**Table 1** NAAQS of Ambient Air Quality of Criteria pollutants around the world.

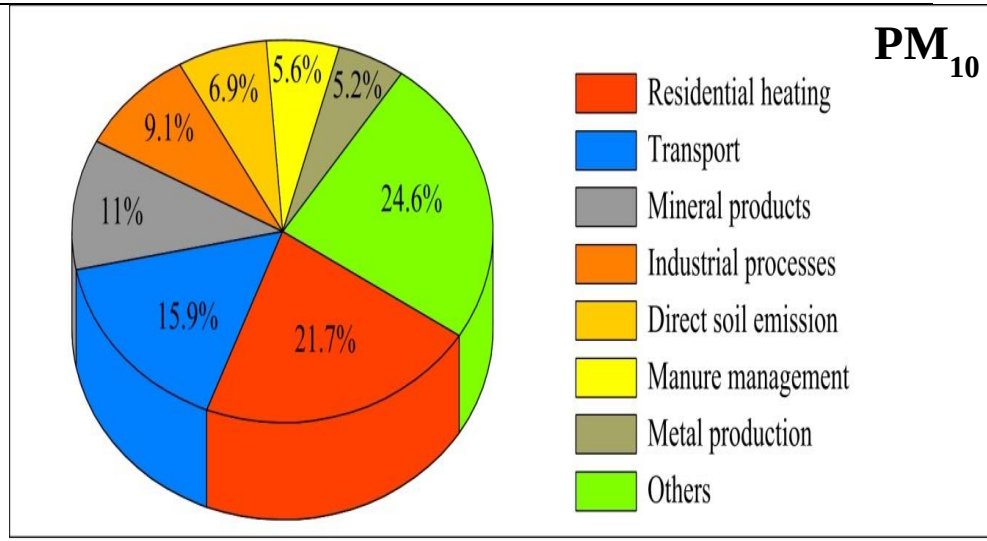
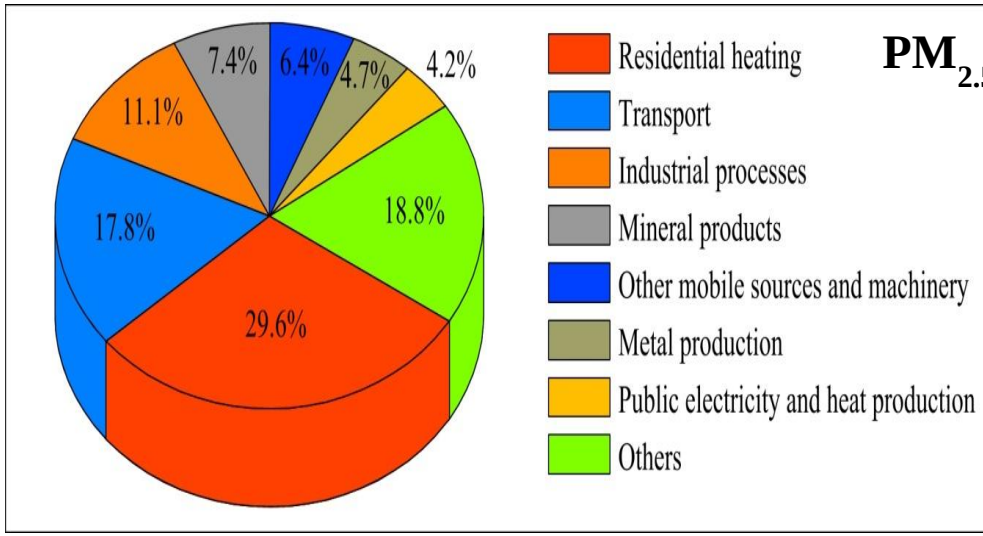
| Pollutants | | | Nitrogen dioxide $NO_2$ (µg/m$^3$) | | | Sulfur dioxide $SO_2$ (µg/m$^3$) | | | Particulate matter | | | | Ground ozone $O_3$ (µg/m$^3$) | | Carbon monoxide CO (mg/m$^3$) | | Lead Pb (mg/m$^3$) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | $PM_{10}$ (µg/m$^3$) | | $PM_{2.5}$ (µg/m$^3$) | | | | | | | |
| | | | 1 hour | Daily | Annual | 1 hour | Daily | Annual | Daily | Annual | Daily | Annual | 8 hour | 1 hour | 8 hour | 1 hour | Daily | Annual |
| WHO | | | 200 | 150 | 40 | 125 | 50 | 20 | 50 | 10 | | | 100 | | | | | |
| Arab Countries | | Egypt | 300 | 150 | 60 | 300 | 125 | 50 | 150 | 70 | 80 | 50 | 120 | 180 | 10 | 30 | | 0.5 |
| | | UAE | 400 | 150 | | 350 | 150 | 60 | 150 | | | | 120 | 200 | 10 | 40 | | |
| | | Jordan | 400 | 150 | | 786 | 370 | | 120 | | 65 | | | | 10 | 30 | | |
| | | Qatar | | 150 | 100 | 1300 | | | | | | | 120 | 235 | 10 | 40 | | |
| African Countries | | South Africa | 200 | | 40 | | 125 | 50 | 75 | 40 | | | 120 | 200 | 10 | 30 | | |
| | | Rwanda | 200 | | 40 | | 125 | | 100 | 50 | 75 | 35 | 120 | 200 | 10 | 30 | | |
| | | Botswana | 200 | | 40 | 350 | 120 | | | 100 | | | 120 | | 10 | 30 | | 0.5 |
| | | Tanzania | 600 | 150 | 100 | | | 100 | | | | | | | 10 | 30 | 1.5 | 1 |
| | | Zambia | 400 | 150 | | 350 | 125 | | 70 | | | | | | 10 | 30 | | 1 |
| European Countries | | European Union | 200 | | 40 | 125 | | 20 | | | | | | | | | | |
| | | Finland | 150 | 70 | | 250 | 80 | | 70 | | | | | | 8 | 20 | | |
| | | UK | | 200 | 40 | 350 | 125 | | 50 | 40 | | 25 | 100 | | | | | 0.25 |
| | | Scotland | 200 | | 40 | 350 | 125 | | 50 | 18 | | 10 | 100 | | 10 | | | |
| | | Turkey | | 300 | 100 | 900 | 400 | 60 | 350 | 150 | | | | | | | | |
| | | Moldova | | | | | 50 | | | | | | | | | | 0.3 | |
| | | New Zealand | | 100 | | 350 | 120 | | 50 | | | | | 150 | 10 | | | |
| | | Russia | | | 40 | | | | | | | | | | | | | |
| Asian Countries | | India | | 80 | 30 | | 80 | 20 | 60 | 60 | | | 100 | 180 | 2 | 4 | 1 | 0.5 |
| | | China | | 80 | 40 | 150 | 50 | 20 | 50 | 40 | | | 100 | 160 | | 10 | | 0.5 |
| | | Japan | 110 | 113 | | 260 | 100 | | | | | | | 120 | 23 | 12 | | |
| | | Pakistan | | 80 | 40 | | 120 | 80 | 150 | 120 | | | | 130 | 5 | 10 | 1.5 | 1 |

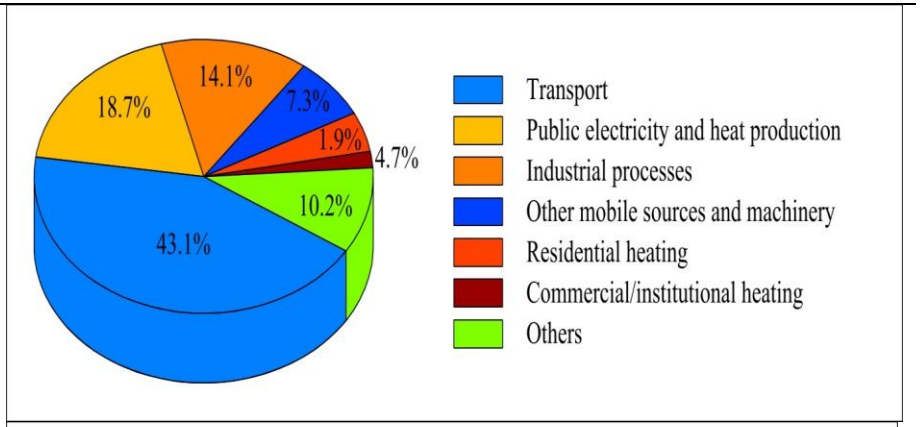
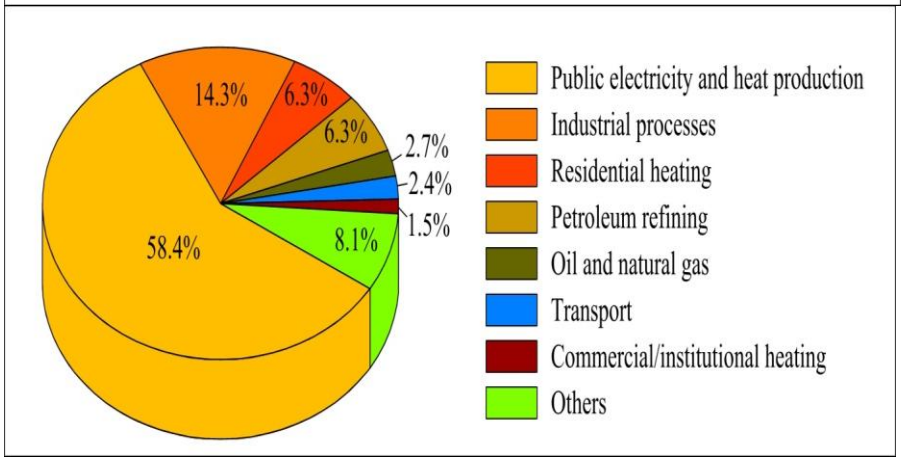
| Pollutants | | Nitrogen dioxide $NO_2$ (µg/m$^3$) | | | Sulfur dioxide $SO_2$ (µg/m$^3$) | | | Particulate matter | | | | Ground ozone $O_3$ (µg/m$^3$) | | Carbon monoxide CO (mg/m$^3$) | | Lead Pb (mg/m$^3$) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | $PM_{10}$ (µg/m$^3$) | | $PM_{2.5}$ (µg/m$^3$) | | | | | | | |
| | | 1 hour | Daily | Annual | 1 hour | Daily | Annual | Daily | Annual | Daily | Annual | 8 hour | 1 hour | 8 hour | 1 hour | Daily | Annual |
| American Countries | Philippines | | 150 | | | 180 | 80 | 150 | 60 | | | 60 | 140 | 10 | 35 | | 1 |
| | Taiwan | 470 | | 90 | 660 | 260 | 80 | 125 | 65 | | | 120 | 240 | 10 | 30 | | |
| | Mongolia | | 40 | 30 | | 20 | 10 | 100 | 50 | | | 100 | | 10 | 30 | 1 | 0.5 |
| | Singapore | 200 | | 40 | | 50 | 15 | 50 | 20 | | | 100 | | 10 | 30 | | |
| | Sir Lanka | 250 | 100 | | 200 | 80 | | 100 | 50 | | | | 200 | 10 | 30 | | |
| | USA | 100 | | 53 | 350 | | | 50 | 40 | | | 120 | | 10 | 35 | | |
| | Canada | 400 | 200 | 100 | 900 | 300 | 60 | | | | | | 160 | 15 | 35 | | |
| | Australia | 320 | | 50 | 520 | 200 | 50 | | 50 | | | | 200 | 10 | | | |
| | Brazil | | | 100 | | 350 | 80 | 150 | 50 | | | | 160 | 10 | 40 | | |
| | Chile | 470 | 100 | | 700 | 260 | | 50 | | | | | 160 | 10 | 40 | | |

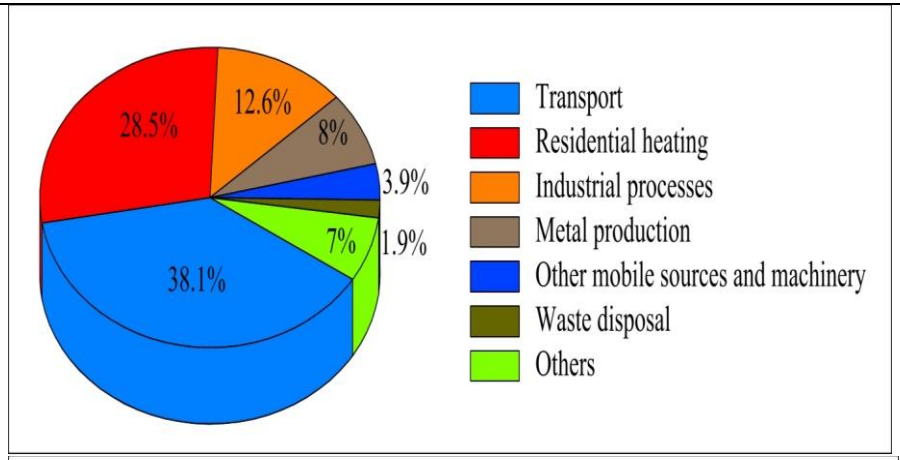
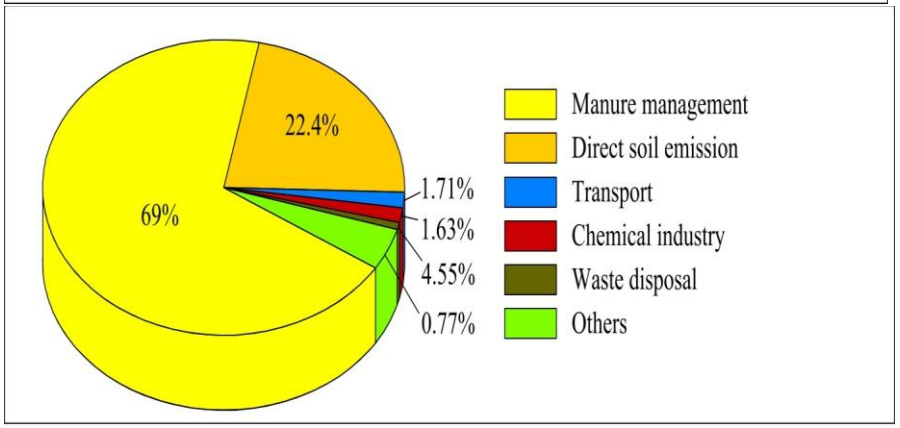
WHO: World Health Organization; USA: United States of America; UK: United Kingdom; UAE: United Arab Emirates.
Sources: WHO, 2014; EANET, 2015; EMB, 2015; CNAP, 2017; EEA, 2017; EEAA, 2017, EAAUAE, 2017.

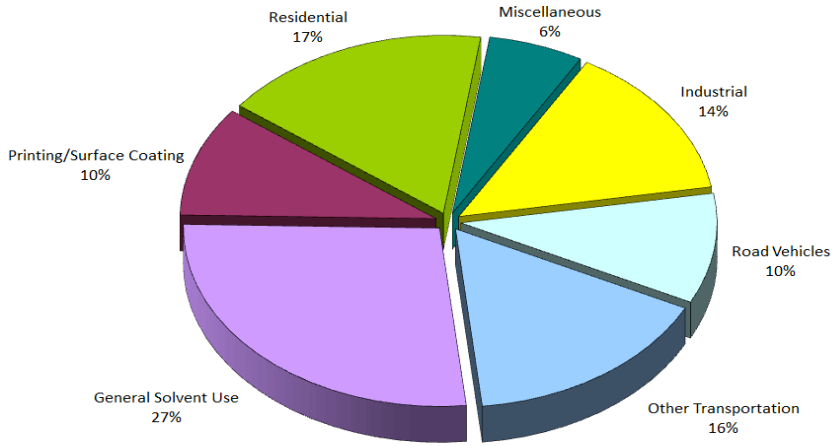
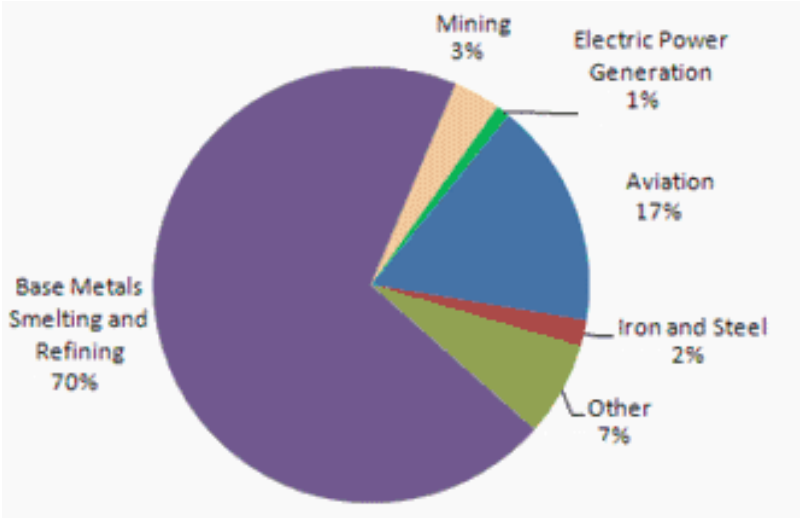
**Table 2** Brief description of air pollutants, their characteristics of sources and contribution

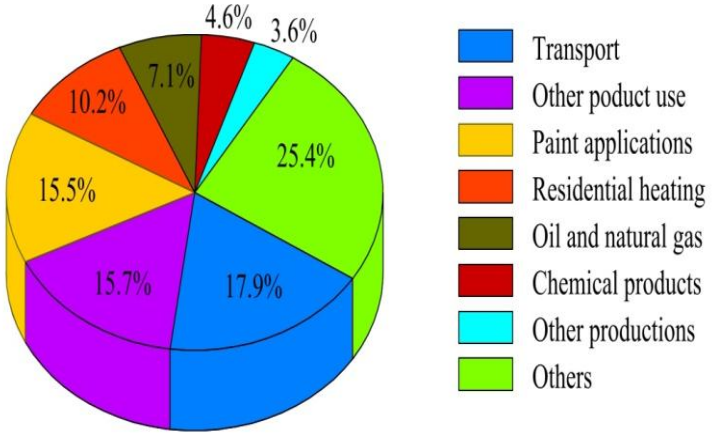
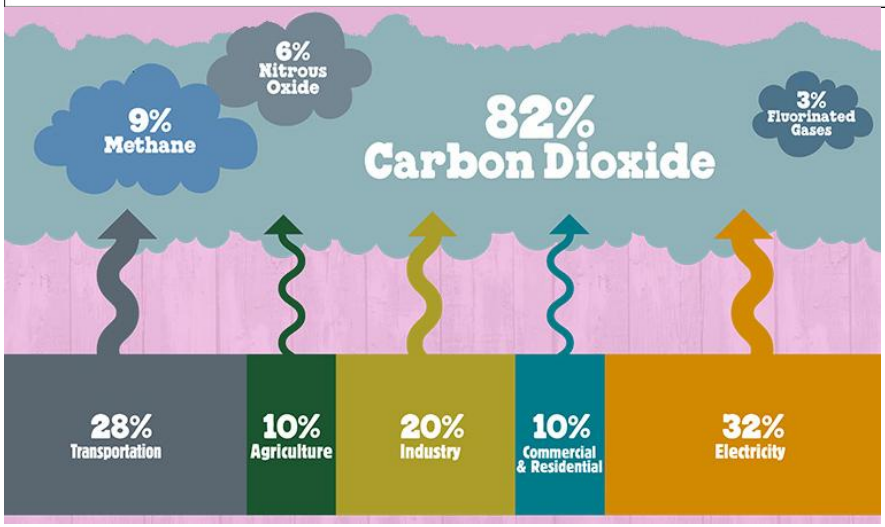
| Pollutant | Characteristics of sources | Contribution of sources |
|---|---|---|

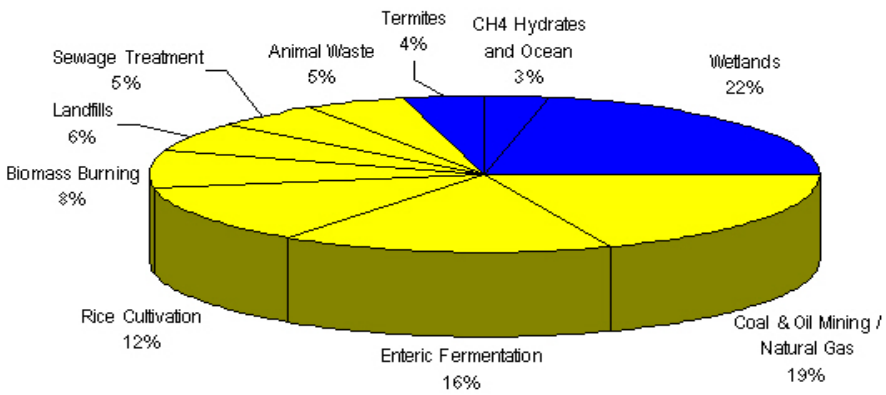
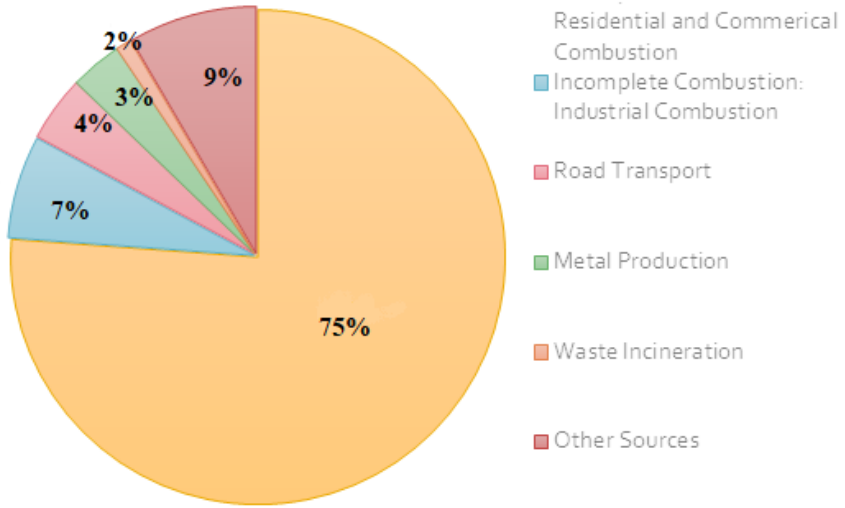
| Pollutant | Characteristics of sources | Contribution of sources |
|---|---|---|
| Particulate Matter (PM) | PM is a mixture of solid particles and liquid droplets (aerosols) found in ambient air. Its chemical composition varies with origin, environmental conditions, and residence time in air. It like dust, aerosols, fumes, smoke, fly ash, and pollen (CNAP, 2017).<br>Particle classified into (NHDES, 2018):<br>▪ Coarse particles (TSP): its diameters ≥ 10 μm.<br>▪ Inhalable coarse particles ($PM_{10}$): its 2.5 μm < diameters < 10 μm.<br>▪ Fine particles ($PM_{2.5}$): its diameters ≤ 2.5 μm.<br>➢ Primary PM originates from both natural and anthropogenic sources (EEA, 2017). The natural sources include: dust storm, sea salt, pollen and volcanic ash. Anthropogenic sources like industry, waste incineration, transport, fuel combustion for power generation, domestic heating, and agriculture.<br>➢ Secondary PM is formed from emissions of $SO_2$, $NO_x$, $NH_3$ and VOCs, mainly anthropogenic sources (EPRS, 2018). |  <br>  |

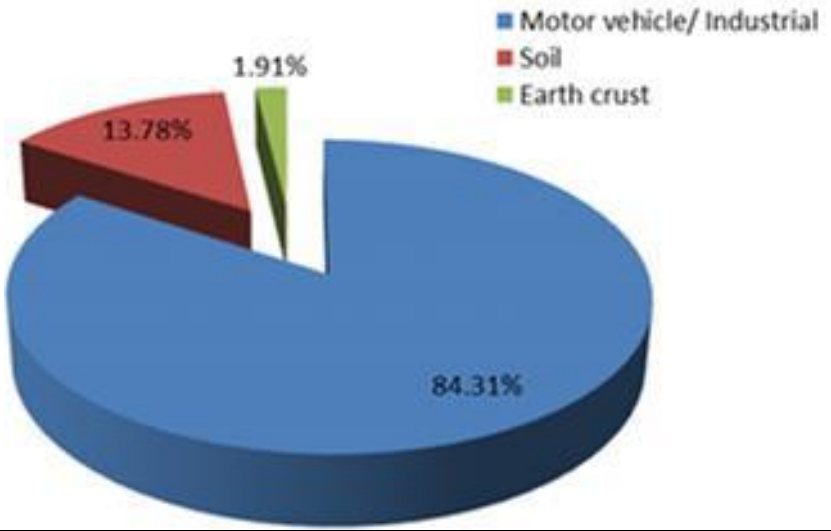
| Pollutant | Characteristics of sources | Contribution of sources |
|---|---|---|
| Nitrogen dioxide ($NO_2$) | $NO_2$ reacts in ambient air to produce ground-level ozone. Its sources are Combustion processes from mobile and stationary sources (CNAP, 2017). |   |
| Sulfur dioxide ($SO_2$) | It is primary pollutant. Anthropogenic sources of $SO_2$ are stationary power generation, industry, fossil fuel combustion, oil refining and metal smelting. The main natural source is volcanoes (EEA, 2017). |   |

| Pollutant | Characteristics of sources | Contribution of sources |
|---|---|---|
| Carbon monoxide (CO) | It is colourless, odorless, and a poisonous gas at high concentrations. The main sources are incomplete combustion of fossil fuel, industrial processes and biomass burning. Mobile sources like cars, buses, trucks, and off-road equipment (construction equipment and marine engines) (CNAP, 2017). |  |
| Volatile Organic Compound s (VOCs) | It is group of compounds (gas and vapors) containing carbon (e.g. benzene, toluene and xylene). The sources of VOCs are combustion, fossil fuel, industrial activities, and natural emissions from vegetation, paints, Solvents, and fires (EPRS, 2018). |  |

| Pollutant | Characteristics of sources | Contribution of sources |
|---|---|---|
| Ground-level Ozone ($O_3$) | It is secondary air pollutant, and also toxic to both humans and vegetation. It is not emitted directly into the atmosphere, but formed in the atmosphere by the reactions of $NO_x$ and VOC with presence of sunlight. Sources of these two pollutants are automobile emissions, the combustion of fossil fuels, and vapors from solvents (CNAP, 2017; EEA, 2017). |  |
| Lead (Pb) | It is a metal found naturally in the environment. The major sources of lead are vehicles, industrial sources, metals processing, car battery plants, burning of aviation fuels, and incinerators (NHDES, 2018). |  |

| Pollutant | Characteristics of sources | Contribution of sources |
|---|---|---|
| Ammonia ($NH_3$) | A colorless gas has pungent odor. It is emitted from agriculture activities, industrial processes, motor vehicles, plant decomposition, biomass burning, and volatilization from soils and oceans (EMB, 2015; EPRS, 2018). |   |
| Carbon dioxide ($CO_2$) | It is a colorless, odorless, tasteless and poisonous gas. It is one of green house gases. Atmospheric carbon dioxide emitted from natural sources like the respiration processes of living aerobic organisms, volcanic, and combustion of organic matter. While, anthropogenic sources of carbon dioxide are burning of fossil fuels in power generation and transport use (Velasco and Roth, 2012; NHDES, 2018). |   |

| Pollutant | Characteristics of sources | Contribution of sources |
|---|---|---|
| Methane ($CH_4$) | It is one of the trace gases in the atmosphere. It is one of green house gases. It is emitted from natural sources and anthropogenic sources (agriculture, waste and coal mining) (Velasco and Roth, 2012; EPRS, 2018). |   |
| Toxic Organics (Hazardous air pollutants) | Toxic organic are polycyclic aromatic hydrocarbons (PAHs), poly-chlorinated biphenyls (PCBs), Dioxins, and Furans. The sources are incomplete combustion of fossil fuels, waste burning and coke production (EPRS, 2018). |   |

| Pollutant | Characteristics of sources | Contribution of sources |
|---|---|---|
| Toxic metals (Hazardous air pollutants) | Several metals, such as cadmium, chromium, and mercury. These metals are originated from industrial processes, fossil fuel combustion, and waste incineration (EEA, 2017; Sulaiman et al., 2018). |   |