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Functional Review of Air Quality Management in Canton Sarajevo, Bosnia and Herzegovina

December 2024



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List of acronyms

AAP	Ambient air pollution
AQ	Air Quality
AQM	Air Quality Management
AQP	Air Quality Plan
As	Arsenic
B(a)P	Benzo[a]pyrene
BD	Brčko District
BiH	Bosnia and Herzegovina
Cd	Cadmium
CAFE	Clean Air for Europe
CEAP	Cantonal Environmental Action Plan
C ₆ H ₆	Benzene
CO ₂	Carbon dioxide
EBRD	European Bank for Reconstruction and Development
ESAP 2030+	Bosnia and Herzegovina Environmental Strategy and Action Plan 2030+
EU	European Union
FBIH	Federation of Bosnia and Herzegovina
FHMI	Federal Hydrometeorological Institute
FMET	Federal Ministry of Environment and Tourism, BiH
FR	Functional Review
GCAP	Green Cantonal Action Plan
GDP	Gross Domestic Product
GHG	Greenhouse gas
Hg	Mercury
IMF	International Monetary Fund
LAP	Law on Air Protection
LEP	Law on Environmental Protection
MCEEP	Ministry of Communal Economy, Infrastructure, Spatial Planning, Construction and Environmental Protection, Canton Sarajevo
MOFTER	Ministry of Foreign Trade and Economic Relations
NGO	Non-Governmental Organization
NH ₃	Ammonia
Ni	Nickel
NO ₂	Nitrogen dioxide
NO _x	Nitrogen oxides
O ₃	Ozone
Pb	Lead
PHI	Institute for Public Health of Canton Sarajevo
PM	Particulate matter
PM _{2.5}	Particulate matter with a diameter of less than 2.5 µm

PM ₁₀	Particulate matter with a diameter of less than 10 µm
RS	Republika Srpska
SFB	Single Family Building
Sida	Swedish International Development Cooperation Agency
SO ₂	Sulfur dioxide
STAP	Short-term Action Plan
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
WHO	World Health Organization
µg/m ³	Microgram per cubic meter

Executive summary

Air Pollution in Bosnia and Herzegovina (BiH), the Federation of BiH, and Canton Sarajevo

People in many parts of Bosnia and Herzegovina (BiH) are exposed to more toxic particulate matter (PM) air pollution than their neighbors in Western Europe. This is especially true for residents in urban areas, such as Sarajevo. In 2021, the limit values for particulate matter (PM₁₀) air pollution were exceeded on more than 80 days of the year at some measuring stations in Canton Sarajevo, and even over 120 days in Ilijaš municipality, located within the canton. Air quality is worst in the winter months when many households burn solid fuels for domestic heating and cooking. Year-round, coal-fired power stations contribute to air pollution, a practice that Western European countries have started to move away from.

The burning of solid fuels – often of poor quality – for domestic heating and cooking, prevalence of inefficient stoves and boilers, industry, and aging vehicle fleets are the main contributors to ambient air pollution (AAP). Source apportionment analysis indicates that at a national level, the residential sector is the largest source of population exposure to harmful PM_{2.5} associated with the burning of solid fuels in homes. Almost 60 percent of PM_{2.5} emissions emanated from the residential sector in BiH in 2015 (World Bank 2019). A more recent estimate for Sarajevo indicates that 40 percent of PM_{2.5} pollution was emitted from burning biomass and coal for heating in 2021-2022 (Grundström, Maria et al. 2022).

The high levels of air pollution in the country have significant negative effects on human health and the economy. A recent study estimated that about 3,600 people die every year from causes associated with AAP (World Bank 2022). This means that over 9 percent of the total annual mortality in BiH can be attributed to air pollution. The annual cost of mortality caused by AAP in BiH is estimated at US\$2.4 billion, equivalent to 15.7 percent of gross domestic product (GDP) in 2019 (ibid).

BiH recognizes Air Quality Management (AQM) as part of a broader set of measures geared towards climate change mitigation, energy transition, and sustainable growth, particularly because air pollution control promises significant co-benefits for climate change mitigation. The BiH Economic Reform Program 2024-2026 posits decarbonization as both an obligation and a key development opportunity (BiH Directorate for Economic Planning 2024). Although economic growth has proven relatively resilient despite the fallout from Russia's invasion of Ukraine, the IMF noted that, without substantially greater reform progress, growth in BiH is expected to remain subdued at around 3 percent in the medium term, too low for significant income convergence with the EU (IMF 2024). Therefore, it will be even more important to strengthen AQM as part of a broader effort to transition to a low-carbon economy and to tackle climate change. Air pollution and climate change share common sources and impacts on the environment and human health. Therefore, policies aimed at reducing air pollution can simultaneously address climate change, leading to significant co-benefits (Box 1).

The cost of inaction is high, and the need for more effective air quality management (AQM) is widely acknowledged. Focusing efforts on the residential sector promises substantial improvements in air quality because it is the largest source of PM air pollution. Effective AQM requires a strategic and

coordinated approach which has proven challenging in BiH given the country's complex governance structure. To tackle air pollution holistically, there is a need to better understand the policy, institutional, and organizational bottlenecks for AQM in BiH.

The objective of this functional review (FR) is to provide insights and develop recommendations for strengthening regulatory and institutional frameworks and capacity for AQM, enabling the country, entity, and cantonal governments to deliver better air quality for its citizens. The FR assesses whether existing legislation and policies clearly define the results to be achieved, assign roles and responsibilities, and establish efficient and accountable processes on how the results are to be delivered ('what government *should* do'). At an organizational level, the FR offers a mechanism to analyze whether and how institutional and implementation arrangements are fit for purpose ('what government *can* do'). Given the highly complex governance structure in BiH, Canton Sarajevo was chosen as the study area.¹

Methodology for functional review

Air quality management is organized into six interdependent functions for the purposes of this FR analysis. Common to all AQM approaches is the aim to deliver impactful action to ensure the best possible quality of air, avoiding or minimizing adverse effects on human health, the environment and the economy. The six AQM functions can be conceived of in a cyclical process whereby each step is embedded in an interdependent sequence of other steps (World Bank Group 2020; Wijetilleke and Karunaratne 1995): (1.) Establishing goals, standards and objectives; (2.) determining required emission reductions; (3.) developing control strategies; (4.) implementing control strategies; (5.) monitoring implementation and enforcing compliance; and (6.) ongoing air quality monitoring, progress measurement, and evaluation vis-à-vis air quality objectives. Communication and public participation are processes, not single events, that run across the six functions to both inform the public and obtain input from them.

Each of the six AQM functions is reviewed against eight scoring criteria for a comprehensive assessment of the formal (*de jure*) prerequisites and practical (*de facto*) implementation conditions that enable or hinder effective AQM performance. The review criteria, questions, and scoring system draw on the literature on AQM, institutional analysis and the World Bank's Country Policy and Institutional Assessment (Rosenbaum 2020; Muller, Domfeh, and Yeboah-Assiamah 2017; McGinnis 2011; Nigussie et al. 2018; World Bank 2017). The eight review criteria are: (a) Functional task definition ('what'); (b) Specification of responsibilities ('who'); (c) Process management ('how'); (d) Capacity; (e) Information and data; (f) Budget, financing, incentives; (g) Communication and participation; (h) Leadership. Scores are assigned to each criterion based on its *de jure* (formal) and *de facto* configuration (in practice). The scores obtained range from 1 to 3: (1) Non-existent or non-functional; (2) existent and/or partially functional; (3) existent and fully functional; or (N/A) not applicable to this function.

¹ The rationale for choosing Canton Sarajevo as the study area is twofold: (i) Canton Sarajevo has been arguably the most active and committed canton regarding AQM in the Bosnian context; it therefore yields the greatest learning potential for other cantons in the country. (ii) Canton Sarajevo and the FBiH have been at the center of recent and ongoing World Bank operations and initiatives by other partner agencies; hence, it offers significant complementarities.

The overall policy and institutional framework

The policy and institutional framework currently in force does not establish clear accountability for AQM, and leaves significant regulatory gaps, especially regarding the residential sector. In the absence of an apex ministry or agency for environmental protection at the country level, the primary responsibility for AQM rests with the entities, with no binding mechanism to address diverging positions between them. Therefore, the country has three legal frameworks, organizational structures, and air quality networks, with varying degrees of harmonization and convergence. Within the FBiH, AQM mandates are not clearly assigned. Therefore, responsibilities to curb air pollution are shifted between the federation and the cantons, and between institutions. Cross-sectoral coordination on AQM does not take place in a significant way. Consequently, AQM is not consistently integrated into key policy areas with major impacts on air quality, including energy, transport, urban development, and agriculture. While all actors are formally obliged to cooperate with each other for effective AQM, in practice no single actor has an incentive to take responsibility, nor are there repercussions for failing to take action against air pollution. Emissions from the residential sector remain largely unregulated. The role of municipalities in AQM is minimal although they would be ideally positioned to help curb residential emissions.

In recent years, the governments of the FBiH and Canton Sarajevo have taken significant steps to draft new strategies or revise existing laws to strengthen the regulatory framework for AQM. If followed through and implemented, these initiatives are likely to enhance air pollution control significantly. The FBiH Environmental Strategy 2022-2032 is based on a realistic assessment of the current air quality-related challenges in the entity's territory. It identifies corrective actions that will introduce significant but difficult changes to reduce pollution and improve air quality. Likewise, the proposed revision of the FBiH Law on Air Protection, in draft form since 2021, will constitute a major stride towards aligning AQM legislation with the EU acquis. Canton Sarajevo has drafted a Strategy to Limit the Use of Coal and Other Solid Fuels 2023-2033. The document contains detailed proposals for curbing emissions from residential sources, including measures to regulate solid fuel quality and an incentive program for stove and boiler replacements at scale. Both initiatives are fully aligned with the FBiH Environmental Strategy.

Main findings of the functional review, by AQM function

(1.) Establishing goals, standards and objectives

The two entities and BD have adopted the overarching air quality standards and objectives defined in the relevant EU directives, with few minor deviations. In the FBiH, the Law on Air Protection determines the limit values per pollutant which are identical to the EU's CAPE Directive objectives.

While the entity level government of the FBiH has formulated further strategic goals for AQM in its Environmental Strategy, cantons must translate the high-level priorities into practical actions in their Cantonal Environmental Protection Plans (CEAP). However, a lack of guidance on how to do this and the absence of quality assurance and accountability mechanisms result in limited compliance and fragmentary CEAPs. Although the FBiH Law on Environmental Protection requires cantons to develop a CEAP, not all of the entity's ten cantons have adopted one to date, with Sarajevo, Tuzla, Una-Sana, and

Zenica being notable exceptions. There are no consequences for not creating a plan. Moreover, section VIII of the FBiH-LEP on environmental protection planning only sketches out the process and type of content to be included in a CEAP in the broadest terms. The law does not set quality criteria for the information to be presented in this strategic document, nor is there a quality assurance mechanism envisaged in the law. It is also unclear which type of analysis and evidence should underpin the CEAP.

(2.) Determining required emission reductions

The emission reduction targets in the FBiH Strategy for Environmental Protection 2022–2032 do not cover all relevant sectors and areas, are based on estimated or missing data, and it is generally unclear whether the proposed reductions will be sufficient to achieve the federal air quality objectives. The strategy only factors in emissions from large plants, transport emissions, and emissions from household heating systems in the three cantons that have developed (partial) emission inventories. An analysis of total emissions and the contributions from different sectors is not provided. Most of the data used in the Federal Environmental Protection Strategy 2022-2032 is based on estimations, with large uncertainties, or data is missing.

None of the ten cantons in the FBiH has attempted to estimate the emission reductions required to meet the air pollution limit values in their territories. This is due to a lack of binding legal requirements, technical guidance, and missing emission inventory data. Canton Sarajevo is actively working to fill this gap. The cantonal government is working on a new, electronic, and geo-referenced inventory in accordance with international standards. The plan is to establish an online platform accessible to the public to share results with citizens and other interested parties. However, there is a risk that the creation of the register stays a one-off activity; a regular updating mechanism does not appear to be defined. In other countries, chimney sweeps not only work towards fire safety and public safety, but they also fulfill extensive inspection and reporting functions which can be used to build up a localized, granular inventory of emission sources. Since Canton Sarajevo closed the public utility that provided chimney sweeping services in 2003, only a small number of private chimney sweeps remains in the canton. They offer on-demand services that are not subject to quality control and are not embedded in the AQM system. However, there are plans to re-introduce chimney sweep services at scale in Canton Sarajevo.

(3.) Developing control strategies

The FBiH Environmental Strategy outlines the most important air pollution control measures targeting residential sources, including interventions to regulate fuel quality, energy efficient stoves and boilers, and better implementation oversight, but it is questionable whether cantons will be able to implement these far-reaching changes; Sarajevo may be an exception. The strategy calls for legislation to ban retail sales of coal with a total sulfur content of above 1% and aims to regulate the quality of fuelwood and pellets. The government is also tasked with introducing a ban on the sale of non-certified stoves or boilers and should design an incentive scheme to encourage households to replace solid fuel-based stoves and boilers with certified heating appliances using pellets, heat pumps, natural gas-based condensation boilers, or to get connected to the district heating system. Moreover, the Environmental Strategy suggests finding ‘a way to initiate inspections of household stoves and increased inspection control of the fuel market’. The draft Strategy to Limit the Use of Coal and Other Solid Fuels in Sarajevo Canton 2023-2033

outlines detailed implementation arrangements for all of these measures, including regulatory changes to re-introduce chimney sweeps into the formal AQM system to perform inspections.

The CEAP is the main instrument for cantons to assess and articulate their AQM measures, but technical guidance, support, or accountability mechanisms for developing and implementing CEAPs do not exist, as outlined above. Although Canton Sarajevo developed a strong CEAP for 2016-2021 and updated its CEAP action plan for 2021-2025, important analytical and strategic elements are still missing. There is no estimation on the required emission reductions to achieve air quality targets, and no indication of whether the measures proposed in the CEAP will be sufficient to do so. The limited analysis is also due to the current lack of emission inventory data, data quality issues, and the dearth of relevant analysis such as source apportionment. Yet, the design and choice of emission control actions requires an understanding of their air quality impacts and the likely health, social, and economic benefits and implications of each potential course of action across all relevant sectors. In a positive move towards effective air quality control strategies, Canton Sarajevo developed the ‘Study on Urban Ventilation Corridors and Impact of High-rise Buildings’. The study was endorsed by the Cantonal Assembly and stopped building projects that could have a negative impact on clean air flow throughout Sarajevo. While the study did not improve air quality per se, it stopped further blockages of ventilation corridors.

(4.) Implementing control strategies at local level

The implementation of the CEAP 2021-2025 appears to be broadly on track. While many AQM-related activities in the CEAP are not designed to control air pollution per se, the execution of the CEAP constitutes progress on important preparatory work that will enable more effective AQM in the future. At the time of writing, the majority of the CEAP measures had either been completed or were in process of implementation. The cantonal government and the cantonal assembly review the progress on CEAP implementation regularly.

The overall capacity of the cantonal government and administration to implement air pollution control strategies is constrained by limited staff and technical expertise. The cantonal government did not assess the existing capacities of the ministries and institutions responsible for implementing the CEAP measures, let alone their ability to manage air quality more holistically. The main activities proposed in the Strategy to Limit the Use of Coal and Other Solid Fuels in Canton Sarajevo 2023-2033, a landmark endeavor, will require capacities that are currently extremely constrained or non-existent in the cantonal administration, particularly for designing the details of a subsidy program for individual households at scale, regulating and controlling fuel quality and use, and the re-introduction of chimney sweep services which is meant to advise, and to monitor implementation and compliance.

(5.) Monitoring implementation and enforcing compliance

The regulatory framework at all levels is characterized by a limited ability to enforce AQM measures. The laws and regulations on environmental and air protection stipulate fines for non-compliance only for business entities. There are no consequences for government institutions at the country, federal, cantonal or municipal levels for not fulfilling their roles in air quality governance, for example, if they do not adopt the required strategic documents or do not develop adequate control strategies. The mandate of the

Federal and Cantonal Inspection is confined to monitoring the compliance of legal entities with their respective environmental permits. This leaves the broader set of air quality-related rules as defined in the laws and by-laws unchecked. Residential emission sources are essentially unmonitored. There are no AQM rules and responsibilities that homeowners would have to comply with and which can be enforced, and enforcement capacity at the cantonal level is extremely limited.

Chimney sweeps could play a pivotal role in the local AQM monitoring and enforcement system, but there is currently no legal basis for residential inspection and reporting. Canton Sarajevo is planning to change this. The draft Strategy to Limit the Use of Coal and Other Solid Fuels in Canton Sarajevo 2023-2033 identifies the detailed steps that are required to enable chimney sweeps to monitor, provide advice, enable compliance, update emissions inventories, and support enforcement of air quality standards, objectives, and control strategies.

(6.) Air quality monitoring and progress evaluation vis-à-vis objectives

Responsibilities for air quality monitoring are clearly defined at the entity and cantonal levels. However, the current status of the measurement network and available capacity do not allow for regular monitoring of all required air pollution parameters. Some pollutants are only measured occasionally (like metals in floating particles), others are not monitored at all (benzene, benzo[a]pyrene, lead, arsenic, cadmium, mercury, nickel), partly for a lack of capacities and partly due to limited funds needed for this type of monitoring.

There is room to strengthen the use of this data to inform air quality control strategies and to evaluate the effectiveness of AQM at the country, entity, and cantonal levels. The available air quality information is not used routinely to review air quality control strategies and to inform an evaluative judgment of the effectiveness of AQM at the federal or cantonal levels. Impactful AQM requires a systematic and holistic effort across sectors and levels of government, instead of a piecemeal approach of individual measures. Currently, several sectors undertake activities that are labeled as improving air quality. For example, investments are made to strengthen energy efficiency in public, shared, and private buildings. Similarly, the Ministry of Transport of Canton Sarajevo drives a number of initiatives with the potential to reduce air pollution. Yet, there is no coherent mechanism to coordinate these activities under an AQM umbrella which could maximize synergies.

Recommendations

The FR indicates that the prevailing regulatory and institutional setup at all levels does not yet approach AQM as a continuous, iterative process of designing, implementing, monitoring, and refining air quality objectives and measures. Instead, advances in AQM depend on the occasional impetus of specific actors, or on emerging opportunities. Lasting improvements in air quality can only be achieved if air pollution emissions are clearly regulated, and they must be managed every day. For the residential sector, a durable solution will require a dual approach: On the one hand, coherent regulation (of permissible fuels used for heating; fuel quality; certified stoves and boilers; energy efficiency of buildings); on the other hand, a functional mechanism for monitoring, reporting, and enforcing compliance at the local level, as well as

providing technical advice to citizens. Inspections and chimney sweeps need to play a leading role in this, but neither function is currently set up to work effectively and at scale.

Most of the recommendations emerging from the FR are geared towards strengthening the coherence and consistency with which air quality is managed across levels of government. A previous World Bank report already provided high-level recommendations for harmonizing the legal and institutional framework across the jurisdictions, strengthening inter-entity and cross-sectoral coordination, and addressing overlapping roles and responsibilities for implementing AQM legislation (World Bank 2019). The recommendations outlined below focus on the entity and cantonal levels of government because citizens’ air quality depends on the formal rules and practical actions devised by these actors, as well as selected changes at state level to create an enabling legal environment for effective AQM.

To prioritize and sequence next steps at the Cantonal level, it is advisable to begin implementation with recommendation 4: Strengthen AQM policy, coordination, and oversight capacity in the cantonal government. This means empowering the Air Quality Center in the Ministry of Communal Economy, Infrastructure, Spatial Planning, Construction and Environmental Protection of Canton Sarajevo with a comprehensive mandate, qualified staff, and financial resources, which can be expected to have a catalytic effect for strengthening AQM across all functions. It would enable the Center to drive air quality policy, regulations, planning, and implementation of incentive schemes for reducing emissions from residential sources.

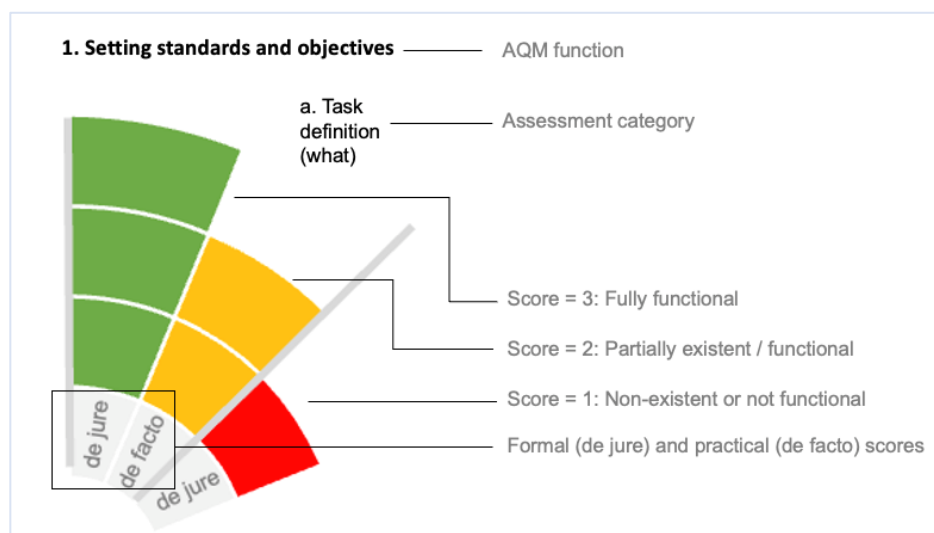
Beyond the Cantonal level, recommendation 1 (creating an enabling legal environment for AQM at the BiH country level) would be the starting point for a holistic reform of AQM in BiH. However, given current politics and the country’s complex governance structure, this will be difficult to tackle. Therefore, the recommended approach resulting from this review is to begin strengthening AQM from the Cantonal level outwards.

Table ES.1: Functional review recommendations by AQM function (details provided in chapter 4).

Recommendations	
FUNCTION 1: ESTABLISHING GOALS, STANDARDS AND OBJECTIVES	
1.	Create an enabling legal environment at the BiH country level to allow effective regulation and management of emissions, primarily from residential sources and traffic.
2.	Set technical guidance for cantons to develop Cantonal Environmental Protection Plans (CEAP) and Air Quality Plans (AQP).
3.	Establish a binding quality assurance and accountability mechanism for CEAPs and AQPs.
4.	Strengthen AQM policy, coordination, and oversight capacity in the cantonal government.
5.	Update the definition of air quality zones and agglomerations to facilitate air quality planning.
6.	Clearly define and strengthen the role of municipalities in AQM.
FUNCTION 2: DETERMINING REQUIRED EMISSION REDUCTIONS	

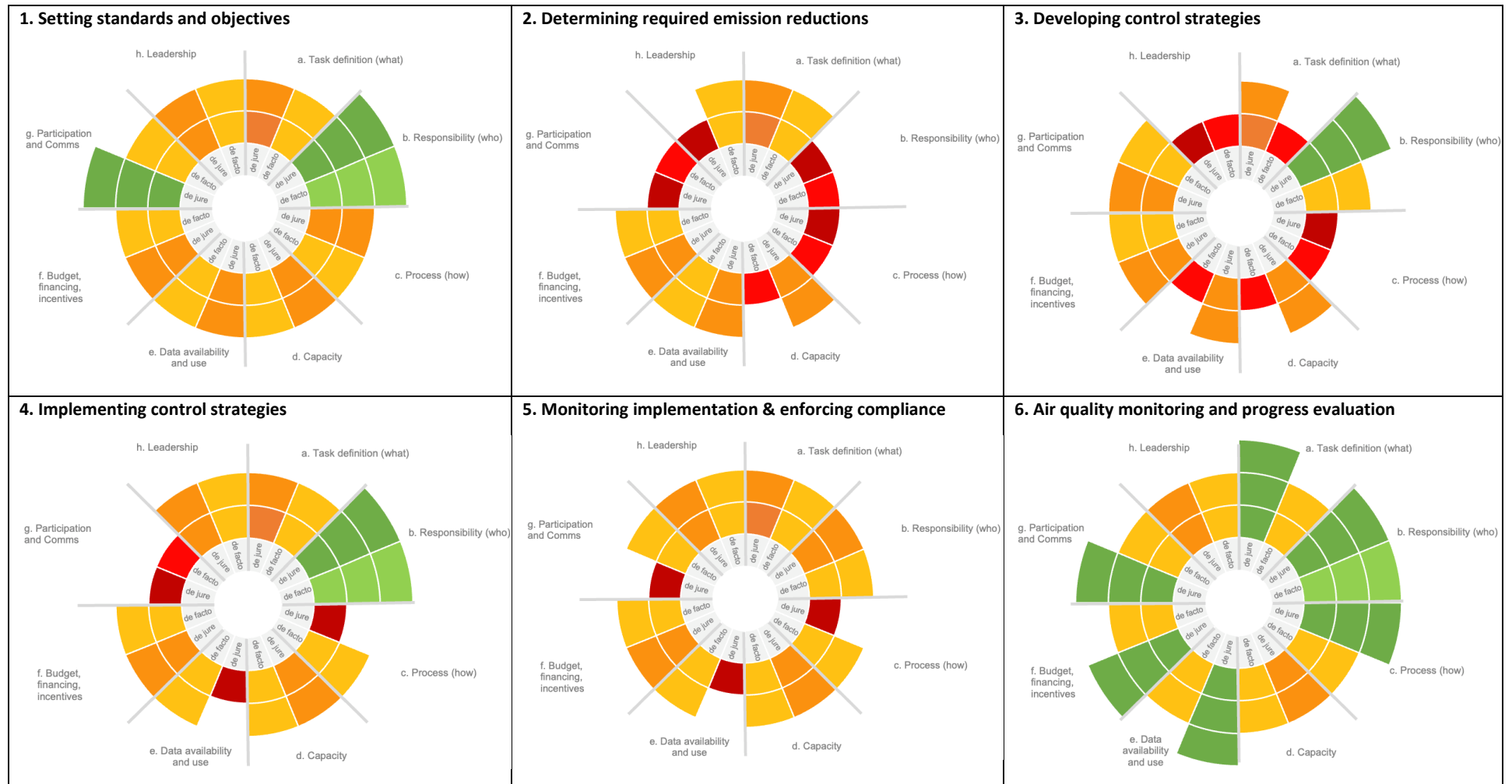
7.	Develop and maintain detailed, localized emission inventories in each canton.
FUNCTION 3: DEVELOPING CONTROL STRATEGIES	
8.	Involve cantons in emission control measures for large polluters under federal jurisdiction.
9.	Strengthen knowledge exchange and learning between cantons through an AQP peer review mechanism and staff secondments.
FUNCTION 4: IMPLEMENTING CONTROL STRATEGIES	
10.	Regulate residential sector heating and energy efficiency.
11.	Introduce and scale incentives for the residential sector for switching to clean heating technology and clean fuel options, and incentivize energy efficiency measures.
12.	Strengthen citizen-focused AQM by establishing eco-managers or energy advisers in municipalities.
FUNCTION 5: MONITORING IMPLEMENTATION AND ENFORCING COMPLIANCE	
13.	Formally and practically embed the function of chimney sweeps in the AQM system, enforce annual inspections of all buildings, use inspection results to build a localized emission inventory and to ensure households comply with air quality regulations.
14.	Strengthen the inspection function at all levels to control emissions from small industrial sources.
15.	Enhance the capacity of environmental inspection authorities to carry out air quality-related monitoring and inspections.
FUNCTION 6: AIR QUALITY MONITORING AND PROGRESS EVALUATION	
16.	Increase public confidence in air quality monitoring results by obtaining accreditation for the Public Health Institute of Canton Sarajevo.
17.	Strengthen technical capacity for monitoring all required air quality parameters.
CROSS-CUTTING	
18.	Enhance information sharing on air quality monitoring results, education on health impacts and measures to be taken, and citizens' roles and responsibilities in AQM.

Figure ES.1: How to read the functional review scoring charts on the following page.



Visualization of functional review results by AQM function

Each of the six AQM functions is assessed against eight review criteria. Each criterion is scored twice, based on the formal and legal design of the function, and the practical implementation. A full-sized version of each chart is included with each scoring table at the end of the respective functional assessment in chapter 3.



1. Introduction

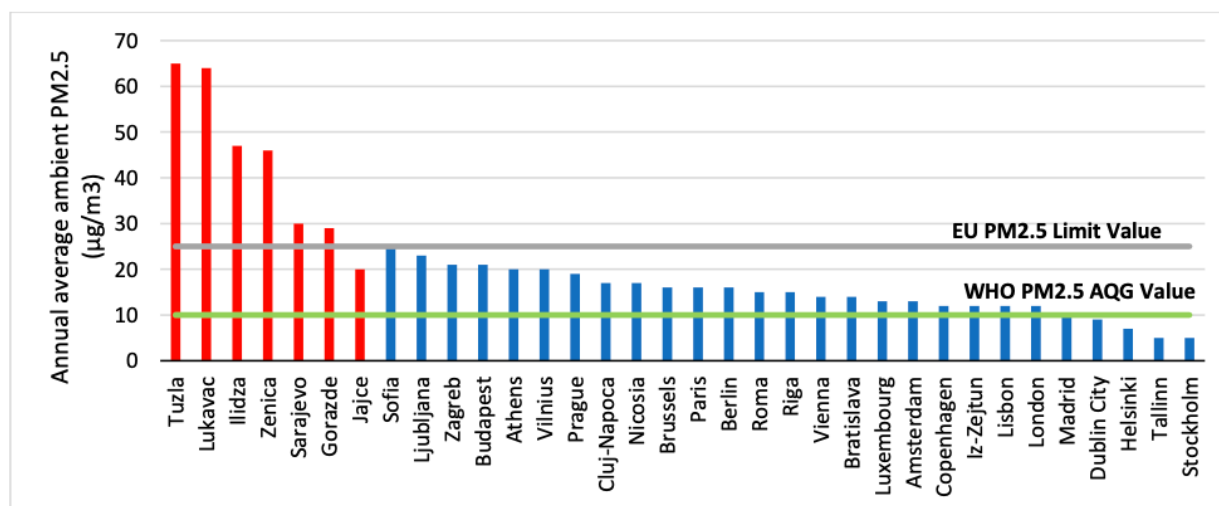
The introduction outlines the challenges with air pollution and its health and economic impacts in Bosnia and Herzegovina (BiH) and Canton Sarajevo. It also explains the rationale for a functional review of air quality management (AQM) and introduces the methodology.

The remainder of the report is structured as follows. Chapter 2 summarizes key features of the policy and institutional framework for AQM at the different levels of government, highlighting important challenges and opportunities. The main findings of the functional review of AQM in Canton Sarajevo are presented in Chapter 3. Recommendations are discussed in detail in chapter 4, including problem statement, proposed action, and responsibility for each action.

1.1 Air pollution in Bosnia and Herzegovina and Canton Sarajevo

People in many parts of BiH are exposed to more toxic particulate matter air pollution than their neighbors in Western Europe. This is especially true for residents in urban areas, such as Sarajevo (Figure 1). In the city, average annual ambient fine particulate matter (PM_{2.5}) pollution concentrations reach three times the WHO Air Quality Guideline level. In 2021, the limit values for particulate matter (PM₁₀) air pollution were exceeded on more than 80 days of the year at some measuring stations in Canton Sarajevo, and even over 120 days in Ilijaš municipality, located within the canton (Ceteor/Environment Energy Efficiency 2023).

The burning of solid fuels for domestic heating and cooking, use of coal-fired power plants, industry, and aging vehicle fleets are the main contributors to elevated AAP concentrations. Source apportionment analysis indicates that at a national level, the residential sector is the largest source of population exposure to harmful PM_{2.5} associated with the burning of solid fuels in homes (World Bank, 2019). Almost 60 percent of PM_{2.5} emissions emanated from the residential sector in BiH in 2015 (Ibid.). A more recent estimate for Sarajevo indicates that 40 percent of PM_{2.5} pollution was emitted from burning biomass and coal for heating in 2021-2022 (Grundström, Maria et al. 2022). Air quality is worst in the winter months when many households burn solid fuels for heating. Year-round, coal-fired power stations contribute to air pollution, a practice that Western European countries have started to move away from. The Balkan region is home to many coal and lignite-fired units and to seven of the ten most polluting coal-fired power stations in Europe (World Bank, 2019). But industry emissions and an aging vehicle fleet further drive the deterioration of air quality in BiH.

Figure 1: Annual average PM_{2.5} concentrations in BiH and other European cities.

Source: WHO 2018.

The geography of Canton Sarajevo accentuates pollution episodes where they occur. Sarajevo is located in a depression surrounded by mountains. The population is concentrated in a narrow urban corridor along the Miljacka River. There is limited air circulation between valleys during surface temperature inversions. Under these conditions, local emissions cause elevated concentrations in individual basins. When wind is weak or there is a stable anticyclone, ambient air pollution (AAP) particles then remain in the basins' ground layers for longer and cause smog. However, looking beyond such pollution hot spots, even the population-weighted mean exposure to PM_{2.5} across BiH exceeds the WHO guideline value by a factor of about two.

1.2 Health burden and economic cost of ambient air pollution

A recent study on the effects of air pollution in BiH estimated that about 3,600 people die every year from causes associated with AAP (World Bank 2022). This means that over 9 percent of the total annual mortality in BiH can be attributed to air pollution. This is more than double the AAP-related mortality in North Macedonia (1,700 deaths) and more than four times the AAP-related mortality in Kosovo (760 deaths). About 81 percent of the 3,600 AAP-related deaths in BiH are from cardiovascular diseases; 68 percent of ischemic heart disease, and 57 percent of strokes occur in people over 70 years of age. Cardiovascular diseases mostly affect people older than 65 years. This subgroup of the population is at heightened risk of adverse health impacts of air pollution in BiH.

About 16 percent of the total health burden attributed to AAP occurs in Sarajevo and Banja Luka.

The annual cost of mortality caused by AAP in BiH is estimated at around US\$2.4 billion, equivalent to 15.7 percent of gross domestic product (GDP) in 2019 (World Bank 2022). Moreover, the AAP-related health effects in the workforce lead to reduced labor productivity, further exacerbating the negative economic impacts of air pollution.

BiH recognizes Air Quality Management (AQM) as part of a broader set of measures geared towards climate change mitigation, energy transition, and sustainable growth, particularly because air pollution

control promises significant co-benefits for climate change mitigation (Box 1). The country signed the Sofia Declaration on the Green Agenda for the Western Balkans in 2020, aligning it with the EU Green Deal. As such, the BiH Economic Reform Program 2024-2026 posits decarbonization as both an obligation and a key development opportunity (BiH Directorate for Economic Planning 2024). Similarly, the Development Strategy of the Federation of Bosnia and Herzegovina (FBiH) has recognized AQM as a building block towards resource efficient and sustainable economic development (FBiH Government 2021). Overall, growth has proven relatively resilient despite the fallout from Russia's invasion of Ukraine. Economic growth in BiH decelerated to 1.75 percent in 2023, down from 4.25 percent in 2022, but is projected to rise to 2.5 percent in 2024. However, the IMF noted that, without substantially greater reform progress, growth in BiH is expected to remain subdued at around 3 percent in the medium term, too low for significant income convergence with the EU (IMF 2024). Therefore, it will be even more important to strengthen AQM as part of a broader effort to transition to a low-carbon economy and to tackle climate change. Air pollution and climate change share common sources and impacts on the environment and human health. Therefore, policies aimed at reducing air pollution can simultaneously address climate change, leading to significant co-benefits.

Box 1: The synergies between air pollution control and climate change mitigation.

Air pollutants and greenhouse gases often come from the same sources, such as combustion in coal-fired power plants and diesel-fueled vehicles. Actions that reduce air pollution can have immediate benefits for the climate, particularly through the reduction of short-lived climate pollutants (SLCP) like methane, black carbon (a component of PM_{2.5}), ground-level ozone, and hydrofluorocarbons. SLCPs are more potent in their climate warming effects than carbon dioxide (CO₂) and are often released alongside other air pollutants such as PM_{2.5} (WHO 2022).

Climate change, in turn, affects air quality via different transmission channels. For instance, climate change has led to more frequent wildfires, which pollute the air and have been linked to respiratory illnesses and premature births (Nolte et al. 2018).

Policies and programs to reduce air pollution can generate important climate co-benefits by reducing GHG and air pollutant emissions. Therefore, maximizing the synergies between climate change mitigation and air pollution control would yield health benefits and reduce major contributors to global warming. Decarbonization strategies that include mitigation of SCLPs can yield significant benefits in the short to medium term, including improved air quality for human health, labor and agricultural productivity, and food security (Sanchez-Triana 2023). Recent World Bank research shows that low- and middle-income countries stand to benefit the most from SLCP mitigation (Sánchez-Triana et al. 2023).

It is important to consider the potential trade-offs implicit in some climate change mitigation and air pollution control interventions. For example, in BiH, biomass – predominantly wood – is a widely-used energy source for residential heating. Sustainable sourcing can make biomass a carbon-neutral fuel. However, burning biomass is an important source of PM_{2.5} pollution. Additionally, incomplete combustion, which frequently occurs in old or inefficient boilers and stoves that are found in many households, releases black carbon, a powerful SLCP. On the other hand, reducing air pollution by curtailing the use of biomass can lead to increased GHG emissions if biomass is substituted with fossil fuels such as gas.

1.3 Rationale for a functional review of AQM

Peak pollution episodes in urban areas have sparked growing interest and pressure from the public to address air pollution. The EU accession process provides further incentives for the government for improving air quality. The Environmental Strategy 2022-2023 of the FBiH summarizes public opinion about the state of air quality management (AQM) as follows: ‘Citizens are dissatisfied because of the lack of access to easily available official information on air quality, impact of air pollution on health, or measures undertaken the official institutions are taking to ensure satisfactory air quality throughout the year’ (Government of the FBiH 2022). This recognition is one among several key drivers for the government’s recent initiatives to improve air quality.

Effective AQM can significantly lower the health and economic burden for BiH associated with illnesses and death from AAP. The cost of inaction is high. Tackling the problem of air pollution is crucial to enhance people’s quality of life and to create the conditions for a thriving economy. The analysis presented in this report seeks to contribute to strengthening AQM in BiH, and specifically in Canton Sarajevo, by assessing air quality governance and management functions at Cantonal and local levels, identifying strengths, key bottlenecks, and areas for improvements.

To tackle air pollution holistically, there is a need to better understand the policy, institutional, and organizational bottlenecks for effective AQM in BiH. This report presents the results of a functional review (FR) of AQM governance in BiH, and specifically in Canton Sarajevo. In the decentralized governance context of BiH, focusing on the cantonal level will allow the analysis to identify AQM constraints and improvements that can be addressed at sub-national level while taking into account policy and institutional constraints and opportunities at the entity and state levels. The FR will place special emphasis on analyzing air quality governance, implementation, oversight and enforcement arrangements, and capacities through the lens of cantonal actors as the main implementers of investment programs. The analysis will put special emphasis on controlling emissions from residential sources because they are the largest emitters of particulate matter (PM) air pollution.

1.4 Methodology

A functional review (FR) is an analytical approach to strengthen public sector performance and government effectiveness in relation to a specific policy objective. The methodology is elaborated in more detail in Annex 1. Rather than a narrow set of tools or methods, FRs have been used in the World Bank as a problem-driven and results-oriented framework for helping public administrations assess the functions they perform, identify performance constraints, and develop practical recommendations for improvement. FRs have also been deployed to assess policies and other formal norms for clarity, coherence and efficiency of objectives, roles, responsibilities, and accountability; to overcome functional fragmentation or compartmentalization, eliminate duplications and other organizational inefficiencies; and to increase the efficiency and cost-effectiveness of administrative performance and service delivery.

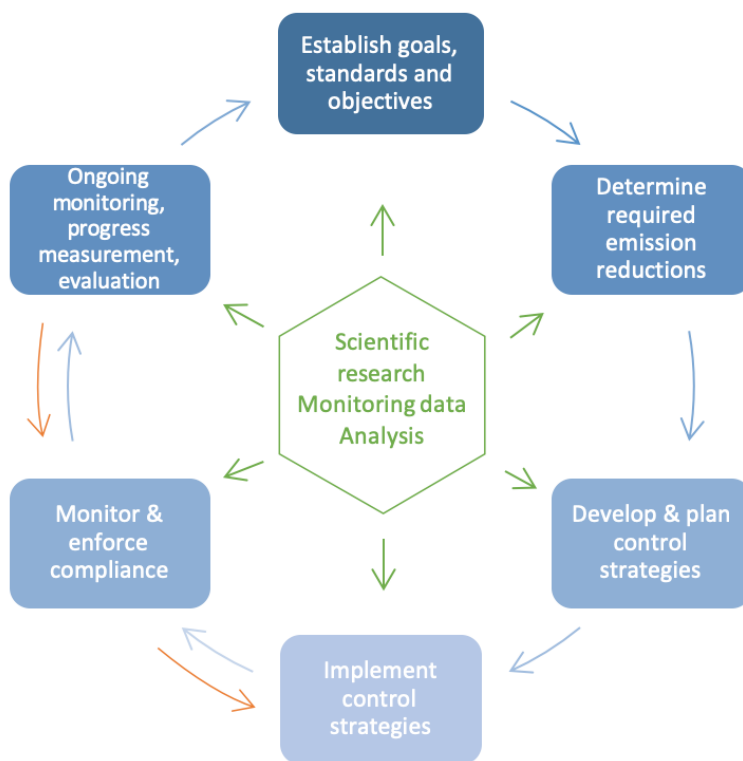
The objective of this analysis is to develop recommendations to strengthen regulatory and institutional frameworks and capacity to allow the government to deliver better air quality for its citizens. Given the

overarching governance objective of effective AQM, this FR assesses whether existing legislation and policies clearly define the results to be achieved, assign roles and responsibilities, and establish efficient and accountable processes on how the results are to be delivered ('what government should do'). At an organizational level, the FR offers a mechanism to analyze whether and how institutional and implementation arrangements are fit for purpose ('what government can do and does'). The aim is to ensure that formal norms and actual behaviors are mutually consistent and targeted towards delivering results. The analytical framework allows identifying both formal and informal, de jure and de facto behaviors of agents within the public sector determining air quality management.

The report aims to inform decision makers at the cantonal and entity level to help shape formal norms and institutional roles that allow for more coherent AQM planning and oversight, and to create enabling framework conditions for more effective implementation at cantonal and local levels. The analysis centers around AQM at the cantonal level of administration as it is shaped by the overall AQM governance framework in BiH and the FBiH. The main audience of the report are cantonal and entity-level authorities that can influence how cantonal and municipal actors perform their crucial roles to control air pollution and protect human health and the environment.

For the purpose of this review, AQM is organized into six interdependent functions or steps (Figure 2). Common to all AQM approaches is the aim to deliver impactful action to ensure the best possible quality of air, avoiding or minimizing adverse effects on human health, the environment and the economy. The six AQM functions are not numbered because they can be conceived of in a cyclical process whereby each step is embedded in an interdependent sequence of other steps (World Bank Group 2020; Wijetilleke and Karunaratne 1995; Committee on Air Quality Management in the United States 2004).

Figure 2: Simplified cyclical model of AQM functions, showing the iterative nature of AQM.²



Each of the six AQM functions will be reviewed against eight criteria for a comprehensive assessment of the formal prerequisites and practical implementation conditions that enable or hinder functional AQM performance. The review criteria are specified as follows: (a) Functional task definition; (b) distribution of roles and responsibilities; (c) process management; (d) capacity; (e) information and data; (f) budget, financing, incentives; (g) communication and participation; and (h) leadership. Each criterion is assessed based on its *de jure* (formal) and *de facto* configuration (in practice). The scores obtained range from 1 to 3: A score of 1 represents a non-existent or not functional property; a score of 2 means partially functional; and a score of 3 is assigned for fully functional areas that are fit for purpose.

² Source: Original illustration for this publication based on a synthesis of AQM concepts as reflected in: (Committee on Air Quality Management in the United States 2004; World Bank Group 2020; Awe et al. 2015; European Environmental Agency (EEA) 2019).

2. Setting the stage: Policy and institutional framework in BiH, FBiH and Canton Sarajevo

Effective air quality management (AQM) requires a strategic and coordinated approach which has proven challenging in BiH given the country's complex governance structure. BiH (henceforth referred to as the state or country level) is politically subdivided into two entities: the FBiH and Republika Srpska (RS), which will be referred to in this report as the entity level. Brčko District (BD) was created in 2000. It officially belongs to both entities but is governed by neither. For election purposes, BD voters can choose to participate in either the FBiH or RS elections. The FBiH is further divided into ten cantons and 79 municipalities. The cantons have a high degree of autonomy. Each of the ten federal units is administered by a cantonal government, headed by a prime minister and various cantonal ministries and agencies.

The governance of AQM in BiH is fragmented. Mandates, responsibilities, and administrative structures for environmental protection and air quality partially overlap, or are duplicated, across jurisdictions and levels of government. Although both constitutional entities – the FBiH and RS – and the self-governing BD had adopted relatively harmonized environmental laws in the early 2000s, the policy and institutional frameworks have since diverged (World Bank, 2019). In the absence of a common, country-level environmental protection law, each jurisdiction has its own regulations pertaining to the environment and air quality.

This chapter highlights key features of the policy and institutional framework shaping AQM at the different levels of government, while the complex landscape of regulations, policy instruments, and actors governing AQM in BiH, and specifically in the FBiH and Canton Sarajevo, is explored in more detail in Annex 2. The section identifies several important policy and institutional gaps and bottlenecks. Their implications for the implementation of the six AQM functions are assessed in chapter 3, while recommendations are developed in chapter 4.

2.1 Key regulations and policy instruments for AQM

The complex legal and institutional arrangements that govern public policy and decision-making in general in BiH also shape AQM at all levels, as is evident from the overview of key AQM regulations and policy instruments below.

2.1.1 Country and entity-level laws and policies

BiH has made considerable progress in harmonizing its legal order with the EU acquis, also in the area of AQM. The country formally applied for EU membership in 2016 and was recognized as a 'candidate country' in late 2022. BiH has adopted a Strategy for Harmonization of Regulations to the EU Acquis in the Field of Environmental Protection (Environmental Approximation Strategy) in 2017, with the aim of implementing the EU acquis in the area of ambient air quality.

Most importantly, the limit values for key pollutants defined in the EU's Clean Air For Europe (CAFE) Directive 2008/50/EC³ have informed the limit values pursued by the entities (FBiH, RS, and BD), as discussed in detail in chapter 3.1 on 'setting air quality standards and objectives'. The CAFE Directive merges most of the existing legislation into a single directive. It sets legally binding limit values for key pollutants, such as PM_{2.5}, PM₁₀, sulfur dioxide (SO₂), nitrogen dioxide (NO₂), and ozone (O₃). The Directive further stipulates that 10-year Air Quality Plans (AQPs) are developed for pollutants that exceed ambient air quality standards within an air quality zone. AQPs define the state of air quality within a zone, pollution sources, and measures to be taken by local authorities to reduce air pollution.

Other important EU directives have not yet been fully transposed or not been transposed at all, such as the National Emissions Ceilings Directive (2016/2284/EU) and the Directive on Sulphur Content of Liquid Fuels (1999/32/EC).

The constitution of BiH does not expressly regulate the issue of environmental protection. A country-level environment ministry or agency does not exist. At the country level, the Ministry of Foreign Trade and Economic Relations (MOFTER) is responsible for defining basic principles for environmental management, coordination with other sectors and levels of government, and for facilitating efforts to harmonize environmental policy and legislation. However, beyond these broad strokes, the constitution stipulates that all governmental functions and powers that are not expressly assigned to the institutions of BiH belong to the entities.

Therefore, the primary responsibility for environmental issues, including air quality management, rests with the constitutional entities (FBiH, RS, and BD), but there is no formal mechanism to address diverging positions between them. An Inter-Entity Coordination Body for the Environment was established in 2006 to help develop a harmonized approach for environmental protection among the FBiH, RS, and BD. However, its decisions are not legally binding. As a result, the country has three legal frameworks, organizational structures, and air quality networks.

Fortunately, the two entities and BD have largely harmonized their ambitions to curb air pollution by adopting the limit values of the EU's CAFE Directive. While the duplication of legal and organizational instruments between the entities persists, at least their content and objectives are now broadly aligned on paper.

Beginning in 2019, BiH started to develop the Environmental Strategy and Action Plan 2030+ (ESAP 2030+), covering the period 2022-2032, in a country-wide effort to define harmonized, ambitious goals for environmental and air protection. With support from the Stockholm Environment Institute, a participatory development process was undertaken to arrive at a policy document that would comprise four strategies and action plans, one for the BiH country level, and one for each of the entities (FBiH, RS) and BD. The BiH ESAP2030+ was finalized in mid-2022. The entity-level strategies contained therein were subsequently adopted, as discussed in the next section. Annex 3 provides an overview of important laws, policy instruments, and strategies related to AQM at the different levels of government.

³ See 'EU air quality standards', https://environment.ec.europa.eu/topics/air/air-quality/eu-air-quality-standards_en.

The FBiH Law on Environmental Protection (FBiH-LEP) and the FBiH Law on Air Protection (FBiH-LAP), both adopted in 2003 and amended in 2010, are the cornerstones of the legal framework governing AQM. The laws broadly regulate the measures to prevent or reduce air pollution emissions caused by human activities on the territory of FBiH; air quality protection planning; rules governing special sources of emissions; emission inventories; air quality measurement; supervision; and fines for offenses for legal entities and natural persons.

With the endorsement of the ESAP 2030+ in August 2022, the Parliament of FBiH also adopted a new Environmental Strategy for the period 2022–2032, which includes strategic goals on air quality, as discussed in further detail in chapter 3.1 on setting air quality standards and objectives. The other entities did the same, effectively moving towards greater harmonization of environmental and air protection regulations across BiH.

The current FBiH Law on Air Protection (FBiH-LAP) and its subsidiary rulebooks and regulations provide a relatively comprehensive AQM governance framework. The FBiH-LAP and associated regulatory documents determine limit values for emissions from all types of industrial sources, pollutant limit values to ensure good air quality for human health and environmental protection, AQ warning and alarm levels, emissions measurement procedures, AQ monitoring methods, and the organization of AQ monitoring networks. This set of rules also stipulates that all cantons must put in place plans and short-term measures in case of exceedances of AQ warning or alarm levels.

However, the FBiH-LAP and its subsidiaries do not sufficiently regulate several important emissions sources, including emissions from residential sources and road traffic. The use of solid fuels is not regulated, nor its quality. Neither monitoring nor certification of households boilers or stoves are controlled. This leaves a major gap in AQM governance, particularly given that emissions from residential sources, particularly the use of solid fuels for heating and cooking, are the main sources of air pollution in FBiH, especially in urban areas and in the winter months, along with old or inefficient boilers and stoves, poor energy efficiency of individual houses, and road traffic.

Considering the gap in the existing FBiH-LAP, the Government of the FBiH drafted a new FBiH Law on Air Protection in 2021. The new law, which was not yet in force at the time of writing, will address many of the current shortcomings. The new FBiH-LAP (see Annex 2 for details) was developed as a follow up to the revised Law on Environmental Protection. Although the draft of the overhauled FBiH-LAP was accepted by the Federal Parliament already in 2021, the remaining steps to adoption – discussion and voting on the floor of the FBiH Parliament – had not been taken at the time of writing this report.

2.1.2 Key AQM laws and instruments in Canton Sarajevo

In the cantons of the FBiH, the FBiH-LEP requires the cantonal assemblies to adopt five-year Cantonal Environmental Protection Plan (CEAP), the most important strategic document for AQM at the cantonal level. The CEAP must be harmonized with the Federal Environmental Strategy.

Not all of the ten cantons in FBiH have adopted a CEAP to date, with Sarajevo, Tuzla, Una-Sana, and Zenica being notable exceptions. A detailed analysis of the latest CEAP for Canton Sarajevo, adopted for

the period 2021-2025, is provided in the discussion on the AQM function of setting standards and objectives (chapter 3.1).

The FBiH Law on Air Protection requires cantons to develop a Cantonal Air Protection Plan, also referred to as AQP, for areas where measured air pollution levels exceed limit values for one or more pollutants.

The AQP must specify the origin of pollution, such as a list or map of the polluting emission sources, the total volume of emissions from these sources (tons per year), information about pollution coming from other areas, detailed description of measures or projects to be adopted in order to reduce pollution, an assessment of the expected air quality improvement, the time needed to achieve these goals, as well as the necessary resource requirements (funds, personnel, information, etc.). Canton Sarajevo decided that its CEAP included all the information required for an AQP and that no separate document needed to be created, as discussed in detail in chapter 3.3. For the period 2013-2018, the Canton had developed a 'Plan for Reduction of Particulate Matter Pollution'. The Plan was based on the first emission inventory from 2013 which significantly underestimated pollution emissions (see chapter 3.2). It outlined mostly organizational measures that were implemented but did not target the key pollution source of solid fuels used in household heating. The effect on air quality remained limited.

Unfortunately, there is no accountability mechanism between levels of government that would ensure that cantons develop and implement AQPs. Moreover, an AQP is not legally binding as currently defined by law. Therefore, cantonal governments are neither required to budget for its implementation nor report on whether results were delivered. This points to the need to establish clear criteria for AQP development, content and accountability for implementation in legislation at the entity level.

Some AQM competencies are transferred to municipalities and mainly refer to small industry emission sources which do not require environmental permits. For these sources, the obligation of the municipalities is to issue building permits. In the process of issuing the permits, several AQM-related parameters must be defined and checked, including the type of fuel and other resources used in operation, the type and amount of air pollution emissions, and a list of suitable air pollution prevention measures is to be provided. Furthermore, the issuance of permits is conditional upon obtaining an 'expert opinion' from the Institute for Planning of Spatial Development of Canton Sarajevo. The Decision on the Protection and Improvement of Air Quality in Canton Sarajevo, adopted by the Cantonal Assembly in May 2016, also demands that existing commercial emission sources, such as stonemason's workshops, asphalt factories, or sawmills, adopt measures to curb air pollution and minimize their impact on their neighborhood. However, the responsibility to implement the Decision is assigned to practically everyone, making it difficult to hold anyone accountable.

To prevent or address episodes of extreme air pollution or smog, the cantonal government can adopt a short-term Intervention Plan, in situations when there is a risk of exceeding predefined warning or alarm thresholds (see Annex 2 for details). The adoption of an Intervention Plan is mandated by the FBiH-LEP and the Decision on the Protection and Improvement of Air Quality in Canton Sarajevo. It is also a standard component in the AQPs of EU countries, referred to as Short-term Action Plan (STAP) in the CAFE Directive. An Intervention Plan specifies measures to reduce the risk of exceeding thresholds and aims to limit the duration of such exceedances. The plan includes control measures, restriction, or suspension of

specific activities (including road traffic) which contribute to exceeding the defined thresholds. In the event of a threshold being reached, all citizens and legal entities are obliged to act in accordance with the Intervention Plan.

When activated, the intervention plan measures have usually had limited effects to curb air pollution episodes and improve air quality. Two main reasons contribute to this. First, not all measures are implemented. As an example, restricting the use of vehicles based on their EURO norm was never fully enforced. This may be partially explained by the fact that, of the 19 legal entities who are responsible for implementing the intervention measures, about 20% do not have staff appointed or responsible to ensure actions are taken. Others face financial constraints (Szigeti 2023). Second, Canton Sarajevo's geographical position and microclimate, particularly when temperature inversions occur in winter, it becomes difficult to reduce pollutant concentrations because they are 'locked' below the inversion layer. In these situations, the measures are primarily aimed at preventing further increases in pollutant concentrations.

A recent review of the Intervention Plan identified areas for improvement and made recommendations which the Cantonal Government endorsed and intends to pursue. The detailed assessment, supported by the World Bank, analyzed the intervention measures and their implementation (Szigeti 2023). It concluded that the *type* of proposed short-term measures was generally suitable for reducing air pollution, but that the technical details would need to be elaborated to ensure effective air quality improvement, if the measures were implemented. The review report provided detailed recommendations to strengthen the technical design of the Intervention Plan actions. Shortly after the review was completed, the Cantonal Government formally endorsed the recommendations of the review and adopted a new Plan accordingly.

2.2 Main AQM actors in BiH, FBiH, and Canton Sarajevo

In the entity of FBiH, the constitution defines shared jurisdiction between the federal government and the cantons in the area of environmental protection and air quality. The cantons can exercise their jurisdiction jointly or separately, based on need, in coordination with the federal government. Formally, ensuring good air quality is the responsibility of the FBiH, cantons, local self-government units, business entities, and other legal entities and natural persons. In short: it is everyone's responsibility. All actors are formally obliged to cooperate with each other for effective air quality management. Unfortunately, when everyone is responsible, there is no incentive for any one actor to take responsibility.

Because there is no clear and unambiguous mandate assigned regarding AQM, responsibility tends to be shifted between levels of government. The obligations of each level are not clear.

The Constitution of BiH does not mandate the establishment of a ministry or agency for environmental protection at the country level, which would be helpful for the effective resolution of air pollution problems. Instead, the Inter-Entity Authority for the Environment was established in 2006 and deals with all environmental protection issues that require a coordinated approach by the two entities and Brčko District. It is responsible for harmonizing environmental laws, regulations, standards and action plans, international agreements on environmental issues as well as their implementation; participates in

international processes and cooperates with international organizations; monitors the environment, information systems, information exchange as well as cross-border and inter-entity environmental issues.

The most important administrative body in the institutional framework governing AQM at the country level is the Ministry of Foreign Trade and Economic Relations (MOFTER) of BiH. The competences of MOFTER are determined by the Law on Ministries and Other Administrative Bodies of Canton Sarajevo. It stipulates that MOFTER is responsible for performing tasks within the jurisdiction of BiH that relate to defining policy, basic principles, coordinating activities, and harmonizing the plans of entity authorities and institutions on the international level and, among other things, in the area of the use of natural resources.

The most important entity-level institution with a role in environmental protection and AQM in FBiH is the Federal Ministry of Environment and Tourism (FMET), but it has limited capacity dedicated to issues of air quality. This ministry performs administrative, professional, and other tasks within the jurisdiction of FBiH that relate to: environmental protection of air, water and land; development of environmental protection strategy and policy; air, water and land quality standards; environmental monitoring and air control. FMET leads the development of the Strategy for Environmental Protection, which includes the Strategy for Air Protection. Every two years, the FBiH-LEP mandates FMET to present a report to the FBiH parliament on the implementation of the strategy and initiates a strategy revision, if called for.

The FBiH Environmental Protection Fund collects funds and finances the preparation, development and implementation of programs, projects, and other activities in the field of environmental and air protection, sustainable use, and improvement of natural resources and the use of renewable energy sources. According to its structure, the Fund is a public institution that has the status of a legal non-profit entity.

In Canton Sarajevo, the administrative body responsible for environmental protection is the Ministry of Communal Economy, Infrastructure, Spatial Planning, Construction and Environmental Protection (MCEEP). The ministry's competencies are defined by the provisions of the Law on the Organization and Scope of Administrative Bodies and Administrative Organizations of Canton Sarajevo. It is responsible for important AQM functions: Overall air quality management; establishment and management of an inventory of emission sources for Canton Sarajevo; and air quality monitoring and assessment, in collaboration with other cantonal authorities, administrative institutions, municipalities, and professional bodies.

Within MCEEP, an organizational unit called the Center for Air Quality for Canton Sarajevo was established in 2020 to lead on all matters related to AQM. An analysis was conducted to justify the establishment of the Air Quality Center and to define its responsibilities. There are outlined as follows:

1. Manage the emission inventory for Sarajevo Canton;
2. Organize dispersion modeling;
3. Air quality analysis and information dissemination to the public;
4. Implement the Plan of Intervention Measures and cooperate with other ministries and government agencies;

5. Yearly air quality reporting;
6. Air quality zoning and development of a map for categorizing territory by air quality;
7. Estimate the health impacts of air pollution;
8. Develop of short and long term measures to improve air quality;
9. Implement short and long-term measures, CEAP, and other strategies;
10. Disseminate information to the public about air quality, control strategies, Plan of Intervention Measures, and other air quality-related matters;
11. Contribute to spatial planning.

The Air Quality Center was meant to be staffed with six officials responsible for overseeing, coordinating, or implementing the tasks above. Currently, the Center employs only two staff. It is not clear when and how additional staff will be hired. Instead, the Air Quality Center relies heavily on the **external** expert group that was assembled to provide technical advice and assistance. Moreover, the role of the Air Quality Center in creating legislation regarding air quality is unclear. Funding, operating equipment, and office space for the Center's day-to-day work is not systematically planned for. Experiences from other countries illustrate various options for institutional structures that drive air quality-related legislation, policy, regulation, and program implementation (Box 2).

Box 2: Institutional arrangements for AQM implementation support: examples from other countries.

Separate environmental protection agency (EPA)

Some countries maintain large and relatively independent environmental protection agencies that support their ministry of environment on a range of functions related to technical, scientific, advisory, and grant management tasks, including for AQM. Examples include the EPA in the United States; the German Environment Agency (UBA), and the French Environment and Energy Management Agency (ADEME).

Latvia provides an example for how a small country like BiH might structure this institution in the long term. A small EU member state, the country affords having a separate EPA, the State Environmental Service (VVD), with over 300 staff (VVD 2023). While Latvia's population is about half the size of BiH, its GDP per capita is nearly three times the figure for BiH. Therefore, it may not be realistic to implement this model in BiH or at the entity level in the near term, given the cost implications and the already existing shortage of qualified technical personnel.

Environmental protection institution within the ministry of environment

Croatia (HAOP, Institute for Environmental and Nature Protection)⁴ and Slovenia (Slovenian Environment Agency, ARSO)⁵ have established environmental agencies or institutions that perform similar roles to an EPA but operate under the overall organizational structure of their ministry. This offers obvious advantages from an efficiency perspective.

Slovakia: AQM focused department and implementation support units within the ministry of environment

⁴ <https://www.haop.hr/index.php/hr>.

⁵ <https://www.arso.gov.si>.

The Slovak Republic also operates a separate EPA, Slovak Environment Agency (SAŽP)⁶. However, the country's ministry of environment features a promising structure that can serve as inspiration for BiH (Slovak Ministry of Environment 2023).

Similar to what has been proposed above, the Slovak ministry of environment houses a department for climate and air protection. Within the department, distinct units are dedicated to emission reduction, air protection including policy and planning, and a separate unit responsible for coordinating activities under the EU-funded LIFE project on air quality improvement.

Most significantly, the ministry has established a separate Department for Program Implementation. It comprises 12 units, one each per environmental media including air, and units for other specialized areas such as flood protection, and for cross-cutting services like technical assistance and human resources.

Municipalities in Canton Sarajevo have been assigned limited AQM responsibilities in the legal and policy framework, despite being 'closest' and therefore well positioned to manage emissions from residential households and traffic, the main PM_{2.5} pollution sources. The Decision on the Protection and Improvement of Air Quality in Canton Sarajevo defines the role of municipalities mainly in the process of issuing building permits for small emission sources that do not require environmental permits. However, municipalities do not have dedicated working positions for such tasks and their role in AQM is not defined clearly enough to use their full potential.

2.3 Synthesis: Challenging framework conditions for effective AQM

The current policy, institutional and governance arrangements present challenging framework conditions for effective AQM at all levels. Several crucial issues stand out and are summarized below, while their implications are assessed in the following chapter:

- **AQM governance is characterized by fragmentation and limited accountability at all levels.** In the absence of an apex ministry or agency for environmental protection at the country level, the primary responsibility for AQM rests with the entities, with no binding mechanism to address diverging positions between them. Therefore, the country has three legal frameworks, organizational structures, and air quality networks, with varying degrees of harmonization and convergence.
- **Within the FBiH, AQM mandates are not clearly assigned. Therefore, responsibilities to curb air pollution are shifted between the federation and the cantons, and between institutions.** While all actors are formally obliged to cooperate with each other for effective AQM, in practice no single actor has an incentive to take responsibility, nor are there repercussions for failing to take action against air pollution.
- **Several emission sources are only partially or not regulated, most importantly emissions from road traffic and residential sources.** Neither the use of solid fuels nor its quality are regulated.

⁶ <https://www.sazp.sk>.

Household boilers or stoves are not monitored or certified. This constitutes a major lapse in curbing pollutant emissions and a missed opportunity regarding more effective AQM.

- **The adoption of the ESAP 2030+ and the new draft FBiH Law on Air Protection are positive signs of change towards greater harmonization, accountability, and the introduction of more effective AQM instruments.** Most significantly, roles and responsibilities for AQM will be more clearly defined, and there are legal provisions to sanction actors who do not fulfill their AQM-related duties.

The following chapter offers a detailed analysis of the six key AQM functions in Canton Sarajevo, reviewing strengths and bottlenecks to identify actionable recommendations for improving air quality.

3. Functional review of AQM in Canton Sarajevo

This chapter applies the analytical framework introduced in chapter 1 and assesses each of the six main AQM functions against eight review criteria in the context of Canton Sarajevo (see Annex 1 for details on the methodology). A narrative summary of important findings is provided for each function while detailed observations are included in the scoring table at the end of each section, offering a comprehensive assessment of the formal (*de jure*) prerequisites and real-world practice (*de facto*) of AQM.

3.1 Setting standards and objectives

The two entities and BD have adopted the overarching air quality standards and objectives defined in the relevant EU directives, with few minor deviations. In the FBiH, the Law on Air Protection determines the limit values per pollutant (Table 1), which are identical to the EU's CAFE Directive objectives.

Table 1: Overview of limit values and guidelines per pollutant, by entity.

Pollutant	WHO (2021) ⁷	EU (2008)	FBiH (2010)	RS (2010)	EU (2022 proposed) ⁸
PM₁₀	15 µg/m ³ annual mean 45 µg/m ³ 24-hour mean	40 µg/m ³ annual mean 50 µg/m ³ 24-hour mean	40 µg/m ³ annual mean 50 µg/m ³ 24-hour mean	40 µg/m ³ annual mean 50 µg/m ³ 24-hour mean	20 µg/m ³ annual mean 45 µg/m ³ 24-hour mean*
PM_{2.5}	5 µg/m ³ annual mean 15 µg/m ³ 24-hour mean	25 µg/m ³ annual mean	20 µg/m ³ annual mean	20 µg/m ³ annual mean	25 µg/m ³ 24-hour mean*
O₃	60 µg/m ³ peak season 100 µg/m ³ 8-hour mean	120 µg/m ³ 8-hour mean	120 µg/m ³ 8-hour mean	120 µg/m ³ 8-hour mean	120 µg/m ³ 8-hour mean
NO₂	10 µg/m ³ annual mean 25 µg/m ³ 24-hour mean 200 µg/m ³ 1-hour mean	40 µg/m ³ annual mean 200 µg/m ³ 1-hour mean	40 µg/m ³ annual mean 200 µg/m ³ 1-hour mean	40 µg/m ³ annual mean 200 µg/m ³ 1-hour mean	20 µg/m ³ annual mean 50 µg/m ³ 24-hour mean* 200 µg/m ³ 1-hour mean [†]
SO₂	40 µg/m ³ 24-hour mean 500 µg/m ³ 10-minutes mean	125 µg/m ³ daily mean 350 µg/m ³ 1-hour mean	125 µg/m ³ daily mean 350 µg/m ³ 1-hour mean	125 µg/m ³ daily mean 350 µg/m ³ 1-hour mean	20 µg/m ³ annual mean 50 µg/m ³ daily mean*

⁷ WHO 2021 (<https://www.who.int/publications/i/item/9789240034228>).

⁸ New EU ambition: COM(2022) 542 final/2 (<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2022:542:FIN>).

					350 µg/m ³ 1-hour mean [†]
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* Not to be exceeded more than 18 times per calendar year.

† Not to be exceeded more than once per calendar year.

At the entity level, the FBiH Law on Environmental Protection⁹ obligates the FBiH to formulate an Environmental Strategy which defines environmental goals and priorities, means of achieving them, the financial and institutional framework for the implementation, monitoring, evaluation, and reporting, as outlined in chapter 2. The current strategy, covering the period 2022-2032, does not set different air quality standards and objectives from those defined in the Law on Air Protection. Instead, it spells out two broad, strategic policy goals (Government of the FBiH 2022):

- 1) **Reduce air pollution by reducing air pollutants to levels that are safe for human health**, through reducing emissions from large combustions, upgrading of industrial facilities so as to comply with the best available techniques, reducing emissions from household stoves and hospitality services, increasing the share of district heating in the total heat supply system, and reducing emissions of pollutants from transport.
- 2) **Upgrade the air quality management system to support strategic decision-making and public information on air quality and emissions**, through further development of air monitoring stations, upgrading of the current system of air quality public information in real and integrated time, and development of the system of international reporting on emissions and air quality.

The FBiH Environmental Strategy includes a situation analysis of the main causes of air pollution and the obstacles to effective AQM. It concludes that ‘the application [of the legal framework for AQM] remains limited, and the principal shortcoming of the air quality management system is the lack of intersectoral approach[es]’ (reference). Indeed, air quality standards and objectives are not integrated into laws and policies across sectors at the country, federal, and cantonal levels. This is particularly true for the laws on traffic safety and vehicle standards, laws on consumer protection, including certification of stoves and boilers, and the regulations which define standards for the quality of fuels where it is not evident that impacts on air pollution and air quality are taken into account. The strategy recognizes that ‘citizens are dissatisfied because of the lack of access to easily available official information on air quality, impact of air pollution on health, or measures undertaken [by] the official institutions to ensure satisfactory air quality throughout the year’ (ibid.). The measures proposed in the FBiH Environmental Strategy to improve the present situation are discussed in chapter 3.3 on developing control strategies.

While FMET has the responsibility to coordinate the implementation of all air quality-related measures listed in the FBiH Environmental Strategy, Cantons must translate the strategic priorities into practical actions in their CEAPs. However, a lack of guidance on how to do this and the absence of quality assurance and accountability mechanisms result in limited compliance and fragmentary CEAPs. Although the FBiH Law on Environmental Protection requires cantons to develop a CEAP, not all the cantons have developed one. There are no consequences for not creating a plan. Moreover, section VIII

⁹ Official Gazette of the FBiH, 15/21.

of the FBiH-LEP on environmental protection planning only sketches out the process and type of content to be included in a CEAP in the broadest terms. The law does not set quality criteria for the information to be presented in this strategic document, nor is there a quality assurance mechanism envisaged in the law. It is also unclear which type of analysis and evidence should underpin the CEAP, as discussed in more detail in chapter 3.3.

Table 2: Functional Review summary table, function 1: Setting standards and objectives.

Review criteria	De jure		De facto	
a. Functional task definition ('What')	2	Country-level legislation only sets general boundaries. At the entity-level, the FBiH-LEP requires FMET to develop an Environmental Strategy and outlines the content categories to be covered. The same applies to the requirement for cantons to develop CEAPs.	2	The FBiH Environmental Strategy was adopted in 2022, developed with external assistance, and includes a relatively thorough situation analysis, based on which air quality-related strategic priorities are defined. Cantons are required to base their CEAPs on the federal Environmental Strategy but guidance, quality assurance or accountability mechanisms for this process do not exist.
b. Distribution of responsibilities ('who')	3	Responsibility for developing the entity-level environmental strategy and the CEAP at cantonal level are clearly defined (FMET; MCEEP).	3	The federal strategy was updated by FMET with support from the ESAP 2030+ project. The Sarajevo CEAP was updated on time by the institutions mandated to develop it, using an externally funded process (GCAP).
c. Process management ('how')	2	Process guidance for the development of the federal Environmental Strategy and the CEAP is very general. Neither quality requirements are specified nor the need for a cross-sectoral approach.	2	The FBiH Environmental Strategy 2022-2032 was developed following a participatory process and includes the most relevant information. While the previous Sarajevo CEAP 2016-2021 included important analytical work, the CEAP 2021-2025 was merely an update of the previous CEAP's action plan table and is not based on new analysis.
d. Capacity ('Are they able to do it?')	2	The responsible federal (FMET) and cantonal ministry (MCEEP) formally have the required technical capacity to commission and oversee the development of the FBiH Environmental Strategy and the Sarajevo CEAP, but less so the capability to design control strategies and estimate the effects the	2	The strategic documents at entity and cantonal levels were developed with significant external assistance. The cantonal level plays an important role in translating federal strategic ambitions into practical action. Yet, the AQM-related function at MCEEP is understaffed,

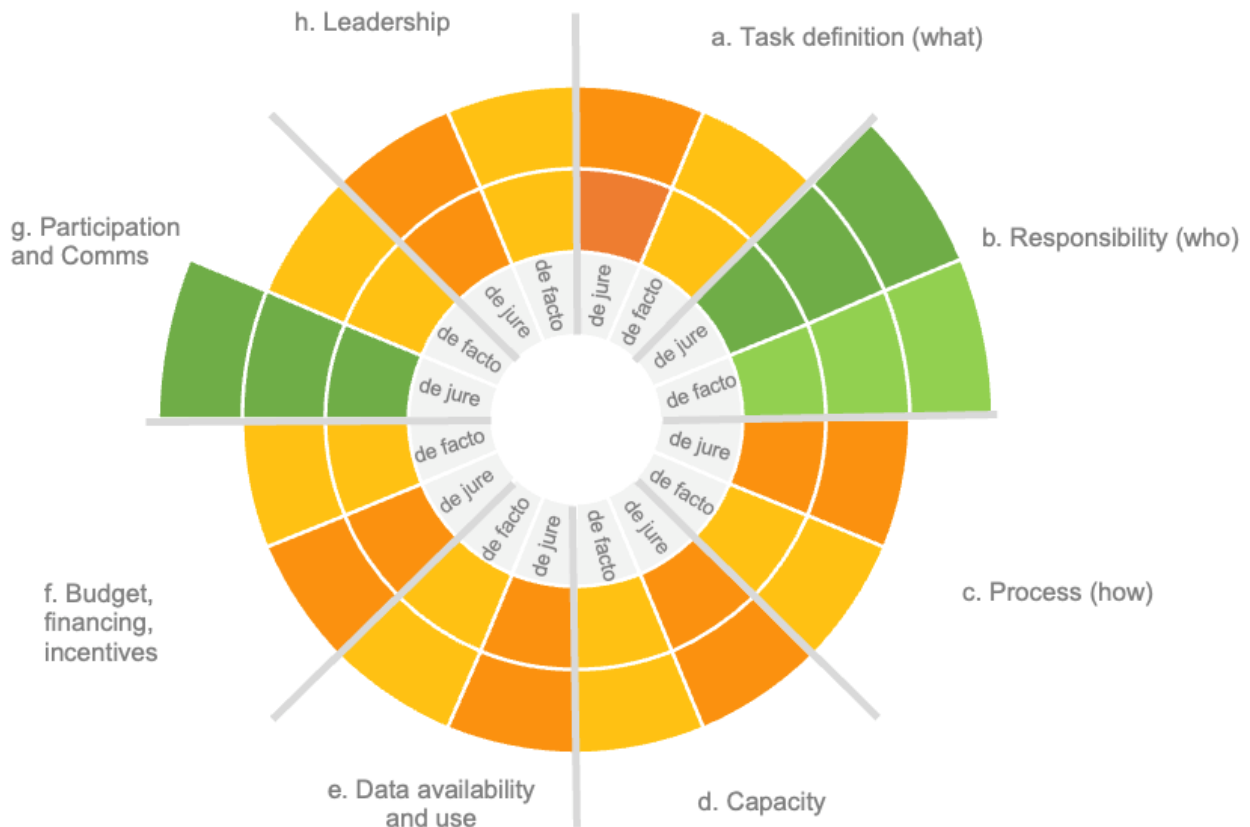
		proposed strategies on air quality. Sarajevo, along with few other cantons (including Tuzla and Zenica-Doboj) exhibits relatively more capacity than other cantons.		with only two people responsible for all air quality-related matters.
e. Information and data requirements, availability, and use	2	The FBiH-LEP stipulates the use of ‘data on the current state of the environment based on scientific experience and information’. There is no other, more specific guidance on what would be required to inform AQM-related components of the entity-level Environmental Strategy or the CEAP.	2	The FBiH Environmental Strategy 2022-2032 includes relevant analytical work. The previous Sarajevo CEAP 2021-2025 also referenced important air quality-related analysis. For the current CEAP, important AQM-related studies have been carried out as one-off efforts (ventilation corridors; source apportionment; geo-mapping of emission sources), although it is unclear how these have informed the selection of measures included in the CEAP 2021-2025.
f. Budget, financing, incentives	2	The development of the FBiH Environmental Strategy 2022-2032 and the CEAP should have been financed from the government’s budget. Government budget lines for the required analyses (e.g. periodic source apportionment studies; emission inventories) do not exist.	2	After the expiration of the previous Strategy (2008-2018), FMET did not start developing the new strategy until Swedish development partners offered support through the ESAP 2030+ project. Likewise, GCAP resources were used at the cantonal level to fund some - but not all - analytical tasks and the overall development of the strategic documents.
g. Communication and participation	3	Formally, the public should be consulted in the process of developing the FBiH Environmental Strategy and the CEAP. All comments received must be considered. A rationale must be provided for comments that are not taken into account.	2	The FBiH Environmental Strategy 2022-2032 indicates that ‘a communication strategy was devised and communication channels with the stakeholders and general public identified’, but it is unclear whether this was implemented. The draft Sarajevo CEAP was available for review and comment, but there was limited proactive communication about it, especially from the responsible institutions. However, stakeholders flagged that, even when documents are shared for public review and input, feedback is rarely received.

h. Leadership commitment and capacity	2	Air quality is formally recognized as a priority in several federal and cantonal strategy and policy documents (including the GCAP), but not consistently across all relevant sectors (including energy, housing, and transport).	2	Formal prioritization rarely translates into tangible, practical action for better AQM, whether in the form of strategic policy initiatives or public investments.
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Rating categories:

- 1: Non-existent or not functional
- 2: Partially existent / functional
- 3: Existent / fully functional

Figure 3: De jure and de facto scores for AQM function 1. Setting standards and objectives.



3.2 Determining required emission reductions

At the entity level, FMET is responsible for determining required emission reductions. The FBiH Environmental Strategy 2022–2032, developed as part of the ESAP 2030+ project, defines overall emission reduction goals for some pollutants, although the rationale and means to achieve the goals is unclear. For example, the strategy sets a short-term goal for reducing average annual PM₁₀ concentrations from 47 µg/m³ to 40 µg/m³ by 2025, which is the limit value set in the FBiH Law on Air Protection. However, it is unclear how the baseline value of 47 µg/m³ was calculated as a single value for FBiH. The measured annual average values of PM₁₀ from stations in FBiH have varied in recent years from as high as 80 µg/m³ at the Zenica-Tetovo station to as low as 19 µg/m³ at the Ivan Sedlo measurement station. Emission reduction objectives for other air pollutants are not defined despite highly problematic pollution peaks. For example, the measured annual concentration of SO₂ exceeds 110 µg/m³ at some stations in FBiH, and maximum daily averages even exceed 1,000 µg/m³. Other pollutants are recognized as carcinogenic or otherwise harmful for human health, like heavy metals or benzo(a)pyrene, are not even measured at the federal or cantonal levels, effectively limiting the government’s ability to determine the extent of the problem and the necessary emission reductions to improve air quality.

The emission reduction targets in the FBiH Strategy for Environmental Protection 2022–2032 do not cover all relevant sectors and areas, are based on estimated or missing data, and it is generally unclear whether the proposed reductions will be sufficient to achieve the federal air quality objectives. The strategy only factors in emissions from large plants, transport emissions, and emissions from household heating systems in the three cantons that have developed emission source registries. An analysis of total emissions and the contributions from different sectors is not provided. Most of the data used in the Federal Environmental Protection Strategy 2022-2032 is based on estimations, with large uncertainties, or data is missing. For example, the starting value for current emissions from residential heating is given as ‘large’. The emission reduction target for this source is set to a flat 50%. The baseline value for transport-related emissions is given as 1,102 tons of PM₁₀ in 2016, and the reduction goal is set to 30%. The baseline is likely to be a considerable underestimation, given that a recent study put the traffic-related emissions in Canton Sarajevo alone at 1,400 tons (Grundström, Maria et al. 2022).

Table 3: Priorities defined in the FBiH Federal Environmental Protection Strategy 2022-2032.

Priorities	Result indicator	Starting value	Target value
Reducing air pollution to levels that are safe for human health	The amount of pollutant emissions from large plants	In 2014, was stating: 142,550 tons of SO ₂ , 14,514 tons of nitrogen oxides (NO _x), 2,253 tons of solid particles	Until 1/1/2028 to: 6,702 tons of SO ₂ , 4,964 tons of NO _x , 496 tons of solid particles
	The degree of compliance of the plant with the Best Available Techniques	Low degree of plant compliance with Best Available Techniques	Alignment of all industrial plants with the best available techniques by 2032

	Percentage reduction of pollutant emissions from home fireplaces and service activities	Large emissions and the impact on air quality of home fireplaces and emissions from service activities	Reduction of emissions from home fireplaces and service activities by 50% by 2032 compared to the base year
	Percentage of district heating in the total heated area in buildings	The share of district heating in the total heated area in buildings is about 8%	Increasing the share of district heating in the total heated area in buildings to 15% by 2030
	Percentage reduction of emissions of pollutants from transport	Public and non-motorized transport is underdeveloped, the average age of vehicles is high, the emission of PM10 in 2016 was 1,101.8 tons.	Reduction of the emission of pollutants from transport by 30% by 2030 (including the re emission of dust from roads) compared to 2016.
Improvement of the air quality management system, which will serve to support strategic decision-making and inform citizens about air quality and emissions	Degree of citizens' awareness of air quality and emissions	The system of informing citizens about air quality and air pollutant emissions is insufficiently developed	A system of informing citizens in real and integrated time about air quality and missions from 2023 has been established.
	Functionality of the reporting system	There is no complete system of reporting on emissions of polluting substances and greenhouse gases and air quality according to international institutions	A system of reporting to international institutions on emissions and air quality until 2025 has been developed
	Degree of coverage of the territory of the Federation of Bosnia and Herzegovina by the network of measuring stations	22 stations for measuring air quality in 2019 in 10 cities/ municipalities, there are no measuring stations in some parts of the Federation of BiH	Coverage of the entire territory of the Federation of BiH with a network of stations by 2025

At the cantonal level, the cantonal government is required to prepare an Air Protection Plan as part of their CEAP for areas where measured air pollution levels exceed limit values for one or more pollutants, but there is no explicit requirement to calculate emission reduction goals, which therefore is not done.

The previous Sarajevo CEAP (2016-2021) included an analysis of total emissions, based on the last emission inventory that had been created in 2013 (see Table 4). The successor CEAP (2021-2025) that was developed through the GCAP did not re-analyze total emissions for the Canton. It also did not attempt to calculate the required emission reductions to achieve the canton’s and federal air quality objectives. Moreover, Sarajevo did not develop a separate Air Protection Plan but considered the contents of its CEAP to be sufficient, as discussed in section 4.1. Neither the CEAP nor the GCAP have assessed or defined the necessary emission reductions to achieve the set air quality standards and objectives. Moreover, it is unclear how the cantons are expected to align their CEAPs to the federal strategy. At the municipal level, there is currently no federal or cantonal legislation that would require municipalities to play an active role in determining their contribution to overall emissions and to set emission reduction targets.

Table 4: Register of pollutants for Canton Sarajevo, 2013 (Source: Sarajevo CEAP 2016-2021).

Sector	SO ₂ (t/year)	NO _x (t/year)	PM ₁₀ (t/year)
Residential	1,250	393	1,028
Industry	389	227	1,296
Traffic	15	2,935	220
Total	1,654	3,554	2,544

The limited availability of data, and varying levels of quality of the existing data and analyses, poses a significant obstacle to effective AQM at all levels in BiH, particularly at the federal and cantonal levels where air pollution problems must be solved. It is common international practice to determine the emission reductions required to achieve given air quality standards and objectives based on emission source inventories, apportionment studies, and dispersion modeling to understand the potential impacts of emission reductions from specific sources on local air quality and pollutant concentrations. The FBiH Law on Air protection requires FMET to publish a register of air pollution emission sources for the territory of the federation. Likewise, cantons are responsible for creating emission inventories for their territory. At the time of writing, only three cantons had developed their emission registers (Sarajevo, Tuzla, and Zenica-Doboj), while Una-Sana was in the process of developing its inventory. In short, there is no reliable data to calculate total sectoral emission or to estimate their contribution to overall air pollution. Unsurprisingly, the input parameters for dispersion modeling and for estimating the necessary emission reductions at the country, federal, and cantonal levels are therefore underestimated because of missing data, non-existent or incomplete emission source registers, and the dearth of apportionment analyses.

The lack of adequate air quality data and analysis is partly due to the fact that AQM is not defined as a cross-sectoral responsibility, and because of insufficient quality control. Sectors like housing, construction, transport, and energy play crucial roles in managing pollutant emissions. There are regulations with obvious and important impacts on air quality that are not strategically integrated into the AQM control and monitoring system, such as rules regarding permissible types and quality of fuels used for heating and transport, vehicle emission standards, and agricultural emissions. Moreover,

significant quality concerns exist regarding the data contained in existing emission inventories. Although all laboratories that measure pollutant concentrations and emissions are accredited in accordance with the general requirements for the competence of testing and calibration laboratories (ISO/IEC 17025), institutional control and quality assurance of their measurements is missing. The Institute for Accreditation of Bosnia and Herzegovina (BATA) only checks the laboratories' technical capabilities for measuring the pollutant parameters, but their ability to calculate results and report data in accordance with federal legislation is not monitored. There is no mechanism to sanction laboratories for reporting erroneous results or data for which there is no credible base. This can lead to situations whereby businesses that are legally required to report emissions can obtain unrealistically low pollutant measurements from laboratories of their choosing. Although a lab may be officially accredited, it can still supply measurement results that hide pollutant exceedances without quality control or consequences. The Sarajevo CEAP 2016-2021 situation analysis concludes that the emission register 'at the federal and cantonal level does not have quality and relevant data due to the following problems' (Government of Canton Sarajevo 2017): no functional legal framework that will enable timely and efficient control and verification of data on air pollutant emissions, no rulebook or other valid legal act that defines and harmonizes the methodologies for calculating emissions of air pollutants; and no education for all entities that participate in reporting to the register, among other issues.

Because of the limited availability of good quality emissions data, the required emission reductions are likely to be greater than currently acknowledged. The data underlying the cantonal policy and planning documents appears to underestimate air pollution emissions significantly. The Improvement of Air Quality and Air Quality Management in BiH (IMPAQ) project, supported by the Swedish Environmental Protection Agency, conducted a source apportionment study and dispersion modeling in Canton Sarajevo based on two measurement campaigns in the winter seasons of 2020-2021 and 2021-2022, and using new sets of emission data. The data is presented in Table 5 below (Grundström, Maria et al. 2022). It shows that the CEAP underestimates pollutant emissions by 14 to 36 percentage points. This Sarajevo CEAP 2016-2021 acknowledges that the emission inventory data at the time was 'incomplete because shown PM₁₀ emission in [Canton Sarajevo] is unrealistic. (...) It is obvious that the register of emissions for FBiH does not function because not all emission sources submit data to this register' (ibid). The IMPAQ project suggested that their calculations were done conservatively and are likely to still underestimate de facto air pollution emissions in Canton Sarajevo, indicating an even greater need for evidence-based emission reduction calculations.

Table 5: Total annual emission estimates for Canton Sarajevo (Source: IMPAQ project).

Sector	NO _x	SO ₂	PM ₁₀
Public Power	639.7	396.7	12.2
Other Stationary Combustion	326.3	617.1	1,689.8
Industrial combustion & processes*	89.6	911.4	431.8
Transboundary*	0	0	83.7

Transport	3,458.1	2.2	1,418.8
Waste*	102.5	6.1	325.3
Agriculture*	0	0	38.1
TOTAL estimation from IMPAQ	4,616	1,933	3,999
Estimation from CEAP 2016-2021	3,554	1,654	2,544
Difference of CEAP from IMPAQ (in %)	-23%	-14%	-36%

* Total emissions (t/year) of the main air pollutants for the Sarajevo model domain from local emission data set together with the CAMS regional emissions database.

To fill some of the gaps in emissions data and provide a strategic vision for AQM in the residential sector, the cantonal government worked with UNDP to develop a Strategy to Limit the Use of Coal and Other Solid Fuels 2023-2033. The strategy is planned to be adopted by the government and the cantonal assembly in 2023 (see Box 4, chapter 3.3 for details). In preparation of the strategy, a census of individual households was conducted, covering over 60,000 homes, of which around 45,000 were entered into an electronic, GIS-based emission inventory with detailed information on the type of fuel used, solid fuel consumption, type of stove or boiler, energy efficiency of the building, heated living space, among others. The total number of households using solid fuels in Canton Sarajevo Canton is estimated to be over 42,000, with nearly 80% of them using wood, 13% coal, and 7% wood pellets.

Based on this emission inventory for the residential sector, several scenarios for reducing air pollution emissions were created. The consensus result indicates that total emissions will need to be reduced by 90% in some zones to achieve the limit values for PM₁₀. This stands in stark contrast to the 50% emission reduction envisaged in the FBiH Federal Strategy for Environmental Protection. Given that the Strategy to Limit the Use of Coal and Other Solid Fuels 2023-2033 can be considered the most detailed data collection effort and analysis conducted in Canton Sarajevo to date, the 50% goal of the federal strategy appears to be a gross underestimation of what is required to achieve the established air quality standards and objectives. It must be noted that the scenarios did not take into account potential emission reductions from road traffic as the second largest source of PM emissions in Canton Sarajevo. The Canton has developed an urban mobility plan but does not have an overall strategy to manage traffic and air pollution from this emission source. The latter would be necessary for effective AQM in this area.

Building on the recently created emission inventory for the residential sector, Canton Sarajevo plans to establish a GIS-based register of all emission sources as the basis for tackling air pollution more comprehensively. The cantonal government recognizes that the existing inventories that were created in 2010 and 2013, respectively, are incomplete and contain some questionable measurement results. Important data points are missing entirely, including a register of public companies with additional information such as the number of employees, the classification of their main activities, and energy use, and spatial data for streets and house numbers, which makes more detailed inventory building challenging. The new, expanded inventory will map all sources and calculate their emissions using energy

consumption, process and emission factors, in accordance with international standards (ECE/EB.AIR/125) for all 16 pollutants regulated in the FBiH Law on Air protection and divided into ten sectors in line with the United Nations Economic Commission for Europe (UNECE) nomenclature for reporting. The cantonal government already signed a contract with UNDP to support the development of the comprehensive inventory that will include a publicly accessible online platform to share results with citizens and other interested parties. Work has begun and is expected to be completed at the beginning of 2024., providing a strong foundation for more comprehensive, strategic AQM that governs all critical sectors and emission sources.

Table 6: Functional Review summary table, function 2: Determining required emission reductions.

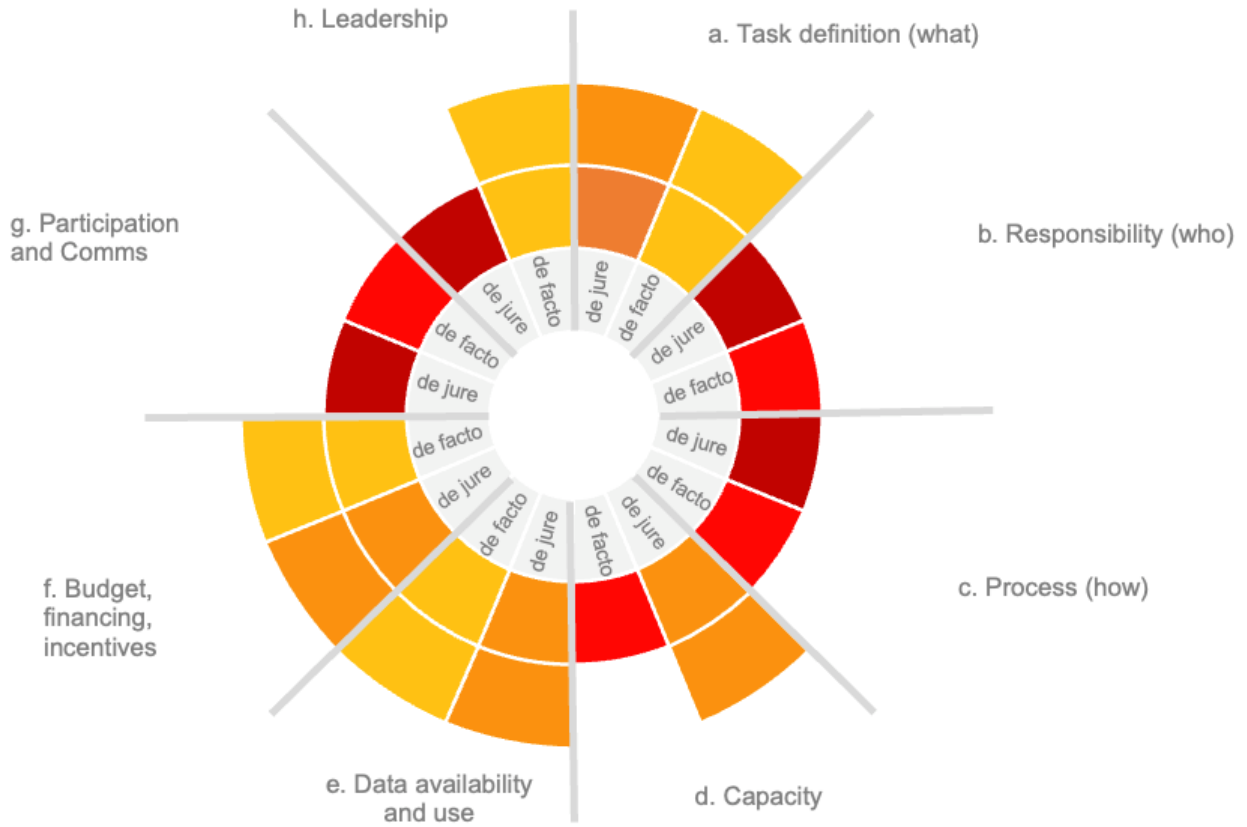
Review criteria		De jure		De facto
a. Functional task definition ('What')	2	FBiH Law on Air protection broadly describes the strategic objective of reducing emissions to achieve good air quality, but no functional task definition is provided.	2	In the absence of more specific requirements, cantonal practice is inconsistent. Required emission reductions are only partially defined, but the method of calculation is unclear and based on incomplete data.
b. Distribution of responsibilities ('who')	1	There is no legal provision that would assign responsibility for determining the required emission reductions.	1	The FBiH Environmental Strategy 2022-2032 indicates the required emission reductions for some pollutants, but it is unclear how these were determined.
c. Process management ('how')	1	Process guidance on determining required emission reductions does not exist.	1	The emission reduction calculations in the Sarajevo CEAP are incomplete and likely based on data that underestimate pollution emissions.
d. Capacity ('Are they able to do it?')	2	The cantonal ministry MCEEP formally has some technical capacity to estimate, or to commission and oversee the analysis to estimate required emission reductions.	1	The AQM-related function in MCEEP is understaffed. Development of the CEAP is outsourced to consultants. Quality assurance of deliverables does not yield satisfactory emission reduction estimates.
e. Information and data requirements, availability, and use	2	Federal and cantonal ministries are required to publish emission source inventories for their territories.	2	Some cantons, including Sarajevo, have published emission source inventories, but source apportionment analysis and dispersion modeling is incomplete or absent, and inventories are mostly incomplete or outdated.
f. Budget, financing, incentives	2	Budget requirements to create emission inventories or to conduct necessary analyses are mostly rough estimates	2	Most of the necessary work on creating and maintaining inventories and additional analyses are funded

		provided in the FBiH Environmental Strategy or the CEAP. If government funds area available, they are allocated accordingly.		from the cantonal budget. For example, the cantonal government has funded the creation of a new emission register with BAM 290,000. Some other activities, like the study on ventilation corridors or a source apportionment study, were financed through supporting projects and with the assistance from third parties, particularly when funds for these projects were not available in the government budget.
g. Communication and participation	1	Although it is common practice in FBiH and Canton Sarajevo to share draft strategies and policies publicly for comment before finalization, there is no requirement to determine required emission reductions and hence no communication and public engagement in this process.	1	Emission reduction targets were not proactively communicated, and neither was there a public debate about the measures that would be required to achieve them.
h. Leadership commitment and capacity	1	There is limited evidence of formal prioritization by political or administrative leaders of determining the required emission reductions to achieve air quality goals.	2	There is evidence of some leadership commitment towards this function as the ministry worked with the IMPAQ project to arrive at more realistic estimates of current annual pollutant emissions in Canton Sarajevo.

Rating categories:

- 1: Non-existent or not functional
- 2: Partially existent / functional
- 3: Existent / fully functional

Figure 4: De jure and de facto scores for AQM function 2: Determining required emission reductions.



3.3 Developing control strategies

The FBiH Environmental Strategy 2022-2032 identifies residential emissions and specific industrial facilities as the main causes of the prevalent air pollution and outlines four measures to control emissions and improve air quality. Based on an analysis of the major contributors to ambient air pollution, the strategy proposes four sets of interventions in the following action areas (Government of the FBiH 2022): reducing emissions from large combustion plants and achieving compliance of all industrial facilities with best available techniques; reducing air pollution from local sources; improvement of the air quality monitoring system; and developing the system for international reporting and coordination of efforts aimed at improving the public information system on air quality. For each measure, the Environmental Strategy provides a to-do list of ‘general areas of intervention’ with indicators to measure progress and an indicative budget amount (ibid, p. 268-277). The FMET is designated as the institution responsible for coordinating the implementation of all AQM-related measures. The implementing institutions are mentioned only in general terms (for example, ‘cantonal ministries’, or ‘universities’).

The FBiH Environmental Strategy outlines the most important air pollution control measures targeting local sources, including interventions to regulate fuel quality, energy efficient stoves and boilers, and better implementation oversight. The strategy calls for legislation to ban retail sales of coal with a total sulfur content of above 1% and aims to regulate the quality of fuelwood and pellets. The government is also tasked with introducing a ban on the sale of non-certified stoves or boilers and should design an incentive scheme to encourage households to replace solid fuel-based stoves and boilers with certified heating appliances using pellets, heat pumps, natural gas-based condensation boilers, or to get connected to the district heating system. Moreover, the Environmental Strategy suggests identifying a way to initiate inspections of household stoves and increased inspection control of the fuel market’. To this end, the Strategy to Limit the Use of Coal and Other Solid Fuels in Sarajevo Canton 2023-2033 proposes detailed regulatory changes to re-introduce chimney sweeps into the formal AQM system, as discussed below. Yet, the FBiH Environmental Strategy does not provide an indication to what extent the proposed initiatives will be sufficient to achieve the air quality standards and objectives defined in the FBiH Law on Air Protection.

It is questionable whether cantons will be able to implement the far-reaching changes that the FBiH Environmental Strategy demands given the absence of technical guidance, support, and accountability mechanisms for developing and implementing CEAPs. The purpose of a CEAP is ‘twofold, on the one hand, to consolidate, analyze and present structured data and assessment of the state of the environment in one place, and on the other hand, to provide a basis for planning and implementation of environmental protection measures’ (Government of Canton Sarajevo 2017). Sarajevo’s cantonal government sees the CEAP as ‘an implementation document of the FBiH Environmental Protection Strategy’ (Ibid.). However, not all cantons have the commitment or capacity to implement the strategic priorities of the FBiH. In fact, although the FBiH Law on Environmental Protection requires cantons to develop a CEAP, not all the cantons have developed a CEAP, even after 20 years of these laws having been in force. There are no consequences for not creating a plan. Moreover, section VIII of the FBiH-LEP on environmental protection

planning only sketches out the process and type of content to be included in a CEAP in the broadest terms. The law does not set quality criteria for the information to be presented in this strategic document, nor is there a quality assurance mechanism envisaged in the law. It is also unclear which type of analysis and evidence should underpin the CEAP.

The CEAP that is prepared by the cantonal government must be aligned to the entity's Environmental Strategy and should specify measures that will result in the required pollution reductions to achieve improvements in air quality, but neither the analytical prerequisites nor guidance or a functional quality control mechanism are in place. As discussed in the preceding chapter, reliable estimates on the required emission reductions do not exist because of limited emission inventory data, data quality issues, and the dearth of relevant analysis such as source apportionment. Yet, the design and choice of emission control actions requires an understanding of their air quality impacts and the likely health, social, and economic benefits and implications of each potential course of action across all relevant sectors. In the absence of the necessary information, the rationale for choosing one control strategy over another will inevitably remain vague, and it is unclear whether any proposed measures are likely to achieve the required – albeit unknown – emission reductions. Guidance on how to develop air pollution control measures to be included in the CEAP does not exist, as has been developed by several EU countries (Box 3), and a systematic quality review is not built into the process of developing the environmental action plan.

Box 3: Guidance and good practice examples for developing AQPs.

Several EU initiatives have developed comprehensive, practical guidance and good practice collections on AQP development. In an early example, the German environmental protection agency (UBA) worked with the government of Bulgaria to create a 'Guideline on Air Quality Plans' that is tailored to the local context (Lorentz and Müller 2016).

More comprehensively, a partnership of four EU member states and six cities compiled a 'Code of good practice for designing and implementing Air Quality Plans' which includes detailed methodologies and tools for elaborating an AQP, good practice examples, and a dedicated section to citizen awareness and participation in the development of the plan (Partnership on Air Quality 2019) also available on the EU's Futurium platform online.¹⁰

Relevant guidance includes:

- Why to develop an AQP: Compliance with EU legislation; health protection and other issues; additional benefits.
- Content: mandatory elements; suggested structure; integration with other plans and programs; strategic environmental assessment; and e-reporting formats.
- How to develop an AQP: Process steps; checklist; key factors.
- How to manage and implement an AQP: Citizen awareness; participatory approaches; funding opportunities; monitoring, reporting and reviewing.
- Methodologies and tools for elaborating an AQP.
- A toolkit on communicating on air quality and health.

¹⁰ <https://futurium.ec.europa.eu/it/urban-agenda/air-quality/news/partnership-air-quality-delivers-tools-help-cities-and-member-states-overcome-challenge-air>.

The UK Department for Environment, Food and Rural Affairs has also compiled a list of six good practice examples of adopted Air Quality Action Plans from across the country (UK Department for Environment 2024).

Ministries have limited capacity to oversee and ensure the quality of the CEAP development process, which is outsourced to third parties, a practice which introduces further quality constraints. The development of federal and cantonal environmental protection plans is typically tendered to external consultants, not least because the cantonal governments have only a small number of staff working on environmental protection. The absence of process and content guidelines has at least two adverse implications. First, it is difficult to ensure that the bidding companies have adequate technical capacity; the Law on Public Procurement makes it difficult to insist on relevant references and proof of competence since bidders can stall the entire tendering process by lodging procedural complaints. Second, the lack of guidance makes it challenging to ascertain consistency between federal and among cantonal plans.

The previous CEAP for Canton Sarajevo, covering the period 2016-2021, was based on a detailed analysis of the available data at the time, however incomplete, and outlined an action plan with 22 measures to control emissions and strengthen the AQM system. The CEAP prioritized foundational activities that should shape air quality control mechanisms in the canton, for example, by establishing the Air Quality Center in MCEEP, conducting important studies, and commissioning the development of pivotal strategic documents. The CEAP scheduled the development of a methodology for the evaluation of spatial air quality changes using dispersion modeling, a source apportionment study, an analysis of urban ventilation corridors, the creation of a GIS-based register of emission sources, and stipulated the design of a Strategy to Limit the Use of Coal and Other Solid Fuels in Canton Sarajevo 2023-2033, which was eventually done in the successor CEAP for the period 2021-2025.

In 2021, the CEAP 2016-2021 action plan table was revised, amended, and adopted as the new Sarajevo CEAP 2021-2025, with resources and inputs from the Green Cantonal Action Plan (GCAP) development process. Sarajevo had joined the Green Cities program of the European Bank for Reconstruction and Development (EBRD) in 2018, along with four other cities in BiH: Banja Luka, Brčko District, Mostar, and Zenica. The program's three core components are the development of a GCAP, sustainable infrastructure investment, and capacity development. The GCAP methodology lets cities identify environmental priorities, define a strategic vision, specific objectives, and to form a set of investments to reach the objectives. The process to develop Sarajevo's GCAP was designed to build on the CEAP 2016-2021 and to update the action plan matrix for the 2021-2025 period. The intention was to ensure that the CEAP would meet the requirements of the FBiH Law on Environmental Protection, and to incorporate specific elements from the GCAP for which funding would then be already secured through the EBRD Green Cities program. One of the strategic objectives of the Sarajevo GCAP is to improve air quality in accordance with EU standards. It sets aspirational limit values for two air pollutants by 2030: an average annual concentration of PM₁₀ of not more than 30 µg/m³ (the proposed EU limit value is 20 µg/m³), and less than 20 µg/m³ average annual concentration of SO₂ (same as the proposed EU limit value). Moreover, the energy consumption of residential buildings using fossil fuels for heating is to be brought down from 101 kWh/m² (2018 baseline) to less than 96 kWh/m² by 2030. These goals are broadly aligned with the strategic goals

articulated in the FBiH Environmental Strategy 2022-2032, even though the GCAP only touches on a small subset of the ambitious air quality-related measures that are proposed in the Strategy.

The CEAP 2021-2025 merely consists of a 16-page table which updates the action plan matrix from the previous period. It includes 31 measures related to AQM, organized into three strategic objectives: Limitation of SO₂ and dust emissions, air quality management, and improvement of energy efficiency and use. There is no analysis or indication to what extent the activities are necessary or sufficient to improve air quality and to meet the pollutant limit values as defined in the FBiH Law on Air Protection. The Sarajevo CEAP 2016-2021 also presented a detailed situation and causal analysis for air pollution and limit value exceedances which was not revisited or updated for the current action plan update. Each CEAP measure is presented with a one-sentence description. The only details provided are an indication of who is responsible for the activity's implementation, the indicative amount of financing needed, the source of funds, a success indicator, a short description of potential obstacles, and the means to overcome them.

The current CEAP for Canton Sarajevo outlines critical activities that will ultimately contribute to better air quality, but it does not tackle residential emissions, except through a small-scale pilot to subsidize stove replacements in individual households. It is striking that emissions from residential sources, one of the most important causes of air pollution in the winter months, are not addressed at all, aside from an activity to create a residential building rehabilitation program to improve energy efficiency and the small-scale pilot to subsidize stove replacements that will be discussed in more detail in chapter 3.4. The CEAP 2021-2025 does not identify emission sources comprehensively. Source apportionment analysis is not conducted, and the necessary emission reductions to achieve improvements in air quality are not assessed. Necessary changes in the institutional and regulatory framework to achieve air quality goals are neither analyzed nor proposed.

Several initiatives with potentially tangible positive effects on air quality are included in the CEAP thanks to the linkage with the GCAP process. The GCAP provided Sarajevo with access to EBRD funding for capital investments in local public transport that promise to have air quality benefits by reducing traffic emissions: rehabilitation and extension of tram lines, and the purchasing of new trams and trolley buses. Also, a key study for AQM that was conducted as part of the GCAP development was the 'Study on Urban Ventilation Corridors and Impact of High-rise Buildings'¹¹ to identify areas and corridors where the construction of high-rise buildings should be restricted to enable natural wind ventilation corridors across the Sarajevo basin to improve air flow and quality. The study was endorsed by the Cantonal Assembly and stopped building projects that could have a negative impact on clean air flow throughout Sarajevo. While the study did not improve air quality per se, it stopped further blockages of ventilation corridors.

However, integrating the development of the CEAP with the GCAP process also created incentives to prioritize infrastructure investments over strategic AQM policy initiatives, with the exception of the new Strategy to Limit the Use of Coal and Other Solid Fuels in Canton Sarajevo 2023-2033. The primary goal of the CEAP with respect to air quality in Canton Sarajevo should be the reduction of pollutant

¹¹ https://ebrdgreencities.com/assets/Uploads/PDF/EBRD_GCAP_Study-of-urban-ventilation-corridors-V23_Final.pdf.

emissions. The main goal of the GCAP is to support sustainable infrastructure investment through facilitating and stimulating public or private green investments in water and wastewater, urban transport, district heating, energy efficiency in buildings, solid waste management, and other interventions that improve the city's adaptation and resilience to climate shocks. The CEAP and GCAP goals are complementary, but the proposed GCAP measures do not directly target the emission source with the greatest impact on ground level air quality, which are emissions from individual households that use solid fuels for heating. Moreover, the GCAP projects to rehabilitate and improve public transport will only partly reduce emissions from traffic, but will not tackle other traffic-related pollution issues, such as the existing problems with vehicle eco-tests, poor conditions or absence of filtration systems in older vehicles, the large fleet of aging diesel vehicles, and the poor quality of fuels. Neither the GCAP nor the CEAP include strategic, policy or institutional analyses or initiatives that would address the management of air pollution holistically. The CEAP contains one notable exception: it envisages the development of a 'Strategy to Limit the Use of Coal and Other Solid Fuels in Canton Sarajevo 2023-2033'. The draft of this strategy yields significant potential to reduce air pollution from residential sources, if adopted and implemented.

Box 4: Strategy to limit the use of coal and other solid fuels in Sarajevo Canton, 2023-2033.

The preparation of the strategy is one of the most promising air pollution control measures developed as part of the CEAP 2021-2025. A draft was available for review at the time of writing this report.

The strategy is based on an in-depth analysis of the current air pollution situation in Canton Sarajevo and the recently created emission inventory of over 45,000 individual households. It proposes concrete steps to reduce emissions from residential sources with organizational, spatial planning, and energy efficiency measures, taking into account the socio-economic profiles of the affected households. The strategy models the air quality effects of these measures in three different scenarios.

The analysis presented in the study identifies nine priority zones in the canton which register the highest emissions of solid particles from household stoves and boilers, and which have the greatest air quality impact on the rest of Canton Sarajevo. The current estimated annual emissions are 661 tons of PM₁₀ and 238 tons of SO₂ in priority zones, and a total of 1,498 tons of PM₁₀ and 557 tons of SO₂ overall. The three scenarios target the nine priority zones. All scenarios assume that a district heating system will be established in Stup II, a neighborhood near the Sarajevo airport. Scenario 2 was rated to be the optimal case for implementation based on effectiveness, efficiency, and feasibility criteria.

- **Scenario 1: The use of coal and firewood in priority zones will be reduced by 50% by 2032.**
 - Installation of a gas central heating system in 8,174 individual residential buildings.
 - Installation of pellet central heating systems in 722 individual residential buildings within priority zones.
 - Energy efficiency measures in all 9,059 prioritized buildings.
 - Total cost over ten years: BAM 222 million (USD 125 million)
 - Estimated emission reductions:
 - SO₂: 53% (reduction of 113 tons)
 - PM: 47% (reduction of 295 ton)
- **Scenario 2: The use of coal and firewood in priority zones will be banned by 2032.**
 - Installation of a gas central heating system in 15,343 individual residential buildings.

- Installation of pellet central heating systems in 2,149 individual residential buildings.
- Energy efficiency measures in all 18,081 prioritized buildings.
- Total cost over ten years: BAM 366 million (USD 206 million)
- Estimated emission reductions:
 - SO₂: 98% (reduction of 209 tons)
 - PM: 97% (reduction of 607 tons)
- **Scenario 3: By 2032, a complete ban on all types of solid fuel will be implemented in the priority zones.**
 - Installation of a gas central heating system in 18,081 individual residential buildings.
 - Energy efficiency measures in all prioritized buildings.
 - Total cost over ten years: BAM 371 million (USD 209 million)
 - Estimated emission reductions:
 - SO₂: 100% (reduction of 238 tons)
 - PM: 100% (reduction of 661 tons)

The strategy also proposes a range of detailed legal and organizational changes to monitor and control residential emissions, heating/cooking installations, and fuel quality. The document recommends reintroducing chimney sweeps into the AQM system because they can play a crucial role in local-level advisory, monitoring, and supporting enforcement, as discussed in chapter 3.5 on monitoring and enforcing compliance.

The CEAP includes an indicative financial framework, providing a cost estimate for each measure as well as the suggested source of funds. The total funding need is estimated around BAM 400 million (approx. USD 225 million) for the five-year implementation period. About half of this amount is earmarked for investments in public transport and for infrastructure projects. Financing is mostly expected to come from different cantonal ministries, but also municipalities for some activities. Capital investments are planned to be resourced through the canton and municipalities, through credit arrangements, and public-private partnerships. However, it is clear that the budgetary resources of Canton Sarajevo are limited, and implementation might be uncertain for lower-priority measures. The CEAP does not yet include a budget estimate for activities related to reducing emissions from residential sources and industry. It is indicated that these financial needs will be appraised once the emission inventory is updated. Generally, it is unrealistic to expect that the Cantonal budget can finance the necessary structural projects or large investments that are required to achieve satisfactory levels of air quality, such as the expansion of the district heating system, subsidies for incentivizing the replacement of household heating systems, and energy efficiency measures for individual households.

The public can theoretically participate in the development of air quality control strategies by submitting feedback, but a strategic approach to public communication and information on AQM does not exist. The draft CEAP is usually published on the ministry's website where comments and suggestions from the public are accepted for a period of 30 days. However, feedback from the public, experts and non-governmental organizations (NGOs) is said not to be forthcoming, likely owing to the technical nature of the subject matter. Dedicated information sharing sessions for non-technical audiences or media campaigns targeting the public or specific population groups in air pollution hot spots could lead to greater participation in AQM.

The FBiH Federal Law on Air Protection requires cantons to develop separate air quality action plans for zones where limit values are exceeded, which Sarajevo plans to do after updating its emission inventories. Based on air quality monitoring results in Canton Sarajevo, limit values are exceeded at most measurement stations. The cantonal government has budgeted funds for the development of the specific air quality action plans in the second half of 2023 because it wants to build on the new and expanded emission inventory for which data is already being collected. As with the CEAP, detailed guidance on the process and content of the new action plans does not exist, and there is no systematic quality assurance system. Therefore, it remains to be seen how constructive these plans will be.

For some cantons, developing air quality action plans is more complicated because an outdated definition of air quality zones requires cantons with significantly different air pollution problems to develop a common AQM response. Air quality zones and agglomerations should be defined based on the assessment thresholds for the measured ambient concentrations of SO₂, NO₂ or NO_x, particulate matter (PM₁₀, PM_{2.5}), lead (Pb), benzene (C₆H₆), or carbon monoxide (CO). The Federation of Bosnia and Herzegovina has been divided in four zones (Figure 5): Canton Sarajevo (Zone 1), Zenica-Doboj and Central Bosnia Cantons (Zone 2), Tuzla and Posavina Cantons (Zone 3), and Una-Sana, Canton 10, West Hercegovina, Hercegovina-Neretva and Bosnian Podrinje Cantons (Zone 4). The different climatic and geographic features, sources of emissions and different pollutant concentrations of the different cantons pose distinct air quality challenges that require different AQM responses, but the common zones require the cantons to approach their different air quality problems with the same action plan. This adds an unnecessary layer of complexity, especially because measuring stations now exist in all cantons and would allow the re-definition of zones according to cantonal boundaries or agglomerations within cantons. However, although the air quality monitoring network has been expanded in past years, continuous monitoring of lead and benzene concentrations have not yet been established in the FBiH.

Figure 5: Air quality zones in the Federation of Bosnia and Herzegovina



Source: FHMI 2023.

A cantonal government can also adopt a short-term Intervention Plan to prevent or address episodes of extreme air pollution or smog, as outlined in chapter 2. The short-term Intervention Plan of Canton Sarajevo has defined two thresholds for air pollution: Warning and alarm levels. The main conditions for triggering the thresholds are the measured values for SO₂, NO_x, CO, O₃, PM₁₀, and expected meteorological conditions (see Annex 2 for details). Although road traffic and transport are significant sources of air pollution and measures that can reduce these emissions can be triggered effectively and quickly in the short term, the Intervention Plan measures to control traffic emissions are not implemented consistently.

The design of the environmental permit system provides another opportunity to control air pollution emissions. However, the new FBiH Law on Environmental Protection will introduce changes with potentially negative consequences for AQM. By raising permit thresholds, smaller pollution sources are left beyond supervision. The federal and cantonal thresholds for facilities that need to obtain environmental permits are proposed to be increased significantly. This means that a large number of plants will remain de facto without any supervision. For example, for combustion plants, the threshold for

federal environmental permits is raised from 50 MWth to 100 MWth, while the threshold for cantonal environmental permits was set to 10-100 MWth. Any plants of under 10 MWth capacity, regardless of the type of fuel, are not required to produce an emission control plan. This leaves inspectors without any possibility for supervising their activities, irrespective of their potentially damaging air quality impacts. Similar changes are proposed for other industry sources where the prescribed thresholds are set based on yearly production capacities and the covered areas of operation, among others. Smaller combustion facilities and industry sources should be controlled through the process of issuing building permits and through lower-level technical inspections. However, at the cantonal and municipal levels, there is no legal basis for these inspections to control facilities after they have been built and once they already have a permit to operate. Therefore, air quality standards and objectives are of purely theoretical value at this level.

Table 7: Functional Review summary table, function 3: Developing control strategies.

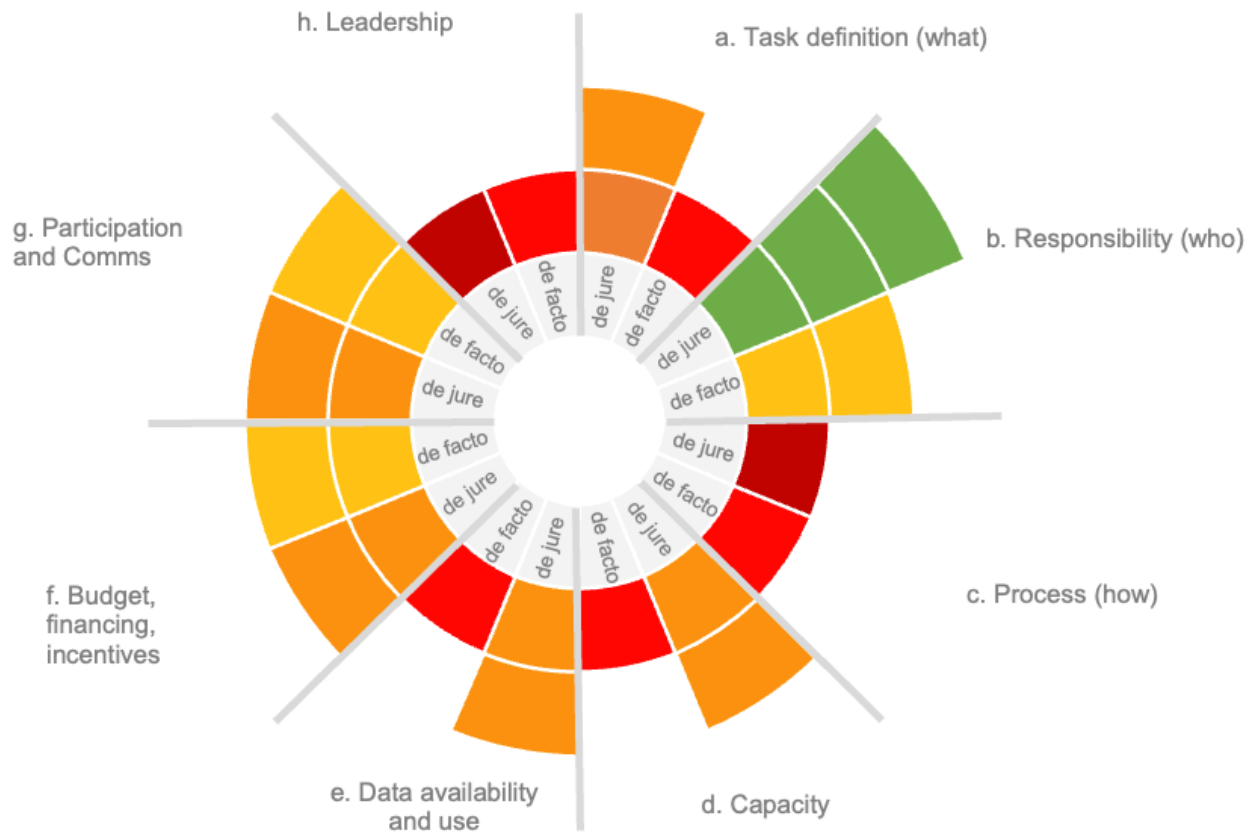
Review criteria		De jure		De facto
a. Functional task definition ('What')	2	FBiH Law on Air protection broadly describes the need to develop an action plan to control air pollution.	1	In the absence of more specific guidance and no quality assurance mechanism, it is unclear how the control measures are designed and prioritized, and whether they are likely to have the desired air pollution reduction effect.
b. Distribution of responsibilities ('who')	3	The cantonal government, and specifically MCEEP, is responsible for developing the CEAP.	2	The assigned responsibility is understood but only partially followed. The development of the CEAP is outsourced to consultants but not always consistently monitored for quality
c. Process management ('how')	1	Detailed guidelines on how to design, prioritize, and assess air pollution control measures do not exist.	1	In the absence of the prerequisite analysis of needed emission reductions and expected impacts of the proposed measures, it is unclear how CEAP actions are prioritized and what effect they will have.
d. Capacity ('Are they able to do it?')	2	The cantonal ministry MCEEP has some technical capacity to develop, or to commission and oversee the development of the CEAP.	1	The AQM-related function in MCEEP is understaffed. Development of the CEAP is outsourced to consultants. The quality assurance of deliverables is not always consistent and does not always yield a results-oriented selection of high-impact AQM actions.
e. Information and data requirements, availability,	2	Federal and cantonal ministries are required to publish emission source	1	It is not entirely evident how data and analysis have informed the selection of

and use		inventories for their territories which must inform the selection of proposed control strategies.		control strategies in the Sarajevo CEAP, but it is important to note that the comprehensive emission inventory which is being developed should enable more evidence-based action planning in the future.
f. Budget, financing, incentives	2	The development of the CEAP should be funded by the Cantonal government. It is unclear whether there is dedicated funding to generate the data and analysis required to develop an evidence-based CEAP. Incentive schemes, for example, for switching to cleaner heating technologies or fuels, do not exist.	2	The current CEAP was updated using resources from the GCAP project. A subsidy scheme to encourage households to switch to cleaner heating equipment and fuels was piloted successfully.
g. Communication and participation	2	For all Environmental Protection Strategies and Action Plans, according to Art. 45., public participation has to be ensured in the environmental protection planning process at the cantonal level and at the level of the Federation of Bosnia and Herzegovina. This happens in the form of making the respective document publicly available via the internet for comment for 30 days.	2	The public is consulted during the CEAP development process and can provide inputs. However, overall public awareness of the relevance and opportunity to participate in the process is limited and would require a dedicated communication strategy by the responsible ministry. Even then, AQM remains a technical subject matter. It will be difficult for the wider public to provide feedback unless the consultation process is tailored to non-technical audiences.
h. Leadership commitment and capacity	1	There was no formal leadership commitment to develop control strategies. FBiH was without an Environmental Strategy between 2018 and 2022 when the strategy was finally developed with support from the Swedish embassy and the ESAP 2030+ project.	1	Statements by selected political figures about the general importance of environmental protection surface intermittently in the media, but political parties do not prioritize AQM, and there does not appear to be recognition of the necessity to develop and implement comprehensive strategies, CEAPs or AQP.

Rating categories:

- 1: Non-existent or not functional
- 2: Partially existent / functional
- 3: Existent / fully functional

Figure 6: De jure and de facto scores for AQM function 3. Developing control strategies.



3.4 Implementing control strategies

The responsibility for implementing the 31 time-bound, AQM-related measures of the Sarajevo CEAP 2021-2025 are distributed across the cantonal government, its line ministries, the City of Sarajevo, specific city institutions, and the municipalities. Responsibilities are assigned for each measure separately, instead of a holistic and strategic approach to AQM that links the local to the cantonal and national levels. The cantonal ministries with most implementation tasks are MCEEP, the Ministry of Transport, and the Ministry of Economy. The cantonal institutions involved are the Public Health Institute, the Institute for Development Planning, the publicly owned transport company (KJKP Gras), and the publicly-owned parks company (KJKP Park). For each AQM measure, the CEAP describes the timeline, estimated budget amount, source of funding, success indicators, potential obstacles, and actions to overcome them.

The implementation of the CEAP 2021-2025 appears to be broadly on track. While many AQM-related activities in the CEAP are not designed to control air pollution per se, the execution of the CEAP constitutes progress on important preparatory work that will enable more effective AQM in the future. At the time of writing, the majority of the CEAP measures had either been completed or were in process of implementation. The cantonal government and the cantonal assembly review the progress on CEAP implementation regularly. Large investments have already been made in the public transport system with funding from GCAP/EBRD, including the purchasing of new electric trams and trolleybuses, rehabilitation of tram lines, and other preparation activities for the expansion of tram and trolleybus lines. An apportionment study was conducted. The Strategy to Limit the Use of Coal and Other Solid Fuels in Canton Sarajevo 2023-2033 was developed; an emission inventory was created; and an expanded air quality action plan is being designed. The CEAP also envisages the development of an Energy Development Study for Canton Sarajevo which has not yet been undertaken but which would provide important analytical work, including on the current energy needs of the canton, projections of future energy demand, available energy sources, and the environmental impacts of different energy mixes. This is particularly important given that Canton Sarajevo is largely dependent on imported national gas, and the current plans to reduce PM and SO₂ emissions will rely on gas-fired district heating and gas-fired central heating upgrades for individual households.

The overall capacity of the cantonal government and administration to implement air pollution control strategies is constrained by limited staff and technical expertise. The cantonal government did not assess the existing capacities of the ministries and institutions responsible for implementing the CEAP measures, let alone their ability to manage air quality more holistically. Table 8 shows that the number of people dedicated to air quality issues is low across the institutions and agencies of the cantonal government. Looking forward, the main activities proposed in the Strategy to Limit the Use of Coal and Other Solid Fuels in Canton Sarajevo 2023-2033 will require capacities that are currently extremely constrained or non-existent in the cantonal administration, particularly for designing the details of a subsidy program for individual households, regulating and controlling fuel quality and use, and the re-introduction of chimney sweep services which is meant to advise, and to monitor implementation and compliance.

Table 8: Overview of institutions with important AQM roles and their staff in Canton Sarajevo.

Institution	Current number of employees involved in AQM	Full time on air quality issues?	Responsibilities
Ministry of Environment and Tourism, Federation of Bosnia and Herzegovina	4	No	Environmental permits for large polluters, legislation, transposition of EU directives for AQ, federal strategies, etc.
Center for Air Quality, Canton Sarajevo	2	Yes	Overall AQM
Ministry of Communal Economy, Infrastructure, Spatial Planning, Construction and Environmental Protection of Canton Sarajevo (MCEEP)	5 (1)	No	Environmental permits
Public Health Institute of Canton Sarajevo	2	Yes (1) No (1)	Monitoring of air quality
Environmental Inspection of Canton Sarajevo	1	No	Inspections
Institute for Planning of Development of Canton Sarajevo	2	No	Air quality modeling, expert opinions
Federal Hydrometeorological Institute (FHMI)	3	Yes	Monitoring of AQ (2); Laboratory (1)
Municipalities in Canton Sarajevo	1 per municipality	No	Limited to issuing building permits

The full-scale implementation of the Strategy to Limit the Use of Coal and Other Solid Fuels in Canton Sarajevo 2023-2033 is urgently needed. Otherwise, the residential sector remains effectively excluded from AQM governance, a major missed opportunity for improving air quality in Canton Sarajevo. Household heating and cooking are among the biggest contributors to ambient air pollution with particulate matter in Canton Sarajevo. Yet, the residential sector is mostly unregulated regarding the types of stoves and boilers used, the type and quality of fuel used, and the resulting pollutant emissions. Even if emissions from households were regulated, a local-level layer for advising citizens on their air-quality related roles and responsibilities, monitoring, and enforcement of rules is practically absent. One of the biggest obstacles in implementing the Strategy is considered to be the large number of illegally built individual houses that do not have building or use permits. Considering that public funds will be used for subsidies for stove and boiler replacements in individual households, there is a legal concern about whether public funds can be used on objects that do not have a legal status. Moreover, current legislation

does not allow connecting illegally built houses to the natural gas network. Therefore, the Strategy includes a recommendation regarding the expected process to legalize the illegally built houses: As a precondition for receiving any future building permits, all structures must install natural gas heating, or certified boilers where a connection to the gas network is not available.

In other countries, including many EU member states, chimney sweeps or eco-advisers fulfill this important function of connecting homeowners and residents to the AQM governance system. In some contexts, the roles of chimney sweeps and eco-advisers are carried out by the same professional, while in other jurisdictions they are separate occupations (Box 5). The opportunities for re-introducing chimney sweeps in Canton Sarajevo are discussed in more detail in the next chapter.

Box 5: Strengthening local-level capacity for AQM and citizen-oriented advisory services: Air Quality Managers in Slovakia and Eco-Managers in Poland.

Slovakia and Poland's Małopolska region both used funding from the EU's LIFE program to strengthen AQM at local level. The LIFE Program is the EU's funding instrument for the environment and climate action.

Air Quality Managers in Slovakia

In early 2021, the EC referred Slovakia to the Court of Justice of the EU because of poor AQM, evidenced by sustained high levels of PM₁₀ pollution. To manage air quality better, the Ministry of Environment successfully applied for EU funding to set up the LIFE-IP SK Air Quality Improvement project. The total funding volume of EUR 15 million includes an EU contribution of EUR 9 million for the 2020–2027 implementation period (European Commission 2024a).

The project established Air Quality Managers as a key pillar for effective AQM. A total of 14 positions were established to cover the entire territory of the country. Air Quality Managers operate within the eight territorial units of self-governing regions and cooperate directly with municipalities, prioritizing settlements where air pollution from residential emissions is particularly prevalent.

Air Quality Managers coordinate and work to improve AQM measures directly with the most affected municipalities. Their tasks include the following:

- Propose measures to improve regional air quality in cooperation with state institutions, self-government, the industry, educational system, NGOs and the public;
- Provide direct assistance to regional and local authorities in implementing AQPs;
- Monitor the implementation of individual measures included in local AQPs and report to the competent government authority;
- Share information on funding opportunities from national and EU funds, and prepare projects and grant applications for AQM;
- Design and run public information and awareness raising campaigns, educational programs, including on social media, to advise citizens on concrete means for reducing pollution and improving air quality (Populair 2024).

Eco-Managers in Poland's Małopolska region

The region of Małopolska is home to Poland's second largest city, Krakow, and a major coal producer. Coal is also a popular energy source for residential heating, along with other low-quality solid fuels. Combustion in obsolete

boilers has contributed significantly to air pollution, making it one of the EU's most polluted regions in terms of PM₁₀ pollution.

Małopolska started implementing the LIFE project 'Małopolska in a healthy atmosphere' already in 2015, with a total funding volume of EUR 16.5 million – including an EU contribution of nearly EUR 10 million – until 2025 (European Commission 2024b). Based on a consultative process involving all 90 municipalities in the region with AQP implementation responsibilities, the regional government developed the concept of Eco-Managers as a pivotal instrument for strengthening local AQM (Deloitte 2015).

Eco-Managers have been employed in 55 municipalities benefiting from the EU LIFE program. They undergo a one-year university course on AQM specifically designed to prepare them for their roles in municipalities. Their tasks include the following:

- Provide AQM advisory and administrative services to residents;
- Encourage citizens to replace old boilers with clean, energy efficient devices and to undertake thermal modernization of their homes;
- Conduct environmental education in schools and for the general public, promoting environmentally friendly behavior;
- Control compliance with AQM regulations;
- Support municipalities in obtaining funds from the EU and national sources to implement air quality control measures.

The regional government reports that, to date, eco-managers have held nearly 1.4 million advisory consultations with citizens, conducted 28,000 inspections of suspected incidents of waste burning (which is illegal in Małopolska), and prepared projects worth EUR 97 million in co-financing, thereby more than compensating the cost of maintaining the Eco-Manager positions.

Overall, municipalities that employ Eco-Managers are perceived to be more effective in implementing AQP measures than those not benefiting from their advisory support and outreach activities.

In 2021, Canton Sarajevo implemented a pilot scheme to subsidize the replacement of coal and other solid-fuel-fired stoves and boilers in individual households, to reduce emissions from residential sources and test whether an incentive program would work at scale (see Box 6 for details). The subsidy pilot was designed and rolled out with support from the United Nations Development Programme (UNDP) and the Swedish International Development Cooperation Agency (Sida), together with funds from the cantonal budget. It appears to emerge that there is considerable interest from homeowners to make use of opportunities for switching to cleaner and more efficient heating technologies. Moreover, the breadth and depth of the market for certified boilers, stoves, and the associated service providers in BiH may require further analysis and strengthening. Likewise, there appears to be room to enhance the design of the administration of the subsidy scheme to make it leaner, more efficient, and possibly decentralized, or to assign a more active role to the private sector in supporting citizens in the application process and in handling the financial transactions.

Box 6: Pilot project to subsidize the replacement of solid-fuel stoves and boilers in Canton Sarajevo.

The objective of the subsidy pilot was to incentivize households in Canton Sarajevo to replace existing solid-fuel stoves and boilers which use inefficient technology and cause high emissions of air pollutants, especially SO₂ and

PM. The goal was to encourage the installation of certified pellet stoves or boilers, or the adoption of electric air-to-water heat pumps.

Planned subsidy amounts:

- **For certified pellet stoves or boilers:** Up to BAM 5,000 (USD 2,800) per user or a maximum of 70% of the total investment cost including planning.
- **For electric air-to-water heat pumps:** Up to BAM 7,000 (USD 3,900) per user or a maximum of 40% of the total investment cost.

The project issued a public call to identify qualified manufacturers and distributors of certified stoves, boilers, and heat pumps.

A total of 2,515 households applied for participation in the pilot project through a public call for applications, open from January 4 to February 15, 2021. After a review of all applications and inquiries, it was determined that 998 applications were complete. The largest number of incomplete applications did not have a building permit for a residential building, or their residential building was not registered in the land registry.

Each submission was rated based on three criteria: the current type of fuel used; the available household living space; and the level of air pollution in the geographic location of the house.

The pilot project was implemented in two phases:

Phase I:

- 104 first-ranked applicants (77 boilers/pellet stoves and 27 heat pumps) were invited to submit a stove or boiler replacement project (outlining the equipment and construction requirements and costs) in accordance with the instructions sent to each of these applicants by mail.
- Of the mentioned number, 61 users initiated implementation with the submission of the project documentation and the payment of 30 percent of the total cost of replacing the furnace/boiler. The remaining 70 percent of the costs were financed by the project.
- The average amount paid by users was BAM 1,734 (USD 970). The average amount subsidized by UNDP was BAM 4,811 (USD 2,690).
- The procurement and installation of the equipment was carried out by a company selected through the UNDP procurement system.
- The installation of heat pumps was not implemented in any of the selected households because not a single applicant for the purchase and installation of a heat pump submitted a project.

Phase II:

- Following a review of the subsidy and process model applied in phase I, the operating model of the pilot project was changed with the aim of reducing costs for end users. This was achieved by expanding the range of eligible companies authorized to install the subsidized equipment, taking advantage of a broader offer and increased competition. In this way, it is possible to replace a larger number of stoves and boilers.
- In this phase, the next 324 applicants from the ranked list of applications were invited to proceed with project submissions (309 for pellet stoves/boilers and 15 for heat pumps).

- UNDP managed the procurement of furnaces/boilers, circulation pumps and expansion vessels. The end users were obliged to provide the rest of the equipment and installations, as well as the selection of contractors and installation according to the scope of works.
- In this way, the average cost for end users was reduced to BAM 956 (USD 535), which is about 45% less compared to the first phase (without the cost of design which was included in the user's costs in the first phase).
- The average subsidy per household borne by UNDP was BAM 3,707 (USD 2,075) or about 23% less compared to the cost in the phase I.

Following the completion of phases I and II, a total of 365 applications were subsidized. Stoves were replaced with certified pellet stoves or heat pumps.

The short-term Intervention Plans to mitigate episodes of extreme air pollution are triggered reliably in Sarajevo. However, once triggered, the measures defined in the Implementation Plan are not implemented as planned. As indicated in chapter 2, an Intervention Plan specifies measures to reduce the risk of exceeding air pollution thresholds and aims to limit the duration of such exceedances. The plan includes control measures, restriction, or suspension of specific activities (including road traffic) which contribute to exceeding the defined thresholds. In the event of a threshold being reached, all citizens and legal entities are obliged to act in accordance with the Intervention Plan. Not all the authorities act quickly and decisively to implement the required measures. This applies to cantonal ministries and organizations across sectors. For example, the most significant measures regarding traffic control and the limitation of certain vehicle types were never fully implemented. Moreover, the Ministry of Internal Affairs of Canton Sarajevo and the Traffic Police has not found a way to ground certain types of vehicles stated in the Intervention Plan, and it did not fine the drivers, after more than a decade of the Intervention Plan's existence. Another Intervention Plan measure stipulates inspections of the largest polluters, but these were limited due to capacity constraints of the responsible inspectorates.

In 2022, several efforts were made to map and understand the current difficulties in implementing short-term air quality measures. A survey was conducted among the 19 legal entities who are responsible for the implementation of the plan. The results of the survey revealed that almost all stakeholders are familiar with their obligations. However, some of them (about 20%) do not even have staff appointed and responsible to ensure implementation. Financial issues were also reported in several cases. Therefore, further reforms are needed to fully operationalize Intervention Plan measures in future activations.

The timing of the activation of each measure is critical and requires better modeling and use of forecast data. The activation of the intervention plan is usually based on the available air quality monitoring data and meteorological forecast. There is a need to analyze past exceedance episodes to inform the development of a specific air quality forecast model for Sarajevo which would combine air quality with meteorological parameters. This will allow for more accurate triggers of the short-term measures when needed.

A comparison of the different threshold levels defined in the previous Intervention Plan for Canton Sarajevo with practices across Europe revealed that the threshold values defined for the alarm level appear too high in Sarajevo and miss fine particulate matter. Therefore, in November 2023, the cantonal

government updated the Intervention Plan and reduced the warning level of PM₁₀ from 150 to 90 µg/m³ and the alarm level from 300 to 200 µg/m³.

Compliance of citizens with the Intervention Plan measures is said to be poor because citizens are not familiar with the measures, and there is little information about how to implement them. In general, a small group of passionate activists recognizes the importance of improving air quality, but awareness levels among the public are still relatively low.

Municipalities could play an important role in implementing air quality control strategies at the local level, but their function is limited to issuing permits. Other AQM roles are not clearly defined and vary by municipality. Currently, the AQM role of municipalities is confined to primarily issuing building or working permits to small industry emission sources which do not require environmental permits. Other potential functions, for example, advising and supporting residential households in switching to cleaner heating sources and energy efficiency measures, are not defined. Municipal inspections could support AQM control strategy implementation but do not have a legal mandate to act. Financing AQM implementation at local level could also be an issue, although comprehensive guidance exists and shows a wide range of options for mobilizing resources for air pollution control (Box 7).

Box 7: Guidance and mechanisms for financing AQP implementation.

The European Investment Bank Advisory Hub has created guidance on financing air quality plans for cities and local authorities (European Investment Advisory Hub 2019). The document provides insights into how to analyze AQPs to categorize measures into non-financially sustainable and financially sustainable measures.

The guidance identifies the types of funding sources that LSGUs can harness for each category, and how to leverage these resources. Examples include:

- **User charges:** Payment in exchange for a particular service usually aimed at cost recovery of collective services. The fee can be based on a quantity or quality of pollutants released into the environment. Example: Private vehicle owners can be forced to pay when entering a pollution-restricted area.
- **Compensation measures:** Payment of a fee to offset an action that, albeit lawful, entails negative impacts on air quality. Example: Developers can be forced to pay a surplus costs for the construction of buildings subtracting agricultural areas.
- **Monetizing added value:** Revenues come directly generated by the development or improvement of the goods or services offered. Example: Investment in eco districts would allow to improve buildings and infrastructure in the area, increasing the real estate economic value.
- **Costs savings:** Due to increased operational efficiency of a system. Example: Energy efficiency interventions allow to save costs of energy consumption.
- **Tax credits (for the local authority):** Tax credits allow taxpayers to save costs by subtracting the amount of the credit they have accrued from the total they owe. Example: Tax credit mechanisms incentivize home owners to undertake energy efficiency modernization.
- **Soft loans:** Soft loans represent a mechanism coming between revenue models and non-revenue models. These are forms of support where borrowers repay investments at better-than-market conditions (e.g. low or non-existent interest rates), usually foundations or public authorities.

Example: Loans can be channeled through state-owned banks at interest rates ranging from zero to just marginally below commercial interest rates for pollution abatement investments.

Large polluters such as steel mills and power plants are typically under federal jurisdiction, i.e. beyond the control of cantonal authorities, but have a significant effect on air quality within a canton, posing a challenge to effective AQM. For example, the air quality in Canton Sarajevo is affected by emissions from a steel plant in the Ilijaš municipality in Canton Sarajevo, but also from the coal-fired power plant in Kakanj, in Canton Zenica-Doboj, to the north of Sarajevo. Due to their size, both facilities are under federal control regarding permitting and inspections. The cantonal government does not have means to influence these processes, frustrating local efforts to implement effective air pollution control strategies.

Table 9: Functional Review summary table, function 4: Implementing control strategies.

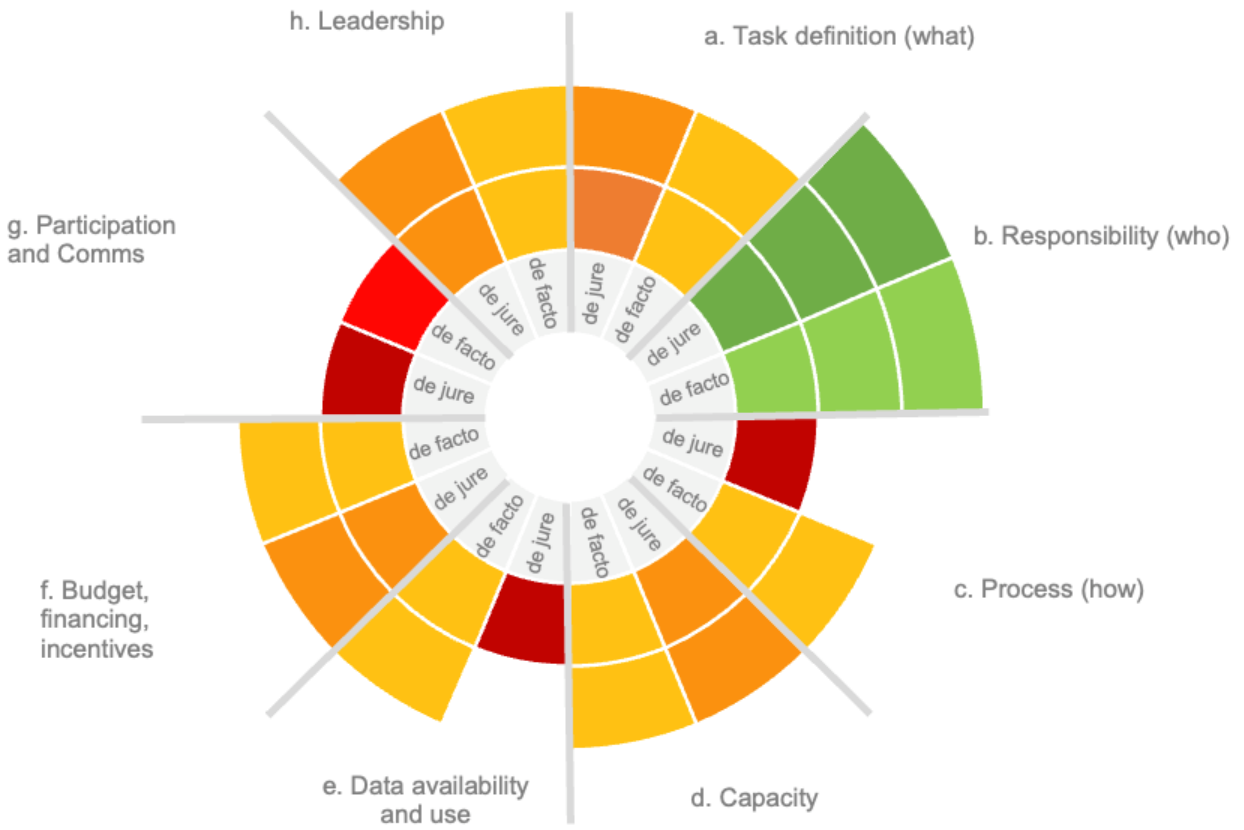
Review criteria	De jure		De facto	
a. Functional task definition ('What')	2	The Sarajevo CEAP 2021-2025 defines 31 measures related to AQM, all of which are one-off investments or foundational analytical or strategy development activities. None of the measures is designed to drive ongoing control strategy implementation, for example, of residential emissions or traffic.	2	The CEAP tasks are mostly well understood by the responsible stakeholders and implementation is broadly on track. However, important emission sources (including residential emissions; traffic) are largely unregulated in practice, therefore control strategies relating to these sectors are not implemented.
b. Distribution of responsibilities ('who')	3	The implementation responsibility is defined for each AQM activity contained in the CEAP.	3	CEAP implementation responsibilities are largely followed, although ministry capacities dedicated to AQM are generally limited and it is questionable whether more ambitious control strategies could be implemented with existing capacities.
c. Process management ('how')	1	Neither the Sarajevo CEAP nor another document includes implementation process guidance, partly because <i>regular</i> air quality control strategy implementation is not foreseen in the current system, although this is bound to improve with the adoption of the new FBiH Law on Air Protection.	2	Despite the absence of well-defined implementation processes for air quality control strategies, CEAP measures appear to be successfully implemented, although effective control strategy processes, especially for the residential sector, are not defined and therefore neither implemented routinely nor at scale.
d. Capacity ('Are they able to do it?')	2	The relevant ministry staff have the formal technical capacity to implement their assigned CEAP tasks, but the overall number of staff dedicated to AQM-related tasks across the relevant agencies is	2	Owing to the extremely limited number of staff dedicated to AQM, the deployable technical capacity to implement and oversee air quality control strategies is limited.

		extremely limited.		
e. Information and data requirements, availability, and use	1	Data and information requirements for implementing control strategies are not defined.	2	The Sarajevo CEAP 2021-2025 included several analytical activities to strengthen the evidence base for future AQM implementation, including an expanded emission inventory and the development of the Strategy to Limit the Use of Coal and Other Solid Fuels 2023-2033.
f. Budget, financing, incentives	2	The Sarajevo CEAP identifies budget sources for the AQM-related activities, some of which rely on additional, external financing (non-regular government budget). But regular inspection and chimney sweeping are not foreseen in the AQM system and budget.	2	Budget is allocated to CEAP 2021-2025 activities which allowed implementation to be broadly on track. Budget for ongoing air quality control mechanisms is neither foreseen nor allocated.
g. Communication and participation	1	Communication and participation are not formally defined in implementing air quality control strategies, aside from public information about short-term Intervention Plan measures.	1	A standardized communication and participation channel on air quality control strategy implementation does not exist. Some CEAP activities include communication and participation components which appear to function well overall.
h. Leadership commitment and capacity	2	There is some evidence of political leadership commitment to implementing control strategies in the form of public statements about the importance of clean air and environmental protection generally.	2	The level of de facto leadership awareness and prioritization of air quality control implementation is difficult to determine, although good progress on CEAP activity implementation shows that there is some leadership support.

Rating categories:

- 1: Non-existent or not functional
- 2: Partially existent / functional
- 3: Existent / fully functional

Figure 7: De jure and de facto scores for AQM function 4. Implementing control strategies.



3.5 Monitoring implementation and enforcing compliance

At the entity level, FMET is formally responsible for supervising the implementation of the FBiH Law on Environmental Protection, the Law on Air Protection, and the subordinate regulations adopted based on the laws. This has limited effect in practice given that the current laws are vague regarding AQM responsibilities and do not stipulate consequences for non-compliance. Every two years, the Law on Environmental Protection requires the government to report to the Parliament of the FBiH on the implementation of the Federal Environmental Protection Strategy. The report is prepared by FMET. Parliament could put political pressure on the administration in case of unsatisfactory implementation by rejecting the strategy progress report, something that has not happened in the past. There is limited evidence of an effective federal engagement to monitor whether air quality control strategies, to the extent that they exist, are implemented and whether there is progress towards the achievement of the clearly defined air quality standards and objectives, i.e. the pollutant limit values defined in the Law on Air Protection. Examples from EU countries illustrate that it is possible institutionalize realistic accountability mechanisms (Box 8).

Box 8: Ensuring accountability for preparing and implementing air quality plans. An example from Poland.

Poland has been a member of the EU since 2004. The country is divided into 16 provinces (voivodeships). Administrative authority in each province is shared between a governor (the voivode) who is appointed by the central government, an elected assembly (the provincial parliament or Sejmik), and an executive board chosen by that assembly. A voivodeship Marshall leads the executive board.

The country's Environmental Protection Law requires the provincial parliament to adopt an AQP within 18 months from the date of receiving air quality monitoring results indicating that the alarm threshold for a pollutant has been exceeded in a particular zone. Since AQPs must be adopted as resolution by the Sejmik, they carry considerable legal weight. The Marshall as the leader of the provincial executive is ultimately responsible for implementing the AQP.

The Voivodeship Inspectorate for Environmental Protection monitors the timely adoption and implementation of AQPs at provincial level. In the event of irregularities, for example, failure to prepare an AQP on time or to implement the measures defined therein, the Inspectorate is obliged to impose a fine of up to PLN 500,000 (approx. EUR 115,000) on the provincial parliament for non-preparation or the Marshall for non-implementation. This constitutes a significant incentive for the provincial government to comply with their air quality planning obligations.

However, although the provinces generally comply with the requirement to develop AQPs, the scope and quality of the plans still varies considerably across the country (World Bank 2020).

At the cantonal level, the implementation of Sarajevo's Decision on the Protection and Improvement of Air Quality cannot be effectively monitored and enforced because the Decision cannot assign legally binding mandates and responsibilities equivalent to a law. The Decision, described in Annex 2 in more detail, does not have the same rank as a cantonal law. Therefore, the obligations of the key players in the AQM governance system can be described, but they cannot be held accountable for (not) carrying out their functions. Moreover, the roles of the most critical sectoral ministries for AQM at the cantonal level

– including Economy, Transport, Internal Affairs, and Health – are left vague or entirely undefined. Hence, their engagement in AQM is limited. The same holds for the role of municipalities. In contrast, the implementation of the AQM-related measures defined in the CEAP 2021-2025 can be easily monitored because the task-based responsibilities are clearly defined. However, the CEAP activities are not designed to constitute a comprehensive system of air quality control strategies that can be routinely implemented and monitored. They comprise a set of 31 singular, time-bound measures of mostly foundational character or investment projects.

Overall, the regulatory framework at all levels is characterized by limited control over the AQM process.

The laws and regulations on environmental and air protection stipulate fines for non-compliance only for business entities. There are no consequences for government institutions at the country, federal, cantonal or municipal levels for not fulfilling their roles in air quality governance, for example, if they do not adopt the required strategic documents or do not develop adequate control strategies. Similarly, no administrative entity faces any repercussions if air pollution limit values are exceeded.

The Office for the Audit of Institutions in the FBiH could play an important role by assessing whether government institutions adequately fulfill their AQM implementation roles, something it has started to engage in only recently.

At the level of the EU and within many member states, the court of auditors and supreme audit institutions have independently assessed the effectiveness of the respective air quality governance systems (for example, see Netherlands Court of Audit and Supreme Audit Office of Poland 2019; Netherlands Court of Audit 2018; European Court of Auditors 2018; Supreme Audit Office of Poland 2018). A systematic audit can identify regulatory and implementation gaps and challenges. It can also assess the cost effectiveness of the existing AQM governance mechanisms and the impacts of consistent implementation – or lack thereof – on air quality, human health, and economic outcomes. In the FBiH, a comprehensive audit of AQM would provide a strong starting point to identify room for improvement. However, it must be noted that audit recommendations would not have binding force for the stakeholders they address. In 2019, the Office for the Audit of Institutions in the FBiH conducted a first performance audit of the 'activities of competent institutions to reduce air pollution'. The findings support the conclusions presented in this report, namely that roles and responsibilities for AQM are not clearly assigned across institutions, and that there is overall insufficient planning and implementation of measures that are suitable to reduce air pollution in the cantons (Office for the Audit of Institutions in the FBiH 2019). In 2022, a follow-up report found that that 'the shortcomings noted in the performance audit report from 2019 have still not been remedied. An appropriate regulatory framework governing the field of air protection has not been established' (Office for the Audit of Institutions in the FBiH 2022). While it is unfortunate that little action was taken based on the audit findings, the candid stocktaking presented in the 2019 performance audit on AQM is a good starting point for periodic analyses by the Office for the Audit of Institutions in the FBiH to remind the key stakeholders of existing gaps and priority intervention areas.

The mandate of the Federal and Cantonal Inspection is confined to monitoring the compliance of legal entities with their respective environmental permits. This leaves the broader set of air quality-related rules as defined in the laws and by-laws unchecked. Inspections of businesses or plants are carried out by the inspection authority at the level of administration that issued the specific permit, primarily by

federal or cantonal inspectors. Checkups of whether legal entities comply with environmental permits and regulations typically only happen based on the list of issued permits. There are two main challenges with this. Firstly, it means that it is unlikely for a business that did not apply for a permit to be inspected for compliance with environmental and air protection regulations. Secondly, although there is a list of legal entities that can have adverse impacts on air quality which could form the basis for more expansive inspections, the list is incomplete and requires comprehensive updating. This is planned as part of the CEAP 2021-2025 measure to create a consolidated emission inventory for Canton Sarajevo in 2023.

The new FBiH Law on Environmental Protection introduces changes to the environmental permit system that will likely make monitoring and enforcing air pollution control strategies even more challenging. The thresholds for facilities that need to obtain environmental permits will increase significantly. This means that, under the revised law, a large number of plants will remain de facto without any supervision. For example, for combustion plants, the threshold for federal environmental permits will be raised from 50 MWth to 100 MWth, while the threshold for cantonal environmental permits was set to 10-100 MWth. Any plants of under 10 MWth capacity, regardless of the type of fuel, will not be monitored or supervised. Similar changes are proposed for other industry sources where the prescribed thresholds are set based on yearly production capacities and the covered areas of operation, among others.

The existing legal framework does not allow municipal inspectors to monitor factories and facilities that do not require environmental permits but whose operations might still impact air quality. The local-level inspection for environmental protection and urban planning should supervise air pollution emission sources in their jurisdiction. However, once a business or plant has obtained its permit to operate or business license, there is no legal basis for a municipal inspector to monitor the operation on a regular basis.

Residential emission sources are essentially unmonitored. There are no AQM rules and responsibilities that homeowners would have to comply with, and which can be enforced, and enforcement capacity at the cantonal level is extremely limited. The inspection authority can only monitor legal entities. The legislation does not allow for controlling emissions from individual households or other privately-owned emission sources, illustrating the limited coherence of the existing legal and regulatory framework pertaining to AQM. For example, although Sarajevo's cantonal Decision on the Protection and Improvement of Air Quality, described in Annex 2, prohibits burning waste in household heating and cooking installations, there is no viable legal mechanism to enforce this rule. Citizens can lodge a complaint with the Cantonal Inspection if they feel an emission source puts their health at risk or if they observe illegal activities that can negatively impact air quality. However, at the time of writing, Sarajevo had only one environmental inspector to cover the entire canton. Even if the official would find time to investigate an individual complaint, there is no legal basis for entering or inspecting private property without the owner's consent. Moreover, the environmental regulations envisage fines only for legal entities, not for private persons.

Chimney sweeps could play a pivotal role in the local AQM monitoring and enforcement system, but there is no legal basis for residential inspection and reporting, and there are only few professional sweeps left in the canton. In Canton Sarajevo, chimney sweeping services were provided by the public

utility company Dimnjačar for the longest time. In 2003, the cantonal government closed the company and removed chimney sweeping from the Law on Communal Activities. The number of sweeps subsequently declined, now working in small private companies or as individuals, and demand for their work waned. Unlike in other countries and jurisdictions, the federal and cantonal laws and regulations do not define clear legal requirements for residential inspections and reporting on heating installations and air pollution emissions. In Germany (see Box 9, details provided in Annex 4) and other EU countries, chimney sweeps not only work towards fire safety and public safety, they fulfill extensive functions in inspecting and cleaning furnaces and fireplaces, measuring emissions, checking permissible fuel types and quality, and advising homeowners on how to reduce emissions, save energy, and save heating costs. Importantly for FBiH and Canton Sarajevo, the results of chimney sweep inspections can easily be used to build up a localized, granular inventory of emission sources. This will enable authorities to follow up with house owners in case their installations do not comply with air quality regulations, ultimately improving air quality.

Box 9: The contribution of chimney sweeps to effective AQM – an EU example.

Germany and Austria have arguably the most stringent chimney sweeping regulations and the most advanced chimney sweep service sector among the EU member states. Similarly, Finland's chimney sweeping sector is highly active and successful, but it is less comprehensively regulated, as is the case in some parts of Italy.

Germany has a long history of chimney sweeps being in charge of inspection and maintenance of all fireplaces in the country. The authorized district chimney sweep is officially assigned to one district for seven years by the local administrative authority. The sweep typically oversees 2,000 or more households. Only the authorized district chimney sweep has the legal competency to (a) carry out the official inspection of furnaces and fireplaces, including the issuance of an inspection certificate, and (b) maintain a sweep-book containing a list of all furnaces and fireplaces and their technical specifications in the district.

The official inspection of furnaces and fireplaces must take place at the earliest three, at the latest five years after the last official inspection. An official inspection comprises a holistic assessment for the purpose of certifying operational furnaces and fireplaces and ensuring fire safety. It covers controlling the firing equipment, connectors, chimneys, flues, combustion air supply, fuel quality including fuel wood moisture, decommissioning, or retrofitting of solid fuel fireplaces, among other tasks. After completing the holistic assessment, the authorized district chimney sweep issues an inspection certificate.

The inspection certificate informs house and apartment owners about the schedules of the annual inspection, measurement and sweeping requirements as defined in the Federal Sweeping and Inspection Ordinance. Depending on the type of furnace or fireplace used and the intensity of use, **routine sweeps must occur between one to three times per year**. These annual inspections are mandatory, even in years without an official inspection carried out by the authorized district chimney sweep. Following a revision of the law in 2013, the annually recurring cleaning and measurement can be done by qualified contractors. Previously, the authorized district chimney sweep did both the official inspection every three to five years as well as the annual measurement and sweeping.

House and apartment owners are responsible for implementing in a timely manner any repairs, upgrades, or other tasks assigned to them in the inspection certificate, and they must be able to prove it to the authorized district chimney sweep. For this purpose, the contractor who conducts the annual cleaning and measurement fills

out a compliance form which the house owner must forward to the authorized district chimney sweep to be recorded in the sweep-book.

If house or apartment owners are in violation of the legal provisions, the authorized district chimney sweep is obliged to report the incident to the responsible district authority. Such incidents include the non-submission of required forms; not initiating the statutory activities (for example, tasks assigned in the inspection certificate); refusing household inspections; or operating unapproved furnaces or fireplaces. The house owner will then receive an official advisory from the responsible authority. In case of continued non-compliance, the authority imposes fines on the owner of the residence ranging from EUR 5,000 to 50,000 (USD 5,500 to 55,000).

The draft Strategy to Limit the Use of Coal and Other Solid Fuels in Canton Sarajevo 2023-2033 recognizes the critical role of chimney sweeps and proposes to reintroduce them into the AQM system at scale. The strategy also identifies the detailed steps that are required to enable chimney sweeps to monitor, provide advice, enable compliance, and support enforcement of air quality standards, objectives, and control strategies. The first measure would be to create the legal and organizational basis for chimney sweeps to operate. The strategy document suggests re-establishing a public utility company, although international experience shows that there may be more efficient and less costly operating modalities, for example, through networks of authorized independent chimney sweeps or certified contractors. Professional training and qualification procedures must be established; re-training of people who work in similar crafts is also considered. The strategy further outlines necessary changes to legislation and the contents of a new ordinance on the performance of chimney sweeps which, among other issues, must regulate the frequency of inspections, types of measurements and controls to be conducted, prices that can be charged, reporting requirements, supervision, and applicable fines for non-compliance, among other matters.

The short-term Intervention Plan for episodes of air pollution exceedances in Canton Sarajevo is another potentially effective AQM control mechanism. When triggered, implementation appears to work well overall, although there is room to strengthen the communication and enforcement of measures. Canton Sarajevo established an expert body for the implementation and supervision of the Plan of Intervention Measures. It includes government agencies, ministries, utility companies, and eight municipalities, all tasked with implementing various intervention measures. However, the respective focal points in these entities are said to function more as proxy point of contacts on a technical level, rather than having decision-making authority, particularly at municipality level. As a result, not all measures are consistently implemented. The CEAP 2016-2021 concludes that, 'as far as coordination during episodes of excessive pollution is concerned, it can be said that [the Plan] functions at a satisfactory level' (Government of Canton Sarajevo 2017). However, the analysis also indicates that the plan should be updated more regularly, taking into account the lessons learned about the effectiveness of the intervention plan measures that were taken. Moreover, 'the measures should be enforceable, and the competent institutions involved in the implementation of the Plan must be more interested in more efficient coordination and implementation in order to stop further pollution in [Canton Sarajevo]' (ibid.).

Table 10: Functional Review summary table, function 5: Monitoring implementation and enforcing compliance.

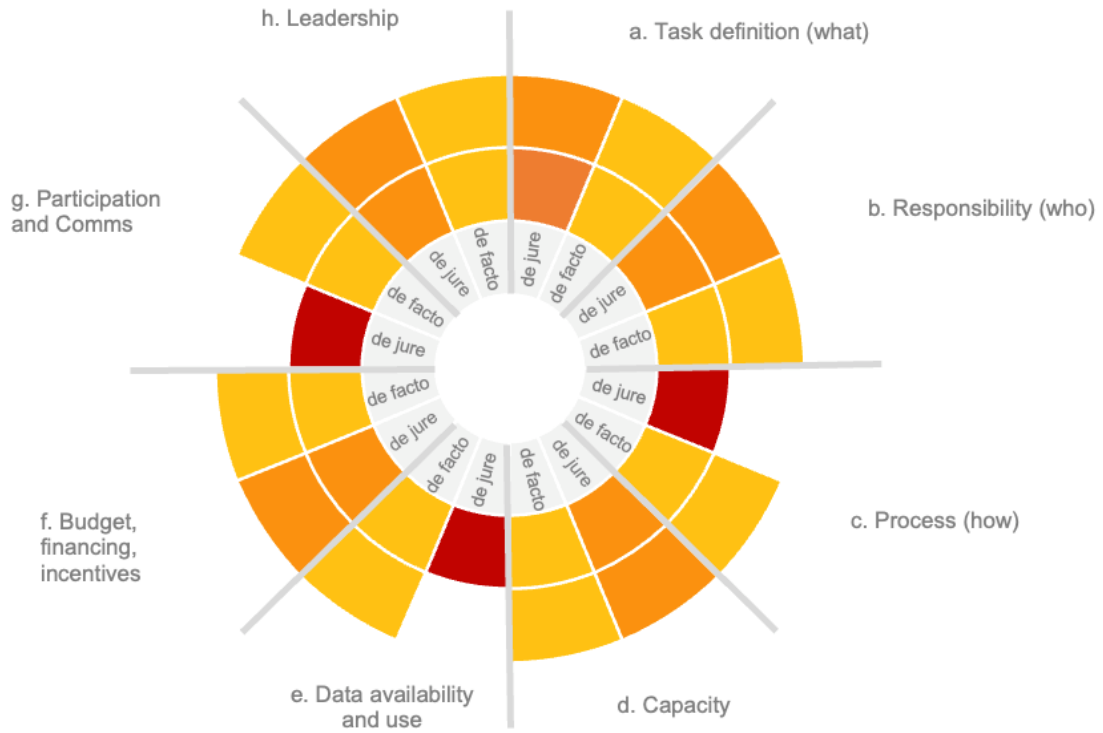
Review criteria	De jure		De facto	
a. Functional task definition ('What')	2	Every two years, the government is required to report to the Parliament of the FBiH on the implementation of the Federal Environmental Protection Strategy. At the cantonal level, implementation progress on the CEAP must be reported annually. The role of inspections is very limited.	2	Overall implementation progress reporting is done as required, but there are practically no disincentives associated with non-compliance at any level. The residential sector is largely excluded from air quality control strategies, monitoring, and enforcement.
b. Distribution of responsibilities ('who')	2	Responsibilities for implementation progress reporting are reasonably well defined. Environmental inspections are mostly limited to permit holding legal entities. Aside from these rare inspections, an enforcement mechanism for air quality control strategies is currently not foreseen.	2	The assigned roles for implementation progress monitoring and reporting are mostly followed, but it is unclear who is responsible for enforcing compliance with air quality control strategies of which few exist. The residential sector is not included, and the omission of a local advisory and monitoring role, for example, through chimney sweeps, constitutes a major missed opportunity.
c. Process management ('how')	1	There is no specific process guidance on air quality control implementation monitoring and enforcement, except for the inspection authority whose role is limited to environmental permits and complaints from citizens. However, the permit system does not cover important emission sources, including from the residential sector.	2	Federal and cantonal progress reporting on high-level strategy and policy documents works reasonably well, but there is little evidence for a systematic approach to how air quality control strategies are designed, implemented, monitored and enforced.
d. Capacity ('Are they able to do it?')	2	The relevant ministry and inspectorate staff dedicated to air quality mostly appear to have the formal technical capacity to monitor the implementation of air quality control strategies. However, the overall number of staff dedicated to AQM is extremely limited. A local (e.g. municipal) layer of monitoring and enforcement beyond environmental inspections does not formally exist.	2	The de facto monitoring and enforcement capacity must be considered very limited, given the extremely limited number of available staff and the absence of chimney sweeps or another viable monitoring and enforcement mechanism at local level.
e. Information and data requirements, availability, and use	1	Data and information requirements for monitoring implementation and enforcing compliance are not defined.	2	Emission inventories play a crucial role in identifying potentially problematic pollution sources or zones. Based on

				<p>this information, compliance with air quality standards can be enforced. Canton Sarajevo has only recently started to invest in updating and expanding its emission inventory.</p>
f. Budget, financing, incentives	2	<p>In theory, the government-funded institutions involved in the supervision system over the implementation of air quality control measures should have adequate resources for the necessary tasks. Disincentives in the form of fines for excessive air pollution exist only for legal entities holding environmental permits.</p>	2	<p>Monitoring the implementation of air quality control measures - beyond tracking CEAP activity implementation - does not happen beyond limited environmental inspections. There are no disincentives for public institutions, agencies, or private individuals who do not fulfill their supervisory or compliance roles.</p>
g. Communication and participation	1	<p>It is not evident that the functional design includes communication or public participation requirements.</p>	2	<p>A standardized communication and participation channel for informing citizens about air quality control strategies, or the need to comply, does not exist.</p> <p>Implementation updates on the CEAP and the Federal Environmental Protection Strategy can be publicly accessed in theory, but there is no proactive sharing or involvement of citizens.</p>
h. Leadership commitment and capacity	2	<p>There is some evidence of political leadership commitment to implementing control strategies and ensuring compliance in the form of public statements about the importance of clean air and environmental protection generally.</p>	2	<p>The level of de facto leadership awareness and prioritization of air quality control implementation, monitoring and enforcement is difficult to determine.</p>

Rating categories:

- 1: Non-existent or not functional
- 2: Partially existent / functional
- 3: Existent / fully functional

Figure 8: De jure and de facto scores for AQM function 5. Monitoring implementation and enforcing compliance.



3.6 Air quality monitoring and progress evaluation

The FBiH Law on Air Protection mandates FMET to establish the rules for a network of measurement stations for the systematic monitoring of air quality, covering federal, cantonal, and municipal entities, and ensuring adequate coverage of pollution sources. The locations of the stations in the federal network are determined by the federal government, based on the proposal from FMET. FMET is obliged to inform the federal government about areas where pollution levels exceed the prescribed limit values, the duration of the exceedance, and about the results of measurements in those areas.

The Federal Hydrometeorological Institute (FHMI) is responsible for monitoring air quality in the FBiH. The federal monitoring network comprises eight locations. Data is published on the FHMI website. Several cantons have established their own air quality monitoring networks, namely Sarajevo, Tuzla, and Zenica-Doboj. All data on air quality monitoring is made publicly available on the internet site of FHMI¹².

A reference laboratory for quality assurance and control of air quality measurements does not exist in the FBiH, although it is recommended as good practice and implemented in neighboring EU countries. Reference laboratories typically support and uphold traceability standards for each pollutant to be measured, as such an important quality assurance and quality control function. In the past, attempts were made to establish reference laboratories for air quality in the FBiH, but the initiative was not pursued further. There is flexibility regarding the number of laboratories that share and implement reference responsibilities, depending on their respective competencies. Therefore, it is advisable for the FBiH to establish reference laboratories and determine which institution(s) should fulfill this role.

In Canton Sarajevo, air quality monitoring is carried out by the Institute for Public Health (PHI) of Canton Sarajevo which maintains six measurement stations (at Otoka, Ilidža, Vijećnica, Ilijaš, Vogošća since 2022, plus one mobile station situated in Hadžići at the time of writing). Another two stations are operated on the territory of Canton Sarajevo by FHMI at Bjelave and Ivan Sedlo. The mobile station operated by PHI features an expanded set of instruments that can measure SO₂, O₃, NO_x, CO, C₆H₆, hydrogen sulfide (H₂S), PM₁₀, and aromatic compounds in order to calculate an odor index. In 2018, the Embassy of the United States of America, located in downtown Sarajevo, installed a PM_{2.5} monitoring station on its roof. The data is publicly available on the embassy website¹³. Some have suggested that the general public trusts these measurements more than the government's official air quality data.

The relevant rulebook defines the air pollutants to be monitored as well as the limit values, but the current status of measurement equipment and capacity do not allow for regular monitoring of all required parameters. According to the rulebook on monitoring air quality and defining the types of pollutants, limit values and other air quality standards (Official Gazette of FBiH, No. 01/12, 2012), air quality is monitored by measuring concentrations of SO₂, NO_x, PM₁₀ and PM_{2.5}, Pb, C₆H₆, CO, arsenic (As), cadmium (Cd), mercury (Hg), nickel (Ni), and B(a)P, with automatic measuring instruments or sample analysis. However, the existing measurement stations do not allow for regular monitoring of all pollutants. Some are only measured occasionally (like heavy metals in PM), other pollutants are not

¹² <https://www.fhmzbih.gov.ba/latinica/ZRAK/AQI-satne.php>.

¹³ <https://ba.usembassy.gov/embassy/sarajevo/air-quality-monitor-sarajevo/>.

monitored at all (benzene, benzo[a]pyrene, lead, arsenic, cadmium, mercury, nickel), partly for a lack of laboratory capacities and partly due to limited funds needed for this type of monitoring.

PHI is not accredited as a measurement laboratory for air quality monitoring according to the general requirements for the competence of testing and calibration laboratories (ISO/IEC 17025). In spite of this, its current air quality monitoring is conducted in accordance with the ISO/IEC norms, and the equipment it uses complies with the relevant standards. Although the accreditation process would be demanding and time-consuming, it can help to increase public confidence in air quality monitoring results. The successful accreditation would also underscore the legitimacy of measurements, which is particularly important in situations when limit value exceedances trigger air pollution control measures that may be perceived to be unpopular or overly restrictive.

The FBiH Federal Environmental Protection Strategy 2022-2032 aims to enhance the network of air quality monitoring stations significantly while strengthening the capacity of FHMI and cantonal institutions to manage the network and report utilization-focused results. The express goal of the strategy is to cover the entire territory of the FBiH with a network of measuring stations. An action plan is to be developed which will outline the necessary changes to the network, the appropriate designation of AQM zones across the entire territory, and the pollutants to be monitored. This is expected to require procuring, installing, and maintaining additional measuring stations. In addition to these material enhancements of the air quality monitoring network, the strategy sees the need to strengthen the capacity of FHMI and cantonal-level measurement capabilities to manage the measurement network and produce results that can be used to inform spatial planning and decision-making.

The Sarajevo CEAP 2021-2025 includes several measures to improve air quality monitoring. The plan envisages expanding the cantonal network by three new municipal measurement stations in Centar, Hadžići, and Novo Sarajevo. A study is meant to be conducted to determine the ideal location for each of the three new stations. Resources are meant to be earmarked for the continuous maintenance and regular calibration of all existing and new stations to ensure air quality monitoring and reporting according to international standards.

The entity and cantonal governments are in discussions with the World Bank to invest in a stronger air quality monitoring network in Canton Sarajevo. At the time of writing, a dialogue was underway to determine areas for investment support, including a regulatory revision and update of the cantonal monitoring plan decree, support to air quality modelling to strengthen the layout of the monitoring network, and upgrades to the network equipment itself. There is a desire to move from the current design of physically large measurement stations, requiring extensive permits, to using smaller and lighter analyzers that can produce valid results but are not subject to prolonged placement procedures.

The Strategy to Limit the Use of Coal and Other Solid Fuels in Canton Sarajevo 2023-2033 also calls for consistent air quality monitoring. Chimney sweeps need to play an important role in this at the local level. Monitoring of PM₁₀ and PM_{2.5} is planned to be intensified in priority zones to inform air quality control strategies and monitor the effectiveness of existing regulations. It will also serve to inform citizens and raise awareness of the often-poor air quality in these zones. Moreover, the Strategy stipulates reintroducing chimney sweeps into the AQM system. The sweeps can measure emissions from individual

heating installations based on flue gas metrics. It is relatively easy to accurately detect elevated concentrations of carbon monoxide and the excess air coefficient (λ) as a sign of inadequate combustion. In addition, by measuring the concentration of SO₂, chimney sweeps can determine whether the household uses coal with sulfur content beyond the permissible limits.

Public information and participation are important elements of effective air quality monitoring and management. Although these functions are currently underutilized, civil society is already engaged and contributes to strengthening government accountability. The Decision on the Protection and Improvement of Air Quality in Canton Sarajevo defines communication as an integral part of AQM. The public must be informed about current pollutant emissions and air quality levels. The PHI of Canton Sarajevo publishes yearly reports, including on the state of air quality. The results of most air quality monitoring stations can be accessed in near-real time via the FHMI website¹⁴. However, there is room to enhance the user-friendliness of the presentation and add modern features. For example, it would be desirable to provide easy access to historical monitoring data, an easily understandable air quality index, and to offer users to receive notifications or alerts when given thresholds are exceeded. In theory, citizens can request additional information on air quality by submitting inquiries to FHMI or PHI. Both institutions are obliged to answer these questions, but responses are said to often take too long because of limited organizational capacities.

The NGO Eko Akcija (Eco Action) advocates for effective AQM. To keep citizens informed, it has also built a web-based portal which uses air quality data from the government but presents it in a more accessible format¹⁵. The Sarajevo-based organization, established in 2009, has been vocal in demanding more stringent AQM and environmental protection. In 2022, ahead of the BiH general elections in October which decide the makeup of the country's Presidency as well as national, entity, and cantonal governments, Eko Akcija published a screening of programs and 'pre-election promises' of 16 political parties contending in the elections¹⁶. Only three of them mentioned air quality as a priority. Eko Akcija's advocacy activities have generated considerable public interest in the issue – over 10,000 people follow its Facebook page¹⁷.

In summary, a significant amount of useful air quality monitoring data is generated and publicly available, but there is room to strengthen the use of this data to inform air quality control strategies and to evaluate the effectiveness of AQM at the country, entity, and cantonal levels. While the network of air quality monitoring stations may not be without flaws, the data it produces is sufficient to indicate that air pollution is a significant concern and must be addressed effectively. Still, the available air quality information is not used routinely to review air quality control strategies and to inform an evaluative judgment of the effectiveness of AQM at the federal or cantonal levels. Impactful AQM requires a systematic and holistic effort across sectors and levels of government, instead of a piecemeal approach of individual measures. The federal and cantonal air quality data provide a good-enough basis for taking

¹⁴ <https://www.fhmzbih.gov.ba/latinica/ZRAK/AQI-satne.php>.

¹⁵ <https://zrak.ekoakcija.org/>.

¹⁶ <https://www.ekoakcija.org/sadrzaj/izbori-2022-kakav-je-odnos-bh-politickih-stranaka-prema-najvaznijim-problemima-okolisa>.

¹⁷ <https://www.facebook.com/Ekoakcija/>.

action, but this has not yet been done at scale. However, several ongoing federal and cantonal initiatives are bound to introduce positive change, primarily the revised draft of the FBiH Law on Air Protection and the Strategy to Limit the Use of Coal and Other Solid Fuels in Canton Sarajevo 2023-2033.

Table 11: Functional Review summary table, function 6: Air quality monitoring and progress evaluation.

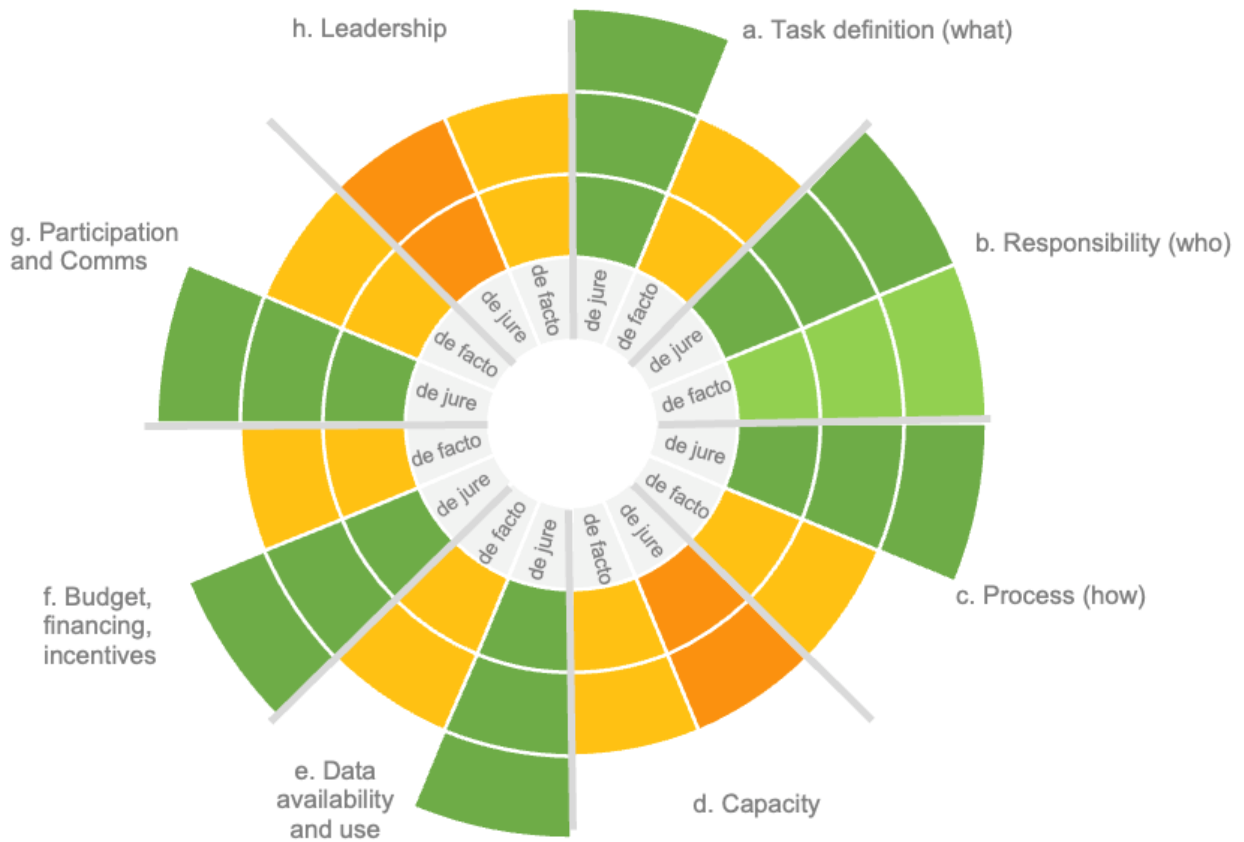
Review criteria		De jure		De facto
a. Functional task definition ('What')	3	The functional task definition is clearly laid out in federal and cantonal legislation.	2	Air quality monitoring requirements are mostly fulfilled, except where technical or capacity limitations result in selected pollutants not being monitored consistently, or not at all.
b. Distribution of responsibilities ('who')	3	Air quality monitoring responsibilities are formally and clearly assigned.	3	Mandates and responsibilities are known, understood, and followed by FHMI and the PHI of Canton Sarajevo.
c. Process management ('how')	3	Air quality monitoring processes are designed efficiently. The coverage and exact locations of the measurement network is to be determined by the implementing institution.	2	The existing network is managed with sufficient efficiency, given the resource and capacity limitations. The network leaves room for expansion and the measurement equipment requires more consistent maintenance and upgrading to ensure all required pollutants can be monitored consistently and reliably.
d. Capacity ('Are they able to do it?')	2	The technical equipment used at air quality measurement stations complies with the relevant standards. The PHI of Canton Sarajevo is not formally accredited as a testing and calibration laboratory (ISO/IEC 17025).	2	The network of air quality monitoring stations is not able to monitor all required pollutants consistently, and some are not monitored at all. FHMI and PHI staff have the technical knowledge and capacity to conduct most of the required measurements, even without formal accreditation of the laboratory.
e. Information and data requirements, availability, and use	3	The function of air quality monitoring and evaluating progress is formally fully evidence-based. Measurement data is to be used by the responsible authorities to report on the state of air quality in the respective jurisdiction.	2	Air quality data and status reports are not used consistently to inform the design of strategic, holistic control strategies and to monitor whether existing strategies achieve the required air quality improvements.
f. Budget, financing, incentives	3	The network of air quality monitoring stations is routinely financed from the government's budget.	2	The allocated budget has not been sufficient to finance the desired expansion and quality upgrade of the air quality monitoring network. The Strategy to Limit the Use of Coal and Other Solid Fuels in Canton Sarajevo 2023-2033 calls for additional

				investments in the network of measurement stations.
g. Communication and participation	3	The Decision on the Protection and Improvement of Air Quality in Canton Sarajevo requires public information and communication about the air quality situation as an integral part of AQM.	2	Data is publicly available on the FHMI website, albeit with room to improve user-friendliness and the range of parameters that can be accessed. Public communication and participation leaves room for improvement.
h. Leadership commitment and capacity	2	Only three of 16 political parties found air quality issues worth mentioning in the programs for the 2022 general elections. Beyond this, formal leadership commitment and capacity regarding air quality monitoring is unclear.	2	There is little available evidence on de facto leadership commitment and capacity, although the air quality monitoring demands formulated in the Strategy to Limit the Use of Coal and Other Solid Fuels in Canton Sarajevo 2023-2033 can be interpreted as a positive sign of administrative intention.

Rating categories:

- 1: Non-existent or not functional
- 2: Partially existent / functional
- 3: Existent / fully functional

Figure 9: De jure and de facto scores for AQM function 6. Air quality monitoring and progress evaluation.



3.7 Synthesis of functional review findings

The functional review of AQM in BiH, with a focus on Canton Sarajevo and controlling emissions from residential sources, has identified several opportunities but also fundamental constraints to manage air quality more effectively.

In recent years, the governments of the FBiH and Canton Sarajevo have taken significant steps, or are currently in the process, to strengthen the regulatory framework for AQM and to enable effective air pollution control. The FBiH Environmental Strategy 2022-2032 is based on a realistic assessment of the current air quality-related challenges in the entity's territory. It identifies corrective actions that will introduce significant but difficult changes to reduce pollution and improve air quality. Likewise, the proposed revision of the FBiH Law on Air Protection, in draft form since 2021, will constitute a major stride towards aligning AQM legislation with the EU acquis. Canton Sarajevo has followed through on its CEAP commitment and drafted a Strategy to Limit the Use of Coal and Other Solid Fuels 2023-2033. The document contains detailed proposals for curbing emissions from residential sources, including measures to regulate solid fuel quality and an incentive program for stove and boiler replacements at scale. Both initiatives are fully aligned with the FBiH Environmental Strategy.

Significant room for improvement remains to strengthen vertical coordination, guidance, quality assurance, and accountability for all AQM functions, and most urgently for setting air quality standards and objectives, and for designing and implementing control strategies. This is particularly important given that not all Cantons in FBiH command the level of capacity and engagement seen in Canton Sarajevo. The cantonal environmental protection plans are important instruments for air pollution control, yet there are no institutionalized mechanisms to ensure that the CEAPs are aligned with entity and country-level ambitions, or to ascertain whether the actions planned by the cantons are suitable and sufficient to improve air quality to the desired level. Technical guidance does not exist, and there is no accountability mechanism at entity or cantonal level for not preparing a CEAP or not achieving the required air pollution emission reductions. Municipalities are the administrative level closest to the main air pollution emission source, the residential sector, but not yet effectively included in the AQM system. Moreover, the lack of reliable, comprehensive emission inventory data hinders effective air quality planning and decision-making at all levels. Overall, there is room to refine the national, federal and cantonal AQM frameworks to make them more consistent and coherent, with a clear distribution of legally binding roles and authorities. Recommendations to this effect will be elaborated in the final chapter.

Cross-sectoral coordination and integration of AQM is limited. Effective AQM requires air quality impacts to be considered in multiple policy areas beyond a narrow focus on the environment, especially in transport, urban development, energy, industry and commerce, agriculture, and health. None of these sectors routinely reviews the effects of its policies and interventions on air quality comprehensively, with inputs from other sectors, and there are no specific and time-bound targets related to air quality impacts to guide decision-making.

Several sectors invest significantly in initiatives with potential impacts on air quality, currently especially transport, but cooperation and coordination with the Center for Air Quality can be

strengthened to ensure positive synergies are fully exploited. The Canton Sarajevo Ministry of Transport leads a number of investments, multiple of them with funding from the EBRD, to improve public transport, including an expansion of the ‘park and ride’ infrastructure. The investment project under preparation with the World Bank supports the creation of a low emissions zone. While some coordination already exists, the collaboration between transport, other sectors, and the Center for Air Quality and the Ministry of Communal Economy, Infrastructure, Spatial Planning, Construction and Environmental Protection has not yet reached its full potential. Better coordination and integration, including with the Ministry of the Economy, can maximize the air quality impacts of ongoing sectoral interventions.

The prevailing regulatory and institutional setup at all levels does not yet approach AQM as a continuous, iterative process of designing, implementing, monitoring, and refining air quality objectives and measures. Instead, advances in AQM depend on the occasional impetus of specific actors, or on emerging opportunities. The governments of the FBiH and Canton Sarajevo have been strategic in using external opportunities, mainly the ESAP 2030+ and the GCAP projects, to update and expand AQM-related policies and regulations. On the other hand, it could be said that the key recent initiatives with the potential to enhance the AQM system – the FBiH Environmental Strategy 2022-2032 and Sarajevo’s Strategy to Limit the Use of Coal and Other Solid Fuels 2023-2033 – were externally funded (the latter Strategy only to 50%), one-off endeavors and at least partially outsourced to consultants. This raises questions about the extent to which air quality standards and objectives are conceptualized holistically, and when and how policies can be updated to reflect changing needs and ambitions. It is already clear that the EU will set more ambitious air quality goals in the near future, as indicated in chapter 3.1. As an aspiring member state, BiH – and by extension the entities and cantons – will have to move in lockstep. In the absence of a reliable mechanism and guidance on how to shape the AQM governance framework, future adjustments to the current ambitions and efforts to harmonize regulations across the entities and across levels of government, are bound to be challenging.

Potentially the most consequential gap in the existing AQM system is the lack of effective control over emissions from residential sources, which Canton Sarajevo intends to tackle with the planned implementation of the Strategy to Limit the Use of Coal and Other Solid Fuels 2023-2033. A durable solution will require a dual approach: On the one hand, coherent regulation (of permissible fuels used for heating; fuel quality; certified stoves and boilers; energy efficiency of buildings); on the other hand, a functional mechanism for monitoring, reporting, and enforcing compliance at the local level, as well as providing technical advice to citizens. Inspections and chimney sweeps need to play a leading role in this, but neither function is currently set up to work effectively and at scale.

4. Recommendations for more effective AQM

The complex governance framework of BiH implies that changes will be required at different levels of the political and administrative system for AQM to become more effective.

At the country level, the World Bank's 2019 report on AQM in BiH assessed the main challenges and formulated a set of high-level recommendations (World Bank 2019). The analysis saw the need to harmonize the legal and institutional framework *across* the jurisdictions for environmental management in general and AQM in particular. Moreover, overlapping roles and responsibilities for implementing legislation constitute significant obstacles for meaningful progress toward improving air quality in BiH, as well as a lack of organizational, human, and financial resources to take key actions. Therefore, the report recommended strengthening inter-entity and cross-sectoral coordination and harmonization, better vertical integration, and a number of more specific measures to curb emissions from specific sources.

The recommendations outlined below focus mainly on the entity and cantonal levels of government because citizens' air quality depends on the formal rules and practical actions devised by these actors.

In addition, several recommendations require changes at the country level to create an enabling legal environment for results-oriented, effective AQM decision-making and implementation in the entities and cantons.

To prioritize and sequence next steps at the Cantonal level, it is advisable to begin implementation with recommendation 4: Strengthen AQM policy, coordination, and oversight capacity in the cantonal government. This means empowering the Air Quality Center in the Ministry of Communal Economy, Infrastructure, Spatial Planning, Construction and Environmental Protection of Canton Sarajevo with a comprehensive mandate, qualified staff, and financial resources, which can be expected to have a catalytic effect for strengthening AQM across all functions. It would enable the Center to drive air quality policy, regulations, planning, and implementation of incentive schemes for reducing emissions from residential sources.

Beyond the Cantonal level, recommendation 1 (creating an enabling legal environment for AQM at the BiH country level) would be the starting point for a holistic reform of AQM in BiH. However, given current politics and the country's complex governance structure, this will be difficult to tackle. Therefore, the recommended approach resulting from this review is to begin strengthening AQM from the Cantonal level outwards.

While each recommendation is assigned to one primary AQM function in Table 12, other AQM functions are likely to benefit from a suggested change, given the high interdependence of the six core functions.

Table 12: Recommended actions for more effective AQM in the FBiH and Canton Sarajevo.

FUNCTION 1: SETTING STANDARDS AND OBJECTIVES

Recommendation 1: Create an enabling legal environment at the BiH country level to allow effective regulation and management of emissions, primarily from residential sources and traffic

Problem statement	High air pollution emissions from traffic persist vehicles and fuels are not sufficiently regulated. Residential air pollution emissions are high but heating installations in private buildings are not subject to regulation and inspection. In situations where there are signs of waste burning or inadequate fuel use that cause dangerous pollution emissions, the constitution and laws on regulate private property and privacy do not allow for inspections to enter private property even in the event that the level of air pollution can be expected to cause health damage to other citizens.
Required action	The follow measures require changes in state-level legislation to enable effective AQM and to achieve emission reductions: <ul style="list-style-type: none"> - Introduce legislation that makes certification of boilers and stoves for energy efficiency and eco-design mandatory. Only certified stoves may be imported and sold in BiH. - Adopt legislation that allows inspectors to inspect private households in case of suspected illicit AQM-related activities, or enable them to issue fines if entry is refused. After the general legal framework is set at the state level, the regulation can be further developed and adopted at entity level. - Revise the law on traffic safety to strengthen obligatory eco-tests as a prerequisite for the registration of vehicles. Enable traffic police to check and control vehicles on the road. Introduce mandatory tests of exhaust gasses and enforce compliance with the EURO norm for imported vehicles.
Responsible	The Council of Ministers of BiH
Also strengthens AQM functions:	3. Developing control strategies 4. Implementing control strategies 5. Monitoring implementation and enforcing compliance

Recommendation 2: Set technical guidance for cantons to develop Cantonal Environmental Protection Plans (CEAP) and Air Quality Plans (AQP)

Problem statement	Section VIII of the FBiH Law on Environmental Protection, in the planning section, only sketches out the process and type of content to be included in a CEAP in the broadest terms. The law does not set quality criteria for the analysis and information to be presented in this strategic document. The same applies for AQPs. Required emission estimations are not required, and neither is it mandatory to determine whether the proposed control strategies are sufficient to improve air quality, and to what extent.
Required action	Develop technical guidance that includes: the type of analysis required; information to be included; calculation of required emission reductions; definition of control strategies; estimation of the extent to which implementation of control strategies will achieve emission reductions. Clear responsibilities must be defined for all stakeholders, as well as ways to implement and monitor results. Anchor the guidance in the FBiH Law on Air Protection to make it binding and subject to review and accountability (next recommendation).
Responsible	FMET
Also strengthens AQM functions:	2. Determining required emission reductions 3. Developing control strategies

Recommendation 3: Establish a binding quality assurance and accountability mechanism for CEAPs and AQPs	
Problem statement	CEAPs and AQPs are not reviewed for content, quality, or effectiveness. There are no consequences for not developing these important strategic documents.
Required action	<p>FBiH Law on Air Protection must assign clear obligations to all cantons where limit values are exceeded that an AQP needs to be created. A timeline for creating the AQP must be defined, and each AQP should be valid for a period of three to five years.</p> <p>CEAPs / AQPs must be reviewed by FMET; feedback & guidance must be provided within a given timeframe. It may be necessary to strengthen the capacity of FMET fulfill this quality assurance function since the ministry currently carries out more procedural tasks related to AQM than providing expertise. It is advisable to involve and strengthen FHMI to provide expert reviews of AQPs.</p> <p>AQPs should be adopted by the cantonal assemblies and become local law, which will lend weight to the plan and bind the government to implement it.</p> <p>Progress reports on CEAPs and AQPs should be submitted to the cantonal assembly annually.</p> <p>An accountability mechanism should be established to sanction cantons which do not develop CEAPs and AQPs when required, or when they deliver poorly designed documents, or when measures end up not achieving AQ targets. For example, certain government budget allocations can be withheld, like budget from the Fund on Environmental Protection that are collected as ‘funds from air polluters’.</p> <p>Large emission sources, such as power plants or the steel industry, are subject to federal regulations. The FBiH Law on Air Protection should set clear boundaries and responsibilities how these sources are to be treated in cantonal AQPs. Cantons currently do not have the means to prescribe measures for these emission sources. Moreover, these sources typically impact air quality in more than one canton.</p>
Responsible	FMET
Also strengthens AQM functions:	3. Developing control strategies

Recommendation 4: Strengthen AQM policy, coordination, and oversight capacity in the cantonal government	
Problem statement	Key actors in the AQM governance system are under-capacitated to deliver their functions effectively. The most important institution in Canton Sarajevo is the Air Quality Center in the Ministry of Communal Economy, Infrastructure, Spatial Planning, Construction and Environmental Protection. Moreover, air-quality related responsibilities are distributed across different departments within the ministry. There is insufficient coordination within and across ministries on AQM.
Required action	Consolidate air-quality related responsibilities within the Ministry of Communal Economy, Infrastructure, Spatial Planning, Construction and Environmental Protection in the Center for Air Quality to lead on the AQM agenda.

	<p>Add 4-6 staff roles in the Center for Air Quality, Canton Sarajevo to cover:</p> <ul style="list-style-type: none"> ● AQM policy creation and coordination with other sectors and ministries; ● Air quality planning; control strategies; AQP development; ● Allocation of funds available for implementing the control strategies in accordance to plans and adopted action plans; ● AQP implementation oversight, enforcement, and quality assurance; ● Status of air quality; monitoring; reporting, emission inventories; maintenance and updating of electronic emission registers; ● Residential sector (education/information, incentive schemes, chimney sweeps, eco-advisers).
Responsible	Center for Air Quality, Ministry of Communal Economy, Infrastructure, Spatial Planning, Construction and Environmental Protection (MCEEP)
Also strengthens AQM functions:	<p>3. Developing control strategies</p> <p>4. Implementing control strategies</p> <p>5. Monitoring implementation and enforcing compliance</p> <p>6. Air quality monitoring and progress evaluation</p>

Recommendation 5: Update the definition of air quality zones and agglomerations to facilitate air quality planning

Problem statement	<p>The EU ambient air quality directives oblige EU Member States to divide their territories in zones and agglomerations for the purposes of air quality assessment and management.</p> <p>At the time when FHMI drew up the air quality zones, some cantons did not have measuring stations in place. Therefore, Goražde, Bihać (canton Una-Sana) and Mostar (canton Herzegovina-Neretva) were assigned to a common air quality zone. Their different climatic and geographic features pose distinct air quality challenges that require different AQM responses, but the common zone requires the cantons to approach their different air quality problems with the same action plan. This adds an unnecessary layer of complexity, especially because measuring stations now exist in all cantons and would allow the re-definition of zones according to cantonal boundaries or agglomerations within cantons, relieving the pressure for inter-cantonal coordination where it is not necessarily required.</p>
Required action	Review and update the definition of air quality zones and agglomerations with the objective of facilitating air quality action planning.
Responsible	FHMI
Also strengthens AQM functions:	<p>3. Developing control strategies</p> <p>4. Implementing control strategies</p> <p>5. Monitoring implementation and enforcing compliance</p> <p>6. Air quality monitoring and progress evaluation</p>

Recommendation 6: Clearly define and strengthen the role of municipalities in AQM

Problem statement	Although municipalities would be ideally positioned on the frontlines of controlling one of the largest PM _{2.5} emission sources – residential heating – their AQM role is largely confined to issuing building and use permits for small industrial sources that do not require environmental permits. They do not have clearly defined roles to advise and support citizens on AQM issues, develop and implement air pollution control measures, and monitor or enforce compliance.
Required action	Assign clear AQM responsibilities to municipalities, complemented by training and technical support from cantonal authorities in the start-up phase. Municipalities could use part of their local taxes to fund dedicated AQM or eco-adviser positions.
Responsible	Cantonal government
Also strengthens AQM functions:	3. Developing control strategies 4. Implementing control strategies 5. Monitoring implementation and enforcing compliance 6. Air quality monitoring and progress evaluation

FUNCTION 2: DETERMINING REQUIRED EMISSION REDUCTIONS

Recommendation 7: Develop and maintain detailed, localized emission inventories in each canton

Problem statement	The absence of granular data on emission sources makes it difficult to estimate the required emission reductions, which forms the basis for developing control strategies. The establishment of comprehensive emission inventories is made more difficult by the fact that Canton Sarajevo does not have a registry of small businesses.
Required action	<ul style="list-style-type: none"> • Ensure every Canton has a functional electronic emission register. The registers currently under development must meet technical requirements to be easily updatable and upgradable. • Integrate small, medium and large sources from all sectors. • Collaborate with the Ministry of Economy of Canton Sarajevo, and the Chamber of Commerce, to encourage the creation of a small business registry. This can serve as a basis for engaging these commercial entities in AQM governance and emission data gathering. • Complement the emission inventory based on data from other sources, for example, the register of public companies, the energy balance report for Sarajevo Canton, registers of people requiring social assistance, registers of illegal housing, and other sources can provide a starting point for capturing additional emission sources. • Keep inventories updated with emission data from residential sources (see measure on chimney sweeps below, recommendation 10) and from laboratories measuring point emission sources that are required to do emission monitoring.
Responsible	Responsible cantonal ministry; in Sarajevo: Ministry of Communal Economy, Infrastructure, Spatial Planning, Construction and Environmental Protection (MCEEP)

Also strengthens AQM functions:	<ul style="list-style-type: none"> 2. Determining required emission reductions 3. Developing control strategies 5. Monitoring implementation and enforcing compliance 6. Air quality monitoring and progress evaluation
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FUNCTION 3: DEVELOPING CONTROL STRATEGIES

Recommendation 8: Involve cantons in emission control measures for large polluters under federal jurisdiction

Problem statement	Large polluters such as steel mills and power plants are typically under federal jurisdiction, i.e. beyond the control of cantonal authorities regarding permitting and inspections, but have a significant effect on air quality within a canton, posing a challenge to effective AQM.
Required action	<p>Involve affected cantons in the process of issuing permits and conducting inspections of large polluters under federal jurisdiction.</p> <p>Cantons should have the opportunity to review and provide inputs into federal procedures to process permit applications, issue permits and conduct inspections.</p>
Responsible	Lead: FMET; with cantonal ministries responsible for environment / AQM
Also strengthens AQM functions:	4. Implementing control strategies

Recommendation 9: Strengthen knowledge exchange and learning between cantons through an AQP peer review mechanism and staff secondments

Problem statement	<p>Cantons that are less advanced and knowledgeable in matters related to AQM currently do not benefit from the successes and learnings of more advanced cantons such as Sarajevo and are thus prone to adopting air quality objectives, control strategies or enforcement measures, if at all, that have been proven to be ineffective, inefficient or unsuitable.</p> <p>In addition to the other recommendations that will strengthen this function, it is suggested that routine opportunities are created for cantons to be exposed to the best available practices and a mandatory quality assurance process that can inform their selection of air quality control strategies.</p>
Required action	<p>Amend the regulation on the preparation of AQPs to include a mandatory peer review period.</p> <p>Establish an annual or bi-annual peer learning platform for key cantonal stakeholders involved in AQM to exchange experiences and lessons learned.</p> <p>Finance and facilitate a minimum number of one to two staff secondments per canton per year, allowing staff with AQM responsibilities from less advanced cantons to shadow their more experienced counterparts from the more advanced cantons in AQM.</p>
Responsible	Lead: FMET; with cantonal ministries responsible for environment / AQM
Also strengthens AQM functions:	<ul style="list-style-type: none"> 4. Implementing control strategies 6. Air quality monitoring and progress evaluation

FUNCTION 4: IMPLEMENTING CONTROL STRATEGIES

Recommendation 10: Regulate residential sector heating and energy efficiency

Problem statement	Emissions from residential sources are the largest contributor to PM ambient air pollution and are mostly due to the unregulated use of inefficient or outdated heating technology and the use of low-quality solid fuels in individual households.
Required action	<p>The following measures partly require prior regulatory changes from the state level, as outlined in recommendation 1:</p> <ul style="list-style-type: none"> - Regulate permissible fuels and fuel quality; - Introduce eco-design certification of stoves and boilers. <p>These and other measures are included in the Strategy to Limit the Use of Coal and Other Solid Fuels in Canton Sarajevo 2023-2033 which should be fully implemented:</p> <ul style="list-style-type: none"> - A public campaign to raise citizens' awareness of the importance of energy efficiency and the reduction of particulate emissions and their impact on health; - Continuously informing consumers about possible ways to save energy and costs; - Revised regulations on energy efficiency measures and the replacement of energy sources in households and the introduction of district heating systems; - Establishment of an educational center for energy efficiency; - Capacity strengthening and awareness raising of construction and design firms in the field of energy efficiency principles of construction and design; - Formation of a fund for financing energy efficiency projects.
Responsible	Center for Air Quality, Ministry of Communal Economy, Infrastructure, Spatial Planning, Construction and Environmental Protection, Canton Sarajevo (MCEEP)
Also strengthens AQM function:	5. Monitoring implementation and enforcing compliance

Recommendation 11: Introduce and scale incentives for the residential sector for switching to clean heating technology and clean fuel options, and incentivize energy efficiency measures

Problem statement	The use of inefficient stoves and poor-quality solid fuels occurs in all social strata, but particularly among income-constrained households.
Required action	<p>Establish an incentive scheme, similar to what is proposed in the Strategy to Limit the Use of Coal and Other Solid Fuels in Canton Sarajevo 2023-2033, to encourage stove and boiler replacements at scale.</p> <p>The scheme should be based on good practices in other countries, refine the operating model to make it as easy as possible for eligible citizens to access the incentives. This may include (different from what is described in the Strategy):</p> <ul style="list-style-type: none"> ● An active role for the private sector to facilitate incentive applications; ● Environmental Protection Fund or private banks can process funding.

Responsible	Center for Air Quality, Ministry of Communal Economy, Infrastructure, Spatial Planning, Construction and Environmental Protection, Canton Sarajevo (MCEEP)
Also strengthens AQM function:	N/A

Recommendation 12: Strengthen citizen-focused AQM by establishing eco-managers or energy advisers in municipalities

Problem statement	The majority of municipalities do not have the organizational capacity or staff expertise to provide guidance and technical advice to citizens in the area of AQM. Local-level eco-managers (also called eco-advisers or energy advisers in some countries) can perform important advisory and outreach functions, creating a linkage between the administration and households whose cooperation is required to achieve compliance with air quality standards and objectives.
Required action	<p>Following good practice examples, establish eco-manager/eco-adviser positions at municipal level who provide advice to citizens on current AQM regulations and how they affect citizens, potential for cost/energy savings, etc. The positions can be stand-alone or they can be fulfilled by chimney sweeps, as is the case in some EU countries.</p> <p>There are at least two options for the operating modality:</p> <ul style="list-style-type: none"> ● Public sector: The position is established in the municipality (public service). ● Private sector: It can be offered as an add-on professional qualification for eligible contractors; training is offered by technical colleges or institutions certified by the government. <ul style="list-style-type: none"> ○ The government can provide incentives for the start-up phase (for example, vouchers for eligible households to use the services of an eco-adviser)
Responsible	FMET to provide conceptual design and financial incentives. For the municipality level, the responsible entity according to the Law on Local Government. It could also be adopted through a decision of the cantonal assembly.
Also strengthens AQM function:	5. Monitoring implementation and enforcing compliance

FUNCTION 5: MONITORING IMPLEMENTATION AND ENFORCING COMPLIANCE

Recommendation 13: Formally and practically embed the function of chimney sweeps in the AQM system, enforce annual inspections of all buildings, use inspection results to build a localized emission inventory and to ensure households comply with air quality regulations

Problem statement	Residential emission sources are essentially unmonitored. There are no AQM rules and responsibilities that homeowners would have to comply with and which can be enforced, and enforcement capacity at the cantonal level is extremely limited. Chimney sweeps could play a pivotal role in the local AQM monitoring and enforcement system, but there is no legal basis for residential inspection and reporting, and there are only few professional sweeps left in the canton.
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<p>Required action</p>	<p>Necessary changes:</p> <ul style="list-style-type: none"> ● Chimney sweeping must become mandatory again for all residential heating installations, as envisaged in the Strategy to Limit the Use of Coal and Other Solid Fuels in Canton Sarajevo 2023-2033; ● Determine the most efficient operational model (public utility as per the Law on Communal Services; independent, certified contractors; or other), learning from practices in other countries; ● Chimney sweep inspection certificates will record any non-compliance and necessary changes; they form the basis of the follow-up inspection; ● In the event of non-compliance, the chimney sweep reports the infringement to the relevant authority (if the operating model works through the Law on Communal Services, this would be the communal inspection authority). <ul style="list-style-type: none"> ○ The authority issues a fine to the non-compliant household ● Chimney sweep measurement and inspection reports feed into the cantonal emission inventory of residential emission sources. <p>Steps required to re-introduce the chimney sweep function at scale:</p> <ul style="list-style-type: none"> - Create the legal prerequisites for the introduction of chimney sweeping services, potentially as a communal activity. - Create the legal framework for the work of the chimney sweeps through the drafting of regulations and technical guidelines for chimney sweeps. - Ensure a sufficient number of qualified chimney sweeps is trained through retraining programs for similar trades and by introducing this course in high schools in Sarajevo Canton, as well as additional training for emissions and fuel quality measurement tasks. - Depending on the prescribed number of mandatory inspections for the cleaning and control of fireplaces, it is estimated that between 70 and 100 new jobs will be created in this sector in Canton Sarajevo. - Ensure supervision of the implementation of monitoring through communal police or communal wardens. - Ensuring the maintenance of a register of small emission sources in Canton Sarajevo.
<p>Responsible</p>	<p>Responsible cantonal ministry; in Sarajevo: Center for Air Quality, Ministry of Communal Economy, Infrastructure, Spatial Planning, Construction and Environmental Protection (MCEEP)</p>
<p>Also strengthens AQM functions:</p>	<p>4. Implementing control strategies 6. Air quality monitoring and progress evaluation</p>

Recommendation 14: Strengthen the inspection function at all levels to control emissions from small industrial sources

<p>Problem statement</p>	<p>Any plants of under 10 MWth capacity, regardless of the type of fuel, are required to submit emission measurement reports to the government administration, but these are not checked for undue exceedances. There is no supervision or inspection if they do not require an environmental permit, irrespective of their potentially damaging air quality</p>
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	impacts. Canton Sarajevo does not maintain a formal register of small businesses, making it difficult to include these commercial entities in the AQM governance system. There is no prescribed emission limit value for dust emissions from boilers smaller than 1 MW or any other rule for boiler certification or any limitation on solid fuel quality.
Required action	<p>The new draft FBiH Law on Air Protection establishes the right for cantons to adopt their own cantonal Law on Air Protection; the law is not yet in force.</p> <ul style="list-style-type: none"> • The FBiH Law on Air Protection should require cantonal Laws on Air Protection to ensure that small industrial sources fall under environmental inspections. • In a cantonal Law on Air Protection, yet to be developed, ensure environmental inspections cover small industrial sources and small businesses. • Municipal inspectors need to be able to inspect legal entities, even after they have obtained their use permit. • Individual households will be covered by chimney sweepers.
Responsible	Federal, Cantonal, and Municipal Inspection Authority
Also strengthens AQM function:	6. Air quality monitoring and progress evaluation

Recommendation 15: Enhance the capacity of environmental inspection authorities to carry out air quality-related monitoring and inspections

Problem statement	The number of inspectors is low overall, and the number of inspectors with the technical capacity to conduct inspections focused on air pollution emission sources is even lower.
Required action	<ul style="list-style-type: none"> • Increase the number of inspectors at cantonal and municipal levels dedicated to air quality. • Offer training and technical guidance to AQM-focused inspectors to ensure adequate capacity to carry out qualified inspections. • Inspectors should be allowed to carry out unannounced inspections of any legal or private entity, not only those subject to environmental permits.
Responsible	Federal, Cantonal, and Municipal Inspection Authority
Also strengthens AQM function:	6. Air quality monitoring and progress evaluation

FUNCTION 6: AIR QUALITY MONITORING AND PROGRESS EVALUATION

Recommendation 16: Increase public confidence in air quality monitoring results by obtaining accreditation for the Public Health Institute of Canton Sarajevo

Problem statement	PHI is not accredited as a measurement laboratory for air quality monitoring according to the general requirements for the competence of testing and calibration laboratories (ISO/IEC 17025). In spite of this, its current air quality monitoring is conducted in accordance with the ISO/IEC norms, and the equipment it uses complies with the relevant standards. Although the accreditation process would be demanding and time-consuming, it can help to increase public confidence in air quality monitoring results.
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Required action	Seek accreditation according to BAS EN 17025 for the measurement laboratory of the PHI of Canton Sarajevo. Accreditation is done by the Institute for Accreditation of Bosnia and Herzegovina (BATA). The scope of accreditation should include all the required, measured pollutants and needs to be expanded regularly with new pollutants according to federal legislation.
Responsible	PHI of Canton Sarajevo
Also strengthens AQM functions:	2. Determining required emission reductions 3. Developing control strategies

Recommendation 17: Strengthen technical capacity for monitoring all required air quality parameters

Problem statement	The current status of measurement network and capacity do not allow for regular monitoring of all required parameters. Some are only measured occasionally (like heavy metals in PM), other pollutants are not monitored at all (benzene, benzo[a]pyrene, lead, arsenic, cadmium, mercury, nickel), partly for a lack of laboratory capacities and partly due to limited funds needed for this type of monitoring.
Required action	<ul style="list-style-type: none"> ● Upgrade the network of measurement stations; ● Establish a federal reference laboratory for air quality ● Train staff in FHMI and PHI and equip them with methods for sampling and measurement of the following pollutants: <ul style="list-style-type: none"> ○ Heavy metals in the air; ○ Benzene ○ Benzo[a]pyrene ○ Black Carbon ○ Polychlorinated dibenzodioxins (PCDD/F, or simply dioxins)
Responsible	FHMI; PHI of Canton Sarajevo
Also strengthens AQM functions:	N/A

CROSS-CUTTING

Recommendation 18: Enhance information sharing on air quality monitoring results, education on health impacts and measures to be taken, and citizens' roles and responsibilities in AQM

Problem statement	Public communication and participation regarding AQM is mostly limited to passively posting draft strategy documents and plans on government websites for public comment. There is limited to no pro-active communication about AQM measures, energy and air pollution-reducing options for individual households, cost savings, and regulatory compliance requirements.
Required action	<ul style="list-style-type: none"> ● FHMI and PHI to modernize sharing of air quality information via web portal; offer mobile alerts and use social media to share monitoring results ● FMET / MCEEP: Proactive communication campaign about: <ul style="list-style-type: none"> ○ Upcoming policy changes and regulations ○ Advice and mandatory regulations on permissible fuel and quality of fuel; stoves and boilers; energy efficiency; and other issues.

Responsible	FHMI; PHI of Canton Sarajevo FMET Center for Air Quality in the Ministry of Communal Economy, Infrastructure, Spatial Planning, Construction and Environmental Protection, Canton Sarajevo
Also strengthens AQM functions:	All

ANNEXES

Annex 1: Methodology: Analytical framework for the functional review of AQM

1. What are functional reviews?

A functional review (FR) is an analytical approach to strengthen public sector performance and government effectiveness in relation to a specific policy objective. Rather than a narrow set of tools or methods, FRs have been used in the Bank as a problem-driven and results-oriented framework for helping public administrations assess the functions they perform, identify performance constraints and develop practical recommendations for improvement (Manning and Parison 2004). The overarching goal is to increase the effectiveness with which policy objectives are translated into actions and outcomes.

FRs typically serve one or several of the following objectives, recognizing the increasing pressures on government services to become more accountable, client-focused and results-oriented:

- Review policies and other formal norms for clarity, coherence and efficiency of objectives, roles, responsibilities and accountability.
- Align government functions, structures and resource allocations with policy objectives and citizen demands.
- Overcome functional fragmentation or compartmentalization, eliminate duplications and other organizational inefficiencies.
- Increase efficiency and cost-effectiveness of administrative performance and service delivery, for example, by consolidating functions across levels and units of government, streamlining work processes, setting incentives and controls, and identifying services and assets that can be outsourced or shared across government (Eckardt, n.d.).

The focus and scope of a FR depend on the problem area that it seeks to address, typically with a view to informing potential reforms in one or both of two dimensions: 'policy' and 'organization'. Given an overarching governance objective, such as effective air quality management, a FR can help to assess whether existing policies clearly define the results to be achieved, assign roles and responsibilities and establish efficient and accountable processes how the results are to be delivered ('what government should do'). At an organizational level, FRs offer a mechanism to analyze whether and how institutional and implementation arrangements are fit for purpose ('what government can do').

Table 13: Generic Functional Review types¹⁸

Review type	Main Focus	Results	Application	Scope
Structural Public Sector Reviews	Distribution of Functions between Government and Private Sector	Reduced Fiscal Burden/ Revenue Generation Rightsizing Improved Service Quality through leveraging private sector and competition	Reviews in preparation for the divestiture/ privatization of non-core activities	Whole of Government, Policy Sectors (Health, Railways, Energy and Utilities, etc.)
Horizontal Portfolio Reviews	Distribution of Functions across Government Institutions	Alignment of Cabinet Portfolio to Public Policy Priorities	Reviews in response to particular policy crisis or new emerging priorities	Machinery of Government, Policy Sectors
Vertical Agency Reviews	Distribution of Functions within Government Institutions	Improved Efficiency and Effectiveness in execution of Core Functions Elimination of duplications	Reviews as part of ongoing service improvement initiative or in response to particular policy issue	Policy Sectors/ Individual Government Entities
Spending Program Reviews	Distribution of Resources across programs/ functions	Resource Prioritization and Efficiency Gains	Selective or Comprehensive reviews as part of budget process or one off fiscal consolidation	Spending Programs
Business Process Reviews	Optimization of processes and controls	Improved Efficiency and Effectiveness in execution of Core Functions	Reviews as part of ongoing service improvement initiative or in response to particular policy issue	Business Processes

2. A cyclical model of AQM

For the purpose of this review, AQM is organized into six interdependent functions or steps (Figure 2 in chapter 1). Common to all AQM approaches is the aim to deliver impactful action to ensure the best possible quality of air, avoiding or minimizing adverse effects on human health, the environment and the economy. The six AQM functions are not numbered because they can be conceived of in a cyclical process whereby each step is embedded in an interdependent sequence of other steps (World Bank Group 2020; Wijetilleke and Karunaratne 1995; Committee on Air Quality Management in the United States 2004).

Six core AQM functions:

- **Establishing goals, standards and objectives:** Goals or targets for air emissions or air quality define a pollution level – or standard – that protects health, welfare or the environment. Defining limits on emissions and particulate matter pollution, requires information generated by scientific research on the health and welfare impacts of air pollution. Air Quality standards and objectives

¹⁸ Table based on a presentation by Gary Reid as referenced in (Eckardt, n.d.)

are typically set at the national level. The European Union has also issued an extensive body of air quality legislation that sets boundaries for the standards to be adopted by member states in line with WHO guidelines. Therefore, Governments typically establish ambient air quality standards following the EU and WHO parameters, and design regulations that require regional, district or municipal jurisdiction – to achieve these standards within a specified time period.

- **Determining required emission reductions:** Once AAP standards have been set per pollutant, the necessary level of emissions reduction can be identified to attain and maintain the standards. This step depends on three prerequisites: air quality monitoring data; an emissions inventory that provides a list of sources that contribute to air pollution along with data that are needed to calculate actual emissions; and source attribution that provides data analysis and modeling to determine which sources are the primary contributors to air pollution (see Box 10 below for the relationship between emission inventories and source apportionment).
- **Developing control strategies:** Depending on a country's regulatory framework, it may be the responsibility of national, regional/state or municipal decision makers to develop emissions prevention and control strategies that convey how the standards will be met. The design and choice of emissions reduction options requires an understanding of the air quality, health, social and economic benefits and implications of different courses of action across relevant sectors. Each jurisdiction then agrees and adopts a control strategy along with a detailed, comprehensive and legally binding plan to meet the standard by a future date.
- **Implementing control strategies:** Roles and responsibilities for implementation are assigned in the emissions prevention and control strategies. Implementation can involve a broad range of stakeholders that extend beyond government entities, for example, by requiring households to replace old furnaces or to avoid certain types of fuel for heating. The implementation of control strategies is closely linked with compliance measures and enforcement oversight to ensure the effectiveness of the AQM regime.
- **Monitoring implementation and enforcing compliance:** In contrast to air quality monitoring that is used to measure prevailing air pollution levels (see below), routine implementation monitoring is required to assess whether the actions of individuals and institutions comply with the provisions of the air control strategies. For example, authorities may need to determine whether households comply with a ban of certain fuels or equipment modernization requirements. In case infringements are detected, mechanisms must be in place to enforce compliance. The monitoring and enforcement functions are not necessarily assigned to the same entity. For example, chimney sweepers may be obligated to conduct annual chimney checks and to report non-compliant household heating equipment to government authorities to follow up and enforce compliance. The enforcement function may require the collaboration of several government agencies, for example, environmental protection agencies, environmental officers of local authorities, and local police. Regardless of the regulatory design, the performance of the monitoring and enforcement function is critical to achieve emission reductions that can be detected in the last step, air quality monitoring.

- **Ongoing air quality monitoring, progress measurement, and evaluation vis-à-vis objectives:** Monitoring of the air quality and emissions, through a network of measurement stations or remote sensing¹⁹, is used to evaluate if the control strategy is working effectively and emissions reduction objectives are met. If not, or if the standards or goals are to be adjusted, the air quality monitoring data informs the redefinition of standards and control strategies.

Box 10: The role of emission inventories and source apportionment.

Emission inventories and source apportionment

Emission inventories: The main goal of an emission inventory is to determine the key emission sources affecting air quality in a geographic location. Different categories of sources are typically distinguished, including point sources (e.g. smoke stacks), area sources (e.g. residential neighborhoods) and mobile sources (e.g. road traffic, trains, planes, etc.).

The inventory data can be used to identify strategies to reduce pollution by helping air quality control agencies understand the types and quantities of different pollutants emitted in and around an area. A second use of the inventory is to establish the temporal and spatial distribution of pollutants in a region through reporting and tracking. In many cases, simply knowing the types and amount of emissions within a large geographic region may not be enough to explain observed air pollution patterns. Understanding where emissions occur, or when changes in emissions take place, can help regulators to verify expected emissions and to track progress in planned reductions over time.

Source apportionment refers to the practice of investigating the amount that each known emission source contributes to prevailing air pollution levels. One of the main approaches to do this is by using data from emission inventories. Another approach is through receptor-oriented models that apportion the measured mass of an atmospheric pollutant at a given site, called the receptor, to its emission sources by using multivariate analysis.

Therefore, source apportionment is an important decision tool to inform the design of air pollution control strategies.

Communication and public participation are processes, not single events, that run across the six functions to both inform the public and obtain input from them. Transparent and participatory AQM can strengthen the design, public acceptance and compliance with air quality standards and air control strategies. Public participation provides stakeholders the opportunity to influence decisions that affect their lives. Stakeholders include anyone with an interest or stake in an issue, including individuals, interest groups, and whole communities.

Depending on the form of participation sought, public engagement makes use of a variety of tools and techniques to inform the public, generate public input, and, in some cases, build consensus and reach agreement. The information that comes from these processes can enable analysis of costs of control

¹⁹ In the EU, emissions from industrial facilities are reported through the European Pollutant Release and Transfer Register (E-PRTR), a Europe-wide register that provides key environmental data from European Union Member States and in Iceland, Liechtenstein and Norway.

measures across a range of sectors as compared to the benefits of undertaking these programs. The results can be expressed either as a cost-benefit comparison in one sector or presented in terms of cost-effectiveness, i.e. identifying the amount of health benefit, energy savings, or expected productivity gains across different sectors. This can help administrative or environmental officials speak to different constituencies whose support will be needed to adopt measures by demonstrating how emissions reductions support multiple sustainable development objectives.

3. Functional review criteria and data

Each of the six AQM functions will be reviewed against eight criteria (Table 2) for a comprehensive assessment of the formal prerequisites and practical implementation conditions that enable or hinder functional AQM performance. The review criteria, questions and scoring system draw on the literature on AQM, institutional analysis and the World Bank’s Country Policy and Institutional Assessment (Rosenbaum 2020; Muller, Domfeh, and Yeboah-Assiamah 2017; McGinnis 2011; Nigussie et al. 2018; World Bank 2017). Table 2 provides the scoring system for each criterion which will be assessed based on its de jure (formal) and de facto configuration (in practice). The scores obtained range from 1 to 3:

- 1 Non-existent or not functional
- 2 Partially functional
- 3 Fully functional and fit for purpose
- N/A Not applicable to this function

Table 14: Overview of the FR assessment framework – eight review criteria and associated questions.

Function	Review criteria	Guiding assessment questions
Each of the six AQM functions will be assessed against all criteria	a. Functional task definition ('what')	Do legal, regulatory or institutional rules exist that clearly define what is to be done, and are these rules followed? Are air quality related rules and functions aligned with other (e.g. climate or sectoral) policies, international obligations, and coherent across sectors and levels of government?
	b. Distribution of responsibilities ('who')	Is it clear who is formally mandated and responsible to carry out the function? Are responsibilities coherently assigned and aligned within and across government institutions and levels of government, avoiding overlaps, gaps and competition of authority?
	c. Process management ('how')	Are processes and work flows organized to maximize utility and put scarce resources to optimum use? Are processes and work flows adaptive to changes in context, objectives, resources or capacity?

d. Capacity	<p>Do the stakeholders with the responsibility to carry out the function have the necessary knowledge and skills for this purpose?</p> <p>Do the stakeholders with the responsibility to carry out the function have the required non-financial means for this purpose?</p>
e. Information and data	<p>Are the stakeholders with the responsibility to carry out the function required, make use of or generate evidence? Is this data and information available and accessible in practice?</p> <p>Do the stakeholders with the responsibility to carry out the function actively use relevant information and data?</p>
f. Budget, financing, incentives	<p>Are sufficient financial resources allocated and available for this function to be performed effectively?</p> <p>Are financial or non-financial incentives provided to encourage and reward carrying out the function?</p>
g. Communication and participation	<p>Does the function include adequate provisions for dissemination of relevant information to pertinent audiences, for example, duty bearers or the public?</p> <p>Are mechanisms for stakeholder participation, feedback loops and grievance redressal mechanisms built into the functional design? Are they implemented?</p>
h. Leadership	<p>Do political, administrative, business or civil society leaders involved in this function prioritize this function? Do they publicly express commitment to the functional goals and objectives?</p> <p>Do political, administrative, business or civil society leaders have sufficient subject matter understanding and capacity to steer and/or support this function?</p>

To generate policy and organizational recommendations for strengthening AQM with a focus on the residential sector, the following three analytical lenses will be applied to each function and review criterion:

- (i) **The residential sector** is the central reference point for this FR. Therefore, the review will identify and assess functional tasks, rules or instruments for each AQM function as they pertain to the residential sector.
- (ii) **Institutional or individual actors** with a role in or affected by each function will be traced by the review to capture any potential opportunities and constraints of functional performance.
- (iii) **Different levels of government or organization** will be considered in the FR because the local context of individual households, their decision space and incentives are shaped by rules and practices that originate at the local, regional or national level.

The FR will consist of a narrative summary of the analytical findings and a completed scoring table against the eight review criteria (or the applicable subset), with reference to the three analytical lenses mentioned above.

The analysis is based on data from a desk review and key informant interviews in Canton Sarajevo. The team has reviewed relevant laws, policies and regulatory provisions at the national, regional and local levels.

Annex 2: The policy and institutional framework for AQM in BiH, FBiH and Canton Sarajevo

1. Key regulations and policy instruments governing AQM

The complex legal and institutional arrangements that govern public policy and decision-making in general in BiH also shape AQM at all levels, as is evident from the overview of key AQM regulations and policy instruments below.

1.1 European Union directives

Since BiH was identified as a potential candidate for EU membership in June 2003, the country – and by extension each jurisdiction – has had an incentive to harmonize air quality-related legislation. The EU *acquis* must be incorporated into the country's legal order by the time of accession.

BiH has made considerable progress in harmonizing its legal order with the EU acquis, also in the area of AQM. The country formally applied for EU membership in 2016 and was recognized as a 'candidate country' in late 2022. BiH has adopted a Strategy for Harmonization of Regulations to the EU Acquis in the Field of Environmental Protection (Environmental Approximation Strategy) in 2017, with the aim of implementing the EU acquis in the area of ambient air quality.

Most importantly, the limit values for key pollutants defined in the EU's Clean Air For Europe (CAFE) Directive 2008/50/EC²⁰ have informed the limit values pursued by the entities (FBiH, RS, and BD), as discussed in detail in chapter 3.1 on 'setting air quality standards and objectives'. The CAFE Directive merges most of the existing legislation into a single directive. It sets legally binding limit values for key pollutants, such as PM_{2.5}, PM₁₀, SO₂, and O₃. The Directive further stipulates that 10-year Air Quality Plans (AQPs) are developed for pollutants that exceed ambient air quality standards within an air quality zone. AQPs define the state of air quality within a zone, pollution sources, and measures to be taken by local authorities to reduce air pollution.

Other important EU directives have not yet been fully transposed or not been transposed at all, such as the National Emissions Ceilings Directive (2016/2284/EU) and the Directive on Sulphur Content of Liquid Fuels (1999/32/EC).

1.2 Country level air quality laws and policy instruments in BiH

The constitution of BiH does not expressly regulate the issue of environmental protection. A country-level environment ministry or agency does not exist. At the country level, the Ministry of Foreign Trade and Economic Relations (MOFTER) is responsible for defining basic principles for environmental management, coordination with other sectors and levels of government, and for facilitating efforts to

²⁰ See 'EU air quality standards', https://environment.ec.europa.eu/topics/air/air-quality/eu-air-quality-standards_en

harmonize environmental policy and legislation. However, beyond these broad strokes, the constitution stipulates that all governmental functions and powers that are not expressly assigned to the institutions of BiH belong to the entities.

Therefore, the primary responsibility for environmental issues, including air quality management, rests with the constitutional entities (FBiH, RS, and BD), but there is no formal mechanism to address diverging positions between them. An Inter-Entity Coordination Body for the Environment was established in 2006 to help develop a harmonized approach for environmental protection among the FBiH, RS, and BD. However, its decisions are not legally binding. As a result, the country has three legal frameworks, organizational structures, and air quality networks.

Fortunately, the two entities and BD have largely harmonized their ambitions to curb air pollution by adopting the limit values of the EU's CAFE Directive. While the duplication of legal and organizational instruments between the entities persists, at least their content and objectives are now broadly aligned on paper.

Beginning in 2019, BiH started to develop the Environmental Strategy and Action Plan 2030+ (ESAP 2030+), covering the period 2022-2032, in a country-wide effort to define harmonized, ambitious goals for environmental and air protection. With support from the Stockholm Environment Institute, a participatory development process was undertaken to arrive at a policy document that would comprise four strategies and action plans, one for the BiH country level, and one for each of the entities (FBiH, RS) and BD. The objective was to strengthen the environmental frameworks holistically within BiH, to provide an overview of the current environmental situation and challenges, and a 10-year plan on how to address these challenges. Another important goal was to further align regulations and processes with the EU acquis, to facilitate a future accession to the EU. The BiH ESAP2030+ was finalized in mid-2022. The entity-level strategies contained therein were subsequently adopted, as discussed in the next section. Annex 3 provides an overview of important laws, policy instruments, and strategies related to AQM at the different levels of government.

1.3 Key AQM laws and instruments in the entity of FBiH

The FBiH Law on Environmental Protection (FBiH-LEP) and the FBiH Law on Air Protection (FBiH-LAP), both adopted in 2003 and amended in 2010, are the cornerstones of the legal framework governing AQM. The laws broadly regulate the measures to prevent or reduce air pollution emissions caused by human activities on the territory of FBiH; air quality protection planning; rules governing special sources of emissions; emission inventories; air quality measurement; supervision; and fines for offenses for legal entities and natural persons.

The guiding principles enshrined in the FBiH-LEP follow international good practice regarding AQM measures:

- a. An integrated approach to environmental protection, including air, water and soil.
- b. The obligation to reduce emissions to the lowest possible extent by using the best available technology.

- c. The polluter pays, which ensures that the costs of reducing air pollution are borne by the operators of pollutant emitting sources.
- d. Compliance of occupational safety with environmental protection rules.

The FBiH-LEP requires the Federal Ministry of Environment and Tourism (FMET) to develop a Strategy for Environmental Protection, including a Strategy for Air Protection. The strategy is developed with inputs from cantonal ministries and an advisory council. The law requires the public to be consulted on the draft for comments. The strategy covers a validity period of ten years and must be adopted by the Parliament of the FBiH. The last strategy covered the period 2008–2018.

With the endorsement of the ESAP 2030+ in August 2022, the Parliament of FBiH also adopted a new Environmental Strategy for the period 2022–2032, which includes strategic goals on air quality, as discussed in further detail in chapter 3.1 on setting air quality standards and objectives. The other entities did the same, effectively moving towards greater harmonization of environmental and air protection regulations across BiH.

The current FBiH Law on Air Protection (FBiH-LAP) and its subsidiary rulebooks and regulations provide a relatively comprehensive AQM governance framework, with a significant gap. The FBiH-LAP and associated regulatory documents determine limit values for emissions from all types of industrial sources, pollutant limit values to ensure good air quality for human health and environmental protection, AQ warning and alarm levels, emissions measurement procedures, AQ monitoring methods, and the organization of AQ monitoring networks. This set of rules also stipulates that all cantons must put in place plans and short term measures in case of exceedances of AQ warning or alarm levels.

However, the FBiH-LAP and its subsidiaries do not sufficiently regulate several important emissions sources, including emissions from residential sources and road traffic. The use of solid fuels is not regulated, nor its quality. Neither monitoring nor certification of households boilers or stoves are controlled. This leaves a major gap in AQM governance, particularly given that emissions from residential sources, particularly the use of solid fuels for heating and cooking, are the main sources of air pollution in FBiH, especially in urban areas and in the winter months, along with old or inefficient boilers and stoves, poor energy efficiency of individual houses, and road traffic.

In light of the gap in the existing FBiH-LAP, the Government of the FBiH drafted a new FBiH Law on Air Protection in 2021. The new law, which was not yet in force at the time of writing, will address many of the current shortcomings. The new FBiH-LAP was developed as a follow up to the revised Law on Environmental Protection. Although the draft of the overhauled FBiH-LAP was accepted by the Federal Parliament already in 2021, the remaining steps to adoption – discussion and voting on the floor of the FBiH Parliament – had not been taken at the time of writing this report.

Box 11: Summary of important changes to AQM governance introduced in the new FBiH Law on Air Protection (draft of 2021, not yet adopted).

The proposed new FBiH Law on Air Protection will deliver significant improvements in the framework conditions for AQM at the entity and cantonal levels.

- The **actors** playing a significant role in AQM are comprehensively defined, and roles and responsibilities are clearly assigned. The actors include the competent authorities of the country, FBiH, cantons, local self-government units (municipalities, cities), business entities, and other legal entities and individual persons.
- The **territory** of FBiH is divided into air quality zones and agglomerations, based on the assessment of air quality, for the purposes of monitoring, maintaining or improving air quality.
- It will be mandatory for the government to establish a federal and cantonal **network of air quality measurement** stations and/or measuring points. The establishment of a municipal network of measuring stations and/or measuring points will be optional.
- A range of **AQM policy and planning instruments** are (re-)introduced:
 - The Air Protection Strategy must be an integral part of the Environmental Protection Strategy;
 - **Air Quality Plans (AQP)**, in line with EU directives;
 - **Short-term Action Plans (STAP) / Intervention Plans**, in line with EU directives;
 - A State Program for the Gradual Reduction of Annual Maximum Pollutant Emissions;
 - Plans for operators to reduce emissions from stationary plants.
- Cantonal authorities are **required to adopt AQPs** for air quality zones in which air pollution levels exceed the defined limit values over a period of time. The objective of the AQP is to achieve the desired levels of air quality within the permissible limit values.
- Cantons are given the authority to adopt **cantonal air protection laws** if deemed necessary. The cantonal laws must be aligned with federal laws but can go beyond them to take regulatory measures that are suitable to the local context.
- The **responsibility for inspection and supervision** of compliance with the new FBiH-LAP and the regulations adopted for its implementation is assigned to the federal environmental protection inspection, the cantonal environmental protection inspection, and the inspection for urban planning and construction in local self-government units.
- Legal entities that do not comply with their responsibilities to submit data on air quality or that do not adopt AQPs or STAPs where required are to be **penalized**. Moreover, in case of violations against the provisions of the law, protective measures can be imposed that prohibit a legal entity from engaging in certain economic activities, and prohibit an individual from performing certain duties, for a period of 30 days up to six months.

1.4 Key AQM laws and instruments in Canton Sarajevo

In the cantons of the FBiH, the FBiH-LEP requires the cantonal assemblies to adopt five-year Cantonal Environmental Protection Plan (CEAP), the most important strategic document for AQM at the cantonal level. The CEAP must be harmonized with the Federal Environmental Strategy.

The FBiH-LEP defines the following principles and processes regarding the content, development, and adoption of the CEAP:

- a) The CEAP constitutes the overarching guiding document that determines the goals and priorities of environmental protection and air protection, the means to achieve them, the financial and institutional framework for implementation, as well as monitoring, evaluation, and reporting arrangements.
- b) The development of the CEAP follows an open, consultative process. The participating cantonal ministries must include federal, cantonal, and municipal institutions, where relevant.
- c) The draft CEAP is submitted to the Federal Ministry of Spatial Planning, the Federal Ministry of Agriculture, Water Management and Forestry, the Advisory Council, municipalities, and other relevant entities to provide an opportunity to offer inputs and suggestions.
- d) Once finalized, the cantonal government presents the CEAP to the cantonal assembly with a recommendation for adoption.
- e) The cantonal assembly adopts the CEAP.

Not all of the ten cantons in FBiH have adopted a CEAP to date, with Sarajevo, Una-Sana, and Zenica being notable exceptions. A detailed analysis of the latest CEAP for Canton Sarajevo, adopted for the period 2021-2025, is provided in the discussion on the AQM function of setting standards and objectives (chapter 3.1).

The FBiH Law on Air Protection requires cantons to develop a Cantonal Air Protection Plan, also referred to as AQP, for areas where measured air pollution levels exceed limit values for one or more pollutants. However, none of the Cantons has done this to date, and there is no accountability mechanism. The AQP must specify the origin of pollution, such as a list or map of the polluting emission sources, the total volume of emissions from these sources (tons per year), information about pollution coming from other areas, detailed description of measures or projects to be adopted in order to reduce pollution, an assessment of the expected air quality improvement, the time needed to achieve these goals, as well as the necessary resource requirements (funds, personnel, information, etc.). Canton Sarajevo decided that its CEAP included all the information required for an AQP and that no separate document needed to be created. Unfortunately, there is no accountability mechanism between levels of government that would ensure that cantons develop and implement AQPs. Moreover, an AQP is not legally binding as currently defined by law. Therefore, cantonal governments are neither required to budget for its implementation nor report on whether results were delivered.

In Canton Sarajevo, the second main legal instrument governing AQM is the Decision on the Protection and Improvement of Air Quality in Canton Sarajevo, adopted by the Cantonal Assembly in May 2016. The Decision sets the framework for AQM in the territory of Canton Sarajevo and pertains to administrative bodies and organizations of the canton, cities and municipalities, and other legal entities in the AQM system. It regulates source identification and emission inventories, limitation and monitoring of air pollution emissions, air quality measurement and assessment, assessment of threats to the health of citizens and ecosystems, and maintenance of flue installations. The Decision identifies public communication and education as important components of an effective AQM system. The public must be

informed about emissions and air quality levels to enable citizens and other interested parties to influence plans and decisions that shape air quality.

The responsibility to implement the Decision is assigned to practically everyone, making it difficult to hold anyone accountable. Implementation responsibilities are given to the government of Canton Sarajevo, the City of Sarajevo, and municipalities, within their powers, as well as business entities, legal and natural persons, and citizens who own, sell and use fuel. In order to achieve the goals of the Decision, FMET is obliged to cooperate with the canton in accordance with the FBiH-LEP, although this has limited practical consequences.

The cantonal parliament has transferred some competencies regarding AQM to municipalities, as envisaged by the constitution of Canton Sarajevo. In theory, the constitution also enables the canton to transfer some of its competencies to the federal (FBiH) authorities if this would ensure more effective or efficient implementation. In practice, no such transfer of competence to the federal level has been done in the fields of environmental protection or AQM.

The competencies transferred to municipalities mainly refer to small industry emission sources which do not require environmental permits. For these sources, the obligation of the municipalities is to issue building permits. In the process of issuing the permits, several AQM-related parameters must be defined and checked, including the type of fuel and other resources used in operation, the type and amount of air pollution emissions, and a list of suitable air pollution prevention measures is to be provided. Furthermore, the issuance of permits is conditional upon obtaining an 'expert opinion' from the Institute for Planning of Spatial Development of Canton Sarajevo. The Decision also demands that existing commercial emission sources, such as stonemason's workshops, asphalt factories, or sawmills, adopt measures to curb air pollution and minimize their impact on their neighborhood.

To prevent or address episodes of extreme air pollution or smog, the cantonal government can adopt a short-term Intervention Plan, in situations when there is a risk of exceeding predefined warning or alarm thresholds. The adoption of an Intervention Plan is mandated by the FBiH-LEP and the Decision on the Protection and Improvement of Air Quality in Canton Sarajevo. It is also a standard component in the AQPs of EU countries, referred to as Short-term Action Plan (STAP) in the CAFE Directive. An Intervention Plan specifies measures to reduce the risk of exceeding thresholds and aims to limit the duration of such exceedances. The plan includes control measures, restriction, or suspension of specific activities (including road traffic) which contribute to exceeding the defined thresholds. In the event of a threshold being reached, all citizens and legal entities are obliged to act in accordance with the Intervention Plan.

The short-term Intervention Plan of Canton Sarajevo has defined two thresholds for air pollution: Warning and alarm levels. The main conditions for triggering the thresholds are the measured values for SO₂, NO_x, CO, O₃, PM₁₀, and expected meteorological conditions. The latter are particularly important because of the canton's complex geographical position in a valley system and the occurrence of temperature inversions during the winter months. Therefore, Canton Sarajevo is divided in multiple independent valleys and areas below 700 m elevation above sea level (above the inversion layer).

A recent review of the Intervention Plan identified areas for improvement and made recommendations which the Cantonal Government endorsed and intends to pursue. The detailed assessment, supported by the World Bank, analyzed the intervention measures and their implementation (Szigeti 2023). It concluded that the *type* of proposed short-term measures was generally suitable for reducing air pollution, but that the technical details would need to be elaborated to ensure effective air quality improvement, if the measures were implemented. The review report provided detailed recommendations to strengthen the technical design of the Intervention Plan actions. Shortly after the review was completed, the Cantonal Government formally endorsed the recommendations of the review and adopted a new Plan accordingly.

Following the review and because of high pollution during the winter season and its geographical and meteorological conditions, Canton Sarajevo updated its Intervention Plan in November 2023. The updated Plan defines preventive measures that will be taken before the start of the heating season and continuous measures that are in place from 15 October to 15 April. The updated Intervention Plan has also reduced the warning threshold level for PM₁₀ from previously 150 to 90 µg/m³ and for alarm-level episodes from previously 300 to 200 µg/m³ (daily average).

Table 15: Air pollution thresholds triggering Intervention Plan measures in Canton Sarajevo.

Thresholds	Limit values by pollutant in µg/m ³ (measurement period)				
	SO ₂ (1 hr)*	NO ₂ (1 hr)*	PM ₁₀ (24 hrs) [†]	CO (8 hrs)	CO (24 hrs)
Warning	400	250	90	12,000	7,500
Alarm	500	400	200	15,000	10,000

* Values must be exceeded at least three consecutive hours.

[†] Values must be exceeded as 24 - hourly average for the previous day.

In case the Intervention Plan measures are insufficient to achieve a reduction in pollutant concentrations within 48 hours from the time that the threshold exceedance was declared, the cantonal government can take further measures to achieve effective emission reductions.

Examples of updated Intervention Plan measures, by threshold:

- **Preventive measures**
 - Undertaking of all necessary, technically feasible measures to reduce air emissions, including regular maintenance of boilers and cleaning of chimneys installations.
 - Mandatory cleaning of chimneys in accordance with the Decision on the Protection and Improvement of Air Quality in Sarajevo Canton.
 - Recommendations to all entities that, just before the winter season, organize actions and inform citizens on the preparation of vehicles in terms of inspection of filters, brake systems, and checks of combustion and exhaust systems.

- Control solid fuel storage in terms of weather protection in order to ensure fuel quality and thereby reduce emissions.
- Conduct an information and education campaign with the aim of increasing awareness of the impact on air quality.
- **Continuous measures:**
 - Mandatory cleaning of roads in order to prevent solid particles from rising into the air in accordance with weather conditions.
 - Warn that any burning of waste in home fireplaces and boiler rooms is prohibited and punishable by law.
 - Ensure traffic flow without long delays on the main city roads.
 - Make appeals to the population to reduce the number of vehicles on the road by encouraging ride sharing.
 - Warn citizens who use solid fuels for heating that it is punishable to dispose of hot ashes in municipal waste containers.
 - Conduct an information and education campaign with the aim of increasing awareness of the impact on air quality.
- **Warning:**
 - All plants for the production of thermal energy with a power of more than 50 kW that use solid and liquid fuels reduce the temperature in the rooms they heat by a minimum of 2°C.
 - Intensify the cleaning of roads if weather conditions allow, and in case of low temperatures apply the "wet procedure" with a solution to reduce the concentration of particles in the air on all main city and regional roads, and on at least 40 percent of the busiest local roads.
 - Intensify supervision over the technical compliance of vehicles in case of suspected excessive environmental pollution in accordance with the Rulebook on Vehicle Technical Inspections ("Official Gazette of Bosnia and Herzegovina", number 33/19).
 - Prohibit construction work in the open space that produces dust emission into the air.
 - Prohibit traffic for heavy-duty motor vehicles with a maximum permissible weight of over 3.5 tons on the main city longitudinal road from Baščaršija to Nedžarić, with traffic diverted to alternative directions.
 - Prohibit movement in zone A of cars and trucks whose engines have the EURO2 norm or less.
 - Shift the start of working hours, if possible, to relieve the capacity of public city transport and city roads.
 - Prohibit public gatherings outdoors to prevent endangerment of people's health.
 - Prohibit outdoor sports activities according to the Canton Sarajevo Sports Law to prevent endangering or worsening the health of athletes.
 - Prohibit children staying outside the school building during major and minor holidays, as well as physical education classes in school yards.
 - Ensure the protection of workers who work outdoors (for example, postal service, police, utility workers, etc.).
 - Warn at-risk population groups to reduce movement and avoid staying outdoors.

- **Alarm:**
 - All warning measures. In addition:
 - Prohibit the movement of cars and trucks in zone A whose engines have EURO3 norm and below.
 - Temporarily stop all technological processes that result in dust emissions into the air where it is technically feasible, i.e. if these technological processes allow stopping. In the event that due to the characteristics of the technological process, it is not possible to completely stop them, it is necessary to reduce them to a technical minimum.
 - Maximize the capacity of public city transport which does not pollute the environment.
 - Subsidize transport tickets or provide free public transport.
 - Organize work from home, depending on the possibility, with the aim of relieving the capacity of public transport and city roads.

When activated, the intervention plan measures have usually had limited effects to curb air pollution episodes and improve air quality. Two main reasons contribute to this. First, not all measures are implemented. As an example, restricting the use of vehicles based on their EURO norm was never fully enforced. This may be partially explained by the fact that, of the 19 legal entities who are responsible for implementing the intervention measures, about 20% do not have staff appointed or responsible to ensure actions are taken. Others face financial constraints (Szigeti 2023). Second, Canton Sarajevo's geographical position and microclimate, particularly when temperature inversions occur in winter, it becomes difficult to reduce pollutant concentrations because they are 'locked' below the inversion layer. In these situations, the measures are primarily aimed at preventing further increases in pollutant concentrations.

2. Main actors in AQM governance in BiH, FBiH, and Canton Sarajevo

In the entity of FBiH, the constitution defines shared jurisdiction between the federal government and the cantons in the area of environmental protection and air quality. The cantons can exercise their jurisdiction jointly or separately, based on need, in coordination with the federal government. Formally, ensuring good air quality is the responsibility of the FBiH, cantons, local self-government units, business entities, and other legal entities and natural persons. In short: it is everyone's responsibility. All actors are formally obliged to cooperate with each other for effective air quality management. Unfortunately, when everyone is responsible, there is no incentive for any one actor to take responsibility.

Because there is no clear and unambiguous mandate assigned regarding AQM, responsibility tends to be shifted between levels of government. The obligations of each level are not clear.

The Constitution of BiH does not mandate the establishment of a ministry or agency for environmental protection at the country level, which would be helpful for the effective resolution of air pollution problems. Instead, the Inter-Entity Authority for the Environment was established in 2006 and deals with all environmental protection issues that require a coordinated approach by the two entities and Brčko District. It is responsible for harmonizing environmental laws, regulations, standards and action plans, international agreements on environmental issues as well as their implementation; participates in

international processes and cooperates with international organizations; monitors the environment, information systems, information exchange as well as cross-border and inter-entity environmental issues.

The most important administrative body in the institutional framework governing AQM at the country level is the Ministry of Foreign Trade and Economic Relations (MOFTER) of BiH. The competences of MOFTER are determined by the Law on Ministries and Other Administrative Bodies of BiH. It stipulates that MOFTER is responsible for performing tasks within the jurisdiction of BiH that relate to defining policy, basic principles, coordinating activities, and harmonizing the plans of entity authorities and institutions on the international level and, among other things, in the area of the use of natural resources.

Other important institutions at the country level, which, among other things, deal with environmental issues are the Ministry of Foreign Affairs of BiH, which is responsible for the preparation of bilateral and multilateral agreements and contracts, and the Directorate for European Integration of BiH, which deals with the coordination of work on the harmonization of the legal system of BiH with the standards for EU accession. The Federal Ministry of Health performs administrative, professional, and other tasks established by law that relate to the competences of FBiH in the field of health and, by extension, consequences of environmental and air pollution.

The most important entity-level institution with a role in environmental protection and AQM in FBiH is the Federal Ministry of Environment and Tourism (FMET). This ministry performs administrative, professional, and other tasks within the jurisdiction of FBiH that relate to: environmental protection of air, water and land; development of environmental protection strategy and policy; air, water and land quality standards; environmental monitoring and air control. FMET leads the development of the Strategy for Environmental Protection, which includes the Strategy for Air Protection. Every two years, the FBiH-LEP mandates FMET to present a report to the FBiH parliament on the implementation of the strategy and initiates a strategy revision, if called for.

The FBiH Environmental Protection Fund collects funds and finances the preparation, development and implementation of programs, projects, and other activities in the field of environmental and air protection, sustainable use, and improvement of natural resources and the use of renewable energy sources. According to its structure, the Fund is a public institution that has the status of a legal non-profit entity.

In Canton Sarajevo, the administrative body responsible for environmental protection is the Ministry of Communal Economy, Infrastructure, Spatial Planning, Construction and Environmental Protection (MCEEP). The ministry's competencies are defined by the provisions of the Law on the Organization and Scope of Administrative Bodies and Administrative Organizations of Canton Sarajevo. It is responsible for important AQM functions: Overall air quality management; establishment and management of an inventory of emission sources for Canton Sarajevo; and air quality monitoring and assessment, in collaboration with other cantonal authorities, administrative institutions, municipalities, and professional bodies.

Within MCEEP, an organizational unit called the Center for Air Quality for Canton Sarajevo was established in 2020 to lead on all matters related to AQM. An analysis was conducted to justify the establishment of the Air Quality Center and to define its responsibilities. There are outlined as follows:

1. Manage the emission inventory for Sarajevo Canton;
2. Organize dispersion modeling;
3. Air quality analysis and information dissemination to the public;
4. Implement the Plan of Intervention Measures and cooperate with other ministries and government agencies;
5. Yearly air quality reporting;
6. Air quality zoning and development of a map for categorizing territory by air quality;
7. Estimate the health impacts of air pollution;
8. Develop of short and long term measures to improve air quality;
9. Implement short and long-term measures, CEAP, and other strategies;
10. Disseminate information to the public about air quality, control strategies, Plan of Intervention Measures, and other air quality-related matters;
11. Contribute to spatial planning.

The Air Quality Center was meant to be staffed with six officials responsible for overseeing, coordinating, or implementing the tasks above. Currently, the Center employs only two staff. It is not clear when and how additional staff will be hired. Instead, the Air Quality Center relies heavily on the external expert group that was assembled to provide technical advice and assistance. Moreover, the role of the Air Quality Center in creating legislation regarding air quality is unclear. Funding, operating equipment, and office space for the Center's day-to-day work is not systematically planned for.

Annex 3: Overview of important laws, policy instruments, and strategies related to AQM

This table complements the overview provided in the previous World Bank study on AQM (World Bank, 2019).

Level of government	Law	Subordinate	Strategy
State level BiH	<p>Constitution of Bosnia and Herzegovina</p> <p>The law on the basics of road safety in Bosnia and Herzegovina</p> <p>The decision on the quality of liquid petroleum fuels (SN BiH 27/02, 28/04, 16/05, 14/06, 22/07, 101/08, 71/09, 58/10)</p>	n/a	<p>BiH ESAP 2030+ (Bosnia and Herzegovina Environmental Strategy and Action Plan 2030+).</p> <p>The content of BiH ESAP 2030+ will cover the following seven EU environmental policy areas:</p> <ul style="list-style-type: none"> - Water - Waste - Biodiversity and nature conservation - Air quality, climate and energy - Chemical safety and noise - Resource management - Environmental management (as horizontal policy)
Entity Republic of Srpska	<p>Law on Air Protection (SG RS broj 124/11,46/17)</p>	<p>Regulation on limit values of air quality (SG RS 124/12)</p> <p>Rulebook on measures to prevent and reduce air pollution and improvement of air quality (SG RS br. 3/15, 51/15, 47/16)</p>	<p>Air protection strategy RS (2011) (According to Law on Air protection)</p> <p>The air protection strategy determines the air protection policy and air quality management. This strategy is an integral part of the strategy and action plan for environmental protection. The air protection strategy is adopted for the period of six years.</p>

<p>Brcko District</p>	<p>Law on Air Protection (SG BD br. 25/04, 1/05, 19/07, 9/09)</p>	<p>Rulebook on limit values of air emissions (SG BD br. 30/06) Rulebook on limit values of emissions of polluting substances into the air (SG BD br. 30/06) Regulation on air quality monitoring (SG BD br. 30/06) Regulation on Monitoring Air Emissions (SG BD br. 30/06) RULEBOOK on limit and target VALUES OF AIR QUALITY, INFORMATION AND ALERT THRESHOLDS (SG BD br. 18/11)</p>	
<p>Canton Sarajevo</p>	<p>Cantonal Assembly - Decision on the Protection and Improvement of Air Quality in Canton Sarajevo</p> <p>Valid from FBiH level:</p> <ul style="list-style-type: none"> - Law on Environmental protection of FBiH (2021) - Law on Air Protection (SN FbiH br. 33/03, 4/10) 	<p>Valid from FBiH level:</p> <ul style="list-style-type: none"> Rulebook on the method of monitoring air quality and defining species of pollutants, limit values and other air quality standards (SN FBiH br. 1/2012) Rulebook on the monitoring of pollutants in the air (SN FBiH br. 9/2014) Rulebook on air quality monitoring (SN FbiH 12/05, 9/16) Rulebook on air emission limit values from plants for combustion (SN FbiH br. 03/13) 	<p>Cantonal environmental protection plan of Sarajevo Canton - CEAP (2021-2025)</p> <p>The Law on Environmental Protection of the Federation of BiH (FBiH) stipulates the obligation to draw up the Cantonal Environmental Protection Plan (CEAP) which, relying on strategic documents of a higher order, should determine the strategic direction in which the cantons should plan for environmental protection. The purpose of creating the CEAP is to provide a basis for the planning and implementation of environmental protection measures in the area of Sarajevo Canton (KS).</p> <p>Methodology for evaluation of impact on AQ of new spatial changes and base dispersion model (developed 2019.; not being implemented)</p> <p>Strategy for limitation of coal and other solid fuels in households in Canton Sarajevo 2023-2033 (waiting for official adoption)</p>

Annex 4: The contribution of chimney sweeps to effective AQM – an EU example

Chimney sweeps fulfil important fire safety and public safety functions, but they can also play important and extensive roles in inspecting and cleaning furnaces and fireplaces, measuring emissions, checking permissible fuel types and quality, and advising homeowners on how to reduce emissions, save energy, and save heating costs.

Germany and Austria have arguably the most stringent chimney sweeping regulations and the most advanced chimney sweep service sector among the EU member states. Similarly, Finland's chimney sweeping sector is highly active and successful, but it is less comprehensively regulated, as is the case in some parts of Italy.

To illustrate how chimney sweeps can contribute to effective AQM, this annex briefly summarizes key features of the German chimney sweeping system.

According to Germany's Federal Association of Chimney Sweepers, around 11.7 million so called single room firing systems are installed in Germany (Umwelt Bundesamt 2019). At the same time, the association reports that the number of traditional coal stoves is decreasing, while the number of modern wood and coal burning stoves and featured fireplaces is increasing. 27% of German households have such stoves in addition to a central heating system.

In order to counteract any worsening of air quality, the first ordinance of the implementation of the Federal Emission Control Act (Ordinance on Small and Medium-sized Firing Installations - 1st BImSchV) determines the fuels permissible for use in boilers and stoves, as well as technical and emission-related requirements and demands for their supervision by the district chimney sweep. The Federal Emission Control Act (BImSchV) and its regulations are implemented by federal states (*Bundesländer*), with municipalities and administrative districts being responsible for air pollution control tasks. For an effective enforcement of boiler, stove and fuel standards, the German government requires all house and apartment owners to have their fireplaces checked on a regular basis.

Who can do the inspection of a fireplace?

Germany has a long history of chimney sweeps being in charge of inspecting and maintaining all fireplaces in the country. Until recent legal changes, chimney sweeps had a full monopoly on passing and checking chimneys and gas heating - German home and apartment owners had a legal duty to use their local sweep to carry out servicing and inspection work at fixed prices. The market started to open in 2009, when Germany was pressured to allow in chimney sweeps from other EU countries. But low statutory prices made the move unappealing to most foreign firms.

In 2013, the new Chimney Sweep Craft Act (*Schornsteinfeger-Handwerksgesetz, SchfHWG*) came into force, bringing Germany in line with EU directives on liberalizing the service sector. Under the new rules, house and apartment owners are authorized to hire licensed free contractors, instead of authorized district sweeps, for measuring, cleaning and inspection of fireplaces. Further, the traditional allocation of districts to chimney sweeps was changed. Now, chimney sweeps must formally apply to work for a district

at the responsible authority (*Bauordnungsbehörde*). According to § 3 SchfHWG, the chimney sweep register provides an overview of who fulfills the requirements for the independent exercise of chimney sweep work.

The master chimney sweep is officially assigned to one district for seven years, typically overseeing 2,000 or more households. After a term of seven years, the master sweep can apply again for the same or any other district. S/he is responsible for carrying out so-called sovereign activities (*hoheitliche Tätigkeiten*). Only the authorized district chimney sweep may a) carry out the public inspection of fireplaces (*Feuerstättenschau*) including the issuance of an inspection certificate (*Feuerstättenbescheid*) (§ 14 Chimney Sweep Craft Act, SchfHWG), and b) maintain a sweep-book (*Kehrbuch*) with a list of all the fireplaces and their technical specifications in the district (§§ 13, 19 SchfHWG).

How often does a fireplace need to be inspected and what is checked?

The public inspection of fireplaces (*Feuerstättenschau*) should take place at the earliest three, at the latest five years after the last public inspection (§14 SchfHWG). A public inspection comprises a wholistic system assessment for the purpose of certifying operational fireplaces and ensuring fire safety. The public inspection is carried out for all fuel systems (solid, liquid, gaseous), and contains the following tasks inspecting:

- All furnaces in one house (heaters, fireplaces and stoves);
- all associated smoke and flue pipes, chimneys and ventilation systems;
- the distances to components of flammable building materials;
- the installation room and fuel supply;
- additional facilities, such as non-flammable templates in front of firing openings;
- collection of various data for the official register held by the responsible administrative authority (age of the heating, dust emissions etc.).

In addition, the central government has stipulated further regulations, e.g. the Energy Saving Ordinance (EnEV) and the 1st BImSchV, including these tasks to verify:

- Whether old boilers that had to be decommissioned in accordance with the EnEV were decommissioned;
- whether heat distribution and hot water pipes and fittings to be insulated are now insulated;
- classification of solid fuel fireplaces regarding decommissioning or retrofitting;
- determining the wood moisture content.

The authorized district chimney sweep issues an inspection certificate after completing the wholistic public system assessment. The inspection certificate informs house and apartment owners about the implementation and schedule of regular sweeping, measuring and inspection tasks, defined in the Federal Sweeping and Inspection Ordinance (KÜO). The annual inspection, sweeping and measuring tasks (*freie Tätigkeit*) – different from the overall public inspection carried out only by the authorized district chimney sweep every three to five years – can also be implemented by qualified free contractors, following the new SchfHWG of 2013. The KÜO specifies how often chimneys must be cleaned and how modern heating and ventilating systems must be inspected:

- "Occasionally used fireplaces" only need to be swept once a year;
- "More than occasional but not regularly used fireplaces" should be swept twice a year;
- "Fireplaces used regularly during the usual heating period" three times a year.

What are the responsibilities and costs for house owners?

With the new Chimney Sweep Craft Act (SchfHWG) being in force, the responsibility to ensure that required fireplace inspections are carried out on time has been transferred to houseowners. Houseowners can choose between the district chimney sweep and a licensed free contractor for regular tasks specified in the household inspection certificate. If chimney sweep work is carried out by a free contractor, the house or apartment owner must prove to the authorized district chimney sweep that specified tasks have been carried out in a timely manner. For this purpose, the commissioned chimney sweep fills out a compliance form that the house owner forwards to the authorized district chimney sweep to be recorded in the sweep-book (*Kehrbuch*, a register).

In Germany, the costs depend on the respective activities carried out by the chimney sweep. Since 2013, houseowners have been free to choose their chimney sweep and thus negotiate their own prices with the chimney sweep for inspection, sweeping and measuring work. For the so-called sovereign tasks of the authorized district chimney sweep, such as certification of new chimneys and fireplaces, a uniform fee schedule continues to apply. The KÜO, which has been in effect since 2010, allows chimney sweeps to charge "work values" for the public inspection of a stove according to the amount of time spent.

What happens in case of non-compliance?

In the event of violation of the legal provisions by house and apartment owners, the authorized district chimney sweep is obliged to report the incident to the responsible administrative authority, the district administration authority (*Kreisverwaltungsbehörde*). Such incidents include the non-submission of required forms; not initiating the statutory activities; refusing household inspections; or operating unapproved fireplaces. The houseowner receives a reminder by the responsible authority. If non-compliance continues, the authority imposes fines on the house owner, between EUR 5,000 and EUR 50,000.

Who controls the work of chimney sweeps?

Following § 21 SchHWG, the authorized district chimney sweeps are subject to the supervision of the administrative authority. The authorized district chimney sweep must, upon request, provide the administrative authority free of charge with the sweep-book and documents required for keeping the sweep-book. The administrative authority can check district chimney sweeps at any time regarding the performance of tasks assigned to the sweep and compliance with legal obligations. If authorized district chimney sweeps do not or do not properly perform the duties and obligations defined under SchHWG, the administrative authority can issue a written reprimand or impose a warning fee of up to EUR 20,000.

What are the main challenges regarding existing control strategies?

Although district chimney sweeps are obligated by law to provide administrative authorities with information registered in the sweep-book, some authorities face difficulties in receiving requested

information for review. The household information is of great value for emission inventories, assessment of air quality and formulation of policies. However, chimney sweeps might be hesitant to insist on compliance with existing regulations to not lose their clients – the homeowners. As the chimney sweep's income depends, at least partly, upon the household's request to implement so called free activities – inspection, cleaning and measuring – the chimney sweep may prioritize to maintain the client relationship instead of implementing stringent standards.

What is the role of chimney sweeps in providing advice to households in matters relating to energy efficiency and air pollution?

Until now, it remains challenging for administrative authorities in Germany to increase the uptake of energy efficiency measures and renewable energies. Chimney sweeps have a unique knowledge about combustion devices used across the districts and they have direct and regular contact with house and apartment owners. Therefore, they are important intermediaries to inform a large number of households on energy efficiency measures and options for adopting renewable energies. However, chimney sweeps are less interested in the promotion of energy efficiency and renewables, as ultimately, they would lose clients with the switch of households to other energy options that do not require chimneys or firing devices. A new development is the option for chimney sweeps to qualify as certified energy advisors. Chimney sweeps can advise household and apartment owners on, for example, energy efficiency, sustainable construction of buildings and renewable energy options.

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