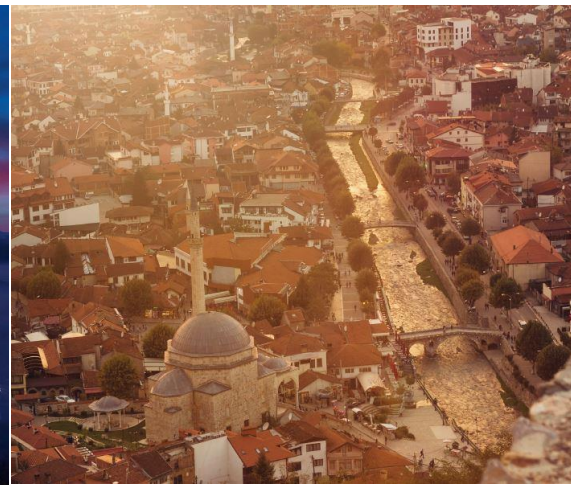
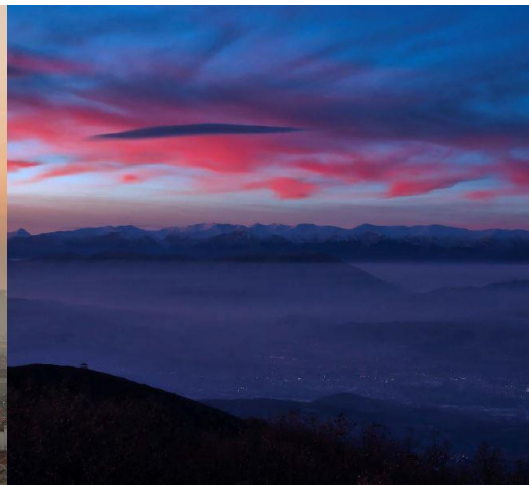


Public Disclosure Authorized

# Regional Note on Air Quality Management in the Western Balkans:

## *Bosnia and Herzegovina, Kosovo, and North Macedonia*



## Acknowledgments

This Regional Note was prepared by a team comprising Klas Sander (Senior Environmental Economist), Simon Ellis (Program Leader), Yewande Aramide Awe (Senior Environmental Engineer), Sameer Akbar (Senior Environmental Specialist), Nina Rinnerberger (Environmental Specialist), Trandelina Baraku (Water Resource Management Specialist), Shpresa Kastrati (Environmental Specialist), Esmá Kreso (Senior Environmental Specialist), Mirjana Karahasanovic (Senior Operations Officer), Luan Aliu (Program Assistant), Anita Bozinovska (Program Assistant), Mjellma Rrecaj (Program Assistant), and Camilla Erencin (Consultant). Grzegorz Peszko (Lead Economist) provided input for the box summarizing key aspects of the nexus between air pollution and climate change.

This note synthesizes and builds on analytical work conducted by the World Bank during 2018–2019 on Regional Air Quality Management in the Western Balkans, which comprises three country-level reports on air quality management in Bosnia and Herzegovina, Kosovo, and North Macedonia.

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## Abbreviations and Acronyms

AAP	Ambient Air Pollution
AAQ	Ambient Air Quality
AMHIB	Air Monitoring and Health Impact Baseline
ASI	Avoid-Shift-Improve
AQM	Air Quality Management
BCA	Benefit-Cost Analysis
BD	Brčko District
BiH	Bosnia and Herzegovina
CAFE	Clean Air for Europe
CV	Cardiovascular
ECJ	Court of Justice of the EU
EU	European Union
FBiH	Federation of Bosnia and Herzegovina
GDP	Gross Domestic Product
GHG	Greenhouse Gas
IHD	Ischemic Heart Disease
IHME	Institute for Health Metrics and Evaluation
LAAQ	Law on Ambient Air Quality
LEP	Law on Environmental Protection
MoEW	Ministry of Environment and Water
NAPCP	National Air Pollution Control Program
NAQIP	National Air Quality Improvement Program
NEC	National Emission Ceiling
NECD	National Emission Ceilings Directive
OECD	Organisation for Economic Co-operation and Development
PAF	Population Attributable Fraction
PM	Particulate Matter
RAS	Reimbursable Advisory Service
RS	Republika Srpska
VSL	Value of Statistical Life
WHO	World Health Organization

## Executive Summary

**Ambient air pollution (AAP) is a serious global health problem that accounts for an estimated 4.2 million premature deaths worldwide per year.**<sup>1</sup> Around 91 percent of the world's population lives in areas where air pollution levels are above those considered safe by the World Health Organization (WHO). Exposure to fine particulate matter (PM<sub>2.5</sub>) is especially dangerous to human health because these particles find their way deep into the lungs and bloodstream, resulting in serious health effects (for example, lower respiratory infections; tracheal, bronchial, and lung cancer; ischemic heart disease (IHD); strokes; and chronic obstructive pulmonary diseases) and death. The economic costs of air pollution are startlingly large. Premature deaths due to air pollution cost the global economy about US\$225 billion in lost labor income or about US\$5.11 trillion in welfare losses worldwide in 2013.<sup>2</sup> The exposure to AAP increases with urbanization: the agglomeration of households in urban results in an concentration of emissions from inefficient and outdated heating systems during the winter season, more vehicles, and more industrial firms in a smaller space, which means a higher concentration of pollution emissions.<sup>3</sup> About 55 percent of the world's population lives in urban areas; for Europe and Central Asia, the urban population share is higher at 72 percent.<sup>4</sup>

**People in Eastern Europe and the Western Balkans are frequently exposed to air pollution levels above those considered safe, particularly in the winter.** For most areas in Bosnia and Herzegovina (BiH), Kosovo, and North Macedonia, the estimated levels of PM<sub>2.5</sub> concentrations are significantly above the WHO guideline value,<sup>5</sup> with urban areas exceeding this value by a factor of 3–4.<sup>6</sup> According to the Institute for Health Metrics and Evaluation (IHME), an independent global health research center, air pollution is the leading environmental risk factor that drives the most death and disability combined in the Western Balkans. It is estimated that as a result of exposure to ambient PM<sub>2.5</sub> air pollution, 3,300 people die prematurely every year in BiH; 1,600 people in North Macedonia; and 760 people in Kosovo. Around 80–90 percent of these deaths are from cardiovascular (CV) disease (i.e. stroke and IHD). The majority of AAP-related mortality occurs in people of productive age, over the age of 50.<sup>7</sup> The annual economic cost associated with the health damage from AAP in the three Western Balkan countries (BiH, Kosovo, and North Macedonia) ranged between 3.6 percent and 8.2 percent of gross domestic product (GDP) or on average between US\$240 million and US\$1.38 billion in 2016.<sup>8</sup>

**The increased exposure to air pollution and its linkage to higher prevalence of lung, respiratory, or chronic obstructive pulmonary disease (COPD) is also likely to increase the vulnerability of the affected population to the currently emerging COVID19 pandemic.** Patients with chronic lung and heart

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<sup>1</sup> This is due to stroke, heart disease, lung cancer, and chronic respiratory diseases, according to the WHO (<https://www.who.int>).

<sup>2</sup> World Bank. 2013. *The Cost of Air Pollution: Strengthening the Economic Case for Action*.

<sup>3</sup> World Bank. 2015. *Clean Air and Healthy Lungs. Enhancing the World Bank's Approach to Air Quality Management*.

<sup>4</sup> In BiH, the share of urban population (as percentage of the total population) was 48 percent; in North Macedonia, 58 percent (2018). No data are available for Kosovo. Source: World Bank data, based on United Nations Population Division. World Urbanization Prospects: 2018 Revision.

<sup>5</sup> The WHO guideline value stipulates that mean annual concentrations of PM<sub>2.5</sub> should not exceed 10 micrograms per cubic meter.

<sup>6</sup> World Bank data, based on Brauer et al. 2017, for the Global Burden of Disease Study 2017.

<sup>7</sup> Country reports, Regional Air Quality Management in the Western Balkans (P166430).

<sup>8</sup> This estimated cost is conservative and does not include the costs associated with hospital stays, cost of illness, and loss of work days.

conditions caused or worsened by long-term exposure to air pollution are less able to fight off lung infections and more likely to die – and is likely also the case for Covid-19<sup>9</sup>. Accordingly, lowering air pollution levels can help the most vulnerable in their fight against this and any possible future pandemics. There is evidence from previous coronavirus outbreaks that confirm these hypotheses that those exposed to dirty air are more at risk of dying. Scientists who analyzed the SARS coronavirus outbreak in China in 2003 found that infected people who lived in areas with more air pollution were twice as likely to die as those in less polluted places.

**In the Western Balkans, the residential sector is the largest source of harmful PM<sub>2.5</sub> emissions.** Current trends indicate that PM<sub>2.5</sub> emissions are not expected to decline markedly under existing policies due to the burning of solid fuel for heating in stoves and boilers.<sup>10</sup> While it would be technically feasible to bring ambient PM<sub>2.5</sub> concentrations in the residential sector below or slightly above the WHO-recommended PM<sub>2.5</sub> guideline value, including at the city level, this would require implementation of a range of measures from improving fuel quality to significantly improved stoves and boilers in line with the stringent standards of the Ecodesign Directive of the European Union (EU).

**Transport-related emissions are a significant source of localized air pollution, especially in urban areas.** This is often related to factors such as traffic congestion (during peak commuting times), inefficient transport systems, and aging vehicle fleets. The WHO estimates that road transport is responsible for up to 30 percent of particulate matter (PM) emissions in European cities and up to 50 percent of PM emissions in the Organisation for Economic Co-operation and Development (OECD) countries – mostly due to diesel traffic. The EU's transport policy aims to meet the challenges of air quality and continue to reduce vehicle pollution by setting a reduction target for transport emissions of 60 percent by 2050 (compared with the 1990 levels).<sup>11</sup>

**While not yet the dominant source of air pollution in the Western Balkans, transport-based emissions are gaining in prominence and – in contrast to heating – represent a year-round growing environmental challenge.** Current standards for fuel quality in the Western Balkans are inadequate to limit emission from mobile sources in line with EU legislation. In Kosovo, the transport sector is responsible for around 10 percent of total greenhouse gas (GHG) emissions of the country, with considerable associated economic costs.<sup>12</sup> There is a need to modernize transport and traffic infrastructure with respect to environmental norms, especially in urban areas, to decrease pollution from mobile sources, while maintaining or improving citizens' level of mobility.

**The EU accession process provides an incentive to improve air quality in the Western Balkans by adapting legislation and learning from the experience of other EU countries.**<sup>13</sup> Further efforts are needed to meet key obligations and requirements as part of the EU accession process. Under the EU's Industrial Emissions Directive,<sup>14</sup> for instance, the region must reduce emissions by 90 percent for sulfur dioxide, 67

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<sup>9</sup> Sara De Matteis of Cagliari University, Italy (Environmental Health Committee of the European Respiratory Society) quoted in The Guardian, March 17, 2020 (<https://www.theguardian.com/environment/2020/mar/17/air-pollution-likely-to-increase-coronavirus-death-rate-warn-experts>)

<sup>10</sup> Country reports, Regional Air Quality Management in the Western Balkans (P166430).

<sup>11</sup> European Union, [https://europa.eu/european-union/topics/transport\\_en](https://europa.eu/european-union/topics/transport_en).

<sup>12</sup> World Bank Group. 2019. *Kosovo: A Future of Green Transport and Clean Air*.

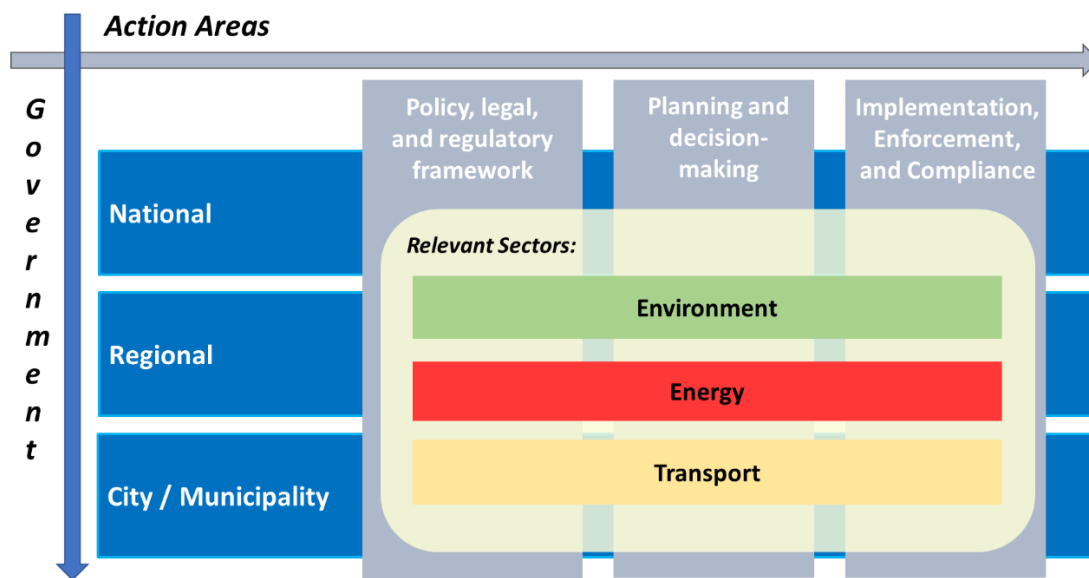
<sup>13</sup> BiH applied for membership in the EU in February 2016. Kosovo launched the European Reform Agenda in November 2016. North Macedonia is a candidate country to join the EU.

<sup>14</sup> Directive 2010/75/EU, entered into force on January 6, 2011.

percent for nitrogen oxides, and 94 percent for airborne particulates by 2028 for potential accession to the EU. A recent decision by the Court of Justice of the EU (ECJ) reaffirms the importance of air quality protection and could have wider implications for air quality management (AQM) in Europe. Specifically, the ECJ clarified two important points under the EU Air Quality Directive:<sup>15</sup> (a) individuals are entitled to take their governments to court over air pollution and (b) measurements of air quality from a *single* sampling point can be used to determine whether a breach of limit values has occurred, which in turn could trigger the obligation to draw up an air quality action plan.<sup>16</sup>

**In addition to strengthening the legal and policy framework for AQM at the national level, it is important to develop subnational solutions, particularly for urban pollution hot spots.** Effective urban planning can improve air quality in the long run and help address the problems of toxic emissions and their impacts on human health in the Western Balkans.<sup>17</sup> This requires city structures that balance multiple objectives to create healthy and livable cities, of which air quality improvements are a core element. Opportunities and smart solutions for creating healthier and livable cities exist and should be increasingly explored in the Western Balkan region. One such element that is currently underplayed is the wide range of benefits and services resulting from the integration of green space – for example, urban forests, trees, and other green infrastructure – into urban planning and development. A strategic long-term vision of these elements can provide multiple benefits to urban communities, not to the least reducing air pollution, enhancing environmental quality, and improving the overall quality of urban life.<sup>18</sup>

Figure 1: The vertical and horizontal dimensions of actions on AQM



<sup>15</sup> Directive 2008/50/EC, adopted on May 21, 2008, sets air quality objectives including limit values and exposure-related targets.

<sup>16</sup> Practical Law Environment. 2019. *Clarification of Air Quality Sampling Point Requirements under Air Quality Directive (ECJ)*.

<sup>17</sup> World Bank. 2002. *Urban Air Pollution, South Asia Urban Air Quality Management Briefing Note No. 6*.

<sup>18</sup> World Forum on Urban Forests, <https://www.wfuf2018.com/>.

**Overall, a comprehensive approach to tackle air pollution in the Western Balkans should be composed of three core components: (a) data, knowledge, and strategy; (b) measures to reduce exposure to air pollution in the short term, especially for the young, weak, and vulnerable; and (c) policy and institutional reforms, as well as investment to bring persistent medium- to long-term reduction of pollution levels below internationally accepted standards.** In many countries, the underlying data, knowledge, and strategy development is not yet sufficient given the challenge at hand. As most institutions are sector based, policies and institutional reforms to improve air quality should enhance cross-sectoral capacities and measures. Investments in AQM have to be based on an inclusive, cross-sectoral strategy that brings together the relevant sectors across all levels of government. The true challenge in tackling air pollution is often not the lack of appropriate technology; it is to a large extent the lack of coordination, prioritization, and lack of funding across sectors and levels of government. This includes the lack of coordination to set in place a corresponding policy and legislative framework (Figure 1 provides a stylized scheme of these dimensions). Altogether, these measures may also help unlock the necessary financing, including mobilizing innovative financing, which is emerging in different forms and ways.

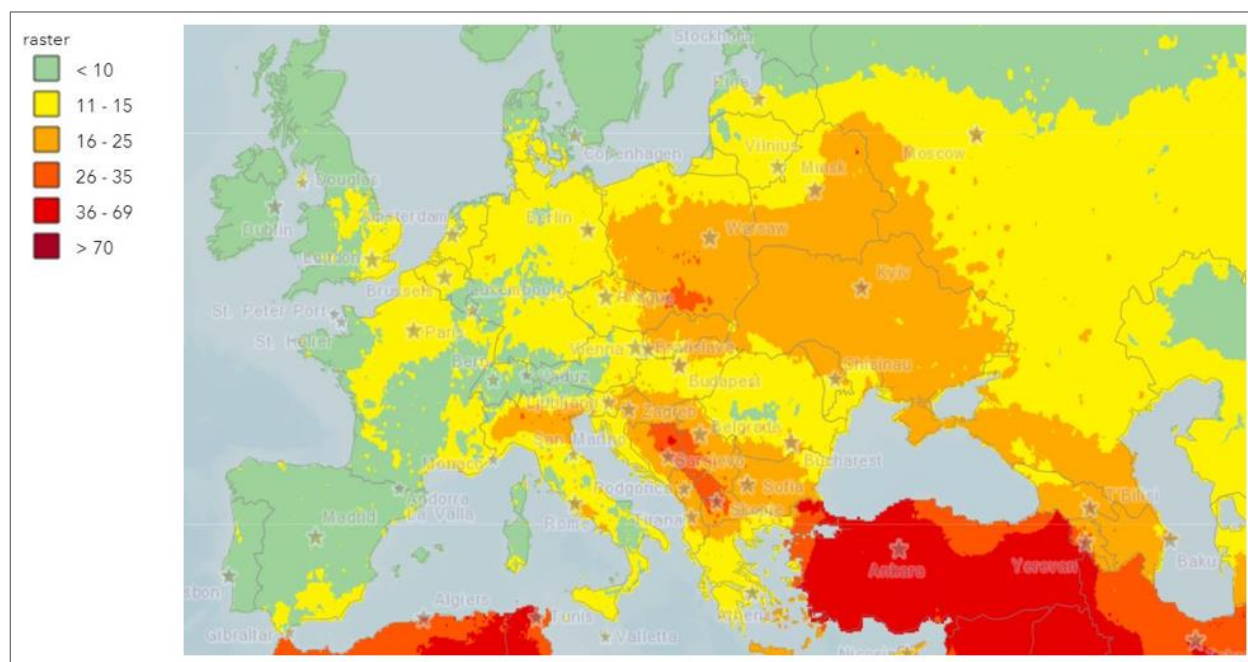
**By acting on air pollution reduction, countries prepare the grounds for the long-term transition to a low-carbon economy and climate change mitigation, yet the synergies and trade-offs have to be carefully evaluated and understood.** Transition to low-carbon economy will eventually eliminate most fuel-combustion sources, improving local air quality as a ‘free lunch’. However, low-carbon transition is a long-term, deep structural transformation that will take several decades, while smog causes thousands of premature deaths every year in the most polluted cities. Arresting climate change requires retiring and replacing most of the existing industrial and transport assets and infrastructure built for using fossil fuels. In contrast, significant improvements of air quality can be achieved relatively quickly and at lower cost by retrofitting existing plants and vehicles with pollution control equipment. Such investments, however, may have some climate warming effect. Filters that reduce dust emissions, flue-gas desulphurization units, or catalytic converters that reduce NO<sub>x</sub> emissions all require electricity to operate and hence increase the on-site use of fossil fuels, increasing CO<sub>2</sub> emissions of a plant or a vehicle by a small percentage. These investments also increase the value of the fossil fuel assets, making them more expensive to be retired early. On the other hand, they make these plants and vehicles more expensive versus non-fossil alternatives, which may encourage conversion to low-carbon, clean assets instead of retrofitting. In many rural areas, substituting biomass for gas in heating and cooking is good for the health of families but not so good for climate when renewable alternatives are not available or affordable.



## 1. Air Pollution in the Western Balkans: Facts and Figures<sup>19</sup>

Air pollution is a significant problem in cities and urban centers in the Western Balkans and Eastern Europe. Although formal air quality standards in Bosnia and Herzegovina (BiH), Kosovo, and North Macedonia are largely aligned with European Union (EU) air quality standards, people in the region are typically breathing more toxic particulate air pollution than their neighbors in Western Europe (Figure 2). Air pollution in Pristina (Kosovo) rivals that of big cities like Beijing, Mumbai, and New Delhi. PM<sub>2.5</sub> concentrations in Skopje (North Macedonia) are 4.5 times the safe level recommended by the World Health Organization (WHO), over 8 times the safe level in Tetovo (North Macedonia), and 3 times the safe level in Sarajevo (BiH).<sup>20</sup> This is due to weak legal frameworks for addressing air pollution, incomplete emissions inventory and air quality monitoring networks, and challenges related to institutional capacity. Emission trends in the region indicate that the main sources of air pollution include residential heating and cooking (particularly the burning of solid fuels), industry, and transport. The dominant share of PM<sub>2.5</sub> pollution originates within the geographical boundaries of each of the respective countries (BiH, Kosovo, and North Macedonia), which underscores the need for each government to take concerted and committed action to tackle air pollution.

**Figure 2: Locations where annual mean PM<sub>2.5</sub> concentrations ( $\mu\text{g}/\text{m}^3$ ) meet or exceed WHO guidelines (2016)**



Source: World Health Organization, 2018, <http://maps.who.int/airpollution>.

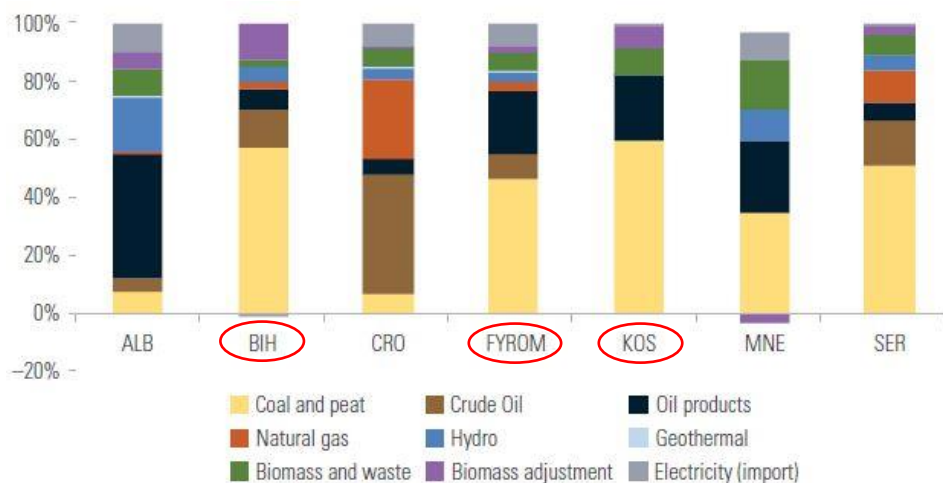
<sup>19</sup> Note: If not otherwise stated, all data presented in this Regional Summary Note has been sourced from the three individual country reports for Bosnia and Herzegovina, North Macedonia, and Kosovo available publicly from the World Bank website.

<sup>20</sup> Breathe Life, based on data from WHO Global Platform on Air Quality and Health, <https://breathelife2030.org>.



Source apportionment analysis<sup>21</sup> conducted as part of the country-level reports indicates that at a national level, the residential sector is the largest source of population exposure to harmful PM<sub>2.5</sub> associated with the burning of solid fuels in homes.<sup>22</sup> Particularly in the winter, the use of fuelwood as a primary source for heating of households causes serious problems with air quality in densely populated residential areas. The residential sector was responsible for nearly half of PM<sub>2.5</sub> emissions in Kosovo and North Macedonia and almost 60 percent in BiH in 2015. Previous analysis by the World Bank shows that when accounting for unregistered use, the share of biomass in total energy supply is relatively high between 7 percent and 17 percent in the Western Balkans (Figure 3).

**Figure 3: Primary energy supply of Western Balkan countries (adjusted for unregistered biomass consumption)**



Source: World Bank. 2017. *Biomass-based Heating in the Western Balkans*.

Although a marginal source nationally, the transport sector is a significant and growing contributor to air pollution at the city level. In BiH and Kosovo, the average age of vehicles circulating is 17–18 years, around 10 years older than the average age of vehicles in the EU. Older vehicles typically emit more pollution and are less fuel efficient than newer models due to outdated or worn-out pollution control devices. About 70 percent of cars operate on highly polluting diesel in BiH, while about half of the passenger cars and buses in North Macedonia belong to the high-emission category (Euro 0) with no emission control technology.

Industry and power plants are considerable contributors to air pollution too. While much of the EU has moved away from coal, the Balkan region is home to 7 of the 10 most polluting coal-fired power stations in Europe. About 19 percent of total PM<sub>2.5</sub> emissions in BiH are estimated to originate from power and heating plants, with industry contributing about 14 percent. In Kosovo, the overwhelming share of SO<sub>2</sub> emissions is caused by coal combustion, mainly in the power sector. In North Macedonia, coal is responsible for more than 50 percent of the emissions of PM<sub>2.5</sub> from power plants, industry, and

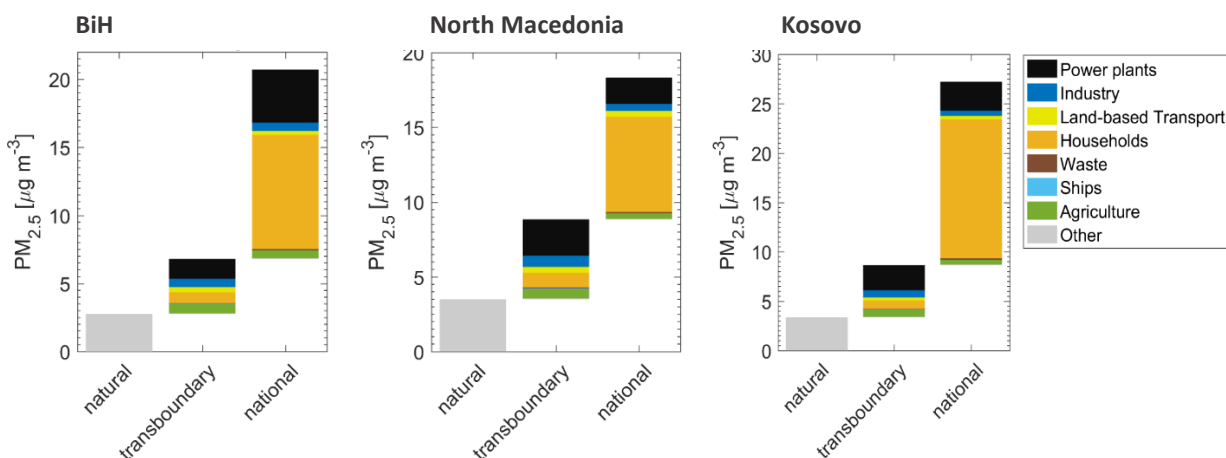
<sup>21</sup> The quantitative analysis was performed using the Greenhouse Gas - Air Pollution Interactions and Synergies (GAINS) model, developed by the International Institute for Applied Systems Analysis, <http://www.iiasa.ac.at/>.

<sup>22</sup> Other sectors considered in the source apportionment analysis included power plants, industry, transport, waste management, ships, and agriculture. Comprehensive and reliable emission inventories as well as robust monitoring data at the local level would be required to conduct more granular analysis of localized pollution hot spots.

residential combustion. Figure 4 shows the estimated contributions of key sectors to ambient PM<sub>2.5</sub> concentrations based on country-level source apportionment analysis.

Based on available data and analyses, future emission trajectory up to 2030 indicates that existing environmental and air quality policies, if effectively enforced, are expected to deliver a strong decline in the emissions of SO<sub>2</sub> and NO<sub>x</sub> in the Western Balkan region. This is mainly due to EU legislation for emission standards for new vehicles and large combustion plants, which require that SO<sub>2</sub> emissions in the power sector be cut by about 80–90 percent, and NO<sub>x</sub> emissions by about 40–50 percent. At the same time, emissions of primary PM<sub>2.5</sub> are not likely to change significantly in the near term, as the underlying energy projections for the region do not foresee major shifts away from fuelwood combustion in household stoves and boilers.<sup>23</sup>

**Figure 4: Source apportionment for population-weighted annual mean concentrations of PM<sub>2.5</sub>, for three countries in 2015 (GAINS model, 2018)<sup>24</sup>.**




Lack of long-term air quality monitoring data precludes detailed assessment of air quality status and trends, which are essential for developing interventions and measures to reduce air pollution. Improvements in national air quality monitoring networks are needed to fill important data gaps. Box 1 highlights the status of air quality monitoring networks and data coverage in the Western Balkans.

Policy and institutional aspects of air quality management (AQM) present additional challenges for achieving sustained reductions in air pollution in the Western Balkans. Although the EU accession process provides an incentive to improve air quality, further measures are needed in all three countries to fully develop a comprehensive legal and regulatory framework for AQM. Box 2 highlights some of the institutional developments and key gaps for effective AQM in BiH, North Macedonia, and Kosovo.

<sup>23</sup> Country reports.

<sup>24</sup> Note that the GAINS modeling and source attribution was executed at country level and not for specific airsheds, for example, at city-level. Therefore, source attributions, especially the shares of different pollution sources, may differ significantly if a more detailed analysis is executed, e.g. for specific cities. Please see also Figure 7 of this report.

### Box 1: Status of air quality monitoring networks and coverage in BiH, North Macedonia, and Kosovo

 **Key message.** All three countries need to strengthen completeness of air quality monitoring data and availability of long-term data.<sup>25</sup> In addition, monitoring efforts, currently primarily focused on the less harmful PM<sub>10</sub>, should be expanded for PM<sub>2.5</sub>.

- In **BiH**, the Federation of Bosnia and Herzegovina (FBiH) and Republika Srpska (RS) operate separate air quality monitoring networks. Ten out of twelve of FBiH's air quality monitoring stations recorded annual average PM<sub>10</sub> concentrations close to or higher than EU ambient air quality (AAQ) limit values over 2015–2017. PM<sub>2.5</sub> concentrations were only monitored and recorded at six stations; the annual average measurements at all stations exceeded the maximum levels allowed under national and WHO air quality standards (20 µg/m<sup>3</sup> and 10 µg/m<sup>3</sup>, respectively). The population-weighted average annual PM<sub>2.5</sub> concentration is estimated to be 30 µg/m<sup>3</sup> in FBiH. In RS, annual average concentrations of PM<sub>10</sub> and PM<sub>2.5</sub> were exceeded at a quarter of the measurement stations that recorded data; the population-weighted average annual exposure is estimated at 19 µg/m<sup>3</sup>.
- In **North Macedonia**, annual average PM<sub>10</sub> concentrations (recorded at 14 out of 15 air quality monitoring stations) consistently exceeded limit values during 2013–2017. Daily limit values were exceeded during almost one-third of the year. Only two monitoring stations recorded complete PM<sub>2.5</sub> data over time; the annual average concentrations measured at both stations were well above the annual limit value of 25 µg/m<sup>3</sup>. The average annual population-weighted PM<sub>2.5</sub> concentration is estimated to be 37 µg/m<sup>3</sup> in highly polluted areas and 14 µg/m<sup>3</sup> in cleaner, rural areas.
- In **Kosovo**, limit values for annual average ambient concentrations of PM<sub>2.5</sub> and PM<sub>10</sub> were exceeded at six (PM<sub>10</sub>) and seven (PM<sub>2.5</sub>) out of eleven air quality monitoring stations in 2015. According to national and EU air quality standards, the daily mean concentration of PM<sub>10</sub> should not be exceeded more than 35 times in a calendar year. Among the stations that recorded exceedances, the number of days above the daily mean concentration of PM<sub>10</sub> ranged between 45 and 90 days. The population-weighted average annual ambient PM<sub>2.5</sub> concentration is estimated to be 26–31 µg/m<sup>3</sup>.

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<sup>25</sup> The EU-wide data quality objective for AAQ assessment is based on EU Directive 2008/50/EC and stipulates that data should be recorded at least 90 percent of the time at a given monitoring station.

## Box 2: Policies and institutions to manage air quality in the Western Balkans

✎ In **BiH**, environmental legislation was highly harmonized across the FBiH, RS, and Brčko District (BD) in the early 2000s when each of the jurisdictions had adopted similar packages of environmental laws. The legal frameworks have since diverged, and the country has three inconsistent legal frameworks, organizational structures, and air quality networks. There is no national-level environmental protection law. While an Inter-Entity Coordination Body for the Environment was established in 2006 to help develop a harmonized approach for environmental protection among FBiH, RS, and BD, its decisions are not legally binding.

In **Kosovo**, efforts in the regulatory management of air quality have been geared toward transposing EU directives into the domestic legislation. Specifically, provisions in the 2009 Law on Environmental Protection (LEP) mandate the government to establish norms to limit emissions and monitor environmental quality in the air, soil, and water. The government has also established environmental institutions with dedicated responsibilities for AQM and assigned responsibilities to authorities from relevant sectors. However, significant challenges remain in terms of implementing existing laws and regulations, exacerbated by significant resource constraints.

**North Macedonia's** institutional and policy framework for AQM has evolved rapidly over the last decades, largely driven by efforts to gradually transpose EU directives into domestic legislation. The government has developed some initial regulatory framework of AQM, which is required for tackling the harmful levels of ambient air pollution (AAP) observed in the country. The Law on Ambient Air Quality (LAAQ) was adopted in 2004 and constitutes the backbone of North Macedonia's legal framework for AQM. Challenges exist related to institutional and technical capacity, adequacy of resources, and enforcement of existing laws and air pollution limits.

## 2. Health Impacts and Economic Costs of Air Pollution

According to the Institute for Health Metrics and Evaluation (IHME), air pollution is the leading environmental risk factor that drives the most death and disability combined in BiH and North Macedonia. The most severe exceedances occur during the winter season, likely a combination of the increased combustion of solid fuels for heating and adverse meteorological conditions typically associated with the winter months. It is well documented that the strongest and most rigorously proven causal associations between poor air health and poor air quality are between cardiovascular (CV) and pulmonary disease and fine particulate matter (PM<sub>2.5</sub>) pollution.<sup>26</sup> Exposure to PM<sub>2.5</sub> is particularly dangerous to human health because these particles find their way deep into the lungs and the bloodstream resulting in disease and death. Premature deaths and illnesses caused by air pollution can result in increased health expenditures and labor productivity losses.

As part of the underlying analysis for this Regional Note, country-level assessments of health and economic damages from air pollution, primarily from PM<sub>2.5</sub>, were conducted in the three countries based on the most up-to-date methodologies. The analysis finds that population exposure to air pollution, especially PM<sub>2.5</sub>, causes a significant health burden in all three countries, particularly affecting the elderly. The analytical approach to health damage estimation is presented in Box 3.

### Box 3: Analytical approach to health damage estimation

✦ Toxic emissions and their impacts on human health need to be addressed with an integrated approach, in line with the EU strategy Clean Air for Europe (CAFE) and the guidance of the European Environment Agency. The approach includes estimation of the health burden of air pollution, valuation of attributable health burden, identification of responsible polluters, and prioritization of cost-efficient mitigating interventions.

**Step 1.** Estimate population exposure to the pollutant of interest, particulate matter (PM) with diameter less than 2.5 µm-fine particulates (PM<sub>2.5</sub>), in terms of number of people exposed and level(s) of concentration.

**Step 2.** Calculate the health burden, premature death (mortality) due to a disease, that may be *attributed to the pollutant* in question (population attributable fraction [PAF]<sup>27</sup>) based on population exposure and relative risk (RR)<sup>28</sup> that the pollutant presents for the occurrence of the disease, according to epidemiological studies.

**Step 3.** Estimate the economic value of this health burden in monetary terms with a welfare-based approach.

In Kosovo, about 760 people die prematurely every year as a result of exposure to AAP. About 11 percent of this health burden is carried by Pristina. Of the total number of AAP-related deaths, 90 percent are from ischemic heart disease (IHD) and stroke combined. About 53 percent of IHD and 63 percent of strokes occur in people of productive age before attaining the age of 70. Population age groups between 50 and

<sup>26</sup> As recommended by the WHO, health risk factors are divided into three groups: metabolic, behavioral, and environmental (<http://ghdx.healthdata.org/gbd-results-tool>). Other risk factors for CV and pulmonary disease include tobacco smoking, alcohol and drug use, dietary risks, and high blood pressure.

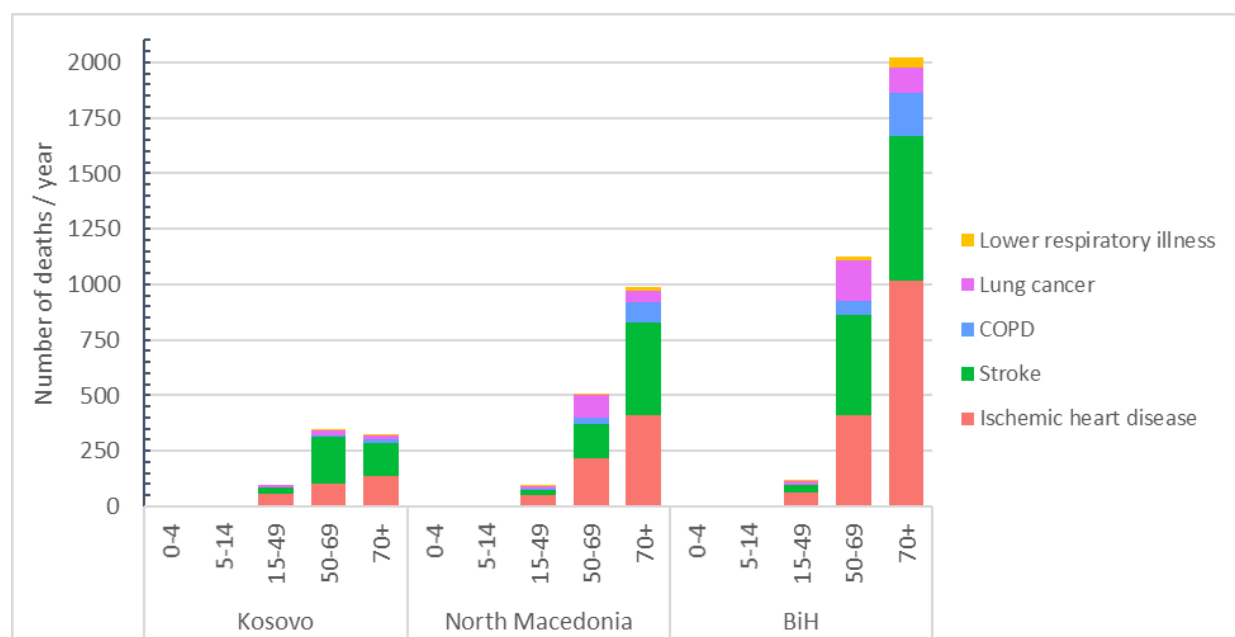
<sup>27</sup> PAF is defined as the reduction in population health outcome that would occur if exposure to the pollutant were reduced to an alternative ideal exposure scenario, such as pollutant concentrations below the WHO limits.

<sup>28</sup> RR is defined as the ratio of the probability of a health outcome, namely premature death (mortality) or disability from a disease, occurring in an exposed group to the probability of it occurring in a non-exposed group.

69 years carry the largest share (about 45 percent) of the total health burden associated with exposure to AAP, followed by people over 70 years of age.

In North Macedonia, about 1,600 people die prematurely every year as a result of exposure to PM<sub>2.5</sub> with about 21 percent of this burden being carried by the capital city, Skopje. Of the total number of AAP-related deaths, 80 percent are from CV diseases, of which about 95 percent occur in the age groups from 50 years and above. The number of deaths from lung cancer is the highest in the age group 50–69 years. CV deaths mostly affect populations older than 65 years of age, suggesting that mitigation measures to reduce the adverse health impacts attributed to air pollution in North Macedonia should include a focus on this subgroup of the population.

**Figure 5: Annual health burden attributed to air pollution, by country and age group**



In BiH,<sup>29</sup> about 3,300 people die prematurely every year as a result of exposure to ambient PM<sub>2.5</sub> air pollution, of which about 81 percent are from CV diseases. Around 16 percent of this health burden is carried by Sarajevo and Banja Luka. Analysis shows that 9 percent of the total annual mortality in BiH is attributable to air pollution. The majority of AAP-related mortality occurs in people that are 50 years of age and older. About 68 percent of IHD and 57 percent of strokes caused by AAP occur in people over 70 years of age.

Figure 5 summarizes the annual health burden attributed to air pollution, as estimated by the authors, in BiH, Kosovo, and North Macedonia.

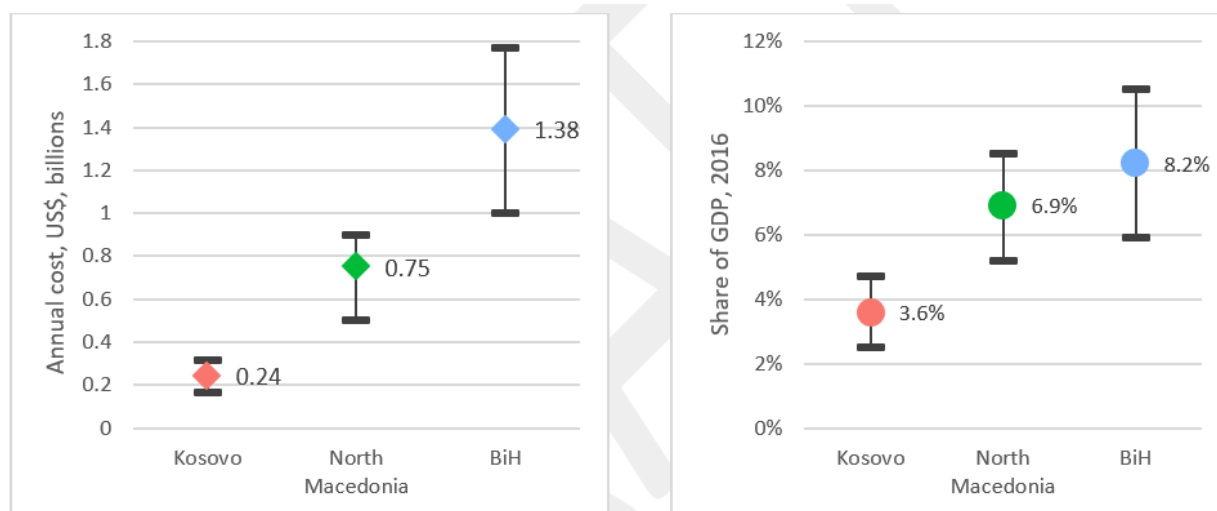
<sup>29</sup> The health burden of exposure to AAP was estimated separately for FBiH and for RS based on PM<sub>2.5</sub> population-weighted concentrations of 30 µg/m<sup>3</sup> and 19 µg/m<sup>3</sup>, respectively.

### Economic costs of exposure to AAP

In economic terms, the annual cost associated with the health damage from AAP in the three Western Balkan countries is significant: between 3.6 percent and 8.2 percent of gross domestic product (GDP) or on average between US\$240 million and US\$1.38 billion in 2016.<sup>30</sup>

Specifically, in Kosovo the economic cost associated with the health damage from AAP is on average US\$240 million, equivalent to 3.6 percent of GDP in 2016. Data shortcomings precluded disaggregation of the health and economic burden at the subnational level, which could help prioritize specific geographical areas. Nonetheless, based on the estimated exposure, about 11 percent of the total health burden attributed to AAP originates in Pristina.

Figure 6: Economic costs associated with health damage from AAP (US\$, billions and share of GDP in 2016)



In North Macedonia, the costs of AAP-related health damage are even higher, on average US\$750 million or 6.9 percent of GDP in 2016. Of the US\$750 million, the cost of pollution in urban and industrial areas is estimated at US\$600 million, while an estimated US\$150 million comes from other areas.

The economic cost of health damage from AAP is the highest in BiH, ranging between US\$1 billion and US\$1.38 billion, equivalent to an average of 8.2 percent of GDP in 2016. The FBiH carries 67 percent of the total estimated cost burden, while the RS carries the remaining 33 percent. The estimated cost is conservative and does not include the costs associated with hospital stays, cost of illness, and loss of work days, which would potentially increase the cost estimate if considered. Figure 6 summarizes the economic costs associated with health damage from AAP in the three countries.

The estimated economic cost associated with mortality from exposure to air pollution is summarized in

<sup>30</sup> This estimated cost is conservative and does not include the costs associated with hospital stays, cost of illness, and loss of work days.



Table 1. A welfare-based approach was used to quantify the economic burden.<sup>31</sup>

**Table 1: Economic cost of mortality from AAP in Western Balkans, 2016**

Country	US\$, millions	Share of GDP
Kosovo	160–310	2.5–4.7
North Macedonia	500–900	5.2–8.5
BiH <sup>32</sup>	1,000–1,800	5.9–10.5

**The increased exposure to air pollution and its linkage to higher prevalence of lung, respiratory, or chronic obstructive pulmonary disease (COPD) is also likely to increase the vulnerability of the affected population to the currently emerging COVID19 pandemic.** Patients with chronic lung and heart conditions caused or worsened by long-term exposure to air pollution are less able to fight off lung infections and more likely to die – and is likely also the case for Covid-19<sup>33</sup>. Accordingly, lowering air pollution levels can help the most vulnerable in their fight against this and any possible future pandemics. There is evidence from previous coronavirus outbreaks that confirm these hypotheses that those exposed to dirty air are more at risk of dying. Scientists who analyzed the SARS coronavirus outbreak in China in 2003 found that infected people who lived in areas with more air pollution were twice as likely to die as those in less polluted places.

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<sup>31</sup> The welfare-based cost of mortality was calculated by multiplying the estimated number of deaths by the Value of Statistical Life (VSL). Baseline VSL data were derived from updated Organisation for Economic Co-operation and Development (OECD) estimates.

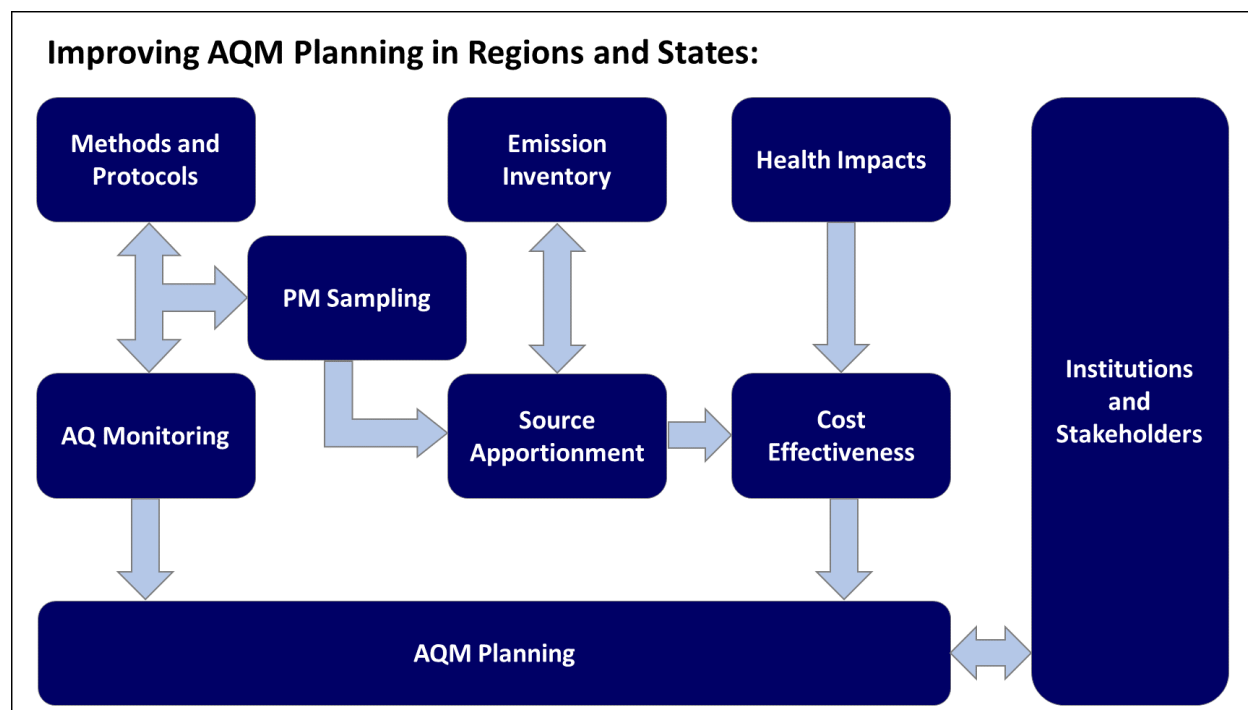
<sup>32</sup> This cost estimate does not include BD.

<sup>33</sup> Sara De Matteis of Cagliari University, Italy (Environmental Health Committee of the European Respiratory Society) quoted in The Guardian, March 17, 2020 (<https://www.theguardian.com/environment/2020/mar/17/air-pollution-likely-to-increase-coronavirus-death-rate-warn-experts>)

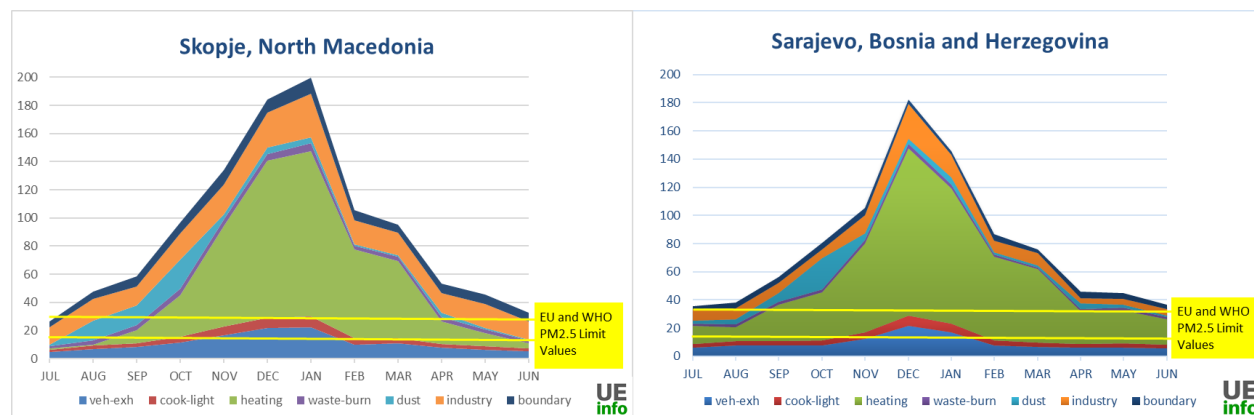
### 3. Addressing Air Pollution in the Western Balkans

Addressing air pollution effectively in the Western Balkans will require policy and institutional interventions across key sectors and sources that affect air quality, at both the national and local levels. While Kosovo and North Macedonia have started to develop comprehensive legal and regulatory frameworks governing AAQ, institutions and policies related to AQM are still more fragmented in BiH, with different legal and planning instruments in each jurisdiction (FBiH, RS, and BD). It is vitally important that governments commit to developing institutional capacity and allocating sufficient resources to improve AQM. Sustained financing and skilled staff are needed to establish and maintain effective AQM regimes in all technical areas, in each country to varying degrees: clarifying and streamlining legislation and regulation for consistency and effectiveness; planning and overseeing implementation of air quality improvement measures; investing in more robust systems for air quality monitoring; enforcing regulations; and managing environmental funds – where applicable. Efforts to establish reliable air quality monitoring networks should prioritize developing complete emissions inventories and obtaining reliable time series of air quality monitoring data with a focus on increased geographic coverage and pollutants critical to health (notably PM<sub>2.5</sub>). This should, however, not underestimate the importance of continuous modeling and understanding of source apportionment. This will be required to avoid a serious lack of understanding what the best interventions are due to a lack of prioritization of the critical elements in an AQM planning process from the beginning. Figure 7 showcases a stylized model for improving AQM policies, regulations, and institutions.

Figure 7: Stylized model for improving AQM policies, regulations, and institutions



**Figure 8: Source attributions to modeled PM<sub>2.5</sub> pollution over an annual cycle in two selected Western Balkan cities (monthly average; 2018)**



Source: Modeling executed by UrbanEmissions.info for World Bank, November 2019

Note: veh exh = Vehicle exhaust.

A long-term phased engagement and investment approach facilitates an efficient and effective use of available resources, as the entire investment envelope needed for addressing air pollution completely is too large for any country to handle in the short term. Prioritization of actions should be based on cost-effectiveness of interventions, institutional feasibility, and targeting of pollution hot spots. Considering the annual air pollution of Western Balkan cities (Figure 8), reducing extreme and highly toxic pollution peaks in the winter months should be a high priority. To achieve this objective, policy reforms and investments in the residential heating sector are necessary as those drive air pollution in the winter to the largest extent. However, given the spatial and socioeconomic heterogeneity of the heating sector, designing effective and lasting intervention actions remains a significant challenge. Next, transport-based pollution will have to be tackled as it provides an important pollution ‘base load’ throughout the year. Given the trend toward increasing mobility and individual car ownership in the region, this type of air pollution is expected to grow over the years, in absolute and especially relative terms.

To inform any such strategy, action plan, and policy and investment decisions, strengthening the availability of reliable and comprehensive data of air pollution is needed. At the moment, though more advanced than countries in other regions, air pollution data are far from optimal and significant investments are needed. Capturing the benefits of new technologies, especially remotely sensed data and associated modeling, could allow countries to leapfrog and achieve improved quality of air pollution data at lower costs. These data are needed not only to detect and report air quality issues but also to inform policy and investment decisions at a micro scale, to evaluate associated impacts in reducing air pollution, and to mobilize innovative, impact-oriented financing.

### *Residential*

While interventions to reduce harmful emissions from the residential sector will need to be tailored to specific country contexts, there are common elements and best practices for addressing air pollution from the residential sector. In many countries, large-scale programs to substitute traditional stoves with more efficient ones have been implemented with positive results. In the short term, this could start with a pilot program, coupled with a public awareness program to help educate the public on the purpose of stove replacement, low-emission stove use, and available resources for households to adopt cleaner

alternatives. Over the medium to long term, additional measures such as expanding district heating could be developed. Distributional impacts of alternatives should be well understood to ensure that poor households are not disproportionately affected.

#### **Box 4: Climate change and AQM - synergies and discords**

For decades, air pollution and climate change were managed as separate environmental problems. More recently, however, as climate change has gained prominence in the policy agenda, the focus has shifted to synergies. Air quality is often seen as an ancillary benefit of climate change mitigation policies, underscoring the local rationale for global climate action. Local actions on air pollution are also expected to provide global climate benefits by reducing GHG emissions. The co-benefit arguments are underpinned by the observation that both global and local pollutants are often co-emitted by the same sources associated with combustion of fossil fuels.

Yet, the reality is slightly more complex as the impacts of several pollutants and abatement measures on climate change and air quality are not always aligned. Some air pollutants, such as black carbon, chlorofluorocarbons, carbon monoxide, or methane, also contribute to global warming, so their abatement clearly delivers a double environmental dividend. Others, however, such as SO<sub>2</sub> and NO<sub>x</sub>, are climate coolants, while several hazardous local pollutants (such as heavy metals, benzo-alpha-pyrene, persistent organic pollutants, or dioxins) are neutral with respect to climate. Likewise, the most potent greenhouse gas (GHG), CO<sub>2</sub>, is harmless to the health of the local population.

Transition to a low-carbon economy will eventually eliminate most fossil fuel combustion sources, improving local air quality as a 'free lunch'. However, it is a long-term, deep structural transformation that will take several decades, while smog causes thousands of premature deaths every year in the most polluted cities, incl. in the Western Balkan region. Significant improvements of air quality can be achieved relatively quickly and at lower cost by retrofitting existing plants and vehicles with pollution control equipment. Such investments, however, may have some climate warming effect as they require additional energy to operate. Switching from biomass to clean solid fuels or gas in heating and cooking is good for health but not good for climate when renewable alternatives are not available or affordable.

Air pollution and climate policies are not mutually exclusive, but the synergies and trade-offs need to be navigated in an integrated way depending on the local circumstances. Immediate health impacts of air pollution determine the priority of policy action and public spending in many smaller and lower-income countries, including those in the Western Balkan region, where the decision makers at all levels struggle with limited resources and institutional capacity to handle multiple local and global goals at the same time. Larger GHG emitters with stronger capacity and better access to renewable energy can afford improving air quality by accelerated decarbonization, thus avoiding potentially expensive legacy of long-lived carbon-intensive assets. On a national and local scale, some trade-offs just need to be acknowledged and managed.

Well-motivated actions focused too narrowly on long-term synergies may in some circumstances miss opportunities to address critical local air quality improvements that save lives today, just like excessive separation of these two environmental problems leads to missed opportunities for cost savings.

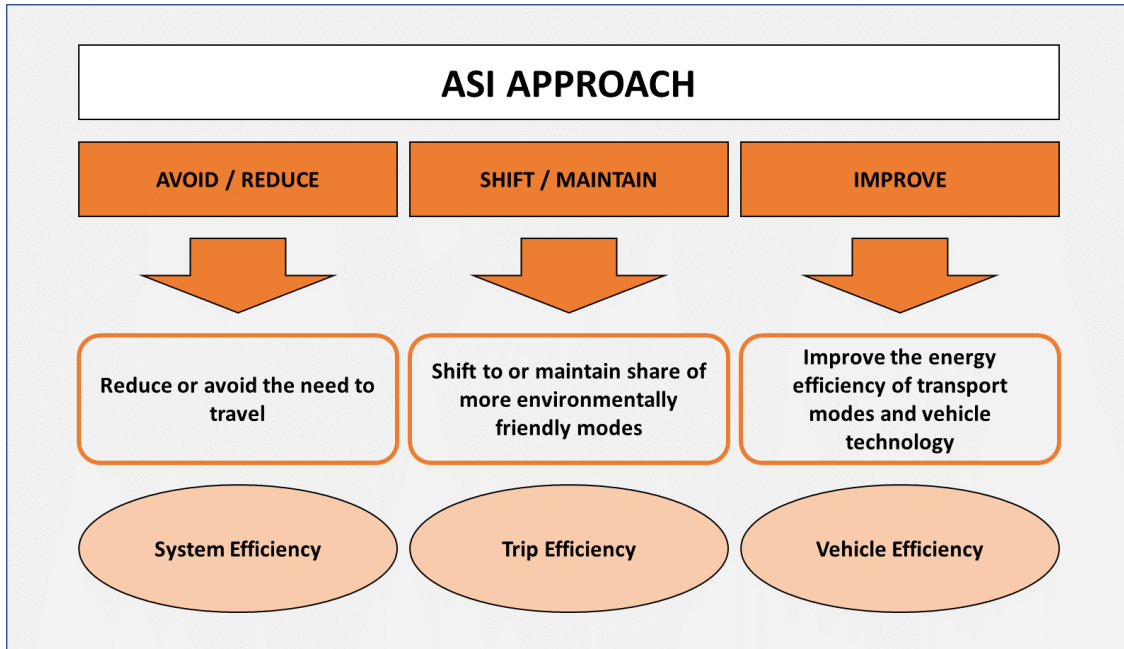
*Source: World Bank. Forthcoming. Air Pollution and Climate: How Many Stones to Hit Both Targets?*

## *Transport*

Transport is known to be highly locally polluting and needs to be urgently addressed. Current standards for fuel quality are insufficient to meet the limit requirements set by EU legislation. A wide range of proven options are available to reduce emissions from the sector, for example, within the framework of 'Avoid-Shift-Improve' (ASI), which seeks to achieve significant GHG emission reductions, reduced energy

consumption, and less congestion, with the final objective to create more livable cities. This approach goes beyond the traditional supply-side interventions of expanding road infrastructure, which have typically resulted in induced traffic.<sup>34</sup> Within the AIS framework, interventions focus on reducing or avoiding the need to travel (for example, through telecommuting and car sharing); shifting from high-emitting transport modes to low-emitting ones (that is, increasing trip efficiency); and improving the vehicle efficiency (for example, through hybrid or electric vehicles).<sup>35</sup> Figure 9 illustrates the concept.

Figure 9: Framework of ASI with illustrative examples



<sup>34</sup> Sustainable Urban Transport: Avoid-Shift-Improve (ASI), [https://www.sutp.org/files/contents/documents/resources/E\\_Fact-Sheets-and-Policy-Briefs/SUTP\\_GIZ\\_FS\\_Avoid-Shift-Improve\\_EN.pdf](https://www.sutp.org/files/contents/documents/resources/E_Fact-Sheets-and-Policy-Briefs/SUTP_GIZ_FS_Avoid-Shift-Improve_EN.pdf)

<sup>35</sup> World Bank. 2019. *Kosovo: A Future of Green Transport and Clean Air*.

## 4. Air Quality Management in the Western Balkans - The Way Forward

Air pollution is a complex challenge, and a comprehensive approach to tackle air pollution and to achieve proactive AQM in the Western Balkans needs to consider several broad principles:

- (a) First, to respond to the complexity of the air pollution challenge, a collaborative approach is needed that not only spans across several sectors horizontally but also strives for a vertical integration of institutions and decision making. As AQM requires an area-based approach, institutional reforms and measures should enhance cross-sectoral capacities and cooperation between environment, energy, transport, urban, and health sectors. In addition to strengthening the legal and policy framework for AQM at the national level, it is important to develop and support subnational solutions, particularly for urban pollution hot spots. To ensure effective implementation of air pollution reduction measures at subnational levels, roles and responsibilities for AQM need to be consolidated and clarified at different governmental levels. An integrative approach should equally aim at facilitating a dialogue between various stakeholders, including the government, civil society, academia, private sector, and other development partners, at the national and local levels.
- (b) Second, the design and implementation of economically effective interventions to successfully reduce air pollution must be underpinned by a sound foundation of analytical work to inform the selection of priorities and interventions and to set realistic and achievable air quality targets. Reliable monitoring and reporting of air pollution data is a necessary precondition for such analytical work. The selection of interventions in a given context should be supported by the analysis of benefits and costs of implementation. The benefit-cost analysis (BCA) compares health benefits of an intervention – avoided cost of premature mortality and morbidity due to air pollution – to costs of implementing the intervention. Policy makers can rank and prioritize alternative interventions and select interventions with a benefit-cost ratio greater than one.

Here, one should note that Cost-Effectiveness Analysis could offer an alternative to BCA as it is simpler and requires less information and does not necessarily include health impact assessments (HIA). Also, due to the data demand, BCA is generally more costly and requires more elaborate HIA – and is, thus, politically more sensitive in many cases.

- (c) Third, and as discussed in section 3, a phased approach is needed. Even though the severity of air pollution and its health impacts in the Western Balkans reflects the urgency for immediate and full-fledged interventions, no country, region, or municipality will have the resources or capacity to design, let alone implement, such a program that would achieve all needed changes simultaneously. Prioritization of actions should be based on cost-effectiveness of interventions, institutional feasibility, and targeting of pollution hot spots. With the dominance of residential heating as a source of air pollution during the high and often toxic peaks in the winter months, immediate actions should put much emphasis on restricting pollutions from these known stationary sources.
- (d) Fourth, in the near term, strategies and mechanism need to be developed that help manage emergency situations when air pollution rises to extremely high and toxic levels. While these

events often only last for a few days, they have severe impacts on people, especially the old, impaired, and children. While these actions are not targeted at effectively reducing air pollution, they will make a significant contribution to help people deal with these extreme events and mitigate impacts.

- (e) Fifth, policies and regulatory frameworks to reduce air pollution need to consider distributional and social impacts on affected people in different income groups. It is important that strategies and interventions to reduce air pollution do not disproportionately burden poor and vulnerable people and that restrictions are met with the offering of feasible, but clean, alternatives. Otherwise, the individual economic burden triggered by well-meant policies could lead to resistance and unintended opposition by the affected population. With the challenge of changing individual households' behavior with respect to residential heating, feasible solutions must cover the 'free riding' behavior of individual households and motivate collective action.
- (f) Sixth, the importance of providing financing solutions that meet the constraints of those that need to make the necessary investments cannot be underestimated. To reduce actual air pollution emissions and proactively engage in AQM, governments in the Western Balkans should be able to develop – and offer – bankable solutions and mobilize financial resources for investments in identified cost-effective measures to reduce air pollution. Financing options need to meet the heterogeneity of investments and investors. Public investments in air pollution, especially when addressing residential heating, will have to be provided largely in the form of grants and subsidy schemes. The facilitation of donor coordination and information exchange at the national and regional levels can support the alignment of technical and financial assistance offered for AQM through different organizations.

Annex 2 summarizes these principles by providing a stylized summary of a program for operationalizing AQM in the Western Balkan Region.



## Annex 1: Learning from International Experience in Tackling Air Pollution

### *Example A: Tackling air pollution for domestic heating in Mongolia*

**Background.** Annual average ambient concentration of PM pollution in Ulaanbaatar, Mongolia, can range from 200  $\mu\text{g}/\text{m}^3$  to 350  $\mu\text{g}/\text{m}^3$ . Air pollution is particularly severe during the winter months, when households burn coal and wood for heating and cooking. The Government of Mongolia, with World Bank support, decided to undertake full-scale AQM planning to obtain a complete understanding of sources, concentration levels, and health impacts and identify the most economically effective abatement options for reducing air pollution. The World Bank mobilized grant funding to provide technical assistance to the Government, which was underpinned by the Ulaanbaatar Air Monitoring and Health Impact Baseline (AMHIB) study.

**Process.** The three-year technical assistance entailed

- (a) Redistribution of air quality monitors across Ulaanbaatar to cover the central area, as well as the Ger areas;
- (b) One full year of air quality monitoring at all locations to allow for capture of seasonal variations;
- (c) Establishment of an inventory of emissions from all major sources in the city, air pollution modeling, and estimation of population exposure to PM pollution;
- (d) A health impact assessment in Ulaanbaatar to establish a baseline for health impacts; and
- (e) Identification of economically effective interventions.

The development of AMHIB entailed an extensive process of bringing together and engaging various stakeholders. The World Bank played a central role in technical coordination of the AQM planning process, administrative coordination of engagement of diverse stakeholders including national (various ministries including health, energy, transport, housing, and urban development; the Ulaanbaatar city departments; and academia) and international institutions, and engagement of international expertise in the AQM planning process.

**Actions.** The AMHIB study identified that small stoves in 150,000 Gers were the main source of PM in Ulaanbaatar and examined nine options for reducing air pollution:

- (a) Reducing start-up emissions by backlighting the fire
- (b) Reducing start-up emissions through stove modifications
- (c) Replacing existing stoves with cleaner stoves and no fuel change
- (d) Replacing existing stoves and fuel with cleaner stoves and semi-coked coal
- (e) Installing electric heating in Ger homes
- (f) Relocating Ger households into apartment buildings
- (g) Improving heat-only boilers

- (h) Cleaning street to reduce road dust suspension
- (i) Greening urban areas to prevent dust suspension

The abatement options that provided the highest net benefit – that is, monetary value of reduced health impact minus the cost of the abatement – were examined. Realizing the cost of not applying immediate abatement options, in favor of longer-term options, the government decided to go ahead with a program to replace existing stoves with clean, certified stoves.

**Results.** Between 2011 and 2015, more than 168,000 stoves were distributed, representing 91 percent of the households that used coal-fueled stoves for cooking. Importantly, households received a subsidy that reduced the costs of replacing the stoves. During 2011-2013, the average subsidy was equivalent to 91 percent of the cost and was eventually reduced to 66 percent during 2014-2015. The implementation of the program resulted in clear improvements in air quality in Ulaanbaatar. However, air pollution remains high, which underscores the need to broaden implementation of additional multisectoral interventions to reduce pollution emissions in the medium to long term.

### *Example B: Planning for investments in AQM to meet EU directives in Bulgaria*

**Background.** Bulgaria has some of the highest levels of fine PM pollution in the EU and the highest rate of premature deaths due to air pollution in Europe. Bulgaria is facing an infringement procedure due to exceedance of limit values for PM<sub>10</sub> and NO<sub>x</sub> in 25 municipalities. The principal source of PM<sub>10</sub> emissions within all municipalities is residential heating using solid fuel-fired stoves and boilers. Road transport is a further contributor and may be locally significant. To support Bulgaria to comply with EU directives, the Ministry of Environment and Water (MoEW) of Bulgaria and the World Bank signed a Reimbursable Advisory Service (RAS) agreement ‘Support for AQM’, which was designed around three activities:

- **Activity 1: Local AQM - Achieving compliance with EU air quality legislation.** In 2015, only 4 of 29 municipalities in Bulgaria managed to achieve compliance with EU limit values for PM<sub>10</sub> pollutant. The World Bank analyzed reasons for the prevalent noncompliance and provided inputs and support to the MoEW and the municipalities to reach compliance through adequate measures. The World Bank supported Bulgaria in piloting a National Air Quality Improvement Program (NAQIP) to reach compliance with the CAFE Directive. The World Bank team also supported the MoEW in stakeholder and sensitive technical consultations with the European Commission.
- **Activity 2: National emissions targets - Implementing requirements of the revised National Emission Ceilings Directive (NECD).** The aim of the second stage was to prepare a strategic National Air Pollution Control Program (NAPCP) for meeting the new National Emission Ceilings (NECs) by 2030. The NAPCP presents the commitment of Bulgaria to achieve certain emission reduction commitments by 2030 relative to 2005. The World Bank identified the policy baseline and analyzed the emission reduction efforts made till 2016. Building on the historic emissions data sets, emission projections from 2016 to 2030 were prepared, based on which additional emission reduction measures were proposed.

- **Activity 3: Institutional coordination and engagement.** In addition to helping Bulgaria meet its EU-related obligations, the RAS aimed to strengthen institutional coordination and public engagement on air quality issues within the government, strengthen communications, and build capacity through learning by doing. The World Bank team worked with the MoEW to produce a detailed capacity-building program. To meet the goal, the World Bank team developed a communication plan, created a coordination committee, and led a stakeholder workshop for endorsement of strategic plans.

**Results and the way forward.** The World Bank is seen by the Government of Bulgaria as the main solutions provider for issues and challenges in reaching compliance with the EU air quality standards. The proposal for AQM identifies policies and measures for addressing both the institutional and technical challenges for reaching compliance with EU air quality directives, as well as assesses their cost-effectiveness. Four measures were proposed to reduce PM<sub>10</sub> emissions from residential heating, addressing fuel type, fuel quality, and technologies used to convert fuel energy into useful heat. The principal measure, regarding complexity, costs, and maximum emissions reduction, is to phase out the use of traditional solid fuel heating appliances in noncompliant municipalities. The preparatory phase of the central measure will involve active engagement, analysis, and decision making at the municipal level, with the need of effective project management. The World Bank stays committed to explore further opportunities to support the air quality agenda in Bulgaria through technical assistance and co-financing of air quality projects.

## Annex 2: A stylized approach to operationalizing AQM

Activities	Energy	Transport	Urban	Environment
<b>1. AQM Framework</b> Based on robust diagnostics	Assessing sources of emissions and their impact on air quality concentrations, translating concentrations to human health and economic impacts, identifying policies and measures across sectors, prioritizing them by cost-effectiveness of emission reductions, finalizing them through political/economic/social filters, agreeing on spatial (municipal) scope of impacts, agreeing on indicators to track progress and impacts, identifying potential sources of financing/co-financing, and facilitating dialogue between decision makers and the population with the objective of enhancing the public support base when introducing air pollution reduction policies and measures.			
<b>2. Policies</b> Aimed at removing barriers	Regulation on early implementation of the EU Ecodesign directive for heating stoves and boilers  Tariff rationalization to facilitate the provision of district heating/gas for domestic heating	Tax break for import or purchase of electric vehicles  Regulation enabling the designation of low (traffic) emission zones in city centers	Legislation enabling municipalities to declare public health emergency on days of high air pollution  Regulation on creation of x% green area within municipal boundaries	Regulation on making real-time air quality information available to the public  Regulation banning the burning of waste such as plastics and tires
<b>3. Measures</b> Operations with disbursement-linked indicators that disburse to municipalities on showing measurable improvement in air quality	Procurement and installation of Ecodesign-compliant stoves and boilers  Upgrading of district heating or gas supply infrastructure and connecting to households	Development of electric charging infrastructure and procurement for electric buses  Pedestrianization and parking infrastructure	Distribution of masks for children and elderly and installation of high efficiency air filters in schools and hospitals  Better waste management services	Procurement and installation of automatic air quality monitoring stations  Urban afforestation programs
<b>4. Institutional strengthening</b> Support of policies and measures at national, regional, and municipal levels	AQM planning; identification and prioritization of sectoral measures; monitoring and reporting on progress and results; enforcement across sectors; communication/coordination and inter-sectoral collaboration between national, regional, and municipal levels; coordination platform; international good practice; alignment with EU directives; and so on. This will also focus on strengthening vertical coordination of capacities and responsibilities from the national to the municipal level.			
<b>5. Innovative financing</b>	Catalyze the use of innovative financing with the objective to scale up interventions (for example, Breathe Better Bonds).			