

**The Ambient Air Quality Management Plan
for the Tbilisi Agglomeration
2024-2026**

Ministry of Environmental Protection and Agriculture of Georgia expresses its deep respect and gratitude towards the Delegation of the European Union to Georgia, for supporting the preparation of the Ambient Air Quality Management Plan for the Tbilisi Agglomeration. The Ministry expresses its gratitude to everyone who participated in the elaboration of the document.



**MINISTRY OF ENVIRONMENTAL PROTECTION
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LEPL National Environmental Agency
LEPL Environmental Information and Education Center
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Decree of the Government of Georgia

№1361, 17 September, 2024 Tbilisi

On the Approval of the Ambient Air Quality Management Plan for the Tbilisi Agglomeration 2024-2026

1. In pursuance to the article 44¹ of the Law of Georgia on “Ambient Air Protection”, the enclosed “Ambient Air Quality Management Plan for the Tbilisi Agglomeration 2024-2026” (hereinafter - the plan) to be approved.
2. Relevant ministries and agencies shall implement measures stipulated in the plan in accordance with the deadlines defined by the plan.
3. Tbilisi City Hall is asked to ensure implementation of the actions stipulated in the plan in accordance with the deadlines defined by the plan.
4. The Ministry of Environmental Protection and Agriculture of Georgia shall be responsible for the coordination of the implementation of the measures stipulated in the plan.

Prime Minister



Irakli Kobakhidze

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Abbreviations

| | |
|-------------------------|---|
| AA | Association Agreement |
| BAT | Best Available Techniques |
| CNG | Compressed Natural Gas |
| COVID-19 | Coronavirus Disease of 2019 |
| DES | Department of Environmental Supervision |
| EC | European Community |
| EEA | European Environment Agency |
| EU | European Union |
| GCMS | Gas Chromatography with-Mass Spectrometric detection |
| GDP | Gross Domestic Product |
| GNERC | Georgian National Energy and Water Supply Regulatory Commission |
| JSC | Joint Stock Company |
| LEPL | Legal Entity of Public Law |
| LLC | Limited Liability Company |
| MEPA | Ministry of Environmental Protection and Agriculture |
| MESD | Ministry of Economy and Sustainable Development |
| MIA | Ministry of Internal Affairs |
| MRDI | Ministry of Regional Development and Infrastructure |
| NCDC | National Center for Disease Control and Public Health |
| NEA | National Environmental Agency |
| NEAP-4 | Fourth National Environmental Action Program of Georgia 2022-2026 |
| NMVOCs | Non-Methane Volatile Organic Compounds |
| NNLE | Non-entrepreneurial (non-commercial) legal entity |
| NOAA | USA National Oceanic and Atmospheric Administration |
| PAH | Polycyclic Aromatic Compounds |
| PM_{2.5} | Particulate matter 2.5 micrometers or less |
| PM₁₀ | Particulate matter 10 micrometers or less |
| QA/QC | Quality Assurance/Quality Control |
| QHIA | Quantitative health impact assessment |
| SDGs | Sustainable Development Goals |
| SOPs | Standard Operating Procedures |
| SSD | State Sub-Agency Institution |
| TSP | Total Suspended Particles |
| UFP | Ultrafine Particles |
| VOCs | Volatile Organic Compounds |
| WHO | World Health Organization |
| WHO AQG | World Health Organization Air Quality Guidelines |

1. Introduction

1.1. The rationale for the development of the plan

Clean air is necessary to meet one of the human rights determined by the Constitution of Georgia - to live in a healthy environment (Article 29). According to the last State of the Environment Report of Georgia (2018-2021) and monthly and yearly newsletters published by the National Environmental Agency (NEA), air pollution by particulate matter (PM₁₀, PM_{2.5}) and nitrogen dioxide (NO₂) is observed in the country's large cities, including Tbilisi. Hence, ambient air protection is among the top priorities of Georgia's declared national environmental policy.

The present Air Quality Management Plan for the Tbilisi agglomeration is a sector action plan that aims to improve the ambient air quality in the Tbilisi agglomeration¹. The development of this plan is stipulated by the Law of Georgia “On Protection of Ambient Air”. As amended in accordance with Directive 2008/50/EC of the European Parliament and of the Council of 21st of May 2008 on ambient air quality and cleaner air for Europe in 2020 to fulfill the obligations of the Georgia-EU Association Agreement (AA), the law requires that monitoring and management of ambient air quality is carried out in zones and agglomerations throughout the territory of Georgia and where in a given zone and/or agglomeration the levels of main pollutant substances in ambient air exceed any limit norms or target value, and any relevant margin of tolerance, the Ministry of Environmental Protection and Agriculture of Georgia (MEPA) in agreement with the municipal authorities within the relevant zone and/or agglomeration shall develop an ambient air quality management plan to ensure that the limit norms or target values specified in the technical regulation “On Ambient Air Quality Standards” are achieved. The Tbilisi agglomeration is one of the areas where, according to the results of ambient air quality monitoring carried out by NEA, concentrations of particulate matter and nitrogen dioxide are exceeded (see chapter 2.4). Accordingly, as required by law, a respective ambient air quality management plan shall be developed.

The first action plan to address the air quality situation in Tbilisi – “the State Program on Measures to Reduce Ambient Air Pollution in Tbilisi 2017-2020”, was approved by the Georgian Government in 2017², when the development of air quality management plans was not yet a legal obligation. Despite a number of measures taken, air pollution is still a problem in Tbilisi. Accordingly, the new plan shall determine more effective activities to address air pollution from various sectors, such as transport, industry, construction, etc.

In addition to the legal obligation, the development of this action plan is stipulated by national policy documents. One of the objectives of the Vision 2030 Development Strategy of Georgia³, approved by Resolution № 517 of the Government of Georgia on November 3, 2022, is to improve the quality of ambient air and develop a system for monitoring and evaluation of the

1 According to Order №2-1293 of the Minister of Environmental Protection and Agriculture of Georgia dated by August 30, 2021 on the approval of Ambient Air Quality Monitoring and Management Zones and Agglomerations, the Tbilisi agglomeration includes the self-governing city – Tbilisi Municipality

2 Decree №2 of the Government of Georgia dated by July 12, 2017 on approval of the State Program on Measures to Reduce Ambient Air Pollution in Tbilisi

3 <https://matsne.gov.ge/ka/document/view/5604706?publication=0>

quality of ambient air. To achieve this objective, the 2023 Action Plan of the Vision 2030, approved by decree № 342 of the Government of Georgia on February 15, 2023, outlines five activities, one of which is developing and approving air quality management plans for zones and agglomerations.

The main national-level framework policy document in the field of environment and natural resources protection - the fourth National Environmental Action Program of Georgia 2022-2026 (NEAP-4)⁴, approved by Resolution №1629 of the Government of Georgia dated September 7, 2022, aims for clean and healthy ambient air throughout the entire territory of the country. To achieve the mentioned goal, NEAP-4 sets two objectives: “reducing the emissions of harmful substances from various sources of pollution” and “developing the ambient air quality monitoring and assessment system.” A total of 12 activities are planned to fulfill these objectives. Among them is the development of air quality management plans for those zones and agglomerations where the concentrations of the main pollutants exceed the limit norms or target values.

Climate Change Strategy of Georgia 2030 and Action Plan 2021-2023 is another national-level document that includes a number of activities defining policy in the field of ambient air protection, e.g., related to the promotion of clean and technically fit cars and alternative, clean forms of transportation, the introduction of emission standards for imported vehicles, improved enforcement, encouragement of the use of energy-efficient wood stoves, etc.

The development of ambient air quality management plans represents the best practice for addressing ambient air pollution in the EU countries. In 2014-2020, a total of 944 air quality management plans were developed in 23 European countries, including 21 EU countries. The majority of these plans are focused on reducing nitrogen dioxide (NO₂) and particulate matter (PM) levels. 70% of the activities fall on the transport sector, 12% - on the commercial and residential energy sectors linked to domestic heating, and 8% - on the industry. In addition, the plans address public awareness raising as an essential factor for gaining support for action to improve air quality.⁵

Goals related to air protection are among the national priorities of the United Nations Sustainable Development Goals (SDGs). In particular, one of the nationalized targets of Goal 3: "Ensure healthy lives and promote well-being for all at all ages," is Target 3.9: "By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination." Among the nationalized targets of Goal 11: "Make cities and human settlements inclusive, safe, resilient and sustainable," is Target 11.6, which aims to reduce the adverse per capita environmental impact in large cities by paying particular attention to air quality.

1.2. Reforms and measures implemented before the development of the plan

Significant reforms and measures have been implemented in recent years to address air pollution problems in Georgia. Most of these measures were stipulated by the air quality-

4 <https://mepa.gov.ge/Ge/PublicInformation/34047>

5 <https://www.eea.europa.eu/publications/managing-air-quality-in-europe>

related commitments under the Georgia-EU Association Agreement (AA), the third National Environmental Action Program of Georgia 2017-2021 (NEAP-3), the State Program on Measures to Reduce Ambient Air Pollution in Tbilisi 2017-2020, the Action Plan for improvement of Ambient Air Quality in Rustavi 2020-2022, and the Action Plan 2021-2023 of the Climate Change Strategy. In particular:

- Georgia's air quality-related framework legislation was harmonized with that of the EU, based on which the management of ambient air quality in the country is gradually shifting towards the European practice.⁶ New ambient air quality assessment and monitoring standards were approved that are in line with the EU standards.⁷
- The automatic ambient air monitoring network was expanded to 18 stationary and mobile stations. In addition, quarterly indicator measurements of atmospheric air pollution are carried out in 30 large cities in Georgia. An air quality portal – air.gov.ge was created, where near real-time air quality data is available.
- An electronic system for accounting for stationary sources and their emissions – emoe.gov.ge and a publicly available interactive web map – map.emoe.gov.ge were introduced. The extent of emissions inventory has increased, and data quality has improved. A dispersion forecasting report was developed.
- Regulations targeting major industrial facilities were tightened with an obligation to report real-time instrumental monitoring data⁸ and increased fines for excessive emissions and other non-compliance.⁹
- The Law on Industrial Emissions was adopted in June 2023, which creates a framework for introducing the European principles of regulation of industrial emissions, implying the introduction of the best available techniques in each branch of industry and the determination of its corresponding emission limit values.
- Mandatory periodic technical inspection of motor vehicles was launched in 2018, and the requirements (e.g., related to CO limits, the use of catalytic converters etc.) were further tightened in the following years.¹⁰ The specific requirements were established for technical inspection centers.¹¹ Furthermore, the related sanctions were also tightened.¹² The control of visible exhaust emissions from motor vehicles was introduced in four major cities of Georgia on September 4, 2023.¹³
- Petrol quality standard EURO 5 was introduced in 2017, and additional parameters were added to the existing norms in 2021.¹⁴ Diesel quality standard EURO 4 was

6 The Law on Ambient Air Protection as amended on 22 May 2020

7 GoG Resolution #383, 27 July 2018, - technical regulation on the approval of ambient air quality standards and GoG Resolution #563 1 December, 2021 on the approval of the technical regulation for the minimum standard number of observation points/stations on the level of atmospheric air pollution by harmful substances, the rules for their placement and operation, as well as the list of standard methods for measuring the level of pollution.

8 GoG Resolution #413, 31 December 2013, on the approval of the technical regulation for the self-monitoring and reporting of the release of harmful substances from stationary sources of pollution as amended by Resolution #192 of 27 April 2021 that entered into force on 1 June 2021

9 Administrative Offences Code of Georgia (Articles 761, 77, 78, 792, 793, 798, etc.) as amended on 12 March 2021

10 GoG Resolution # 510, 1 December 2017, on the approval of the technical regulation on periodic technical inspection of motor vehicles and their trailers, entered into force on January 2018

11 GoG Resolution # 511, 1 December 2017, on the approval of the technical regulation on the requirements for the technical qualification of the facilities, equipment and personnel of the periodic technical inspection centers of motor vehicles

12 Administrative Offences Code of Georgia (Article 118), as amended on 23 December 2017 and 22 March 2023

13 Law of Georgia #3465-XIIrs-Xmp of July 7, 2023 on Amendments to the Code of Administrative Offenses of Georgia

14 GOG Resolution #124, 31 December 2004, on the automobile petrol quality norms. The requirements equivalent to EURO 5 standard entered into force in 2017

introduced in January 2019, and EURO 5 in January 2023¹⁵. In addition, new parameters were added to the diesel quality norms, approximating those of the EU standards. Limit values were established for sulphur in some liquid fuels.¹⁶ In addition, the sanctions for violating fuel quality standards were tightened.¹⁷

- A technical regulation was adopted on the enactment in the territory of Georgia of the maximum allowable norms provided for by the EU legislation for the emissions from different types of vehicles and other mobile-mechanical means of transportation polluting ambient air with harmful substances based on which the Euro 5 vehicle emission standard came into effect for M1 and M2 category vehicles from January 1, 2024, and from January 1, 2025, the standard will also apply to M3 and N category vehicles.
- Tightened sanctions for administrative offenses related to violating environmental measures during construction or transportation of construction materials, e.g., transportation of dusty material by uncovered means of transport; spillage of concrete from a concrete truck during transportation; not covering dusty material during construction; violating obligation for using the wet method of processing of dusty material and others entered into force in Tbilisi in 2019¹⁸ and nationwide in 2023¹⁹. In addition, Tbilisi City Council adopted the regulation on disposal and/or selling used tires, ferrous and non-ferrous metal scraps, out-of-service vehicles and their parts, and easily flammable, explosive or dusty materials²⁰, that will enter into force in January 2025.
- An interdepartmental commission studying the issues of improving the quality of ambient air was established by the decree №1354 of the Government of Georgia dated July 24, 2020, the primary purpose of which is to develop various thematic state programs to promote the improvement of the quality of the ambient air in the country and the reduction of harmful effects on human health and the environment, and discussion of the possibilities for ratification of the protocols of the Air Convention and fulfillment of relevant obligations.

In the framework of the implementation of the State Program on Measures to Reduce Ambient Air Pollution in Tbilisi 2017-2020, activities were implemented in five main directions:

1. Road transport
2. Construction
3. Green spaces
4. Monitoring of air quality and public health

15 GoG Resolution #238, 28 December 2005, on diesel fuel composition norms, analysis methods and their implementation measures. The requirements equivalent to EURO 4 standard entered into force in 2019

16 GoG Resolution #256 of 25 May 2017 on the approval of the technical regulation on the establishment of limit values of sulfur content in some liquid fuels

17 Administrative Offences Code of Georgia (Article 913), as amended on 17 July 2020, entered into force on 22 August 2020, and Criminal Code of Georgia (Article 1981) as amended on 17 July 2020, entered into force on 15 August 2020

18 Administrative Offences Code of Georgia, as amended on 10 June 2019 (Articles: 1524, 1525, 1526, 1527, 1528, 1529), entered into force in 10 June 2019 and some of the provisions on 1 May 2020

19 Administrative Offences Code of Georgia, as amended on 26 April 2022 (Articles: 1525, 1526, 1527, 1528, 1529), entered into force in 10 June 2019 and some of the provisions on 1 May 2020 on 31 December 2022

20 Tbilisi City Council Resolution #54-35 of 28 February 2020 on the approval of the rules for disposal and/or selling used tires, ferrous and non-ferrous metal scraps, out-of-service vehicles and their parts, easily flammable, explosive or dusty materials, entered into force on 1 January 2024

5. Informing the public and awareness-raising

Of the planned 38 activities, 21 (55%) were fully implemented, 6 (16%) were mostly completed, 8 (21%) – were partially completed, and three activities (8%) were not implemented. Most of the progress was achieved in the directions 3 – green spaces and 5 – informing the public and awareness-raising. Several important measures and activities were implemented within the direction 1 – road transport sector, including the introduction and implementation of a regular technical inspection of motor vehicles, improving the quality of motor fuel and replacing the public transport fleet with more environmentally friendly buses. The lowest progress has been achieved in the direction 2 – the construction sector, where 50% of the activities were not implemented.²¹ In addition to the activities implemented at the national level, the following activities have been implemented at the city level:

- The public transport fleet in Tbilisi was modernized with 860 M3 Buses (from which 634 are 8-m diesel EURO 6 buses and 226 – 12-m CNG buses) and 1,000 new EURO 5 diesel minibuses. Bus lines with a total length of 26 km were arranged on 16 Central Streets.
- To optimize the management of traffic flows, 109 units of additional traffic lights were installed, and the zonal-hourly parking system was launched on 63 streets.
- 38 fast charging stations for electric vehicles were installed.
- The concept of a taxi management system was developed, and two stages of taxi reform were carried out.
- 18 km of pedestrian sidewalks, and a total of 19 km of bicycle paths were arranged.
- 137,432 trees and 795,000 seasonal flowers were planted in different city areas. Green spaces were arranged on a total of 281,432 m².
- The area covered by greenery maintenance measures in Tbilisi increased by 163,700 m² and amounted to 442,705 m².
- Indicative measurements of ambient air quality are carried out four times a year at 26 locations in the capital. A mobile automatic air quality monitoring station was purchased.
- Indicators and methodology for monitoring the health status of the population in the area of influence of polluted air were selected.
- A number of campaigns and events were carried out to raise public awareness on the impact of air pollution on human health and the environment, as well as on air protection.
- Topics on eco-driving techniques were added to the theoretical driving license test. The principles of sustainable development were included in the national curriculum.

As a result of implemented activities, specific air quality parameters in Tbilisi improved by 2020 compared to 2017. In particular, average annual concentrations of both PM₁₀ and PM_{2.5} decreased and were under limit norms in 2020 at all three monitored locations. According to the Final Report on the Implementation of the State Program on Measures to Reduce Ambient Air Pollution in Tbilisi 2017-2020, this improvement was conditioned by the reduced pressure from natural and anthropogenic sources. Desert dust storm events causing transboundary air

²¹ Final report on the implementation of the State Program on Measures to Reduce Ambient Air Pollution in Tbilisi 2017-2020, 2021

pollution in Tbilisi occurred less frequently in 2020 than in 2017. In addition, pollution by solid particles from the open grounds has decreased due to implemented measures of lawn care, mulching, and other means of covering the ground surface in the city. Also, implementing such measures as tightening construction norms, fuel norms, and technical requirements for motor vehicles and improving enforcement should have reduced pressure from anthropogenic sources. Meanwhile, no significant change in the NO₂ concentration was observed in Tbilisi. However, considering the 5% annual growth of the fleet, which should have caused increased pressure in this regard, we can assume that the NO₂ pollution indicators were maintained at the expense of improving the fleet.²²

1.3. Methodology used and process for developing the plan

The Ambient Air Quality Management Plan for the Tbilisi agglomeration was prepared in accordance with the “Rules of Procedure for Development, Monitoring, and Evaluation of Policy Documents” approved by Resolution №629 of the Government of Georgia dated December 20, 2019. The plan also takes into account issues stipulated by other national strategic documents and international obligations of Georgia.

The preparation of the plan was preceded by carrying out the situation analysis related to the status of ambient air in the target area. The situation analysis was based on a comprehensive baseline study developed by an international expert in the framework of the EU Project “Support to Environmental Protection and Fight against Climate Change in Georgia.”

Based on the data, information, and main findings provided in the baseline study, the *problem tree* method was used to identify the *main problem* related to ambient air pollution and to determine its causative factors – *root causes*, as well as the *negative effects* caused by the problem. The problems and issues described in the baseline study and highlighted in the situation analysis are supported by the ambient air quality monitoring data produced by NEA, further verified by international experts, the data of the national system for accounting for emissions of harmful substances from stationary sources of pollution in the Tbilisi agglomeration and other, including city level data to calculate emissions, and the inspection data of the Department of Environmental Supervision.

In the process of strategic planning, the so-called *objective tree* tool was used. In particular, as a response to the identified problem, taking into account the root causes, the goal and objectives of the plan were determined, which form the main framework of the strategic part of the document.

To support the process of preparation of the plan and to ensure coordination between the parties involved, a working group promoting the improvement of the ambient air quality of the Tbilisi agglomeration was established, which was staffed by representatives of Ministry of Environmental Protection and Agriculture, National Environmental Agency (NEA), Department of Environmental Supervision (DES), Ministry of Economy and Sustainable Development (MESD), Ministry of Regional Development and Infrastructure (MRDI), Ministry of Internal Affairs (MIA), National Center for Disease Control and Public Health (NCDC), Revenue Service

²² Final report on the implementation of the State Program on Measures to Reduce Ambient Air Pollution in Tbilisi 2017-2020, 2021

(RS), National Statistics Office of Georgia, Parliamentary Committee of Environmental Protection and Natural Resources, Tbilisi Municipality City Hall and City Council (Sakrebulo), the civil movement “My City Kills Me” and a non-governmental organization “Green Alternative”. The first meeting of the working group was held on June 20, 2023, where information related to the status and the management of ambient air quality in the Tbilisi agglomeration was presented, and the related issues and approaches to solving the problems were discussed. The second meeting of the working group was organized on November 24, 2023, where the results of the assessment of the ambient air baseline situation in Tbilisi and the potential measures for improving the air quality were presented and discussed. Taking into account the results of the discussion and the comments received, the final version of the plan proposal was prepared.

Following discussions, input from working group members, and expert recommendations, a preliminary version of the Tbilisi Agglomeration Ambient Air Quality Management Plan was developed and shared with the working group for review on January 29, 2024. Incorporating feedback from the group and additional consultations with relevant agencies, a draft of the air quality management plan was completed and made available for public consultation on July 9, 2024. Stakeholders were invited to submit comments and suggestions until August 7, 2024. A public discussion of the draft took place on August 2, 2024, in a hybrid format with 46 participants. Through public consultations, 19 comments were received: 7 were fully adopted, 3 partially adopted, and 9 not adopted.

1.4. Structure of the plan

The document consists of six chapters and four appendices. The first chapter provides an introduction. The second chapter is devoted to the situation analysis, briefly describing the Tbilisi agglomeration and reviewing the main problem - ambient air pollution in Tbilisi and causal factors - sources of pollution. Chapters 3 and 4 represent the strategic part of the plan. Chapter 3 presents the goal and objectives of the plan. The goal is developed based on the identified main problem and the objectives – based on causal factors. Chapter 4 presents a logical framework, which tabulates the plan's goal, objectives, indicators, and corresponding baseline and target values, timelines, and sources of verification. Chapter 5 describes the mechanism of implementation and coordination of the activities outlined in the plan. Chapter 6 explains how the plan's implementation will be monitored and evaluated. The first annex presents a 3-year action plan that outlines the activities, responsible agencies, performance indicators, deadlines, and budgets. Annex 2 represents the budgeting instrument. Annex 3 is a Passport of Indicators. Finally, Annex 4 provides information on the organized public consultations.

2. Situation Analysis

2.1. General description of the Tbilisi Agglomeration

Tbilisi is the capital and the largest city of Georgia, lying in the Eastern part of the country on the banks of the Kura River. It is bordered by the Kvemo Kartli and Mtsketa-Mtianeti regions, particularly, the Gardabani, Tetritskaro, and Mskheta municipalities. The city covers an area of 502 km², divided into two clearly outlined parts by the Kura River – left and right banks. Administratively, Tbilisi consists of 10 districts.

The population of Tbilisi is 1 258 526 people – a third of the country’s population, of which 97.6% are urban and 2.4% rural (as of January 1, 2024).²³ The population density in Tbilisi is 2,495.9 people per square km (as of January 1, 2024), which is the highest compared to other cities in the country.²⁴

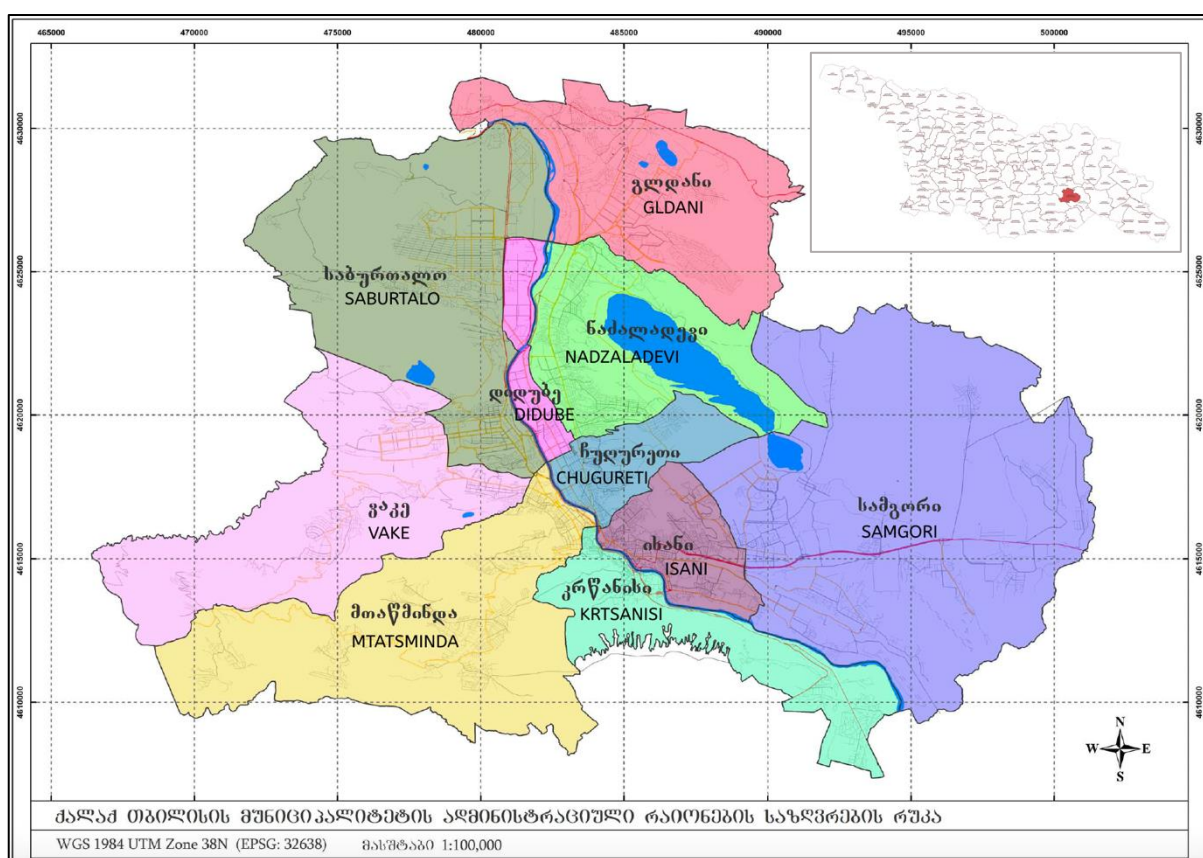


Figure 2-1: Map of the boundaries of the administrative districts of Tbilisi municipality²⁵

23 National Statistics Office of Georgia, as of January 2023: <https://www.geostat.ge/en/modules/categories/41/population>

24 National Statistics Office of Georgia, Statistical Publication “Demographic Situation in Georgia 2021”, 2022: <https://www.geostat.ge/en/single-archive/3376>

25 Tbilisi Municipality City Council Decree №16-41 of 5 December 2014 on determining the boundaries of the administrative units - districts of Tbilisi Municipality and taking appropriate measures

Table 2-1: Data on Tbilisi districts according to the General Population Census, 2014

| District | Area (km ²) ²⁶ | Population ²⁷ | Population % | Density |
|------------------------|---------------------------------------|--------------------------|--------------|--------------|
| Mtsatsminda | 73 | 49,052 | 4 | 672 |
| Vake | 61.7 | 111,903 | 10 | 1,814 |
| Saburtalo | 75.5 | 138,493 | 12 | 1,834 |
| Krtsanisi | 31.7 | 39,286 | 4 | 1,239 |
| Isani | 16.7 | 125,610 | 11 | 7,522 |
| Samgori | 128.4 | 177,844 | 16 | 1,385 |
| Chugureti | 14.3 | 65,230 | 6 | 4,562 |
| Didube | 8.4 | 70,018 | 6 | 8,335 |
| Nadzaladevi | 42 | 154,067 | 14 | 3,668 |
| Gldani | 50.3 | 177,214 | 16 | 3,523 |
| City of Tbilisi | 502 | 1,108,717 | 100 | 2,209 |

The population on the left bank is twice as large as on the right bank. The highest population density is observed in the Didube district (8,335 people per 1 km²), and the lowest – is in Mtsatsminda (672 people per 1 km²). Urbanized areas in Tbilisi cover 158 km² (31%), and green space is 145.5 km² (29%).²⁸

Tbilisi has a complex terrain. It is surrounded by hills on three sides. To the North, Tbilisi is bounded by the Saguramo Range, to the East and South-East by the Iori Plain, and to the South and West by various sub-ranges of the Trialeti Range. Because of these natural boundaries, the city has developed linearly, stretching 33 km along the Kura River. Hills are a significant barrier to urban development, especially for the part lying on the right bank, which is built along the foothills of the Trialeti Range. Such topographic features result in pockets of densely developed areas, while other parts of the city are undeveloped due to the complex relief. The city's elevation ranges between 380-770 meters above sea level. Kura is the main water artery crossing the city from the North-West to the South-East. There are eight more small rivers in Tbilisi – tributaries of the Kura River, which are prone to flash floods due to their narrow and steep riverbeds. Natural hazards such as flooding, landslides, and mudflows have been historically common in Tbilisi, aggravated by anthropogenic factors such as deforestation and urbanization.

Tbilisi lies in a moderately humid climate zone²⁹ with relatively cold winters and hot summers. Due to the specific geography – surrounding hills, the proximity to large bodies of water (the Black Sea and the Caspian Sea), and the Greater Caucasus Mountain Range that hinders the

26 Tbilisi City Hall, Economic Development Office, Tbilisi in Figures, 2018

27 2014 General Population Census Results: <https://www.geostat.ge/en/modules/categories/737/2014-general-population-census-results>

28 Tbilisi City Hall, Economic Development Office, Tbilisi in Figures, 2018

29 Tbilisi Encyclopedia, Academy of Sciences of Georgia, Tbilisi, 2002

intrusion of cold air masses from the North, Tbilisi has a relatively mild micro-climate compared to other cities along the same latitudes and with a similar continental climate.³⁰ The average annual temperature varies from 10.8°C to 12.8°C in the different parts of the city. January is the coldest month, with an average temperature of 0.5°C. July is the hottest month, with an average temperature of 24°C. The highest recorded temperature is 41°C, and the lowest is -24°C. The average annual relative humidity is 66-68%. The average yearly precipitation varies in the range of 540-635 mm. Snow cover lasts, on average, 15-25 days.³¹ North and North-West winds prevail in Tbilisi, and South-East winds are also frequent, conditioned by the surrounding mountains, creating a relief corridor from North-West to South-East. The average annual wind speed is 3-4 m/sec in most parts of Tbilisi, while it is higher in some open areas, such as Dighomi, Samgori, and Saburtalo. In particular cases, wind speed can exceed 40 m/sec.³²

Tbilisi is Georgia's political, economic, financial, cultural and educational center. Tbilisi's gross domestic product is 37 billion GEL (2630,263 GEL per capita), 51% of the country's GDP.³³ Tbilisi's leading sector of the economy is wholesale and retail trade paired with the repair of motor vehicles and motorcycles, accounting for 24% of the capital's GDP, followed by real estate activities (11%) and construction (10%). The industry share in Tbilisi's GDP is 12%, and the share of the transport and storage sector is 8%.³⁴

Tbilisi has a diverse public transit network including an international airport, national railway, subway, municipal buses, minibuses, cabs, cable cars, bike lanes and a funicular.

2.2. Ambient air quality monitoring network in the Tbilisi agglomeration

Ambient air quality monitoring in Tbilisi is carried out using five automatic stations installed in the districts in the city – Didube, Saburtalo (2 stations³⁵), Chugureti, and Samgori, and indicative measurements through quarterly passive sampling. Each of the automatic stations measures the concentrations of particulate matter (PM₁₀, PM_{2.5}), nitrogen oxides (NO_x), sulfur dioxide (SO₂), carbon monoxide (CO), and ozone (O₃) continuously. In 2023, passive samples were taken from 31 different locations of the city to monitor concentrations of nitrogen dioxide, ozone and benzene. In particular, nitrogen dioxide was measured at 29 locations, and ozone and benzene - at 5 locations. In addition, a gravimetric sampling devices were placed gradually next to the each automatic station throughout 2022-2023 for analysis of lead and substances defined by the European Union Directive 2004/107/EC - benz(a)pyrene, arsenic, cadmium, and nickel.

The network is designed, following guidelines in the EU directive 2008/50/EC as laid down in the Georgian legislation Resolution N563 (01.12.21), to monitor the air quality situation aimed to protect human health and ecosystems. For adequate representativeness the number and

30 Geo-cities Tbilisi, an Integrated Environmental Assessment of State and Trends for Georgia's Capital City, 2011

31 Order № 1-1/1743 of the Minister of Economic Development of Georgia dated by August 25, 2008 on the approval of design norms "Construction Climatology"

32 ibid

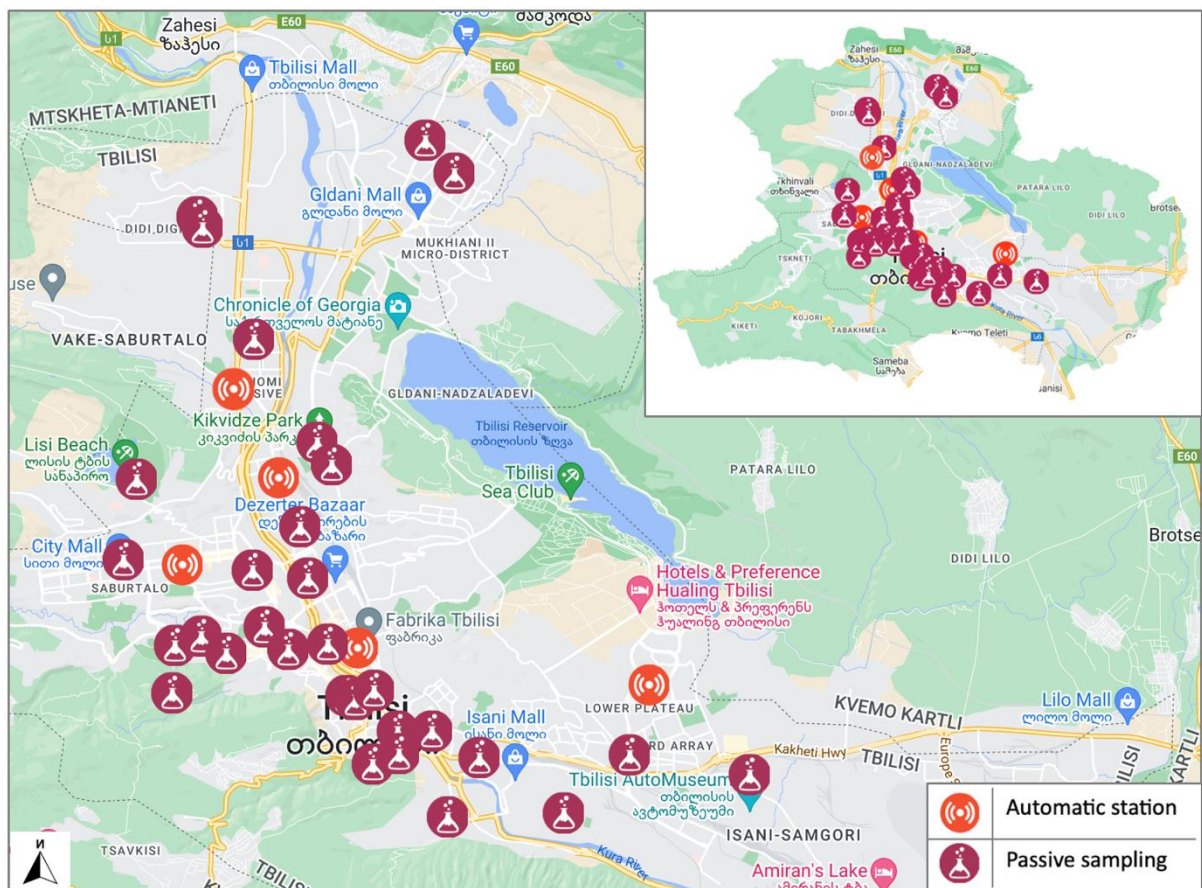
33 National Statistics Office of Georgia, 2022: <https://www.geostat.ge/en/modules/categories/93/regional-statistics>

34 ibid

35 A new 5th station was installed in the Dighomi settlement in the end of 2023. However, monitoring data from this station was not available during the elaboration of this document.

siting of the stations and the data capture rate³⁶ need to comply to minimum number of monitoring sites and percentage of validated measurement results. The minimum is based on the population size and the actual air pollution levels in relation to upper and lower assessment threshold values, specified for each air quality parameter. The actual number of particulate matter monitoring stations is the sum of sites where PM_{2.5} and PM₁₀ are measured (Directive 2008/50/EC, Annex V). Given the population of Tbilisi agglomeration of 1,258,526 million (as of January 1, 2024) and the current (2023) air quality situation, the number of stations is equal or more than required; for particulate matter the total is 10 where 6 would be required. The number of monitoring sites for the other pollutants is in compliance with the requirements. After some years with insufficient data capture the actual data capture rate (2022) is conform the required high value (90%) for most of the stations and parameters. An exception is the monitoring of nitrogen dioxide at the Varketili monitoring site. For the other air pollution components, the levels are so low (below the lower threshold value) that periodic surveys suffice. The monitoring locations for the various pollutants are listed in Table 2-2 and given in Figure 2-2.

The current operation of the network is sub-optimal. To improve operation quality assurance and quality control (QA/QC) practice needs to be further developed and the validation of data needs to be intensified. The foreseen establishment of the National Reference Laboratory is expected to support these improvements.



36 Capture rate is the ratio of validated data with respect to potentially available data points. It indicates the time coverage of the successful monitoring

Figure 2-2: Ambient air quality monitoring in the Tbilisi agglomeration

Table 2-2: Automatic stationary stations for ambient air monitoring and locations for the periodic and indicative ambient air quality monitoring in the Tbilisi agglomeration in 2023³⁷

| Type of monitoring | Measured Pollutants | Location of the monitoring point in Tbilisi | Latitude | Longitude |
|---------------------------|---|---|----------|-----------|
| urban roadside | PM ₁₀ , PM _{2,5} , NO ₂ , SO ₂ , CO, O ₃ | Tserenteli Avenue | 41.7419 | 44.7793 |
| urban roadside | PM ₁₀ , PM _{2,5} , NO ₂ , SO ₂ , CO, O ₃ | Kazbegi Avenue | 41.7249 | 44.7543 |
| urban roadside | PM ₁₀ , PM _{2,5} , NO ₂ , SO ₂ , CO, O ₃ | Varketili 3, I microdistrict | 41.7017 | 44.8756 |
| urban background | PM ₁₀ , PM _{2,5} , NO ₂ , SO ₂ , CO, O ₃ | 73a Agmashenebeli Avenue, Park of Ilia | 41.7088 | 44.7997 |
| urban background | PM ₁₀ , PM _{2,5} , NO ₂ , SO ₂ , CO, O ₃ | Marshal Gelovani Avenue 34, Dighomi | 41.7600 | 44.7691 |
| Periodic | Pb, As, Cd, Ni, PAH ³⁸ | At all above locations | | |
| Indicative | NO ₂ | 29 Tianeti highway | 41.8073 | 44.8174 |
| | NO ₂ , O ₃ | Gldani Garden | 41.8011 | 44.8250 |
| | NO ₂ | Ioane Petritsi St | 41.7926 | 44.7580 |
| | NO ₂ | Didi Digomi, Public School #186 | 41.7904 | 44.7595 |
| | NO ₂ | Digomi Park | 41.7688 | 44.7727 |
| | NO ₂ | Veterans' Park | 41.7489 | 44.7892 |
| | NO ₂ | 275 Tsotne Dadiani St | 41.7443 | 44.7930 |
| | NO ₂ , O ₃ | Lisi Lake | 41.7415 | 44.7421 |
| | NO ₂ , benzene | 60 Tsereteli Ave | 41.7325 | 44.7847 |
| | NO ₂ | Komarovi School | 41.7261 | 44.7389 |
| | NO ₂ | 21 Pekini St | 41.7238 | 44.7723 |
| | NO ₂ | Mushtaidi Park | 41.7223 | 44.7868 |
| | O ₃ | Turtle Lake | 41.7000 | 44.7515 |
| | NO ₂ , O ₃ , benzene | Vake Park | 41.7092 | 44.7522 |
| | NO ₂ | 44 Chavchavadze Ave | 41.7110 | 44.7591 |
| | NO ₂ | 27 Abashidze St | 41.7077 | 44.7656 |
| | NO ₂ | Tbilisi Zoo | 41.7130 | 44.7753 |
| | NO ₂ , C ₆ H ₆ | 2 Melikishvili Ave | 41.7085 | 44.7815 |
| | NO ₂ | 9 Ushangi Chkheidze St | 41.7096 | 44.7921 |
| | NO ₂ | 6 Rustaveli Ave | 41.6997 | 44.7969 |
| | NO ₂ | April 9 Garden | 41.6988 | 44.7993 |
| | NO ₂ | "Deda Ena" Garden | 41.7007 | 44.8040 |
| | NO ₂ , O ₃ | Rike Park | 41.6927 | 44.8101 |
| | NO ₂ , benzene | Heroes' Park | 41.6926 | 44.8192 |
| | O ₃ | Botanical Garden | 41.6862 | 44.8035 |
| | NO ₂ , O ₃ | Abanotubani | 41.6882 | 44.8105 |
| | NO ₂ | 80 Ketevan Tsamebuli Ave | 41.6874 | 44.8315 |
| NO ₂ | Krtsanisi Garden | 41.6759 | 44.8233 | |
| NO ₂ | Navtlugi, Sergi Tsuladze St | 41.6767 | 44.8534 | |
| NO ₂ , benzene | Varketili, 5 Javakheti St | 41.6880 | 44.8706 | |
| NO ₂ | 13 Kiziki St | 41.6843 | 44.9018 | |

³⁷ Source: air.gov.ge

³⁸ For the category polycyclic aromatic hydrocarbons (PAH) benz[a]pyrene is measured as as proxy.

2.3. Emission inventory

Information on the emissions from sources with an impact in the Tbilisi agglomeration leads to the identification of relevant sources needed to develop measures for. The emission inventory for the situation analysis was based on data obtained from the Ministry of Environment Protection and Agriculture (MEPA), specifically from Ambient Air Division under the Environment and Climate Change Department providing information on stationary (point) sources of air pollution; general official statistics (population, geography, etc.) were collected from the National Statistics Office of Georgia (GEOSTAT); certain specific sectoral data was provided by the Municipality of Tbilisi (Municipal Transport Department, Department for Infrastructure development, Department of Environment Protection, Tbilisi Architecture Service, LLC Tbilisi service group). Other relevant sources of information were the Ministries of Economy and Sustainable Development (MoESD), the Ministry of Internal Affairs (MIA), the Georgian National Energy and Water Regulation Commission (GNERC) and furthermore the Georgian Railway and the Civil Aviation Agency. Activity information was converted to emission information using the EMEP/EEA Air Pollutant emission inventory guidebook³⁹ or specific emission models (for traffic the COPERT5 model⁴⁰ with special EU emission factors⁴¹ was used).

This gathered emission information provides insight in the relative contribution of sources to the total emissions. An optimal use of this information was to apply atmospheric dispersion models to calculate annual average or period average concentration. As such models are currently not operational for Tbilisi the monitoring results are the only information on concentration levels in Tbilisi. In a first-order approach, in which the differences in the way the emissions take place are disregarded, emission contributions to the total emitted amount and their contributions to the total measured concentration are assumed to be proportional. A complication with this approach is the contribution of natural sources.

Natural sources are considered all those sources that contribute to the concentrations of air pollutants but are not linked to manmade activities. This list of natural sources include (i) transport of natural particles from dry regions, (ii) dusting from open ground, (iii) sea spray, (iv) volcanic eruptions and seismic activities and (v) wild-land fires. The contribution of these sources might be left out of the compliance testing if sufficient evidence is presented. The nature of the contribution, such as primary biological aerosol particles or secondary organic biogenic aerosols, is not sufficient to be eligible for subtraction. The contribution of natural sources add to that of the anthropogenic sources and are measured in the total concentration.

2.4. Evaluation of ambient air quality in the Tbilisi Agglomeration

The evaluation of air quality monitoring data reveals the ambient air pollution issues in Tbilisi, including the levels of particulate matter (PM₁₀ and PM_{2.5}), nitrogen dioxide (NO₂), and ozone (O₃). Other pollutants are apparently in compliance with the national/EU standards and are monitored in a reduced manner. The evaluation is based on the data generated with the regular ambient air quality monitoring performed by the NEA. This data was studied and validated by the international experts of the EU Project "Support to Environmental Protection

³⁹ <https://www.eea.europa.eu/publications/emep-eea-guidebook-2019>

⁴⁰ <https://copert.emisia.com/w/Copert>

⁴¹ <https://www.eea.europa.eu/data-and-maps/data/external/copert-emission-factors>

and Fight against Climate Change in Georgia.” The obtained results were evaluated with respect to the national air quality standards, which are based on EU standards, for compliance checking, and on the standards recommended by the World Health Organization as Air Quality Guidelines (WHO AQG). The latter focusses on human health impacts and are stricter than the European standards. Currently the EU standards are being revised to align more with the WHO AQG recommendations.

2.4.1. Particulate Matter PM₁₀

PM and the related health effects

Particulate matter PM₁₀ and PM_{2.5} are particles with an (aerodynamic) diameter of less than 10 and 2.5 micrometers (µm) respectively. These particles are inhalable and are associated with adverse health effect. Increasingly, based on recent findings, smaller particles, UFP fraction (ultrafine particles, PM_{0.1}) are related with health effects. The UFP fraction is gaining interest from a health perspective as these particles can pass physiological barriers and enter the bloodstream.

Among the potential negative health effects of PM are respiratory problems, cardiovascular problems, and developmental problems in children. Long-term exposure to PM has been linked to an increased risk of lung cancer and other types of cancer. In addition, there is growing evidence that PM exposure may contribute to cognitive decline and dementia, especially in older adults. Overall, exposure to particulate matter is identified as causing premature death and shortening healthy life expectancy.

The particles are emitted by various sources in a wide variety of compositions. Both physical and chemical mechanisms can generate particulate matter under various chemical and atmospheric conditions. Mechanical mechanisms predominantly create the coarse particles of the particulate matter of PM₁₀ (PM₁₀-PM_{2.5}), and chemical reactions as part of the emission processes and atmospheric chemical processes create the fine particles, often identified as PM_{2.5}. An even smaller fraction (PM₁) is the result of specific (often high-temperature) reactions.

PM₁₀ Levels in Tbilisi

The results for PM₁₀ monitoring are presented in Figure 2-3 for the years 2017 to 2023. The monitoring station in the Park of Ilia came into commission in May 2019. The values of 2023 are only based on the monitoring results until June 2023. The number of days with PM₁₀ concentrations higher than 50 µg/m³ is shown in Figure 2-4.

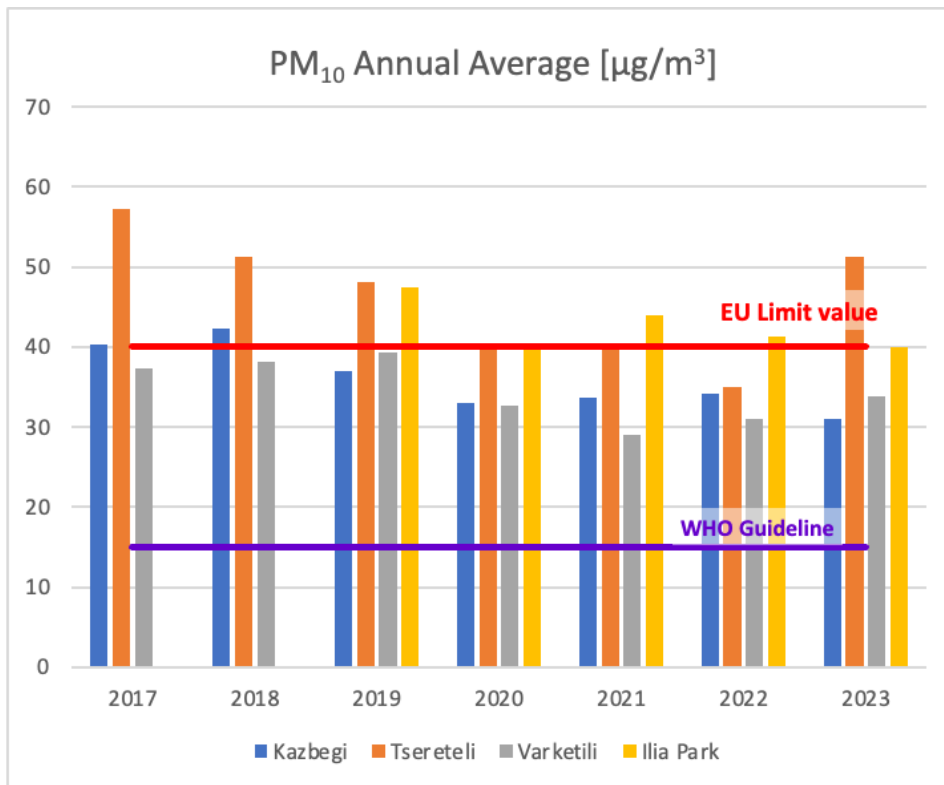


Figure 2-3: Annual average concentration PM_{10} (in $\mu g/m^3$) at the four stations in Tbilisi for the years 2017-2023 (until June) and the EU limit value for annual average concentration and the corresponding WHO limit value

The annual averaged PM_{10} concentrations at the three monitoring stations, Kazbegi, Tsereteli, and Varketili, show a similar pattern over the years (see Figure 2-3). The concentrations at Tsereteli are higher than at the other sites. This difference is decreasing from 45% in 2017 to a few % in 2022. The higher concentration at Tsereteli for 2023 (only 1st half year) is caused by road construction works that took place during most of the first six months and very close to the monitoring station. The annual average PM_{10} concentration at the Park of Ilia site, which is considered an urban background station, is surprisingly high. Analysis of the daily averaged data shows that the levels at this station on particular days in winter are the highest compared to the other stations. Inspection of the surroundings suggests the commercial activities developed after the installation of the monitoring station might have a more than proportional impact on the measurements. This impact limits the characterization of the Park of Ilia station as an urban background station. The low ratio $PM_{2.5} / PM_{10}$ compared to common values in urban areas, indicated in the database of EEA, suggests high contribution of particles created by mechanical forces, such as those with construction and demolition activities, and is in line with the emission inventory data (see hereafter).

The annual average concentration varies from 30 to just over 40 $\mu g/m^3$ for Kazbegi and Varketili, whereas the maximum concentration over the entire evaluation period for Tsereteli and Park of Ilia is around 50 to 60 $\mu g/m^3$ (1.25 to 1.5 limit value). The effect of lower activity during the COVID-19 pandemic is visible but not for the Park of Ilia.

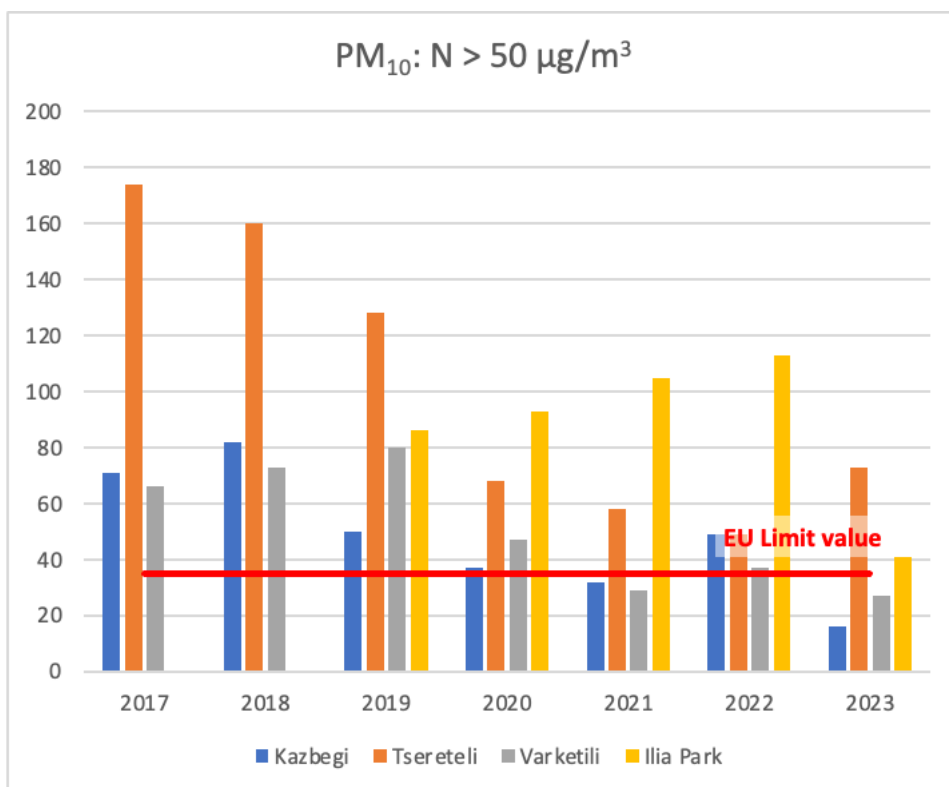


Figure 2-4: Number of days per year with daily averaged PM_{10} concentrations larger than $50 \mu\text{g}/\text{m}^3$ and the limit number according to the EU Directive ⁽³⁵⁾.

The number of days with daily averaged concentrations higher than $50 \mu\text{g}/\text{m}^3$ at the stations are high, in particular at Tsereteli, decreasing from 2017 to 2020 to become comparable with the other two stations. The number of days at the Park of Ilia increase from 2020 on. The low number for 2023 might be caused by the fact that only the first half year is evaluated. Values between 100 (Park of Ilia) and 175 (Tsereteli) implies that 25 to 50% of the time, the concentrations are higher than $50 \mu\text{g}/\text{m}^3$, where $40 \mu\text{g}/\text{m}^3$ is an annual average limit value.

The origin of particulate matter at the days with high concentrations ($>50 \mu\text{g}/\text{m}^3$) was initially associated with the presence of dust clouds identified at the monitors of the meteorological division of NEA. However, these data from satellite observations do not indicate the elevation of the dust clouds, relevant as only tropospheric pollution is measured in the network.

To investigate the notion that long-range transport of dust could have a significant impact on the air quality in Tbilisi the origin of particulate matter was investigated. For all the days in 2021, identified by the meteorological division of NEA as days where the PM_{10} concentration potentially is affected by dust clouds originated elsewhere, most likely outside Georgia, the back trajectories were calculated with HYSPLIT, an operational model of the Air Resource Laboratory of NOAA⁴². Georgia is surrounded - south-west, south, south-east and north-west - by arid areas (low Arid Index) where dust storms are likely to develop under favorable conditions (see Figure 2-5).

⁴² USA National Oceanic and Atmospheric Administration. <https://www.noaa.gov/>

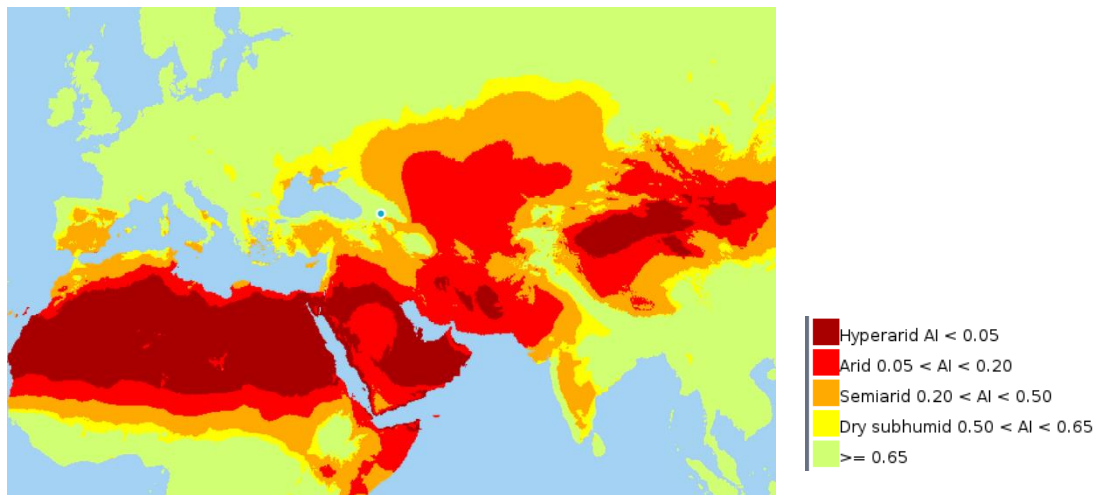


Figure 2-5: Aridity Index for the surroundings of Georgia (blue spot)

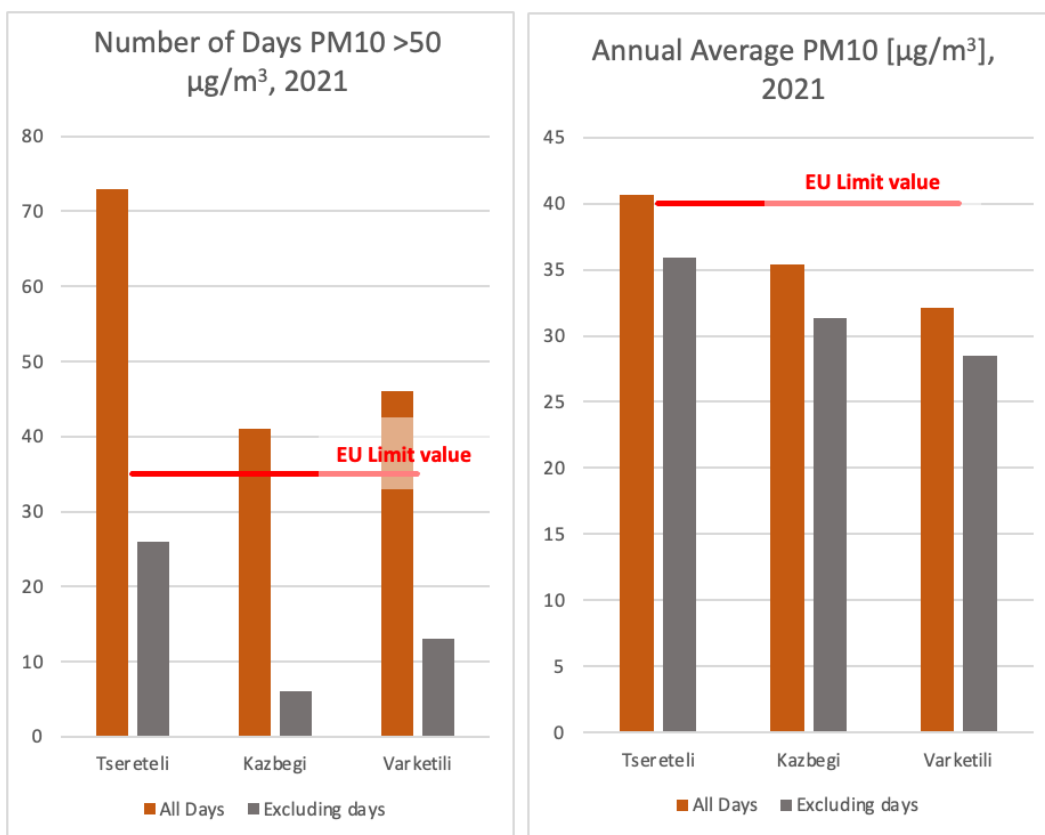


Figure 2-6: (Left) Number of days with concentration > 50 µg/m³ for all days of 2021 and after days with a possible dust contribution have been excluded. (Right) Annual average concentration in µg/m³ for all days of 2021 and after days with a possible dust contribution have been excluded.

The back trajectories show that for most of the days identified by satellite images the likelihood for long-range transboundary air pollution contribution - dust clouds - are high. Not for all days the back trajectories were conclusive and could not be linked definitely to dust clouds. Nevertheless, the relevance of the phenomenon is illustrated with the maximum decrease of number of days with levels higher than 50 µg/m³ to maximum well below 35 (5 – 25), whereas the annual average is reduced by only 10% (see Figure 2-7). While the findings

of this study are inconclusive, given their relevance and significance, further research is strongly recommended.

Compliance with the standards

Table 2-3: PM₁₀ national standards

| Air Pollutant | Maximum allowable level | Tolerance limit | Averaging period | Number of allowable excesses during the year |
|------------------|-------------------------|-----------------|------------------|--|
| PM ₁₀ | 50 µg/m ³ | 50% | 24 hours | 35 |
| | 40 µg/m ³ | 20% | 1 year | 0 |

The monitoring data show that Kazbegi and Varketili comply with the annual averaged limit value (40 µg/m³) except in 2017 through 2019. At Tsereteli, the annual averaged concentrations are equal to or higher than the limit value, but for 2022 (34.9 µg/m³). Again, the high concentrations observed in 2023 at Tsereteli are highly likely attributed to road construction works.

The number of days with concentrations higher than 50 µg/m³ is higher than the allowable 35 days per year but for Kazbegi (32) and Varketili (29) in 2021. The number of days was decreasing since 2017, further accentuated in the COVID-19 period. The number for 2023 is only of half a year, so it might easily double throughout this year.

In summary, levels at a part of the stations comply with the limit values for annual averaged concentrations, but show high concentrations (>50 µg/m³) at more days than allowed. Consequently, PM₁₀ forms a reason for concern. This will be more accentuated when limit values follow the WHO AQG.

Sources of PM₁₀ in Tbilisi

The emission of PM₁₀ from antropogenic sources in the Tbilisi agglomeration and from the direct surroundings are given in Figure 2-7.

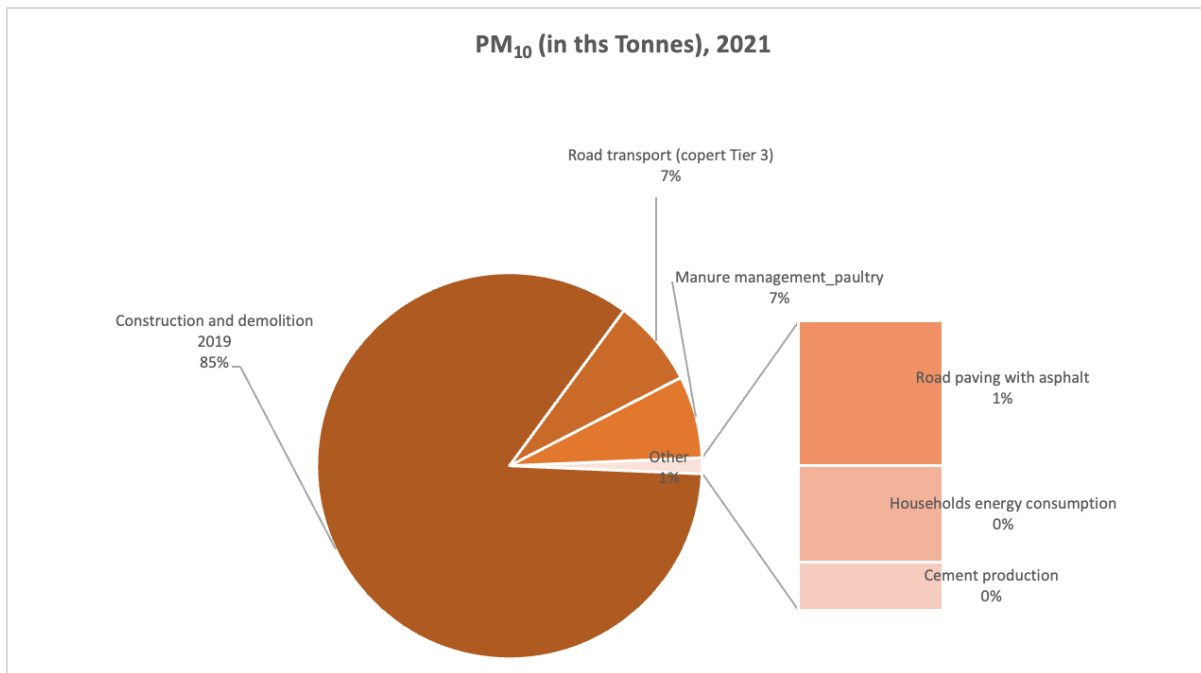


Figure 2-7: Source categories of the PM₁₀ emissions in Tbilisi agglomeration and direct surroundings. For methodology see text

Construction and demolition are the major contributors in the total PM₁₀ emissions, with 84%, and the two categories, transport and manure management, emit most of the remaining (7% each). The construction and demolition emissions are mainly generated by physical processes and mechanical forces and subsequently most of the main particles are in the coarse mode (larger than 2.5 µm). The other categories contribute 1% or less. The uncertainty in the emission values for the construction and demolition category is substantial (rough estimate: 1 to 4 times). This is due to a lack of information on the status of registered activities and their dimensions, for which the published emission factors are applied. Reducing the estimated emission from construction by a factor of 4 would increase the emission contribution of traffic and manure management to 19%. The latter PM₁₀ contribution is due to activities taking place in the southern part of the city and may have less effects on monitored PM concentration in Tbilisi.

Except from antropogenic sources natural, biogenic sources are relevant as well for the PM₁₀ concentrations. Usually the background concentrations are monitored at stations specially located for this purpose. At this stage this site is not available. The observation of the dust clouds and the limited survey to identify source areas mentioned hereabove is part of the natural contribution. More investigation is required to estimate the level of this contribution.

2.4.2. Particulate Matter PM_{2.5}

PM_{2.5} levels in Tbilisi

The annual averaged concentrations of PM_{2.5} measured at the various monitoring stations from 2017 to June 2023 are shown in Figure 2-8.

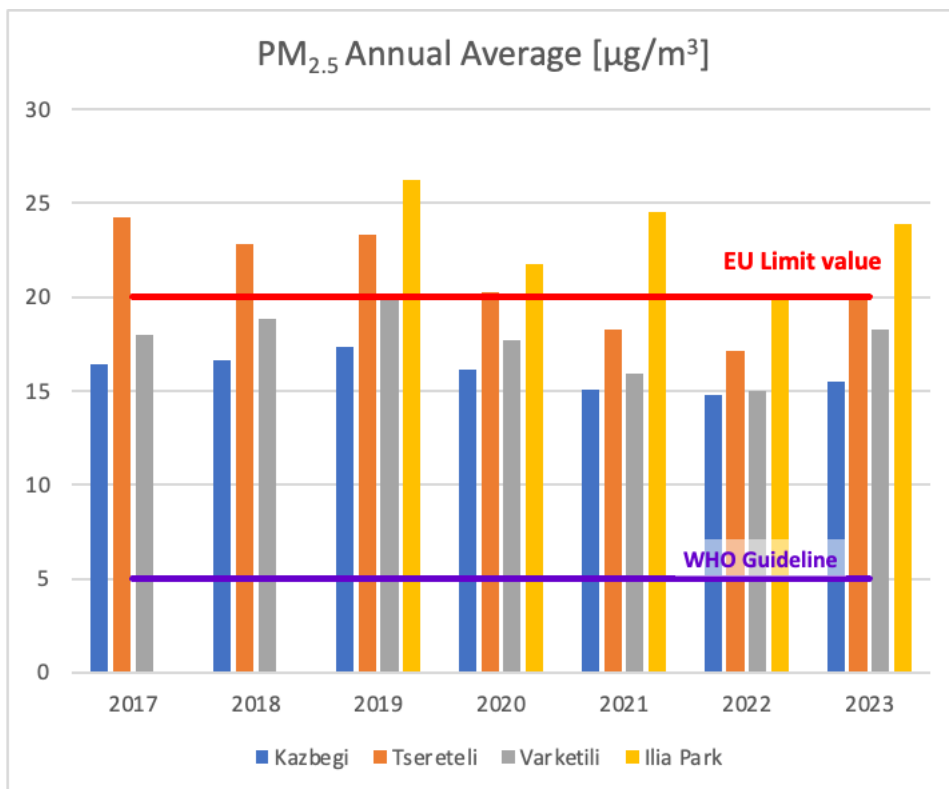


Figure 2-8: Annual average concentration $PM_{2.5}$ (in $\mu\text{g}/\text{m}^3$) at the four stations in Tbilisi for the years 2017-2023 (until June) and the EU limit value for annual average concentration and the corresponding WHO limit value

The annual average $PM_{2.5}$ concentration (Figure 2-9) ranges from 15 to 20 $\mu\text{g}/\text{m}^3$ for Kazbegi and Varketili. For Tsereteli, the level is higher in 2017 – 2019 (20 to 25 $\mu\text{g}/\text{m}^3$) and for the Park of Ilia each year since it is operational (20 to 26 $\mu\text{g}/\text{m}^3$). The circumstances at the Park of Ilia station, already mentioned in the evaluation of PM_{10} , have an even stronger effect for $PM_{2.5}$.

Inspection at the Park of Ilia site shows a substantial exhaust, most likely from heating and cooking facilities. The smoke from these ovens will have a high content of $PM_{2.5}$ and even smaller particulate matter. The condition in the Park of Ilia also leads to high extreme values (in this case, the 99 percentile – 3 days have higher concentrations, see Figure 2-9). For this reason, the results of the station at Park of Ilia are not included in the evaluation.

Both for the annual average and the 99-percentile, the COVID-19 pandemic has had some noticeable effects.

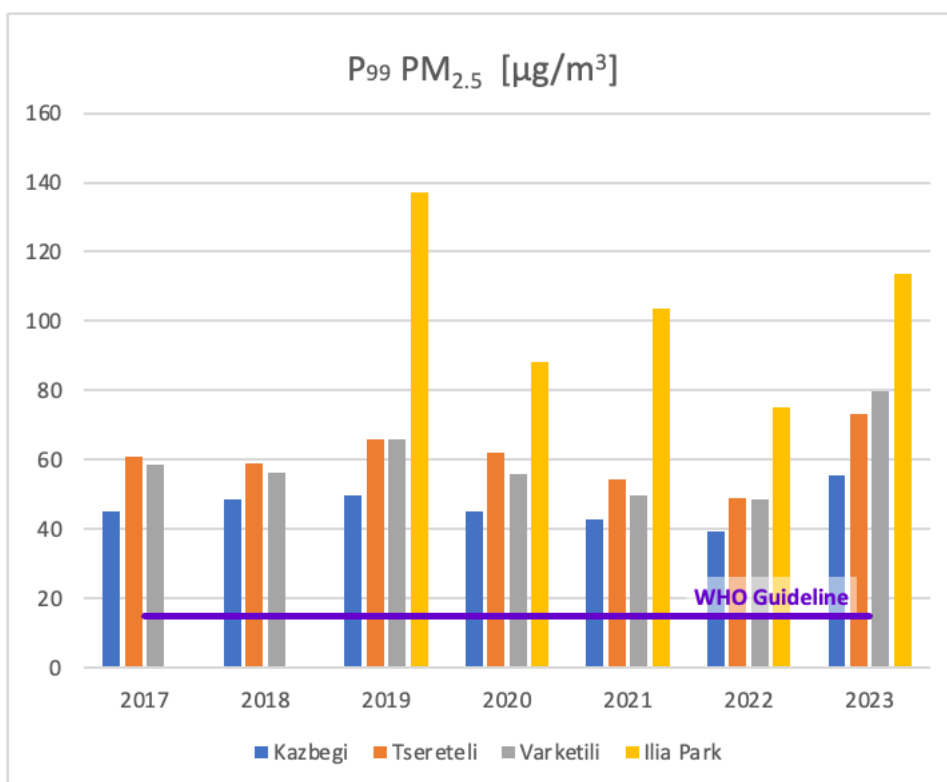


Figure 2-9: 99-percentile of the daily averaged PM_{2.5} concentrations at the various monitoring stations for the year 2017 – 2023 (until June)

Compliance with the standards

Table 2-4: PM_{2.5} national standards

| Air Pollutant | Maximum allowable level | Tolerance limit | Averaging period | Number of allowable excesses during the year |
|-------------------|-------------------------|-----------------|------------------|--|
| PM _{2.5} | 20 µg/m ³ | 20% | 1 year | 0 |

The annual average PM_{2.5} concentrations at the three urban stations - Kazbegi, Varketili, and Tsereteli - are below the maximum allowable level of 20 µg/m³ after 2020. This implies that the air quality with respect to PM_{2.5} is since then in compliance with the current Georgian standards and the EU directives.

With regard to the WHO AQG, with an annual averaged allowable level of 5 µg/m³, the levels at all stations are 3 to 4 times higher. The same applies to the 99-percentile (15 µg/m³).

In summary, the urban stations are currently in compliance with the Georgian and European standards but far beyond the WHO AQG levels. If not currently, then after updating the EU and, subsequently, Georgian limit values to become more aligned with the WHO AQG limit values, PM_{2.5} levels will exceed the limit norms. Therefore, PM_{2.5} is a reason for concern for air quality management in the Tbilisi agglomeration.

Sources of PM_{2.5} in Tbilisi

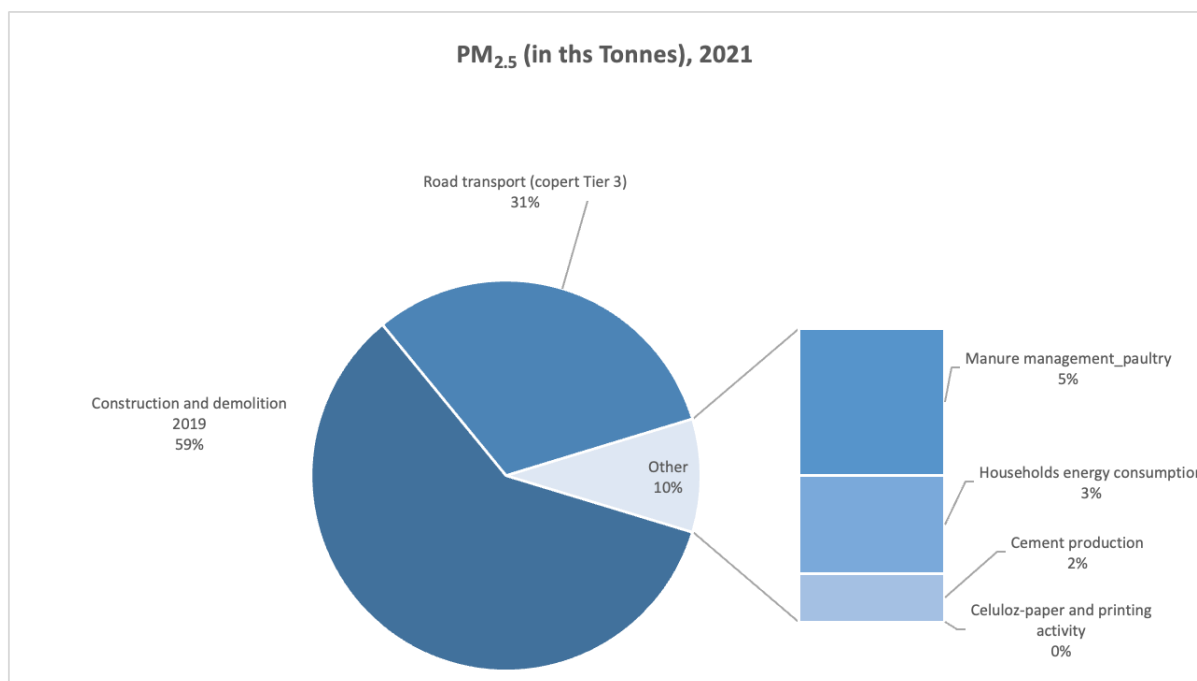


Figure 2-10: Source categories of the PM_{2.5} emissions in the Tbilisi agglomeration and direct surroundings

The antropogenic sources of PM_{2.5} emissions are presented in Figure 2-10. A large contribution is from the category construction and demolition (59%), followed by the emission from mobile sources (transport/traffic, 31%). The remaining 10% is emitted by other categories, of which domestic heating (household energy, 3%) is the main contributor. As is the case for the PM₁₀ emissions from the category construction and demolition, also for PM_{2.5}, the uncertainty is substantial. If the range is 1:3 the contribution of the category construction and demolition to the total emission in the Tbilisi agglomeration is 1/3 of it at the minimum and consequently the contribution of traffic is 51%.

Biogenic, natural source contributions are hard to estimate as no data of background stations are available. The PM_{2.5} fraction is smaller than PM₁₀ and the lifetime in the atmosphere is much longer. The fine particles are predominantly the result of chemophysical reactions in the atmosphere of compounds either emitted from antropogenic activities or natural emissions. Vegetation, forest – both emitting reactive gasses that produce particles - and sea (as spray) can contribute to the concentration of PM_{2.5} at far distances. Detailed analyses of particulate matter – such as measuring secondary and carboneaceous aerosols might reveal the origin of the particulate matter.

2.4.3. Nitrogen Dioxide

Nitrogen oxides and the related health effects

Emission of nitrogen oxides (NO_x) is mainly caused by combustion processes, often as a mixture of nitrogen monoxide (NO) and nitrogen dioxide (NO₂). NO reacts with oxygen (or ozone) over time to form NO₂. Nitrogen dioxide forms nitrate with water and, as such, acts as

a precursor for secondary particulate matter. Nitrogen oxides are involved in the formation and destruction of tropospheric ozone in complicated atmospheric chemistry. NO₂ and ozone are important oxidants in the atmosphere, and NO₂ poses a risk for human health and ecosystems (vegetation). Short-term exposure to high concentrations or long-term exposure to low concentrations are related to serious health effects and, as such, are of interest for air quality management.

Among the potential negative health effects associated with NO₂ are respiratory irritation, aggravated lung disease, reduced lung function, increased risk of respiratory infections, cardiovascular problems, and developmental problems in children. Also, emerging research suggests a potential link between long-term NO₂ exposure and cognitive decline and dementia, particularly in older adults.

NO₂ Levels in Tbilisi

The results of the measurements at four monitoring stations in Tbilisi from 2017 to June 2023 are shown in Figure 2-11. These data are not complete due to problems with erroneous calibration or disfunction of the instrument. Overall, the NO₂ concentrations vary from 30 to 50 µg/m³, averaging 40 µg/m³.

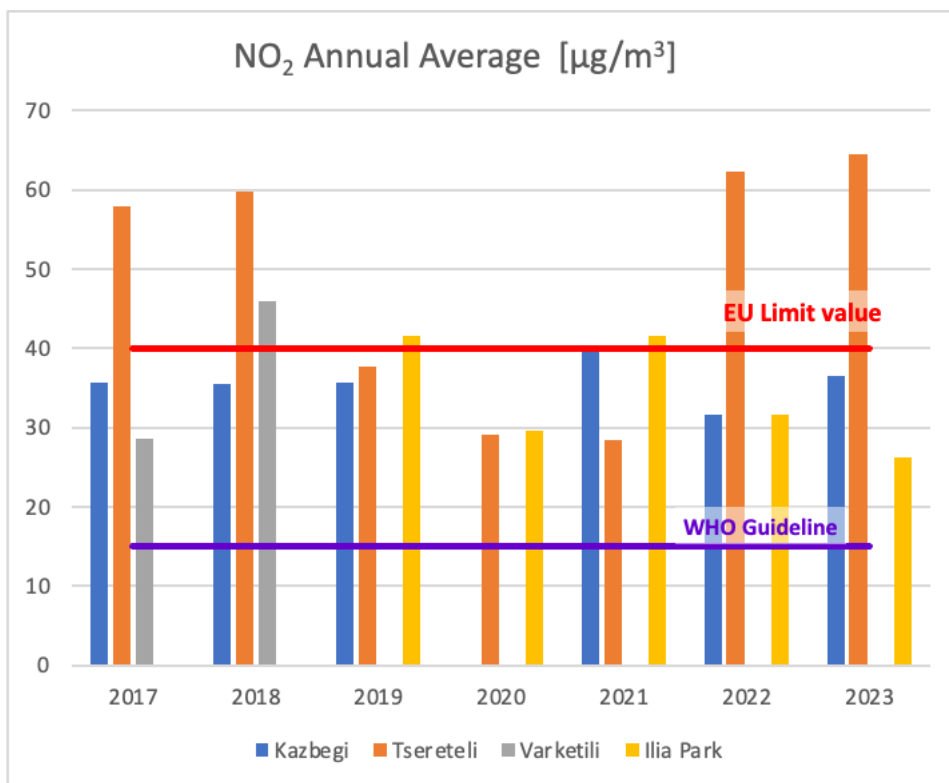


Figure 2-11: Annual averaged NO₂ concentration (in µg/m³) at the four stations in Tbilisi for the years 2017-2023 (until June). Missing data due to erroneous calibration or instrument disfunction.

Another source of information on NO₂ concentrations are the results of the passive sampling followed by laboratory analyses for NO₂ in the years 2019 – 2022. The sampling duration was about 14 days, and the 4-stage sampling campaign was spread over the year – 56 days in total.

The samplers were located all over the Tbilisi agglomeration (see Figure 2-2 and Table 2-2). The results are combined in the Box-Whisker Plot, indicating the quartiles (see **Error! Reference source not found.**).

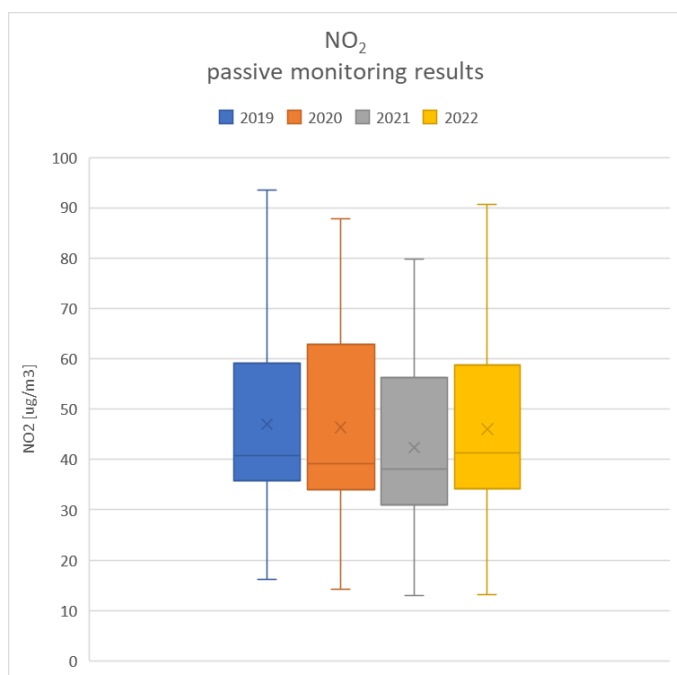


Figure 2-12: Box-whisker plot of all NO₂ test results during the period 2019-2022 in µg/m³, showing the minimum, 25 percentile, median (cross), 75 percentile and maximum values of the dataset for each year.

Compliance with the standards

Table 2-5: NO₂ national standards

| Air Pollutant | Maximum allowable level | Tolerance limit | Averaging period | Number of allowable excesses during the year |
|-----------------|-------------------------|-------------------|------------------|--|
| NO ₂ | 200 µg/m ³ | 50% ⁴³ | 1 hour | 18 |
| | 40 µg/m ³ | 50% ⁴⁴ | 1 year | 0 |

The monitoring results for nitrogen dioxide (NO₂) of the continuous monitoring (variation in time) indicate annual average levels of 40 µg/m³. The results of the passive monitoring (variation in space) indicate median levels of approximately 45 µg/m³ for the years 2019 to 2022. Based on the limit data it can be concluded that the annual averaged NO₂ concentration is higher than the current limit value - 40 µg/m³, and consequently, NO₂ is reason for concern.

The given NO₂ monitoring results do not enable checking compliance for the hourly average concentration (200 µg/m³). It might be considered unlikely that such a high concentration will develop in ambient air and measured at the monitoring site if no an extreme condition exists.

With regard to the comparison with the WHO AQG levels (10 µg/m³), the reason for concern is even stronger as the current level is four times higher.

⁴³ After every 12 months, it is reduced in equal amounts finally to 0% by 1 January 2025.

⁴⁴ Same as footnote 35

Comparing the 99-percentiles at the Tsereteli monitoring site shows that these values are 3 – 5 times higher than the WHO AQG level of 45 µg/m³.

Sources of NO₂ in Tbilisi

Nitrogen oxides are formed and emitted in combustion processes, particularly at moderate to high temperatures. In an urban environment, such as Tbilisi, traffic is a major contributor (62%), as are processes producing heat or power, such as domestic heating (household energy 23%) and stationary sources of combustion (9%). The remaining (6%) is emitted through processes that use heat or power (Figure 2-13).

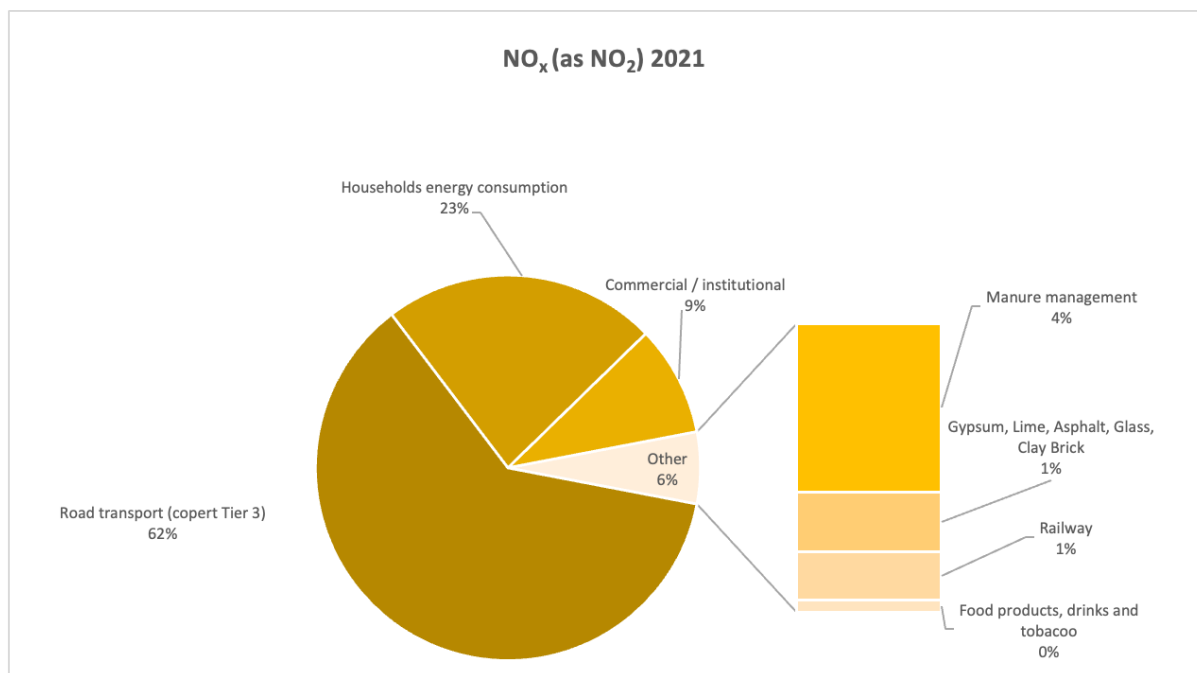


Figure 2-13: Sources of nitrogen oxides (NO and NO₂) in the Tbilisi agglomeration

2.4.4. Ozone

Ozone and health effects

Ozone is formed in the atmosphere under specific meteorological conditions (temperature, radiation) in the presence of nitrogen oxides, volatile organic compounds (VOC), carbon monoxide and methane. Nitrogen oxide titrates ozone, removing it by chemical reaction with ozone. In an extremely complicated set of atmospheric chemical reactions, nitrogen oxides also promote the formation of ozone. Nature emits compounds that promote the formation of ozone, and a base level (especially over the sea) is present. The increase of ozone concentration especially occurs in nitrogen and VOC-rich conditions downwind of the area where these emissions occur. Ozone levels stabilize during cooler nighttime temperatures.

While ozone plays a crucial role in protecting Earth from harmful ultraviolet radiation in the upper atmosphere, ground-level (tropospheric) ozone can have adverse effects on human health, such as respiratory irritation, aggravated lung diseases, reduced lung function, increased risk of infections, and cardiovascular problems. Long-term exposure to ozone pollution has been associated with an increased risk of premature death from respiratory and

cardiovascular causes. Current levels of ozone have acute effects on a large part of the population especially people with sensitive lungs or breathing conditions.

Ozone Levels in Tbilisi

The measurements of ozone are only partly successful and substantial number of results are missing. As ozone has a direct harmful effect on humans when exposed sufficiently intense or long, a short-term average is considered as an appropriate metric for protecting health as a moving 8hr average value. In addition, for long-term effects, the ozone-season-peak value is defined by WHO⁴⁵ as the average of the maximum of the moving 8hr averages for each day per month calculated over 6 months with the highest values.

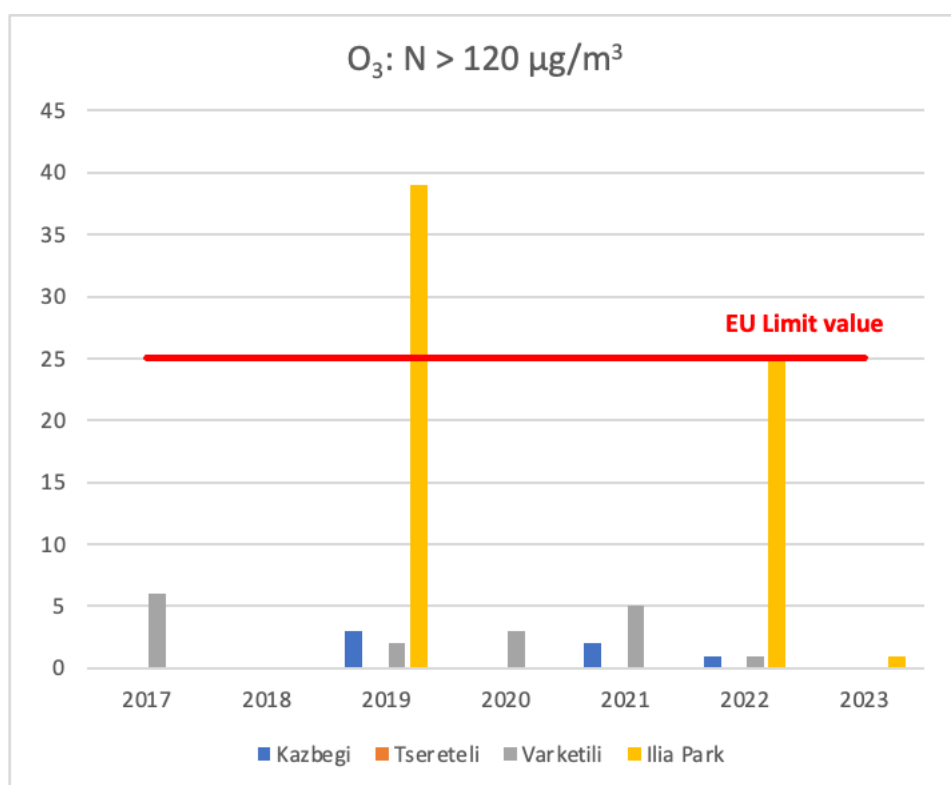


Figure 2-14: Number of days per year with ozone concentrations (8hr mean) higher than 120 µg/m³ for all sites and the years 2017 – 2023 (until June)

The short-term exposure indicator as the number of days with maximum 8hrs average concentration is shown in Figure 2-15. Only for the station at Park of Ilia these days occur at a substantial rate in 2019 and 2022. The data capture during the years in between were not sufficient. At the other station, measurements were successful but the values were not often high. This is in line with the higher concentration of nitrogen oxides at the urban station, impacted by traffic emissions.

45 WHO global air quality guidelines. Particulate matter (PM 2.5 and PM 10), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide. Geneva: World Health Organization; 2021. Licence: CC BY-NC-SA 3.0 IGO

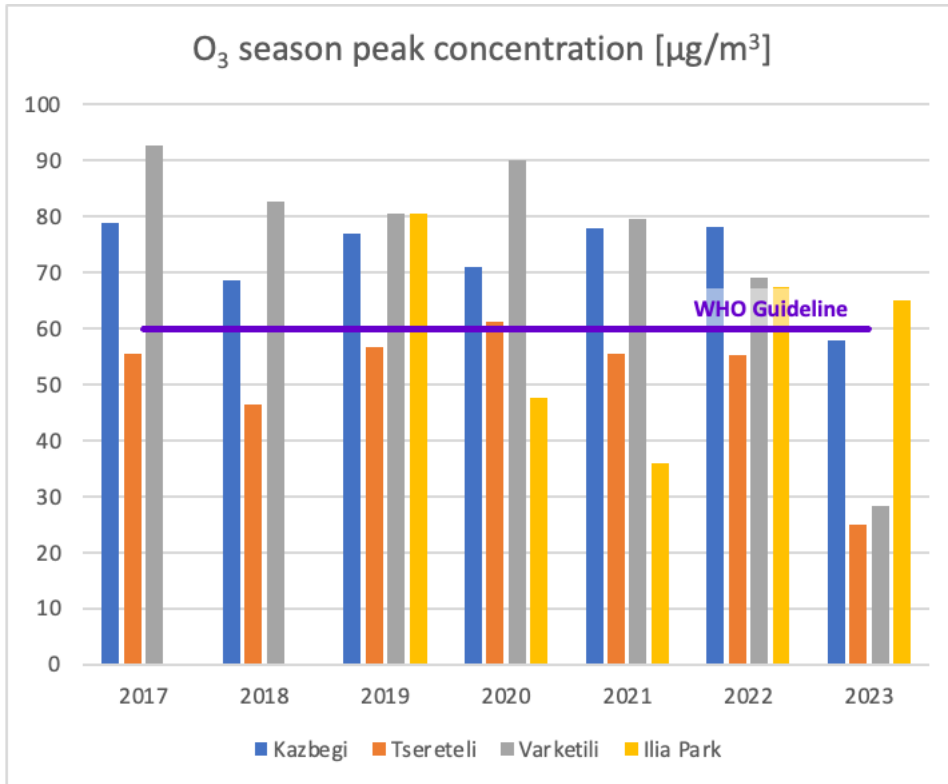


Figure 2-15: Ozone season peak concentration (µg/m³) at the four monitoring stations for 2017-2023 (until June).

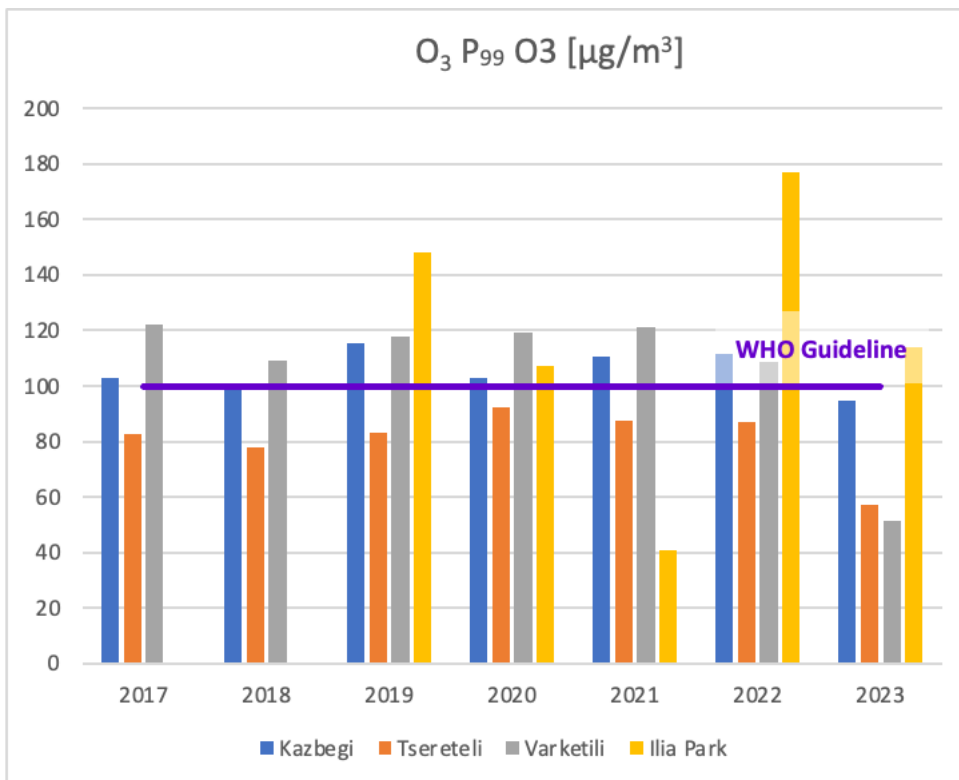


Figure 2-16: Extreme values (99-percentiles) of the 8hr-averaged maximum values per day for all monitoring sites for the years 2017 – 2023.

The indicator for the long-term exposure, the ozone season peak concentration (See Figure 2-16), shows that at the stations, less directly affected by traffic emissions (Park of Ilia and to a lesser extent Kazbegi and Varketili), this indicator is higher than the limit value of 60 µg/m³. The capture rate at the Park of Ilia station in 2020 and 2021 was such that months with lower averages were added for the calculation.

The indicator for short term exposure to ozone, defined by WHO as the 99-percentile of the 8hr maximum value per day is given in Figure 2-17. It shows exceedances of the guideline value - 100 µg/m³. Again, at the stations less directly affected by traffic emission these values are higher. This is caused by the atmospheric chemical reaction of nitrogen oxide emitted by the combustion in the car engine with ozone, removing ozone from the air.

Compliance with the standards

The number of days with ozone concentrations higher than 120 µg/m³ is low for the monitoring sites Kazbegi, Tsereteli, and Varketili. For the Park of Ilia location, the number of days with concentrations higher than 120 µg/m³ is high for 2019 and 2022 and null for the other years due to missing data. The number for 2019 (39 days) even exceeds substantially the maximum allowable number (25 days).

Table 2-6: Ozone national standards

| Air Pollutant | Maximum allowable level | Tolerance limit | Averaging period | Number of allowable excesses during the year |
|----------------|-------------------------|-----------------|---|--|
| O ₃ | 120 µg/m ³ | 100% | Maximum daily 8- hour average ⁴⁶ | 25 ⁴⁷ |

With regard to the WHO AQG, the 99-percentile at the Kazbegi and Varketili locations in all the years (except 2023) exceeds the limit value of 100 µg/m³. The values stay below the limit value at the Tsereteli location, for the Park of Ilia station the concentration exceeds the limit value in the years when sufficient data is available.

For all the years (except the half year of 2023), the peak season concentration, a renewed indicator for long-term exposure to ozone⁴⁸, exceeds the limit (60 µg/m³) at the Kazbegi and Varketili location, sites where the impact of traffic might be less than at the Tsereteli location. At the Tsereteli site, the peak season value exceeds the limit values only in 2020 (slightly – 61.1 µg/m³). The pattern of the peak season concentration at the Park of Ilia site is erratic, which might be caused by the rather low capture rate for the ozone monitoring at this site.

In summary, although the levels of ozone in Tbilisi over the past 6 years suggest compliance, the evaluation of the data in light of the renewed WHO AQG indicates a serious source for concern.

Sources of Ozone in Tbilisi

46 Same as footnote 35

47 In a 3-year averaging period. If a three-year average cannot be determined on the basis of the total and consistent annual data, the minimum data for the purpose of verifying compliance with the threshold limit shall be one-year reliable data

48 WHO global air quality guidelines. Particulate matter (PM 2.5 and PM 10), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide. Geneva: World Health Organization; 2021. Licence: CC BY NC SA 3.0 IGO

Ozone is a secondary air pollutant, meaning it forms as a result of atmospheric chemical reactions involving various compounds like volatile organic compounds, nitrogen oxides, carbon monoxide, and water. These reactions are initiated by sunlight, leading to the formation of ozone through radical formation. It is not only the amount of each of the precursors but also the composition of the mixture of compounds that react in a complex pathway. Anthropogenic emissions, as well as natural emissions, play an important role. The source strength of the latter shows strong seasonal variation. Anthropogenic emissions are nitrogen oxides and the non-methane volatile organic compounds. Figure 2-17 shows the source categories for these nmVOCs.

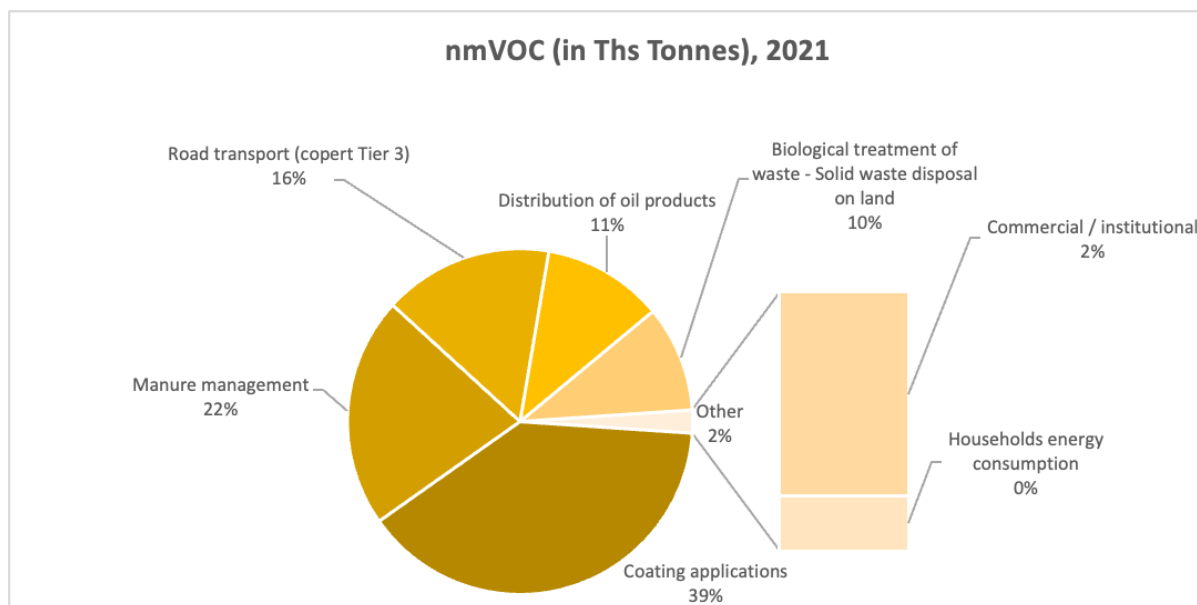


Figure 2-17: Emissions of non-methane volatile organic compounds (nmVOC)

Industrial production in which VOCs are used as ingredient in a production process or because of physical features (e.g., solvent) (49%), manure management (21%), traffic (16%) and fugitive emission (e.g., petrol handling and storage) (11%) are the main anthropogenic sources. Very reactive compounds are released from vegetation, controlled by meteorological factors (temperature, humidity, season) beyond human control. The presence (and hence emission) of nitrogen oxides also plays an important role in the formation and titration (removal) of ozone.

2.4.5. Other Measured Pollutants

Benzene

Numerous sources contribute to the presence of benzene, including many of the same sources that emit volatile organic compounds (VOCs), among which benzene is included. Traffic has historically been a significant contributor, but over decades, the benzene content in fuel has decreased to 1% and is now regulated under the EURO5 standard.⁴⁹ Exposure to benzene

⁴⁹ DIRECTIVE 2009/30/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 April 2009

might occur in the occupational as well as in the private setting and it is generally assumed that indoor exposure is more important.⁵⁰

Benzene was measured using passive sampling and GCMS analysis at 3 varying locations in Tbilisi in March, June, September, and November from 2017 to 2021. The annual averaged concentrations over the years are lower than the limit value set for benzene (5 µg/m³). There is a tendency to decrease further, so benzene is not a reason for concern from an ambient air quality management perspective.

The WHO approaches the limit value from a risk assessment perspective because benzene is carcinogenic, and no safe level exists. An acceptable risk (excess lifetime risk 1/100 000) corresponds to an annual average concentration of 1.7 µg/m³. The annual averaged concentration for 2021 is approximately 1.5 times as high as the acceptable concentration.

Sulfur Dioxide

The emission of SO₂ has long been reduced to levels where the resulting concentrations are not significant anymore. When sulfur-containing fuel is used, SO₂ will be emitted unless technology is applied to minimize the emissions. Half of the emissions are fugitive emissions, for which no control is in place.

The concentrations measured in the period 2017 – 2023 at the two sites in Tbilisi (Kazbegi and Tsereteli) are well below the national/EU limit values and the highest measured concentration is about 50% of the WHO AQG limit values. Therefore, SO₂ is no source of concern.

Carbon Monoxide

Based on the emission inventory the main and nearly sole source of carbon monoxide in Tbilisi Agglomeration is traffic (91%). The other sources (together 9%) are domestic heating/household energy, stationary combustion, and industrial combustion.

The concentrations measured at all four sites in Tbilisi (Kazbegi, Tsereteli, Varketili, Ilia Park) over the years 2017 – 2023 are substantially lower (max. 35%) than the national/EU limit values and also lower (6% - 88%) than the WHO AQG limit values. This implies that CO is no source of concern.

Lead

Primary sources of lead in the ambient air are traffic and industrial production. Other sources hardly contribute to the total source emission.

Lead was analyzed in ambient air particulate matter collected from September 2018 until March 2020. The annual average concentration is substantially lower than the limit value of 0.5 µg/m³ in nearly 300 samples. One sample had a concentration equal to the limit value.

Since the second half of 2021, the determination of the concentration of lead (Pb) and other heavy metals in the air has been started by new gravimetric equipments next to the stations of Tsereteli and the Park of Ilia. In 2022-2023 the same equipments was installed next to all

⁵⁰ <https://www.ncbi.nlm.nih.gov/books/NBK138708/>

stations including the new station in Dighomi. The annual mean concentration of lead in 2022 equaled to 0.0484 $\mu\text{g}/\text{m}^3$ at Tsereteli station and 0.0044 $\mu\text{g}/\text{m}^3$ in the Park of Ilia, which is 10 to 100 times less than the limit value. Hence, it can be concluded that the levels are in compliance with the applicable national/EU limit values.

Other Heavy Metals

Sources of heavy metals include traffic as the main source for all, clinical waste incineration (in particular, Cd), households (As), and fugitive emission during refining and storage. The wear of other (mechanical) processes might also contain heavy metals if they are applied in the devices.

Heavy metals (Cd, As, Ni) were measured in the particulate matter samples collected from August 2021 until December 2022 in the Park of Ilia and Tsereteli Avenue. Evaluation of the data against the limit values shows that the concentrations of the measured heavy metals at the stations located in Park of Ilia and at the Tsereteli Avenue are well below the National/EU limit values.

Polycyclic Aromatic Hydrocarbons

The primary source of PAHs (benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, and indeno[1.2.3-cd]pyrene) is the manufacturing and handling of food products and drinks and smoking of tobacco. Other relevant sources are railways and printing activities. Although not included in the emission inventory, traffic is also considered a relevant source.

The concentration of benzo[a]pyrene measured from August 2021 till December 2022 at the Park of Ilia and Tsereteli station, average and 95-percentile, are 6% and 34% of the national/EU limit value (1 ng/m^3). The level is well below the lower assessment threshold⁵¹ and the approach suffice for assessing the PAH contamination level.

2.4.6. Other factors contributing to the problem

Insufficient air quality and related health data and information

Precise monitoring data is essential for identifying sources of ambient air pollution and thus enabling targeted policies, regulations, and interventions to reduce emissions. Adequate monitoring data is also important for measuring the effectiveness of implemented policies and adjusting the strategies as needed. At the same time, understanding the link between air pollution and specific health outcomes helps to understand the actual burden of air pollution on individuals and communities as a response to which policymakers can develop more effective air quality regulation and public health measures. This can lead to improvements in air quality and reductions in associated health problems.

As mentioned in Chapter 2.2, the existing monitoring system needs improvement to adequately assess air quality situation in Tbilisi, including additional automatic station and

⁵¹ DIRECTIVE 2008/50/EC, Annex II: 'upper assessment threshold' shall mean a level below which a combination of fixed measurements and modelling techniques and/or indicative measurements may be used to assess ambient air quality; 13. 'lower assessment threshold' shall mean a level below which modelling or objective-estimation techniques alone may be used to assess ambient air quality lower assessment threshold' shall mean a level below which modelling or objective-estimation techniques alone may be used to assess ambient air quality

QA/AC systems. It is also essential to develop air quality modelling to generate a more comprehensive picture of how pollutants will disperse and react in the atmosphere under different conditions, including varying weather patterns and emission scenarios. That will allow policymakers to prepare for potential problems and assess the impact of proposed regulations or emission reduction strategies before they are implemented.

There is currently no national-level data on the health impacts of air pollution in Georgia. It is essential to study and assess the exposure of the Tbilisi population to excess concentrations of harmful substances and the related health consequences. Further development and implementation of quantitative health impact assessment (qHIA) will enable assessing the impact of measures as well as (autonomous) developments in terms of improvement of human health situation in Tbilisi

Low level of public awareness

Public support is crucial for better air quality management. Public support puts pressure on decision-makers to prioritize air quality improvements. This translates into stronger legislation, stricter emission standards, and increased funding for air quality monitoring, research, and infrastructure development. At the same time, public support is essential for effective implementation of air quality policies and regulations, resulting in enhanced compliance and behavior change. When the public understands the seriousness of air pollution and its impact on their health and well-being, they are more likely to comply with regulations and adopt behaviors that improve air quality. This can include actions like using public transportation, reducing car usage, opting for cleaner fuels, and conserving energy. Additionally, public support fosters community-led initiatives like tree planting programs, carpooling schemes, and clean air campaigns, further amplifying the positive impact.

2.4.7. Evaluation Summary

Applicability of air quality monitoring network results

The air quality monitoring network operated by NEA is in need of some extension, improvement of quality assurance mechanisms and thorough inspection of the surroundings of the monitoring stations, which is anticipated for the coming period. Nevertheless, the results that are available when the air quality assessment was done, give a sufficiently clear description of the air quality situation of the Tbilisi Agglomeration to identify concerns to be addressed by quantitative air quality management. Further, improvements of the network and its operation will make it comply with the requirements set forth in the EU directive and ensure better comparison with standards and other locations. Most likely these will not change the perceived situation substantially.

Conclusion on air quality situation: particulate Matter – PM₁₀/PM_{2.5}

Particulate matter concentrations are a matter of concern and the activities of the main sources, traffic and construction/demolition, are likely to develop further resulting in higher emissions if no abatement measures are implemented. Given the increasing load of evidence of the harmful effects on human health and the associated tendency to lower the limit values⁵² particulate matter emissions are to attract management attention.

Conclusion on air quality situation: nitrogen dioxide

Nitrogen dioxide annual average concentrations are higher than the limit value and consequently need to be addressed by quantitative air quality management. With increasing activity of the sector traffic (projected increase of the number of cars) NO₂ concentrations are expected to be further increased in the near future. Motivated by the scientific review of the WHO, EU also proposes to lower the limit values and include daily averaged limit value⁵³, underpinning the need for quantitative air quality management attention.

Conclusion on air quality situation: ozone

Ozone is usually lowered by the presence of combustion emissions (such as traffic emissions) and therefore not a (big) air quality management issue in dense urban areas. In spite of this effect, in areas with high sun radiation levels, emissions of volatile organic compounds, both natural and anthropogenic, ozone levels will be substantial. This is the case in Tbilisi, where the levels at the urban background station are high (measured so if sufficient data is available) and indicated by the ozone-season-peak value. Ozone is a secondary air pollutant and can only be reduced if the (simultaneous) reduction of (anthropogenic) VOCs and nitrogen oxides is accomplished.

Conclusion on other air pollutants

For the other pollutants the information obtained with the periodic surveys and indicative campaigns show no reason for concern. Periodical surveys, every 3 to 5 years, might warrant that the air pollution with these compounds remains in check. With the revision of the air quality directives also new parameters might become part of the suite of indicators in the (near) future.

52 [https://www.europarl.europa.eu/RegData/etudes/BRIE/2023/747087/EPRS_BRI\(2023\)747087_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/BRIE/2023/747087/EPRS_BRI(2023)747087_EN.pdf)

53 *ibid*

3. Goals and Objectives of the Action Plan

The plan aims to **improve ambient air quality in the Tbilisi Agglomeration**. As mentioned in the introduction, the development of an action plan is stipulated by the law of Georgia on “Ambient Air Protection,” which requires the development of an ambient air quality management plan for a zone and/or agglomeration where the levels of main pollutant substances in ambient air exceed any limit norm or target value.

The number of monitoring points in the Tbilisi agglomeration, where the average annual concentrations of certain pollutants are within the norms, are suggested as *impact indicators* in the plan. The aim is to decrease pollution caused by problematic pollutants and keep the levels of those currently within the norms. This approach is in line with the national legislation and the EU Directive on Ambient Air Quality (Directive 2008/50/EC) which aims at maintaining air quality where it is good and improving it in other cases. Even though ozone levels in Tbilisi are a concern, an ozone norm was not added as a separate impact indicator as ozone formation depends on other pollutants - NO₂ and VOCs, for which respective measures are being planned.

Georgian national air quality standards - limit norms and target values have been harmonized with the corresponding EU standards and values. However, air quality standards recommended by the WHO that consider the health effects of air pollution are significantly lower. As a part of the Zero Pollution Ambition, the EU is in the process of revising its air policy, where air quality standards are planned to align with the values of WHO air guidelines. Therefore, while the target for the given action plan is to reach the national, i.e., the EU standards, the longer-term goal should be aiming at WHO standards to ensure air quality that is not unhealthy for humans.

To achieve its goal and the target values, objective 1.1 of the action plan addresses ambient air pollution by solid particles caused by major emission sources such as industry and construction and also smaller contributing factors - dust pollution from streets and open spaces; objective 1.2 focuses on the reduction of NO₂ emissions from the transport sector and most likely will also achieve reduction of PM_{2.5}; objective 1.3 aims at improving the system for monitoring and assessment of ambient air quality and related health impacts, which is essential for better understanding of linkages between the ambient air quality and human health to promote air quality improvement further; and lastly, objective 1.4 aims at public education and awareness raising on air pollution and its impact on human health, which is essential for supporting the successful implementation of the plan. Specific measures to achieve these objectives (42 measures for four objectives) are described below.

Objective 1.1. Reduction of ambient air pollution with solid particles in the Tbilisi agglomeration

The given objective aims to reduce the concentration of solid particles in the ambient air in the Tbilisi agglomeration by reducing emissions from the respective emission sources such as industry, construction, and open areas. The transport sector, another significant source of PM emissions in Tbilisi, is addressed in another objective (objective 1.2) targeting NO₂ emissions.

Implementation of the activities under the given objective will also reduce the transport share in PM emissions and contribute to a reduction in overall PM emissions.

According to the currently available data, the share of the industrial sector in the total PM₁₀ and PM_{2.5} emissions in the Tbilisi agglomeration is not major. Still, it is essential to keep the control over the industrial emissions so that these are within the established maximum allowable emission norms. Regulations targeting major industrial facilities in Georgia were tightened in 2021. These included the introduction of the obligations for reporting real-time continuous instrumental monitoring data⁵⁴ and increasing fines for excessive emissions and other non-compliance.⁵⁵ To support adequate implementation of these obligations, strengthening their enforcement is essential. Accordingly, it is planned to increase the number of annual inspections (activity 1.1.1).

Dust emissions from the streets and open areas contribute to air pollution with PM₁₀ and PM_{2.5} in Tbilisi, even though to a lesser degree. To address this, activities such as regular wet cleaning using modern methods (activity 1.1.2) and rehabilitation of open spaces with greening or other means (activity 1.1.6) will be implemented to reduce the dispersion of dust particles. Covering the areas will reduce the potential for reemission of dust and particulates into the ambient air. The positive co-effects of decreasing the number of open areas are improved living environment, partially reduced land-slide and erosion risk, and reduced surface water pollution risk.

According to the situation analysis, the construction sector is the biggest source of PM₁₀ and PM_{2.5} in Tbilisi. The proposed measures to reduce the impact from the construction sector are: improving existing regulations to reduce dust emissions caused by construction and demolition (1.1.3); improving enforcement of regulations on prevention of dust emissions during construction and demolition in Tbilisi (1.1.4); and improving the enforcement of regulations on the placement, transportation and sale of dusty construction materials in Tbilisi (1.1.5). The sanctions for administrative offenses related to violating environmental measures during construction or transportation of construction materials in Tbilisi have been tightened since 2019. Activity 1.1.3 implies supporting the implementation of the existing regulations by developing practical guidelines for dust reduction for construction sites, including road construction/rehabilitation and building. The requirement has been in place already in previous Air Quality Management plans, but little has been achieved during the previous period. One of the obstacles can be defined as the requirement for dust and particulates reduction and prevention being too general. The activity foresees the development and adoption of clear guidelines on dust and particulates emission prevention. It is assumed that clear guidance on operation will help construction companies understand and comply with the established rules. Guidance also allows effective enforcement that will be implemented according to the developed annual plans to inspect implementation of the regulations on

⁵⁴ GoG Resolution #413 of 31 December 2013 on the approval of the technical regulation for the self-monitoring and reporting of the release of harmful substances from stationary sources of pollution as amended by Resolution #192 of 27 April 2021 that entered into force on 1 June 2021

⁵⁵ Administrative Offences Code of Georgia, as amended on 12 March 2021

prevention of dust emissions during construction and demolition as well as disposal, transportation and sale of dusty construction materials in Tbilisi.

Objective 1.2 Reduction of nitrogen dioxide (NO₂) emissions in the Tbilisi agglomeration

The objective to reduce actual emissions of NO₂ is targeting the transport sector, which is the major source of not only NO₂ emissions but also PM₁₀ and PM_{2.5} emissions in Tbilisi. There are 25 activities planned under the given objective. Some of these are focused on strengthening the regulations and enforcement, such as improving road monitoring and inspection of vehicles (activities 1.2.1 – 1.2.4), establishing noise standards from operating vehicles (1.2.17), and Introduction of EURO 6 vehicle emission standard (1.2.22). The focus will be on the catalytic converter, a key component of a vehicle's emissions management system that plays a critical role in reducing harmful emissions, such as particulate matter and NO₂, released into the atmosphere. This report (1.2.6) will explore opportunities to reduce the harmful practice of catalytic converter removal and outline a plan to take additional steps to prevent such occurrences in the future. While the presence of a catalytic converter is currently verified during periodic technical inspections, instances exist where converters are temporarily installed solely for inspection and then removed afterward. Additionally, in 2023, a 3-year ban was introduced on the export of catalytic converters to further deter their removal.

Some activities are aimed at improving traffic management, including expanding the design of the intelligent traffic light system to consider the actual air quality condition in Tbilisi and the development of modern road infrastructure design standards for the Tbilisi agglomeration (activities 1.2.5, 1.2.8). Intelligent traffic light systems can optimize traffic flows and shorten travel times. With actual air quality information, it could induce measures to reduce emissions in sensitive areas, thus supporting the application of dynamic low-emission-zones.

The intensification of construction activities in the Tbilisi agglomeration has a negative impact on transport. In particular, the impact at the construction stage may be related to traffic disruptions and also traffic congestion due to the movement of construction trucks. A more long-term effect is an increase in traffic flows towards the new facilities and an increased demand for parking spaces. In order to promote the consideration of the mentioned impacts in the decision-making process, it is planned to develop a methodology for assessing the impact of architectural projects to be implemented in Tbilisi on the transport (activity 1.2.23).

Other activities in this task focus on encouraging behavioral change and promoting alternative transportation by implementing car restrictions (e.g., by the expansion of the zonal-hourly parking system) and enhancing public transportation, including connections between Tbilisi and the surrounding cities and settlements, improving infrastructure for pedestrians and bicycles, and supporting the use of electric cars (1.2.9, 1.2.10, 1.2.12 – 1.2.16, 1.2.18 – 1.2.21, 1.2.24). Tbilisi is a central hub, with people commuting daily from surrounding areas. Emissions from vehicles traveling into and out of the city place a strain on air quality. Enhancing public transport links, including rail lines, will significantly improve bus and rail traffic between Tbilisi and nearby areas, helping reduce reliance on private vehicles.

In addition, it is planned to analyze the effects of the tax reform implemented in 2017 that aimed to encourage the import of cleaner and newer cars (1.2.7). Finally, due to the urgency

of the issue, a working group on transport issues for the economic agglomeration of Tbilisi will be created at the governmental level (activity 1.2.11).

Objective 1.3. Improving the assessment of the ambient air quality and the impact of air pollution on human health in the Tbilisi agglomeration

The reliable monitoring data is essential for assessing the air quality situation within a zone/agglomeration, which is a basis for developing the air quality plan. Therefore, improving air quality monitoring, data collection, storage, analysis, and quality control systems is highly relevant. The activities that aim at this objective are improving knowledge on the status of the ambient air and its health effects and helping to assess the impact of the activities on air quality.

The activities outlined in this plan aim to enhance the quality of data and the information system related to ambient air quality. This will be achieved through the development of relevant standard operating procedures (SOPs), creation of training programs, and delivery of training sessions (activity 1.3.1), updating the emissions inventory for the Tbilisi agglomeration (activity 1.3.2), and implementing urban-level air quality modeling within the Tbilisi agglomeration (activity 1.3.5). The emissions inventory is the primary source of information on air pollution sources and their contribution to the air quality situation in Tbilisi. The emissions inventory needs to be updated, corrected and complemented for each cycle of development of an air quality management plan to be able to identify types and scales of measures to address each pollution source effectively. Air quality modelling is an essential tool for understanding and managing air pollution. It allows linking emission inventory data with concentration data, considering the complex processes that affect air quality, including the emission, transport, and transformation of pollutants. Information provided by air quality models can be used to identify pollution sources, assess the effectiveness of air pollution control measures, and develop air quality forecasts.

To better understand the impacts of the construction sector, which is the most significant contributor to PM emissions in Tbilisi, a specific assessment will be conducted on the impacts of construction and demolition on the ambient air situation in Tbilisi (activity 1.3.3).

Finally, an assessment of the exposure of the Tbilisi population to excess concentrations of harmful substances (PM₁₀, PM_{2.5}, NO₂) will be undertaken (activity 1.3.4). Exposure to air pollutants is directly related to adverse health effects. Linking health-related information to the air quality situation is essential to better plan and justify the measures' relevance to improving air quality.

Objective 1.4. Public awareness raising on air protection in Tbilisi Agglomeration

Raising public awareness about air quality and pollution empowers people to take action. It encourages a collective movement for cleaner air and builds political support that can lead to stronger environmental regulations and increased funding for air quality programs, thus fostering a healthier and more sustainable future for all.

Various general and more specific information and awareness-raising events will be implemented under the given objective for different target groups, such as the general public

(activities 1.4.2 and 1.4.3), educational institutions (activity 1.4.1), public transport drivers (activity 1.4.4), and construction sector operators (activity 1.4.6).

Awareness of the risks associated with air pollution empowers individuals to make informed decisions to protect themselves and their families, including making informed choices about their daily activities, such as avoiding outdoor exercise on high-pollution days (e.g., during winter or summer smog conditions) or using public transportation instead of driving own private cars. Increased awareness can lead to positive behavioral changes that contribute to cleaner air. For instance, individuals may choose to carpool, use energy-efficient appliances, or reduce their use of wood-burning stoves. The planned information campaigns to educate/inform the public on the benefits of sustainable (shared) mobility (activity 1.4.3) aim to reduce the number of vehicles on the streets and thus reduce air pollutant emissions. In addition, Tbilisi will participate in the annual European Mobility Week (activity 1.4.2). Every year, in September, the European Commission's flagship awareness-raising campaign on sustainable urban mobility invites towns and cities across Europe and beyond to participate in the European Mobility Week. During the week, almost 3,000 towns and cities encourage behavioral change in favor of active mobility, public transport, and other clean, intelligent transport solutions by organizing awareness-raising activities and events with local stakeholders.

The planned information campaigns for public transport drivers are intended to raise their awareness on the benefits of eco-driving. Aggressive driving (high acceleration and intensive braking) causes increased emissions from the vehicle. (Limited) scientific publications indicate high emissions (up to 10 – 20 times of NO₂ and PM) during the high acceleration periods, adding high emissions of PM₁₀ and PM_{2.5} caused by excessive wear of tires, brakes, and road surfaces. High acceleration is also related to excessive noise production. In addition, aggressive driving causes other negative impacts on health of others due to stress, linked to back pain, neck pain, headaches, fatigue, stress, and anxiety. Aggressive driving is widely observed in Tbilisi, including among public transport drivers. The activity aims to promote eco-driving by educating and informing the drivers about eco-driving (slow acceleration, anticipation for braking, stopping, applying correct tire pressure, etc.) and about the health benefits for fellow urban dwellers.

Information campaigns for construction operators (activity 1.4.6) intend to educate and inform operators of the construction sector about the existing regulations and methods for preventing dust emissions in operation and transportation. The activity will include information campaigns at all construction sites in the city using dedicated information material. The aim is to inform and educate construction operators about the methods (including dust mitigation/suppression measures) and regulations to prevent dust from being emitted during handling and transport.

Finally, to expand information and raise awareness on the existing air quality situation in Tbilisi, a one-time extended indicator monitoring campaign will be conducted, the results of which will be publicly available (activity 1.4.5).

The goal of the action plan is fully consistent with the relevant goal (goal 7) of the sectoral priority – air protection of the NEAP-4 – "ensuring clean and safe air for human health throughout the territory of Georgia" and with objective 14.4 of the Vision 2030 Development Strategy of Georgia - "Improving Ambient Air Quality and Development of the Ambient Air Quality Monitoring and Assessment System." The objectives of the Action Plan are also consistent with the objectives of the NEAP-4 and Vision 2030.

Table 3-1: Compliance of the goals and objectives of the Tbilisi Agglomeration Ambient Air Quality Management Plan with the national policy documents

| Ambient Air Quality Management Plan for the Tbilisi Agglomeration 2024-2026 | The 4th National Environmental Action Program of Georgia 2022-2026 | Vision 2023 Development Strategy of Georgia |
|---|---|---|
| Goal: Improvement of ambient air quality in the Tbilisi Agglomeration | Goal 7: Ensuring clean and safe air for human health throughout the territory of Georgia | Objective 14.4: Improving Ambient Air Quality and Development of the Ambient Air Quality Monitoring and Assessment System |
| Objective 1.1: Reduction of ambient air pollution with solid particles in the Tbilisi agglomeration | Objective 7.1 Reducing the emission of harmful substances from various sources of pollution | |
| Objective 1.2: Reduction of nitrogen dioxide (NO ₂) emissions in the Tbilisi agglomeration | | |
| Objective 1.3: Improving the assessment of the ambient air quality and the impact of air pollution on human health in the Tbilisi agglomeration | Objective 7.2 Development of the ambient air monitoring and assessment system | Objective 14.4: Improving Ambient Air Quality and Development of the Ambient Air Quality Monitoring and Assessment System |
| Objective 1.4: Public awareness raising on air protection in the Tbilisi Agglomeration | Goal 4: Improving access to environmental information; Objective 4.1: Creating a mechanism for collecting information related to the environment and facilitating access to it | |
| | Goal 16: Promotion of environmental education Objective 16.1 Promoting environmental behavior change and related skills development Objective 16.2 Providing adult learning and access to educational materials on environmental issues | |

The responsibility for implementation of objective 1.1 of the action plan lies within the Central Office of the Ministry of Environmental Protection and Agriculture, National Environmental Agency, Environmental Supervision Department, and Tbilisi Municipality City Hall.

Implementation of objective 1.2 is under the responsibility of numerous state agencies – Ministry of Internal Affairs, Ministry of Environmental Protection and Agriculture, Environmental Supervision Department, Tbilisi, Mtskheta and Gardabani Municipality City Halls, National Agency of State Property, Railway Transport Agency, Ministry of Finances, and Ministry of Economy and Sustainable Development. Ministry of Environmental Protection and Agriculture, the National Environmental Agency, and the National Center for Disease Control and Public Health are responsible for implementing objective 1.3. Finally, the Environmental Information and Education Centre, National Environmental Agency, and Tbilisi Municipality City Hall are responsible for implementing objective 1.4.

The projected budget for implementing the action plan is 62.8 million GEL (direct costs only), with 50.4 million GEL covered by state and local government budgets and 5.8 million GEL funded by donors. There remains a deficit of 6.6 million GEL, out from which primarily 5.8 million GEL, allocated for activities such as wet cleaning of Tbilisi streets, procurement of street cleaning machines, and initiatives promoting public transport use in Tbilisi's surrounding areas (activities 1.1.2 and 1.2.10). To address the deficit, the Secretariat will collaborate with agencies responsible for implementing these activities to negotiate with international donor organizations. If needed, municipal and state budget resources will be optimized and/or loan agreements pursued to support deficit-related activities.

Regarding budget allocation by tasks, approximately 96.1% of the budget (excluding the deficit) will be directed toward achieving tasks 1.1 and 1.2, while task 1.3 will be fully funded by donor contributions. By year , 40.9% of the action plan budget will be spent in 2024, 29.5% in 2025, and 29.6% in 2026. A substantial portion of the budget (39 million GEL) will be dedicated to reducing dust particle dispersion in Tbilisi through the rehabilitation of open ground areas (activity 1.1.6).

4. Logical Framework

| | | | | | | |
|---------------------------------|---|--------------|--|--|--|-------|
| Goal: | Improvement of ambient air quality in the Tbilisi Agglomeration | | | | Link to SDGs: | 11; 3 |
| Impact Indicator 1.1: | The number of monitoring points in the Tbilisi agglomeration, where the average annual concentration of PM _{2.5} and PM ₁₀ exceeds the limit norms | | Baseline | Target | Source of Verification: 1. Air.gov.ge 2. Air Yearbook | |
| | | Year | 2022 | 2026 | | |
| | | Value | 1 | 0 | | |
| Impact Indicator 1.2: | The number of indicative monitoring points in the Tbilisi agglomeration, where the average annual concentration of NO ₂ does exceeds the limit norm | | Baseline | Target | | |
| | | Year | 2023 | 2026 | | |
| | | Value | 14 | 12 | | |
| Impact Indicator 1.3: | The number of monitoring points in the Tbilisi agglomeration, where the average concentration of SO ₂ , CO, O ₃ , Pb, Cd, As, Ni, C ₆ H ₆ and C ₂₀ H ₁₂ exceeds the limit norm | | Baseline | Target | | |
| | | Year | 2022 | 2026 | | |
| | | Value | 0 | 0 | | |
| Objective 1.1: | Reduction of ambient air pollution with solid particles in the Tbilisi agglomeration | | | | | |
| Outcome Indicator 1.1.1: | Amount of fine particulate matter released into the ambient air in the Tbilisi Agglomeration | | Baseline | Target | Source of Verification: Inventory report of emissions into the ambient air | |
| | | Year | 2021 | 2026 | | |
| | | Value | PM ₁₀ – 4,530 tons PM _{2.5} – 650 tons TSP – 14,500 tons | PM ₁₀ – 4,000 tons PM _{2.5} – 600 tons TSP – 12,000 tons | | |
| Risk: | Incomplete information about industrial/commercial activities; Failure of industrial facilities to comply with the requirements of the air protection legislation; Difficulties in retrofitting the installations to introduce cleaner technologies; insufficient administrative resources of executive and supervisory agencies; non-fulfillment of established requirements by construction companies; Competing interests in the use of open spaces. | | | | | |
| Objective 1.2: | Reduction of nitrogen dioxide (NO ₂) emissions in the Tbilisi agglomeration | | | | | |
| Outcome Indicator 1.2.1: | The annual amount of nitrogen oxides (NO _x) emissions from road transport in the Tbilisi agglomeration in relation to the number of vehicles | | Baseline | Target | Source of Verification: inventory report of harmful substances released into the ambient air | |
| | | Year | 2021 | 2026 | | |
| | | Value | NO _x – 5 kg/unit | NO _x – 4.8 kg/unit | | |
| Risk: | Delays in implementation of the SUMP, problems with behavior change, lack of enforcement due to lack of resources | | | | | |
| Objective 1.3: | Improving the assessment of the ambient air quality and the impact of air pollution | | | | | |

| on human health in the Tbilisi agglomeration | | | | | |
|---|--|--------------|-----------------|---------------|---|
| Outcome Indicator 1.3.1: | Number of ambient air quality assessment tools | | Baseline | Target | Source of Verification: Annual Report of National Environmental Agency |
| | | Year | 2023 | 2026 | |
| | | Value | 4 | 6 | |
| Risk: | Lack of resources to improve the ambient air quality assessment system. | | | | |
| Objective 1.4: Public awareness raising on air protection in Tbilisi Agglomeration | | | | | |
| Outcome Indicator 1.4.1: | The number of participants of the environmental events held in the Tbilisi agglomeration | | Baseline | Target | Source of Verification: Annual Report of the Center for Environmental Information and Education, LEPL |
| | | Year | 2023 | 2026 | |
| | | Value | 300 | 1,000 | |
| Risk: | Insufficient public interest in environmental campaigns. | | | | |

5. Implementation and Coordination of the Action Plan

The implementation of the Air Quality Management Plan for the Tbilisi agglomeration will be coordinated by the Ministry of Environmental Protection and Agriculture of Georgia. At the same time, the Ambient Air Division of the Ministry's Department of Environment and Climate Change (hereinafter the Secretariat) will perform the function of the Secretariat. The coordination mechanism will be represented by the Interagency Commission for Studying the Issues Related to Ambient Air Quality Improvement created by the decree of the Government of Georgia dated July 24, 2020 N1354. The Secretariat will ensure the work of the commission technically, will organize meetings, will ensure the involvement of all relevant stakeholders in the process, will prepare and present information materials, will document the results of the meeting, will share them with the participants, etc.

The Commission is staffed with representatives of partner government agencies responsible for implementing the activities envisaged by the plan. The session of the Commission is held periodically, based on the decision of the chairman of the Commission - the Minister of Environmental Protection and Agriculture of Georgia or upon the request of one of the members of the Commission. The Commission is authorized to make a decision by a majority of those present if more than half of the members of the Commission attend the session. The Commission will evaluate the progress of the plan's implementation, identify the problems and difficulties encountered, and suggest additional corrective measures to be taken.

At least one meeting will be organized with representatives of the scientific, non-governmental, and private sectors to receive opinions and recommendations on the implementation of the activities envisaged by the plan from other interested parties and the public. The plan will be presented to the stakeholders, as well as information on the progress and next steps in implementing the plan. The recommendations expressed at the meeting will be analyzed and presented to the Commission for consideration to determine the need to update the document or make changes to it.

6. Monitoring and Evaluation of the Action Plan

The Secretariat will monitor and evaluate the implementation of the Air Quality Management Plan for the Tbilisi Agglomeration.

Based on the status reports from the responsible agencies, the Secretariat will develop a draft progress report of the action plan monitoring every six months and a draft annual report once a year. The progress report should provide information on the progress and status of the implementation of the output indicators of each activity with an appropriate brief description. The annual report should contain information on the results achieved, not only about the activities but also the objectives. The Secretariat will submit the drafts of the annual report for consideration to the Working Group Promoting the Improvement of the Ambient Air Quality of the Tbilisi Agglomeration, which is staffed by the main stakeholders interested in the issue. Progress reports and annual reports of the action plan implementation are published on the website of the Ministry of Environmental Protection and Agriculture of Georgia.

The final evaluation of the action plan will be conducted after its implementation is completed. The evaluation aims to study the results and achievements of the action plan in detail and determine the impact. The action plan implementation evaluation report should also be published on the website of the Ministry of Environmental Protection and Agriculture of Georgia.

The exact timelines for monitoring and evaluation of the implementation of the action plan are defined in the table below.

Table 6-1: Action plan monitoring and evaluation calendar

| Report type | Period of development of the report/assessment | Deadline for publication of the report/assessment |
|--|---|--|
| Annual Report of 2024 | January-February 2025 | 28 February 2025 |
| Progress report of the first and second quarters of 2025 | July-August 2025 | 31 August 2025 |
| Annual Report of 2025 | January-February 2026 | 28 February 2026 |
| Progress report of the first and second quarters of 2026 | July-August 2026 | 31 August 2026 |
| Annual Report of 2026 | January-February 2027 | 28 February 2027 |
| Evaluation | January-June 2027 | 30 June 2027 |

