/assets/pdf_file/0005/74732/E71922.pdf (accessed 02 October 2018)

[27] U.S. EPA (2017) *Technical Overview of Volatile Organic Compounds* webpage, https://www.epa.gov/indoor-air-quality-iaq/technical-overview-volatile-organic-compounds (accessed 02 October 2018)

[28] Sector share of non-methane volatile organic compounds emissions, https://www.eea.europa.eu/data-and-maps/daviz/sector-share-of-non-methane-2 (accessed 02 October 2018)

Concentration levels of dioxins (FDES 1.3.1.a.9)

A dioxin is any compound that contains the dibenzo-p-dioxin nucleus. The 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) compound represents the most toxic compound of their families. Polychlorinated dibenzodioxins (PCDDs) are a type of dioxin addressed by the WHO Europe 2000 Guidelines.[29] The only differences between members within a dioxin family are in the nature and position of substituents.

Dioxins are emitted into the atmosphere from a wide variety of processes such as waste incineration, combustion of solid and liquid fuels in stationary sources for heat and power generation, iron and steel foundries/scrap metal melting, combustion-aided metal recovery, craft pulp and paper production/black liquor combustion, internal combustion engines, carbon regeneration, forest fires, organic chemical manufacture and use, and Portland cement manufacture.[30]

Remark:

- Inhalation exposure to PCDDs and Polychlorinated dibenzofurans (PCDFs) is generally low. WHO Europe (2000) does not propose an air quality guideline for PCDDs and PCDFs because direct inhalation exposures constitute only a small proportion of the total exposure. Urban ambient toxic equivalent air concentrations of PCDDs and PCDFs are estimated to be about 0.1 picogram per cubic metre (pg/m^3). Air concentrations of 0.3 pg/m^3 or higher are indications of local emission sources that need to be identified and controlled.[31]

Concentration levels of furans (FDES 1.3.1.a.10)

A furan is any compound that contains the dibenzofuran nucleus. 2,3,7,8-tetrachlorodibenzofuran (TCDF) compounds represent the most toxic compounds of their respective families. Dibenzofurans (PCDFs) are a type of furan addressed by the WHO Europe 2000 Guidelines.[32] Furans are emitted into the atmosphere from sources such as waste incineration, combustion of solid and liquid fuels in stationary sources for heat and power generation.[33]

Remark:

- See above note on PCDD and PCDF.

Concentration levels of other pollutants (FDES 1.3.a.11)

Other pollutants may be related to emissions from industrial processes, including ammonia (NH_3), inorganic substances (S, Be, Cd, Tl, Hg, As, Co, Ni, Se, Te, Cr, Cu, F, Pd, Pt, Rh, Pb, V, Zn, Mn, Sb and Sn), and halogens (Cl, HCl and HF).

Number of days when maximum allowable levels were exceeded per year (FDES 1.3.a.12)

A way to evaluate the daily air quality standard is using the count of the number of days per year in which monitoring stations record values that exceed the primary quality standard.

---

[29] WHO Europe (2000) *Air Quality Guidelines for Europe, 2nd edition, WHO Regional Publications, European Series, No.91*, http://www.euro.who.int/__data/assets/pdf_file/0005/74732/E71922.pdf (accessed 02 October 2018)

[30] U.S. EPA (1997) *Locating and estimating air emissions from sources of dioxins and furans*, U.S. Environmental Protection Agency, Washington, DC, EPA-454/R-97-003, https://www3.epa.gov/ttn/chief/le/dioxin.pdf (accessed 02 October 2018)

[31] WHO Europe (2000) *Air Quality Guidelines for Europe, 2nd edition, WHO Regional Publications, European Series, No.91*, http://www.euro.who.int/__data/assets/pdf_file/0005/74732/E71922.pdf (accessed 02 October 2018)

[32] WHO Europe (2000) *Air Quality Guidelines for Europe, 2nd edition, WHO Regional Publications, European Series, No.91*, http://www.euro.who.int/__data/assets/pdf_file/0005/74732/E71922.pdf (accessed 02 October 2018)

[33] U.S. EPA (1997) *Locating and estimating air emissions from sources of dioxins and furans*, U.S. Environmental Protection Agency, Washington, DC, EPA-454/R-97-003, https://www3.epa.gov/ttn/chief/le/dioxin.pdf (accessed 02 October 2018)

3B. Indoor air quality

The FDES 2013 focuses primarily on local ambient air quality and global issues. Indoor air quality due to household fuel combustion has been recognized as a significant contributor to health as reflected in the Sustainable Development Goals, and is thus presented in the methodology sheet although it is not in the FDES 2013. WHO has recognized indoor air pollutants of $PM_{2.5}$, PM_{10}, benzene, carbon monoxide, formaldehyde, naphthalene, nitrogen dioxide, and polycyclic-aromatic hydrocarbons as affecting health.

Level of concentration is considered together with aspects of the home environment which affect the level of exposure to pollutants, primarily use of solid fuel for cooking and heating versus clean fuels and the types of technologies used for cooking and heating.

- WHO Europe guidelines on concentrations:[34]

<u>$PM_{2.5}$</u>
25 µg/m^3 on average for 24 hours with maximum exceedance of 3 days/year
10 µg/m^3 on average for 1 year

<u>PM_{10}</u>
50 µg/m^3 on average for 24 hours with maximum exceedance of 3 days/year
20 µg/m^3 on average for 1 year

<u>Benzene</u> unit risk of leukaemia per 1 µg/m^3 air concentration is $6.0x\ 10^{-6}$ with no safe level of exposure

<u>CO</u> (mg/m^3)
100 mg/m^3 on average for 15 minutes
35 mg/m^3 on average for 1 hour
10 mg/m^3 on average for 8 hours
7 mg/m^3 on average for 24 hours

<u>Formaldehyde</u> (mg/m^3) 0.1 mg/m^3 on average for 30 minutes

<u>Naphthalene</u> (mg/m^3) 0.01 mg/m^3 on average for 1 year

<u>Nitrogen dioxide</u> (mg/m^3)
200 mg/m^3 on average for 1 hour
40 mg/m^3 on average for 1 year

<u>Polycyclic-aromatic hydrocarbons</u> unit risk of lung cancer is $8.7x\ 10^{-5}$ per 1 ng/m^3 BaP (benzoapyrene) with no safe level of exposure

<u>Fuel type and stove type</u>[35]
In addition, statistics are collected on fuel type used for cooking and heating:

- Solid fuels – wood, animal dung, crop wastes, charcoal, kerosene;
- Clean fuels – LPG/natural gas, electricity, ethanol, biogas, solar cookers;

and

[34] WHO (2014) *WHO guidelines for indoor air quality: household fuel combustion*, http://apps.who.int/iris/bitstream/handle/10665/141496/9789241548885_eng.pdf?sequence=1 (accessed 02 October 2018)
[35] WHO (2014) *WHO guidelines for indoor air quality: household fuel combustion*, http://apps.who.int/iris/bitstream/handle/10665/141496/9789241548885_eng.pdf?sequence=1 (accessed 02 October 2018)

- Non-improved stoves – open fires, traditional stoves;
- Improved stoves – improved solid fuel stoves with chimney, improved solid fuel stoves without chimney, mixed (stove plus other improvements to kitchen and cooking arrangements).

4. International sources and recommendations

4A. Classifications and groupings

Primary or Secondary air pollutants: The air pollutants are labelled by their origin, whether it is primary or secondary. It is helpful to know the mechanisms of formation and release of the common air pollutants.

Primary air pollutants: SO_2, NO_2, CO, VOC, $PM_{2.5}$, PM_{10}
Secondary air pollutants: O_3

Scale of pollutant
Local scale: Some pollutants, by virtue of their source or of having a very short atmospheric lifetime, are only encountered in appreciable concentrations close to where they are emitted.

Urban scale: Pollutants from urban sources, such as nitrogen oxides and carbon monoxide generated by road traffic, tend to be present at high concentrations throughout the city and at significantly reduced concentrations in adjacent rural areas.

Regional scale: Pollutants in the form of fine particles (<2.5 µm diameter, but not ultrafine particles) and some gas-phase pollutants such as ozone have atmospheric lifetimes of days or even weeks, which permit them to be transported over a regional area.

Hemispheric and global scales: Some pollutants, especially those associated with greenhouse warming effects, have atmospheric lifetimes of years and are therefore capable of distribution throughout a hemisphere and ultimately globally.

UNECE Standard Statistical Classification of Ambient Air Quality (1990)[36]
The classification lists the most important substances, parameters and variables recommended for measurement at impact, regional and background monitoring stations.

[36] United Nations Statistics Division (2017) *Framework for the Development of Environment Statistics (FDES 2013)*, https://unstats.un.org/unsd/environment/fdes/FDES-2015-supporting-tools/FDES.pdf (accessed 02 October2018)

Chemicals and their relevance in measurement estimation	E	CI	CB	G
1. Sulphur compounds				
1.1 Sulphur oxides (incl. emissions of hydrogen sulphide)	X	X	X	
1.2 Particulate sulphate			X	X
2. Oxidized nitrogen compounds and oxidants				
2.1 NO_x (excluding nitrous oxide)	X	X	X	
2.2 Nitric acid and particulate nitrate		X	X	X
2.3 Ozone –tropospheric			X	X
–stratospheric				X
2.4 Nitrous oxide (tropospheric)				X
3. Reduced nitrogen compounds				
3.1 Ammonia	X	X	X	
3.2 Particulate ammonium compounds		X	X	X
4. Inorganic carbon compounds				
4.1 Carbon monoxide	X	X		X
4.2 Carbon dioxide	X			X
5. Halogens and inorganic halogen compounds	X		X	
6. Volatile organic compounds (incl. halogenated compounds)[a]				
6.1 Methane	X			X
6.2 Non methane compounds				
6.2.1 Aldehydes	X	X	X	
6.2.2 CFCs	X			X
6.2.3 Halons	X			X
6.2.4 Other halogenated hydrocarbons	X			X
7. Heavy metals (to be specified)	X	X	X	
8. Suspended particulate matter	X	X	X	X
9. Chemical composition of precipitation water			X	X

[a] It may become possible to add relevant dioxins (toxic polychlorinated debenzo dioxins and furans) as a separate group under this heading once sufficiently reliable emission and/or concentration data become available.

Emissions [tons/year]
1. Emissions from stationary sources
1.1 By process
1.1.1 Combustion of fuels
1.1.1.1 In power plants
1.1.1.2 In industrial establishments, excl. power plants
1.1.1.3 In other economic activities and domestic heating
1.1.2 Other processes, incl. evaporation
1.1.2.1 In industrial sources
1.1.2.2 In non-industrial and domestic sources
1.2 By activity[b]
1.2.1 Agricultural etc. (ISIC 01)
1.2.2 Mining and quarrying (ISIC 10-14)
1.2.3 Manufacture of paper and paper products (ISIC 21)
1.2.4 Manufacture of coke oven products (ISIC 231)

[b] United Nations Statistics Division. *International Standard Industrial Classification of All Economic Activities, Rev. 3*, available from http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=2 (accessed 4 August 2017).

1.2.5	Manufacture of refined petroleum products (ISIC 232)
1.2.6	Manufacture of chemicals and chemical products (ISIC 24)
1.2.7	Manufacture of rubber and plastics products (ISIC 25)
1.2.8	Manufacture of other non metallic mineral products (ISIC/26)
1.2.9	Manufacture of basic iron and steel (ISIC 271)
1.2.10	Manufacture of basic precious and non ferrous metals (ISIC/272)
1.2.11	Electricity, gas, steam and hot water supply (ISIC 40)
1.2.12	Other economic activities
1.2.13	Households
1.3	By availability of cleaning
1.3.1	Without cleaning
1.3.2	With cleaning or equivalent device
2.	Emission from mobile sources
2.1	From road transport
2.1.1	Using motor spirit (gasoline)
2.1.2	Using gas (diesel) oil
2.1.3	Using other fuels
2.2	From railway transport
2.3	From other transport
2.4	From other mobile sources
Emissions should at this time be reported on the following materials:	
	Sulphur oxides, incl. hydrogen sulphide [in units of SO_2]
	NO_x, excl. nitrous oxide [in units of NO_2]
	Ammonia
	Carbon monoxide
	Carbon dioxide [in units of CO_2]
	Total volatile organic compounds, incl. halogenated compounds
	Lead

Mercury
Cadmium
Suspended particulate matter
Emission data on items 1.1.1.1 to 1.1.1.3 should be broken down by type of fuel as follows:
Coal and coal products
Products obtained from petroleum refineries
Natural gas
Other fuels
Concentrations in ambient air
2.1 Concentrations at impact stations
2.1.1 Sulphur oxides [expressed as SO_2]
2.1.2 Nitrogen oxides [expressed as NO_2]
2.1.3 Carbon monoxide
2.1.4 VOCs (to be specified)
2.1.5 Lead
2.1.6 Mercury
2.1.7 Cadmium
2.1.8 Suspended particulate matter

2.2	Concentrations at national/regional background stations
2.2.1	Sulphur oxides [expressed as SO_2]
2.2.2	Particulate sulphate
2.2.3	Nitrogen oxides [expressed as NO_2]
2.2.4	Nitric acid and particulate nitrate
2.2.5	Ozone (tropospheric)
2.2.6	Ammonia
2.2.7	Particulate ammonium compounds
2.2.8	VOCs (to be specified)
2.2.9	Chemical composition of precipitation (pH/H+ ammonium, nitrate, chloride and sulphate ions, sodium, potassium, magnesium and calcium ions, conductivity)
2.3	Concentrations at global background stations
2.3.1	Ozone (stratospheric)
2.3.2	Carbon dioxide
2.3.3	Methane
2.3.4	CFCs
2.3.5	Halons
2.3.6	Nitrous oxide
2.3.7	Suspended particulate matter
Depositions	
3.1	Wet acidifying deposition
3.1.1	Sulphur dioxide and sulphate expressed in sulphur content
3.1.2	Nitrogen dioxide, nitric acid and nitrate expressed in nitrogen content
3.1.3	Ammonia and ammonium compounds expressed in nitrogen content
3.1.4	pH/H+

Note: Other deposition indicators may be added, once their development is sufficiently advanced.

4B. Reference to international statistical recommendations, frameworks and standards

- WHO Europe Air Quality Guidelines for Europe 2000, 2nd edition, WHO Regional Publications, European Series, No.91, provides information on carbon monoxide, dioxins and furans not covered in the 2005 update http://www.euro.who.int/__data/assets/pdf_file/0005/74732/E71922.pdf
- WHO Europe Air Quality Guidelines. Global Update 2005. Particulate matter, ozone, nitrogen dioxide and sulfur dioxide http://www.euro.who.int/en/health-topics/environment-and-health/air-quality/publications/pre2009/air-quality-guidelines.-global-update-2005.-particulate-matter,-ozone,-nitrogen-dioxide-and-sulfur-dioxide
- The United Nations Environment Programme (UNEP) provides policy information on the environmental impacts of air pollution, particularly related to sulfur dioxide, nitrogen oxides, $PM_{2.5}$, carbon monoxide, VOCs and ammonia. It also provides information on household air pollution from unclean cooking and heating fuels https://www.unenvironment.org/explore-topics/air

4C. Sources of global and regional environment statistics and indicators series

WHO publishes statistics and indicators for mortality from ambient air pollution. Data are available on annual mean concentrations of PM_{10}, $PM_{2.5}$, as well as disease burden related to ambient air pollution. Available from http://www.who.int/gho/en/

World Bank provides environmental indicators for access to clean fuels and technologies for cooking, cost of particulate emissions damage, $PM_{2.5}$ exposure, and PM_{10} exposure. Available from https://data.worldbank.org/indicator?tab=all

OECD Statistics publishes data on indicators on the environment relating to climate, air quality and health covering exposure to $PM_{2.5}$ and mortality, exposure to O_3, NO_2 concentrations, and welfare cost from exposure to air pollution. Available from:

- https://stats.oecd.org/
- http://www.oecd.org/greengrowth/green-growth-indicators/

EUROSTAT offers databases with Environment Statistics, Emissions of greenhouse gases and air pollutants by year including air emissions accounts and inventories and air pollutants by source. Available from http://ec.europa.eu/eurostat/data/database

EEA provides datasets with several statistical products such as data, maps, statistics and indicators on atmospheric greenhouse gases and air quality for Europe, including the CITEAIR (Air Quality in Europe - and European Air Quality Index). Available from:

- Environmental data and maps: https://www.eea.europa.eu/data-and-maps
- Air Quality Index: http://airindex.eea.europa.eu/
- EEA indicators: https://www.eea.europa.eu/data-and-maps/indicators

Air Pollution Information Network for Africa (APINA) is a network of African policy makers, scientists, NGOs, industry and other stakeholders interested in air pollution, who are moving towards implementation of the Harare Resolution on Prevention and Control of Regional Air Pollution in Southern Africa and its Likely Transboundary Effects and the Maputo Declaration on the Prevention and Control of Regional Air Pollution in Southern Africa and its likely Transboundary Effects.

5. Data collection and sources of data

Scope
Air quality at sub-national levels across the entire country. Local levels commonly include point measurement at monitoring stations, city statistics and regional averages.

Statistical unit
The statistical unit for each type of pollutant is described under the FDES statistics in Section 3.

Measurement units
The measurement unit for each type of pollutant is described under the FDES statistics in Section 3.

Sources and institutions
Data on air quality are obtained from ministries of environment and environmental management agencies who collect data through a network of monitoring stations. Air quality monitoring stations provide data on the critical air pollutants (which have quality standards).

Increasingly, geospatial data may be used for global indicators of air quality, for example, PM concentrations have been derived using satellite observations together with chemical transport modelling plus calibration through measurements from air quality monitoring networks. Other pollutants which have been measured include nitrogen dioxide, sulfur dioxide and carbon monoxide. Research is ongoing on how to use satellite data to monitor ground-level pollutants in ways which can be used for air quality management.

Data on indoor air pollution and types of cooking fuel used are obtained from household poverty monitoring and health surveys, such as the Demographic and Health Survey (DHS), Multiple Indicator Cluster Survey (MICS), Living Standards Measurement Survey (LSMS), and household energy surveys. Pollution concentrations around homes are measured using local studies measuring air pollutant concentrations together with household variables to model estimates. When measuring indoor air quality, levels of ambient air quality also need to be considered as regardless of emission levels indoors, high levels of ambient air quality will affect levels of air pollution entering homes.

Aggregation
Temporal aspects
Air quality data are collected and aggregated at a variety of temporal intervals, those most common for monitoring of guidelines or targets are covered under Section 3 above. In addition, for monitoring compliance to targets, some statistics also require the number of days the target levels are exceeded per time period, e.g., per year.

Spatial aspects
The network of monitoring stations can measure concentrations of point source pollution as well as non-point sources across various environment types such as rural, suburban and urban background, urban and suburban industrial, and urban traffic. Sampling points are selected to include background values representative of the exposure of the general population, as well as areas of highest concentration to which population will be exposed.

Measurement points are located based on the sample selected for the air quality monitoring network and the measured data are aggregated to higher level spatial dimensions. These higher level spatial measures of pollution, such as city or regional pollution levels are calculated using modelling techniques such as dispersion models or receptor modelling (particularly for PM emissions). These models often require ancillary data such as meteorological data.

Validation

The validation process includes quantitative and qualitative validation related to the historical information of the measurement site, the operational status of the equipment, calibrations, measurement range, and the conditions of the measurement.

Aggregate statistics include time series of pollutants, by hour, day, month and/or year, which are used for calculating moving averages, daily averages and annual averages, depending on the parameter that is being analysed. In addition, modelling is used to generate spatial estimates of pollution.

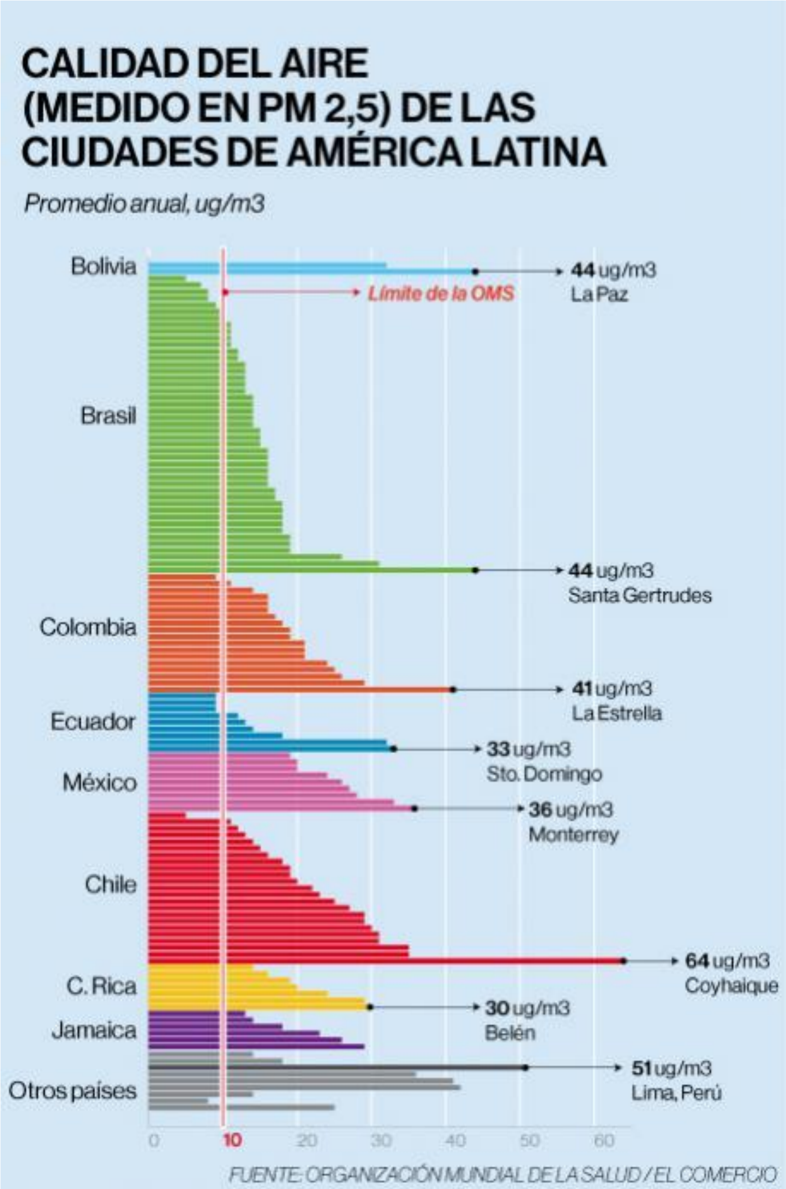
Some examples of criteria are:

- To obtain a representative statistic it is necessary to have a minimum of data, e.g., not less than 75% of the hourly data.
- Moving averages are calculated using hourly data to get longer time periods, e.g., hourly data used to calculate an 8-hour moving average.
- Daily averages correspond to the average of the 24-hourly data recorded on the day.
- The maximum daily value corresponds to the maximum value recorded in the 24-hourly data of the day.
- Number of days when maximum allowable levels were exceeded, exposed population and the area where the maximum permissible levels are exceeded can be very important at the national and local levels.

6. Uses and dissemination

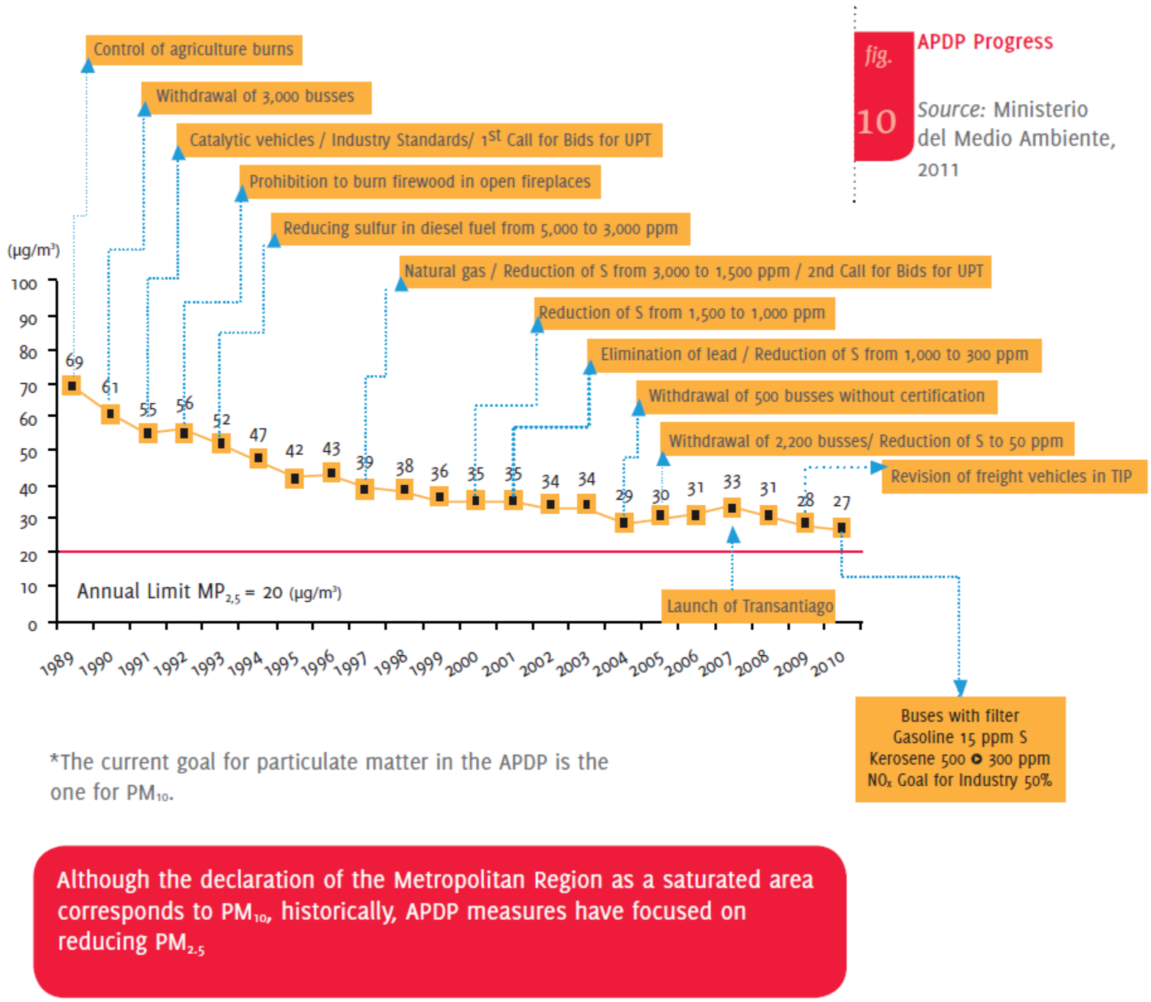
6A. Potential presentation/dissemination formats

Figure 6.1: Air quality ($PM_{2.5}$) in Latin American cities



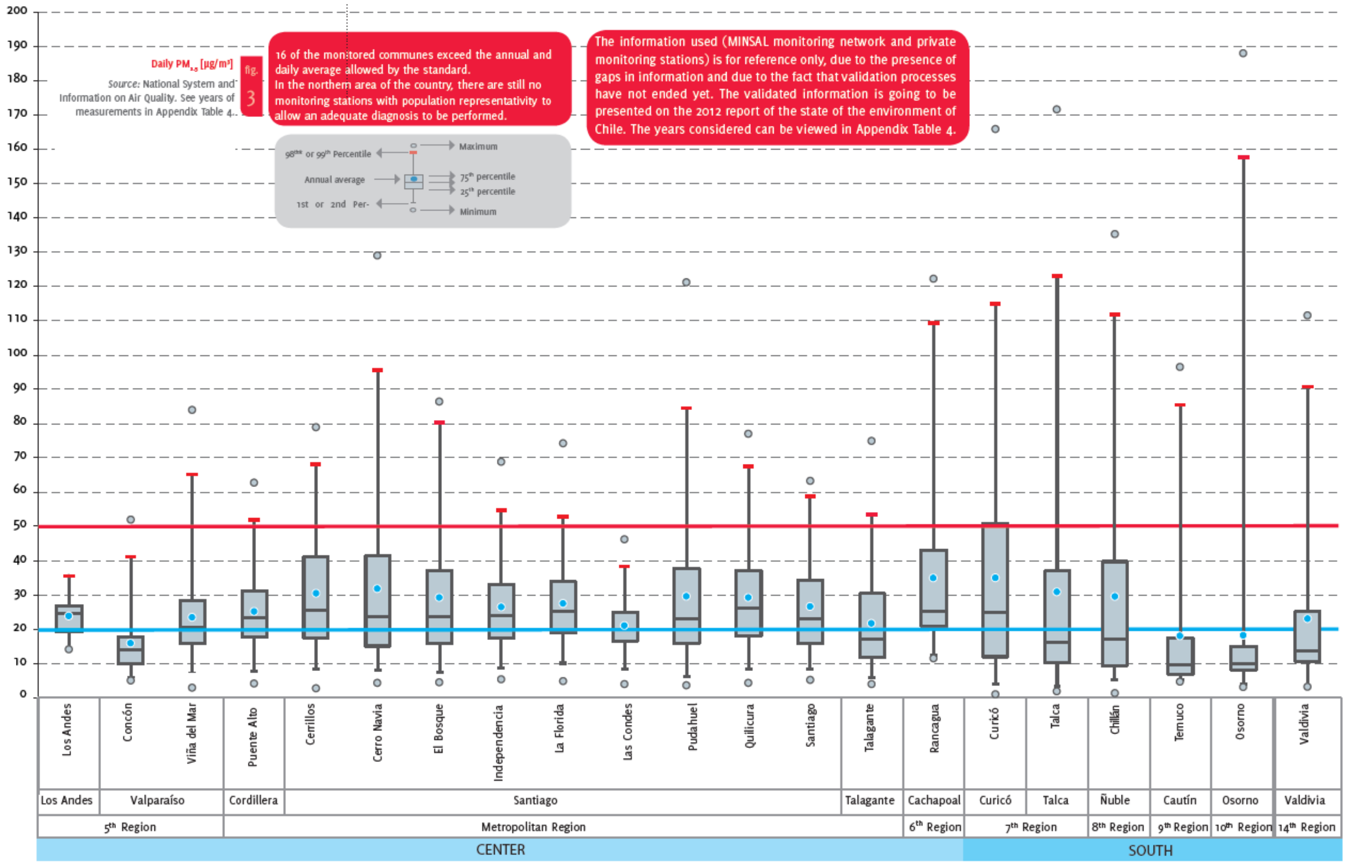
Source: WHO/El Comercio https://www.elcomercio.com/tendencias/ciudades-ecuador-polucion-enfermedades-contaminacion.html (accessed 02 October 2018)

Figure 6.2: Annual $PM_{2.5}$ average concentrations and progress of the Air Prevention and Decontamination Plan (APDP) in the Metropolitan Region of Chile



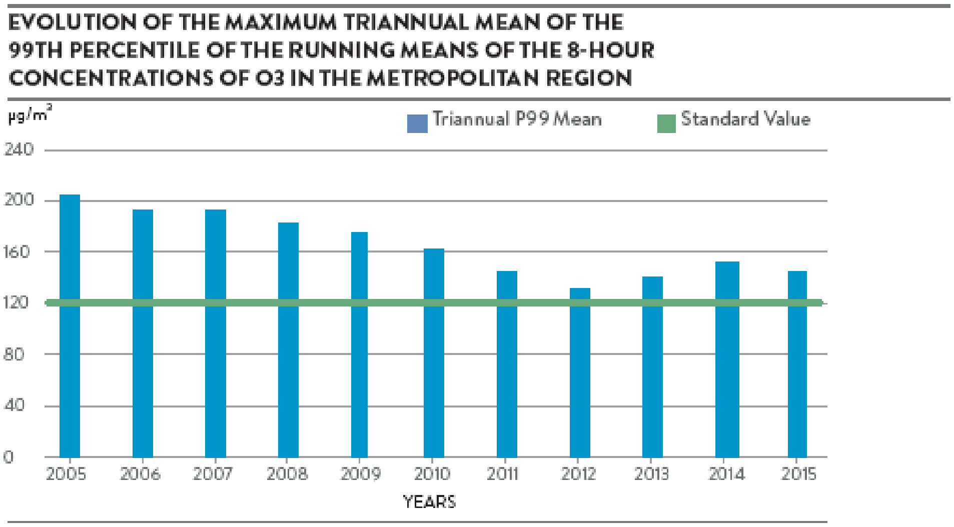
Source: Ministerio del Medio Ambiente, Chile (2011) *Informe del Estado del Medio Ambiente 2011*, http://sinia.mma.gob.cl/wp-content/uploads/2017/08/Informe-del-estado-del-medio-ambiente.pdf (accessed 02 October 2018)

Figure 6.3: Daily $PM_{2.5}$ average concentrations in communes of Chile



Source: Ministerio del Medio Ambiente, Chile (2011) *Informe del Estado del Medio Ambiente 2011*, http://sinia.mma.gob.cl/wp-content/uploads/2017/08/Informe-del-estado-del-medio-ambiente.pdf (accessed 02 October 2018)

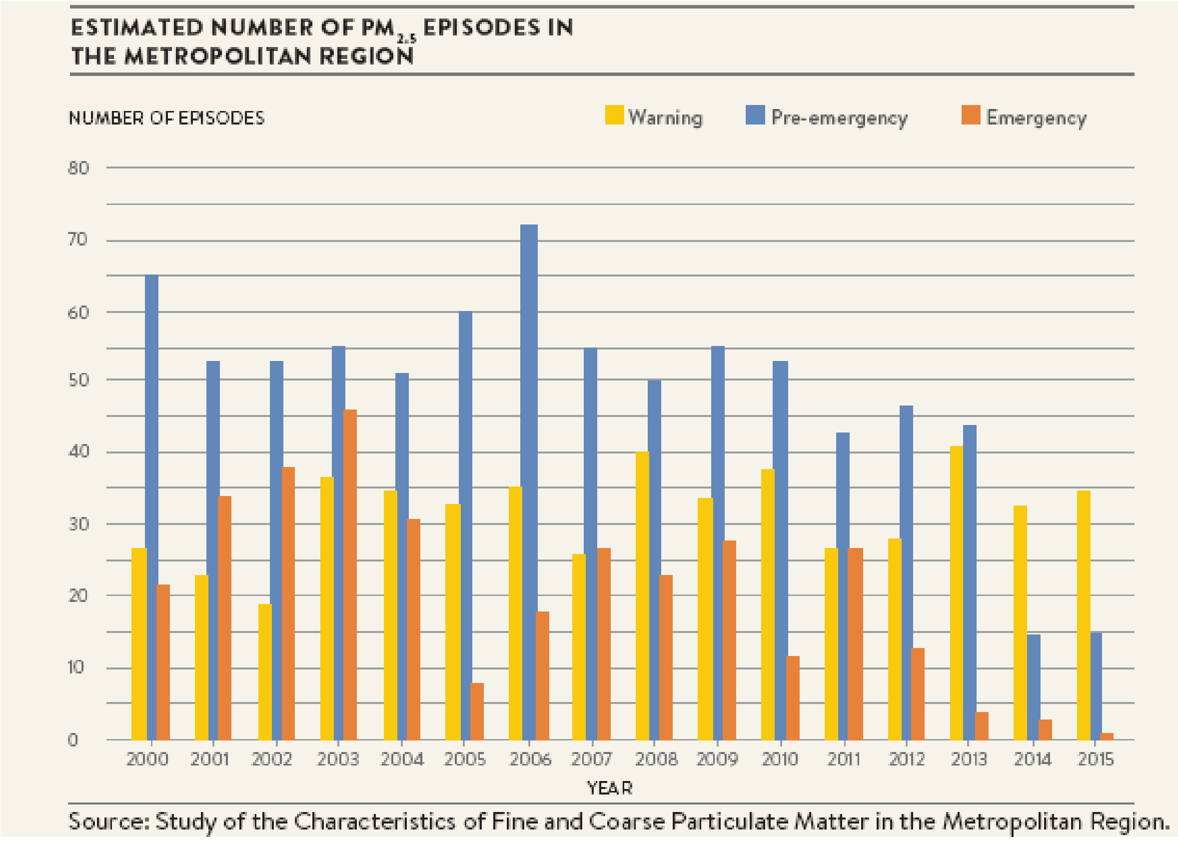
Figure 6.4: Maximum triannual mean of the 99th percentile of the running means of the 8-hour concentrations of ozone (O_3) in the Metropolitan Region of Chile



Source: Department of Monitoring Networks.
Note: Annual means do not represent the level of compliance with the standard. Hence, they are for reference only.

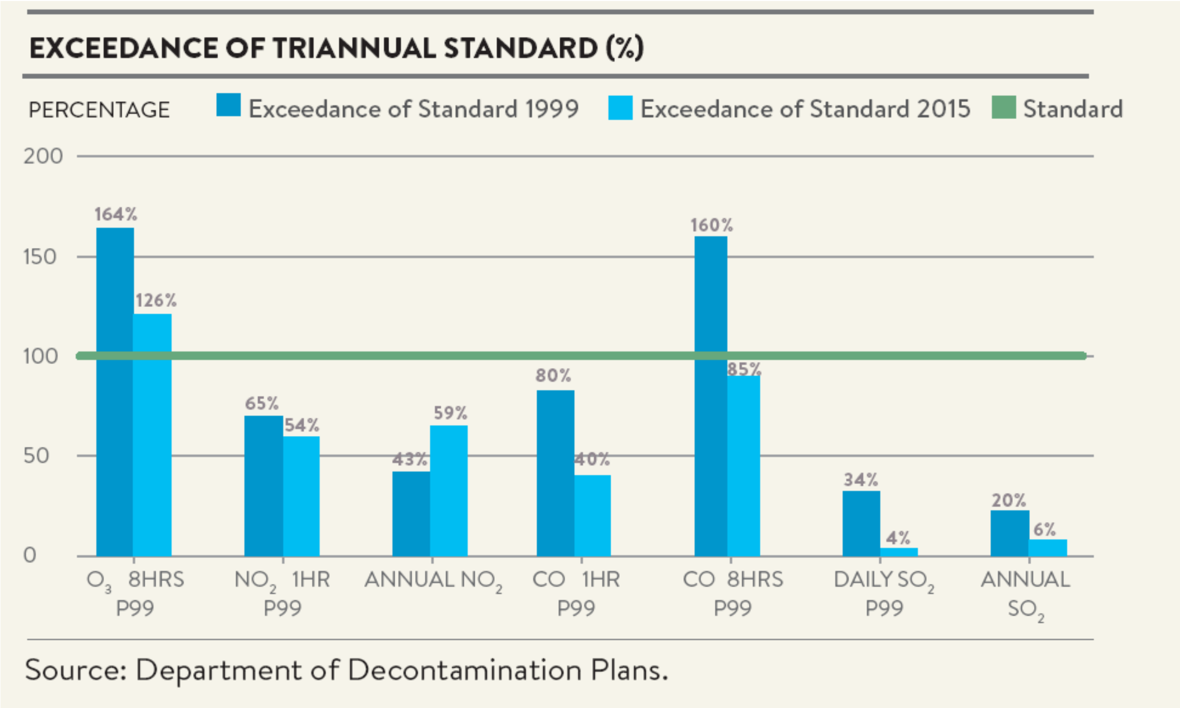
Source: Ministerio del Medio Ambiente, Chile (2016) *Informe del Estado del Medio Ambiente 2016*, http://sinia.mma.gob.cl/wp-content/uploads/2017/08/IEMA2016.pdf (accessed 02 October 2018)

Figure 6.5: Estimated number of $PM_{2.5}$ episodes in the Metropolitan Region, Chile



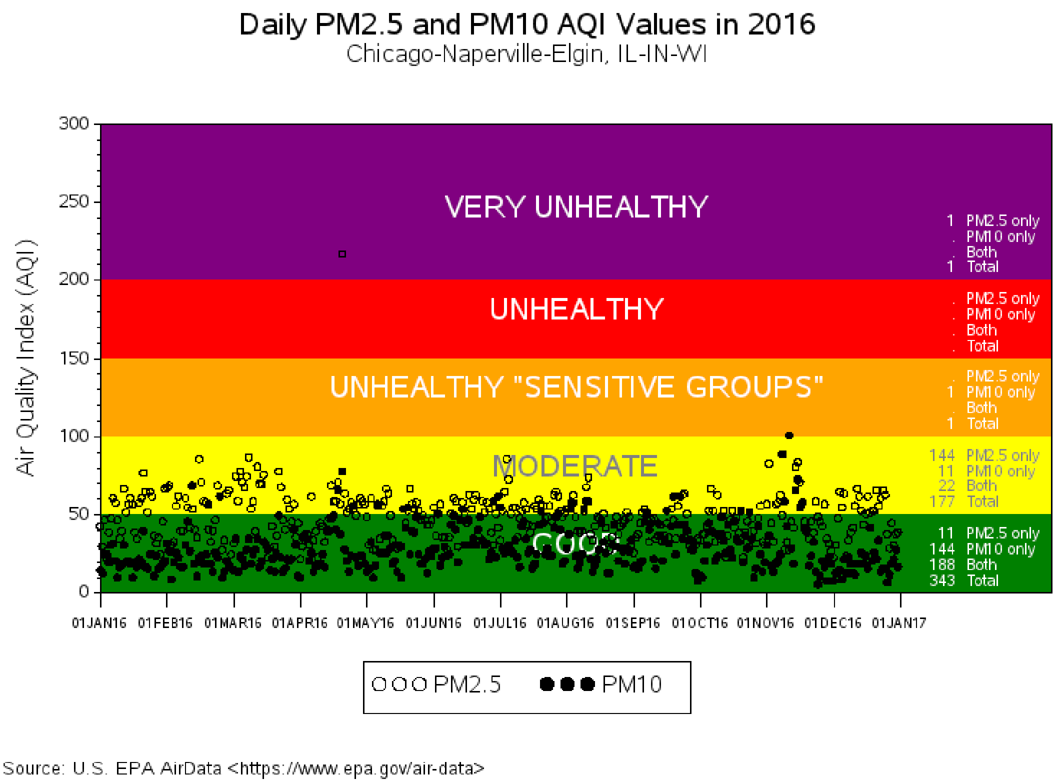
Source: Ministerio del Medio Ambiente, Chile (2016) *Informe del Estado del Medio Ambiente 2016*, http://sinia.mma.gob.cl/wp-content/uploads/2017/08/IEMA2016.pdf (accessed 02 October 2018)

Figure 6.6: Exceedance of triannual standard (%)



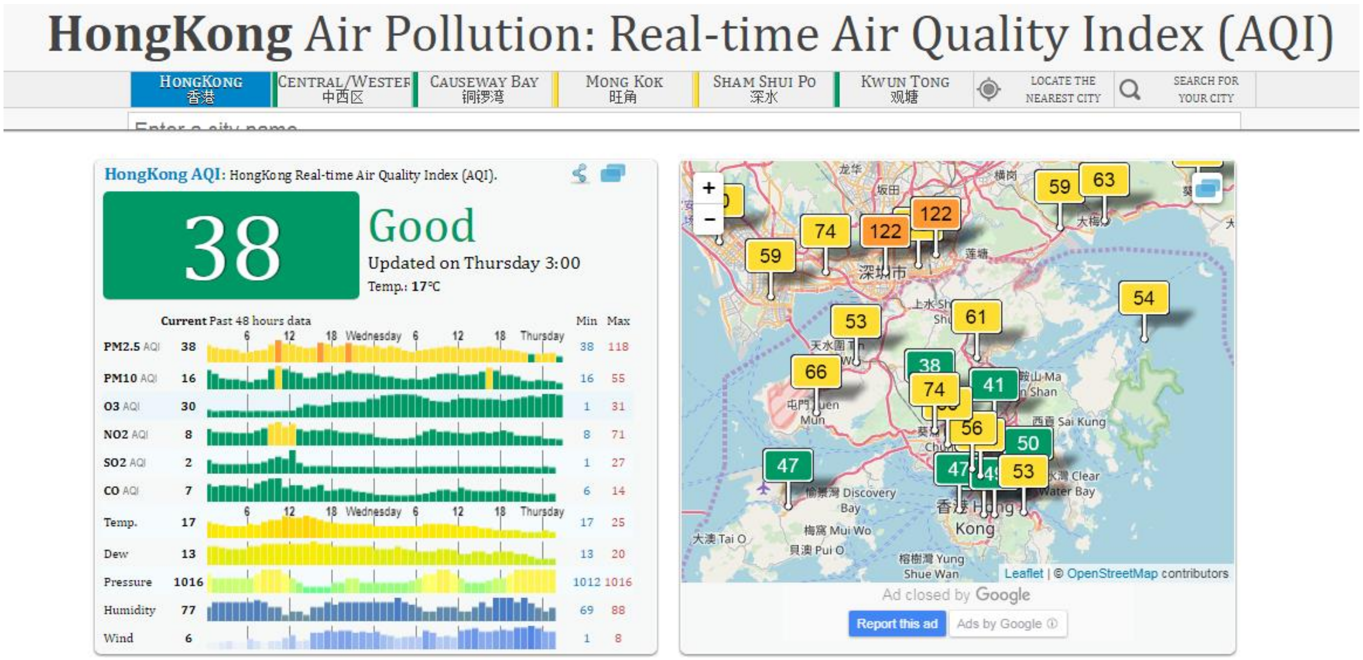
Source: Ministerio del Medio Ambiente, Chile (2016) *Informe del Estado del Medio Ambiente 2016*, http://sinia.mma.gob.cl/wp-content/uploads/2017/08/IEMA2016.pdf (accessed 02 October 2018)

Figure 6.7: Daily $PM_{2.5}$ and PM_{10} AQI values in Chicago-Naperville-Elgin



Source: U.S. EPA (2016) AirData-AQI Plot, https://www.epa.gov/outdoor-air-quality-data/air-data-aqi-plot (accessed 02 October 2018)

Figure 6.8: Real-time Hourly Air Quality Index (AQI) in Hong Kong



Source: Hong Kong Air Quality Index, by region http://aqicn.org/city/hongkong/ (accessed 02 October 2018)

6B. SEEA accounts/tables that use these statistics

The System of Environmental Economic-Accounting Central Framework (SEEA) does not include air quality accounts (concentrations). However, it includes emissions to air (FDES sub-component 3.1), which are potentially harmful to health and the environment.

The SEEA Experimental Ecosystem Accounting includes air filtration (clean air) and sequestering of carbon as ecosystem services.

6C. Commonly used indicators that incorporate these statistics

Calculation of air pollution indicators requires complex modelling which is best conducted by air pollution specialists. Nonetheless, common indicators are:

- Concentrations of air pollutants: mean, percentile, maximum, daily average.
- Number of days and levels of exceedance of air quality limit values (standard).
- Air Quality Index: provides levels of air pollution, e.g., low, moderate, high, very high, with the levels shown on a map which can be used by the population as a guide to alert to pollution episodes and suitability of air quality for public health. An index can be produced for different types of pollutants, e.g., ozone, PM, carbon monoxide, sulfur dioxide and nitrogen dioxide.
- Population exposure to air pollution. For example, the OECD Green Growth Indicators include:
  - Mean population exposure to $PM_{2.5}$ (μg/m^3)
  - Percentage of population exposed to more than 10 μg/m^3 (percentage)
  - Percentage of population exposed to more than 35 μg/m^3 (percentage)

6D. SDG indicators that incorporate these statistics[37]

Indicator 3.9.1: Mortality rate attributed to household and ambient air pollution
The indicator assesses the mortality resulting from exposure to ambient (outdoor) air pollution and household (indoor) air pollution from polluting fuels use for cooking.

Attributable mortality is calculated by first combining information on the increased (or relative) risk of a disease resulting from exposure, with information on how widespread the exposure is in the population (e.g., the annual mean concentration of particulate matter to which the population is exposed, proportion of population relying primarily on polluting fuels for cooking).

This allows calculation of the 'population attributable fraction' (PAF), which is the fraction of disease seen in a given population that can be attributed to the exposure (e.g., in that case of both the annual mean concentration of particulate matter and exposure to polluting fuels for cooking).

Applying this fraction to the total burden of disease (e.g., cardiopulmonary disease expressed as deaths) gives the total number of deaths that results from exposure to that particular risk factor (in the example given above, to ambient and household air pollution).

The statistics of FDES Topic 1.3.1 can be used in calculating the 'joint population attributable fraction' for ambient air pollution. Exposure to ambient air pollution uses annual mean estimates of particulate matter of a diameter of less than 2.5 µm ($PM_{2.5}$) (FDES 1.3.1.a.2).

Indicator 7.1.2: Proportion of population with primary reliance on clean fuels and technology
The number of people using clean fuels and technologies for cooking, heating and lighting divided by total population reporting any cooking, heating or lighting, expressed as percentage. 'Clean' is defined by the emission rate targets and specific fuel recommendations (i.e., against unprocessed coal and kerosene) included in the normative guidance WHO guidelines for indoor air quality: household fuel combustion.

Indicator 11.6.2 Annual mean levels of fine particulate matter (e.g. $PM_{2.5}$ and PM_{10}) in cities (population weighted)
The mean annual concentration of fine suspended particles of less than 2.5 µm in diameters ($PM_{2.5}$) is a common measure of air pollution. The mean is a population-weighted average for urban population in a country and is expressed in $\mu g/m^3$.

The annual urban mean concentration of $PM_{2.5}$ is estimated with improved modelling using data integration from satellite remote sensing, population estimates, topography and ground measurements. Countries which have air quality monitoring networks in places in urban areas can use the annual mean concentrations from ground measurements. Relevant FDES statistics would be 1.3.1.a.1 Concentration level of particulate matter (PM_{10}), and 1.3.1.a.2 Concentration level of particulate matter ($PM_{2.5}$).

Air quality related indicator
Indicator 11.2.1 Proportion of population that has convenient access to public transport, by sex, age and persons with disabilities
The indicator is related to air quality, as rising traffic congestion results in negative air quality in many metropolitan areas; enhancing public transport, particularly clean public transport, helps to reduce reliance on private transport, therefore reducing CO_2 emissions and transport-related pollutants.

The indicator is the proportion of the population that has convenient access to public transport. The access to public transport is considered convenient when an officially recognized stop is accessible within a distance

[37] United Nations Statistics Division, *SDG Metadata* webpage, https://unstats.un.org/sdgs/metadata/ (accessed 02 October 2018)

of 0.5 km from a reference point such as a home, school, work place, market etc. Relevant FDES statistics are from Component 5: Human Settlements and Environmental Health, Topic 5.1.5 Environmental concerns specific to urban settlements, 5.1.5.d Population using public modes of transportation, with related statistics of 5.1.5.c Number of private and public vehicles, and 5.1.5.e Population using hybrid and electric modes of transportation.

F D E S

Manual on the Basic Set of Environment Statistics

2018