**2024- 2028**

**Municipality of Gjilan**



LOCAL ACTION PLAN FOR AIR QUALITY

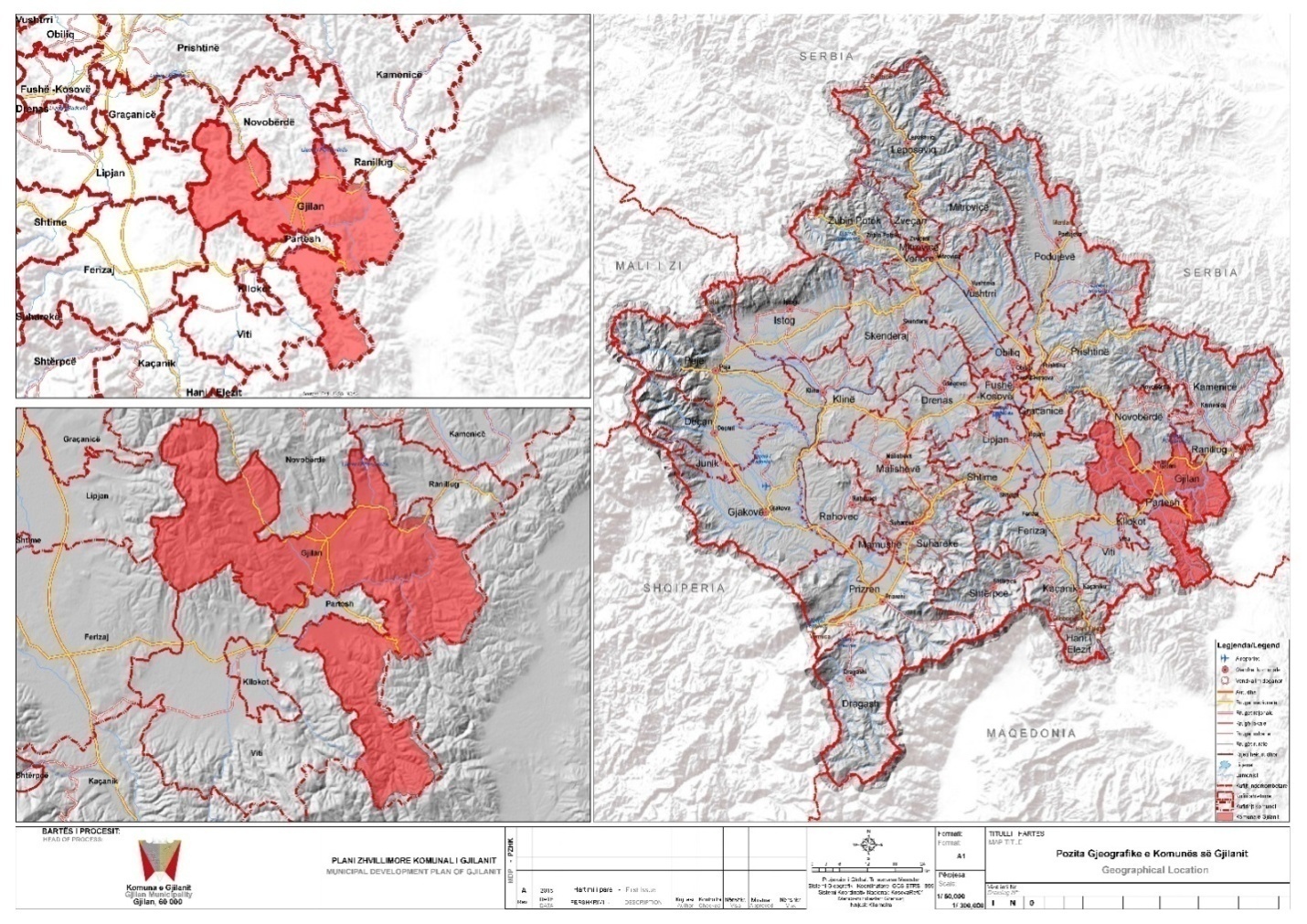
http://wikimapia.org/13575618/Gjilan



|  |  |  |
| --- | --- | --- |
|  | **2024- 2028**  **LOCAL ACTION PLAN FOR AIR QUALITY**  **2022** | PC |

**Municipality of Gjilan/ Gnjilane**

**2023**



# FOREWORD

 Dear citizens of Gjilan,

In my capacity as the Mayor of the Municipality of Gjilan, I am pleased to present to you the Local Action Plan for Air Quality (LAPAQ) for the Municipality of Gjilan, 2024-2028.

Given that this action plan identifies existing measures, new initiatives, as well as it quantifies their impact in the Municipality of Gjilan upon the implementation, we have established the Working Group composed of municipality representatives, experts from various fields, representatives of Civil Society Organizations. Furthermore, it also gives priority to the contributions of the citizens of the Municipality of Gjilan, through the expression of their opinions.

LAPAQ for the Municipality of Gjilan 2024-2028 is a strategic document, which is expected to serve as the first step in the implementation of projects and investments during the next five years that aim to improve air quality in Gjilan.

Bearing in mind the negative impact that the air pollution has and its various sources, we are committed to increasing the quality of life for citizens, therefore we believe that this document will also be an important contributor to the fulfillment of this goal.

In the end, I want to thank the Government of the Grand Duchy of Luxembourg, the UNDP Office in Kosovo, and the consultants, for the support and training provided to our officials during the development of this document.

Alban Hyseni

Mayor of the Municipality of Gjilan

# WORKING GROUP FOR DRAFTING THE LOCAL ACTION PLAN FOR AIR QUALITY

1. Ali Arifi, Director of DUPMM, Chairman of G.P
2. Valbonё Zymeri, Environmental Protection Officer from DUPMM, member
3. Valon Shefiku, Official from DUPMM, member
4. Er linw Rudaku, Waste Management Officer from DSHPIE, member
5. Arjeta Bllaca, Communication Officer from DSHPIB, member
6. Fehmi Agushi, Inspector of Environmental Protection from DI, member
7. Arsim Ibrahimi, Traffic Inspector from DI, member
8. Burim Elezi, Office for European Integration, Office of the President, member
9. Naser Muja, Official from the Directorate of Agriculture and Forestry, member
10. Fadil Kajrtazi, Directorate for Security and Emergency, member
11. Igballe Shalaku, Institute of Public Health - Gjilan, member
12. Lulzim Behxheti, representative from civil society, member
13. Lule Bajrami, Association of Architects and Engineers, member
14. Fisnik Muji, representative from civil society, member
15. Ujmir Krasniqi,NGO ”Zeri Rinor”, member
16. Mensur Morina,NGO ”Liza R”, member

**TABLE OF CONTENT**

[FOREWORD 4](#_Toc148449054)

[WORKING GROUP FOR DRAFTING THE LOCAL ACTION PLAN FOR AIR QUALITY 5](#_Toc148449055)

[LIST OF TABLES 8](#_Toc148449056)

[LIST OF FIGURES 9](#_Toc148449057)

[ABBREVIATIONS AND ACRONYMS 10](#_Toc148449058)

[EXECUTIVE SUMMARY 13](#_Toc148449059)

[1.0 INTRODUCTION 15](#_Toc148449060)

[2.0 RESPONSIBILITIES AND COMMITMENT 16](#_Toc148449061)

[3.0 LEGAL FRAMEWORK 16](#_Toc148449062)

[4.0 METHODOLOGY 17](#_Toc148449063)

[5.0 CONSULTATION 17](#_Toc148449064)

[6.0 GENERAL INFORMATION 19](#_Toc148449065)

[6.1 Agriculture Sector 22](#_Toc148449066)

[6.2. Transport Sector 23](#_Toc148449067)

[6.3 Land Use and Land Cover 26](#_Toc148449068)

[6.4 Meteorological data 26](#_Toc148449069)

[7.0 AIR QUALITY 29](#_Toc148449070)

[7.1 Air Quality monitoring data 30](#_Toc148449071)

[7.2 Emissions data of Gjilan/ Gnjilane 38](#_Toc148449072)

[7.2.1 Emission calculation 38](#_Toc148449073)

[7.3. Summary of Emissions in Gjilan/Gnjilane Municipality 39](#_Toc148449074)

[7.4. Emissions from Residential Stationary Sources in Gjilan/Gnjilane Municipality 44](#_Toc148449075)

[7.5. Emissions from Services and Industries in Gjilan/Gnjilane Municipality 50](#_Toc148449076)

[7.6. Emissions from Vehicle in Gjilan/Gnjilane Municipality 51](#_Toc148449077)

[7.7. Emissions from other sources in Gjilan/Gnjilane Municipality 53](#_Toc148449078)

[8.0. SUMMARY OF AIR POLLUTION CONTROL MEASURES IN GJILAN/GNJLIANE MUNICIPALITY 54](#_Toc148449079)

[9.0 OBJECTIVES AND MEASURES 54](#_Toc148449080)

[9.1 Objectives 54](#_Toc148449081)

[**Objective 1:** Reducing the use of fossil fuels in the household. 55](#_Toc148449082)

[**Objective 3:** *To decrease emissions from the construction sector.* 55](#_Toc148449083)

[**Objective 4:** *Raising awareness.* 55](#_Toc148449084)

[9.2 56](#_Toc148449085)

[Measures 56](#_Toc148449086)

[10.0 RANKING OF PRIORITIES 56](#_Toc148449087)

[11.0 ACTIONS AND LEADING INSTITUTIONS OF LAPAQ 57](#_Toc148449088)

[12.0 IMPACT OF IMPLEMENTATION 57](#_Toc148449089)

[13.0 ASSESSING THE IMPLEMENTATION OF THE ACTION PLAN 57](#_Toc148449090)

[14.0 THE EXPECTED IMPACT OF THE LAPAQ 58](#_Toc148449091)

[15.0 MONITORING AND ASSESSMENT 58](#_Toc148449092)

[15.1 Responsible body conducting monitoring. 58](#_Toc148449093)

[15.2 Monitoring Period 59](#_Toc148449094)

[16.0 CONCLUSION 59](#_Toc148449095)

[17.0 TABLE OF ACTIVITIES 0](#_Toc148449096)

[ANNEX 1 7](#_Toc148449097)

[1.1 TECHNICAL EVIDENCE FOR LOCAL ACTION PLAN FOR AIR QUALITY 7](#_Toc148449098)

[1.2. Emission reductions calculation 7](#_Toc148449099)

[1.2.1. Emission Reduction Calculation for Small Combustion (Residential: Stationary sources) in Gjilan/Gnjliane Municipality 7](#_Toc148449100)

[1.2.2 Emission Reduction Calculation for Transport (Road) in Gjilan/Gnjilane Municipality 11](#_Toc148449101)

[1.2.3. Emission Reduction Calculation on subjects to Municipality Environmental Permit 14](#_Toc148449102)

[1.2.4. Emission Reduction Calculation from Municipal Buildings and Facilities 15](#_Toc148449103)

[1.2.5. Emission Reduction Calculation from Service Industries 15](#_Toc148449104)

[1.2.6. Emission Reduction Calculation from Waste Management 16](#_Toc148449105)

[1.2.7. Emission Reduction Calculation from Agriculture 16](#_Toc148449106)

# LIST OF TABLES

[Table 1- Statistical data for the inhabitants of Gjilan/ Gnjilane 18](#_Toc146553062)

[Table 2- Number of enterprise for each category in the municipality of Gjilan/ Gnjilane 19](#_Toc146553063)

[Table 3- Land Use Data on Agricultural Sector in the municipality of Gjilan/Gnjliane 21](#_Toc146553064)

[Table 4- Livestock Data in the municipality of Gjilan/ Gnjilane 21](#_Toc146553065)

[Table 5- Labor force Data for Agriculture Sector in the municipality of Gjilan/ Gnjilane 21](#_Toc146553066)

[Table 6- Agriculture Tractor Data in the municipality of Gjilan/ Gnjilane 22](#_Toc146553067)

[Table 7- Vehicle Registration Data for Gjilan/ Gnjilane 22](#_Toc146553068)

[Table 8- Average maximum and minimum temperatures in Gjilan/ Gnjilane 26](#_Toc146553069)

[Table 9-Kosovo Air Quality Standard 29](#_Toc146553070)

[Table 10- Monthly Average AQMS data of Gjilan/ Gnjilane on SO2 (2019- 2022) 31](#_Toc146553071)

[Table 11- Monthly Average NO2 data (μg/m3) from AQMS 2019 to 2022 33](#_Toc146553072)

[Table 12- Monthly Average AQMS data of Gjilan/ Gnjilane on PM10 (2019 to 2022) 35](#_Toc146553073)

[Table 13- Monthly Average AQMS data of Gjilan/ Gnjilane on PM2.5 (2019 to 2022) 36](#_Toc146553074)

[Table 14- SO2 Emissions Trend, related Municipality of Gjilan/ Gnjilane from 2015 to 2022 39](#_Toc146553075)

[Table 15- NOx Emissions Trend related Municipality of Gjilan/ Gnjilane from 2015 to 2022 40](#_Toc146553076)

[Table 16- PM10 Emissions Trend related Municipality of Gjilan/ Gnjilane from 2015 to 2022 41](#_Toc146553077)

[Table 17- PM2.5 Emissions Trend related Municipality of Gjilan/ Gnjilane from 2015 to 2022 43](#_Toc146553078)

[Table 18- SO2 Emissions Trend from Residential: Stationary sources in Municipality of Gjilan/ Gnjilane 44](#_Toc146553079)

[Table 19- SO2 Emissions from Detached House by fuel types in Municipality of Gjilan/ Gnjilane 44](#_Toc146553080)

[Table 20- NO2 Emissions Trend from Residential: Stationary in Municipality of Gjilan/ Gnjilane 45](#_Toc146553081)

[Table 21- NO2 Emissions from Detached House by fuel types in Municipality of Gjilan/ Gnjilane 45](#_Toc146553082)

[Table 22- PM10 Emissions Trend from Residential: Stationary in Municipality of Gjilan/ Gnjilane 46](#_Toc146553083)

[Table 23- PM10 Emissions from Detached House by fuel types in Municipality of Gjilan/ Gnjilane 47](#_Toc146553084)

[Table 24- PM2.5 Emissions Trend from Residential: Stationary in Municipality of Gjilan/ Gnjilane 48](#_Toc146553085)

[Table 25- PM2.5 Emissions from Detached House by fuel types in Municipality of Gjilan/Gnjliane 48](#_Toc146553086)

[Table 26- SO2 Emissions Trend from Service Industries in Municipality of Gjilan/ Gnjilane 49](#_Toc146553087)

[Table 27- NOx Emissions Trend from Service Industries in Municipality of Gjilan/ Gnjilane 50](#_Toc146553088)

[Table 28- PM10 Emissions Trend from Service Industries in Municipality of Gjilan/ Gnjilane 50](#_Toc146553089)

[Table 29- PM2.5 Emissions Trend from Service Industries in Municipality of Gjilan/ Gnjilane 50](#_Toc146553090)

[Table 30- Emissions from Vehicle in Municipality of Gjilan/ Gnjilane in 2022 51](#_Toc146553091)

[Table 31- NOx and PM10 Emissions from Agriculture Sector in Municipality of Gjilan/ Gnjilane 53](#_Toc146553092)

[Table 32- Action Plan on fuel shift from Wood/Lignite to Pellet/Electricity for Residential Stationary sources in Municipality of Gjilan/Gnjliane 8](#_Toc146553093)

[Table 33- Draft Action Plan on Road Transport Category in Municipality of Gjilan/ Gnjilane 12](#_Toc146553094)

[Table 34- Action Plan on subject to Municipality Environmental Permit 15](#_Toc146553095)

[Table 35- Action Plan on Municipal Buildings and Facilities 15](#_Toc146553096)

[Table 36- Action Plan on Service Industries 16](#_Toc146553097)

[Table 37- Action Plan on Waste Management in Municipality 16](#_Toc146553098)

[Table 38- Action Plan on Agriculture in Municipality 17](#_Toc146553099)

# LIST OF FIGURES

[Figure 1- Number of Each Type of Vehicle in Gjilan/ Gnjliane 23](#_Toc146553100)

[Figure 2- Number of Vehicles with EURO Regulation in Gjilan/ Gnjliane 24](#_Toc146553101)

[Figure 3- Average maximum and minimum temperatures in Gjilan/ Gnjilane (2015-2023) 26](#_Toc146553102)

[Figure 4- Probability of daily rainfall in Gjilan/ Gnjilane (2023-2015) 27](#_Toc146553103)

[Figure 5- Average wind speed in Gjilan/ Gnjilane 28](#_Toc146553104)

[Figure 6- Monthly Average Data of Gjilan/ Gnjilane on SO2 32](#_Toc146553105)

[Figure 7- Monthly Average NO2 data (μg/m3) from AQMS 2019 to 2022 34](#_Toc146553106)

[Figure 8- Monthly Average AQMS data of Gjilan/ Gnjilane on PM10 (2019 to 2022) 36](#_Toc146553107)

[Figure 9- Monthly Average AQMS data of Gjilan/ Gnjilane on PM2.5 (2019 to 2022) 37](#_Toc146553108)

[Figure 10- SO2 Emissions Trend related Municipality of Gjilan/ Gnjilane from 2015 to 2022 39](#_Toc146553109)

[Figure 11- NOx Emissions Trend related Municipality of Gjilan/ Gnjilane from 2015 to 2022 40](#_Toc146553110)

[Figure 12- PM10 Emissions Trend related Municipality of Gjilan/ Gnjilane from 2015 to 2022 42](#_Toc146553111)

[Figure 13- PM2.5 Emissions Trend related Municipality of Gjilan/ Gnjilane from 2015 to 2022 43](#_Toc146553112)

[Figure 14- SO2 Emissions from Detached House by fuel types in Municipality of Gjilan/ Gnjilane 45](#_Toc146553113)

[Figure 15- NOx Emissions from Detached House by fuel types in Municipality of Gjilan/ Gnjilane 46](#_Toc146553114)

[Figure 16- PM10 Emissions from Detached House by fuel types in Municipality of Gjilan/ Gnjilane 47](#_Toc146553115)

[Figure 17- PM2.5 Emissions from Detached House by fuel types in Municipality of Gjilan/Gnjliane 49](#_Toc146553116)

[Figure 18- Emissions from Vehicle in Municipality of Gjilan/ Gnjilane on NOx and PM2.5 52](#_Toc146553117)

# ABBREVIATIONS AND ACRONYMS

|  |  |
| --- | --- |
| **AA** | Accreditation Agency |
| **AAS** | Atomic Absorption Spectrometer |
| **AFOLU** | Agriculture, Forestry, and Other Land Use |
| **AI** | Administrative Instruction |
| **AQI** | Air Quality Index |
| **AQMS** | Air Quality Monitoring Station |
| **BAT** | Best Available Technology |
| **CA** | Capacity Assessment |
| **CD** | Capacity Development |
| **CEMS** | Continuous Emission Monitoring System |
| **ECS** | European Committee of Standardization |
| **CFD** | Computational fluid dynamics |
| **CO** | Carbon monoxide |
| **DEPW (MESPI)** | Department for Environmental Protection and Water |
| **EC** | European Commission |
| **ELVs** | Emission Limit Values |
| **EMEP/EEA Guidebook** | European Monitoring and Evaluation Programme/European Environment Agency air pollutant emission inventory guidebook 2019 |
| **EEA** | European Environment Agency |
| **ESP** | Electrostatic Precipitator |
| **EU** | European Union |
| **FC** | Fixed Carbon |
| **FS** | Feasibility Study |
| **GHG** | Greenhouse Gas |
| **GIS** | Geographic Information System |
| **HDV** | Heavy Duty Vehicle |
| **IPPC** | Integrated Pollution Prevention and Control  (Law No. 03/L-043) |
| **IPPU** | Industrial Process and Product Use |
| **ISP (MESPI)** | Institute for Spatial Planning |
| **IT** | Information Technology |
| **JICA** | Japan International Cooperation Agency |
| **KCA (MESPI)** | Kosovo Cadastral Agency |
| **KEK** | Kosovo Energy Corporation |
| **KEPA (MESPI)** | Kosovo Environmental Protection Agency |
| **KHMI (MESPI)** | Kosovo Hydro-meteorological Institute |
| **TPP Kosovo A** | Kosovo A Thermal Power Plant |
| **TPP Kosovo B** | Kosovo B Thermal Power Plant |
| **KSA** | Kosovo Statistics Agency |
| **LCP** | Large Combustion Plant |
| **LCV** | Light Commercial Vehicle |
| **LHV** | Lower Heating Value |
| **Lignite** | Lignite |
| **LPG** | Liquid Petroleum Gas |
| **MCC/MFK** | Millennium Challenge Corporation/ Millennium Foundation Kosovo |
| **MESPI** | Ministry of Environment, Spatial Planning and Infrastructure |
| **ME** | Ministry of Economy |
| **MITE** | Ministry of Industry, Trade and Entrepreneurship |
| **NEC** | National Emission Ceilings  （National Emission Ceilings Directive: DIRECTIVE (EU) 2016/2284 on the reduction of national emissions of certain atmospheric pollutants） |
| **NMVOC** | Non-methane volatile organic compounds |
| **NOX** | Nitrogen oxides |
| **NO2** | Nitrogen dioxide |
| **O3** | Ozone |
| **O&M** | Operation and Maintenance |
| **PAH** | Polycyclic Aromatic Hydrocarbon |
| **PM10, PM2.5, PM1** | Particulate Matter with a diameter of 10µm or less, 2.5µm or less and 1.0µm or less |
| **PC** | Passenger Car |
| **PO** | Plan of Operation |
| **QA** | Quality Assurance |
| **QC** | Quality Control |
| **SAP** | Stabilization and Association Process |
| **SAA** | Stabilization and Association Agreement |
| **SIDA** | Swedish International Development Cooperation Agency |
| **SDGs** | Sustainable Development Goals |
| **SO2** | Sulfur Dioxide |
| **SOP** | Standard Operating Procedure |
| **TPP** | Thermal Power Plant |
| **TSP** | Total Suspended Particulates |

# EXECUTIVE SUMMARY

This action plan aims to create a framework that will help all actors identify gaps for support and their role in improving air quality in the Municipality of Gjilan's/ Gnjilane. Furthermore, it will identify a series of measures that will improve the air quality in the municipality.

Despite having had a large number of industries in the past, Gjilan/Gnjilane did not historically suffer from major air pollution because it lacks heavy chemical or metallurgical industries. However, in recent years, air pollution has become a notable problem. The air pollution problem in Gjilan/Gnjilane is primarily caused by the transport sector, namely the large number of very old vehicles, and by households that burn coal and wood for heating purposes, and to a lesser extend industry and service sectors.

To assess the state of air quality in Gjilan/ Gnjilane, data from the air quality monitoring station located near the elementary school "Selami Hallaqi" and data from the sources of air pollution that contribute to the problem, identified based on the collected data of household heating, number of vehicles, agriculture, and so on, are used.

Because air quality monitoring stations can be placed in locations that do not represent the level of background pollution, their data collection cannot always represent the average air pollution in a city, as has been the case in this Municipality, where the station was initially located at the Municipal Assembly. As a result, this station was deployed and installed in the yard of the aforementioned school to provide us with accurate data on the state of air quality in this town.

Vehicles, households, and public and private services are the major sources of air pollution in the Gjilan/Gnjilane area, according to data analysis. According to AQMS data, annual average PM2.5 concentrations (in 2020) in some areas of the city continue to exceed national targets, particularly in January and February.[[1]](#footnote-1)

Following an examination of the state of air quality, the working group made recommendations for developing measures to improve air quality and protect human health. Each measure proposes a number of new areas of action, as well as progress indicators. These measures define a series of actions that will aid in the achievement of the objectives of this action plan. An annual review will be conducted, and progress measures on those actions that have been implemented will be reported.

Article 28 of the Law No. 08/L-025 for Air Protection from Pollution mandates the development of a Local Action Plan for Air Quality, which requires municipalities to develop a Local Action Plan for Air Quality for a five-year period. LAPAQ will be developed in accordance with the roles and responsibilities of the Municipality. This LAPAQ was developed in accordance with the principles of the Government of Kosovo's Programme 2021-2025, while also taking into account other strategic documents that will be or are being implemented. During the LAPAQ preparation process, consultative meetings with various relevant organizations, including public consultation, were held in accordance with the legislation, which aided in the formulation of measures and actions that will contribute to the improvement of air quality in their city. Working Group of the Municipality of Gjilan/ Gnjilane has worked closely with other relevant organizations and the support of local and international experts of UNDP Office in Kosovo to identify the range of actions needed.

This LAPAQ includes actions that will be implemented between 2024 and 2028 with the goal of reducing air pollution significantly below the current level.

# 1.0 INTRODUCTION

Ensuring clean air is a critical factor in maintaining good health. Therefore, it becomes imperative to undertake a series of actions and modify our behaviors. Air pollution stands as one of the main factors behind numerous ailments, including cancer, strokes, heart diseases, and asthma. This global predicament claims the lives of more than six million individuals each year while posing a grave threat to the environment. According to the World Health Organization, a staggering 98% of cities in low- and middle-income countries exceed safe air quality levels, adversely impacting the health of their populations, especially vulnerable groups such as the young, elderly, and economically disadvantaged.[[2]](#footnote-2)

In the case of Kosovo, upon analyzing data from air quality monitoring stations, it becomes evident that air pollution spikes significantly, particularly during the winter season. This spike can be attributed to the burning of fossil fuels in homes, the prevalence of old vehicles on city streets, as well as other contributing factors from agriculture and industry. This data leads to the unequivocal conclusion that the current state of air quality in this municipality is not satisfactory.

To achieve good air quality in the municipality, the Municipality of Gjilan/ Gnjilane has decided to prepare the Local Action Plan for Air Quality.

The Municipality of Gjilan/Gnjilane has taken a proactive step toward achieving improved air quality within its borders by initiating the development of a Local Action Plan for Air Quality. This ambitious plan aims to enhance air quality through a comprehensive set of measures, including lowering emissions, establishing an efficient air quality monitoring system, reducing emissions from various sources, supporting industry controls, minimizing machinery emissions, and setting an example through mobile source emissions reduction. Additionally, the Municipality will promote sustainable transportation, cleaner household fuels, dust reduction in construction and demolition activities, forest preservation, and green space expansion. Outreach campaigns will be essential for reducing emissions and promoting behavioral changes among the public.

To realize these objectives within the timeframe of 2024 to 2028, the Municipality of Gjilan/Gnjilane will collaborate closely with various relevant organizations. This collaborative effort will focus on reducing air pollutant levels and minimizing exposure to air pollution in Gjilan/Gnjilane, ultimately leading to an enhanced quality of life for the city's residents.

# 2.0 RESPONSIBILITIES AND COMMITMENT

The Local Action Plan for Air Quality (LAPAQ) was prepared by the Working Group of the Municipality of Gjilan/Gjilane. This document was supported by the Government of Luxembourg and local and international experts from the UNDP Office of Kosovo.

While LAPAQ is a five-year document, it will undergo an annual review, and the progress made each year will be reported to the Municipality Assembly and included in the MESPI Annual Report on the State of the Environment produced by the Kosovo Environmental Protection Agency (KEPA), as part of its statutory responsibilities for Local Air Quality Management.

# 3.0 LEGAL FRAMEWORK

Law No.08/L-025 on Air Protection from Pollution aims to determine the competencies and responsibilities of the institutions to ensure the right of citizens to live in an environment with clean air, by protecting the human health, fauna, flora, and natural and cultural values of the environment from air pollution.

This law defines the basic indicators and obligations for air protection, categorizes pollution sources, and establishes the obligation to determine emission limit values and air quality norms in accordance with EU and WHO standards. As part of the overall environmental protection program, this law requires the central government to develop an Air Quality Strategy and Action Plan, and it also requires municipalities to develop a Local Action Plan for Air Quality for a period of five (5) years, to achieve the limit or target values.

Administrative Instructions (A.I.) that emerged from the law are:

* A.I. No. 02/2011 for Air Quality Norms.
* A.I. (GRK) No. 07/2021 on Rules and norms of air emissions from stationary sources of pollution.
* A.I. (GRK) No. 08/2016 for the allowed norms of discharges into the air from mobile sources.
* A.I. No. 04/2009 on control of the emission of Volatile Organic Compounds during the storage, filling, discharging, packaging, and transfer of fuels.
* Administrative Instruction MESPI No. 09/2023 on the Method of Air Quality Monitoring, Data Collection, Criteria and Methodology
* A.I. (GRK)- No. 21/2013 on Arsenic, Cadmium, Mercury, Nickel, and Polycyclic Aromatic Hydrocarbons in the Air.
* A.I. (GRK) No. 16/2013 on Substances that Deplete the Ozone Layer and Fluorinated Greenhouse Gases

# 4.0 METHODOLOGY

The development of LAPAQ is based on a participative planning process that ensures comprehensive consultation with all relevant institutions. A working group, comprising representatives from various key directorates within the local institutions, including the municipal gender officer, as well as representatives from central institutions and other pertinent stakeholders, was established for this purpose. The UNDP Kosovo Office provided invaluable support to the working group by leveraging input from both local and international experts, with financial support of the Government of Luxembourg.

The LAPAQ development process included several workshops, meetings of the working group, meetings with local and international experts, consultations with stakeholders, and desk research (based on published material, analysis of existing data, existing policies etc.).

Public consultation was also integral to this process, with input solicited from all pertinent institutions and entities within the broader community.

During the development of LAPAQ, reference was made to several strategic documents and plans, including the Local Development Strategy from 2008, the Municipal Action Plan for Energy Efficiency (PKVEE) spanning from 2019 to 2021, the Urban Development Plan of Gjilan/Gnjilane from 2006 to 2015 and beyond, the Local Environmental Action Plan for Gjilan/Gnjilane Municipality for the period 2020-2024, the Urban Regulatory Plan "Center (Zone 1)" in Gjilan/Gnjilane, the 2016 Report on Environmental Protection in 16 Municipalities, and various other pertinent strategic documents.

The Municipality of Gjilan/ Gnjilane and MESPI, as well as other involved institutions, will monitor the implementation of the specific projects outlined in this document.

# 5.0 CONSULTATION

The development of LAPAQ involved a series of meetings and consultations within the working group and various other stakeholders, complemented by the organization of three workshops. These workshops played a pivotal role in gathering diverse perspectives and inputs to shape the plan.

In a commitment to transparency and civic engagement, the draft LAPAQ was made accessible to the public through the Municipality's official website. Furthermore, a public debate was conducted, fostering a platform for community members to voice their opinions and concerns. Additionally, the draft plan was shared with relevant institutions to solicit their feedback.

It's important to note that all the proposed measures and activities contained within LAPAQ were meticulously identified through ongoing consultations with Municipality officials. The plan features a detailed table of activities, providing a comprehensive overview of the planning and evaluation status for each item.

This document has taken into consideration the feedback and comments provided by interested parties during the consultation process. Comments that are deemed reasonable and pertinent have been thoughtfully incorporated into the plan to ensure that it aligns with the diverse needs and perspectives of the community it serves.

# 6.0 GENERAL INFORMATION

Gjilan/ Gnjilane is located in the southeastern part of Kosovo, within the Anamorava region. Its strategic geographic location facilitates strong connections with other key centers in Kosovo and the surrounding region. In the vicinity of Gjilan/Gnjilane, there are several notable geographical features, including the Hill of Martyrs (Popovica), Gllama/Glama, Dheu i Bardhë/Bela Zemlja, the area of Malisheva/Mališeva (within Gjilan/Gnjilane), Zabeli of Sahit Agës/Zabeli of Sahit Aga, and Bregu i Thatë/Dry Shore. Notably, there are three small rivers – Mirusha/Miruša, Banja/Banja, and Stanishor/Stanišor – which converge and flow into the Morava e Binçёs/Binačka Morava River, located to the west of the Uglar/Ugljare village.

The Municipality of Gjilan/ Gnjilane has an area of 391.88km2and consists from consists of 1 urban and 41 rural settlements. Its favorable geographical position, relief, and climatic conditions create a conducive environment for the development of diverse flora and fauna. Gjilan/Gnjilane has a diverse biodiversity, encompassing herbaceous plants, pastures, medicinal and aromatic herbs, agricultural crops such as wheat, corn, oats, and potatoes, as well as shrubs and forests with a variety of tree species. Furthermore, it is also rich in water resources, having numerous rivers and two artificial dams, that of Livoç/Livoč and Përlepnicё/Prilepnica, known to host various populations, including fish, within their habitats, as well as the last creatures of the rivers that we call the benthos life community. The Gjilan/ Gnjilane area is defined by the [Morava River](https://en.wikipedia.org/wiki/Bina%C4%8Dka_Morava), which collects all the small rivers, with an average monthly flow rate of 6.7 cubic meters/second. In the southeast it is surrounded by the [mountains of Karadak](https://en.wikipedia.org/wiki/Skopska_Crna_Gora)/ Karadak[[3]](#footnote-3).

Table 1 shows the population of Gjilan/ Gnjilane based on data from the Kosovo Statistics Agency. According to data, the population has been decreasing since at least 2012.

Table - Statistical data for the inhabitants of Gjilan/ Gnjilane[[4]](#footnote-4)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Year | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
| Gjilan/ Gnjilane | 22,011 | 22,105 | 21,056 | 19,165 | 18,994 | 19,144 | 18,660 | 17,899 | 18,218 |

In 2018, the municipality had 4,100 officially registered private enterprises, providing employment opportunities for approximately 6,900 individuals. Before the year 1999, Gjilan/Gnjilane held a significant position as an industrial hub in Kosovo. Presently, it still hosts operational entities, such as a radiator factory and a tobacco factory, both of which have undergone privatization. Additionally, the city inaugurated a modern business incubator in the summer of 2007, thanks to support from the European Agency for Reconstruction.[[5]](#footnote-5)

In recent years, Gjilan/Gnjilane municipality has witnessed a diverse array of economic activities, with a significant presence of enterprises across various sectors. Notably, the category with the largest number of enterprises is "Wholesale and retail trade, including the repair of motor vehicles and motorcycles." The economic landscape of Gjilan/Gnjilane predominantly comprises enterprises engaged in professional, scientific, and technical activities, alongside administrative and support functions. For more information, please refer to the table 2. Table 2 displays the count of registered enterprises in the Municipality of Gjilan/Gnjilane, categorized by their respective sectors of economic activity for the years spanning from 2019 to 2022.

Table - Number of enterprise for each category in the municipality of Gjilan/ Gnjilane

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Gjilan/  Gnjilane's | A  Agriculture, Forestry and Fishing | B  Mining and quarry | C  Production | D  Supply of Electricity, Gas, Steam and Air Conditioning | E  Watter Supply, sewerage, waste management, and land revitalization | F  Construction |  |
| 2021 |  |  |  |  |  |  |
| 2020 | 21 | 0 | 78 | 1 | 0 | 54 |
| 2019 | 03 | 0 | 84 | 2 | 1 | 61 |
| 2018 | 9 | 9 | 2 | 63 | 1 | 76 |
| Gjilan/  Gnjilane's | G  Wholesale And Retail, Trade, Repair of Motor Vehicles, Motorcycles | H  Transport And Storage | I  Accommodation And Service Activities with Food | J  Information And Communication | K  Financial And Insurance Activities | L  Real Estate Activities |
| 2021 |  |  |  |  |  |  |
| 2020 | 136 | 30 | 53 | 11 | 5 | 5 |
| 2019 | 139 | 38 | 59 | 21 | 5 | 3 |
| 2018 | 155 | 20 | 67 | 30 | 0 | 2 |
| Gjilan/  Gnjilane's | **M**  **Professional, Scientific, and Technical Activities** | N  Administrative and Support Activities | O  Public Administration and Defense Compulsory Social Insurance | P  Education | Q  Human Health and Social Work Activities | R  Arts, Entertainment and Recreation | S  Other Service Activities |
| 2021 |  |  |  |  |  |  |  |
| 2020 | 46 | 30 | 0 | 6 | 12 | 10 | 25 |
| 2019 | 43 | 27 | 1 | 9 | 10 | 10 | 26 |
| 2018 | 33 | 20 | 2 | 6 | 21 | 11 | 27 |

## 6.1 Agriculture Sector

Currently, there are a total of 20 private agricultural enterprises operating within the Municipality. When it comes to the utilization of agricultural land, out of the total area of 18,399.28 hectares, approximately 43.86% is dedicated to cultivating agricultural products, 10.81% remains unused for agricultural purposes, and approximately 44.79% is allocated for meadows and pastures.

Tab. 3 provides data from the Agriculture Census conducted in the Republic of Kosovo in 2014, showcasing the agricultural land utilization in Gjilan/ Gnjilane. The agricultural sector in this municipality demonstrates significant development. There is a notable presence of agricultural machinery, including a substantial number of tractors. However, it's worth noting that more than 90% of these tractors have been in use for over a decade.

Table - Land Use Data on Agricultural Sector in the municipality of Gjilan/Gnjliane

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Vegetables- Total** | | **Orchard Plantations- Total** | | | **Number of Trees/ Bushes- Total** | | **Permanent Grassland** | | **Total Utilized Land Area** | | **Total Irrigated Area** | |
| Number of Agricultural Holdings | Area (Ha) | Number of Agricultural Holdings | Area (Ha) | Number of Fruit Trees, Bushes in Plantations | Number of Agricultural Holdings | Number of Trees, Bushes | Number of Agricultural Holdings | Area (Ha) | Number of Agricultural Holdings | Area (Ha) | Number of Agricultural Holdings | Area (Ha) |
| 1317 | 121.08 | 413 | 293.81 | 389,785 | 1,137 | 29,095 | 2,021 | 8,285.44 | 4,369 | 18,499.28 | 1187 | 357.91 |

Table 4 presents data from the same census, highlighting that within the municipality of Gjilan/Gnjilane, poultry holds the top position among registered livestock, followed by sheep and cattle in terms of numbers.

Table - Livestock Data in the municipality of Gjilan/ Gnjilane

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Cattle** | | | **Buffalo** | | | **Sheep** | | | **Goats** | | |  | |
| Number of Agricultural Holdings | Nr. Of Cattle | Livestock Size Units (LSU) | Number of Agricultural Holdings | Nr. Of Buffalo | Livestock Size Units (LSU) | Number of Agricultural Holdings | Nr. Of Sheep | Livestock Size Units (LSU) | Number of Agricultural Holdings | Nr. Of Goats | Livestock Size Units (LSU) |
| 1,561 | 7,148 | 5,586 | k | k | k | 98 | 9,340 | 934 | 143 | 2,225 | 223 |
| **Pigs** | | | **Hose, Donkeys and Mules** | | | **Poultry** | | | **Other Livestock** | | | **Beehives** | |
| Number of Agricultural Holdings | Nr. Of Pigs | Livestock Size Units (LSU) | Number of Agricultural Holdings | Nr. Of Animals | Livestock Size Units (LSU) | Number of Agricultural Holdings | Nr. Of Poultry | Livestock Size Units (LSU) | Number of Agricultural Holdings | Nr. Of Animals | Livestock Size Units (LSU) | Number of Agricultural Holdings | Nr. Of Beehives |
| 209 | 1,389 | 305 | 34 | 73 | 58 | 2,404 | 234,579 | 3,251 | 24 | 239 | 5 | 157 | 3,490 |

Moreover, within the agricultural sector, there is a workforce of 13,490 individuals employed, with 2,336 of them being non-family labor force members engaged in seasonal employment.

Table - Labor force Data for Agriculture Sector in the municipality of Gjilan/ Gnjilane

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Labor Force- Total** | | **Holder** | | **Members of Holders’ family** | | **Regularly employed on agricultural households and individual businesses** | | **Regularly employed in agricultural legal entities** | | **Non-family labor force working on non-regular basis (seasonal workers)** | | **Labor force not directly employed by the holdings (contracted workers)** | |
| Agricultural Work (AWU) | Number of Persons | Agricultural Work (AWU) | Number of Persons | Agricultural Work (AWU) | Number of Persons | Agricultural Work (AWU) | Number of Persons | Agricultural Work (AWU) | Number of Persons | Agricultural Work (AWU) | Number of Persons | Agricultural Work (AWU) | Number of Persons |
| 3,244 | 13,494 | 1,435 | 4,348 | 1,472 | 6,266 | 37 | 80 | 239 | 456 | 61 | 2,336 | 0 | 8 |

Presently, in Gjilan/Gnjilane, there is a fleet of 2,324 tractors; however, it's noteworthy that over 93 percent of these tractors are older than 10 years, potentially contributing to increased environmental pollution.

Table - Agriculture Tractor Data in the municipality of Gjilan/ Gnjilane

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Total number of tractors** | | **0-10 years** | | **More than 10 years** | |
| Number of agricultural holdings | Number of owned tractors | Number of agricultural holdings | Number of owned tractors | Number of agricultural holdings | Number of owned tractors |
| 2,033 | 2,324 | 142 | 157 | 1,909 | 2,167 |

## 6.2. Transport Sector

Gjilan/Gnjilane boasts a modern road transport network, establishing vital connections with other cities within Kosovo, including Pristina and Ferizaj/Uroševac, as well as facilitating access to the municipality of Kamenica/Kamenica. This network also enables further connections to Bujanoc/Bujanovac, Preshevë/Preševo, and Medvegjë/Medveđa. Notably, Gjilan/Gnjilane plays a pivotal role as a key linkage point between the northern region of North Macedonia and the city of Kumanovë/Kumanovo.*[[6]](#footnote-6)*

Gjilan/Gnjilane currently lacks a structured urban transportation system and heavily relies on mini vans, private buses, and taxis. This mode of urban transportation places a substantial burden on city traffic and elevates the potential for vehicle-related air pollution in the urban area. The absence of adequate infrastructure, including narrow streets, insufficient crossings, limited parking facilities, and a lack of urban stations, predefined bus routes, as well as pedestrian and cycling lanes, all contribute to the challenges faced in public transportation within the city.*[[7]](#footnote-7)*

The Table 7. and Figure 2. shows the Vehicle registration data in municipality of Gjilan/Gnjliane.

As seen on the Table 7 and Figure 1 and 2, the predominant vehicle type in Gjilan/Gnjilane is passenger cars (PC), followed by light commercial vehicles (LCV) as the second-largest category, and heavy-duty trucks (HDT) as the third. Notably, the majority of vehicle ownership consists of vehicles rated under Euro 3 emission standards, and the ownership of vehicles falling within Euro 3 and 4 standards also exceeds 50%. This data highlights that emissions from vehicles constitute one of the primary sources of air pollutants within the municipality of Gjilan/Gnjilane.

Table - Vehicle Registration Data for Gjilan/ Gnjilane[[8]](#footnote-8)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **EURO 0** | **EURO 1** | **EURO 2** | **EURO 3** | **EURO 4** | **EURO 5** | **EURO 6** | **Others** | **Total** |
| **Bus** | 6 | 7 | 13 | 9 | 3 | 0 | 0 | 0 | 38 |
| **HDT (3.5t and over 3.5t)** | 69 | 65 | 189 | 224 | 112 | 84 | 6 | 8 | 757 |
| **LCV (under 3.5t)** | 114 | 127 | 239 | 458 | 354 | 107 | 22 | 0 | 1421 |
| **Mini Van** | 10 | 5 | 5 | 12 | 8 | 4 | 0 | 0 | 44 |
| **Passenger Car** | 1380 | 334 | 1370 | 4135 | 3235 | 2682 | 906 | 3 | 14045 |
| **Others** | 7 | 9 | 2 | 21 | 4 | 1 | 0 | 1 | 45 |
| **Total** | 1586 | 547 | 1818 | 4859 | 3716 | 2878 | 934 | 12 | 16350 |

Figure - Number of Each Type of Vehicle in Gjilan/ Gnjliane

Figure - Number of Vehicles with EURO Regulation in Gjilan/ Gnjliane

## 6.3 Land Use and Land Cover

With the city's population steadily increasing, there is a growing demand for additional residential, commercial, healthcare, educational, and recreational facilities, among others. These demands must be integrated into urban planning processes, necessitating the expansion of city boundaries in alignment with Urban Plans (UP) that consider these new developments. It is crucial that these plans are informed by comprehensive and accurate on-the-ground data, which serves as the foundational information required for effective planning.

Without access to detailed data regarding the current state of the city, including essential facts needed for planning, there is a risk of formulating unrealistic urban plans. This, in turn, can impact the balanced growth of various sectors and potentially harm air quality within the city. The Municipal Assembly of Gjilan/ Gnjilane has approved a new Urban Regulation Plan for an area of around 290 hectares "District." This region is located on the southern borders of the city, between M25.2 towards Pristina and M25-3 towards Ferizaj/ Uroševac.[[9]](#footnote-9)

This plan will enable an effective land use model and will play a pivotal role in both regulating the emissions profile and managing the distribution of pollutants, making it indispensable for formulating and assessing air pollution reduction and control strategies. Furthermore, utilizing Geographic Information System (GIS) and remote sensing techniques for land use will enable the development of a land use inventory as well as providing the temporal information needed to understand sustainable land use management practices.[[10]](#footnote-10)

## 6.4 Meteorological data

The region of Gjilan**/** Gnjilane has a medium continental climate, characterized by a relative altitude of 410m. In this area, summers tend to be warm and mostly clear, while winters are very cold, with snow and partial clouds. Throughout the year, the temperature generally ranges from -5°C to 28°C and is rarely below -12°C or above 34°C.

The warm season lasts 3.4 months, from June 3 to September 15, with average daily maximum temperatures above 23 °C. The hottest month of the year in Gjilan**/** Gnjilane is July, with a maximum temperature of 28°C and an average of 14°C[[11]](#footnote-11).

The cold season lasts 3.4 months, from November 23 to March 2, with average daily maximum temperatures below 8°C. The coldest month of the year in Gjilan**/** Gnjilane is January, with a minimum temperature of -5 °C and an average of 3 °C.

The table and figure below show the average maximum and minimum temperatures in Gjilan**/** Gnjilane for the years 2015-2023.

Table - Average maximum and minimum temperatures in Gjilan/ Gnjilane

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Average | jan | feb | mar | apr | may | jun | jul | aug | sep | oct | nov | dec |
| High | 3 °C | 6 °C | 11°C | 16°C | 21°C | 25°C | 28°C | 28°C | 23°C | 17°C | 9°C | 4 °C |
| Temp. | -1°C | 1 °C | 5 °C | 10°C | 15°C | 19°C | 21°C | 21°C | 16°C | 11°C | 5°C | 0 °C |
| Low | -5°C | -3°C | 0 °C | 4 °C | 9 °C | 12 °C | 14 °C | 13 °C | 10 °C | 5 °C | 0 °C | -3 °C |

years: [2023](https://pt.weatherspark.com/h/y/148473/2023/Condi%C3%A7%C3%B5es-meteorol%C3%B3gicas-hist%C3%B3ricas-durante-2023-no-Skopje-%22Alexander-the-Great%22-Airport-Maced%C3%B4nia#Figures-Temperature) [2022](https://pt.weatherspark.com/h/y/148473/2022/Condi%C3%A7%C3%B5es-meteorol%C3%B3gicas-hist%C3%B3ricas-durante-2022-no-Skopje-%22Alexander-the-Great%22-Airport-Maced%C3%B4nia#Figures-Temperature) [2021](https://pt.weatherspark.com/h/y/148473/2021/Condi%C3%A7%C3%B5es-meteorol%C3%B3gicas-hist%C3%B3ricas-durante-2021-no-Skopje-%22Alexander-the-Great%22-Airport-Maced%C3%B4nia#Figures-Temperature) [2020](https://pt.weatherspark.com/h/y/148473/2020/Condi%C3%A7%C3%B5es-meteorol%C3%B3gicas-hist%C3%B3ricas-durante-2020-no-Skopje-%22Alexander-the-Great%22-Airport-Maced%C3%B4nia#Figures-Temperature) [2019](https://pt.weatherspark.com/h/y/148473/2019/Condi%C3%A7%C3%B5es-meteorol%C3%B3gicas-hist%C3%B3ricas-durante-2019-no-Skopje-%22Alexander-the-Great%22-Airport-Maced%C3%B4nia#Figures-Temperature) [2018](https://pt.weatherspark.com/h/y/148473/2018/Condi%C3%A7%C3%B5es-meteorol%C3%B3gicas-hist%C3%B3ricas-durante-2018-no-Skopje-%22Alexander-the-Great%22-Airport-Maced%C3%B4nia#Figures-Temperature) [2017](https://pt.weatherspark.com/h/y/148473/2017/Condi%C3%A7%C3%B5es-meteorol%C3%B3gicas-hist%C3%B3ricas-durante-2017-no-Skopje-%22Alexander-the-Great%22-Airport-Maced%C3%B4nia#Figures-Temperature) [2016](https://pt.weatherspark.com/h/y/148473/2016/Condi%C3%A7%C3%B5es-meteorol%C3%B3gicas-hist%C3%B3ricas-durante-2016-no-Skopje-%22Alexander-the-Great%22-Airport-Maced%C3%B4nia#Figures-Temperature) [2015](https://pt.weatherspark.com/h/y/148473/2015/Condi%C3%A7%C3%B5es-meteorol%C3%B3gicas-hist%C3%B3ricas-durante-2015-no-Skopje-%22Alexander-the-Great%22-Airport-Maced%C3%B4nia#Figures-Temperature)

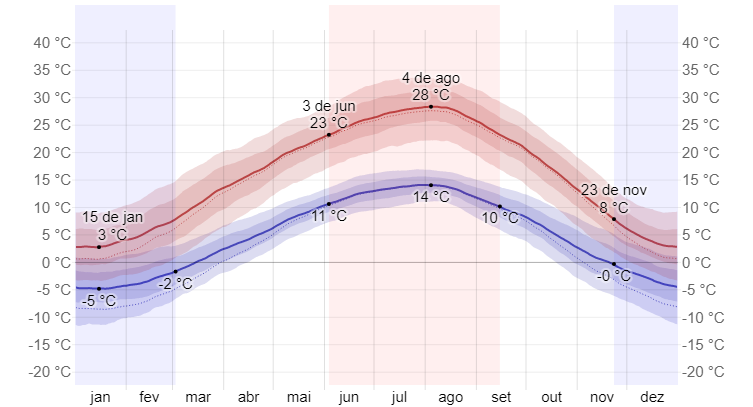


Figure - Average maximum and minimum temperatures in Gjilan/ Gnjilane (2015-2023)

(Average maximum (red line) and minimum (blue line) temperature, thin dotted lines are the corresponding average perceived temperatures).

* ***Rainfal***

A rainy day is one with a minimum liquid or liquid equivalent precipitation of 1 millimeter. The possibility of wet days in Gjilan**/** Gnjilane varies throughout the year.

The wettest season lasts 8.2 months, from April 2 to December 7, with a greater than 23% chance that a given day will experience precipitation. The wettest month in Gjilan**/** Gnjilane is May, with an average of 8.2 days with at least 1 inch of precipitation.

The driest season lasts 3.8 months, from December 7 to April 2. The month with the fewest wet days in Gjilan**/** Gnjilane is January, with an average of 5.9 days with at least 1 millimeter of precipitation.

Among rainy days we distinguish those with only rain, only snow or a mixture of both. The month with the most days of pure rain in Gjilan**/** Gnjilane is May, with an average of 8.2 days. Based on this categorization, the most common form of precipitation throughout the year is rain alone, with a maximum probability of 29% in May.

It rains in Gjilan**/** Gnjilane throughout the year. The wettest month in Gjilan**/** Gnjilane is October, with an average of 49 mm of rainfall. The month with the least rain in Gjilan**/** Gnjilane is January, with an average of 17 mm of precipitation.

[2023](https://pt.weatherspark.com/h/y/148473/2023/Condi%C3%A7%C3%B5es-meteorol%C3%B3gicas-hist%C3%B3ricas-durante-2023-no-Skopje-%22Alexander-the-Great%22-Airport-Maced%C3%B4nia#Figures-PrecipitationProbability) [2022](https://pt.weatherspark.com/h/y/148473/2022/Condi%C3%A7%C3%B5es-meteorol%C3%B3gicas-hist%C3%B3ricas-durante-2022-no-Skopje-%22Alexander-the-Great%22-Airport-Maced%C3%B4nia#Figures-PrecipitationProbability) [2021](https://pt.weatherspark.com/h/y/148473/2021/Condi%C3%A7%C3%B5es-meteorol%C3%B3gicas-hist%C3%B3ricas-durante-2021-no-Skopje-%22Alexander-the-Great%22-Airport-Maced%C3%B4nia#Figures-PrecipitationProbability) [2020](https://pt.weatherspark.com/h/y/148473/2020/Condi%C3%A7%C3%B5es-meteorol%C3%B3gicas-hist%C3%B3ricas-durante-2020-no-Skopje-%22Alexander-the-Great%22-Airport-Maced%C3%B4nia#Figures-PrecipitationProbability) [2019](https://pt.weatherspark.com/h/y/148473/2019/Condi%C3%A7%C3%B5es-meteorol%C3%B3gicas-hist%C3%B3ricas-durante-2019-no-Skopje-%22Alexander-the-Great%22-Airport-Maced%C3%B4nia#Figures-PrecipitationProbability) [2018](https://pt.weatherspark.com/h/y/148473/2018/Condi%C3%A7%C3%B5es-meteorol%C3%B3gicas-hist%C3%B3ricas-durante-2018-no-Skopje-%22Alexander-the-Great%22-Airport-Maced%C3%B4nia#Figures-PrecipitationProbability) [2017](https://pt.weatherspark.com/h/y/148473/2017/Condi%C3%A7%C3%B5es-meteorol%C3%B3gicas-hist%C3%B3ricas-durante-2017-no-Skopje-%22Alexander-the-Great%22-Airport-Maced%C3%B4nia#Figures-PrecipitationProbability) [2016](https://pt.weatherspark.com/h/y/148473/2016/Condi%C3%A7%C3%B5es-meteorol%C3%B3gicas-hist%C3%B3ricas-durante-2016-no-Skopje-%22Alexander-the-Great%22-Airport-Maced%C3%B4nia#Figures-PrecipitationProbability) [2015](https://pt.weatherspark.com/h/y/148473/2015/Condi%C3%A7%C3%B5es-meteorol%C3%B3gicas-hist%C3%B3ricas-durante-2015-no-Skopje-%22Alexander-the-Great%22-Airport-Maced%C3%B4nia#Figures-PrecipitationProbability)

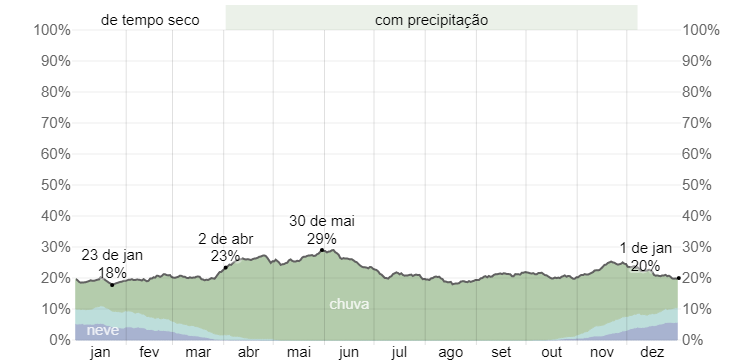


Figure - Probability of daily rainfall in Gjilan/ Gnjilane (2023-2015)

* ***Winds***

This section provides insights into the hourly mean wind vector (speed and direction) over a wide area at 10 meters above the ground. The perception of wind in a particular depends greatly on the local topography and other factors. Wind speed and direction change instantaneously much more than the hourly average values. The average hourly wind speed in Gjilan**/** Gnjilane experiences slight seasonal variation over the course of the year. The windiest part of the year lasts for 5.4 months, from November 11 to April 25, during which average wind speeds surpass 6 miles per hour. The windiest month in Gjilan**/** Gnjilane is February, with an average hourly wind speed of 10.8 kilometers per hour. Conversely, the calmest time of the year lasts for 6.6 months, from April 25 to November 11. The windiest month in Gjilan**/** Gnjilane is August, with an average wind speed of 7.8 kilometers per hour.

[2023](https://pt.weatherspark.com/h/y/148473/2023/Condi%C3%A7%C3%B5es-meteorol%C3%B3gicas-hist%C3%B3ricas-durante-2023-no-Skopje-%22Alexander-the-Great%22-Airport-Maced%C3%B4nia#Figures-WindSpeed) [2022](https://pt.weatherspark.com/h/y/148473/2022/Condi%C3%A7%C3%B5es-meteorol%C3%B3gicas-hist%C3%B3ricas-durante-2022-no-Skopje-%22Alexander-the-Great%22-Airport-Maced%C3%B4nia#Figures-WindSpeed) [2021](https://pt.weatherspark.com/h/y/148473/2021/Condi%C3%A7%C3%B5es-meteorol%C3%B3gicas-hist%C3%B3ricas-durante-2021-no-Skopje-%22Alexander-the-Great%22-Airport-Maced%C3%B4nia#Figures-WindSpeed) [2020](https://pt.weatherspark.com/h/y/148473/2020/Condi%C3%A7%C3%B5es-meteorol%C3%B3gicas-hist%C3%B3ricas-durante-2020-no-Skopje-%22Alexander-the-Great%22-Airport-Maced%C3%B4nia#Figures-WindSpeed) [2019](https://pt.weatherspark.com/h/y/148473/2019/Condi%C3%A7%C3%B5es-meteorol%C3%B3gicas-hist%C3%B3ricas-durante-2019-no-Skopje-%22Alexander-the-Great%22-Airport-Maced%C3%B4nia#Figures-WindSpeed) [2018](https://pt.weatherspark.com/h/y/148473/2018/Condi%C3%A7%C3%B5es-meteorol%C3%B3gicas-hist%C3%B3ricas-durante-2018-no-Skopje-%22Alexander-the-Great%22-Airport-Maced%C3%B4nia#Figures-WindSpeed) [2017](https://pt.weatherspark.com/h/y/148473/2017/Condi%C3%A7%C3%B5es-meteorol%C3%B3gicas-hist%C3%B3ricas-durante-2017-no-Skopje-%22Alexander-the-Great%22-Airport-Maced%C3%B4nia#Figures-WindSpeed) [2016](https://pt.weatherspark.com/h/y/148473/2016/Condi%C3%A7%C3%B5es-meteorol%C3%B3gicas-hist%C3%B3ricas-durante-2016-no-Skopje-%22Alexander-the-Great%22-Airport-Maced%C3%B4nia#Figures-WindSpeed) [2015](https://pt.weatherspark.com/h/y/148473/2015/Condi%C3%A7%C3%B5es-meteorol%C3%B3gicas-hist%C3%B3ricas-durante-2015-no-Skopje-%22Alexander-the-Great%22-Airport-Maced%C3%B4nia#Figures-WindSpeed)

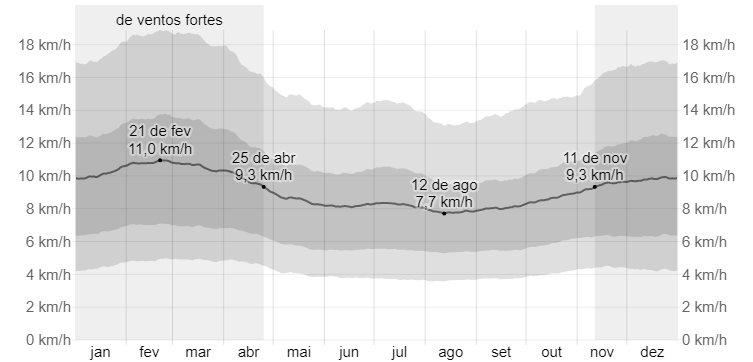


Figure - Average wind speed in Gjilan/ Gnjilane

# 7.0 AIR QUALITY

The term "air quality" refers to the state of the air in our surroundings. Good air quality refers to how clean the air is from pollutants such as smoke, dust, and smog, as well as other gaseous contaminants in the air. A variety of pollution indicators are used to monitor air quality. Maintaining the delicate balance of life on Earth for humans, plants, animals, and natural resources requires good air quality. As a result, when air pollution reaches significant quantities, human health, plants, animals, and natural resources are threatened.[[12]](#footnote-12)

Poor air quality can have negative impact on human health and/or the environment. Natural and man-made sources can both worsen air quality. Volcanic eruptions and windstorm dust are examples of natural sources. Pollution from moving vehicles, emissions from industry, coal-powered plants, household heating, open-air burning of wood or other materials, and landfills are examples of man-made sources. Both of these sources can have a significant impact on overall air quality and cause serious health problems in humans and environment.

Pollutants emitted by air pollution sources include sulfur dioxide (SO2), particulate matter (PM10, PM2.5, PM1), hydrocarbons (HC) and volatile organic compounds (VOC), lead, carbon dioxide (CO2) and carbon monoxide (CO), nitrogen oxides (NOx), and smog. Smoke, dust, CO, NOx, SO2, HC, and smog from industries, smelters, power plants and vehicles, are notable air quality degraders in most regions, particularly around urban and industrial areas.[[13]](#footnote-13)

Gjilan/ Gnjilane has no heavy industry. Data shows that two sectors with most impact on air pollution are the Transport sector[[14]](#footnote-14) and residential heating.[[15]](#footnote-15)

## 7.1 Air Quality monitoring data

Law No. 08/L-025 For Air Protection from Pollution requires monitoring of air quality and trends of increasing or decreasing air quality. Gjilan**/** Gnjilane air quality is monitored by one air quality monitoring stations (AQMS) located in the courtyard of the primary school "Selami Hallaqi" (GPS: (21.460363, 42.46807)), active from: 05 April 2012. Pollutants that are measured at the station with an automatic analyzer are: SO2 (µg/m3), NO2 (µg/m3), NO2 expressed as NO2 (µg/m3), O3 (µg/m3), CO (mg/m3), PM10 (µg/m3), PM2.5 (µg/m3),

The quality of air quality data was not satisfactory enough to be useful until 2018, but with the implementation of the Millennium Challenge Corporation (MCC)/ Kosovo Millennium Foundation (MFK) project and a related Japanese International Cooperation Agency (JICA) project for Capacity Development on Air Pollution Control, all 12 AQMSs were rehabilitated. As a result, data from 2019 onwards have proven suitable for analysis and form the basis of this research.

The requirements of Air Quality Standard for Kosovo are outlined in Administrative Instruction No. 02/2011 on Air Quality, shown in tab.9.

Table -Kosovo Air Quality Standard[[16]](#footnote-16)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | Limit Values | Units of measure | Limit Values  (μg/m3) | Rate of allowed exceedance in a year |
| NO2 | Limit value for 1 hour for the protection of human health | μg/m3 | 200 | 18 |
| Annual limit value for the protection of human health | μg/m3 | 40 | Not foreseen |
| Annual limit value for the protection of vegetation | μg/m3 | 30 | Not foreseen |
| SO2 | Limit value for 1 hour for the protection of human health | μg/m3 | 350 | 24 |
| Limit value for 24 hours for the protection of human health | μg/m3 | 125 | 3 |
| CO | Limit value for the 8-hour daily average for the protection of human health | μg/m3 | 10 | Not foreseen |
| PM10 | Limit value for 24 hours for the protection of human health | μg/m3 | 50 | 35 |
| Annual limit value for the protection of vegetation | μg/m3 | 40 | Not foreseen |
| PM2.5 | Annual limit value for the protection of vegetation | μg/m3 | 25 | Not foreseen |
| O3 | Long-term objective for the protection of human health | μg/m3 | 120 | Not foreseen |
| Information threshold | μg/m3 | 180 | Not foreseen |
| Alarm threshold | μg/m3 | 240 | Not foreseen |

The air quality monitoring data from the Air Quality Monitoring Station (AQMS) of Gjilan/ Gnjilane are collected from Hydro-Meteorological Institute of Kosovo (KHMI)[[17]](#footnote-17) and analyzed annual average data and monthly average data. The pollutants described are Sulfur dioxide (SO2), Nitrogen dioxide (NO2), Particulate Matter PM10, and Particulate Matter PM2.5.

**Sulphur dioxide (SO2)** is a heavy, colorless, and poisonous gas with a pungent and irritating odour. Its smell is often described similar to that of a burnt matchstick. The gas forms secondary particulate matter (PM2.5) when it oxidizes to sulphuric acid (H2SO4) by combining with water vapour. It also reacts with ammonia (NH3) to create another dangerous compound called ammonium sulphate((NH4)2SO4). SO2 also contributes to sulphurous smog, which results from a high concentration of sulfur oxides (SOx) in the atmosphere and is exacerbated by dampness and particulate matter (PM). Sulphur dioxide is released into the atmosphere through burning fossil fuels (coal, oil) for domestic heating, transport (locomotives), power plants, and other industrial facilities. Smelting mineral ores that contain sulphur (iron pyrite, copper pyrite), etc. Impact of sulphur dioxide is capable of turning into sulphuric acid (H2SO4), which is a major component of acid rain. Acid rain has many harmful effects, such as: acidifying aquatic ecosystems (lakes, streams, wetlands), which lowers biodiversity by killing plants and animals; deforestation through the damaging of vegetation, depriving the soil of essential nutrients (calcium, aluminum, magnesium), corroding buildings and materials.

In human health, sulfur dioxide can affect lung function and cause and worsen respiratory diseases in humans and animals. In the long term, exposure to SO2 leads to an overall increase in hospitalization rates for heart disease and generally higher mortality rates.[[18]](#footnote-18)

Monthly Average AQMS data of Gjilan/Gnjliane on SO2 (2019- 2022) are shown in table 10 and fig. 6.

Table - Monthly Average AQMS data of Gjilan/ Gnjilane on SO2 (2019- 2022)

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **SO2**  **(μg/m3)** | Jan. | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| **Year 2019** | 9.8 | 9.1 | 10.4 | 10.9 | 11.0 | 11.0 | 14.3 | 17.5 | 18.5 | 25.5 | 4.6 | 2.2 |
| **Year 2020** | 3.2 | 2.3 |  |  |  | 0.8 | 1.1 | 10.6 | 11.5 | 6.2 | 10.7 | 11.5 |
| **Year 2021** | 12.5 | 13.9 | 6.0 | 1.6 | 0.9 | 1.0 | 0.8 | 1.1 | 1.4 | 1.4 | 2.1 | 2.6 |
| **Year 2022** | 3.4 | 2.7 | 2.6 | 1.9 | 4.2 | 1.8 | 1.3 | 2.2 | 3.4 | 6.1 | 8.0 | 7.2 |

Figure - Monthly Average Data of Gjilan/ Gnjilane on SO2

The data quality of 2019 is not good, because there are some gaps between October and November.  Monthly averages of SO2 are quite low in comparison to the SO2 Air Quality Standard, indicating that SO2 air pollution control measures are not a high priority.

**Nitrogen Dioxide (NO2)** is one of a group of highly reactive gases known as oxides of nitrogen or nitrogen oxides (NOx). Other nitrogen oxides include nitrous acid and nitric acid. NO2 is used as the indicator for the larger group of nitrogen oxides. NO2 primarily gets in the air from the burning of fuel. NO2 forms from emissions from cars, trucks and buses, power plants, and off-road equipment.

Environmental effects- NO2 and other NOx interact with water, oxygen and other chemicals in the atmosphere to form acid rain. Acid rain harms sensitive ecosystems such as lakes and forests.

High concentration of NO2 can have impact on human health. This causes irritation of the respiratory tract. Such exposures over short periods can aggravate respiratory diseases, particularly asthma, leading to respiratory symptoms (such as coughing, wheezing or difficulty breathing). Longer exposures to elevated concentrations of NO2 may contribute to the development of asthma and potentially increase susceptibility to respiratory infections. People with asthma, as well as children and the elderly are generally at greater risk for the health effects of NO2.

NO2 along with other NOx reacts with other chemicals in the air to form both particulate matter and ozone. Both of these are also harmful when inhaled due to effects on the respiratory system.[[19]](#footnote-19)

Monthly Average AQMS data of Gjilan/ Gnjilane on NO2 (2019- 2022) are shown in table 11 and fig. 7.

Table - Monthly Average NO2 data (μg/m3) from AQMS 2019 to 2022

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **NO2**  **(μg/m3)** | Jan. | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| **Year 2019** | 67.7 | 51.2 | 35.2 | 24.3 | 17.9 | 16.0 | 19.2 | 23.4 | 20.8 | 28.6 | 22.2 | 21.3 |
| **Year 2020** | 31.8 | 27.1 |  |  |  | 10.5 | 9.4 | 10.6 | 16.0 | 25.6 | 28.2 | 27.7 |
| **Year 2021** | 29.1 | 40.5 | 29.9 | 18.6 | 12.3 | 14.8 | 17.7 | 18.2 | 17.2 | 20.5 | 24.6 | 26.9 |
| **Year 2022** | 36.6 | 32.4 | 25.1 | 17.1 | 15.1 | 11.7 | 16.2 | 17.1 | 13.9 | 22.1 | 22.2 | 24.7 |

Figure - Monthly Average NO2 data (μg/m3) from AQMS 2019 to 2022

Data set against the Air Quality Standard of NO2, which is an annual average, these monthly averages generally not exceeding 40μg/m3 except for an exceedance in January 2019 that could be an error from AQMS data or an increase for due to the heavy traffic and the burning of wood for heating in the household. It is suggested that air pollution control measures for NO2 are not such a high priority.

**Particulate matter (PM)** is made up of particles (tiny pieces) of solids or liquids that are in the air. These particles may include: dust, dirt, soot, smoke, drops of liquid. Particle pollution can come from two different kinds of sources — primary or secondary. Primary sources cause particle pollution on their own. For example, wood stoves and forest fires are primary sources. Secondary sources let off gases that can form particles. Power plants and coal fires are examples of secondary sources. Some other common sources of particle pollution can be either primary or secondary — for example, factories, cars and trucks, and construction sites. Smoke from fires and emissions (releases) from power plants, industrial facilities, and cars and trucks contain mostly PM2.5.

Health impact- bigger particles, called PM10, can irritate eyes, nose, and throat. Dust from roads, farms, dry riverbeds, construction sites, and mines are types of PM10. Fine (smaller) particles, called PM2.5, are more dangerous because they can get into the deep parts of lungs - or even into the blood.[[20]](#footnote-20)

The monthly average PM10 data from AQMS for 2019 to 2022 are shown in Table 12 and Figure 8.

Table - Monthly Average AQMS data of Gjilan/ Gnjilane on PM10 (2019 to 2022)

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **PM10**  **(μg/m3)** | Jan. | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| **Year 2019** | 87.4 | 79.8 | 35.4 | 16.1 | 7.5 | 5.3 | 4.4 | 4.2 | 4.3 | 28.2 | 45.2 | 49.5 |
| **Year 2020** | 94.3 | 63.2 |  |  |  | 21.1 | 20.1 | 19.8 | 13.7 | 26.9 | 57.8 | 40.0 |
| **Year 2021** | 39.9 | 61.1 | 32.4 | 28.7 | 16.4 | 23.6 | 24.2 | 20.4 | 16.8 | 25.9 | 39.7 | 22.7 |
| **Year 2022** | 69.1 | 47.4 | 40.9 | 18.7 | 16.7 | 14.5 | 15.3 | 16.2 | 12.8 | 27.9 | 37.5 | 46.4 |

Figure - Monthly Average AQMS data of Gjilan/ Gnjilane on PM10 (2019 to 2022)

Between 2019 and 2022, all data show a general declining tendency, with occasional swings during the summer season and increases during the winter season. The main sources are wood and lignite burning in houses although building and demolition dust also contributes.

When compared to the Air Quality Standard values for the 24-hour average of PM10, monthly averages in winter reaching or exceeding 50 g/m3 indicate that PM10 emission reduction actions are critical.

**Particulate matter (PM2.5)-** PM2.5 are very small particles usually found in smoke. They have a diameter of 2.5 micrometers (0.0025 mm) or smaller. Common sources of PM2.5 particles include: smoke from fires, [smoke from wood heaters](https://www.epa.vic.gov.au/for-community/environmental-information/air-quality/smoke-from-wood-heaters), [car and truck exhausts](https://www.epa.vic.gov.au/for-community/environmental-information/air-quality/vehicle-emissions-air-quality), industry etc. The PM2.5 concentrations are much higher than the WHO guideline values (annual average of 5μg/m3 and a 24-hour average of 15μg/m3), which were revised on September 21, 2021.

The monthly average PM2.5 data from AQMS for 2019 to 2022 are shown in Table 13 and Figure 9.

Table - Monthly Average AQMS data of Gjilan/ Gnjilane on PM2.5 (2019 to 2022)

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **PM2.5**  **(μg/m3)** | Jan. | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| **Year 2019** | 78.1 | 51.3 | 26.1 | 11.6 | 5.3 | 4.0 | 3.3 | 3.4 | 3.8 | 22.3 | 26.1 | 40.0 |
| **Year 2020** | 76.7 | 48.2 |  |  |  | 10.4 | 10.7 | 11.4 | 9.9 | 21.7 | 52.2 | 36.0 |
| **Year 2021** | 36.9 | 55.3 | 28.0 | 19.9 | 8.1 | 12.3 | 12.9 | 10.6 | 10.6 | 21.4 | 32.0 | 19.8 |
| **Year2022** | 60.4 | 40.8 | 31.3 | 13.2 | 10.5 | 9.6 | 9.3 | 10.8 | 9.1 | 21.6 | 32.1 | 41.4 |

Figure - Monthly Average AQMS data of Gjilan/ Gnjilane on PM2.5 (2019 to 2022)

The monthly averages from October to April are excessive when compared to the WHO recommended value of 15g/m3 for the 24-hour average of PM2.5. As a result, implementing PM2.5 emission reduction measures is very important.

## 7.2 Emissions data of Gjilan/ Gnjilane

### 7.2.1 Emission calculation

Air pollution sources are classified as either stationary or mobile. Stationary sources are further subdivided into point and diffuse sources based on how pollutants are emitted into the air. Pollutants are emitted into the air through a specific and intentional outlet in the case of point sources (chimneys and ventilation outlets of plants, technical processes, industrial facilities, equipment, buildings, etc.). Without a defined outlet/chimney, diffuse sources transfer contaminants into the air. Outdoor activities and processes, as well as fugitive emissions, can be sources of dispersed emissions. Motor vehicles, non-road mobile machinery, self-propelled railway vehicles and airplanes are examples of mobile sources that exhaust pollutants into the atmosphere.

To identify the sources of air pollution that cause poor air quality, it is necessary to know those sources, their capacity, and the quantity of pollutants they emit.

According to Law No. 08/L-025on Protection of Air from Pollution, KEPA is to maintain an Inventory of Air Emissions which is part of the Environmental Information System. These data are collected by operators whose activities during technological processes discharge emissions into the air. Operators are obliged to send their annual reports to KEPA.

KEPA is continuously completing the inventory of air emissions, but due to the lack of information, it is still not possible to include all data from all sources of air pollution. With the data that has been collected, calculations have been made for the emissions for a better overview of the sources of pollution and their emitted quantity.

The data and calculation of emissions for different sectors are presented below.

## 7.3. Summary of Emissions in Gjilan/Gnjilane Municipality

The SO2 emissions in Municipality of Gjilan/ Gnjilane are shown in Table 14. and Figure 10. The category of the largest SO2 emissions is the “1.A.4 Small combustion (Commercial / institutional: Stationary sources)”. The category of the next largest SO2 emissions is the “1.A.4 Small combustion (Residential: Stationary sources)”. The SO2 emissions from other categories are not so large.

Table - SO2 Emissions Trend, related Municipality of Gjilan/ Gnjilane from 2015 to 2022



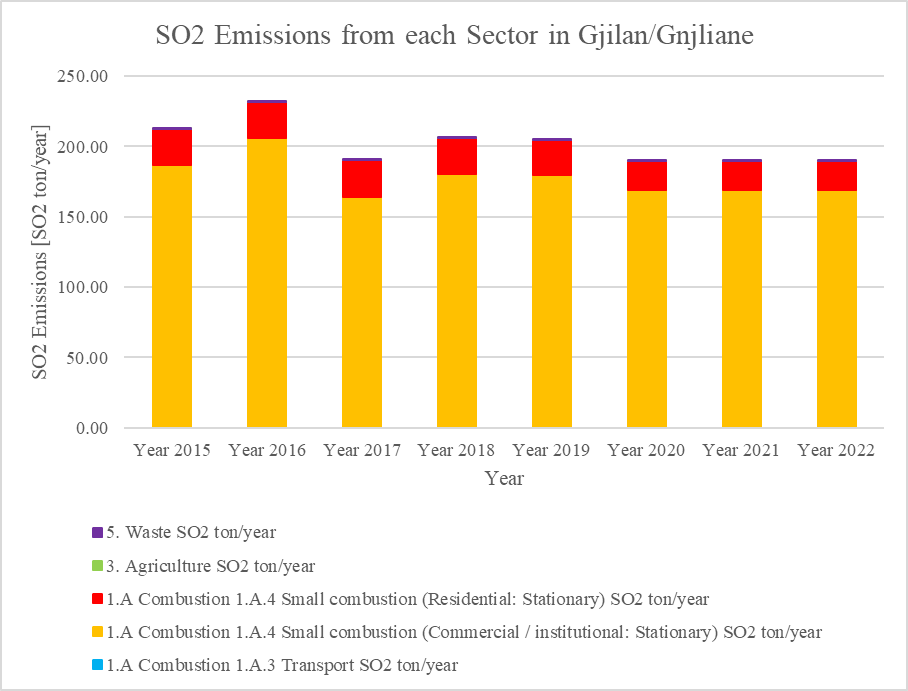


Figure - SO2 Emissions Trend related Municipality of Gjilan/ Gnjilane from 2015 to 2022

The NOx emissions in Municipality of Gjilan/ Gnjliane are shown in Table 15. and Figure 11. The category of the largest NOx emissions is the “1.A.3 Transport”. The category of the next largest NOx emissions is the “1.A.4 Small combustion (Residential: Stationary sources)”, and third one is the “1.A.4 Small combustion (Commercial / institutional: Stationary sources)”. The NOx emissions from the Agriculture Sector are also not so small. Therefore, if the air pollution control measures for NOx are necessary, since there *are many NOx emission sources, the Municipality should consider many emission sources.*

Table - NOx Emissions Trend related Municipality of Gjilan/ Gnjilane from 2015 to 2022



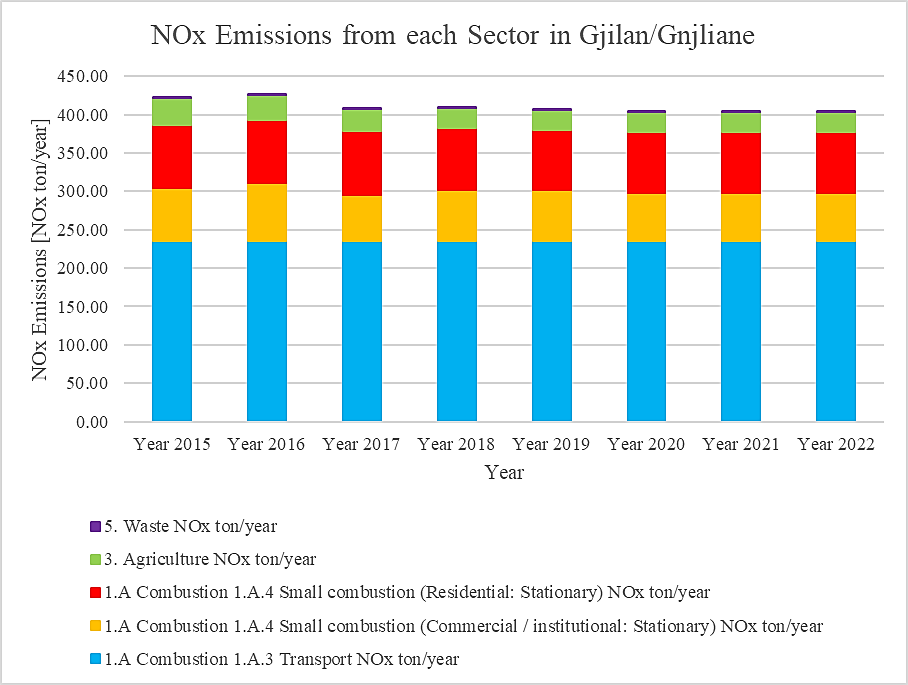


Figure - NOx Emissions Trend related Municipality of Gjilan/ Gnjilane from 2015 to 2022

The PM10 emissions in Municipality of Gjilan/ Gnjilane are shown in Table 16. And Table 16. The category of the largest PM10 emissions is the “1.A.4 Small combustion (Residential: Stationary)”. The other categories and sector such as the “1.A.4 Small combustion (Commercial / institutional: Stationary)” category, the “1.A.3 Transport” category and the agriculture sector are also not so small. However, since the largest emissions source is particularly large, the first priority category of the air pollution control measures for PM10 is the “1.A.4 Small combustion (Residential: Stationary)”.

Table - PM10 Emissions Trend related Municipality of Gjilan/ Gnjilane from 2015 to 2022



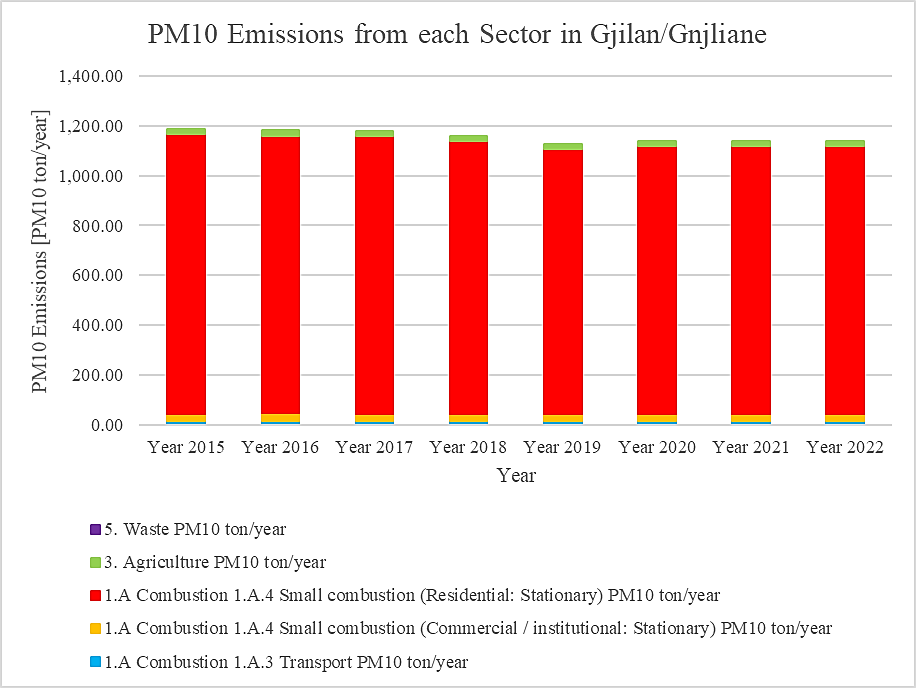


Figure - PM10 Emissions Trend related Municipality of Gjilan/ Gnjilane from 2015 to 2022

The PM2.5 is same situation with PM10. The PM2.5 emissions in Municipality of Gjilan/ Gnjilane are shown in Table 17. and Figure 13. The category of the largest PM2.5 emissions is the “1.A.4 Small combustion (Residential: Stationary)”. The other categories and sector such as the “1.A.4 Small combustion (Commercial/ institutional: Stationary)” category, the “1.A.3 Transport” category and the agriculture sector are also not so small. However, since the largest emissions source is particularly large, the first priority category of the air pollution control measures for PM2.5 is the “1.A.4 Small combustion (Residential: Stationary)”.

Table - PM2.5 Emissions Trend related Municipality of Gjilan/ Gnjilane from 2015 to 2022



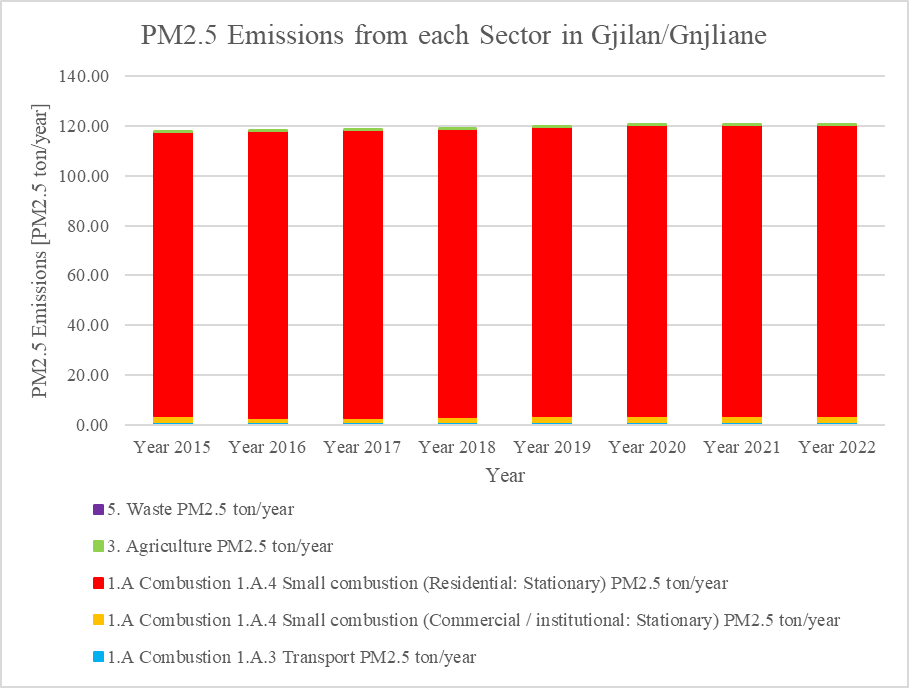


Figure - PM2.5 Emissions Trend related Municipality of Gjilan/ Gnjilane from 2015 to 2022

## 7.4. Emissions from Residential Stationary Sources in Gjilan/Gnjilane Municipality

This is the small combustion (residential: Stationary sources) category of Energy sector. The main sources are fuel combustion for heating and cooking in the household.

The SO2 emissions trend from residential stationary sources in Municipality of Gjilan/ Gnjilane are shown in Table 18. The main emission sources are the detached house. The emissions from the detached house by fuel type are shown in Table 19. The fuel types of main SO2 emission sources are Wood and Pellet. The Figure 14. shows the trend of SO2 emissions from 2015 to 2020 and ratio of emissions in 2022 for detached houses.

Table - SO2 Emissions Trend from Residential: Stationary sources in Municipality of Gjilan/ Gnjilane

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Unit (SO2 ton/year) | Year 2015 | Year 2016 | Year 2017 | Year 2018 | Year 2019 | Year 2020 |
| Detached house | 20 | 20 | 20 | 20 | 19 | 19 |
| Semi-detached house | 4 | 4 | 4 | 4 | 4 | 4 |
| Row or terraced house (with at 3 attached or connected dwelling) | 1 | 1 | 1 | 1 | 1 | 1 |
| Apartment building or block of flats | 1 | 1 | 1 | 1 | 1 | 1 |
| Subtotal Residential: Stationary | 26 | 26 | 26 | 25 | 25 | 21 |

Table - SO2 Emissions from Detached House by fuel types in Municipality of Gjilan/ Gnjilane

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Unit (SO2 ton/year) | Year 2015 | Year 2016 | Year 2017 | Year 2018 | Year 2019 | Year 2020 |
| Lignite | 1.54 | 1.54 | 1.54 | 1.54 | 1.54 | 1.54 |
| LPG | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Gasoline | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Diesel | 0.54 | 0.53 | 0.53 | 0.52 | 0.50 | 0.51 |
| Wood | 12.64 | 12.53 | 12.58 | 12.34 | 11.97 | 12.11 |
| Pellet | 5.43 | 5.38 | 5.41 | 5.31 | 5.15 | 5.20 |
| Subtotal- Detached House | 20.14 | 19.98 | 20.05 | 19.71 | 19.16 | 19.36 |



Figure - SO2 Emissions from Detached House by fuel types in Municipality of Gjilan/ Gnjilane

The NOx emissions trend from residential stationary sources in Municipality of Gjilan/ Gnjilane are shown in Table 20. The main emission sources are the detached house and semi-detached house. The emissions from the detached house by fuel type are shown in Table 21. The fuel types of main NOx emission source is Wood. The Figure 15. shows the trend of NOx emissions from 2015 to 2020 and ratio of emissions in 2022 for detached houses.

Table - NO2 Emissions Trend from Residential: Stationary in Municipality of Gjilan/ Gnjilane

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Unit (NOx ton/year) | Year 2015 | Year 2016 | Year 2017 | Year 2018 | Year 2019 | Year 2020 |
| Detached house | 65 | 64 | 65 | 63 | 62 | 62 |
| Semi-detached house | 13 | 12 | 12 | 12 | 12 | 12 |
| Row or terraced house (with at 3 attached or connected dwelling) | 2 | 2 | 2 | 2 | 2 | 2 |
| Apartment building or block of flats | 3 | 3 | 3 | 3 | 3 | 3 |
| Subtotal Residential: Stationary | 83 | 82 | 83 | 81 | 79 | 80 |

Table - NO2 Emissions from Detached House by fuel types in Municipality of Gjilan/ Gnjilane

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Unit (NOx ton/year) | Year 2015 | Year 2016 | Year 2017 | Year 2018 | Year 2019 | Year 2020 |
| Lignite | 0.19 | 0.19 | 0.19 | 0.19 | 0.19 | 0.19 |
| LPG | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| Gasoline | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Diesel | 0.39 | 0.39 | 0.39 | 0.38 | 0.37 | 0.37 |
| Wood | 57.44 | 56.95 | 57.19 | 56.10 | 54.41 | 55.04 |
| Pellet | 6.93 | 6.87 | 6.90 | 6.77 | 6.57 | 6.64 |
| Subtotal- Detached House | 64.98 | 64.42 | 64.69 | 63.47 | 61.56 | 62.27 |



Figure - NOx Emissions from Detached House by fuel types in Municipality of Gjilan/ Gnjilane

The PM10 emissions trend from residential stationary sources in Municipality of Gjilan/ Gnjliane are shown in Table 22. The main emission sources are the detached house and semi-detached house. The emissions from the detached house by fuel type are shown in Table 23. The fuel types of main PM10 emission source is Wood. The Figure 16. shows the trend of PM10 emissions from 2015 to 2020 and ratio of emissions in 2022 for detached houses.

Table - PM10 Emissions Trend from Residential: Stationary in Municipality of Gjilan/ Gnjilane

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Unit (PM10 ton/year) | Year 2015 | Year 2016 | Year 2017 | Year 2018 | Year 2019 | Year 2020 |
| Detached house | 880 | 872 | 876 | 859 | 833 | 843 |
| Semi-detached house | 163 | 163 | 163 | 161 | 159 | 160 |
| Row or terraced house (with at 3 attached or connected dwelling) | 29 | 29 | 29 | 29 | 29 | 29 |
| Apartment building or block of flats | 50 | 49 | 49 | 46 | 42 | 44 |
| Subtotal Residential: Stationary | 1,122 | 1,113 | 1,117 | 1,096 | 1,064 | 1,076 |

Table - PM10 Emissions from Detached House by fuel types in Municipality of Gjilan/ Gnjilane

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Unit (PM10 ton/year) | Year 2015 | Year 2016 | Year 2017 | Year 2018 | Year 2019 | Year 2020 |
| Lignite | 0.69 | 0.69 | 0.69 | 0.69 | 0.69 | 0.69 |
| LPG | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Gasoline | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Diesel | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Wood | 873.07 | 865.57 | 869.22 | 852.73 | 826.97 | 836.54 |
| Pellet | 5.99 | 5.94 | 5.97 | 5.85 | 5.68 | 5.74 |
| Subtotal- Detached House | 879.77 | 872.21 | 875.89 | 859.29 | 833.35 | 842.99 |



Figure - PM10 Emissions from Detached House by fuel types in Municipality of Gjilan/ Gnjilane

The PM2.5 emissions trend from residential stationary sources in Municipality of Gjilan/ Gnjilane are shown in Table 24. The main emission sources are the detached house and semi-detached house. The emissions from the detached house by fuel type are shown in Table 25. The fuel types of main PM2.5 emission sources is Wood. The Figure 17. shows the trend of PM2.5 emissions from 2015 to 2020 and ratio of emissions in 2022 for detached houses.

Table - PM2.5 Emissions Trend from Residential: Stationary in Municipality of Gjilan/ Gnjilane

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Unit (PM2.5 ton/year) | Year 2015 | Year 2016 | Year 2017 | Year 2018 | Year 2019 | Year 2020 |
| Detached house | 857 | 849 | 853 | 837 | 812 | 821 |
| Semi-detached house | 159 | 158 | 159 | 157 | 155 | 156 |
| Row or terraced house (with at 3 attached or connected dwelling) | 29 | 28 | 29 | 28 | 28 | 28 |
| Apartment building or block of flats | 48 | 47 | 48 | 45 | 41 | 43 |
| Subtotal Residential: Stationary | 1,093 | 1,084 | 1,088 | 1,068 | 1,036 | 1,048 |

Table - PM2.5 Emissions from Detached House by fuel types in Municipality of Gjilan/Gnjliane

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Unit (PM2.5 ton/year) | Year 2015 | Year 2016 | Year 2017 | Year 2018 | Year 2019 | Year 2020 |
| Lignite | 0.68 | 0.68 | 0.68 | 0.68 | 0.68 | 0.68 |
| LPG | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Gasoline | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Diesel | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Wood | 850.10 | 842.79 | 846.35 | 830.29 | 805.21 | 814.53 |
| Pellet | 5.99 | 5.94 | 5.97 | 5.85 | 5.68 | 5.74 |
| Subtotal- Detached House | 856.78 | 849.42 | 853.01 | 836.84 | 811.58 | 820.97 |



Figure - PM2.5 Emissions from Detached House by fuel types in Municipality of Gjilan/Gnjliane

## 7.5. Emissions from Services and Industries in Gjilan/Gnjilane Municipality

The emissions trend from Service Industries in Municipality of Gjilan/ Gnjilane are shown from Table 26. to Table 29. For SO2 emissions, the emissions from Lignite combustion is largest. For NOx emissions, the emissions from Lignite combustion and Gas/ Diesel combustion are larger than the emissions from other fuel types. For PM10 and PM2.5, the emissions from Lignite combustion is largest.

Table - SO2 Emissions Trend from Service Industries in Municipality of Gjilan/ Gnjilane



Table - NOx Emissions Trend from Service Industries in Municipality of Gjilan/ Gnjilane



Table - PM10 Emissions Trend from Service Industries in Municipality of Gjilan/ Gnjilane



Table - PM2.5 Emissions Trend from Service Industries in Municipality of Gjilan/ Gnjilane



## 7.6. Emissions from Vehicle in Gjilan/Gnjilane Municipality

The emissions from vehicle in Municipality of Gjilan/ Gnjilane in 2022 are shown Table 30. The emissions are calculated by multiplying the number of vehicle with each Euro regulation registered in Municipality of Gjilan/ Gnjilane in 2022 by the emission factors for each Euro regulation. The data of vehicle registration are provided by the Agency of Civil Registration. The emission factors are collected from the “1.A.3.b.i, 1.A.3.b.ii, 1.A.3.b.iii, 1.A.3.b.iv Passenger cars, light commercial trucks, heavy-duty vehicles including buses and motor cycles” of the “EMEP/EEA air pollutant emission inventory guidebook 2019 – Update Oct. 2020”[[21]](#footnote-21). The other parameter is the “Average Mileage (km/vehicle/year)”, which is same as the data of the Project for Capacity Development for Air Pollution Control in the Republic of Kosovo[[22]](#footnote-22).

Table - Emissions from Vehicle in Municipality of Gjilan/ Gnjilane in 2022

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **SO2 Emissions** | **NOx Emissions** | **PM10 Emissions** | **PM2.5 Emissions** |
| Year 2022 | kg SO2/year | kg NOx/year | kg PM10/year | kg PM2.5/year |
| Passenger Car (Diesel) | 121.463 | 126,535.060 | 9,875.551 | 9,875.551 |
| Passenger Car (Gasoline) | 1.499 | 148.311 | 5.902 | 5.902 |
| MiniVan | 0.499 | 742.674 | 85.037 | 85.037 |
| LCV | 16.132 | 21,783.038 | 1,899.682 | 1,899.682 |
| HDT | 39.727 | 75,749.939 | 1,756.354 | 1,756.354 |
| Bus | 2.189 | 9,828.748 | 328.087 | 328.087 |
| Motorcycles | 0.029 | 21.031 | 1.011 | 1.011 |
| Total | 181.54 | 234,808.80 | 13,951.63 | 13,951.63 |

The Figure. 18. shows the ratio of NOx emissions by vehicle type, which is the largest emissions among emission sources, and PM2.5 emissions by vehicle type, which has become a problem in recent years.

Regarding NOx emissions, the emissions from PC (Passenger Car) are the largest and the emissions from HDT (Heavy Duty Track) is second largest. The NOx emissions from PCs with from Euro 2 to Euro 5 are very large. This depends on the number of PCs. In addition, NOx emission factors of Vehicle before Euro 3 are large and not so different, and NOx emission factors of Euro 4 and Euro 5 are also not so different. Therefore, for NOx measures, HDT and PC with equal or less than Euro 5 should be replaced to HDT and PC with equal or more than Euro 6.

Regarding PM2.5 emissions, it depends on the Euro regulation. Since the PM2.5 emission factors of PC with equal or more than Euro 6 is completely smaller than one with less than Euro 6, the replacement of PC with less than Euro 6 is very important for the air pollution control measures for PM2.5 on Vehicle. Especially, since the PM2.5 emission factor PC with less than Euro 1 is completely large, the replacement for these PC is first priority.



Figure - Emissions from Vehicle in Municipality of Gjilan/ Gnjilane on NOx and PM2.5

## 7.7. Emissions from other sources in Gjilan/Gnjilane Municipality

Regarding NOx emissions from Agriculture sector, the “Crop production and Agricultural Soil” sub-category of “3.D Land” category is largest emission sources. Regarding PM10 emissions from Agriculture sector, the “3.B Livestock” and the “Crop production and Agricultural Soil” sub-category of “3.D Land” category are large emission sources. The emissions from the Agriculture Sector are shown in Table 31. The emissions from Waste sector is very small.

Table - NOx and PM10 Emissions from Agriculture Sector in Municipality of Gjilan/ Gnjilane



# 8.0. SUMMARY OF AIR POLLUTION CONTROL MEASURES IN GJILAN/GNJLIANE MUNICIPALITY

Regarding the current air quality Municipality of Gjilan/ Gnjliane shown in the 3.1. the biggest issue for the air pollution is PM2.5 and PM10 issue, and the NO2 concentration in the air quality is also not so small.

In addition, for the Emission calculation (4.1) the biggest emission sources of PM2.5 and PM10 is the “1.A.4 Small combustion (Residential: Stationary)” category, and since emissions situation is not so different between PM2.5 and PM10, in this chapter mainly PM2.5 emissions are used. Regarding NOx emissions, the biggest emission source is the “1.A.3 Transport” category.

Therefore, NOx and PM2.5 emission reductions are estimated for air pollution control measures.

The Emission Reductions Calculation for Special Categories is presented in Annex I.

# 9.0 OBJECTIVES AND MEASURES

## 9.1 Objectives

In this LAPAQ objectives are set to decrease all sources of air pollutants to a standard level. In challenging situations, deadlines for complying must be instituted and upheld.

Air pollution is mainly caused by: emissions from combustion; household heating sector, construction and demolition and transport.

### **Objective 1: Reducing the use of fossil fuels in the household**

Almost 80% of detached houses in Gjilan/ Gnjilane are heated with wood. Even though in collective buildings, wood is rarely used as the main source of heating, there are so many detached houses, wood burning is critical for air quality. Because they discharge emissions into residential areas and disperse into the surrounding environment, emissions from wood burning have a significant impact on human health. On days with low temperatures and little wind, the smoke will linger in the yard and enter the house.

Changing the use of wood to pellet heating for detached and semi-detached houses will reduce air pollution, especially PM10 and PM2.5 particles.

A new, more efficient heating device can improve air quality, both indoors and outdoors. Using cleaner fuels, installing efficient appliances and regularly cleaning chimneys can help reduce emissions.

**Objective 2: To improve the city’s traffic flow to reduce emission from the transport sector**

The emphasis is on sustainable modes of transportation, such as walking, cycling, and public transportation. More effective urban transportation can be achieved through lowering car congestion, transportation costs, and negative health and environmental implications.

The Municipality of Gjilan/ Gnjilane should develop a parking plan that includes support for an environmentally sustainable and attractive urban environment and transportation, as well as taking into account the various parking demands of residents, businesses, and other users.

### **Objective 3: To decrease emissions from the construction sector**

Data on new construction and demolitions show that effective emission reductions can only be achieved by influencing the Municipality, construction companies, industry, and stakeholders to ensure compliance with current legislation, encourage low-emission approaches, and develop a path toward improving the rules.

In the coming years, the most effective strategy for reducing local emissions will be to ensure compliance with existing legislation.

Local governments that visit building sites to guarantee dust management compliance might assist improve the problem by monitoring dust at specified places.

### **Objective 4: Raising awareness**

In recent years, air pollution is perceived as one of the main reasons for concern by the population. The "Eurobarometer" survey from 2012 and 2019 reveals the attitude of Europeans towards air quality. It follows that most people do not feel sufficiently informed and express the opinion that public authorities have not done enough to improve air quality. Each perception is influenced by a number of factors, some experts claim that human behavior is driven primarily by perception rather than facts. This has implications for how the public reacts to actions and measures to improve air quality.[[23]](#footnote-23)

Although policies and legislation are good, they cannot be successful without public support. This can only come from citizens who are well informed, aware and fully committed to environmental issues. To raise public awareness and participation, it is important to increase education and awareness programs to cater to specific target groups at different levels. Improving methods for air quality data distribution and providing feedback mechanisms on the effectiveness of program implementation.

It is also very important to create a close partnership between the private sector, Non-Governmental Organizations and other actors to facilitate environmental education programs and public participation. This requires the provision of sufficient materials that will help improve air quality and public health campaigns through mass media, workshops, round tables, etc., including politicians (Members of Municipal Assembly, Government, other agencies corresponding), etc.

## 9.2 Measures

Based on technical evidence analyzed in this document air pollution continues to cause health hazards and environmental damage despite the fact that the emission reduction obligations are met. Due to this, the LAPAQ includes measures to further improve air quality and reduce exposure to pollution. These measures are specifically related to emissions from household heating with wood and coal, street dust, exhaust emission from other different sources such as transport and, on the other hand, to the actions of other sectors that affect air quality.

Such measures will be adopted to top up the resource needs in addition to the municipality and central government funding. In areas where the action depends on private sector participation and investments the detailed guidelines under this plan can guide such investment.

There is also the possibility of supporting the implementation of measures by donors, noting that the protection of air quality should not be seen as a separate sector, but rather as a complement to the European orientations focused on the protection of air quality, climate and environment.

# 10.0 RANKING OF PRIORITIES

LAPAQ determined which forms of action would be most beneficial for improvement of air quality. At this moment, the initiatives have not been prioritized, despite the fact that they will each accomplish various air quality effects within varied timeframes and budgetary constraints.

Individual tasks will be prioritized in the table of actions, taking into account considerations such as cost, benefit, and timeframe.

This will be seen when the success of one activity is dependent on the success of another.

# 11.0 ACTIONS AND LEADING INSTITUTIONS OF LAPAQ

To achieve priorities and actions Municipality will work in partnership with all across the authorities and with partners such as businesses, NGO and other interested stockholders to effectively use the local capacities to tackle air quality issues within our control including:

* joint work with public health professionals.
* to continue to utilize the planning system to drive the air quality agenda via conditions and enforcement where appropriate.
* measures at a wider scale and investigate options to make efficient use of resources by delivering joint actions,

# 12.0 IMPACT OF IMPLEMENTATION

With the implementation of this action plan, the residents of Gjilan/ Gnjilane will benefit to:

* protect the human health and the environment;
* demonstrate the Municipality of Gjilan/ Gnjilane's and people commitment to improve air quality;
* drive a constant effort to improve opportunities of action , considering economic and social development and efficiency;
* identify areas and issues with special focus on air quality protection;
* promote use of cleaner energy, energy efficiency through care in the design, use and reuse of goods.

# 13.0 ASSESSING THE IMPLEMENTATION OF THE ACTION PLAN

By implementation of the LAPAQ many actions may have complementary effects to continuously improve air quality and achieve remarkable environmental and health benefits. The implementation of this action plan's measures necessitates meticulous planning. To determine the success of the actions, the following criteria must be met:

* coordination, communication, and cooperation between all responsible parties involved in the implementation of certain actions.
* political backing, budget allocation, technical skills, and a process of review and improvement.
* sufficient resources for the plan's implementation to ensure that it is completed within the time frame specified.
* considering the small budget of the municipality, the eventual support of donors is very important for the implementation of certain projects.

# 14.0 THE EXPECTED IMPACT OF THE LAPAQ

The local air quality effects of discrete programmes, schemes and interventions may not be measurable (by measuring air quality) due to the cumulative effects of different schemes and other factors.

Therefore, although air quality will continue to be measured, it will not always represent the level of success for the defined actions.

Because air quality improvements are the goal of this action plan, it is often more appropriate to measure another parameter that should directly or indirectly affect air quality. Such a parameter could be bus patronage, or proportion of new vehicles registered. Appropriate means of measuring effects for each action will be identified through monitoring of the implementation of the actions.

Where possible, air quality effects will be measured for discrete schemes, although this will likely be possible only for significant infrastructure projects, such as new roads, where a pre- and post-development monitoring campaign would be used to measure changes in air quality.

# 15.0 MONITORING AND ASSESSMENT

Action planning is like an iterative process of active experimentation that includes progress monitoring. If some points in the Action Plan are not fruitful, the implementation team may need to rethink the plan and adapt, change or add activities.

The Municipality's responsible body shall report and gather information on a regular basis to respond to changes that arise throughout the implementation of the LAPAQ. This will be an effective instrument for monitoring and, if required, adjusting the plan's implementation.

## 15.1 Responsible body conducting monitoring.

A responsible body (commission) selected by the mayor to oversee LAPAQ implementation will be set. This commission must present a monitoring report to the Municipal Assembly by the end of March each year for the previous year. The Municipal Assembly will produce a summary report based on this and submit it to the MESPI by June 1 of the monitoring year.

When conducting monitoring, three factors should be considered:

• monitoring process should consider:

• the efficacy of the LAPAQ-specified activities.

• the social, economic, and environmental repercussions of the activities.

• progress toward reaching the LAPAQ objectives.

## 15.2 Monitoring Period

The implementation of the Action Plan must be assessed once a year, at which point any anticipated obstacles must be discussed and addressed to the party responsible.

The first monitoring report should be completed by March 1, 2025. The information contained in this report will be used to update the plan, as needed.

# 16.0 CONCLUSION

Alignment of inter-sectoral action will be critical to leverage the available resources of funding for maximum impact. In all sectors—household, transport, industry, services, construction industry, municipal solid waste management, air quality monitoring, road building and traffic management—budgetary resources have been earmarked for investment, or investments from other private or bilateral sources can come in. Significant change on a large scale is feasible if these investments are properly informed and linked with this clean air action planning process and purpose.

The total estimated cost of implementing this Air Quality Action Plan is **736,000.00 Euro**

**TABLE OF ACTIVITIES DERIVED FROM THE OBJECTIVES**

# 17.0 TABLE OF ACTIVITIES

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Action | | Indicator | | Responsible Institution | Supporting Institutions | Timeframe | Financial Costs and Resources | Comments |
| Objective 1: *Reducing the use of fossil fuels in the household* | | | | | | | | |
| 1.1. Preparation of the program for replacing fossil fuels in households, for heating with cleaner fuels. | | Prepared program | | Municipality of Gjilan/ Gnjilane | Ministry of Environment, Spatial Planning and Infrastructure (MESPI) | 2024 - 2025 | 10,000.00 Euro  Municipality budget  Potential donor | Need for a favorable taxation and pricing policy to make cleaner fuels more competitive |
| 1.2. Implementation of the program for the replacement of stoves/ boilers with wood/ coal with those that use pellets in public institutions (educational, administrative and health) | | Boilers/stoves and heating fuel have been replaced | | Municipality of Gjilan/ Gnjilane | MESPI and Ministry of Economy | 2024- 2028 | 40,000.00 Euro  Municipality budget | Replacing fossil fuels and biomass with cleaner alternatives in residential heating and cooking can decrease the social health costs,  These initiatives will help improve air quality (reducing PM10 and PM2.5 particles, NOx and SO2) |
| 1.3. Isolation of the facilities of public institutions: school administration, health, culture, sports, etc. | | All mentioned public institutions are isolated | | Municipality of Gjilan/ Gnjilane |  | 2025- 2028 | 100,000.00 Euro  Municipality budget  Potential donor |  |
| 1.4. Development of the database to collect data on fuel use from operators which are subject to Municipal Environmental Permits | | Database is developed | | Municipality of Gjilan/ Gnjilane | MESPI/Kosovo Environmental Protection Agency | 2024- 2027 Regular Process | No cost | The database would help for the collection of the data for Inventory of air emissions, which is critical for developing strategic documents |
| Objective 2: To improve the city’s traffic flow to reduce emission from the transport sector. | | | | | | | | |  | Municipality of Gjilan/ Gnjilane |
| 2.1. Construction of bicycle lanes | The construction of bicycle lanes has been completed | | Municipality of Gjilan/ Gnjilane | | MESPI Ministry of Fonance | 2024 - 2027 | 200,000.00 Euro  Securing funds for subsidies in a period of 1 year/ To explore possible ways of financial support from EU funds  For application, internships, the Municipality should participate with 20% of the funding |  |
| 2.2. Steps to promote the use of battery vehicles including the installation of charging stations | Purchase and placement of stations for charging battery vehicles | | Municipality of Gjilan/ Gnjilane | |  | 2025- 2028 | 20,000.00 Euro  Municipality budget or  Potential donor |  |
| 2.3. Preparation and implementation of the greening plan, buffers along traffic corridors. | Approx. 5,000 plants for each locality  Green areas reduce pollution in city streets up to eight times more than previously believed. (Report on the research appears in the ACS journal Environmental Science and Techonology) | | Municipality of Gjilan/ Gnjilane | | MESPI | 2024- 2027 | 80,000.00 Euro  Municipality budget or  Potential donor | Trees, parks, and other green infrastructure features can reduce particulate pollution by absorbing and filtering particulate matter. Health Effects: Breathing smog and particulate pollution can cause respiratory ailments, including chest pain, coughing, aggravation of asthma,  An study finds that careful placement of grass, climbing ivy and other plants in urban canyons can reduce street-level concentrations of NO2 by up to 40 percent and PM levels by 60 percent, far more than previously believed.  https://www.acs.org/content/acs/en/pressroom/presspacs/2012/acs-presspac-august-29-2012/green-plants-reduce-pollution-on-city-streets-up-to-eight-times-more-than-previously-believed.html |
| 2.4. Planning of the replacement of old urban buses with EURO 6 buses | The purchase of three EURO 6 buses | | Municipality of Gjilan/ Gnjilane | | Ministry of Finance, Potential Donors | 2024-2027 | 228,000.00 Euro  Municipality budget or  Potential donor |  |
| Objective 3: *To decrease emissions from the construction sector.* | | | | | | | | |
| 3.1. Determining the measures for the control of emissions for buildings that are within the scope of Building Permits and Municipal Environmental Permits, etc. | Number of inspectors and inspections has increased. | | Municipality of Gjilan/ Gnjilane | |  | 2024 | 12,000.00 Euro  Municipality budget |  |
| 3.2. Control measures for fugitive emissions from material handling, conveying and screening operations through water sprinkling, curtains, barriers and dust suppression units; | Reduction of dust from the construction and demolition sector | | Municipality of Gjilan/ Gnjilane  and municipality inspectorate | |  | 2024- 2026 | No cost |  |
| 3.3. Organizing workshops and seminars with relevant operators | Are organized 4 workshops within 4 years | | Municipality of Gjilan/ Gnjilane | | MESPI, Operators | 2024- 2027 | 6,000.00 Euro | Informing operators about the new air pollution legislation and rules, as well as data collection for the Inventory of air emissions. |
| Objective 4: *Raising awareness* | | | | | | | | |
| 4.1. Initiating a broad drive against vehicular pollutants to ensure strict compliance with legislation | A campaign has been organized | | Municipality of Gjilan/ Gnjilane | | MESPI | 2024- 2028  Regular activity | No cost | Organization will be initiated from Municipality in cooperation with Municipality NGOs |
| 4.2. Safer cycling awareness day | The day included cooperation with the police, to make the population aware of the greater use of bicycles and giving up the use of automobiles, an action that will affect the reduction of air pollution from vehicles. Information on cycle training, public rides and bicycle maintenance classes was distributed. | | Municipality of Gjilan/ Gnjilane | |  | 2024- 2028  Regular activity | No cost | In addition to information on the Municipality website and social media, a number of press articles were published. |
| 4.3. Organizing the lectures in schools on air protection from pollution and how we can contribute on that | Workshops and lectures organized | | Municipality of Gjilan/ Gnjilane | |  | 2024- 2028 | 4,000.00 Euro | This program will teach students and organizations how to reduce air pollution and enhance their health through voluntary acts. The program provides teachers with a choice of lessons and tools. |
| 4.4. Organization of informative and instructive events aiming at boosting energy efficiency, using more ecologically friendly fuels, and using renewable energy sources. | Forums and seminars were organized and brochures were compiled on the most energy efficient tools | | Municipality of Gjilan/ Gnjilane | | Ministry of Environment, Spatial Planning and Infrastructure, eventual Donors | 2024-2028 | 6,000.00 Euro | Energy efficiency can reduce both indoor and outdoor concentrations of air pollutants. In doing so, energy efficiency drives a range of economic, environmental and health benefits associated with local air quality. |
| 4.5. Awareness campaign and increase of green spaces that reduce air pollution | Trees are planted with the help of students | | Municipality of Gjilan/ Gnjilane | | MMPHI, NGOs | 2025- 2028 | 8,000.00 Euro |  |
| 4.6. Establishment of the Environmental Protection Sector within the DUPMM. | The Environmental Protection Sector is established | | Municipality of Gjilan/ Gnjilane | |  | 2025- 2026 | No cost | Currently, only one official with insufficient professional competence works in DUPMM; consequently, in order to formulate and monitor policies with acceptable effectiveness and efficiency, a specific sector with cadres with adequate professional competence must be established. |
| 4.7. Placement of two monitors that show the level of pollution in two different locations of the city | Two monitors have been installed to display the level of air quality in the municipality of Gjilan/ Gnjilane. | | Municipality of Gjilan/ Gnjilane | | Eventual donor | 2025 | 22,000.00 euro | Notification of the population about the state of air quality so that they can better protect their health, especially in cases where the air is very polluted (in such cases sensitive individuals should not leave the house). |
| **TOTAL: 736,000.00 Euro** | | | | | | | | |

# ANNEX 1

## 1.1 TECHNICAL EVIDENCE FOR LOCAL ACTION PLAN FOR AIR QUALITY

Technical evidence presents the methodology for analyzing the options for improving air quality, with action plans for the following sectors of pollution: emission from Residential Stationary Source Sub-Category (fuel shift for the detached house; emissions from those subject to Municipality Environmental Permit; emissions from Municipal Buildings and Facilities; emissions from Service Industries; fuel shift from wood/lignite to electricity); and emissions from road transport. This analysis incorporates: Scenario; Emission Reduction; Cost; Cost Effectiveness; Implementation Method; and Issues.

## 1.2. Emission reductions calculation

### 1.2.1. Emission Reduction Calculation for Small Combustion (Residential: Stationary sources) in Gjilan/Gnjliane Municipality

The biggest emissions source in the “1.A.4 Small combustion (Residential: Stationary sources)” category in the Municipality of Gjilan/Gnjliane is the usage of wood for heating/ cooking, in the house.

As a result, the fuel transition from wood to pellets and electricity is the goal of the air pollution control measure for small combustion (Residential: Stationary sources). Cooking and heating using pellets and electricity is a common practice in Kosovo. This is not an easy undertaking, however, due to the high expense of transitioning from wood to pellets or electricity. This means that the government should encourage citizens to use alternative energy and include this in the Local Action Plan.

The contents of drafting action plan will be developed as following Table. 32.

Table - Action Plan on fuel shift from Wood/Lignite to Pellet/Electricity for Residential Stationary sources in Municipality of Gjilan/Gnjliane

|  |  |
| --- | --- |
| Name | Fuel shift from Wood and Lignite to Pellet and Electricity on small combustion at Residential Stationary Sources |
| Outline | Target Years are Year 2024 and Year 2028.  Target Year 2024: The number of households using Wood will be decreased through local action plan.  Target Year 2028: The number of households using Wood and Lignite will be decreased through local action plan.  The municipality should carry out some supports such as subsidy or loan system, some campaigns, and monitoring. |
| Scenario | Target Year 2024: Target is the household using **Wood**, and target number is **100**.  **50** households will carry out the fuel shift from **Wood to Pellet**.  **50** households will carry out fuel shift from **Wood to Electricity**.  Target Year 2028: Target is the household using **Wood and Lignite**, and target number is **518**.  **All 18**-household using **Lignite** will change fuel from **Lignite to Pellet**.  **250** households will carry out fuel shift from Wood to **Pellet**.  **250** households will carry out fuel shift from **Wood to Electricity**. |
| Emission Reduction | Target Year 2024  WOM (Business as Usual): 901.0 (ton PM2.5/year)  WEM (Measures Case): 891.8 (ton PM2.5/year)  PM2.5 Emission Reduction: Approximately -9.2 (ton PM2.5/year).  Target Year 2028  WOM (Business as Usual): 790.2 (ton PM2.5/year)  WEM (Measures Case): 743.6 (ton PM2.5/year)  PM2.5 Emission Reduction: Approximately -46.6 (ton PM2.5/year). |
| Cost Case 1 (Year 2024) | <Before the implementation of measures>  1) Initial Cost: 350 Euro/household (Wood burning stove, same level of equipment for existing equipment)  2) Operation Cost per year: 300 Euro/household (Average Wood Cost)  3) Total Cost for 10 years: 350 + 300\*10 = 4350 Euro/household  <After the implementation of measures>  1) Initial Cost: 1000+900=1900 Euro/household (1000 Euro for new Pellet or Electric heater, 900 Euro for Cooker, Pipe, Radiator, and so on)  2) Operation Cost per year: **1800** Euro/household (Average Pellet Cost), Operation Cost per year: **1200** Euro/household (Average Electricity Cost)  3) Total Cost on Pellet for 10 years: 1900 + 1800\*10 = 19900 Euro/household  Total Cost on Electricity for 10 years: 1900 + 1200\*10 = 13900 Euro/household  <Increase of Cost after Measures>  19900 (Pellet) – 4350 (Wood) = 15550 Euro/household for 10 years.  13900 (Electricity) – 4350 (Wood) = 9550 Euro/household for 10 years.  If 50 households for Pellet, 15550\*50 = 777.5 thousand Euro for 10 years (total cost increases)  If 50 households for Pellet, 9550\*50 = 477.5 thousand Euro for 10 years (total cost increases)  Total is 1.255 million Euro for 10 years. |
| Cost Case 2 (Year 2028) | <Before the implementation of measures>  1) Initial Cost: 350 Euro/household (Wood/ Lignite burning stove, same level of equipment for existing equipment)  2) Operation Cost per year: 300 Euro/household (Average Wood/ Lignite Cost)  3) Total Cost for 10 years: 350 + 300\*10 = 4350 Euro/household  <After the implementation of measures>  1) Initial Cost: 1000+900=1900 Euro/household (1000 Euro for new Pellet or Electric heater, 900 Euro for Cooker, Pipe, Radiator, and so on)  2) Operation Cost per year: **1800** Euro/household (Average Pellet Cost), Operation Cost per year: **1200** Euro/household (Average Electricity Cost)  3) Total Cost on Pellet for 10 years: 1900 + 1800\*10 = 19900 Euro/household  Total Cost on Electricity for 10 years: 1900 + 1200\*10 = 13900 Euro/household  <Increase of Cost after Measures>  19900 (Pellet) – 4350 (Wood/ Lignite) = 15550 Euro/household for 10 years.  13900 (Electricity) – 4350 (Wood) = 9550 Euro/household for 10 years.  If 268 households for Pellet, 15550\*268 = 4.1674 million Euro for 10 years (total cost increases)  If 250 households for Pellet, 9550\*250 = 2.2875 million Euro for 10 years (total cost increases)  Total is 6.455 million Euro for 10 years. |
| Cost Effectiveness | Target Year 2024: Cost per PM2.5 Emission Reductions is approximately 13,641 (Euro/ton).  Target Year 2028: Cost per PM2.5 Emission Reductions is approximately 13,852 (Euro/ton). |
| Implementation Method | Campaign/ awareness activities by Municipality will be carried out.  Loan campaign for medium income will be carried out through Commercial Banks, but Municipality will support those programmes.  Subsidies for low income will be carried out through Municipality.  MoF will facilitate the introduction by tax reduction. |
| Issues | How to establish the support of operation cost by Municipality and/or Government for households of low socioeconomic status.  The current price of electricity is too expensive. It is very difficult to predict the near future status.  The annual wood consumption as around 11 m3/household is approximately same as 36 MWh/household as annual electricity consumption. If 10000 (approximately 5%) of detached houses using Wood in Kosovo will change from Wood to Electricity, Kosovo would require additional electricity consumption of approximately 360 GWh/year. This value is approximately 6% increase of the annual electricity consumption in Kosovo.  In addition, if each household with fuel shift from Wood to Electricity need additional 10 kW electricity conduction capacity, Kosovo would require additional 100 MW capacity of electricity.  Although these are very rough estimation, this additional electricity capacity is very difficult for Kosovo under the current situation. |

### 1.2.2 Emission Reduction Calculation for Transport (Road) in Gjilan/Gnjilane Municipality

Emissions from road transport are mainly:1) exhaust emissions from the combustion of fuels such as petrol, diesel, liquefied petroleum gas (LPG) and natural gas in internal combustion engines, and 2) airborne particles produced as a result of the interaction between a vehicle’s tire and the road surface, and also when the brakes are applied to decelerate the vehicle. The air pollution control measure for these emission sources is generally the reduction of traffic volume. Therefore, the municipal task for reduction of these emission sources is only a public awareness campaign for reduction of vehicle use.

The biggest emissions source in the “1.3 Transport” category in the Municipality of Gjilan/Gnjilane is the vehicle with old Euro Regulation.

The contents of the action plan will be developed as following Table 33.

Table - Draft Action Plan on Road Transport Category in Municipality of Gjilan/ Gnjilane

|  |  |
| --- | --- |
| Name | Reduction of Using Vehicle with old Euro Regulation |
| Outline | Target Years are Year 2024 and Year 2028.  Target Year 2024: The number of using vehicle with equal and less than Euro 1 regulation will be stopped. These vehicles will be replacing the vehicles with Euro 4.  Target Year 2028: The number of using vehicle with equal and less than Euro 3 regulation will be stopped. These vehicles will be replacing the vehicles with Euro 4.  Target vehicle types are Passenger Car (PC), Mini Van (MV), Light Commercial Vehicle (LCV), Heavy Duty Truck (HDT), and Bus. |
| Scenario | Target Year 2024: the below number of vehicles will be replaced to vehicle with Euro 4.  Number of PC with 0- and 1-Euro Regulation: 1380 and 334  Number of MV with 0- and 1-Euro Regulation: 10 and 5  Number of LCV with 0- and 1-Euro Regulation: 114 and 127  Number of HDT with 0- and 1-Euro Regulation: 69 and 65  Number of Buses with 0- and 1-Euro Regulation: 6 and 7.  Target Year 2028: (including measures for Year 2024) the below number of vehicles will be replaced to vehicle with Euro 4.  Number of PC with 2- and 3-Euro Regulation: 1370 and 4135  Number of MV with 2- and 3-Euro Regulation: 10 and 5  Number of LCV with 2- and 3-Euro Regulation: 238 and 458  Number of HDT with 2- and 3-Euro Regulation: 189 and 224  Number of Buses with 2- and 3-Euro Regulation: 13 and 9. |
| Emission Reduction | NOx Emission Reductions (ton NOx/year)   |  |  |  |  | | --- | --- | --- | --- | |  | Current Year | Year 2024 | Year 2028 | | Passenger Car (Diesel) | 126.54 | 126.68 | 112.34 | | Passenger Car (Gasoline) | 0.15 | 0.15 | 0.15 | | Mini Van | 0.74 | 0.60 | 0.54 | | LCV | 21.78 | 19.74 | 17.13 | | HDT | 75.75 | 62.41 | 42.40 | | Bus | 9.83 | 7.45 | 4.94 | | Motorcycles | 0.02 | 0.02 | 0.02 | | Total | 234.81 | 217.04 | 177.52 |   PM2.5 Emission Reductions (ton PM2.5/year)   |  |  |  |  | | --- | --- | --- | --- | |  | Current Year | Year 2024 | Year 2028 | | Passenger Car (Diesel) | 9.876 | 5.810 | 4.879 | | Passenger Car (Gasoline) | 0.006 | 0.006 | 0.006 | | Mini Van | 0.085 | 0.035 | 0.023 | | LCV | 1.900 | 1.254 | 0.753 | | HDT | 1.756 | 1.008 | 0.286 | | Bus | 0.328 | 0.131 | 0.042 | | Motorcycles | 0.001 | 0.001 | 0.001 | | Total | 13.952 | 8.244 | 5.990 |   Regarding NOx emissions, the measures for Year 2024 is not enough.  However, PM2.5 emissions, the measures for Year 2024 and Year 2028 are good effect. |
| Cost | Since the cost estimation depends on information on the Price of Vehicle, the estimation for it is impossible now. |
| Cost Effectiveness | Not Estimated. |
| Implementation Method | Municipality will carry out the public awareness campaign to promote the reduction of vehicle usage. |
| Issues | How to prepare and develop the viable system for the reduction of vehicle usage through only public awareness. |

### 1.2.3. Emission Reduction Calculation on subjects to Municipality Environmental Permit

The Table 34. shows the development of the action plan's content.

Table - Action Plan on subject to Municipality Environmental Permit

|  |  |
| --- | --- |
| Name | Name of Action Plan |
| Outline | Summary of measures, target factories and facilities |
| Scenario | Number of target factories and facilities with measures  Basic data for calculating emission reductions and cost |
| Emission Reduction | Calculation of emission reduction of SO2, NOx, PM10, and PM2.5 |
| Cost | Implementation Cost |
| Cost Effectiveness | Cost per emission reduction (Euro/ton) for PM2.5 and/or other pollutants |
| Implementation Method | How to promote and/or implement the Action Plan by Municipality |
| Issues | Review of action plan, including feedback from relevant organizations and stakeholders |

### 1.2.4. Emission Reduction Calculation from Municipal Buildings and Facilities

The contents of the action plan will be developed as follows.

Table - Action Plan on Municipal Buildings and Facilities

|  |  |
| --- | --- |
| Name | Name of Action Plan |
| Outline | Summary of measures, target building and facilities |
| Scenario | Number of target buildings and facilities with measures  Basic data for calculating emission reductions and cost |
| Emission Reduction | Calculation of emission reduction of SO2, NOx, PM10, and PM2.5 |
| Cost | Implementation Cost |
| Cost Effectiveness | Cost per emission reduction (Euro/ton) for PM2.5 and/or other pollutants |
| Implementation Method | How to promote and/or implement the Action Plan by Municipality |
| Issues | Review of action plan, including feedback from relevant organizations and stakeholders |

### 1.2.5. Emission Reduction Calculation from Service Industries

The content of the action plan will be developed as follows.

Table - Action Plan on Service Industries

|  |  |
| --- | --- |
| Name | Name of Action Plan |
| Outline | Summary of measures, target type of service industries and facilities |
| Scenario | Number of target type of service industries and facilities with measures  Basic data for calculating emission reductions and cost |
| Emission Reduction | Calculation of emission reduction of SO2, NOx, PM10, and PM2.5 |
| Cost | Implementation Cost |
| Cost Effectiveness | Cost per emission reduction (Euro/ton) for PM2.5 and/or other pollutants |
| Implementation Method | How to promote and/or implement the Action Plan by Municipality |
| Issues | Review of action plan, including feedback from relevant organizations and stakeholders |

### 1.2.6. Emission Reduction Calculation from Waste Management

The Waste Management Sector emits emissions from three sources: 1) solid waste disposal, 2) medical waste incineration, and 3) open waste burning. Municipalities are responsible for monitoring the areas under their authority. An action plan for emissions from open-space waste burning can be developed.

The content of the action plan will be developed as follows.

Table - Action Plan on Waste Management in Municipality

|  |  |
| --- | --- |
| Name | Name of Action Plan |
| Outline | Summary of measures, target type of waste management activities |
| Scenario | Number of target type of waste management activities for measures  Basic data for calculating emission reductions and cost |
| Emission Reduction | Calculation of emission reduction of SO2, NOx, PM10, and PM2.5 |
| Cost | Implementation Cost |
| Cost Effectiveness | Cost per emission reduction (Euro/ton) for PM2.5 and/or other pollutants |
| Implementation Method | How to promote and/or implement the Action Plan by Municipality |
| Issues | Review of action plan, including feedback from relevant organizations and stakeholders |

### 1.2.7. Emission Reduction Calculation from Agriculture

The air pollutant emission sources in agriculture are livestock, land use, and field burning. Emission levels from livestock depend on the number of livestock and the manure management approach. Since the Ministry of Agriculture has responsibility for these things, the local action plan need not consider them. Emission levels from agricultural land depend on the area of land use and amount of fertilizer. Since these are the responsibility of the Ministry of Agriculture, the local action plan likewise need not consider them.

However, since municipalities must monitor the areas under their jurisdiction, actions can be planned for emissions from the burning of agricultural residues on the ground.

The content of the action plan will be developed as follows.

Table - Action Plan on Agriculture in Municipality

|  |  |
| --- | --- |
| Name | Name of Action Plan |
| Outline | Summary of measures, target type of agriculture activities |
| Scenario | Number of target type of agriculture activities for measures  Basic data for calculating emission reductions and cost |
| Emission Reduction | Calculation of emission reduction of SO2, NOx, PM10, and PM2.5 |
| Cost | Implementation Cost |
| Cost Effectiveness | Cost per emission reduction (Euro/ton) for PM2.5 and/or other pollutants |
| Implementation Method | How to promote and/or implement the Action Plan by Municipality |
| Issues | Review of action plan, including feedback from relevant organizations and stakeholders |

1. https://ammk.rks.net/assets/cms/uploads/files/Dokumente%202022/Raporti%20vjetor%20i%20Ajrit%202021%20(05.05.2022).pdf

   [↑](#footnote-ref-1)
2. https://www.who.int/news/item/12-05-2016-air-pollution-levels-rising-in-many-of-the-world-s-poorest-cities#:~:text=While%20all%20regions%20of%20the,meet%20WHO%20air%20quality%20guidelines. [↑](#footnote-ref-2)
3. [Geographical position"](https://kk.rks-gov.net/gjilan/qyteti/pozita-gjeografike/). *Municipality of Gjilan - Official Website*. Municipality of Gjilan. Retrieved 31 March 2018. [↑](#footnote-ref-3)
4. (<https://askdata.rks-gov.net/pxweb/en/ASKdata/>) [↑](#footnote-ref-4)
5. ["Municipality Profile 2018: Gjilan/Gnjilane"](https://www.osce.org/files/f/documents/c/0/13113_1.pdf)  [↑](#footnote-ref-5)
6. PLANI LOKAL PËR VEPRIM NË MJEDIS, KOMUNA E GJILANIT, 2020-2024 [↑](#footnote-ref-6)
7. Urban Development Plan of Gjilan 2006 - 2015+ [↑](#footnote-ref-7)
8. Source: Vehicle Registration Data [↑](#footnote-ref-8)
9. Urban Development Plan of Gjilan 2006 - 2015+

   [↑](#footnote-ref-9)
10. Guidance framework for Developing Clean Air Action Plan, July 2020 [↑](#footnote-ref-10)
11. <https://pt.weatherspark.com/y/86898/Clima-caracter%C3%ADstico-em-Gjilan-Kosovo-durante-o-ano#Sections-Temperature> [↑](#footnote-ref-11)
12. https://www.conserve-energy-future.com/what-is-air-quality.php [↑](#footnote-ref-12)
13. https://www.conserve-energy-future.com/what-is-air-quality.php [↑](#footnote-ref-13)
14. Kosovo Vehicle Center [↑](#footnote-ref-14)
15. https://askdata.rks-gov.net/pxweb/en/ASKdata [↑](#footnote-ref-15)
16. [*https://ihmk-rks.net/?page=1,18*](https://ihmk-rks.net/?page=1,18)

    [*https://www.ammk-rks.net/al/mjedisi/20/raportet-mujore*](https://www.ammk-rks.net/al/mjedisi/20/raportet-mujore) [↑](#footnote-ref-16)
17. [*https://ihmk-rks.net/?page=1,18*](https://ihmk-rks.net/?page=1,18)*;* [*https://www.ammk-rks.net/al/mjedisi/20/raportet-mujore*](https://www.ammk-rks.net/al/mjedisi/20/raportet-mujore) [↑](#footnote-ref-17)
18. https://www.breeze-technologies.de/blog/sulphur-dioxide-so2/ [↑](#footnote-ref-18)
19. https://www.epa.gov/no2-pollution/basic-information-about-no2 [↑](#footnote-ref-19)
20. https://www.cdc.gov/air/particulate\_matter.html [↑](#footnote-ref-20)
21. URL: https://www.eea.europa.eu/publications/emep-eea-guidebook-2019/part-b-sectoral-guidance-chapters/1-energy/1-a-combustion/1-a-3-b-i/view [↑](#footnote-ref-21)
22. URL: <https://libopac.jica.go.jp/images/report/12363354.pdf> [↑](#footnote-ref-22)
23. file:///C:/Users/PC/Downloads/ETC-ATNI\_2020-2\_Task-1\_1\_2\_2\_Final.pdf [↑](#footnote-ref-23)