Report No: AUS0001029

Turkey

Support to Local Air Quality Management

Diagnostic Analysis of Local Air Quality Management Practices
Pilot Case: Kayseri Province

June 2019

ENV

Document of the World Bank

SUPPORT TO LOCAL AIR QUALITY MANAGEMENT IN TURKEY

DIAGNOSTIC ANALYSIS OF LOCAL AIR QUALITY MANAGEMENT PRACTICES

PILOT CASE: KAYSERI PROVINCE

FINAL

June 2019

(Project Number: P169824)	
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DISCLAIMERS

This report was produced by the World Bank team to provide advisory support to the Ministry of Environment and Urbanization (MoEU) in Turkey. The findings, interpretations and conclusions expressed in this report do not necessarily reflect the views of the Executive Directors of the World Bank or of the Government of Turkey or its MoEU.

ACKNOWLEDGEMENTS

This report was produced by a core team led by Sameer Akbar (Senior Environmental Specialist, Task Team Leader), and Esra Arikan (Senior Environmental Specialist, Team Member), with substantial inputs from Dietmar Koch (International Air Quality Expert), Oznur Oguz Kuntasal (International Air Quality Expert), Emre Tokcaer (Local Consultant), Russell Frost (International Consultant), and Ulker Karamullaoglu (Team Assistant). The contributions of Kseniya Lvovsky (Practice Manager, ECA ENR) and Auguste Kouame (Country Manager) are also acknowledged.

The World Bank would like to acknowledge the assistance in the form of interviews, meetings, data and information of the experts at the Air Quality Directorate, Ministry of Environment and Urbanization (MoEU) especially Pervin Doğan (Division Manager), Canan Esin Köksal (Expert), Ağça Gül Yılmaz (Expert), and İrde Çetintürk Gürtepe (Expert); Konya Clean Air Center (CAC); Kayseri Municipality; Kayseri Mayor Office; and Kayseri Provincial Directorate of MoEU.

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ABBREVIATIONS and ACRONYMS

AQM	Air Quality Management
AQAD	Air Quality Assessment Division
AQAM	By-law on Ambient Air Quality Assessment and Management
ASA	Advisory Services and Analytics
CAAP	Clean Air Action Plan
CAC	Clean Air Centre
CAFE	Directive 2008/50/EC on Clean Air For Europe
CMAQ	Community Multiscale Air Quality Model
DGEM	General Directorate for Environmental Management
CLRTAP	Convention on Long Range Transboundary Air Pollution
EC	European Commission
EF	Emission Factor
EU	European Union
GIS	Geographical Information System
HEY	Air Emission Management (Hava Emisyon Yönetim) Portal
IPPC	Integrated Pollution Prevention and Control
LAQM	Local Air Quality Management
MACC	Marginal Abatement Cost Curve
MoEU	Ministry of Environment and Urbanization
MoH	Ministry of Health
NAPEMS	The Development of National Air Pollution Management System
NAQMN	National Air Quality Monitoring Network
NGO	Non-Government Organization
NO_x	Nitrogen oxides
NMVOCs	Non-methane volatile organic compounds
NH_3	Ammonia
$PM_{2,5}$	Fine Particulate Matter
SO_2	Sulfur dioxide
VOC	Volatile Organic Compounds
WRF	Weather Research and Forecasting model (to be coupled with CMAQ)

EXECUTIVE SUMMARY

BACKGROUND, OBJECTIVES AND SCOPE

Turkey is a European Union (EU) Candidate Country. According to the European Commission (EC) Progress Report published on April 2018, Turkey still struggles with serious air quality problems on province level and this indicates the need for local action. Whilst Turkey continues to improve air quality through the prevention and control of harmful emissions, making progress in tackling air pollutants such as sulfur dioxide (SO_2), lead, nitrogen oxides (NOx) and carbon monoxide (CO), poor air quality driven by particulate matter (PM_{10} and $PM_{2.5}$), benzene, NOx and ground-level ozone (O_3) persists, causing problems to human health and the environment. This is especially the case in urban areas.

Some of the major cities and provinces have been in persistent non-compliance with national ambient air quality limit values. Although Clean Air Action Plans (CAAPs) have been completed for some provinces, their implementation is limited, and mitigation actions are not that effective. A diagnostic analysis as to why this is so should help to improve the extent of CAAP preparation and implementation.

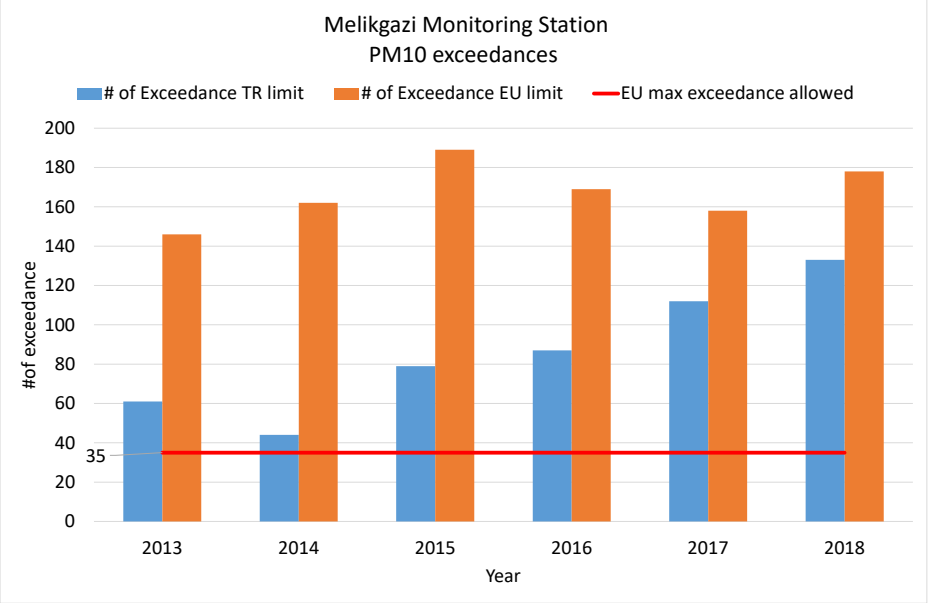

Figure- Kayseri Province urban monitoring station long-term PM10 exceedances

The World Bank (WB) and the Ministry of Environment and Urbanization (MoEU) agreed on an advisory services Support to Air Quality Management in Turkey, over the period of November 2018 and June 2019. Its objective is to support provinces to achieve compliance with ambient air quality limit values through undertaking a diagnostic analysis of the Clean Air Action Planning process, from preparation to implementation and monitoring / evaluation.

The province of Kayseri was selected for diagnostic analysis, the results of which are provided in this report. A field visit, together with desktop review of available documents, reports, legislation, and additional data and information received from the stakeholders, set the basis for this diagnostic

report. A similar diagnostic analysis provided can be replicated in other non-compliant provinces in the country.

Legislative Framework and Institutional Arrangements

The legislative framework for air quality management in the country is in place and full transposition to EU legislation continues. Ambient air quality limit values for some parameters are not in-line with EU levels and the full adoption process will be ongoing until 2024. Legislation and circulars define requirements for Clean Air Action Plans (CAAPs), roles and responsibilities, and required frequency for the update of plans.

Institutional structures to manage air quality at local level is still evolving. Provincial Directorates of MoEU prepare CAAPs and submit to MoEU, which evaluates them and provides feedback. Oversight is provided through CAAP commission, which works under Local Environment Council led by Mayor and includes other relevant stakeholders. Provincial Directorates are also responsible for coordination of implementation of measures stated in the CAAPs.

Local AQM is mainly controlled at central level, principally by the appropriate Provincial Directorate of MoEU, with technical support provided by the relevant Regional Clean Air Centres (CAC) of the MoEU. The CACs support Provincial Directorates on technical aspects such as modelling, monitoring, and emission inventory. Air quality data, however, are collected at central level, before disclosure to the public. Each CAC serves several provinces. This arrangement also ensures consistency of the different CAAPs.

Progress has been made in recent years in several aspects of the preparation and harmonization of CAAPs. The MoEU has conducted several international projects aiming at supporting preparation of CAAPs. Konya CAAP, prepared as part of a Dutch Government supported project (IKONAIR), is one of the good examples that provides step-by-step procedures and methodologies in developing parts of the CAAPs. Another project named CITYAIR aims to help revise local CAAPs for selected provinces over the next three years. In order to prepare local emission inventories a project named HEYGEL (Supporting Air Emission Management Portal) has been initiated and should deliver results by the end of 2023 for all 81 provinces.

However, most of the measures within a CAAP have to be implemented by municipalities at local level. The legislation states that municipalities are members of CAAP commissions, and their involvement in the preparation and implementation of CAAPs is important. However, the coordination of the work of a municipality and the provincial directorate often poses challenges.

Improvements Needed in CAAPs

A review of the CAAPs (with the exception of Konya CAAP) shows that they do not provide linkages between assessments of ambient air quality, emission sources and selected mitigation measures. Though some reports do provide an emissions inventory for industry, traffic and residential heating sectors and mitigation measures to improve air quality, this is an area where additional improvement is needed.

Improvement is needed in quantifying the potential impacts of identified mitigation measures in CAAPs. The estimated impacts of mitigation measures are defined qualitatively (such as high, medium, low, etc.) in some CAAPs with no quantitative assessment of impact on ambient air quality.

Another area for improvement is the use of economic analysis of mitigation measures. None of the CAAPs use economic analysis (e.g. cost-effectiveness - ratio of cost to quantified pollutant abatement), which could also help in prioritization of measures. Though economic analysis is not the only criterion to be considered in adopting and prioritizing measures for implementation, it makes a valuable contribution.

Accounting for transboundary emissions and secondary formation particles in CAAPs is another area where improvement is needed. Currently, CAAPs do not account for these two sources. Source apportionment studies to identify the contributions of these two sources, which in some EU countries account for about 30-40% of the concentrations in urban areas, should be performed and results should be included in the CAAPs.

Review of CAAP for Kayseri Province

Review of Kayseri CAAP revealed that current CAAP need to be improved significantly and implementation and monitoring mechanisms need to be strengthened. Some of the ***specific conclusions*** regarding Kayseri Province CAAP are as follows;

i) An inventory of emissions to air does not exist for Kayseri province; hence the identification of major sources is unclear;

ii) Although emission sources are not known, meaningful emission reduction measures were introduced in the CAAP, such as the ones to reduce emissions from residential heating and road traffic;

iii) Most of the measures identified in the plan need to be implemented and financed by the municipality but municipality needs additional financing to implement the remaining measures;

iv) Eskişehir Bağları district was identified as a major residential heating pollution source in the city and natural gas distribution pipeline was introduced to the area. However, low income families (mostly Syrian refugees) reside in this area and they need financial support to connect to and use natural gas. Additional funding is needed for this measure;

v) Konya CAC has a limited budget and a limited number of staff. There is a need for additional funding to support the operation of the Center. There is also need for capacity development and staff training;

vi) Impact of measures cannot be estimated due to low technical capacity;

vii) Source identification to investigate all possible air emission sources (such as traffic, agriculture, crustal, secondary particle formation etc.) has not been done;

viii) The coordination/communication among various stakeholders of air quality management (such as municipality, provincial directorate and Konya CAC) is poor, especially during implementation and monitoring of measures.

ix) Ministry of Health and MoEU are currently conducting exposure and health risk assessment studies on air pollution, once the results are available it should be disseminated with the public to increase awareness.

Recommendations and The Way Forward

The diagnostic analysis conducted for Kayseri Province highlights following major issues at local level (see text box for recommendations), which could be common across a number of provinces:

1. ***Lack of technical and human resource capacity at municipal level and CAC.*** The preparation of the CAAP is adversely affected as the capacity to undertake requirements of local AQM is lacking.
2. ***Lack of financial resources to implement identified measures in the CAAP.*** The CAC does not have adequate financial resources to undertake necessary tasks, such as operate monitoring network and undertake emission inventory and dispersion modeling.
3. ***Lack of coordination among stakeholders especially during implementation of the CCAP.*** The CAAP commission established under Local Environment Council is operational only during preparation of CAAP but does not oversee implementation and monitor outcomes.

While there are several completed and on-going efforts at national level to help support local level actions and local authorities in AQM, their focus is mostly on CAAP preparation. However, the challenges foreseen are in implementation and measurement of impacts, which are compounded because of lack of capacity and finances. Based on World Bank experience in other countries, the provision of infrastructure is not enough to deliver improved air quality; adequate capacity, delivery of financing, coordination, and awareness raising are also required. The World Bank could provide support through sharing of international knowledge and experience and leverage its engagement in a number of sectors in Turkey that impact air quality - urban, energy, and transport – to mobilize additional support based on a request from the Government.

It should also be noted that effective air quality management and reducing air emissions not only help improve ambient air quality but also help reduce climate change impact via reducing Greenhouse Gases (GHGs) short-lived climate pollutants such as black carbon. Therefore, integrating climate change mitigation and air pollution policies would also help benefit efficient use of resources and increasing impact, which should be considered in Turkey as well.

Recommendations to improve Kayseri CAAP preparation and its implementation are as follows:

- It is recommended that the emissions inventory of the Province is urgently completed (before preparation of the next CAAP) to identify major emission sources in the city. Ongoing efforts of the MoEU are welcome and indicate that emission inventory estimates for the city will be available soon.
- CAAP commission is established during preparation of CAAP, but it does not actively contribute to implementation and monitoring of plan. It is recommended that CAC council keep operational during all phases of CAAP (i.e., preparation, implementation, monitoring).
- Coordination/communication among various stakeholders of air quality management (such as municipality, provincial directorate and Konya CAC) need to be strengthen during all phases of the CAAP (i.e., preparation, implementation and monitoring). This can be achieved by continuation and active contribution of the CAAP commission during all phases of the CAAP.
- Municipality prepared a GHG emission inventory, which can be very useful to develop air emission inventory especially for energy sector. It is recommended to use existing GHG emission inventory as a basis for the air emission inventory.
- Integrating air quality improvement into urban planning (such as providing green urban spaces in densely populated city centers, keeping industry away from residential areas and considering prevailing wind direction in location selection for industrial facilities) should be considered.
- There are no major industrial facilities located in Kayseri but there are many SMEs located in several OIZs located around city. Mining sector is among the most common industry in the city. Air emissions and case-by-case basis ambient concentration levels are reported to Provincial Directorate of MoEU during permit phase. However, there is not a rigorous on-site inspection monitoring of industrial emissions. This could be increased, especially where emissions are expected to be high (such as mining sector). Process emissions of industrial facilities, in addition to heating emissions, should also be inspected.

Possible areas of future support:

Based on the diagnostic analysis, potential areas for engagement, including possible financing, that emerge are as follows:

- Support for Eskişehir Bağları residential heating solutions;
- Support for the training of Konya CAC;
- Capacity increase for provinces (10 provinces) under Konya CAC on following areas:
    - Identifying and prioritizing mitigation measures;
    - Residential heating measures (including funding and implementation mechanisms etc.)
    - Access to finance.
- Support on implementation of new By-law on LEZ;
- It is also recommended to follow an 'Act while Plan' approach, where some most obvious mitigation actions are initiated based on current CAAP, while a robust CAAP (or AQMP) is developed based on source apportionment and emission inventories. The size of such program and number of cities may be selected based on client interest / level of ambition and available lending envelope.
- Air Quality and Greenhouse Gas emissions management program comprising of technical assistance and investments across several municipalities / provinces.

CHAPTER 1. INTRODUCTION

Turkey is a European Union (EU) Candidate Country. According to the European Commission (EC) Progress Report published on April 2018, Turkey still struggles with serious air quality problems on province level and this indicates the need for local action. EC Progress report states that Turkey continues to improve air quality by controlling emissions of harmful substances into the atmosphere, by adopting European fuel quality standards, by promoting renewals of motor vehicle fleets and by integrating environmental protection requirements into the transport and energy sectors. Progress has been made in tackling air pollutants such as sulfur dioxide (SO_2), lead, nitrogen oxides (NOx) and carbon monoxide (CO). However, poor air quality driven by particulate matter (i.e. PM_{10} and $PM_{2.5}$), benzene and NOx (mainly NO_2) and ground-level ozone (O_3) continues to cause problems to human health and the environment especially in urban areas. Some of the major cities and provinces have been in persistent non-compliance with national ambient air quality limit values. Although Clean Air Action Plans (CAAPs) have been completed for some of the provinces, they have not been effective in addressing the problem.

The World Bank (WB) and the Ministry of Environment and Urbanization (MoEU) agreed on an advisory services Support to Air Quality Management in Turkey, over the period of November 2018 and June 2019. This advisory support aims at supporting select provinces in Turkey in achieving compliance with ambient air quality limit values via undertaking a diagnostic analysis of the Clean Air Action Planning process and providing recommendations for improvement. The diagnostic analysis identifies areas that need further improvement and reasons for non-compliance, but it does not include recommendations for how the identified actions may be implemented, which could be the subject of a follow-on project to help achieve compliance. Detailed scope of the Diagnostic Analysis as provided in inception report is included in Annex A of this report.

The province of Kayseri[1] was selected for the diagnostic analysis[2], the results of which are provided in this report. The World Bank team undertook a field visit to Kayseri to visit the site and hold discussion meetings with stakeholders. The outcome of the field visit, together with desktop review of available documents, reports, legislations, and additional data and information received from the stakeholders, set the basis for diagnostic report.

[1] Province and city are used interchangeably. The Governor is appointed for the Province which covers all the districts within province borders. Mayors are elected for each municipal district. Usually greater city municipality includes several districts with high population in the centre along with elected district mayors

[2] Criteria used for selecting pilot city is provided in Chapter 5 of this diagnostic report.

CHAPTER 2. LEGAL FRAMEWORK AND INSTITUTIONAL STRUCTURE FOR LOCAL AIR QUALITY MANAGEMENT IN TURKEY

This chapter provides background information on legal framework and institutional structure for Air Quality Management (AQM) in Turkey at national, regional and local level, with a specific focus on local AQM and Clean Air Action Plans (CAAP). This is important background information in order to understand the reason for continues non-compliance with limit values.

2.1. LEGAL FRAMEWORK

2.1.1. TURKISH LEGISLATION

Turkey is an EU candidate country and transposition of national legislation on environment, including air quality, is still on-going.

The *Turkish Environment Law*[3] refers to protection of air quality and prevention of air pollution in its additional *Article number 6*. The same article states that the Ministry of Environment and Urbanization (MoEU) will define the rules and principles through regulations that will be published. The most important legislation related to AQM in Turkey is the *By-law on Air Quality Assessment and Management* (O.G. 06.06.2008, no: 26898)[4] and *Circular on Air Quality Assessment and Management* (Circular No 2013/37)[5]. Air quality limit values as stated by the By-Law are provided in Table 1, which shows a gradual reduction in Turkish limits values to be achieved by 2024 to finally meet EU limit values for all parameters.

Other legislation on air quality include the following, and are summarized in Annex B:

- By-law on Control of Heating based Air Pollution (O.G. 07.02.2009, no: 27134)[6];
- By-law on Industrial Air Pollution Control (O.G. 07.02.2009, no: 27277)[7];
- By-law on Environment Permit and License (O.G. 10.09.2014, no: 29115)[8];
- By-law on Environmental Impacts of Petrol and Diesel Fuels (O.G. 01.04.2017, no: 30025)[9];
- By-law on Decrease of Sulfur Ratio in some Fuel Oil Types (O.G. 06.10.2009, no: 27368)[10];
- By-law on Control of Exhaust Gas Emission (O.G. 11.03.2017, no: 30004)[11];
- By-law on Increasing Energy Efficiency in Transport Sector (O.G. 02.05.2019, no: 30762)[12]
- Circular on Imported Solid Fuels (Circular No 2015/2)[13];
- Circular on Air Quality Assessment and Management (Circular No 2013/37); and
- Circular on Air Pollution Prevention and Control (Circular No 2010/14).

[3] Law No: 2872, Ratification Date: 9/8/1983, Official Gazette No: 18132
[4] Available at http://www.mevzuat.gov.tr/Metin.Aspx?MevzuatKod=7.5.12188&MevzuatIliski=0&sourceXmlSearch=hava%20kalitesi%20de%C4%9Ferlendirme
[5] Available at https://webdosya.csb.gov.tr/db/cygm/editordosya/GNG2013-37HavaKalitesiDegerl.pdf
[6] Available at http://www.mevzuat.gov.tr/Metin.Aspx?MevzuatKod=7.5.7265&MevzuatIliski=0&sourceXmlSearch=%C4%B1s%C4%B1nmadan%20kaynaklanan
[7] Available at http://www.mevzuat.gov.tr/Metin.Aspx?MevzuatKod=7.5.13184&MevzuatIliski=0&sourceXmlSearch=hava%20kirli
[8] Available at http://www.mevzuat.gov.tr/Metin.Aspx?MevzuatKod=7.5.20033&MevzuatIliski=0&sourceXmlSearch=izin%20ve%20lisan
[9] Available at http://www.mevzuat.gov.tr/Metin.Aspx?MevzuatKod=7.5.23470&MevzuatIliski=0&sourceXmlSearch=benzin%20ve%20motorin
[10] Available at http://www.mevzuat.gov.tr/Metin.Aspx?MevzuatKod=3.5.200915478&MevzuatIliski=0&sourceXmlSearch=baz%C4%B1%20akaryak%C4%B1t
[11] Available at http://www.mevzuat.gov.tr/Metin.Aspx?MevzuatKod=7.5.23410&MevzuatIliski=0&sourceXmlSearch=egzoz
[12] The By-law sets basis for establishment of "Low Emission Zones" at congested urban areas. Available at https://www.mevzuat.gov.tr/Metin.Aspx?MevzuatKod=7.5.31464&MevzuatIliski=0&sourceXmlSearch=Ulaşımda Enerji Verimliliğinin Artırılmasına İlişkin Usul ve Esaslar Hakkında Yönetmelik
[13] Available at https://webdosya.csb.gov.tr/db/cygm/editordosya/genelge(1).pdf

Table 1 Air Quality Limit Values in Turkey and EU.

Pollutant	Averaging Period	Limit Values		Calendar to fully adopt EU limit values
		Turkey (as of 2018)	EU Member States	
Sulfur dioxide (SO_2)	Hourly	380 µg/m^3	350 µg/m^3	1.1.2019
	Daily	150 µg/m^3	125 µg/m^3	
	Warning threshold (3 consequent hours)	500 µg/m^3	500 µg/m^3	
	Maximum number of exceedances of *hourly limits* in a calendar year	-	24 exceedances	
	Maximum number of exceedances of *daily limits* in a calendar year	-	3 exceedances	
	Annual (for ecosystem protection)	20 µg/m^3	20 µg/m^3	1.1.2014
Particulate Matter (PM10)	Daily	60 µg/m^3	50 µg/m^3	1.1.2019
	Annual	44 µg/m^3	40 µg/m^3	
	Maximum number of exceedances of *daily limits* in a calendar year	-	35 exceedances	
Nitrogen dioxide (NO_2)	Hourly	260 µg/m^3	200 µg/m^3	1.1.2024
	Annual	44 µg/m^3	40 µg/m^3	
	Warning threshold (3 consequent hours)	-	400 µg/m^3	
	Maximum number of exceedances of *hourly limits* in a calendar year	-	18 exceedances	
Nitrogen oxides (NO_x)	Annual (for Ecosystem protection)	30 µg/m^3	30 µg/m^3	1.1.2014
Carbon monoxide (CO)	8-hr	10 mg/m^3	10 mg/m^3	1.1.2017
Ozone (O_3)	8-hr	120 µg/m^3	120 µg/m^3	1.1.2022
	Informative threshold (hourly)	-	180 µg/m^3	
	Warning threshold (hourly)	240 µg/m^3	240 µg/m^3	
Benzene (C_6H_6)	Annual	8 µg/m^3	5 µg/m^3	1.1.2021
Lead (Pb)	Annual	0.6 µg/m^3	0.5 µg/m^3	1.1.2019
Arsenic (As)	Annual	-	6 ng/m^3	1.1.2020
Cadmium (Cd)	Annual	-	5 ng/m^3	1.1.2020
Nickel (Ni)	Annual	-	20 ng/m^3	1.1.2020
Benzo a pyrene (B(a)p)	Annual	-	1 ng/m^3	1.1.2020

Source: First National Air Quality Management Workshop, Final Report prepared by MoEU, May 2017.[11]

Legal Framework on CAAPs

The By-law on AQAM also sets requirements for preparing "Clean Air Plans" (Article 10), "Action Plans" (Article 11) as well as exceptions (Article 12). According to By-law, MoEU identifies regions and sub-regions for air quality management in accordance with criteria stated in the By-law. In case one or more of the threshold levels stated in Annex I of the By-law is exceeded in these regions or sub-regions, then the Provincial Directorate of MoEU prepares a "Clean Air Plan" as described by Article 10. The Clean Air Plan should include measures to ensure reaching limit values stated in the By-law. The minimum information that should be covered by the Clean Air Plan is given in Annex IV of the By-law (see Annex C of this report). In case there is a risk to exceed one or more of the threshold levels stated in Annex I of the By-law, then the Provincial Directorate of MoEU should prepare an "Action Plan" that includes measures for limiting the number of exceedances or reducing the related risk in accordance with Article 11. The Action Plan can also be integrated with the Clean Air Plan defined in Article 10 and a "Clean Air Action Plan" (CAAP) can be prepared. According to Article 15 of the By-law, municipalities and other related institutions cooperate and provide input for preparation of CAAPs.

2.2.2. EU Legislation

The main relevant EU legislation is Directive 2008/50/EC on Ambient Air Quality and Cleaner Air for Europe (CAFÉ Directive). It requires the preparation of local air quality plans (AQP) for zones or agglomerations where ambient air limit values are exceeded (Article 23). Annex XV of the Directive 2008/50/EC provides a framework for the information to be included in local, regional or national air quality plans for improving ambient air quality. Additionally, Commission Implementing Decision 2011/850/EU is laying down rules for Directives 2004/107/EC and 2008/50/EC of the European Parliament and of the Council as regards the reciprocal exchange of information and reporting on ambient air quality.

Of special importance are Article 9 on reporting of the quality and traceability of the assessment methods applied and, Article 13 on mandatory elements of the air quality plan to be reported including references to where the public can have access to regularly updated information on the implementation of the air quality plans.

The CAFÉ directive provides a framework for a CAAP outline (see Annex D of this report) and does not provide details as the Directive itself is a framework directive. While this results in consistency among CAAP "outlines" across individual member states, in terms of assessments provided in the CAAPs, the methodologies used, and their content and substance, there are significant variations in practice as each member state develops its own guidance material.

There is a large number of other EU Directives to be considered such as Directive 94/63/EC on the control of volatile organic compound (VOC) emissions resulting from the storage of petrol and its distribution from terminals to service stations and Directive 2004/42/EC on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain paints and varnishes and vehicle refinishing products. The main objective of Directive 2004/42/EC is to prevent or reduce air pollution resulting from VOCs contributing to the formation of tropospheric ozone. This aim is achieved through defining maximum allowable concentrations of VOCs in certain paints and varnishes allowed to be placed on market. Though relevant and efficient regulation on petrol distribution and

limitation of use of organic solvents in certain products were introduced in Turkey, the assessment of their current situation is necessary in the context of the CAAPs.

In addition to EU Directives, initiatives within the UN (Conventions, Protocols[14] and Action Plans[15]) where Turkey is party to are also important. This includes the UNFCCC (Turkey ratified the Convention in 2004, the Kyoto Protocol in 2009; signed the Paris Agreement in 2016 but did not ratify it as yet) and UNECE CLRTAP (Convention signed in 1979, the EMEP Protocol in 1984).

BOX 1- KEY TAKEAWAYS: LEGISLATIVE FRAMEWORK ON LOCAL AQM

Legislative framework for air quality management in the country is in place and full transposition to EU legislation is still on-going. Ambient air quality limit values for some parameters are still not in-line with EU levels and full adoption process will be ongoing until 2024. Regarding Clean Air Action Plans, legislations define requirements, roles and responsibilities, and update frequency of the plans. Several circulars provide supporting information on implementation, such as solid fuel quality inspections, supplier permits, etc. A recently published By-law on energy efficiency for transport sector sets basis to establish "Low Emission Zones" (LEZ), where traffic congestion and air pollution is high.

[14] Different Protocols cover pollutants (Sulfur dioxide, Nitrogen oxides, non-methane Volatile Organic Compounds, Ammonia, Lead, Cadmium, Mercury, Dioxins/Furans, Polycyclic Aromatic Hydrocarbons and Hexachlorobenzene) in relation to the respective emission reduction obligations set for each Party;

[15] Improving air quality for a better environment and human health, The Batumi Action for Cleaner Air (2016–2021), Batumi, Georgia, 8–10 June 2016.

2.2. Institutional Structure

According to Presidential Decree No 1[16] MoEU is responsible for air quality management. Figure 1 shows the institutional structure for air quality management in Turkey, at national, regional and local levels.

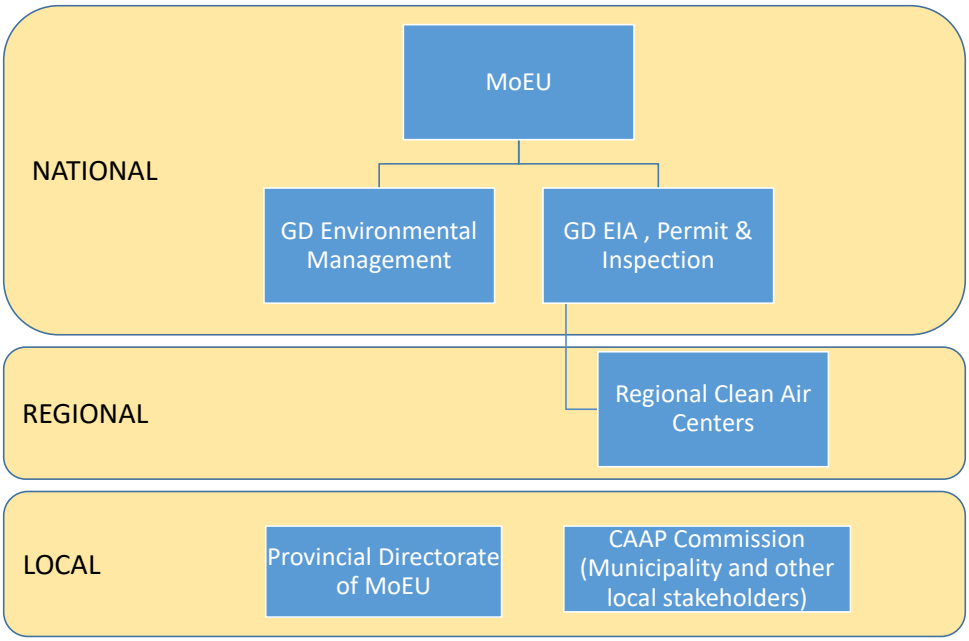

Figure 1 Institutional Structure for Air Quality Management in Turkey.

Responsibilities of General Directorate of Environmental Management (GDEM)

The GDEM of the MOEU has several responsibilities, including air quality management. GDEM's specific responsibilities regarding air quality management are:

- Carry out activities for protection of air quality, reduction or removal of air pollution, noise and vibration;
- Preparation of Clean Air Action Plans (CAAPs);
- Coordination with relevant institutions;
- Promoting clean energy use – renewable energy resources as priority, carrying out studies to identify targets and criteria in fuel use in order to avoid air pollution; and
- Identifying constraints throughout the whole country including free trade zones, waste, chemicals, air pollution, noise and vibration that have negative impacts on environment.

The "Air Management Department" of the GDEM carries out tasks and projects related to the above listed responsibilities of GDEM regarding AQM. It consists of five divisions as shown in Figure 2.

[16] Official Gazette dated July 10th 2018, no 30474.

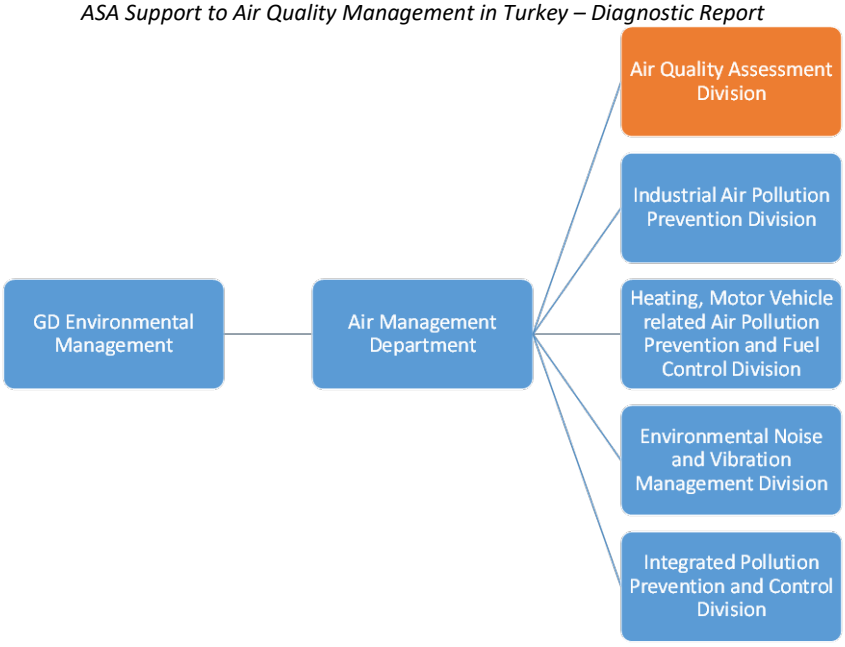

Figure 2 GDEM's Air Management Department and its Divisions.

Responsibilities of General Directorate of Environmental Impact Assessment, Permit and Inspection (GDEIAPI)

The GDEIAPI of the MOEU has several responsibilities, out of which the following is most relevant for CAAPs:

- Carrying out tasks and operations related to establishing and management of Regional Clean Air Centers (CAC).

Figure 3 shows the institutional set-up related to Air Quality Monitoring and Regional Clean Air Centers of GDEIAPI. "Air Quality Monitoring Division" of the GDEIAPI operates *National Air Quality Monitoring Network (NAQMN)* which provides online real time and historic monitoring results for each monitoring station[17]. GDEIAPI publishes monthly and annual air quality bulletins which includes average pollution concentrations monitored at each CAC[18].

[17] Available at https://www.havaizleme.gov.tr/Services/AirQuality
[18] Available at https://ced.csb.gov.tr/hava-kalitesi-haber-bultenleri-i-84139.

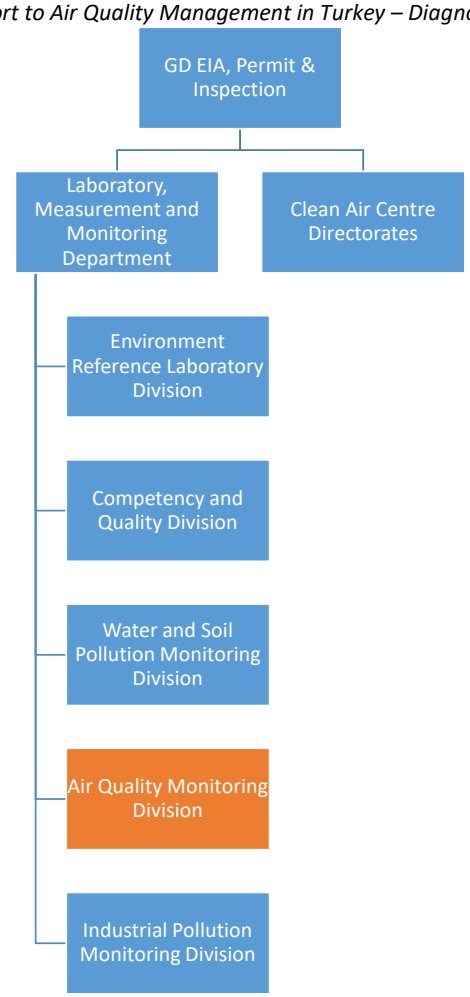

Figure 3 Institutional set-up under GDEIAPI related to air quality monitoring and CAAP.

Regional Clean Air Centers (CAC)

Regional Clean Air Centers (CAC) have recently been established by GDEIAPI. The main purpose of establishing CACs is to support Provincial Directorate of MoEU in preparation of CAAPs. There are eight CACs in the country. Each CAC serves to several (eight to ten) provinces within its zone.

Although there is no legal document to define roles and responsibilities of CACs, website of South Interior Anatolia Clean Air Center (where selected pilot province Kayseri locates) [19] defines center's roles as follows:

- Ensure operation and administration of Regional ambient air quality monitoring data operation center, Calibration laboratory, Analytic laboratory and Air quality monitoring network; carry out maintenance and repair work for cabin, device, software and equipment;
- Develop emission inventories for the region;
- Carry out supplementary model calculations at local scale;
- Support local authorities for development of "Clean Air Action Plans";
- Carry out all duties related to air quality data management;
- Prepare calibration plans, approve them, and carry out calibration tasks suitable to national and international standards;
- Establish working conditions required for the quality assurance system, identify the training needs for laboratory staff as required by quality assurance system and update trainings;

[19] https://giathm.csb.gov.tr/gorev-ve-sorumlulugumuz-i-80085

- Carry out validation, analysis and assessment of air quality measurement data from Air Quality Monitoring Network, ensure coordination and cooperation with National Air Quality Monitoring Network Operation Center;
- Assessing cases of air quality limit value exceedance, inform authorized institutions in cases of exceedance;
- Send information that is required to be reported by By-law on Air Quality Assessment and Management (O.G. 06.06.2008, no: 26898) in coordination with the Provincial Directorates in the region;
- Carry out training, research and project studies on subjects within scope of responsibilities;
- Cooperation and coordination with relevant institutions for meeting, conference, seminar and symposiums;
- Prepare budget proposal and work programs;
- Implement approved budget and programs;
- Supply required equipment, tools, office stock and consumption materials;
- Carry out tasks related to staff personal rights and other expenditure accruals; and
- Carry out other tasks to be given by the MoEU.

During the stakeholder workshop held within the scope of diagnostic analyses, it became clear that CACs has very limited budget and human resources. South Interior Anatolia Clean Air Center (thereafter "Konya CAC") has eight technical staff. Physical building of the center and budget for employees are provided by the MoEU, however, CAC does not have an operational budget for equipment purchase, laboratory set-up, etc. Konya CAC is trying to reach several different financing sources to obtain funding for its operation as well as maintenance of equipment within its network.

CAAP Commission

In accordance with Circular on Air Quality Assessment and Management (Circular No 2013/17), the *Local Environment Council* in each province should establish a CAAP Commission with participation of at least one representative of institutions that carry out work related to air quality.

Provincial Directorate of MoEU

The provincial directorates represent MoEU at local level in each province. They are also within the CAAP Commission and Local Environment Council. The provincial directorate is responsible for coordination of Action Plans in accordance with Article 11 of the By-law on Air Quality Assessment and Management. Therefore, coordination for implementing the measures foreseen in the CAAPs is the responsibility of the Provincial Directorates.

The Provincial Directorates also have inspection and/or monitoring roles within the scope of following legislation:

- By-law on Control of Heating based Air Pollution;
- By-law on Industrial Air Pollution Control;
- By-law on Environment Permit and License; and
- By-law on Control of Exhaust Gas Emission.

Local Environment Council (LEB)

In accordance with By-law on *Working Rules and Principles of Higher Board of Environment and Local Environment Councils* (OG; 03.08.2013-28727); Local Environment Councils are established in each province with the chairmanship of the Governor or Vice Governor and with the participation of the provincial representatives from Ministries of Interior, Treasury and Finance, National Education,

Health, Transport and Infrastructure, Agriculture and Forestry, Energy and Natural Resources, Culture and Tourism, Industry and Technology and representatives of Disaster and Emergency Management Presidency, Presidency of Religious Affairs, Provincial Headquarters of Gendarmerie, Police, Chambers of Industry and Commerce, and the Mayorship. Provincial Directorate of MoEU carries out the secretariat of the board. The LEB meets regularly to take required decisions; prepare programs; and take precautions for protection and improvement of the environment; and prevention of pollution at the provincial level.

Municipalities and Other Institutions

In accordance with the By-law on Air Quality Assessment and Management, the **Metropolitan Municipalities/Municipalities** and other relevant institutions are responsible for cooperating with and providing input into the preparation of a CAAP and for implementing the measures to ensure compliance.

Other relevant institutions include **industrial facilities** which should carry out periodic measurements with accredited institutions/laboratories within the scopes of By-law on Control of Heating based Air Pollution and By-law on Industrial Air Pollution Control; **Energy Market Regulatory Authority (EMRA)** which defines technical specification for petrol and diesel fuels; **Ministry of Industry and Technology** which has monitoring and reporting responsibilities for industrial facilities; **Ministry of Transportation and Infrastructure** which is responsible for the fuel used by maritime vessels; and **traffic police and/or gendarmerie** who have responsibilities for traffic inspections related to vehicle emissions.

BOX 2- KEY TAKEAWAYS: INSTITUTIONAL STRUCTURE AND LOCAL AQM

Institutional structure to manage air quality at local level is still evolving in the country. According to current legislation, Provincial Directorates of MoEU prepare CAAPs and submit to MoEU central office. MoEU central office evaluates the CAAPs and provides feedback to Provincial Directorates. Provincial Directorates are also responsible for coordination of implementation of measures stated in the CAAPs. CAAP is prepared through *CAAP commission*, which works under *Local Environment Council*. Local Environment Council is led by Governor and secretary is Provincial Directorate of MoEU. CAAP commission includes other stakeholders at provincial level, who are relevant to local AQM.

Technical parts of the CAAP such as modelling, monitoring, emission inventory etc. used to be conducted at central level, however, recently (since 2013) *Regional Clean Air Centers (CAC)* of the MoEU were established to help support Provincial Directorates by conducting these technical parts of CAAPs. The air quality monitoring network, for example, which used to be run by central laboratory in Ankara, is run by Regional CACs. Air quality data, however, are still collected at central level, before disclosure to the public. Each CACs serves several provinces.

In summary, local AQM is mainly controlled at central level and the main responsible institution is the appropriate Provincial Directorate of MoEU, with technical support provided by the relevant Regional CAC. Such a setting might have benefit to ensure consistency among quality of different CAAPs especially on technical issues such as emission inventory, air dispersion modelling, etc. However, the role of elected local authorities, i.e. municipalities, is not quite clear though legislation states that they are member of CAAP commissions. **Since most of the measures are implemented by municipalities at local level, coordination and involvement of municipalities into preparation and implementation of CAAPs is important.**

CHAPTER 3. PROGRESS ON LOCAL AIR QUALITY MANAGEMENT AND HARMONIZATION OF CLEAN AIR ACTION PLANS

This chapter reviews progress on CAAP preparation through international projects and national initiatives, the status of CAAP preparations, and harmonization efforts via common templates and national support.

3.1. PROGRESS ON CAAP PREPARATIONS

The MoEU published the Circular on Air Quality Assessment and Management in the year 2013 as explained in Chapter 2. A total of 60 provinces were defined as "High Pollution Potential Provinces" while the remaining 21 provinces were defined as "Low Pollution Potential Provinces". The Circular requires "High Pollution Potential Provinces" to submit their CAAPs covering the period 2014-2019 to MoEU by July 2014 at the latest. In addition, if any of the provinces in the list of "Low Potential Provinces" exceed a limit value or threshold level according to the air quality bulletin published by the MoEU, such provinces should also submit their CAAPs to MoEU by December 2014 at the latest. As a result, 64 CAAPs were prepared and delivered to the MoEU. Figure 4 shows these 64 provinces on a country map. By May 2019, this number reached 67.

Figure 4 Map showing distribution of High and Low Pollution potential provinces.[20]

The CAAPs for seven municipalities were prepared under two EU funded Twinning Projects that were supported by Dutch Government[21].

KENTAIR[22] Project: It is aimed at implementation of the By-law on AQAM at local level. The project started in 2012 and included preparation of "Air Quality Assessment Reports[23]" for the following provinces; Adana, Ankara, Erzurum, Gaziantep, Mersin and Samsun. These reports include sections dedicated to *Air Quality Assessment* and *Emission Inventory*. The emission inventories are prepared for each city for industry, residential heating and traffic. These sections are prepared by experts from the Metropolitan Municipality and/or Provincial Directorate of relevant province by the support of technical experts of KENTAIR project.

[20] MoEU, 2017. *Clean Air Action Plans and their Monitoring*. Presented at 7th National Air Pollution and Control Symposiumby Canan Esin Köksal, Ağça Gül Yılmaz and İrde Çetintürk Gürtepe, November 2017.
[21] Project reports are available at https://cygm.csb.gov.tr/hava-kalitesi-degerlendirme-i-7354
[22] Available at https://cygm.csb.gov.tr/kentlerde-hava-kalitesi-degerlendirme-sisteminin-gelistirilmesi-kentair-projesi-kapanis-toplantisi-gerceklestirildi-haber-11432
[23] Available at https://cygm.csb.gov.tr/hava-kalitesi-degerlendirme-i-7354

IKONAIR[24] Project: Konya was selected as the pilot city for this project and the project started on 2009. The main objectives of the project were:

- Support Turkey for implementation of EU Air Quality Directives;
- Ensure development of appropriate air quality management and action plans;
- Provide recommendations on future action plans and policies to improve air quality; and
- Raising awareness of stakeholders and public.

Air quality assessment for Konya was prepared based on data from 2007 to 2010, as part of the project. The assessment report was published on March 2012[25]. Where additional data were needed the study was supported by passive sampling campaigns. After the air quality assessment, a Clean Air Program was prepared for Konya covering the period 2012-2019. The "Konya Clean Air Program" was published on July 2012.[26]

Both KENTAIR and IKONAIR projects served to initiate the dialogue and cooperation between municipalities and Provincial Directorates of MoEUs on local AQM.

[24] Available at http://ikonair.cob.gov.tr/ikonair/AnaSayfa.aspx?sflang=tr
[25] Available at http://webdosya.csb.gov.tr/dosyalar/images/file/KnyDegRap.pdf
[26] Available at http://webdosya.csb.gov.tr/dosyalar/images/file/KonyaTemizHavaProg.pdf

IKONAIR PROJECT

The Konya CAAP, developed by the project, provides step by step explanations on various steps of analytical work provided in the plan. Such analyses included but was not limited to: analyses of ambient air quality data; assessment of temporal and seasonal variations in ambient air concentrations; preparation of emission inventory (for industry, traffic and residential heating sectors only); preparing dispersion model input files; running dispersion model to assess the impact of existing emissions on ambient air quality; comparison of monitoring and modeling results at the same locations; scenario analyses using different mitigation measures in order to see the impact of different mitigation measures (or combination of mitigation measures) on ambient air quality; cost of implementation of measures (qualitatively, quantitatively where data was available). The project did not however undertake economic analysis of the measures (e.g. cost-effectiveness analysis). Neither did it account for the impact of transboundary air pollution.

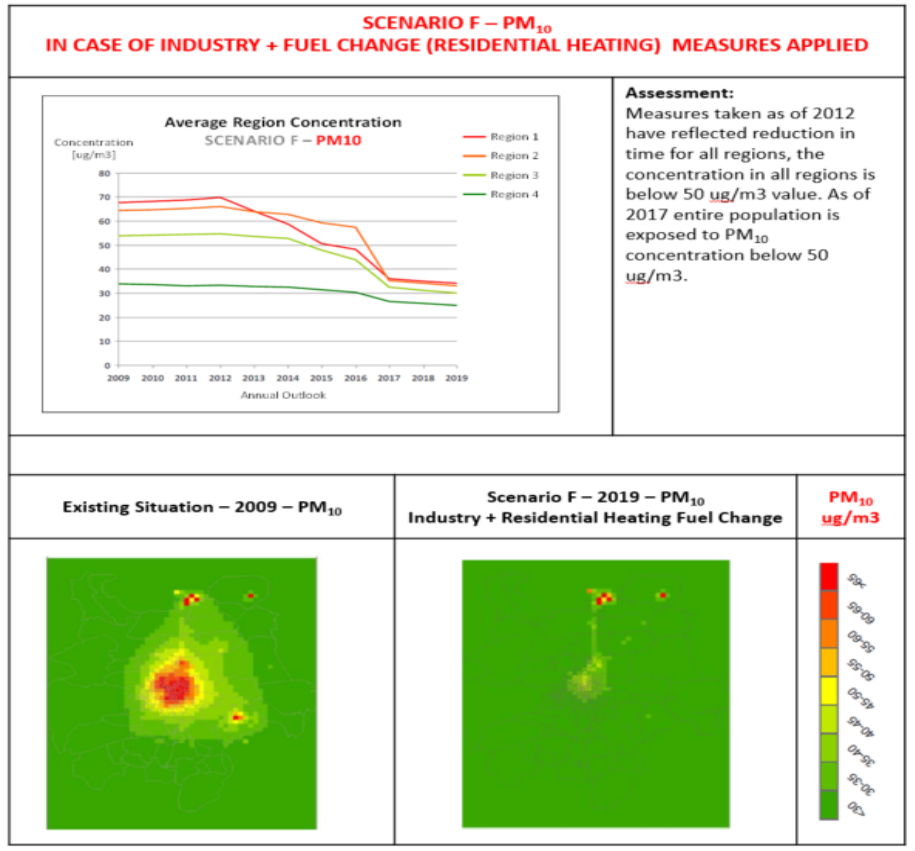

Figure- Example scenario result that shows impact of industrial and residential heating (fuel switch) measures onto ambient PM10 concentrations. Results include both current and future (projected) emission reductions and related ambient concentrations.

3.2. HARMONIZATION EFFORTS: CAAP COMMON TEMPLATE

The MoEU has undertaken several actions and efforts to increase capacities, ensure consistency, and monitor status of CAAPs. The MoEU published a "CAAP Template"[27] in 2014, to ensure a similar format is followed during the preparation of CAAPs for provinces. The template is quite comprehensive and provides explanations and examples to fill each section of the template, such as concentration data

[27] Available at http://cygm.csb.gov.tr/temiz-hava-eylem-plani-hazirlama-sablonu-i-80920

analyses, emission inventory, dispersion modeling etc. (see Annex E). Details of the some of these analyses are explained in air quality By-laws and Circulars.

The CAAP template includes mitigation measures; provides situation analyses and requires identification of reasons for non-compliance including secondary formation and long-range/regional transport; and requires identification and prioritization of mitigation measures, and assessment of impacts of measures on air quality. However, none of the reviewed CAAPs within the duration of this diagnostic analyses has such information, except for Konya CAAP, which is prepared under the IKONAIR Project. Other possible improvements in the methodology are recommended in Section 3.1 (see box on IKONAIR Project).

3.3. National and Regional level support to local level AQM

There are several central level activities to help support preparation of CAAPs, some of which are provided below.

National Air Quality Monitoring Network (NAQMN)

To date, more than 300 monitoring stations have been installed across the country to monitor air pollution concentration levels. The stations are supported by Clean Air Centers and one reference laboratory (Environment Reference Laboratory, Gölbaşı). Most of the stations only measure SO_2 and PM10, while other stations cover pollutants such as CO and NO_2 additionally. A few stations have started to measure PM2.5, aerosols and O_3. The MoEU is planning to extend capacity of monitoring stations to include monitoring of PM2.5 and other pollutants (e.g., NO2, O3, NMVOC, PAH, benzene, etc.).

Air quality monitoring data recorded at these stations are accessible online via *www.havaizleme.gov.tr.* Air quality index for each station and ambient concentration data files are available online for all stations. Figure 5 shows a screen-shot of the online system that provides access to location of stations, concentration data and air quality index for stations.

Hourly monitoring data monitored at all network stations are instantly transferred to Data Collection Center of the Reference Laboratory of MoEU, located in Gölbaşı, Ankara. Validation of data is done at this center. Calibration of the instruments and any error messages of online monitoring instruments are reviewed and assessed during data validation process at the Center. After data validation, data are used to prepare monthly and annual AQM assessment reports including trend analyses of data monitored at network stations. Validated data is available online for all stations (see above link). Real time monitoring data that is provided online is the instant data before validation process. In order to make it easy for general public to understand, Air Quality Index is used instead of concentration values. Concentration data is also available at the site.

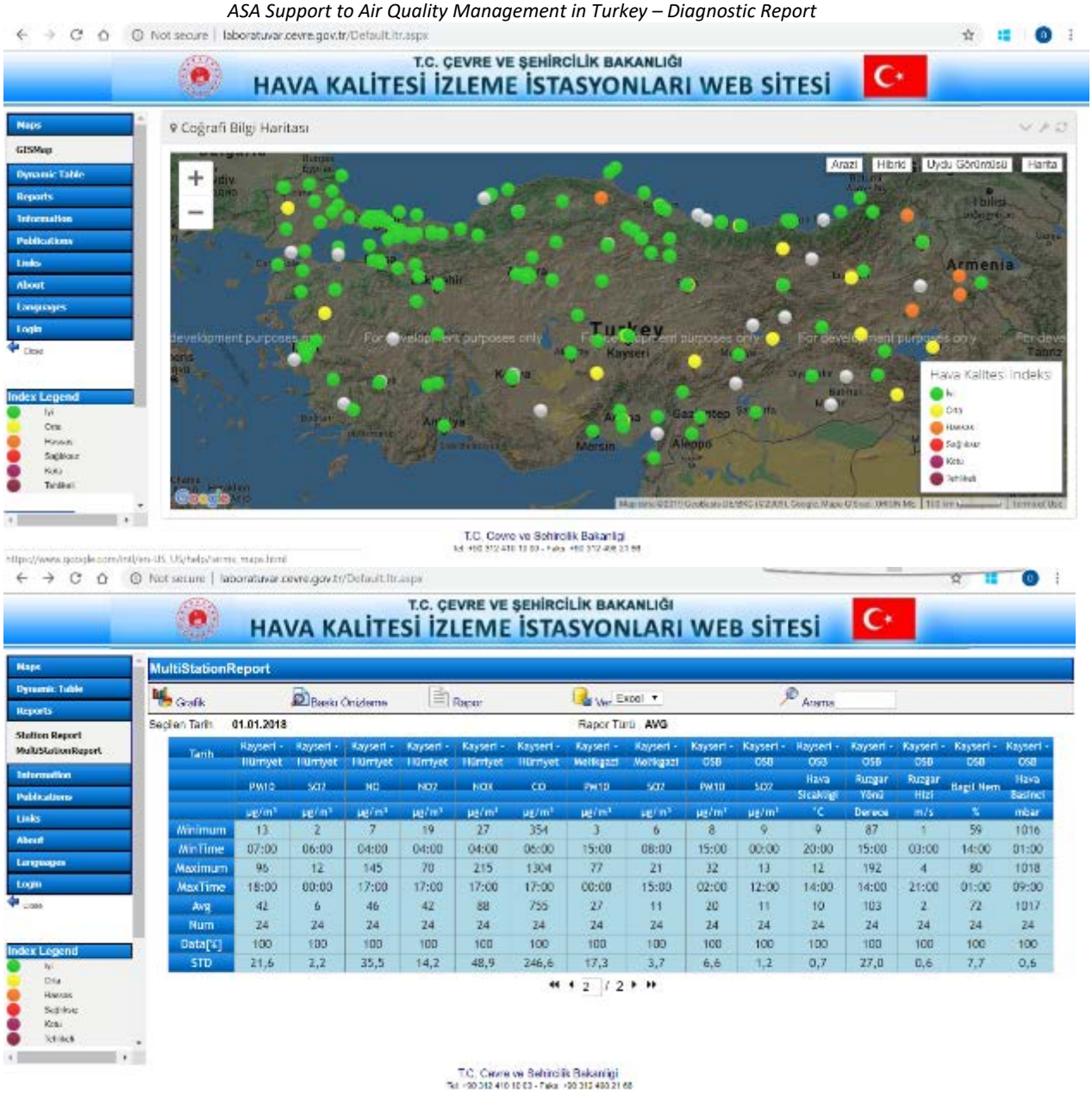

Figure 5 Online air quality monitoring system (screen-shot for several options that system provides).

National Emission Inventory System and HEY (Air Emission Management) Portal

The MoEU prepares national air emission inventories for SO_2, NOx, NMVOC, NH_3, PM_{10} and CO and submit to United Nations European Economic Commission and European Environment Agency (EEA) since 2011[28].

MoEU has also developed "HEY- Air Emission Management Portal" to follow-on emission sources at local level. The portal is established to cover Marmara region as a pilot first under the research project conducted between 2013-2017[29] and supported by the Turkish Scientific and Technical Research Council -TUBITAK. Essential air management steps such as emission inventory compilation, spatial and temporal distribution, historic model run for meteorology and air quality can be done in HEY portal.

[28] Available at http://www.ceip.at/ms/ceip_home1/ceip_home/status_reporting/2018_submissions/, and https://cygm.csb.gov.tr/ulusal-hava-kirleticileri-emisyon-envanteri---national-air-pollutants-emission-inventory-i-81051

[29] https://cygm.csb.gov.tr/ulusal-hava-kirliligi-emisyon-yonetim-sisteminin-gelistirilmesi-projesi-kapanis-toplantisi-21-nisan-2017-tarihinde-istanbul-da-yapildi.-haber-158285

HEY portal is available for use of MoEU, Provincial Directorates of MoEU, and Regional CACs staffs. A User Manual is also available for the portal.[30]

MoEU initiated a new project namely "HEYGEL" (Supporting Air Emission Management Portal) on November 2018 to extend the HEY-Portal to cover entire country. The project aims to further develop the HEY portal and include all data from whole Turkey by 2023.[31]At local level, Regional CACs are responsible to provide data and run HEY Portal. The Portal includes different modules for mapping, emissions calculations, emissions distribution processing, air quality modelling, solid fuels management, and reporting. In the near future, the HEY system shall run scenarios to determine the effect of mitigation measures.

3.4. Monitoring of CAAP implementation

In order to reduce bureaucracy and printed copies, MoEU has developed a digital application named THEP-İZ (Clean Air Action Plan Monitoring Application) to follow the actions within the CAAP. Using THEP-İZ, MoEU uploads CAAPs into this system and the approval status can be followed for each CAAP in the system. The status and progress of actions in the CAAP should be updated and uploaded to the THEP-İZ system by Provincial Directorates every six months. Impact of measures are not recorded in the system. System only records completion status of mitigation actions stated in CAAPs.

[30] HEY Portal User Manual, MoEU, July 2017.
[31] https://cygm.csb.gov.tr/hava-emisyon-yonetim-portalinin-gelistirilmesi-heygel-projesi-acilis-toplantisi-gerceklestirildi.-haber-232477

BOX 3- KEY TAKEAWAYS: PROGRESS ON LOCAL AQM AND HARMONISATION OF CAAPs

Progress has been made in recent years in several aspects of the preparation and harmonization of CAAPs to help support local AQM: The MoEU conducted several international projects aiming at supporting preparation of CAAPs. Konya CAAP, prepared via IKOINAIR project, is one of the good examples that provides step-by-step procedures and methodologies in developing parts of the CAAPs (such as emission inventory, dispersion modelling, assessing impact of mitigation measures, etc.). The MoEU also prepared a detailed CAAP template that need to be followed in preparing local CAAPs. National Ambient Air Quality Monitoring Network provides real-time air quality indexes for all provinces for use and access of citizens. HEY Portal and HEYGEL projects undertaking by the MoEU aim at harmonization of emission inventory and modelling approaches at local level. Once the HEYGEL project is finalized by the end of 2023, emission inventory and dispersion modelling system for the whole country at local level will be available. The system will be operated by Regional CACs with data input support from Turkish National Statistical Institute (TURKSTAT) and local authorities.

The review of the reports of the above-mentioned projects, and other CAAP reports provided by the MoEU, shows that most CAAPs provide detail information on meteorological conditions and assessment of monitoring data. Some reports also provide emission inventory for industry, traffic and residential heating sectors, as well as mitigation measures to improve air quality. However, most of the CAAPs (except the Konya CAAP which was supported through IKONAIR) do not provide linkages between assessments of ambient air quality, emission sources and selected mitigation measures. Impact of mitigation measures are defined qualitatively (such as high, medium, low, etc.) in some reports and there is no quantitative assessment of impacts of mitigation measures on ambient air quality. Furthermore, there is no analysis presented to assess the economic efficiency of the measures (e.g. through cost-effectiveness analysis). Accounting for transboundary emissions and secondary formation particles in CAAPs is another area, where the CAAPS are lacking.

Implementation seems to suffer from a lack of financial resources for most of the mitigation measures identified in CAAPs, and lack of capacity of Regional CACs. At present, most of the technical work required for Local AQM (e.g., ambient air quality monitoring, emission inventory, etc.) are performed by regional CACs. However, Regional CACs have limited number of technical staff and very limited budget to do all the work.

CHAPTER 4. GOOD INTERNATIONAL PRACTICES FOR LOCAL CLEAN AIR ACTION PLANS

Directive 2008/50/EC on Cleaner Air for Europe (CAFE) sets the framework structure for the content of CAAPs. Each member states then prepare their own guidance or guidelines to help support preparation of CAAPs. Some good international examples and components of good CAAPs are provided in the following sections.

4.1. Components of Good International CAAPs

Clean Air Action Plans have three major stages: i) preparation, ii) implementation, and iii) monitoring and evaluation. When there are issues in any of these stages, end result of CAAP (i.e., improvement of air quality) might significantly be affected. Therefore, it is important to ensure adequate human, technical and financial resources are available to support each stage of CAAP.

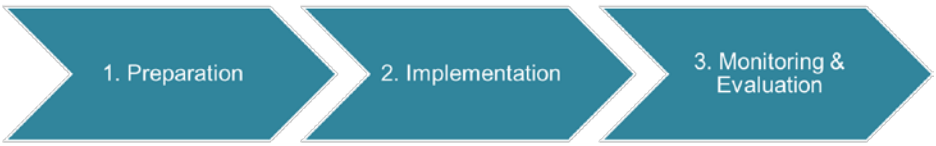

Figure 6 Stages of Clean Air Action Planning.

The CAAP process is a dynamic process. Plans are prepared, implemented and monitored and revised according to monitoring results and overall outcome including citizen responses. Preparation stage of CAAP includes several components as shown in Figure 6. Effective contribution of all relevant stakeholders into processes are of utmost importance, especially in identification of mitigation measures. It needs to be ensured that all relevant stakeholders are heard, implementing bodies are effectively involved, and financial resources are properly assessed. Table 2 provides all stages of preparation including notes on international good practices. A good CAAP is expected to include at least components identified in this table.

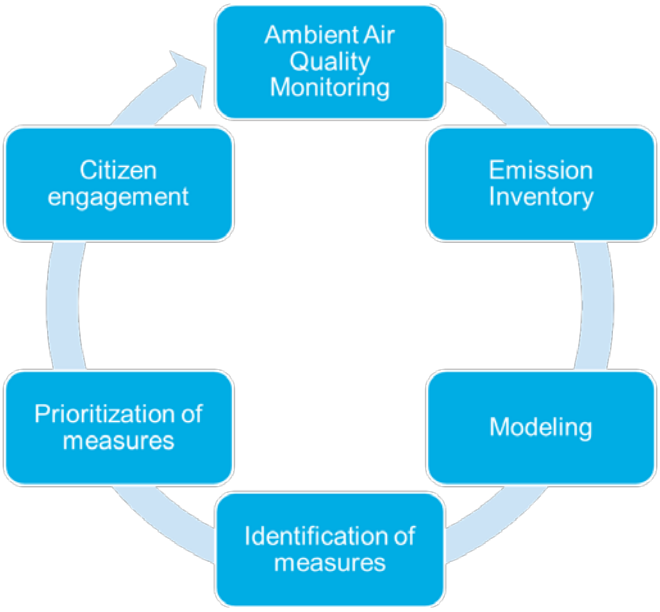

Figure 7 CAAP Preparation Stages.

Table 2 Components of CAAP.

No	CAAP component	International Good Practice
1	Assessment of ambient air quality	At a minimum, location and details of monitoring stations; data completeness; spatial and temporal variations of concentrations; comparison of data with limit values; potential reasons for non-compliance should be assessed
2	Emission Inventory	Activity data for all potential emission sources (e.g., traffic, industry, agriculture, residential heating, etc.) should be provided; emission calculations according to international good practices (such as EU guidance) should be conducted
3	Source Apportionment	Secondary formation particles and transboundary pollution should be identified and quantified. This can be done using regional chemical models and/or chemical speciation of particulate matter followed by source apportionment modeling
4	Dispersion Modeling	Emission inventory prepared for province entered into an atmospheric dispersion model, and ground level concentrations of pollutants are estimated using site specific meteorological data; measured and modelled concentrations are compared; model is used to estimate impact of mitigation measures
5	Identification of measures	Linkages between assessments (emission sources, hot-spots according ambient concentrations, etc.) and mitigation measures should be provided.
6	Impact of measures	Impact of emission reduction measures onto both emission loads of pollution parameters (e.g., PM_{10}, SO_2, NOx, etc.) and on ambient air quality should be estimated and presented; later can be done via dispersion modeling as indicated previously
7	Prioritization of measures	Measures should be prioritized using economic efficiency (e.g. cost-effectiveness) as one of the criterion.
8	Stakeholder participation	All relevant stakeholders including but not limited to commerce chambers, universities, general public, NGOs, etc. should be encouraged to participate in the CAAP preparation process and their concerns should be taken into account in developing CAAPs. Later, during implementation of the Plan, grievance and redress mechanism should be in-place.
9	Effective coordination and ownership	Ownership by institutions which are going to implement the measures, such as municipalities and provincial directorates of MoEU, as well as effective communication and coordination among different stakeholders who took part in CAAP preparation and implementation should be in-place.
10	Implementation mechanisms in-place	Institutional coordination mechanisms, roles and responsibilities within an institution, timeline, and resources for implementation of measures should clearly be identified in the CAAP and such mechanisms should be in-place or should be developed as part of CAAP process. Such mechanisms may also include mechanisms for awareness raising, incentives or penalties to be implemented as stated in CAAP to ensure effective implementation of measures.

No	CAAP component	International Good Practice
11	Monitoring and evaluation mechanism in place	Internal and/or external monitoring and evaluation of implementation of measures stated in CAAP should be in-place. This may include an audit committee, regular monitoring and reporting, follow-up of corrective actions identified by audit committee, etc.
12	Financing of the CAAP (including human and technical capacities)	Cost of implementing measures should be identified in the CAAP and this budget should be allocated to ensure measures are implemented. Budget for CAAP should also include cost of human resources, and technical equipment needed for analyses and implementation.
13	Public awareness and acceptance	For some measures such as fuel switching, building insulation, etc. public buy-in is needed in addition to financial support mechanisms, in order to achieve successful implementation. Where, public awareness is low on air-pollution related health impacts, and possible mitigation measures; public campaigns (via social media, web, TV, newspaper, etc.), education at school etc. can be useful. In case of implementation of specific measures at certain regions, focus group discussions, public hearings could also be useful.

4.2. Examples Effective Planning and Implementation

As indicated in Chapter 3 of this report, the CAAP for Konya prepared under the IKONAIR project provides a relatively better example that comes close to international good practice. Few good practice examples for CAAP preparation and implementation are provided in following paragraphs.

CAAP Preparation

UK DEFRA Guidelines

UK DEFRA provides detailed guidance on local air quality management including but not limited to policy and practice guidance on effective mitigation measures, good examples etc.[32] *Local Air Quality Planning – Technical Guidance Document*, for example, provides detailed technical guidance on different components (e.g., ambient monitoring, emission inventory, mitigation measures) of CAAP as well as general approach and stages of an effective CAAP. The guideline states that an effective CAAP should be tailored to each local situation and it should provide linkages with key policy areas, notably:

- Land-use planning and sustainable development;
- Transport Planning, promoting sustainable transport, local transport management, integration with local transport plans;
- Climate change policies in relation to carbon management and reduction of greenhouse gas emissions; environmental assessments should consider impacts on air quality and climate change issues;
- Low Emission Strategies. Many local authorities are moving towards developing Low Emission Strategies that can be used as an integrated approach to promoting emissions reductions measures across a wide policy spectrum, benefiting both air quality and climate change;

[32] Various guidance notes and reports on local air quality management are available at https://laqm.defra.gov.uk/

- Public Health Outcomes (PHO) policy areas which seek to promote health and wellbeing within the population with direct links to the promotion of physical exercise through walking and cycling initiatives (which reduce reliance on private vehicle use); and
- Education programs which again seek to promote health and wellbeing through walking and cycling, but also the principles of sustainability.

The Guideline also states key common requirements for the development of an effective CAAP as follows:

1) Develop the CAAP in stages;
2) Undertake appropriate local monitoring and assessment (source apportionment);
3) Decide what level of actions are required;
4) Establish links to other key policy areas / strategies;
5) Establish a Steering Group with key stakeholder groups at an early stage;
6) Undertake measures selection and impact assessment;
7) Agree monitoring and evaluation of success; and
8) Undertake consultation.

Developing the CAAP in stages within the concept of the Guideline refers to followings:

- Engagement of key officers and stakeholders at an early stage to capture measures already in place and to develop shared ownership for local solutions;
- Collation of detailed knowledge of the contributory sources, to determine the range and extent of the problem;
- An approach to consider suitable measures to reduce air pollutant emissions across a range of policy areas;
- Development of appropriate targets and indicators across key program areas to monitor progress; and
- Evaluation and detailed consideration of further measures.

The Guideline provides detailed guidance on PM2.5 emission source identification and mitigations measures and states that 'hot-spot' areas of elevated PM2.5 concentrations within the local authority area should be identified and such information should be used in aiding the direction of actions to specific priority areas that are most in need of reductions in PM2.5 levels, and allow measures to be targeted to the identified PM2.5 issues.

The Guideline also provides technical guidance on emission inventory preparations such as data collection, fleet composition, mileage estimations, emission calculations etc., and air dispersion modeling. In addition to this technical guidance document, there are several separate guidance documents for specific areas/actions of CAAP. Some of them are listed as follows;

i) Economic principles for the assessment of local measures to improve air quality;
ii) Low emission zones;
iii) Measures to encourage the uptake of low emission vehicles;
iv) Measures to encourage the uptake of retro-fitted abatement equipment on vehicles;
v) Worked examples, etc.

Although it is expected that the UK will leave the EU, such guidance materials represent good practice and may be consulted as such.

CAAP Implementation

Berlin Air Quality Plan

The AQMP for Berlin (2005-2011) and the recent updated version (for the period 2011-2017) provides an example of good international practice, outlining the crucial parts and assessments of an AQMP.[33.]

Air quality plan for the period 2005-2011 stated that transport was the major source of air pollution and air quality in Berlin had improved significantly due to numerous measures taken. Many of the ambitious EU air quality limit values were already being met reliably. This included SO_2, benzene, CO, fine particles ($PM_{2.5}$), and heavy metals in particulate matter whose concentrations were well below the limit values.

Depending on certain weather conditions, the limit values for PM_{10} and nitrogen dioxide (NO_2) were exceeded on main roads. The most successful measure taken since 2005 was the introduction of low emission zones (traffic ban for vehicles depending on their emissions and three colored stickers for cars to identify) that, together with the developing EURO standards (up to EURO 6 now) boosted the modernization of motor vehicles and trucks in equal proportions. This largely contributed to pollution reduction (ca. 40% soot particles and ca. 5% NO_2) within five years. Retrofitting of diesel cars with particulate filters until 2010 and retrofitting to EURO 5 standard/enhanced environment-friendly vehicle (EEV) standard were the most important technical measures.

The updated CAAP (2011-2017) proposed that the above measures should be complemented by a sustainable transport policy based on the Urban Development Plan on Transport, and envisages

i. transport avoidance,
ii. a re-balancing of transport modes in favor of the most environmentally friendly modes, and
iii. optimized traffic management.

The aim is to integrate the mobility requirements of a growing metropolis with a healthy and sustainably managed environment. Thus, in order to further reduce transport-induced emissions, most of the measures in this plan address the transport sector.

Antwerp and the Flanders Region

According to the European Commission, residents in Brussels, Antwerp and Ghent have been exposed to unhealthy levels of fine dust pollution levels since 2005. Belgium has already received two warnings from the European Commission since 2012 to improve the local air quality.

Traffic has been identified as the major threat to public health and non-compliance with WHO limit values. Consequently, Antwerp brought in a low-emission zone in early 2017, which bans cars that do not meet the minimum EURO standard (from 2020 onwards: diesel vehicle with Euro5/V and 6/VI, petrol/natural gas/LPG with Euro2/II)[34] from entering the city center. The AQ assessment report for the region is based on an inventory of who are emitting pollutants to air, and the pollutants that they emit, thereby identifying the sources responsible for air pollution in Flanders. It evaluates jointly emissions and AQ measurements. Thanks to having good models, the percentage of the population potentially exposed to excessive concentrations of a series of pollutants in 2017 was examined. Traffic induced NO_2 concentrations exceeded the European annual limit value at 13 of the 19 measuring sites in Antwerp and at 7 of the 20 measuring sites in Ghent. There was good compliance with other EU limit values but meeting the more stringent WHO guideline values still is a concern for the authorities. The overall trend of emissions and air quality, and maps of the geographical distribution of air

[33]Available at https://www.berlin.de/senuvk/umwelt/luftqualitaet/de/luftreinhalteplan/download/lrp_150310_en.pdf
[34] Available at https://www.slimnaarantwerpen.be/en/what-will-change-as-of-1-january-2020

pollution are provided. In addition to some standard measures, increase in energy efficiency and fluctuations in production capacity contributed to declining emissions.

Stockholm Environment Programme

The Stockholm Environment Programme (2016-2019)[35] states that one of the targets of environment program is to ensure clean air for its citizens. According the Programme, air quality in Stockholm has steadily improved over time and many of the air pollutants that were major problems earlier have now been reduced to well below the limits. More stringent exhaust limits for vehicles all across the EU, reduced industrial emissions, phasing-in of cleaner fuels, as well as the implementation of an environmental zone, a ban on studded tyres, increased maintenance and congestion charges have contributed to this.

Stockholm environment programme now focuses more on improving indoor air quality by means on increased ventilation to provide fresh air indoors.

San Joaquin Valley Air Quality Plan for PM2.5

Air quality plan for San Joaquin Valley (California, USA) introduces aggressive incentive-based control measures in addition to regulatory measures to achieve massive emissions reductions needed to bring the Valley into attainment with limit values. Despite substantial progress made to improve the air quality in the Valley through the implementation of existing plans and clean air investments by Valley businesses and residents, the Valley continues to face significant challenges in attaining the federal PM2.5 standards, due to emission sources coupled with topographic and meteorological conditions of the area. Emissions from stationary sources have been reduced by 85%, new rules require significant investments and result in minimal emission reductions. Significant additional emissions reductions are needed, including local measures for stationary and area sources, including measures to further reduce emissions from industrial sources, residential wood burning and commercial charbroiling.

Air quality plan states that following additional measures will be introduced to ensure attaining limit values:

- *Regulatory measures* that build off existing stringent requirements, including new stationary source measures to further strengthen NOx and/or PM2.5 requirements to achieve greater emissions reductions from flaring activities, internal combustion engines, boilers/steam generators, glass melting furnaces, agricultural operations, and other local sources.
- *Incentive-based measures* that accelerate the deployment of cleaner vehicles and technologies in a variety of sectors, including residential wood combustion, agricultural internal combustion engines, agricultural equipment, heavy duty trucks, off-road equipment, transit buses, school buses, freight equipment, passenger vehicles, locomotives, commercial lawn and garden equipment, and other sources.
- *State mobile source strategy* that reduces emissions from mobile sources under state and federal jurisdiction, including heavy duty trucks, agricultural equipment, locomotives, and off-road equipment.
- *Targeted "hot-spot" strategy* that focuses additional regulatory and incentive-based measures for residential wood burning and commercial charbroiling operations in remaining areas of the Valley that requires further investment and regulatory efforts for attainment of the federal PM2.5 standards.
- *Public outreach and education* that encourages and empowers the public to understand air quality issues, take advantage of District tools to stay informed regarding local air quality, take actions to protect themselves when necessary, understand the Valley's unique air quality challenges, and take actions to reduce emissions and improve the Valley's air quality.

[35] Available at https://international.stockholm.se/globalassets/rapporter/the-stockholm-environment-programme-2016-2019.pdf

- *Technology advancement* and demonstration efforts to advance technology and accelerate the deployment of innovative clean air technologies that can bring about emission reductions as rapidly as practicable.
- *Call for action by the state and federal governments* to do their part in taking responsibility for regulating, and taking actions, to reduce emissions in the Valley. This includes working together to advocate and secure the significant new funding required to achieve the enormous emissions reductions necessary for attainment under the Plan through incentive-based measures

The plan is a good practice example providing detailed assessment of including but not limited to health risk from air pollution; air emission inventory for stationary, area and mobile sources; discussions on long range and secondary particle formation; emissions from agricultural remaining burning; modeling for both spatial distribution of emissions and dispersion of pollutants. Mitigation measures and impact and cost of measures are also provided in the report along with strategy for health risk reduction.

CHAPTER 5. REVIEW AND BENCHMARKING OF KAYSERI CAAP

Kayseri was selected as the pilot city to be studied in the diagnostic analysis. Selection criteria that led to identification of Kayseri are provided in Annex F of this report. This chapter provides a general overview of air quality situation in Kayseri including monitoring data, emission sources etc., and a review of the existing CAAP covering 2014-2019 period. Review and benchmarking of the Kayseri CAAP was done against both Turkish Legislation and International Good Practices. Results of the review described in this chapter are specific to Kayseri. However, recommendations related to institutional structure, technical capacities, and financial resources are common to all local CAAPs and hence might be applicable to most other cities as well.

5.1. Overview of Ambient Air Quality and Emission Sources in Kayseri

Kayseri is located in the South Inner Anatolian Region of Turkey as shown in Figure 7. It is an inland province with no shore-line hence it has continental climate with cold winters and hot summers. Kayseri is located on the skirts of Mount Erciyes which is an in-active volcano. Population of the province is 1,123,611 as of 2017 and it ranks number nine in the most populated cities in Turkey[36]. About 80% of the population reside on three districts located at the city center namely, Kocasinan, Melikgazi, and Talas (see population density map provided in Figure 7).

[36] https://en.wikipedia.org/wiki/Kayseri

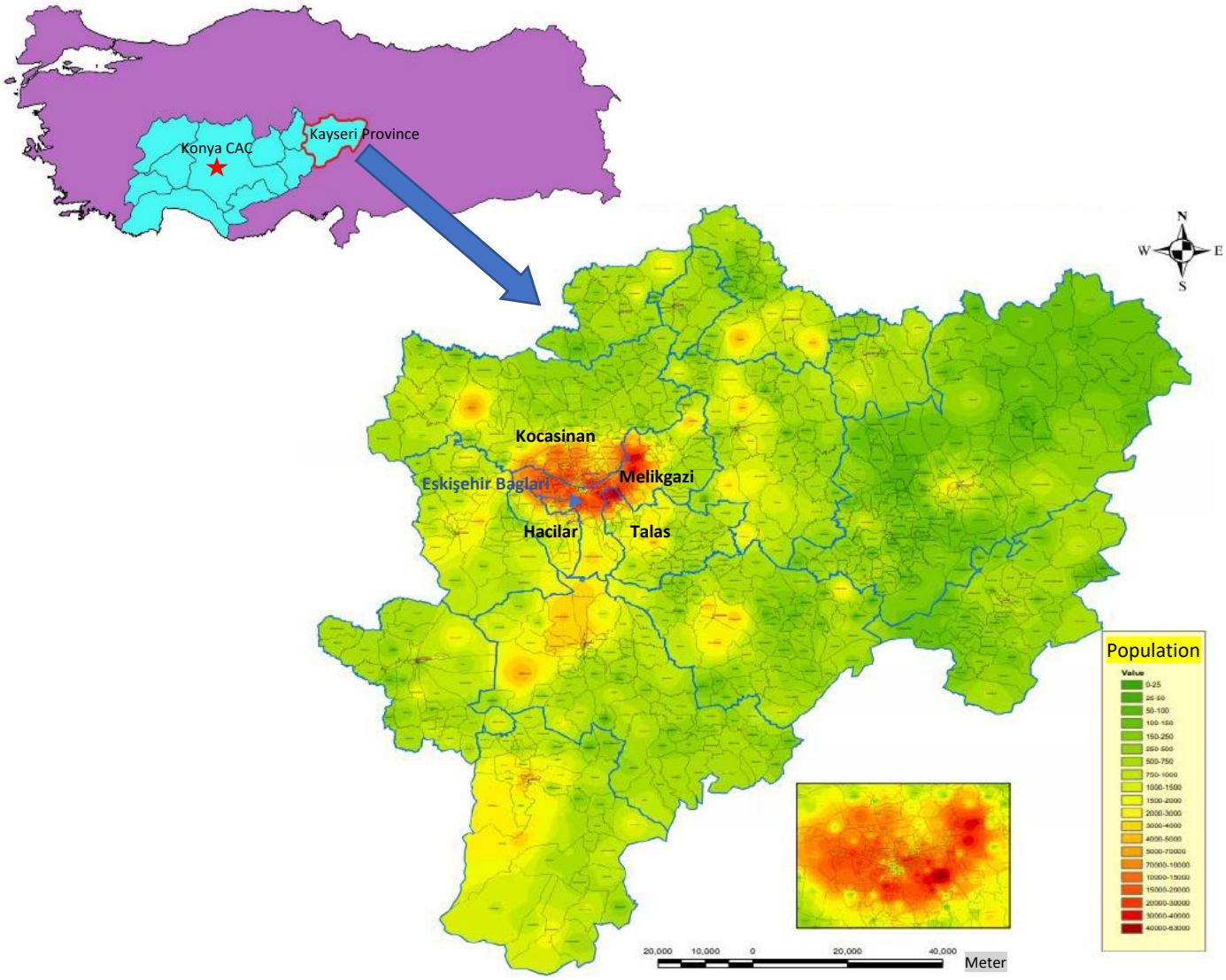

Figure 8 South Inner Anatolian Region (Upper left map in blue), Konya CAC and Kayseri Province and Population Map of Kayseri Province for the year 2017.

(Source: Modified from MoEU, 2018[37]).

5.1.1. Ambient Air Quality

There are three monitoring stations located and operating in Kayseri since 2007 namely, Hürriyet, Melikgazi, and Organized Industrial Zone (OIZ). Melikgazi and OIZ stations monitors only SO2 and PM10, while Hürriyet station monitors SO_2, PM_{10}, NO, NO_2, NOx, and CO. Melikgazi station is located in a residential area in order to monitor residential heating related air pollution. OIZ station is located at the major OIZ in the province (there are three OIZ in province in total) which is located west of the city. OIZ station aims to monitor industry related air pollution. Hürriyet station is located in a traffic junction to monitor traffic related air pollution in the city. In addition to these three monitoring stations, three more new stations have been established in Kayseri, but they are not operational for the time being. Figure 8 shows locations of all monitoring stations (existing and new) located in Kayseri.

[37] MoEU, 2018. *Air Quality Assessment Report for Kayseri Province for the year 2017*. Prepared by Konya CAC of MoEU.

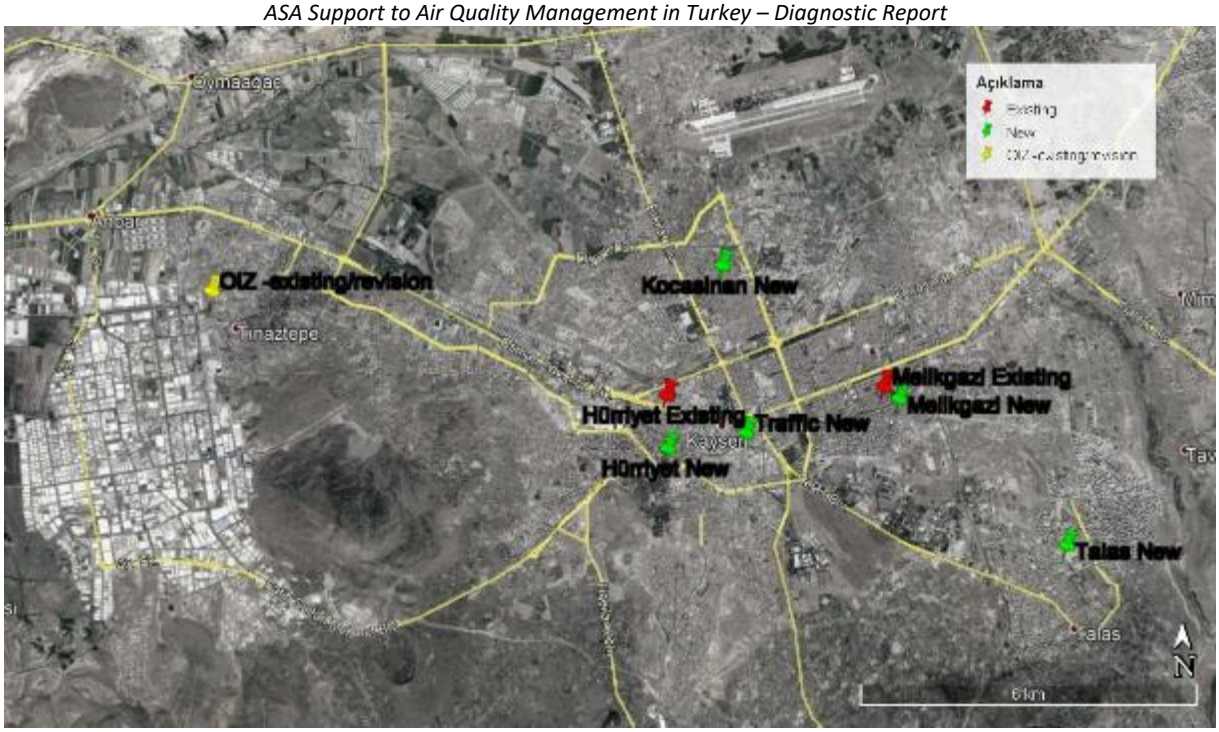

Figure 9 Location of monitoring stations in Kayseri (green pins mark existing stations; red pins show new/relocated stations)

(Source: https://www.havaizleme.gov.tr received on January 30th, 2019, revised on 15th February)

Ambient concentrations of pollutants monitored at all operational stations were retrieved from the National Ambient Air Quality Monitoring Network online system for the last five years (2013-2018). Monitoring data were analyzed to assess compliance with Turkish and EU limit values. Results are provided in Annex G for all pollutants and stations. Assessment showed that PM_{10} is the major pollutant that shows exceedance with limit values at most of the stations.

Figure 9 shows annual average PM_{10} concentrations recorded at Melikgazi, OIZ, and Hürriyet stations and their comparison with Turkish and EU limit values. As described in Chapter 2, Turkish limit values are decreasing gradually over the years to eventually reach EU limit values. As can be seen from Figure 9, annual average concentrations of PM_{10} exceed both Turkish and EU limit values in the last five years (2013-2018) at all monitoring stations. Similarly, number of maximum allowable exceedances for PM_{10} daily average limit values were exceeded at all stations during the same period (see Figure 10).

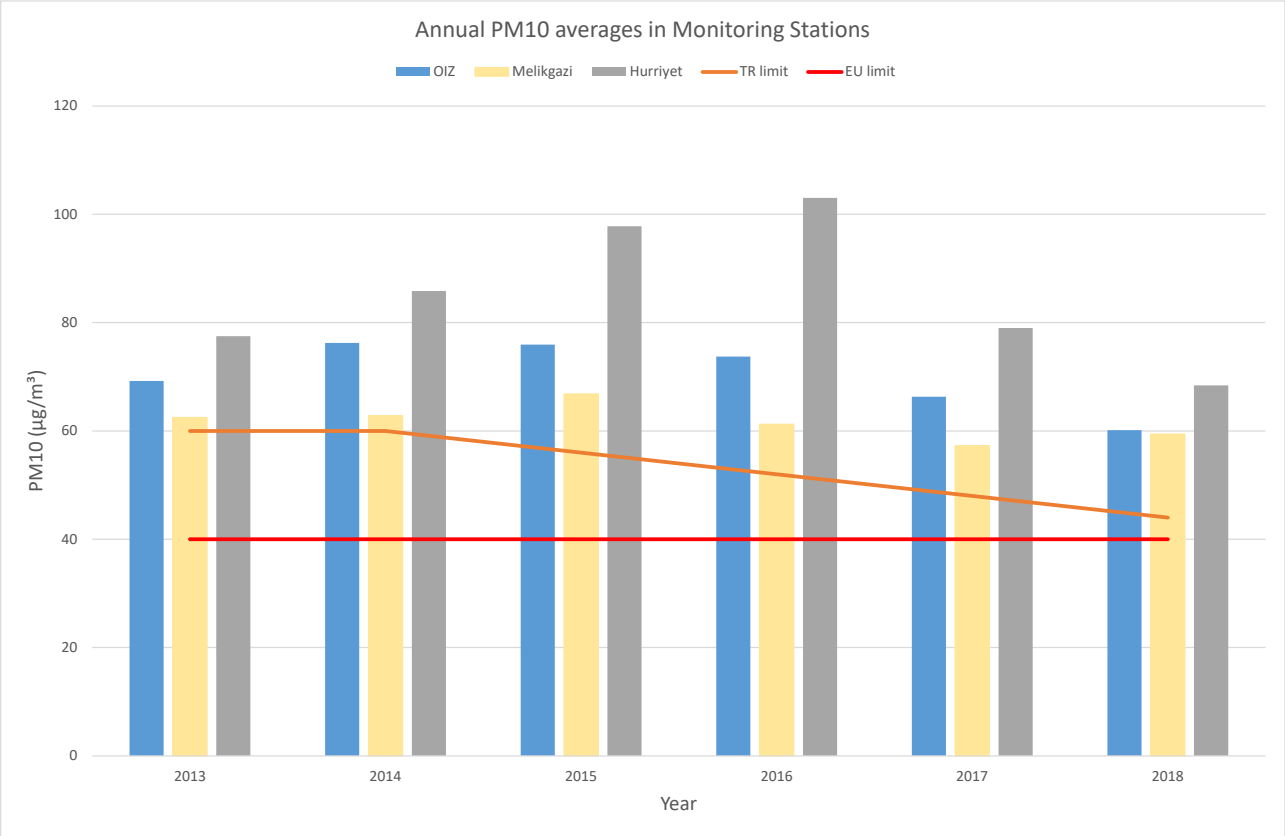

Figure 10 Annual average PM_{10} concentrations recorded at OIZ, Melikgazi, and Hürriyet stations (2013-2018).

In terms of pollution trends, Figure 9 shows that annual average PM_{10} concentrations show an increasing trend until the year 2015 at all stations, then follows a slightly decreasing trend starting in 2016 (except Hürriyet station where decrease in annual average concentrations observed after 2016), yet limit values are still exceeded. Figure 10 should be carefully assessed in terms of trend analyses as Turkish limit values are not constant over the years. As a result, although concentrations show a decreasing trend in the recent years, number of exceedances of Turkish limit values show an increasing trend due to lower limit values set for the recent years. Therefore, number of exceedances of EU limit values (red bars in Figure 10) would be more meaningful to use for trend analysis, which supports concentration trends seen in Figure 9.

Konya Regional CAC of MoEU conducted detailed assessments of monitoring data recorded at the stations during the year 2017[38] and a separate assessment for 2013-2017 data[39]. Data analyses presented in these reports, indicate that pollution concentrations show seasonality with higher concentrations observed during the colder months (November to March). Data analyses also shows diurnal variation in the concentrations with peak values corresponding to morning and evening rush hours. ***These and other analyses indicate the poor atmospheric mixing conditions due to unfavorable atmospheric conditions during winter months and increased emissions (e.g., residential heating, traffic) might led to higher air pollution levels observed during cold months.*** A study[40] conducted by Erciyes University also points out potential impact of residential heating emissions onto high PM_{10} concentrations and exceedances observed during the heating season.

[38] Available at https://webdosya.csb.gov.tr/db/ced/icerikler/son-kayser--cdr-2017-rev-ze2-20180827143719.pdf

[39] *Konya CAC, 2018. Assessment of Long-term Air Quality Monitoring Data Recorded at Kayseri Monitoring Stations for the period 2013-2017*

[40] Özdoğan G. and Dadaşer-Çelik F., 2013. *Investigation of Sulfur Dioxide and Particulate Matter Levels in Kayseri, Turkey from 2008 to* 2012. Proceeding of the ICOEST'2013 Conference.

5.1.2. Emission sources

There is no air emission inventory available for Kayseri Province. Emission inventory for the province is expected to be ready by the end of 2019 as part of ongoing HEYGEL project which is conducted by the MoEU.

Data and information received from the local authorities and local CAAP provides some information on industrial, residential heating and traffic sources in the province. In the absence of an emission inventory, an overview of this information is provided below.

Industrial sources

There are three organized industrial zones (OIZ) and one free trade zone located in the province. Kayseri OIZ is located west of the city is the largest OIZ and more than 1,000 industrial facilities are located within the OIZ. These facilities are mainly SMEs and main sector is furniture production. Mining and construction material production (such as bricks) is also a dominating business in the province. Most of the industrial facilities located in the province are SMEs. About 80% of industrial facilities use natural gas for processes and heating. Two major industrial facilities in the province are Çimsa Cement Factory (72 MW) and Kayseri Sugar Production Factory (66MW). Kayseri Sugar factory has four boilers that are using natural gas and two boilers (with a capacity of 19MW) using coal. **There is not much information available on process emissions of industrial facilities.** However, the mining industry especially may contribute significant PM_{10} emissions, depending on the operation and mitigation measures in place, and hence it is recommended that process emissions in addition to heating emissions from industrial facilities are investigated in future.

Residential heating sources

As explained in Section 5.1.1 of this report, natural gas was introduced in the province rigorously after 2014-2015 and hence today about 60% of buildings has access to natural gas. However, a recent survey conducted by the Provincial Directorate of MoEU shows that not all residents who have access to natural gas pipeline (i.e., connection to natural gas pipeline at street and building level is available) are using natural gas. Some residents connected to natural gas, but they are not actively using natural gas, believing it is much expensive than using solid fuels or simply cannot effort to use it. Some others cannot even effort to connect to the gas line. Table 3 provides number of households located at Melikgazi District (one of the most populated districts in the province) regarding access and use of natural gas, according to survey done by Provincial Directorate of MoEU. As can be seen from the table, actual number of households using natural gas that is obtained by the survey is slightly different than data provided by KAYSERIGAS.

Survey especially pointed out Eskişehir Bağları district of the province, where about 56% of residents are either not connected or not using natural gas, although 90% of the buildings has access to natural gas (see Table 3). Mostly low-income families and Syrian refugees reside in this district. Number of Syrian refugees received by Kayseri Province significantly increased during recent years and it is still increasing making it difficult to estimate future projections of population in this area. Provincial Directorate of MoEU conducted a feasibility study to provide financial support to low income families (including Syrian refugees). However, there is a need for financial support to implement this plan.

Table 3 Melikgazi district residential heating survey

Data from KAYSERIGAS				Survey done by Kayseri Provincial Directorate of MoEU		
		Number of household	%		Number of household	%
ESKİŞEHİR BAĞLARI	Building has connection to NG	18611	**90%**	Household subscribed and actively using NG	9071	**44%**
	Building has no connection to NG	2096	10%	Household subscribed but not using NG	1200	6%
				Building has connection, neighbor is using, but household is not using NG (mostly renter)	7114	34%
				Not using NG in the building	3322	16%
	Total	*20707*	*100%*	*Total*	*20707*	*100%*
ESENYURT	Building has connection to NG	8122	**96%**	Household subscribed and actively using NG	6969	**83%**
	Building has no connection to NG	301	4%	Household subscribed but not using NG	200	2%
				Building has connection, neighbor is using, but household is not using NG (mostly renter)	919	11%
				Not using NG in the building	335	4%
	Total	*8423*	*100%*	*Total*	*8423*	*100%*
BATTALGAZİ	Building has connection to NG	6018	**98%**	Household subscribed and actively using NG	4720	**77%**
	Building has no connection to NG	144	2%	Household subscribed but not using NG	645	10%
				Building has connection, neighbor is using, but household is not using NG (mostly renter)	514	8%
				Not using NG in the building	283	5%
	Total	*6162*	*100%*	*Total*	*6162*	*100%*
TACETTİNVELİ	Building has connection to NG	2803	**98%**	Household subscribed and actively using NG	1925	**67%**
	Building has no connection to NG	64	2%	Household subscribed but not using NG	214	7%
				Building has connection, neighbor is using, but household is not using NG (mostly renter)	342	12%
				Not using NG in the building	386	13%
	Total	*2867*	*100%*	*Total*	*2867*	*100%*

Source: Data received from Kayseri Provincial Directorate of MoEU, May 2019.

In order to reduce emissions from solid fuel burning there are several actions ongoing in the province. Some of these actions, as discussed in Section 5.1.1., include but not limited to fuel quality standards and increased inspections. Kayseri municipality is undertaking rigorous inspections since 2016 to ensure high quality coal is distributed by suppliers. A recent information received from the Provincial Directorate of MoEU shows that about 50% of the coal is used in industry and 50% is used in residential heating according to 2015 data.

Transport sources

The Municipality has undertaken several actions regarding increasing access to public transport and reducing emissions from public transport. Such actions include but not limited to introduction of rail

system for public transport; purchase of new Euro5 and 6, CNG, and electric buses for public transport; green light wave and dynamic junction systems; bicycle paths and bike share system among others.

Motor vehicle emission inspections are conducted at 36 on-site and 1 mobile exhaust emission testing stations. Number of on-the-road inspections were increased during 2014 and 2015. However, this number decreased over the last years due to shortage of staff.

There is a need for a comprehensive transport emission inventory coupled with air dispersion modelling in order to identify potential high emitters and pollution hot-spots in the Province. Urban transport plans should be based on such assessments in the future.

Other sources

There is not much information available regarding other air emission sources in the province such as agriculture, waste burning, fugitive emissions from construction works, crustal dust, secondary particle formation etc. It is recommended that all possible air emission sources are identified and their assessments and mitigation measures are included in the future CAAPs.

Similar provinces

In the absence of an emission inventory for Kayseri Province, other provinces in the country that might have similar characteristics in terms of share of industrial and residential emission sources, etc. was investigated. Emission inventories available at current CAAPs for Ankara, Adana, Gaziantep and Erzurum are provided in Figure 11. Although emissions show variation in different provinces, as expected, residential heating is the dominating emission source in most of these provinces.

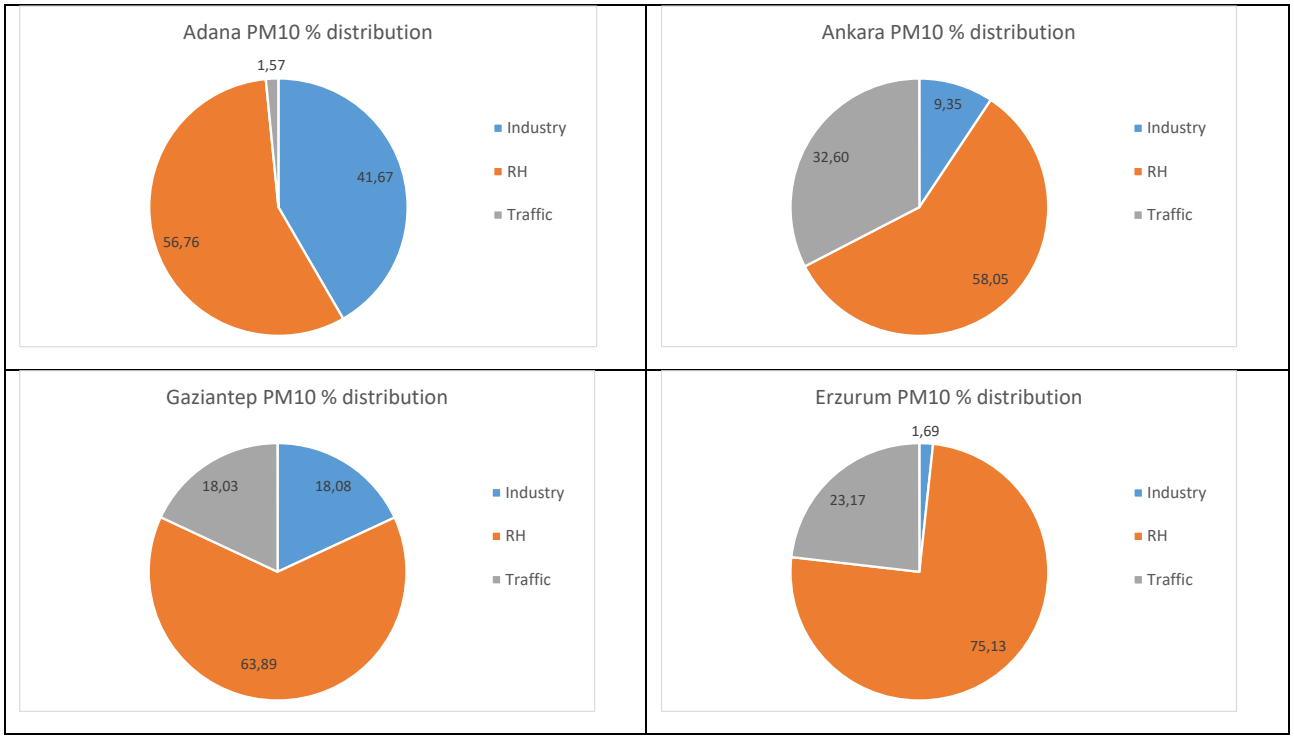

Figure 11 Emission inventories of several provinces in the country.

5.2. Benchmarking against Turkish and EU Legislations and International Good Practices

The Kayseri Province Local Environment Council with the chairmanship of the Governor or Vice Governor and with the participation of the provincial representatives from relevant ministries, and the Mayorship, led the preparation of Kayseri CAAP (please see Section 2.2 on institutional structure for details on Local Environment Council). A CAAP Commission, working under Kayseri Local Environment Council, was established to carry out work related to air quality and preparation of CAAP.

The Kayseri CAAP covering the period 2014-2019 was prepared by Provincial Directorate of MoEU, Kayseri Municipality and Erciyes University and submitted in 2013. This was before the MoEU published guidance on and a template for CAAP preparation in 2014, and before the outcome of several ongoing example projects such as IKONAIR became available. Therefore, Kayseri CAAP for the period 2014-2019 could not benefit from outcome of these supportive actions.

During the time of preparation of Kayseri CAAP, Konya CAC, which is established to undertake many technical works of CAAPs (such as emission inventory, modeling, etc.), was also not operational. Therefore, due to lack of technical capacities and expertise during preparation, the Kayseri CAAP provides some information regarding emission sources and mitigations measures but would benefit from a significant revision and update. The major gaps in the CAAP are as follows; i) emission inventory is missing, ii) air dispersion modeling is missing, iii) impact of mitigation measures are not assessed, and iv) implementation monitoring and evaluation of measures, including financial mechanisms and indicators, are missing.

Kayseri CAAP provides information on the numbers and fuel consumption data for industrial, traffic and residential heating sources. However, the emissions released from these sources might differ significantly according to the type and age of combustion device, internal combustion engine, etc. Hence an emission inventory for the Province according to international standards, using higher Tier methods (such as Tier 2 and 3) where possible, is recommended for inclusion in an update of the plan.

Similarly, Kayseri CAAP also does not provide dispersion modeling, which might help assess the impact of the proposed emission reduction measures. It is important to note that ambient concentrations of pollutants are dependent on several factors such as meteorological conditions, emission amounts, atmospheric mechanisms (such as chemical reactions) etc. Therefore, in order to identify effective measures that might help achieve limit values, it is important to assess the impacts of measures via dispersion modeling. It is recommended that dispersion modeling and assessment of impact of measures are included in the update of the plan.

CAAP provides mitigation measures for short (0-2 years), medium (2-5 years) and long-term (greater than 5 years) implementation periods. Although emission reduction potentials of measures are not elaborated and estimated, most of the proposed measures are meaningful and might provide decrease in emission levels. Some of the selected measures in the Kayseri CAAP are provided in Table 4. However, the roles and responsibilities, financial resources, implementation timeframe, expected results and indicators are not clearly identified in the action plan as they should be.

As an illustration of good practice, template of a plan under preparation is provided in Annex H of this report, showing the various components of an effective action plan.

Table 4 Some of the Measures Provided in Kayseri CAAP

Implementation Period	Measures
Short-term (0-2 years)	Increase use of high-quality fuel
	Undertake public awareness activities via trainings given by relevant authorities, especially at a highly polluted area where Hürriyet Station is located
	Increase motor vehicle emission inspections

Medium-term (2-5 years)	Increase capacity of rail system for public transport
	Ensure use of LNG/LPG at all public buses
	Increase area of green spaces and city forests at city center
Long-term (more than 5 years)	Ensure restriction of infrastructure density at city center
	Undertake urban planning to establish satellite cities (residential areas) away from city centre
	Ensure urban planning take into account prevailing wind directions and wind corridors

Note: Complete list of total 32 measures are available in Kayseri CAAP, only selected measures are provided in the table as example.

Implementation and monitoring of the CAAP is as important as its preparation. Kayseri CAAP does not clearly define implementation and monitoring and evaluation mechanisms for the Plan. The MoEU, however, developed an online monitoring system, namely THEP-İZ (see Section 3.4 for details), to track implementation status of the actions in each CAAP. The status and progress of actions in the CAAP should be updated and uploaded to the THEP-İZ system by Provincial Directorates every six months. A recent progress report for the Kayseri CAAP was requested from the MoEU, and Table 5 provides data that was received. System only records completion status of mitigation actions stated in CAAPs and not impact of measures, implementation arrangements, or financial sources.

Table 5 Implementation status of the actions provided in Kayseri CAAP (2014-2019)

Sector	Action	Status by the end of 2017
Industry	Regarding air emission of industrial facilities	In 2017, 298 facilities received environmental permit on air emission from the provincial directorate in our province.
Transport	Regarding exhaust gas controls	The personnel of our provincial directorate carried out exhaust gas measurements and checked exhaust stickers for 5,770 vehicles in 2015 and 5,080 vehicles in 2016 in total.
Transport	Regarding signalization and dynamic junction model practice	Following activities are translated into practice: accelerating traffic flow with real time interventions in junctions congested due to increased traffic; optimization of signalization; pedestrian buttons and green wave.
Transport	Regarding vehicles with P, S plates and heavy-duty vehicles	Vehicles with P, S plates and heavy-duty vehicles are banned from entry into city center during active hours by UKOME (transport coordination center) decision.
Transport	Regarding transition to public vehicles with CNG fuel	In 2016 the number of vehicles with CNG[41] in municipality fleet was increased to 195, moreover metropolitan municipality added the following clause: 'the vehicles to be added in the system should be between the ages of 0-10 CNG or euro-6 motor and fuel system'.
Transport	Regarding the increase of cycling	600 bicycles and 30 different stations are providing services in the year of 2017 for the purpose of increasing and encouraging cycling. The name of the service is “KayBis”.
Transport	Regarding increasing the number of tramway lines	In 2014 İldem-Beyazşehir tramway line became operational and again in 2014 talas tramway line became operational.

[41] Compressed natural gas

Sector	Action	Status by the end of 2017
Transport	Regarding crossover road works	In our province cloverleaf interchange is built on the intersection of Mustafa Kemal Paşa boulevard and Kocasinan boulevard, an overpass is built for transit pass in the front of highway, an overpass is built on the intersection of İstasyon street and Kocasinan boulevard for vehicles.
Residential Heating	Regarding transition to natural gas	In 2016 in total 293,173 households started to use natural gas (in districts in the center).
Residential Heating	Regarding social assistance coals	Samples were taken from social assistance coals in 2016 (16 samples) and in 2017 (2 samples).
Residential Heating	Regarding reducing air pollution in Hürriyet neighborhood	In 2013-2014 and 2014-2015 education periods awareness raising activities were organized in schools jointly by Kayseri Gaz and Erciyes university department of environmental engineering.

Source: Information received from MoEU that was retrieved from THEP-İZ (Clean Air Action Plan Monitoring Application) system. Data received on May 2019.

Stakeholder engagement during preparation of the plan seems to be achieved via holding several stakeholder meetings. During implementation of the plan, several public awareness activities was undertaken. Some of these activities are as follows; trainings given to children at schools on air pollution; leaflets and brochures prepared and distributed by Konya CAC on air pollution, its impacts on health, how to reduce air pollution with personal actions, and proper stove use and combustion techniques to help reduce air pollution emissions, etc.

International Good Practices

Kayseri CAAP was also benchmarked against international good practices described in Chapter 4.1 of this report. Table 5 and Table 6 provide the outcomes of this benchmarking assessment, along with comments and recommendations.

Table 6 Benchmarking of Kayseri CAAP against international good practices

No	CAAP component	Kayseri CAAP
1	Assessment of ambient air quality	Partly covered. Plan might benefit from including comparison with limit values and discussion of reason for non-compliance. Recent reports prepared by Konya CAC on air quality assessment can provide quality input to revision of this part.
2	Emission Inventory	Some activity data is provided but an emissions inventory is not provided in the Plan, which makes it really difficult to identify and prioritize measures. The HEY Portal project is supposed to prepare emission inventory for the Province. However, data and information cannot be reached for the time-being.
3	Source Apportionment	Not covered; recommended to conduct source apportionment studies in the near future.
4	Dispersion Modeling	Not covered; recommended to be conducted in the near future.

No	CAAP component	Kayseri CAAP
5	Identification of measures	Partly covered; mitigation measures are provided in the Plan, however, linkages to assessment of emission sources and ambient air quality is missing.
6	Impact of measures	Not covered; recommended to be conducted in the near future.
7	Prioritization of measures	Not covered; recommended to be conducted in the near future.
8	Stakeholder participation	Partly covered; stakeholders taking part in the preparation of the Plan were limited to University, Municipality and Provincial Directorate of the MoEU. It is not clear if and how stakeholder comments and requests are handled and integrated in the Plan.
9	Effective coordination and ownership	According to national legislation, a Local Environment Council coordinates the CAAP process. The Plan is not clear about coordination mechanisms
10	Implementation mechanisms in-place	Plan states that each implementing agency defines their own implementation mechanism
11	Monitoring and evaluation mechanism in place	Not covered; recommended to be included in the near future.
12	Financing of the CAAP (including human and technical capacities)	Cost of measures are not provided in the Plan; Plan states that each implementing agency provides its' own finance.
13	Public awareness and acceptance	One of the measures in the Plan is on public awareness.

Table 7 Overall quality of the Kayseri CAAP at different stages of the CAAP process

Stages of CAAP Process	Quality of Kayseri CAAP	Notes
Preparation	Poor	Kayseri CAAP does not provide adequate data, information and analyses to drive most effective mitigation measures. Overall quality of the Plan is poor.
Implementation	Medium	Implementation of measures identified in Kayseri CAAP are followed by Provincial Directorate of MoEU. Most of the short-term and medium-term measures have been completed. Implementation of long-term measures are ongoing and may be constrained by lack of financing. It is important to note that due to limitations in preparation of the CAAP as described previously, the outcome of implementation, in terms of pollutant emissions reduction, might not be high.

Monitoring and Evaluation	Poor	Implementation of the measures is recorded in the THEP-Iz system prepared by the MoEU as a tracking mechanism. However, evaluation of outcomes is missing in this system. It is recommended that monitoring system also monitors emission reduction potentials of measures so as to provide data and information for evaluation of outcomes.
Revision	No data	No data

CHAPTER 6. CONCLUSIONS AND RECOMMENDATIONS

The diagnostic analysis conducted for Kayseri Province highlights following major issues at local level, which could be common across a number of provinces:

4. ***Lack of technical and human resource capacity at municipal level and CAC.*** The preparation of the CAAP is adversely affected as the capacity to undertake requirements of local AQM is lacking.
5. ***Lack of financial resources to implement identified measures in the CAAP.*** The CAC does not have adequate financial resources to undertake necessary tasks, such as operate monitoring network and undertake emission inventory and dispersion modeling.
6. ***Lack of coordination among stakeholders especially during implementation of the CCAP.*** The CAAP commission established under Local Environment Council is operational only during preparation of CAAP but does not oversee implementation and monitor outcomes.

There are several completed and on-going efforts at national level to help support local level actions and local authorities in AQM that could help address the above-mentioned issues to some extent. In this regard, development of a central system run by regional CACs to undertake emission inventory and dispersion modeling (i.e., HEYGEL portal) is a key milestone. Once the system becomes fully operational in 2023, emission inventory and dispersion modeling of all 81 provinces in the country will be available in a central system. An on-going EU funded project (i.e., CITYAIR, which was well coordinated with this effort) also aims at supporting 31 provinces in the country to help update their CAAPs. The CAAP template that now exists (but which Kayseri was unable to follow because it came into effect after Kayseri had already prepared its CAAP) is a good start and is likely to be strengthened through the on-going efforts and based on the finding documented in this report. However, the challenges foreseen are in sustaining the gains because of lack of capacity and finances.

The institutional structure for AQM in Turkey, with the role of the CACs at the provincial level, provides a good model for delivering support to the lowest level of government in preparing the CAAPs. However, the best made CAAPs will not deliver against persistent non-compliance if they cannot be implemented, and their impacts measured; hence addressing the second and third point made above is critical. A good example in Kayseri is the need of residential heating solutions at Eskişehir Bağları which is considered a major contributor to poor air quality. Solutions may lie in ensuring that the natural gas distribution infrastructure is connected, used, and paid for. It is complicated by the presence of low-income families (mostly Syrian refugees) in the area, who cannot be expected to bear the full cost of this measure. Hence there is a need to go beyond the provision of infrastructure, to design of the financial support / delivery mechanisms, coordination amongst stakeholders, and awareness raising, for residents to connect and use natural gas. Similarly, the implementation of measures to address traffic related emissions in the city center may require implementation of a low emission zone combined with strengthening the provision of public transit alternatives. This too would require infrastructure, financing, coordination, and awareness.

It should also be noted that effective air quality management and reducing air emissions not only help improve ambient air quality but also help reduce climate change impact via reducing Greenhouse Gases (GHGs) short-lived climate pollutants such as black carbon. Therefore, integrating climate change mitigation and air pollution policies would also help benefit efficient use of resources and increasing impact, which should be considered in Turkey as well.

In other countries – in Europe, South- and East-Asia, as well as Latin America, the World Bank has been providing support through technical assistance, and investments in measures to reduce emissions from major polluting sources and improve air quality. These international experiences, facilitated through peer-to-peer learning or technical meetings, could be a useful starting point for Turkey to

identify its needs to deliver better air quality and reach compliance with limit values. The World Bank could leverage its engagement with the Government in Turkey across a number of sectors that impact air quality - urban, energy, and transport – to mobilize additional support based on a request.

Specific conclusions regarding Kayseri CAAP are summarized below:

- An inventory of emissions to air does not exist for Kayseri province; hence the identification of major sources is unclear.
- Although emission sources are not scientifically determined, meaningful emission reduction measures were introduced in the CAAP, such as the ones to reduce emissions from residential heating and road traffic. Short and medium-term measures stated in the plan have been implemented.
- Most of the measures identified in the plan need to be implemented and financed by the municipality. Municipality does not have adequate financing to implement all the measures.
- Eskişehir Bağları was identified as a major residential heating pollution source in the city and natural gas distribution pipeline was introduced to the area. However, low income families (mostly Syrian refugees) reside in this area and they need financial support to connect to and use natural gas.
- Konya CAC has a limited budget and a limited number of staff which constrains its operation.
- Source identification to investigate all possible air emission sources (such as agriculture, crustal, secondary particle formation etc.) has not been done.
- The coordination/communication among various stakeholders of air quality management (such as municipality, provincial directorate and Konya CAC) is poor, especially during implementation and monitoring of measures.

Recommendations to improve Kayseri CAAP preparation and its implementation are as follows:

- It is recommended that the emissions inventory of the Province is urgently completed (before preparation of the next CAAP) to identify major emission sources in the city. Ongoing efforts of the MoEU are welcome and indicate that emission inventory estimates for the city will be available soon.
- CAAP commission is established during preparation of CAAP, but it does not actively contribute to implementation and monitoring of plan. It is recommended that CAC council keep operational during all phases of CAAP (i.e., preparation, implementation, monitoring).
- Coordination/communication among various stakeholders of air quality management (such as municipality, provincial directorate and Konya CAC) need to be strengthen during all phases of the CAAP (i.e., preparation, implementation and monitoring). This can be achieved by continuation and active contribution of the CAAP commission during all phases of the CAAP.
- Municipality prepared a GHG emission inventory, which can be very useful to develop air emission inventory especially for energy sector. It is recommended to use existing GHG emission inventory as a basis for the air emission inventory.
- Integrating air quality improvement into urban planning (such as providing green urban spaces in densely populated city centers, keeping industry away from residential areas and considering prevailing wind direction in location selection for industrial facilities) should be considered.
- There are no major industrial facilities located in Kayseri but there are many SMEs located in several OIZs located around city. Mining sector is among the most common industry in the city. Air emissions and case-by-case basis ambient concentration levels are reported to Provincial Directorate of MoEU during permit phase. However, there is not a rigorous on-site inspection monitoring of industrial emissions. This could be increased, especially where emissions are expected to be high (such as mining sector). Process emissions of industrial facilities, in addition to heating emissions, should also be inspected.

Possible areas of future support:

Based on the diagnostic analysis, potential areas for engagement, including possible financing, that emerge are as follows:

- Support for Eskişehir Bağları residential heating solutions;
- Support for the training of Konya CAC;
- Capacity increase for provinces (10 provinces) under Konya CAC on following areas:
    - Identifying and prioritizing mitigation measures;
    - Residential heating measures (including funding and implementation mechanisms etc.)
    - Access to finance.
- Support on implementation of new By-law on LEZ;
- It is also recommended to follow an 'Act while Plan' approach, where some most obvious mitigation actions are initiated based on current CAAP, while a robust CAAP (or AQMP) is developed based on source apportionment and emission inventories. The size of such program and number of cities may be selected based on client interest / level of ambition and available lending envelope.
- Air Quality and Greenhouse Gas emissions management program comprising of technical assistance and investments across several municipalities / provinces.

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ANNEXES

ANNEX A. SCOPE OF THE DIAGNOSTIC ANALYSIS

The scope of the diagnostic analyses provided in this report was presented in "Inception Report" for the Project dated March 2019 that was shared and agreed with the MoEU at the beginning of the Project. Relevant parts of the Inception Report are provided in this Annex. Please see "Inception Report" for complete report.

Work Plan

This chapter presents the approaches to the planned activities to achieve the project objectives and time schedule to achieve these activities. Each activity is described in detail in the following sections.

Approach to Activity 1: Situation Analysis and Initial Assessment

Approach to undertake situation analysis and initial assessment will include; i) desktop review and research of available data and information including but not limited to project documents, reports, legislations, etc.; ii) site visit to meet and interview with stakeholders, capacity assessment; iii) data and information collection from stakeholders throughout process. Activity 1 will include following specific tasks:

- *Review of legal framework*: List of national legislations that will be reviewed as per CAAP requirements are as follows:
  - By-law on Air Quality Assessment and Management (O.G. 06.06.2008, no: 26898)
  - Circular on Air Quality Assessment and Management (Circular No 2013/37)
  - By-law on Control of Heating based Air Pollution (O.G. 07.02.2009, no: 27134)
  - By-law on Control of Industry based Air Pollution (O.G. 07.02.2009, no: 27277)
  - By-law on Decrease of Sulfur Ratio in some Fuel Oil Types (O.G. 06.10.2009, no: 27368)
  - By-law on Control of Exhaust Gas Emission (O.G. 11.03.2017, no: 30004)
  - Circular on Imported Solid Fuels (Circular No 2015/2)
  - Legislations relevant to local air quality management as identified during site visit and stakeholder discussions (such legislation may include energy efficiency, building insulation, old vehicle scrapping, agricultural remaining burning, waste burning, etc.)
- *Review of institutional structure (national, regional and local level)*: Existing legislations provides roles and responsibilities related to local AQM and CAAP preparation and implementation. Institutional structure in AQM including recent updates and revisions in structures will be received from MoEU. Effectiveness of institutional structure in preparing, implementing and monitoring CAAP (and its specific parts such as AQ monitoring, emission inventory, air dispersion modeling, etc.) will be assessed via WB team through stakeholder interviews, site visit and review of available reports, EU progress reports, relevant project documents. Documents used during preparation of Inception Report are as follows. Further assessment of these reports will be done and additional report and information will be explored during stakeholder interviews and site visit:

- First National Air Quality Management Workshop Report, May 2017;
- KENTAIR Twining project reports;
- IKONAIR Twining project reports;
- HEY Portal information available through internet search; and
- Internet sites of Konya CAC, National Ambient Air Quality Network, MoEU.

- *Assessment of technical and institutional capacity (at local and regional level):* This task will be undertaken via site visit through meetings and interviews, and follow up communications, with relevant stakeholders.
  - Areas to be assessed during the site visit will include but not limited to; ambient air quality monitoring (physical and technical human capacity), emission inventory (data collection, robust emission inventory system, QA/QC etc.), dispersion modeling, basis for selection of mitigation measures, institutional arrangements, technical and human resource capacity to prepare, implement and enforce CAAPs, etc.
  - List of the stakeholders to be interviewed during the site visit are provided in Annex C of the Inception report.
  - Questioners will be used during the site visit. Annex D of the Inception Report provides list of questions and questionnaires that will be used during the site visit.
  - A two days site visit between February 20-22 was organised. Format of the stakeholder meetings was roundtable discussion.

- *Assessment of major air emission sources in the selected city*:
  - This task will be undertaken by review of national and local emission inventories, site visit to collect data and information from local stakeholders (such as municipality, commerce chambers etc.).
  - National emission inventory is available through EIONET and also through MoEU website[42]. This relates primarily to industrial emissions, road transport, small and medium sized enterprises, and households. The national emissions inventory is to be updated annually.
  - Regarding local inventory data yet to be developed, availability of an inventory for Kayseri will be explored and assessed within the scope of this project.
  - Contribution of regional air pollution into local air quality via long range transport and secondary particle formation is another source especially for PM. Regional component of PM cannot be identified by emission inventories. It can be either identified and quantified by regional atmospheric chemical transport models or

[42] Available at http://www.ceip.at/ms/ceip_home1/ceip_home/status_reporting/2018_submissions/, and https://cygm.csb.gov.tr/ulusal-hava-kirleticileri-emisyon-envanteri---national-air-pollutants-emission-inventory-i-81051

via source apportionment studies. Availability of such studies for Kayseri province will also be investigated.

Approach to Activity 2: Review of CAAP for the selected city and benchmarking against national guidelines and international good practices

Kayseri CAAP dated 2013 will be reviewed to assess and benchmark against national guidelines and international good practices. National Template to prepare CAAPs was prepared by the MoEU and available online[43]. Kayseri CAAP will be reviewed against national CAAP guideline as well as benchmarked against international good practices. Criteria for benchmarking against good international practices are provided in Annex E of the Inception Report.

Benchmarking of Kayseri CAAP against similar good practice in Europe will focus on key elements such as, local emissions inventory, use of monitoring data and modelling results, source attribution, identification of measures, prioritization of measures by effectiveness, financing support, and implementation arrangements. Identification and prioritization of mitigation measures according to their impact on ambient air quality, effectiveness of measures, cost-effectiveness etc. will also be considered. Furthermore, implementation and monitoring arrangements for identified measures will be reviewed. Areas for improvement at preparation, implementation, and monitoring and revisions stages of CAAP process will be identified and recommendations will be listed.

The review will also provide assessment of air quality trends in Kayseri for the last five years, emission sources

Reason for non-compliance will also be identified and additional mitigation measures will be recommended to help achieve compliance.

Review of Kayseri CAAP will include followings:

- Air quality situation in Kayseri (in the last five years);
- Air pollution emission sources in Kayseri (based on local/national emission inventory data, literature review etc.);
- Assessment of CAAP according to national and international requirements/ good practices;
- identifying reason for non-compliance and areas for improvement at preparation, implementation, and monitoring and revisions stages of the CAAP process;
- Assessment of identification of mitigation measures according to their AQ impact, effectiveness of measures, prioritization of measures (cost-effectiveness etc.), etc.;
- Recommendations for improvement including but not limited to additional analysis/assessment requirements, institutional structure, human and financial resources, monitoring and evaluation, stakeholder engagement etc.

Approach to Activity 3: Assessment of reasons for non-compliance for the selected city, diagnostic report, and dissemination

This Activity will build on results of Activity 1 and 2. Situation analysis and CAAP review will be used to identify reason for non-compliance in the selected city and recommendations on actions to be

[43] Available at http://cygm.csb.gov.tr/hava-kalitesi-degerlendirme-i-7354.

implemented to support the province in reaching compliance will be provided in a diagnostic study report. Activity 3 will include following tasks:

- Preparation of draft diagnostic report based on desktop review and site visit:

  Results of Activity 1 and 2 will be fed into preparation of draft diagnostic report. Especially outcomes of site visit will provide information about technical capacities and institutional set up for preparing and implementing the CAAP. This is expected to form the basis of the diagnostic study to identify areas of improvement that could lead to meeting the ambient air quality limit values.

- Stakeholder workshop to introduce draft report:

  Conducting the workshop include sharing of initial findings and discussing the way forward with stakeholders. Diagnostic report will be shared with relevant stakeholders via a stakeholder workshop where findings will be shared and inputs and comments from stakeholders will be received.

- Revision of the draft report according to workshop outcomes: Upon receiving inputs from the MoEU and relevant stakeholders, diagnostic report will be revised and finalized.

- Final report submission.

Time Schedule of Activities

The time schedule for the activities is presented in the following table.

Task \ Months	January 2019	February 2019	March 2019	April 2019	May 2019	June 2019
Data Collection						
Selection of Pilot city						
Site Visit(s)						
Inception Report						
Draft Diagnostic Analysis Report						
Workshop						
Revised Diagnostic Analysis Report with Workshop Outputs						
Final Diagnostic Analysis Report						
Monthly meetings w/ MoEU and other stakeholders						

Deliverables

Main deliverables associated with this AS are as follows:

- Inception Report;
- Stakeholder workshop; and
- Diagnostic study report; draft and final.

Brief description of these deliverables and timetable are provided in the table below.

Deliverable	Brief Description	Timetable
1. Inception Report	Summary of scope of the AS project, objectives, approach and methodology, results and analysis, work plan and timetable.	February 2019
2. Draft Diagnostic Report	Review of CAAP against good practices in Europe will be complemented with a visit to the province for a first-hand assessment of the technical capacity and institutional set up for preparing and implementing the CAAP, which will form the basis of the diagnostic study to identify areas of improvement that could lead to meeting the ambient air quality limit values. Diagnostic analyses will not include additional analytical work (such as emission inventory preparation, dispersion modeling, cost-benefit analysis etc.). Diagnostic report also will not provide identification or prioritization of mitigation measures as these requires substantial analysis to be done.	April 2019
3. Stakeholder Workshop	Stakeholder workshop towards the conclusion of the diagnostic study with all relevant stakeholders will aim to share the draft results and seek feedback.	May 2019
4. Final Diagnostic Report	Draft diagnostic report will be revised and finalized according to feedback received from stakeholders during stakeholder workshop and MoEU.	June 2019

ANNEX B. TURKISH LEGISLATION ON AQM

By-law on Air Quality Assessment and Management (AQAM)

The By-law aims to:

i) Define and set air quality limit and threshold values, for the purpose of preventing or reducing adverse impacts of air pollution over environment and on public health;
ii) Assess air quality based on defined methods and criteria;
iii) Protect the existing status where air quality is good and to improve in other cases; and
iv) Collect data and information on air quality and ensure public information.

The Turkish by-law on AQAM is in-line with 70% of the new EU Directive 2008/50/EC (CAFÉ Directive).[44] The full transposition of the CAFÉ directive and the National Emission Ceilings (NEC) Directive into national legislation are underway. The latter is expected to include provisions set by the new NECD (2016/2284/EU)[45] entered into force on 31 December 2016, replacing earlier legislation (Directive 2001/81/EC). The more ambitious reduction commitments agreed for 2030 are designed to reduce the health impacts of air pollution by half compared with 2005.

***Circular* on Air Quality Assessment and Management (AQAM)**

Circular No 2013/37 on Air Quality Assessment and Management provides the list of regions and sub-regions identified by the MoEU according to requirements set by the By-law on AQAM. In total eight regions are identified for Turkey under which 15 "large sub-regions" (population above 750,000) and 31 "small sub-regions" (population above 250,000) are defined.

The Circular also provide details on how incremental decrease of limit values per parameter should be achieved to ultimately reach EU limit values. A timeline and limit values for each year from 2013 to 2019 is also given in Annex II of the Circular. The Circular identifies procedures for CAAP preparation and defines a schedule for provinces to submit their CAAPs.

The Circular also requires the provinces to prepare local level emission inventories for heating, traffic and industry sectors only and for pollutants SO_2, Nox, and PM10. A schedule is also defined for provinces within the Circular to submit their emission inventories. The emission inventories should be updated annually every year and submitted to MoEU by Provinces (i.e., Provincial Directorate of MoEU).

Public information procedures are also described in the Circular.

***By-law* on Control of Heating Based Air Pollution**

The By-law aims to control air pollutants (such as soot, smoke, dust, gas, fume and aerosols) that are emitted from combustion devices used for heating purposes. Combustion devices includes boilers, stoves, etc. and they are used for heating in dwellings, public housing, cooperatives, housing complexes, schools, university, hospital, official agencies, work places, public recreational facilities, industry and similar places.

The qualifications and operating principles of the combustion devices, fuel quality criteria (for solid, liquid and gaseous fuels) used in these devices and the emission thresholds are covered under this By-

[44] First National Air Quality Management Workshop final report prepared by MoEU, May 2017. Available at https://webdosya.csb.gov.tr/db/ced/haberler/haberler158701.pdf

[45] Available at http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2016.344.01.0001.01.ENG&toc=OJ:L:2016:344:TOC . Note: The new NECD sets 2020 and 2030 emission reduction commitments for five main air pollutants. It also ensures that the emission ceilings for 2010 set in the earlier directive remain applicable for Member States until the end of 2019. The new directive transposes the reduction commitments for 2020 agreed by the EU and its Member States under the 2012 revised Gothenburg Protocol under the Convention on Long-range Transboundary Air Pollution (LRTAP Convention).

law. Combustion facilities with a heating capacity above 1000 kW are not covered in this By-law as they fall into scope of another by-law (i.e., By-law on Industrial Air Pollution Control).

The emission criteria for solid fuels are defined for combustion devices based on their capacity (whether the capacity is lower than 15 kW or between 15 kW to 1000 kW) within the By-law. The threshold levels for oxygen content in terms of volume as percentage, particulate matter concentration (mg/Nm^3), carbon monoxide concentration (mg/Nm^3) and degree of soot are provided.

The emission criteria for combustion facilities using liquid and/or gas fuel is also given in the By-law. The thresholds are defined based on combustion technology used and heating capacity. Different limit values are set for nitrogen oxide (mg/kWh as NO_2), carbon monoxide (mg/kWh), hydrocarbons (ppm as CH_4), degree of soot, and heat loss due to waste gas.

The rules and principles for monitoring and control of air pollutants emitted are also set in the By-law. Periodic monitoring is described for facilities with heating capacity above 15 kW.

***Circular* on Air Pollution Control and Prevention**

The Circular aims to reduce air pollution and ensure harmonization and consistency in implementation. In accordance with Article 28 of By-law on *Control of Heating based Air Pollution*, MoEU announces pollution ranking of the provinces and villages in the Country before the winter season. This ranking is based on an analysis of meteorology, topography, emission sources, ambient air quality data for the previous years, etc. among others for the provinces. According to pollution ranking of the provinces and villages, fuel quality that can be used in these provinces are identified in this Circular and the By-law on *Control of Heating based Air Pollution.* The circular also requires solid fuel suppliers, to sell relevant type of solid fuels in those provinces and villages.

The Circular describes how solid fuel suppliers should proceed if the pollution ranking of a province or sub-province has changed. The circular is mainly on solid fuel quality according to pollution ranking of provinces, permits and inspections of suppliers, and also includes issues on free coal distribution for social support purposes by the Government.

The Circular also briefly touch on air pollution and control from motor vehicles and industrial facilities and provide cross-reference to relevant legislations.

In relation to CAAPs the circular requires that CAAPs, including studies planned and measures taken in order to prevent air pollution, should be submitted latest by the end of April 2011.

By-law on Industrial Air Pollution Control

The By-law aims; i) to control air emissions (in the form of smoke, dust, gas, vapor and aerosol) released from industrial and energy production facilities; ii) to protect people and environment located in vicinity of these facilities from negative impacts of ambient air pollution; and iii) to provide rules and regulations to achieve these.

Any commercial facility that falls under the definitions and lists provided in the "*By-law on Environment Permits and Licenses*" must have an Environment Permit to be operational. Air emission limit values and requirements for these facilities in order to receive an Environment Permit, are provided by the *By-law on Industrial Air Pollution Control*.

The Annexes of this By-law define the criteria and emission limits to be followed for air emissions from industrial and energy generation facilities. These criteria include but are not limited to; stack height, sampling point, dust concentration (PM10) in relation to emission flow rate, emission thresholds for other parameters in relation to the industrial activity, air dispersion modeling.

Annex II of the By-law states that all existing and new facilities must undertake air dispersion modeling and ambient air quality monitoring, in order to assess contribution of the facility's air emissions onto existing air quality of the receiving environment. Guidance on how to undertake dispersion modeling is described in this annex in detail. The same Annex indicates that facilities and activities within a province have to obey the measures defined in the Clean Air Action Plan (CAAP) prepared in accordance with By-law on AQAM.

The same Annex also defines the Air Quality threshold values that should be achieved within the facility impact area.

By-law on Environment Permit and License

This By-law regulates the environmental permits and licenses required in accordance with the Environment Law (Law no 2872). The activities falling under the scope of this By-law are defined under Annex I and Annex II of the By-law and facilities carrying out these activities need to acquire an environment permit. The permit is given by MoEU for facilities carrying out activities listed under Annex I and by Provincial Directorate of the MoEU for those carrying out activities listed in Annex II.

One of the requirements covered under environment permit is air emissions.

By-law on Environmental Impacts of Petrol and Diesel Fuels

The purpose is to determine the rules and principles in order to limit the impacts to environment and human health of petrol and diesel fuel used in the motor vehicles. This By-law is prepared considering Directive 98/70/EC of the European Parliament and of the Council of 13 October 1998 relating to the quality of petrol and diesel fuels.

By-law on Decrease of Sulfur Ratio in some Fuel Oil Types

The purpose is to determine rules and principles to decrease the SO_2 emissions resulting from combustion of some fuel oil types in order to protect human and environment from hazardous impacts.

The By-law indicates that fuel oil to be used within the country should not have more than 1% sulfur content as of 2012 with exceptions defined for combustion facilities above 50 MW capacity.

The sulfur content of maritime fuels used by Turkish vessels/ships within the Sox Emission Control Areas defined by MARPOL convention cannot exceed 1.5%.

By-law on Control of Exhaust Gas Emission

This By-law aims to determine rules and principles for reducing exhaust gas pollutants to protect living beings and the environment against exhaust gas emissions from motor vehicles in traffic. It was prepared in accordance with Directive 2009/40/EC of the European Parliament and of the Council of 6 May 2009 on roadworthiness tests for motor vehicles and their trailers within the frame for adopting EU legislation.

The by-law defines exhaust gas emission measurements, interval between testing and fees, the rules and principles for exhaust gas measurements, and the assessment of measurements. In addition, the requirements to have an exhaust gas measurement license, standards for measurement devices, and the criteria and working principles for measurement staff are given in the By-law. Inspection of vehicles and measurement stations are also described.

The inspections are carried together with traffic police and provincial directorate staff together. These traffic inspections check if the vehicle inspected has a valid exhaust emission certificate or not. If valid certificate does not exist, then a penal sanction is applied, and the exhaust emission is also measured.

If the exhaust emission measurements are above the thresholds an additional penal sanction is also applied.

Circular on Imported Solid Fuels

The Circular defines the properties of imported solid fuels. The thresholds for total sulfur content, lower calorific value and volatile materials on dry basis determined in the circular.

By-law on Monitoring of Greenhouse Gas Emissions

This By-law aims to set rules and principles for monitoring, reporting and the verification of greenhouse gas emissions for activities listed under Annex I of the By-law. The facilities within the scope of this By-law have to prepare a Monitoring Plan at least six months prior to first monitoring. This monitoring plan should be approved by MoEU. Facilities shall monitor the greenhouse gas emissions according to this plan and submit their GHG emission reports annually by the end of April for the previous year. The GHG emission report should be validated by a validating institution prior to the submission to MoEU.

The By-law defines the requirements for validating institutions and the confidentiality of information and documents provided by facilities within their reports.

By-Law on Increasing Energy Efficiency in Transport Sector

The By-law sets actions to increase energy efficiency in transport sector, such as preparation of urban mobility plans, supporting use of electric vehicles, etc. By-law also sets the basis to establish “Low Emission Zones” (LEZ) in urban areas where traffic congestion and air pollution is high. According to By-Law, municipalities can establish LEZ in urban areas, upon approval of the MoEU. Entry of motor vehicles to LEZ areas will be either limited to certain periods, fully restricted, or fee-based according to vehicle emission values.

ANNEX C. OUTLINE OF CLEAN AIR ACTION PLAN PROVIDED IN ANNEX IV OF THE BY-LAW ON AIR QUALITY ASSESSMENT AND MANAGEMENT

Annex-IV of the By-Law on Air Quality Assessment and Management: INFORMATION TO BE INCLUDED IN CLEAN AIR PLAN TO IMPROVE AMBIENT AIR QUALITY

Information to be provided under Article 10 of this By-law;

1. *Location of pollution exceedance*
   - *Region*
   - *City (map)*
   - *Monitoring station (map, geographical coordinates)*
2. *General information*
   - *"Region" type (urban, industrial or rural area)*
   - *Polluted area (km2) and estimation of population exposed to pollution*
   - *Climate data to be used*
   - *Relevant topographical data*
   - *Sufficient information on type of targets that require protection in the "Region"*
3. *Responsible authorities*
   - *Name and address of persons responsible for development and implementation of improvement plans*
4. *Pollution characteristics and assessment*
   - *Concentrations monitored in previous years (prior to implementation of improvement measures)*
   - *Measured concentration from the beginning of the project*
   - *Techniques used for assessment*
5. *Source of pollution*
   - *List of major emission sources causing pollution (map)*
   - *Total amount of emissions dispersed from these sources (ton/year)*
   - *Information on pollution transferred from other regions*
6. *Situation Analysis*
   - *Details of factors responsible for exceedance (transfer, transboundary transfer, generation)*
   - *Details of possible measures for improving air quality*
7. *Details of improvement projects or measures which existed before this By-law came into force*
   - *Local, regional, national, international measures*
   - *Observed effects of these measures*
8. *Details of improvement projects or measures implemented to reduce pollution after this By-law came into force*
   - *List of all measures identified in the project and their description*
   - *Time schedule for implementation*
   - *Estimation of time required to reach these targets and the improvement of air quality*
9. *Details of searched or planned projects or measures in long term*
10. *List of publications, documents, studies and similar material used to support information requested under this Annex.*

DIRECTIVE 2008/50/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL OF 21 MAY 2008 ON AMBIENT AIR QUALITY AND CLEANER AIR FOR EUROPE (CAFÉ)

ANNEX XV
Information to be included in the local, regional or national air quality plans for improvement in ambient air quality

"A. Information to be provided under article 23 (air quality plans)

1. Localisation of excess pollution

(a) region;

(b) city (map);

(c) measuring station (map, geographical coordinates).

2. General information

(a) type of zone (city, industrial or rural area);

(b) estimate of the polluted area (km2) and of the population exposed to the pollution;

(c) useful climatic data;

(d) relevant data on topography;

(e) sufficient information on the type of targets requiring protection in the zone.

3. Responsible authorities

Names and addresses of persons responsible for the development and implementation of improvement plans.

4. Nature and assessment of pollution

(a) concentrations observed over previous years (before the implementation of the improvement measures);

(b) concentrations measured since the beginning of the project;

(c) techniques used for the assessment.

5. Origin of pollution

(a) list of the main emission sources responsible for pollution (map);

(b) total quantity of emissions from these sources (tonnes/year);

(c) information on pollution imported from other regions.

6. Analysis of the situation

(a) details of those factors responsible for the exceedance (e.g. transport, including cross-border transport, formation of secondary pollutants in the atmosphere);

(b) details of possible measures for the improvement of air quality.

7. Details of those measures or projects for improvement which existed prior to 11 June 2008, i.e:

(a) local, regional, national, international measures;

(b) observed effects of these measures.

8. Details of those measures or projects adopted with a view to reducing pollution following the entry into force of this Directive:

(a) listing and description of all the measures set out in the project;

(b) timetable for implementation;

(c) estimate of the improvement of air quality planned and of the expected time required to attain these objectives.

9. Details of the measures or projects planned or being researched for the long term.

10. List of the publications, documents, work, etc., used to supplement information required under this Annex."

COMMISSION IMPLEMENTING DECISION 2011/850/EU

Laying down rules for Directives 2004/107/EC and 2008/50/EC of the European Parliament and of the Council as regards the reciprocal exchange of information and reporting on ambient air quality

Article 13 - Air quality plans

"1. In accordance with the procedure referred to in Article 5 of this Decision, Member States shall make available the information set out in Parts H, I, J and K of Annex II to this Decision on air quality plans as required by Article 23 of Directive 2008/50/EC including:

(a) the mandatory elements of the air quality plan as listed pursuant to Article 23 of Directive 2008/50/EC in Section A of Annex XV to Directive 2008/50/EC;

(b) references to where the public can have access to regularly updated information on the implementation of the air quality plans.

2. The information shall be made available to the Commission without delay, and no later than 2 years after the end of the calendar year in which the first exceedance was observed."

Annex II

"(H) Information on air quality plans (Article 13)

(1) Provider (data type 'Contact Details')

(2) Change documentation (data type 'Documentation of Change')

(3) Air quality plan: code

(4) Air quality plan: name

(5) Air quality plan: reference year of first exceedance

(6) Competent authority (data type 'Contact Details')

(7) Air quality plan: status

(8) Air quality plan: pollutants covered

(9) Air quality plan: date of official adoption

(10) Air quality plan: timetable of implementation

(11) Reference to air quality plan (web link)

(12) Reference to implementation (web link)

(13) Relevant publication (data type 'Publication')

(14) Code of the relevant exceedance situation(s) (link to G)

(I) Information on source apportionment (Article 13)

(1) Code(s) of exceedance situation (link to G)

(2) Reference year

(3) Regional background: total

(4) Regional background: from within Member State

(5) Regional background: transboundary

(6) Regional background: natural

(7) Urban background increment: total

(8) Urban background increment: traffic

(9) Urban background increment: industry including heat and power production

(10) Urban background increment: agriculture

(11) Urban background increment: commercial and residential

(12) Urban background increment: shipping

(13) Urban background increment: off-road mobile machinery

(14) Urban background increment: natural

(15) Urban background increment: transboundary

(16) Local increment: total

(17) Local increment: traffic

(18) Local increment: industry including heat and power production

(19) Local increment: agriculture

(20) Local increment: commercial and residential

(21) Local increment: shipping

(22) Local increment: off-road mobile machinery

(23) Local increment: natural

(24) Local increment: transboundary

(J) ***Information on the scenario for the attainment year (Article 13)***

(1) Code of exceedance situation (link to G)

(2) Code of scenario

(3) Code of air quality plan (link to H)

(4) Reference year for which projections are developed

(5) Reference year from which projections are started

(6) Source apportionment (link to I)

(7) Relevant publication (data type 'Publication')

(8) Baseline: description of the emission scenario

(9) Baseline: total emissions in the relevant spatial unit

(10) Baseline: included measures (link to K)

(11) Baseline: expected concentration levels in the projection year

(12) Baseline: expected number of exceedances in the projection year

(13) Projection: description of the emission scenario

(14) Projection: total emissions in the relevant spatial unit

(15) Projection: included measures (Link to K)

(16) Projection: expected concentration levels in the projection year

(17) Projection: expected number of exceedances in the projection year

(K) ***Information on measures (Articles 13 and 14)***

(1) Code(s) of exceedance situation (link to G)

(2) Code of air quality plan (link to H)

(3) Code of evaluation scenario (link to J)

(4) Measure: code

(5) Measure: name

(6) Measure: description

(7) Measure: classification

(8) Measure: type

(9) Measure: administrative level

(10) Measure: time scale

(11) Measure: affected source sector

(12) Measure: spatial scale

(13) Estimated implementation costs (where available)

(14) Planned implementation: start and end date

(15) Date when the measure is planned to take full effect

(16) Other key implementation dates

(17) Indicator for monitoring progress

(18) Reduction in annual emissions due to applied measure

(19) Expected impact in level of concentrations in the projection year (where available)

(20) Expected impact in number of exceedances in the projection year (where available)"

ANNEX E. CAAP TEMPLATE DEVELOPED BY THE MOEU

APPENDIX

SAMPLE COVER

T.C.
ÇEVRE VE ŞEHİRCİLİK
BAKANLIĞI

REPUBLIC of TURKEY

MINISTRY OF ENVIRONMENT AND URBANIZATION

... PROVINCIAL DIRECTORATE OF ENVIRONMENT AND URBANIZATION

.... PROVINCE CLEAN AIR ACTION PLAN
THEP (2014-2019)

CONTRIBUTING INSTUTIONS

NAMES OR LOGOS OF OTHER INSTITUTIONS PARTICIPATING IN THE CLEAN AIR ACTION PLAN COMMISION

Approval Date of the Plan

2

FOREWORD

This section might discuss the stages of the clean air action plan, which is prepared as a realistic and feasible action plan, such as content, scope, and implementation steps, so that it could provide guidance to the decision-makers contributing to the plans and programs aiming to improve air quality within the province,

1 page- Governor (This page should also include a signature ratifying the clean air action plan)

1 page- Mayor (This page should also include a signature ratifying the clean air action plan)

3

TABLE OF CONTENTS

Inhalt

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

1.1.Air pollution and its impact on health and environment

This section should provide information from literature on air pollution.

1.2.General information about why this plan was prepared and its significance *(as per the legislation)*

This section should include short information on the legislation requiring the preparation of clean air action plan. .

1.3.Clean Air Action Plan Commission Members (institutions and individuals)

A table of commission members and institutions

1.4.Those who prepared the clean air action plan and their contact information

A table of information about staff who contributed to the clean air action plan, their institutions and their contact details

2. AIR QUALITY AND ESTIMATIONS IN PROVINCES

2.1.Assessment of the data from air quality station *(all the data since the establishment date of the station)*

2.1.1. Current Situation

- Where the information come from *(measurement data (measurement - SO_2, PM_{10}, and $PM_{2.5}$, NO_x, O_3 if exists– and)*?

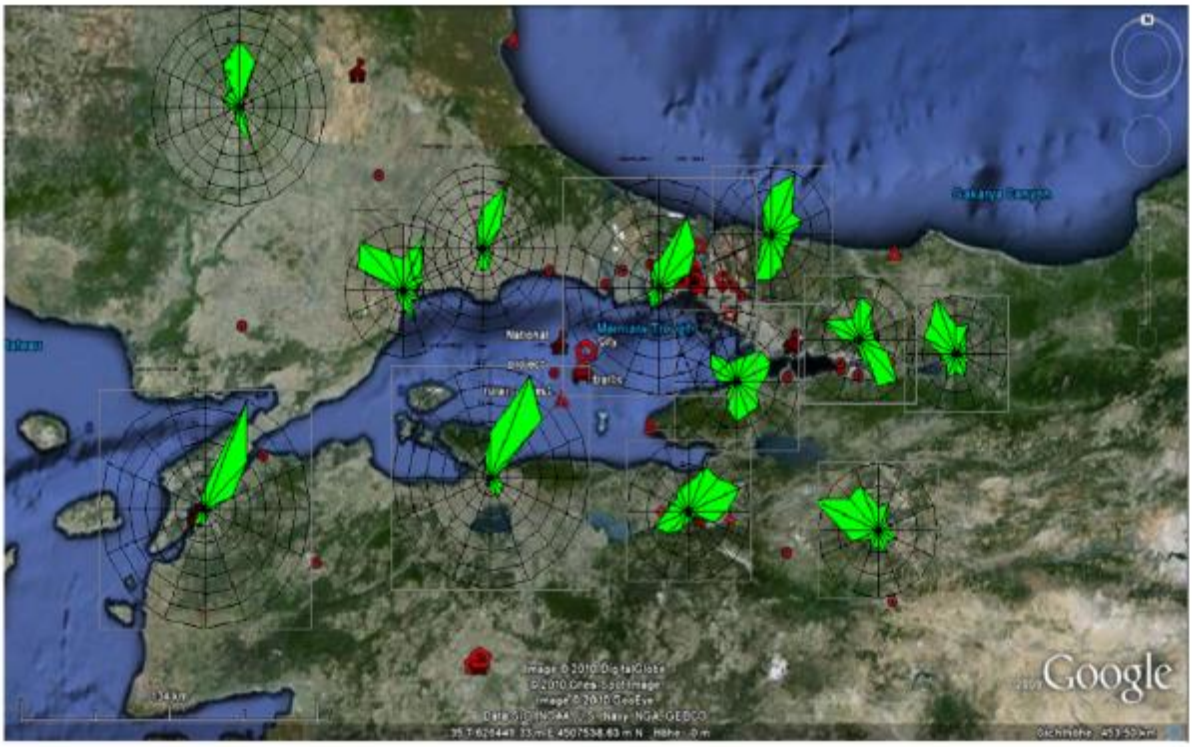
  This section should include all data from the air quality measurement stations within the province. The source of measurement data should be explicitly noted.

- Is there any air quality monitoring station outside the national monitoring network?

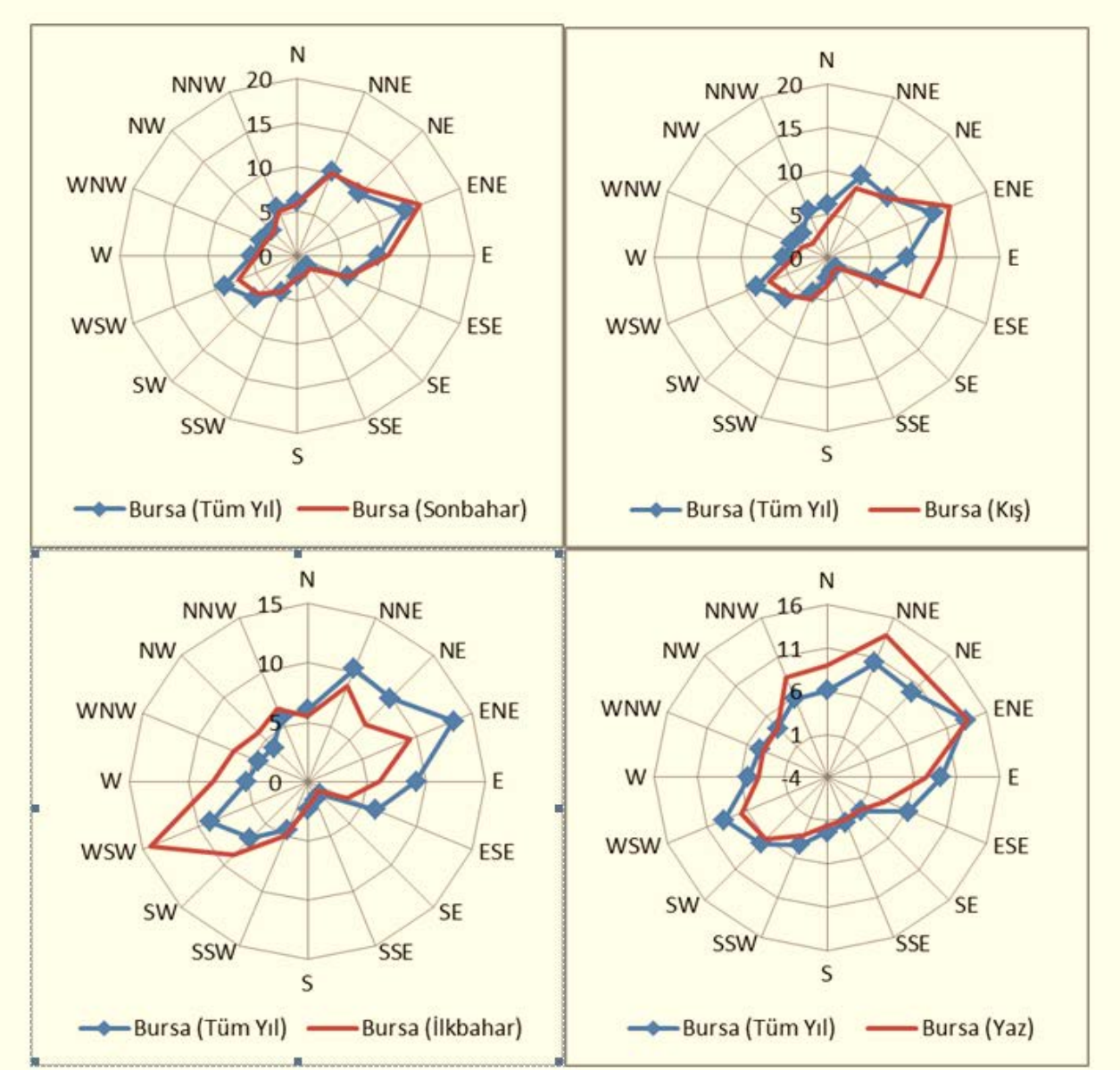
  Information should be provided on other air quality stations within the impact range of industrial facilities such as organized industrial site, universities, etc.

  - Meteorological data

  Sources of meteorological data used should be noted.

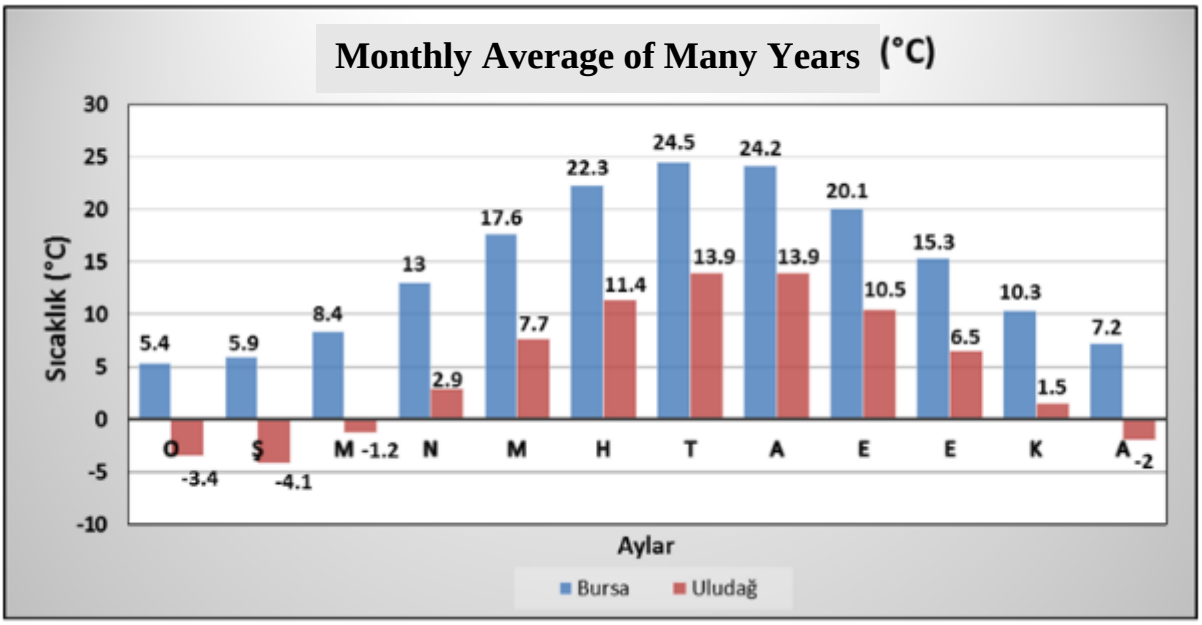


Sample Figure-1: Meteorology map- Institution Building on Air Quality in the Marmara Region Twinning Project Output, Province of Bursa Clean Air Action Plan Draft



- Bursa (Whole Year) - Bursa (Autumn)	- Bursa (Whole Year) - Bursa (Winter)
- Bursa (Whole Year) - Bursa (Spring)	- Bursa (Whole Year) - Bursa (Summer)

Sample Figure-2: Bursa Prevailing Wind Direction- Institution Building on Air Quality in the Marmara Region Twinning Project Output, Province of Bursa Clean Air Action Plan Draft



Sample Figure-3: Meteorological Data Graphics- Institution Building on Air Quality in the Marmara Region Twinning Project Output, Province of Bursa Clean Air Action Plan Draft

- Identification of locations of monitoring station(s)
  Coordinates of station, station type, and parameters measured should be demonstrated in a table. Location of the station should be described in words. Its proximity to the structures such as trees, buildings, roads, etc. and the possible sources of momentary pollution should be noted.
  Photos of stations (dimensions) should be added. .
  Information on coordinates should be defined in the Geographical WGS 84 projection system.

Sample Table-1: Number and types of air quality monitoring stations within the province, the parameters measured and their coordinates

Station Name	Parameters Measured	Station Type	Coordinates	
			X	Y
.....	SO_2 ve PM_{10}	Rural		
.....	SO_2 ve PM_{10}	Traffic		
.....	SO_2, PM_{10}, CO, NO, NO_2, NO_x ve O_3	Background		
.....	SO_2 ve PM_{10}	Urban		

Sample Table-2: Station Information- "Improvement of Urban Air Quality Assessment System Project" (KENTAIR Project), Ankara Province Air Quality Assessment

STATION NAMES	COORDINATES		MEASURED AIR POLLUTANTS							
	LATITUDE	LONGITUDE	PM_{10}	$PM_{2.5}$	SO_2	NO	NO_2	NO_X	CO	O_3
Bahçeli	39.918546°	32.822268°	+	+	+	+	+	+	-	-
Cebeci	39.937039°	32.878052°	+	+	+	+	+	+	+	+
Demetevler	39.896459°	32.840752°	+	+	+	+	+	+	-	-
Dikmen	39.967753°	32.795703°	+	+	+	+	+	+	-	-
Kayaş	39.925411°	32.926750°	+	+	+	+	+	+	-	-
Keçiören	39.967254°	32.862833°	+	+	+	+	+	+	-	+
Sıhhiye	39.927317°	32.859416°	+	+	+	+	+	+	+	-
Sincan	39.972019°	32.585109°	+	+	+	+	+	+	-	-

Sample Table-3: Station Information- Institution Building on Air Quality in the Marmara Region Project Output, Province of Bursa Clean Air Action Plan Draft

NAME	CODE TR	TYPE	POLLUTANTS	MANAGER	WORKING SINCE
BURSA(Nilüfer)	BUM002	Urban	SO_2, NOx, CO, O_3	Municipality of Bursa	2001
BURSA(Yıldırım)	BUM003	Urban	SO_2, NOx, CO	Municiality of Bursa	2001
Kültürpark	TR41102	Urban	NO_2, SO_2, O_3	Marmara MTHM	2013
Yıldırım	TR41103	Trafics	PM_{10}, NO_2, SO_2, CO, BTX	Marmara MTHM	2013
Uludağ Üniversitesi	TR41104	Urban	$PM_{2.5}$, NO_2, SO_2, O_3	Marmara MTHM	2013
Kestel	TR41105	Industry	PM_{10}, NO_2, SO_2	Marmara MTHM	2013
İnegöl	TR41106	Industry	PM_{10}, NO_2, SO_2	Marmara MTHM	2013
BURSA	TR41101	Sub-urban	PM_{10}, SO_2	Ministry of Environment and Urbanization National Refence Laboratory, Gölbaşı	2011

Sample Figure-4: Station photos, Province of Erzurum Air Quality Monitoring Station

- The description of the area assumed to be represented by the station

This section will show the locations of the station on the map. Demonstration of the area represented by the stations by taking into account the station type, the relation between the urban area-industry-traffic density and the sources of pollution/exceedance around each station.

Sample Figure-5: Map of Station and Surroundings- A Study by the Ministry of Environment and Urbanization on Air Quality in Edirne-Keşan

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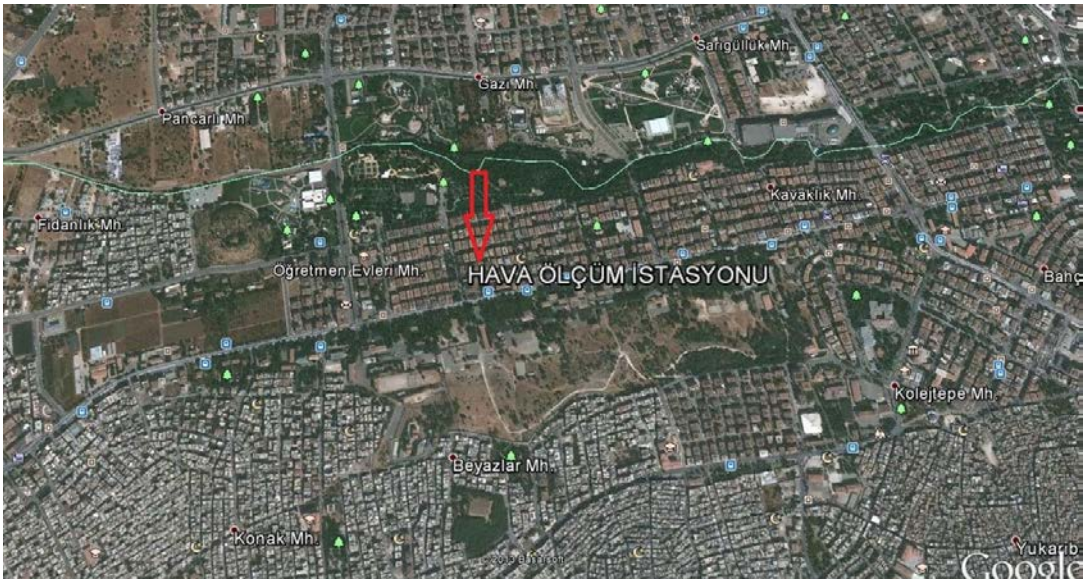

Sample Figure -6: Map of Station and Surroundings - "Improvement of Urban Air Quality Assessment System Project" (KENTAIR Project), Province of Gaziantep Air Quality Assessment Report

- Air quality data measured at stations

This section should assess the annual, seasonal, and daily averages with tables and graphs by taking into account the rate of 90% annual data receiving and 75% monthly and seasonal data receiving. It should also discuss the exceedance values air quality by comparing air quality limit values with the data on all the monitored air pollutants separately for each year and by combining them all. The assessment should be supported by figures and graphs too, including station type info and data recieving rates.

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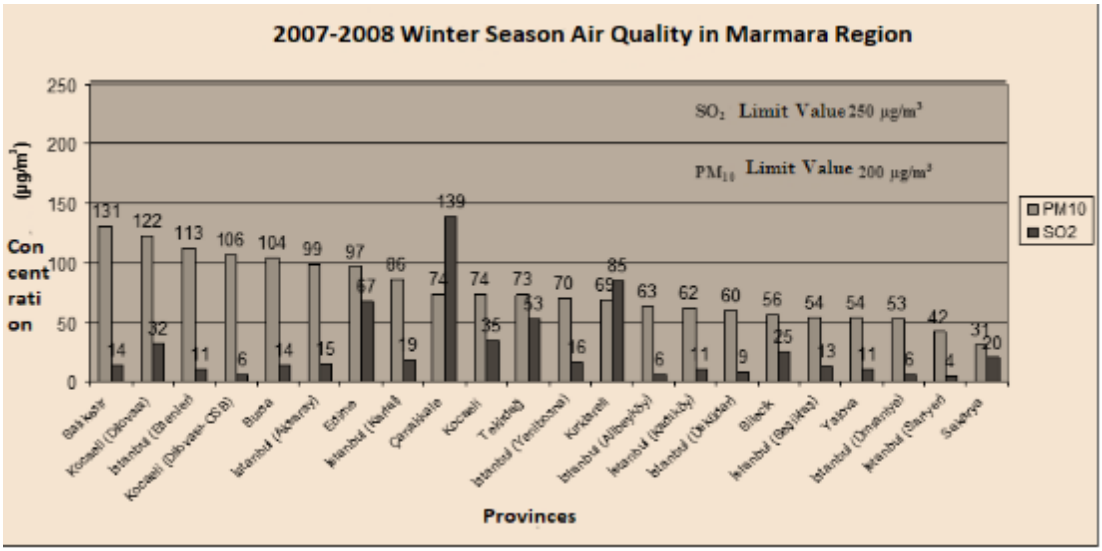
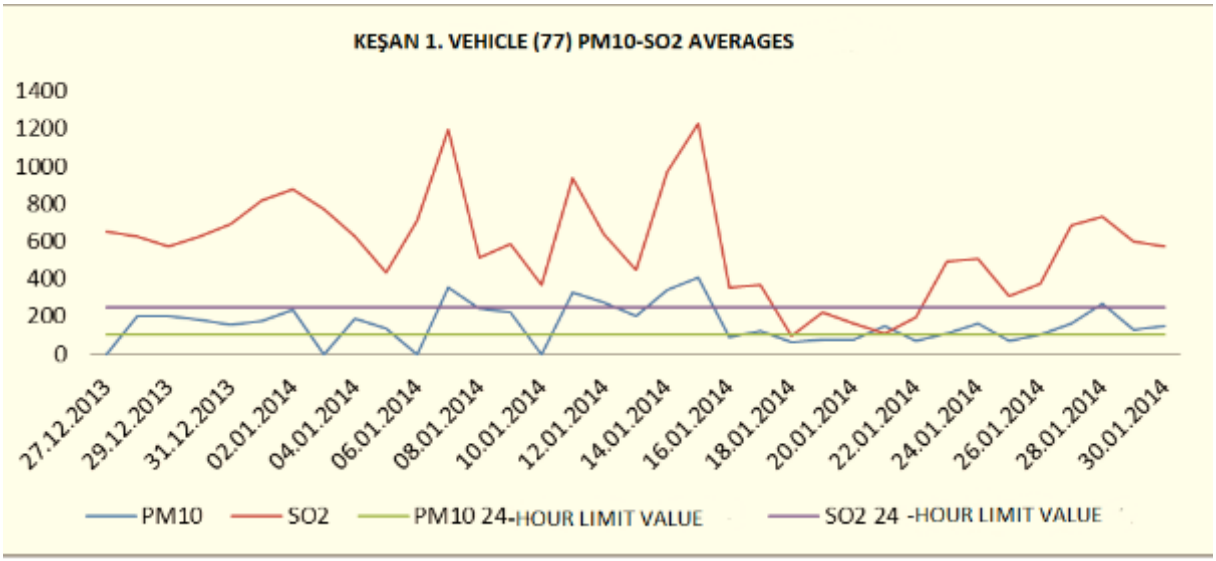


Sample Figure -7: Comparative Graph of Air Quality Monitoring Data and Limit Values – Graph of Marmara Region Data from the National Clean Air Action Plan

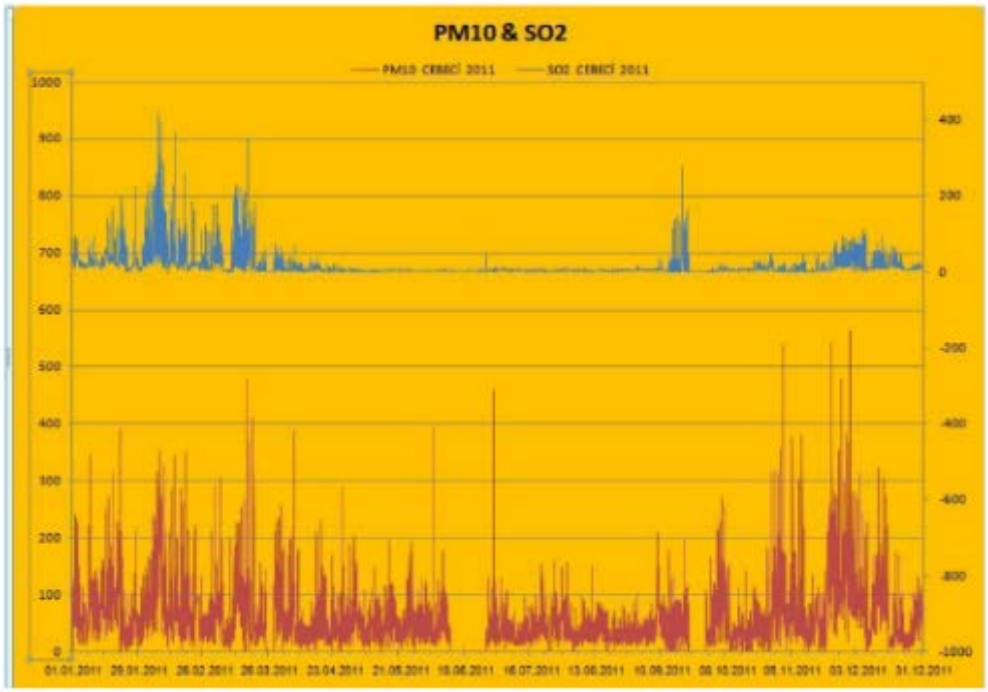
Sample Table-4: Table of Number of Exceedances Assessed by Air Quality Monitoring Data- A Table for Marmara Region from the National Clean Air Action Plan

PROVINCES	2007		2008		2009	
	SO_2	PM_{10}	SO_2	PM_{10}	SO_2	PM_{10}
	Short Term Limit (24-hour)		Short Term Limit (24-hour)		Short Term Limit (24-hour)	
	400 µg/m³	*300 µg/m³*	*400 µg/m³*	*300 µg/m³*	*370 µg/m³*	*260 µg/m³*
Balıkesir	---	√ … times	---	√ … times	---	√… times
Bilecik	---	---	---	---	---	---
Bursa	---	---	---	---	---	√ …times

Çanakkale	√ …times	---	√ … times	---	---	---
Edirne	√ … times	---	---	---	√ … times	√ …times



Sample Figure-8: PM10- SO2 averages on a single graph- A Study by the Ministry of Environment and Urbanization on Air Quality in Edirne-Keşan



Sample Figure -9: PM10- SO2 averages on a single graph - "Improvement of Urban Air Quality Assessment System Project" (KENTAIR Project), Province of Ankara Air Quality Assessment Report

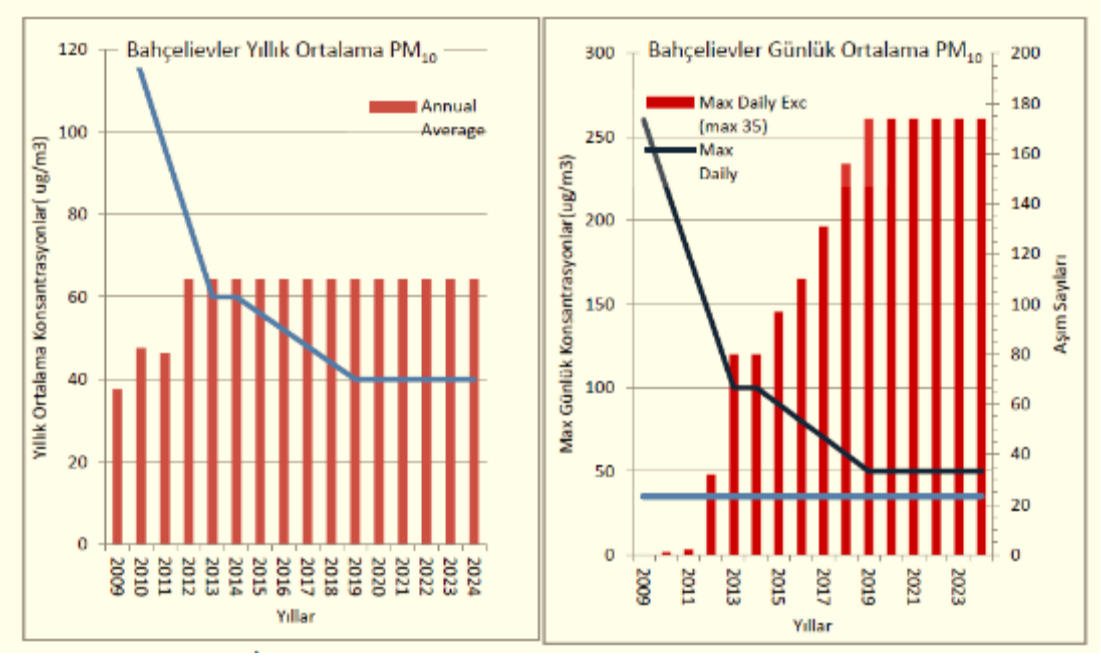
Sample Table-5: Table of Annual Averages of Air Quality Monitoring Data-"Improvement of Urban Air Quality Assessment System Project" (KENTAIR Project), Province of Gaziantep Air Quality Assessment Report

Air Quality Measurement Values Monthly Averages by Years														
		JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	ANNUAL AVERAGE
2007	SO2	103	46	23	6	3	3	3	189	7	10	27	69	41
	PM	149	135	99	67	141	75	70	75	92	138	141	-	107
2008	SO2	-	-	-	-	-	-	-	3	-	-	15	62	27
	PM	-	-	-	-	-	-	-	-	-	-	128	-	128
2009	SO2	61	12	10	9	8	8	8	11	8	11	23	29	17
	PM	-	137	85	68	54	72	46	46	46	113	122	120	83
2010	SO2	30	32	22	6	5	4	3	5	5	5	41	43	17
	PM	124	124	104	48	27	36	25	35	34	67	97	134	71
2011	SO2	42	32	25	4	2	4	4	4	6	7	27	53	18
	PM	143	120	95	96	68	54	66	63	88	112	122	183	101
2012	SO2	19	32	14	3	8	9	5	5	5	8	10	34	13
	PM	130	132	112	85	74	78	77	73	138	164	141	-	109

Sample Table-6: Periodical Averages of Air Quality Monitoring Data-"Improvement Of Urban Air Quality Assessment System Project" (KENTAIR Project) Province of Mersin Air Quality Assessment Report

MEASURED AIR POLLUTION WINTER VALUES MONTHLY AVERAGES BY YEARS (µg/m3)												
YEARS	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		JANUARY	
2007	PM 10	SO2	PM 10	SO2	PM 10	SO2	PM 10	SO2	PM 10	SO2	PM 10	SO2
	98	2	125	5	163	10	-	-	-	-	-	-
2008	PM 10	SO2	PM 10	SO2	PM 10	SO2	PM 10	SO2	PM 10	SO2	PM 10	SO2
	74	1	99	1	116	4	156	23	134	14	112	5
2009	PM 10	SO2	PM 10	SO2	PM 10	SO2	PM 10	SO2	PM 10	SO2	PM 10	SO2
	72	16	53	8	56	17	108	4	125	2	109	1
2010	PM 10	SO2	PM 10	SO2	PM 10	SO2	PM 10	SO2	PM 10	SO2	PM 10	SO2
	76	13	50	2	56	4	62	20	98	14	91	17
2011	PM 10	SO2	PM 10	SO2	PM 10	SO2	PM 10	SO2	PM 10	SO2	PM 10	SO2
	46	4	46	11	62	4	63	24	63	13	45	7
2012	PM 10	SO2	PM 10	SO2	PM 10	SO2	PM 10	SO2	PM 10	SO2	PM 10	SO2
	57	1	51	2	53	4	47	2	54	1	52	0

Bahçelievler Annual Average PM10	Bahçelievler Daily Average PM10



Sample Figure -10: Sample graph of station data. "Improvement of Urban Air Quality Assessment System Project" (KENTAIR Project), Province of Ankara Air Quality Assessment Report

- Reliability and quality check of monitoring values
  This section will provide information on who has made the reliability/quality check for the monitoring values and how..

2.1.2. Future Estimations

This section will compare the measurement data with the reduced limit values with the help of graphs and tables by assuming that the average measurement of the current year will be the same in the following years, and make estimations on air quality for the coming years when the plan is in effect.

Sample Table-7: SO2 Exceedance Risk Scenario for the term 2010-2014 in the light of the Short Term Limits (24-hours) data of 2009- A Table for Marmara Region from the National Clean Air Action Plan

PROVINCES	Years and Limit Values				
	2010	**2011**	**2012**	**2013**	**EU Limit Values**
	340 $\mu g/m^3$	310 $\mu g/m^3$	280 $\mu g/m^3$	250 $\mu g/m^3$	125 $\mu g/m^3$
Balıkesir	---	---	---	---	---
Bilecik	---	---	---	---	√

Bursa	√	√	√	√	√
Çanakkale	√	√	√	√	√
Edirne	√	√	√	√	√

Note: ---: No Exceedance √: Exceedance

2.2.Information on Air Quality Limit Values Exceedance

2.2.1. Place of Pollution Exceedance (KAY)

- Definition of urban, industrial, and rural types
- Display of province and KAY on the map
- Measurement station *(map, geographıc coordinates)*
- Polluted area *(km^2)* and estimated population exposed to the pollution
- Available climate data
- Relevant topographical data
- Informatıon on the type of goals to be protected within KAY
- Detailed information on exceedance

This section will comment on the information about the region represented by the station where the exceedance is observed and about the pollutant that is subject to the exceedance.

2.3.Sources of Pollution and their Evaluation

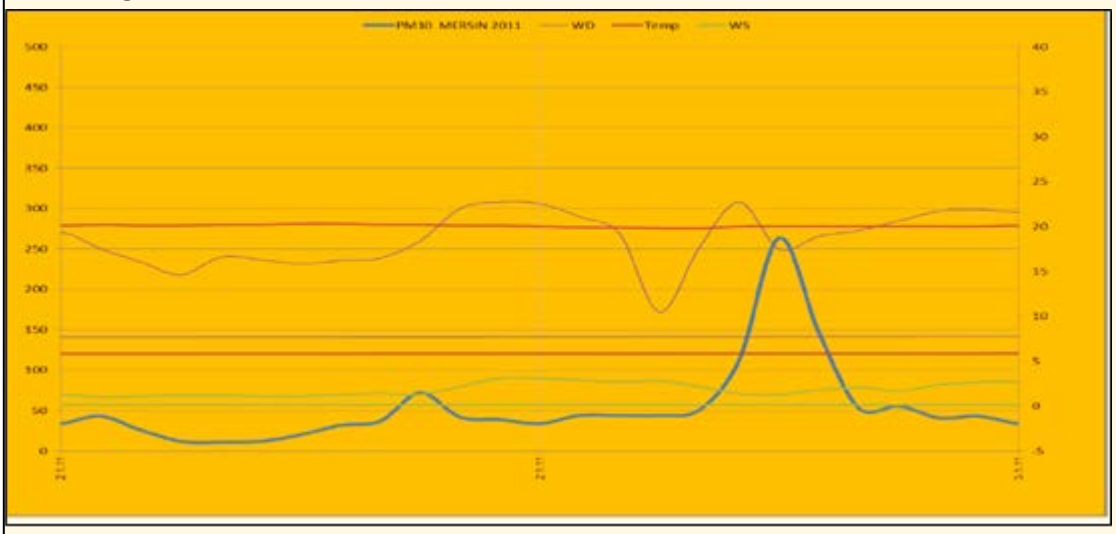
- Graphical evaluation of rapid increases in the sources of pollution (if any), episodes, and explanations
- Identification of causes of pollution
- Information on the spread/transfer of the pollution in the light of meteorological variables
- Methods of evaluation (excel, software, Hysplit Program, WRF Model, Dream Model, etc.)

This section will also include an evaluation of the periods when the air quality measurement values are at the peak point and their sources.

IDENTIFICATION OF THE PARTICULAR POLLUTION INCIDENTS AND THEIR AMOUNTS

a) Evaluation of the January 2011 data and Explanations

Figure 8. Evaluation of the Peak Data on PM10 in 02-03/01/2011

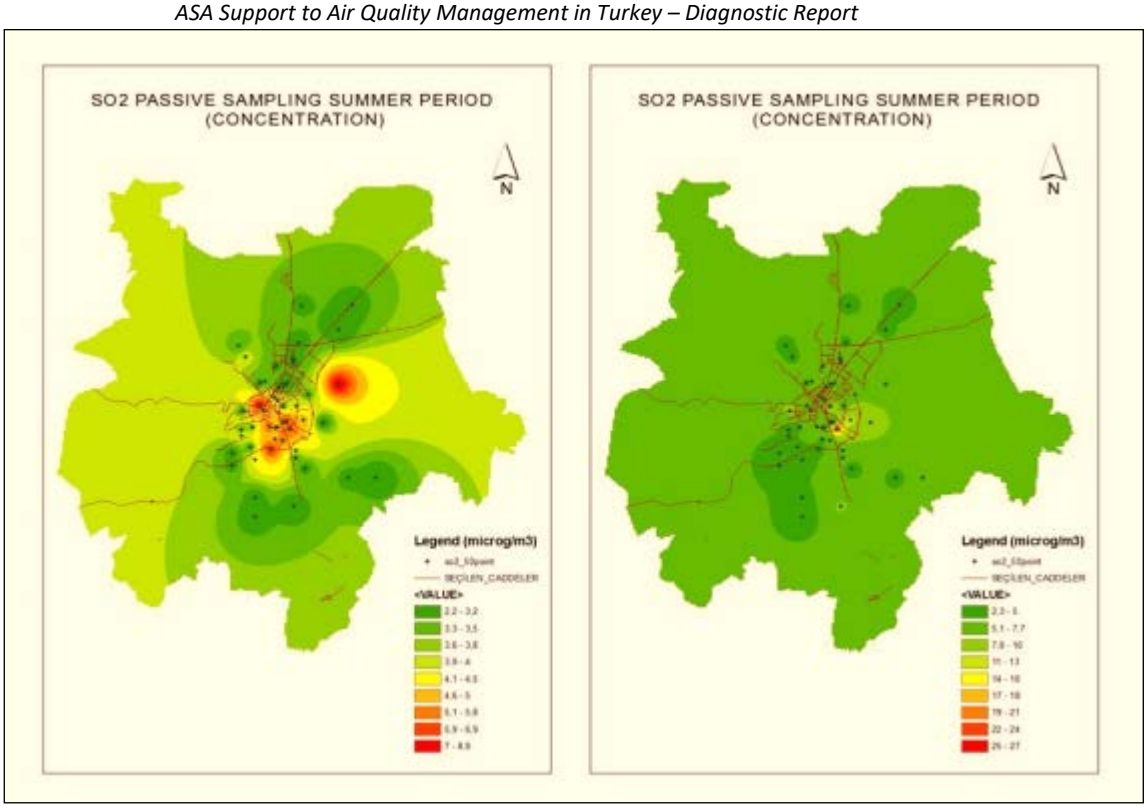


The PM10 spike that was found to have started between the dates 02/01 and 03/01/2011 at 4pm to have reached its peak point at 6pm and then to have started deacreasing took place when the traffic volume is large, therefore led us conclude that it was caused by the traffic. Moreover, wind speed had increased between 10am and 4pm when the traffic was not dense and it was observed that PM10 concentrations decreased accordingly.

Sample Figure -11: Description of pollution exceedance- "Improvement of Urban Air Quality Assessment System Project" (KENTAIR Project), Province of Mersin Air Quality Assessment Report

2.4.Air Quality Indicator Measurements *(if any passive sampling study exists)*

This section will provide information and comment on who did the indicator measurements within the province as well as the goal, date, amount (in tubes), location, and results of the measurement.



Sample Figure -12: Passive sampling study- Improving Air Quality Management in Metropolitan Cities (IKONAIR), Konya Clean Air Program Report

*2.5.*Emission Inventory

This section will provide the calculated total emissions for each pollutant with the help of inventory guide prepared by the Ministry as per the emission inventory preparation schedule stated in the Appendix IV to the Circular no. 2013/37. The calculations will be presented in the form of tables, figures, and graphs.

Moreover if there is any inventory study in the province outside the schedule, this section will be written down according to the existing study.

2.5.1. Sub-titles according to the source of pollution

2.5.1.1. Industry

- Data Providers *(who, which institutions, special notes)*
- Emission factor selection *(to be published by the Ministry with inventory guide)*
- Particular information about the sources *(coordinates, altitude, thermal content. etc.)* More detailed information
- Sub-total of emissions by sectors *(PM_{10}, SO_2, NO_x)*
- Gridding with 1x1 km resolution *(xy coordinated, processed data, vs.) Spatial distribution of sub-totals with Geographical Information Systems*

This section will provide explanation on the details of the calculation of the industry-based emissions and present the results with a table.

Standard grids will be published by the Ministry for all provinces.

Grids and coordinates of the industrial facilities will be overlapped and industrial emissions will be assigned to the grids.

2.5.1.2. Domestic Heating

- Data Providers *(who, which institutions, special notes)*
- Sub-categories of identified fuels *(natural gas, coals, and other fuels)*
- Emission factor selection *(to be published by the Ministry with inventory guide)*
- Particular information about the sources *(coordinates, altitude, thermal content. etc.)* More detailed information
- Sub-total of emissions *(PM_{10}, SO_2, NO_x)*

This section will discuss the details of the calculations of the domestic emissions. The results will be presented with a table.

Standard grids will be published by the Ministry for all provinces.

Grids and building and fuel type/population data will be overlapped and domestic emissions will be assigned to the grids.

NOx EMISSIONS DUE TO COAL USE
RESIDENCES INDIVIDUAL HEATED WITH IMPORTED COAL • Total Amount of Fuel Use = 95,106,00 kg/year • Emission Factor to be Used = 2.7885 g/kg • Annual Total Emission of NOx = 95,106,00 kg/year x 2.7885 g/kg
TOTAL= 265,203,08 kg NOx/year
RESIDENCES COLLECTIVELY HEATED WITH IMPORTED COAL • Total Amount of Fuel Use=3,885,000 kg/year • Emission Factor to be Used= 2,7885 g/kg • Annual Total Emission of NOx = 3,885,000 kg/year x 2,7885 g/kg
TOTAL = 10,833,32 kg NOx/year
RESIDENCES HEATED WITH LOCAL COAL • Total Amount of Fuel Use=24,898,500 kg/year • Emission Factor to be Used = 1,8304 g/kg • Annual Total Emission of NOx = 24,898,500 kg/year x 1,8304 g/kg
TOTAL = 45,574,21 kg NOx/ year

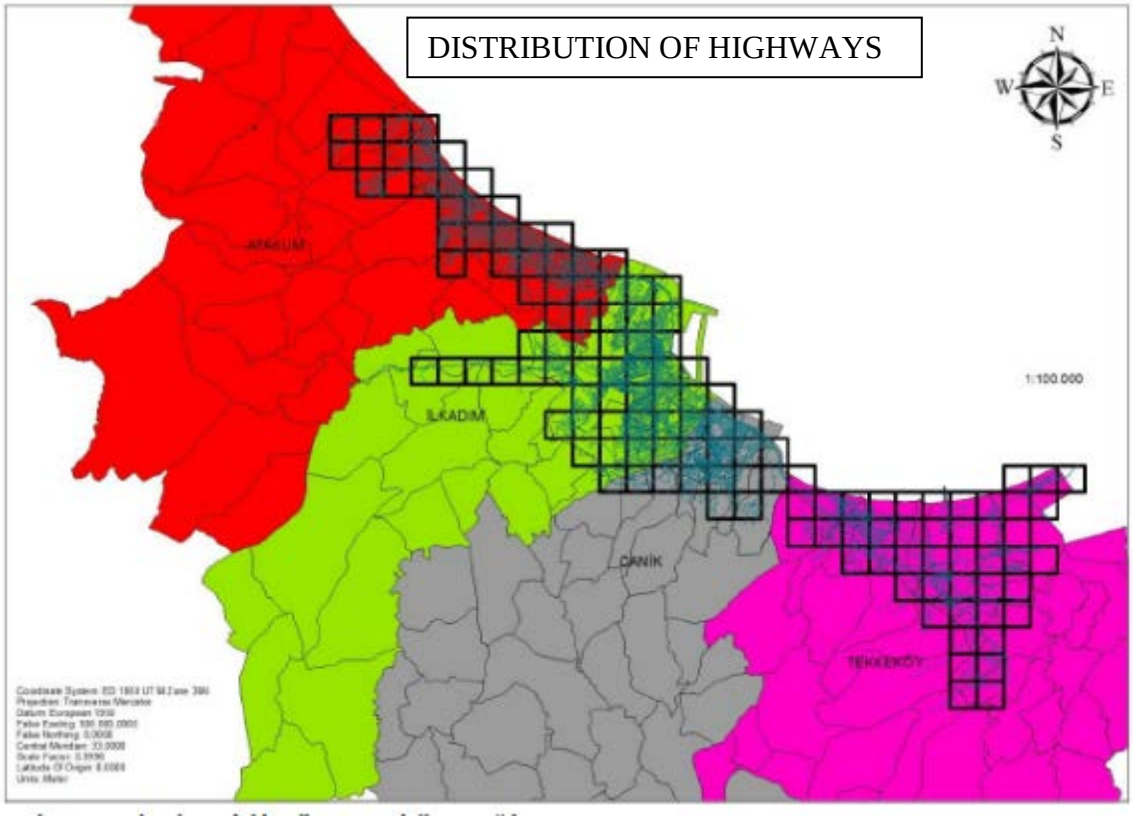
Sample Figure -13: Sample inventory calculation- "Improvement of Urban Air Quality Assessment System Project" (KENTAIR Project), Province of Adana Air Quality Assessment Report

2.5.1.3 Highway Transportation

- Data Providers *(who, which institutions, special notes)*
- Emission factor selection *(to be published by the Ministry with inventory guide)*

- Particular information about the sources *(coordinates, altitude, thermal content. etc.)* More detailed information
- Sub-total of emissions by sectors *(PM_{10}, SO_2, NO_x)*
- Gridding *(xy coordinated, processed data, vs.) Spatial distribution of sub-totals with Geographical Information Systems*

This section will discuss the details of the calculations of the highway-based emissions. The results will be presented with a table.
Standard grids will be published by the Ministry for all provinces.
Grids and highway network data will be overlapped according to the number, length, and type of routes and traffic emissions will be assigned to the grids.

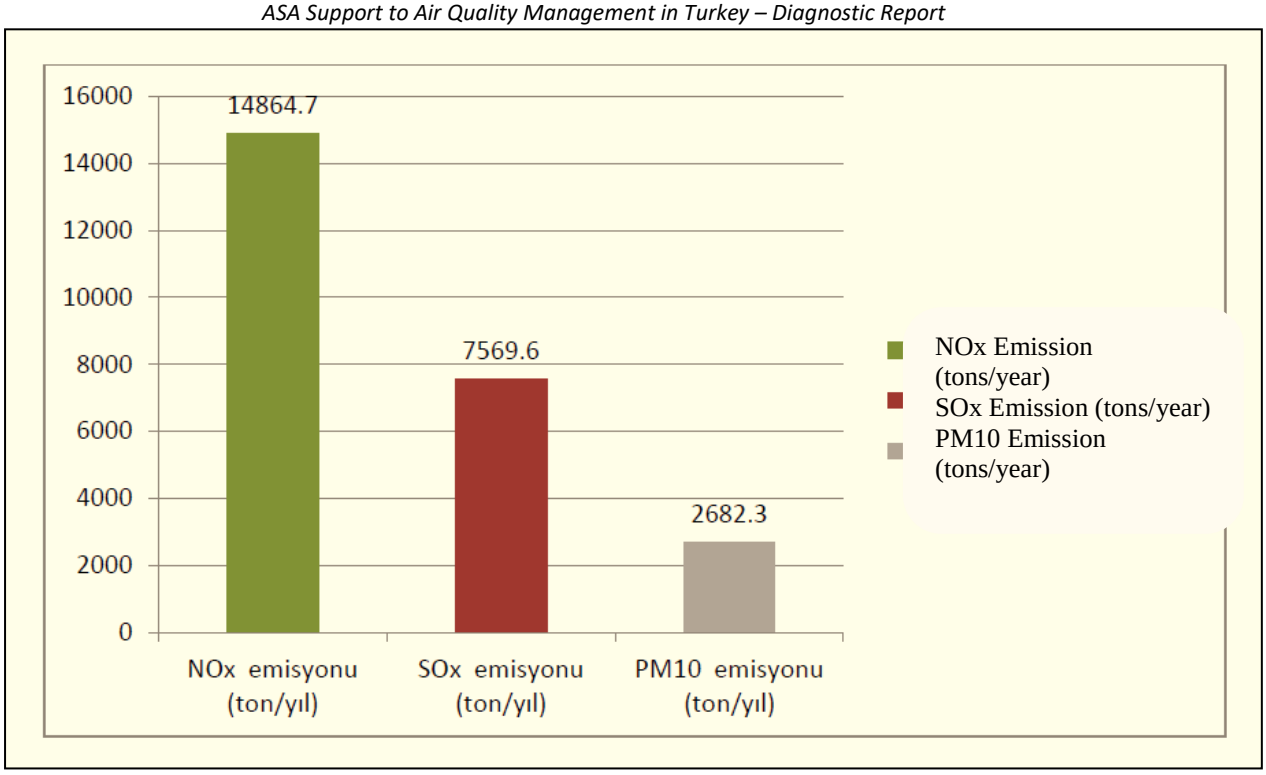


Sample Figure -14: Sample Grid mapping of Highway Network- "Improvement of Urban Air Quality Assessment System Project" (KENTAIR Project), Province of Samsun Air Quality Assessment Report

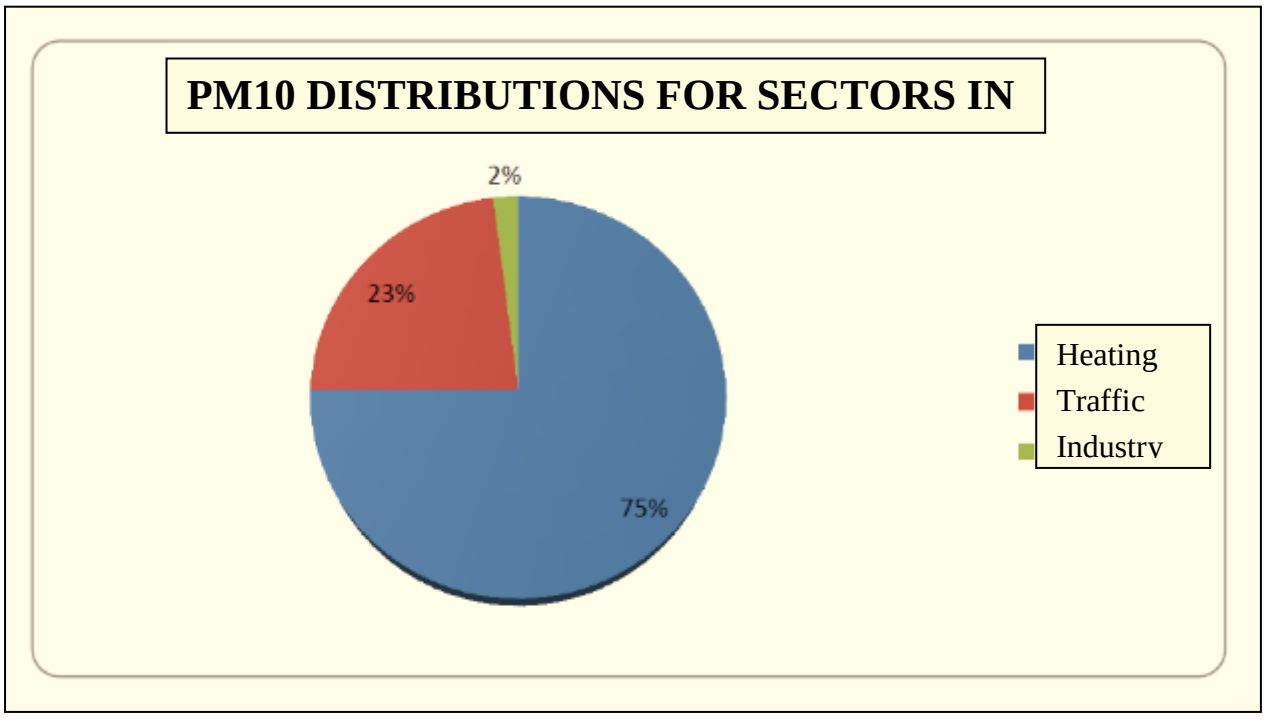
2.6.Evaluation of the emission inventory

- List of main emission sources causing pollution *(map)*
- Total amount of emissions from these sources *(tons/year and rates in percentages)*

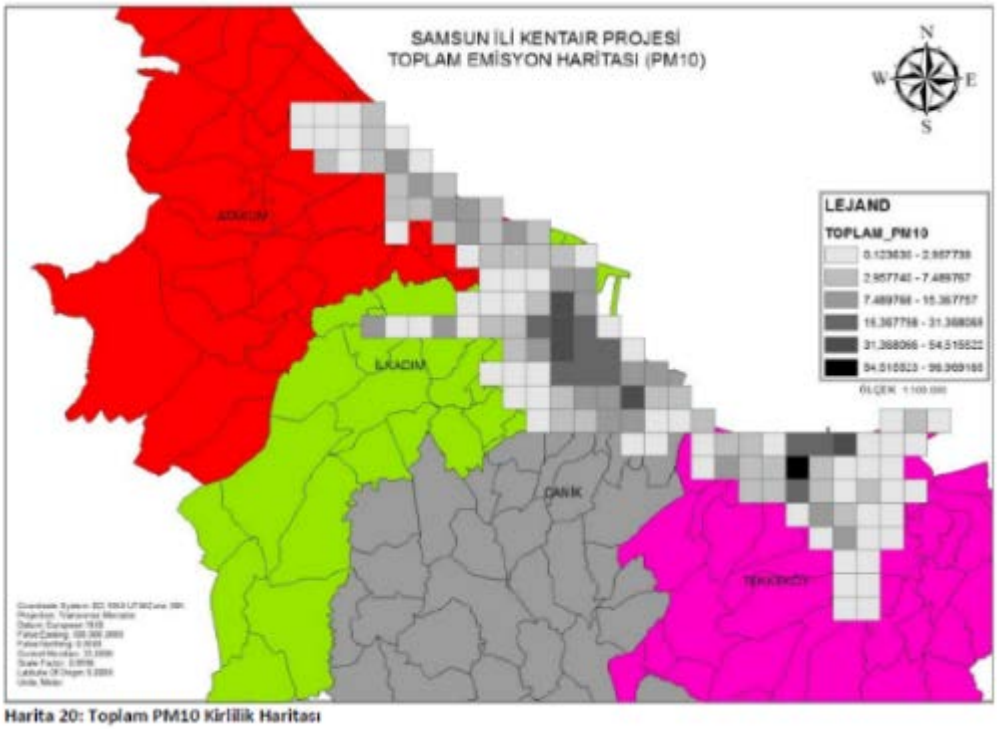
This section will provide emission maps for polluting parameters and sectors as well as tables and graphs for total emissions. A general evaluation will be made in the light of the conditions specific to the province.



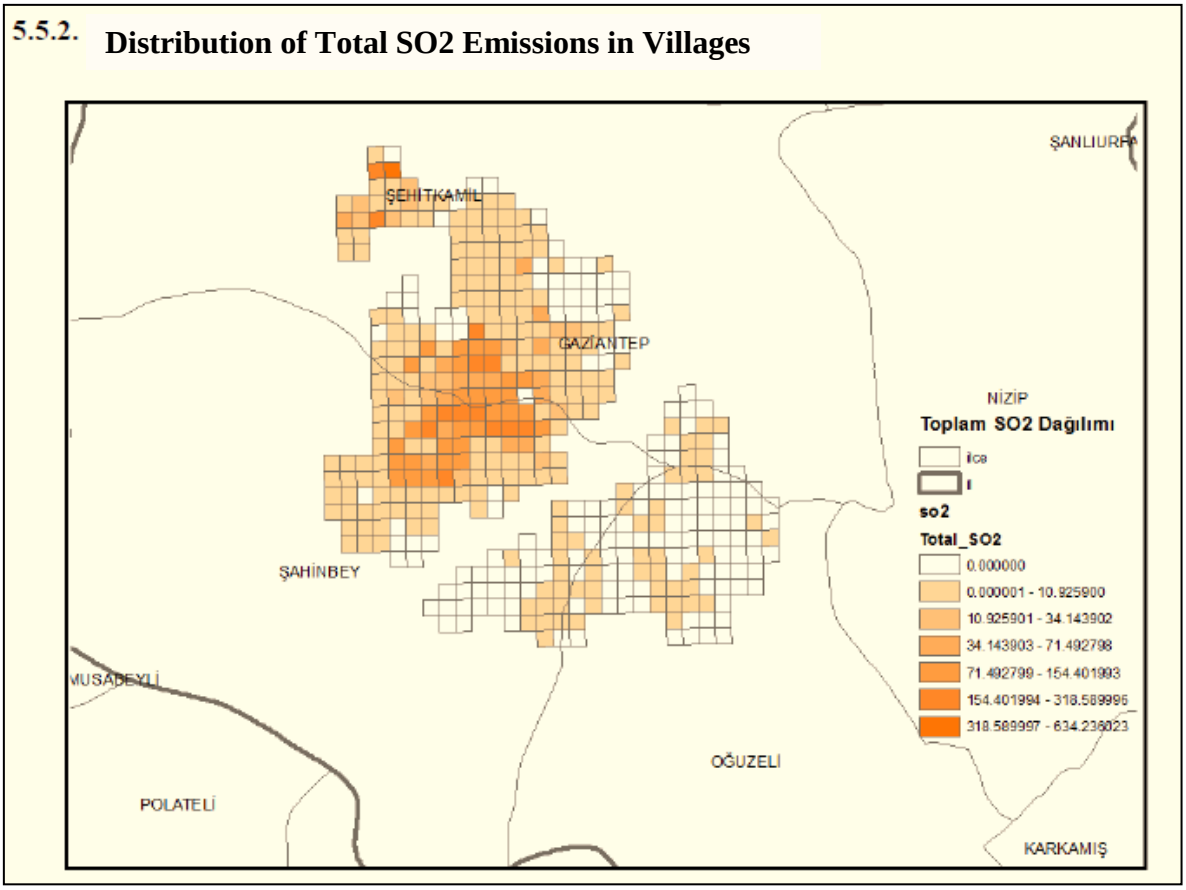
Sample Figure -15: Table of Total Emission- "Improvement of Urban Air Quality Assessment System Project" (KENTAIR Project), Province of Adana Air Quality Assessment Report



Sample Figure -16: Graph of Sectoral Distribution of Emissions- "Improvement of Urban Air Quality Assessment System Project" (KENTAIR Project), Province of Erzurum Air Quality Assessment Report



Sample Figure -17: Map of Total Emission- "Improvement of Urban Air Quality Assessment System Project" (KENTAIR Project), Province of Samsun Air Quality Assessment Report



Sample Figure -18: Sample Map of Total Emissions according to-"Improvement of Urban Air Quality Assessment System Project" (KENTAIR Project), Province of Gaziantep Air Quality Assessment Report

2.7. Modelling- Air Pollution Distribution Map (*if any study on the model of air pollution distribution exists in the province)*

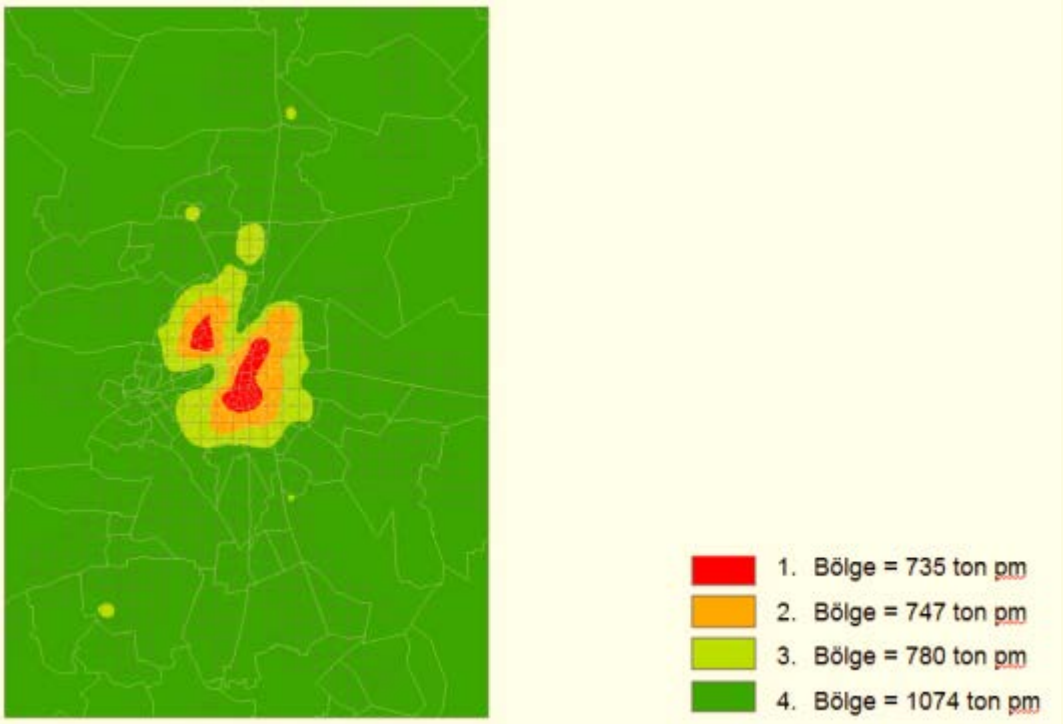
Obtained emission maps will be used in the studies on air quality modeling studies. A map will be made to show the air pollution for the selected episodes. Because this section is complimentary to the air quality management, it has an important place in the clean air action plans.

Thus, it is deemed useful to take support of the institutions and organizations working in the air quality modeling field if possible while completing the section.

Moreover, detection of the impacts by running the scenarios in which the measurements will be taken within the clean air action plan with the modeling program will also have a complementary role.

Sample Figure -19: Air Quality Modelling Output- Improving Air Quality Management in Metropolitan Cities (IKONAIR), Province of Konya Clean Air Program Report

SCENARIOS
The development of scenarios is a repetitive process. The first scenario studies made within the project was modified in the light of the information acquired and evaluations made and six scenarios were studied by taking account the precautions mentioned above and by taking the goal of decreasing PM10 pollution to the core.
SCENARIO A: Autonomous Development- No Precautions are taken
SCENARIO B: Traffic +Industrial Precautions are taken
SCENARIO C: Domestic heating and Industrial precautions are taken
SCENARIO D: Maximum scenario – Traffic + Industry + Domestic Heating
All Precautions are taken
SCENATIO E: Industrial + Domestic Heating Precautions are taken
Thermo-insulation is made
SCENARIO F: Stopping coal use in Industry and Domestic Heating

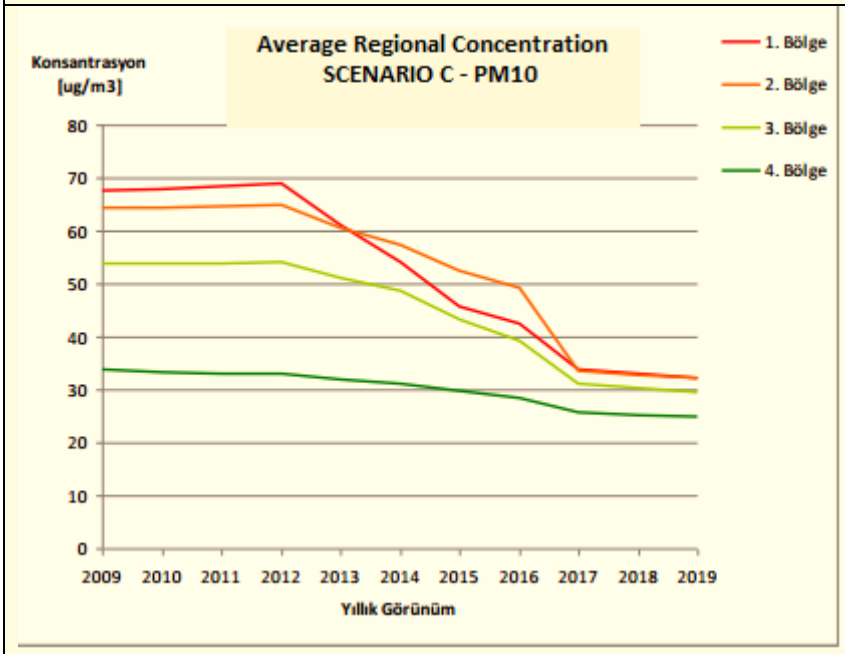


Regions where the scenarios are to be assessed within the provincial limits of Konya

Sample Figure -20: Scenario Analysis of Actions- Improving Air Quality Management in Metropolitan Cities (IKONAIR), Province of Konya Air Quality Program Report

SCENARIO C – PM_{10}

DOMESTIC HEATING AND INDUSTRIAL PRECAUTIONS ARE TAKEN



Assessment: The precautions taken since 2012 are resulted in decrease in all regions in time. By 2019, PM10 concentrations in all regions are reduced below 35 ug/m3 and the most of the population are exposed to a PM10 concentration below 30 ug/m3.

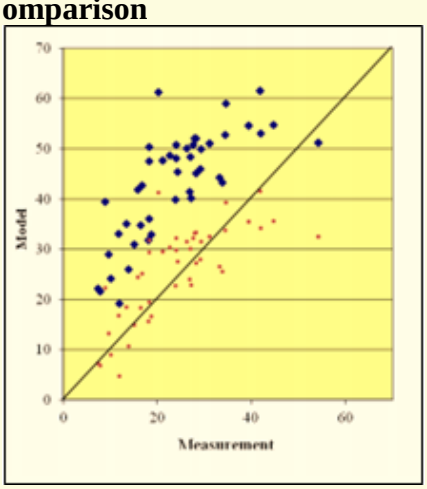
Current State

Sample Figure -21: Results of Scenario Analysis of Actions- Improving Air Quality Management In Metropolitan Cities (IKONAIR), Province of Konya Air Quality Program Report

2.8. Comment on the Evaluation of the Outputs of the Monitoring Data Assessment and the Air Quality Modeling Results/ Emission Inventory

This section will be expected to evaluate the results of the air quality model studies (if any) and the outputs of the monitoring data from air quality measurement station. It will touch upon the obscurity of the comparison between inventory studies/measurements and the results of the measurements and modeling in the same coordinates.
If there is no air quality modeling study, it will assess the outputs of the monitoring data from the air quality measurement station and the emission inventory together. Without any intention to establish a direct relation, pollution indicators should be interpreted.

Model-Measurement Comparison



Comparison of NO_2 concentrations calculated in the model with special measurement. Original data (large blue dots) and corrected data (small orange dots)
Beside the measurement data, the results of the model calculation was acquired as well for NO_2. The comparison demonstrates that the data are obscure. The Figure 15 also shows the obscurity.
The measured concentrations are calculated with the model to be below 12 ug/m3 during the special measurement study. A correction factor of 1.15 was used. The cause of the obscurity might be the proximity of the traffic emission and underestimations of the emissions. Because the model results are higher than the measured values, there is no background level observed. The obscurity is to be eliminate in the future while assessing the limit values. More research is required.

Sample Figure -22: Assessment of model-measurement- Improving Air Quality Management in Metropolitan Cities (IKONAIR), Province of Konya Air Quality Program Report

3. PRECAUTIONS TO BE TAKEN

3.1.Authorities in Charge

- Names and contact information of those who are in charge of development and implementation of clean air action plans.

  This section will include a table of names and contact information of those who contributed to the preparation of the clean air action plan and who might be contacted when needed. Moreover, the institutions and organizations in charge of the implementation of the clean air action plan and the precautions mentioned in the plan will be noted in detail.

3.2.Analysis of State of Affairs

- Details of elements causing exceedance *(transportation, cross-border transportation, formation)*
- Details of possible precautions for air quality improvement

This section will summarize the current situation that is evaluated in detail under Section 2 with regard to the emission inventory and it will relate it to the precautions for air quality improvement.

3.3.Details of Current Improvement Projects or Precautions

- Local, regional, national, and international precautions
- Observed impacts of the precautions

This section will discuss in detail the precautions and improvement projects implemented before the clean air action plans. The positive and negative impacts of these projects on air quality will also be mentioned.

3.4.Details of the projects or precautions to be implemented to reduce pollution *(under the titles of industry, domestic heating and traffic)*

- Lists of all designated precautions and their explanations
- Priorities for reducing precautions
- Time schedule/calendar for implementation
- Estimated required time for reaching the goals and estimated improvement in the air quality

This section will explain in detail the precautions and improvement projects within the period of clean air action plan. The expected results of the studies on the air quality will also be evaluated. If there is any precautions going on since the period before the clean air action plan started, their impacts will also be mentioned with their percentages transferred to the project (for instance projects of transition to natural gas, movement of industrial sites etc.)

No	Action Field	Specific Actions	Goals	Motive	Schedule	Impact on Air Quality	Est. Cost	Impact Indicators	Authority in charge/ Coordinator	Relevant Institution	Side benefits	Approvals	Data Quality (A, B, or C)	Critical Factors	Required Research	Additional Info
EI 1	Domestic Heating	Thermo-insulation of collectively coal heated buildings	Decrease in fuel consumption by 50%	Reduce of PM emissions by 4%, SO2 by 2%, NOx by 0.2%	2009-2017	Decrease in PM10, SO2, NOx concentrations is expected	High	Fuel bills	Municipality of Konya	Municipalities of Villages MEUP Sector Representatives	Economic benefits Comfort	Will of people	B	Decision-making High cost	Number of uninsulated buildings Search for sponsors	15-25TL/m2 cost
EI2	Domestic Heating	Thermo-insulation of individually coal heated buildings	Decrease in fuel consumption by 50%	Reduce of PM emissions by 28%, SO2 by 17%, NOx by 0.5%	2013-2019 and 20% each year	Decrease in PM10, SO2, NOx concentrations is expected	High	Fuel bills	Municipality of Konya	Municipalities of Villages MEUP Sector Representatives	Economic benefits Comfort	Will of people	B	Decision-making High cost	Number of uninsulated buildings Search for sponsors	15-25TL/m2 cost

Sample Figure -23: A table of short definition of actions - Improving Air Quality Management in Metropolitan Cities (IKONAIR), Province of Konya Air Quality Program Report

3.5.Details of Projects of Precautions Studied or Planned for the Long Term Future

This section will mention in detail the precautions and improvement projects to be implemented during a future period partially within or outside the clean air action plan. Long term strategical plans should be taken into consideration. (Development Plan, Climate Change Action Plan, Transportation Master Plan, etc.)

INDUSTRIAL FACILITIES (LONG TERM)

Source	Description of precaution	Implementation Date	Emission Decrease	Authority in Charge
Industry 1	Meetings to raise environmental awareness among kids in primary school	2013-2023		Bursa Provincial Directorate of Environment and Urbanization
Industry 5	Ensuring that all facilities in Appendix 1 and 2 of the Regulation on Permissions and Licenses required per the Environment Law use the best techniques about facility technology and emission reduce.	2013-2018	Decrease in PM, NOX, CO, CO2, SO2 emissions	
Industry 6	NOx according to total emission values in textile facilities			Bursa Provincial Directorate of Environment and Urbanization

Sample Figure -24: Table for long term actions- Institution Building on Air Quality in the Marmara Region Project Output, Province of Bursa Clean Air Action Plan Draft

4. PROBLEMS AND POSSIBLE SOLUTIONS

4.1.What should be done to improve monitoring (data, receiving data, etc.)

This section will provide recommendations deemed necessary for air quality monitoring data. An evaluation of the location of the monitoring station and data receiving rates will also be added.

4.2.What should be done to increase emission data collection rates?

This section will include the actions to be taken to reduce the obscurity of the data essential to the preparation of the emission inventory and to increase the calculation levels.

4.3.What should be done to map the air pollution distribution and to run the air quality models?

This section will provide recommendations on the problems encountered during the mapping process that use emission inventory and the air quality modelling.

*4.4.*What should be done to improve Clean Air Action Plans?

This section will discuss how to improve clean air action plans and evaluate them objectively.

4.5. Other Expectations

5. RESOURCES

- Publications, documents, academic researches, websites, electronic documents, and etc. used to support the requested information.

REFERENCES

ToDoLV0.1D29.02.2012 CN Bursa Provincial Directorate
Bursa Provincial Directorate and Municipality will document all the parts of the Clean Air Plan. Documentation should be transparent and accessible by stakeholders and public.

Dr. Brenner Ingenieurgesellschaft mnH (2011) Großstadtgemeinde BURSA. Master Plan für Transport und Verkehr. Bericht 2B: Status Quo Analyse. Band 1: Text. Aalen.

European Commission (2011O): Commission Staff Working Document which provides guides for the detection of impacts of the particles hanging in the air after road sanding and salting in the winter as per the Directive 2008/50/EC on cleaner air and outside air quality for Europe. SEC (2011) 207 final

TUİK – Turkish Statistics Institution (2011): Statistics on motor land vehicles. (Motor Vehicles Statistics 2010). Ankara

WGI- Working Group on Implementation established by European Commission Directorate General of Environment Unit C1 "Air, Noise and Transportation" (2003): Recommendations on plans and programs to be designed as per Framework Directive on Air Quality 96/62/EC. Draft version modified during the approval period.

LfULG- Landesamt für Umwelt. Landwirtschaft und Geologie (2011). Leitfaden Luftreinhaltepläne in Sachsen. Schriftenreihe. Heft 30/2011

Ministry of Environment and Urbanization Directorate General of Environmental Management (2011) Clean Air Action Plan.

Sample Figure -25: Resources used for Clean Air Action Plan- Institution Building on Air Quality in the Marmara Region Project Output, Province of Bursa Clean Air Action Plan Draft

Because the air management policies are determined in the light of scientific data and methods, it is deemed useful to receive the support of the universities in the provinces during the preparation process of the all stages of the clean air action plan.

ANNEX F. SELECTION CRITERIA FOR PILOT PROVINCE

As described in the Inception Report for the Diagnostic study, a set of criteria was developed to select a pilot city. Selection criteria for the pilot city are as follows:

- A non-compliant city for which air quality monitoring data shows persistent exceedances of limit values for the last couple of years;
- Have a recently prepared CAAP;
- Expected significant room for improvement in ambient air quality;
- Large population can be addressed with AQ related health issues; and
- Part of the CITYAIR project (please see following paragraphs for more information on this project) suggesting mutual benefits.

It is considered that selected province should have a complete emissions inventory, AQ measurement data and a good CAAP. However, the sources of emissions, related AQ projects and measures being implemented may need to be further studied. A current project namely "Technical Assistance for Improving Air Quality and Raising Public Awareness in Cities in Turkey (in line with CAFE Directive)" (CITYAIR) has similar objectives as this WB AS project. CITYAIR project aims to support Turkey in its efforts to improve the ambient air quality in cities. This Project will help further develop air emissions management and the technical capacity for clean air action planning and modelling of air pollution in selected cities, regions and provinces. Therefore, it is considered to select a pilot city that is also being studied under CITYAIR project so as to provide mutual benefits.

As a result of this selection process KAYSERI was selected as pilot city in consultation with the MoEU.

Following benefits are expected though linking the EU CITYAIR and the WB LAQM projects via selected city are as follows:

- The CITYAIR Project will undertake the preparation of a first evaluation of the existing monitoring and inventory data in 2017 for the province of KAYSERI, which is among the 31 cities to be covered by the CITYAIR Project. Follow-up activities include issues of inventory improvement, air pollution management, modelling input/output and CAAP updates.
- The World Bank project initiated with the MoEU, will carry out a comparative analysis of the existing CAAP of KAYSERI. Results of the above undertaking will be fed into the WB Project thus help diagnosing persisting non-compliance. The diagnosis will cover an assessment of the CAAP against good practice including recommendations on actions to be implemented so that the province reaches compliance in the near future.

ANNEX G. ANALYSES OF AMBIENT AIR QUALITY MONITORING DATA RECORDED AT KAYSERI

Indicative assessment of pollution trends

Accurate assessment of the reasons behind observed pollution reduction trends needs detailed analyses including emission inventory, dispersion modeling, source apportionment, etc. to be done. Such analyses were not available during preparation of this diagnostic report. Information, however, was provided by the local authorities regarding completed and on-going mitigation actions aiming at reducing air pollution. Those actions are provided below together with pollution trends as an indicative assessment.

Starting from the year 2016, a decreasing trend at OIZ station (i.e., industrial station) was observed, which coincides with an increased number of environmental inspections held by the Provincial Directorate of MoEU starting from these dates. Number of environmental permits received by industrial facilities on air emissions significantly increased (more than 3 to 4 times) after the year 2015. This might partly explain observed decrease in pollution concentrations recorded at OIZ station. Although a detailed assessment is needed, the decrease in industrial emissions shows the **significance of inspection and legal enforcement in reducing industrial emissions at Kayseri.** Yet, more needs to be done to decrease industrial emissions as ambient PM_{10} concentrations recorded at OIZ station are still above limit values.

PM_{10} concentrations showed a slightly decreasing trend at Melikgazi station (i.e., residential heating station) starting from the year 2016. This decreasing trend coincides with the introduction of natural gas in the province as a result of a rigorous campaign held in 2014-2015. As a result, share of natural gas use for residential heating reached 55% of total fuel use for residential heating. Solid fuels account for about 45% of fuel used for residential heating during the same period, which is still significant. Therefore, inspections of solid fuel use were increased. Solid fuel quality standards were introduced since 2006 and only high-quality coal (defined by the national legislation) are allowed to be used for residential heating in Kayseri. However, inspection of coal suppliers including analyses of coal samples taken from the suppliers were increased after 2015. Introduction of natural gas for residential heating and increased inspections of coal suppliers might have some impact in slight decrease in ambient concentrations, but pollution levels recorded at residential heating station are still much higher than limit values. Detailed studies are recommended to be performed to identify and assess emission sources influencing Melikgazi station, including but not limited to traffic, construction works, small and medium size industrial emissions, crustal dust, long-range transported emissions, etc. in addition to residential heating sources.

A decreasing PM_{10} concentration trend is observed at Hürriyet station (i.e., traffic station) after the year 2016 (see Figure 9). Several mitigation measures were introduced in Kayseri to cope with traffic emissions. Such measures include but not limited to introduction of a 33.7 km rail system for public transport; purchase of 372 new Euro5 and 6 buses, 253 CNG buses, and 6 electric buses for public transport; green light wave and dynamic junction systems; bicycle paths and bike share system[46]. Among others, introduction of rail system line for public transport in vicinity of Hürriyet station might have an influence on observed pollution reduction at the station starting from the year 2017.

[46] Kayseri Municipality presentation during May 3rd 2019 stakeholder workshop.

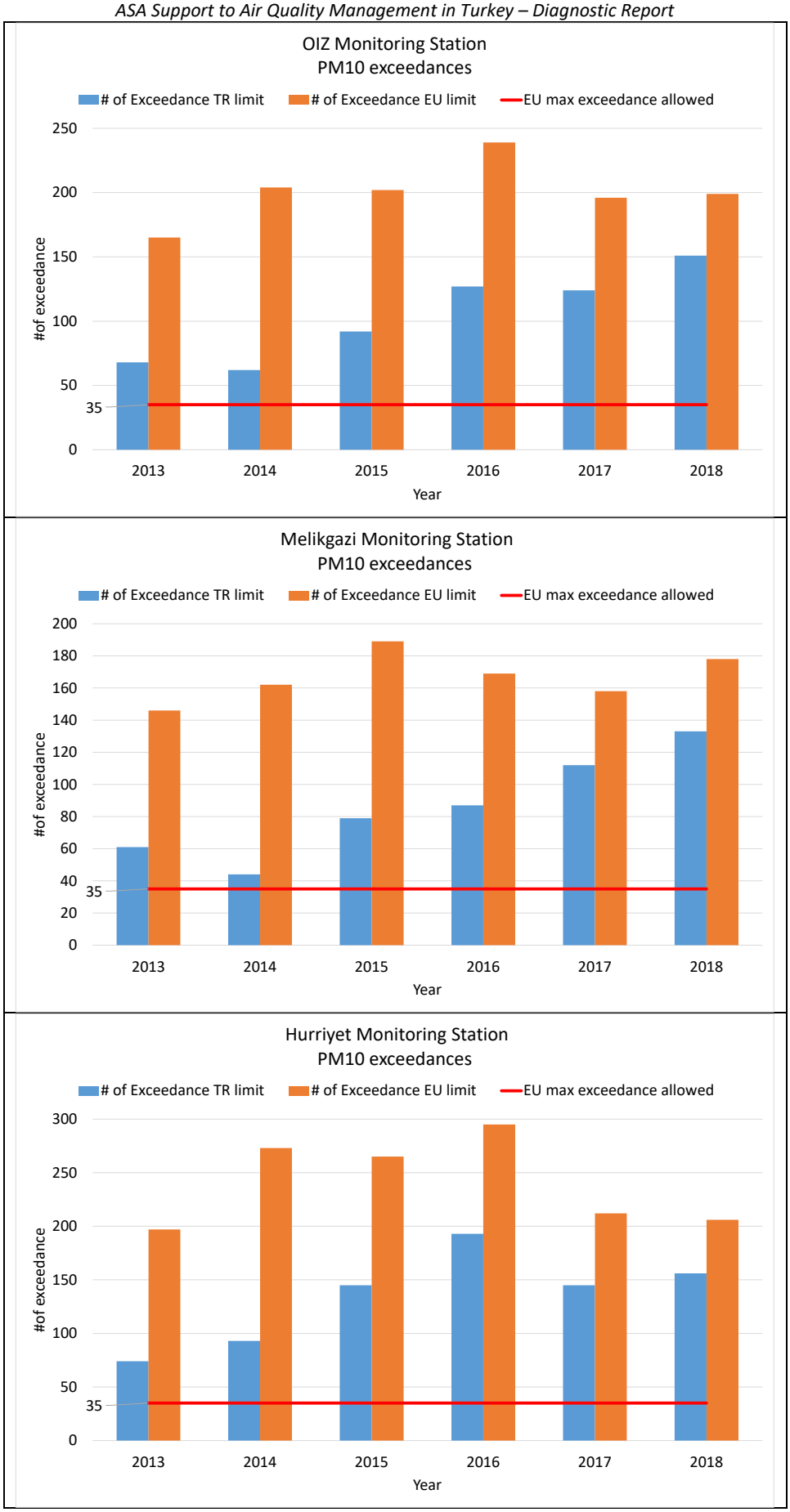
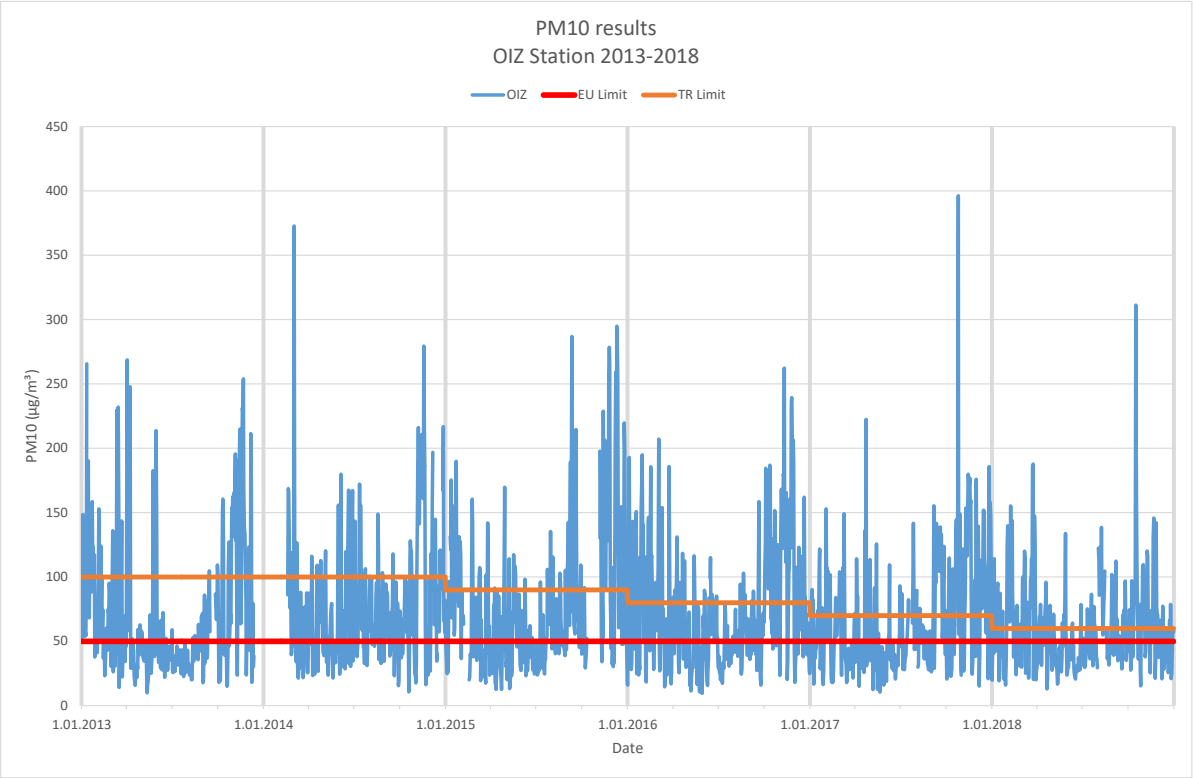


Figure 12 Number of exceedances of daily average PM_{10} concentrations recorded at OIZ, Melikgazi and Hürriyet stations (2013-2018)

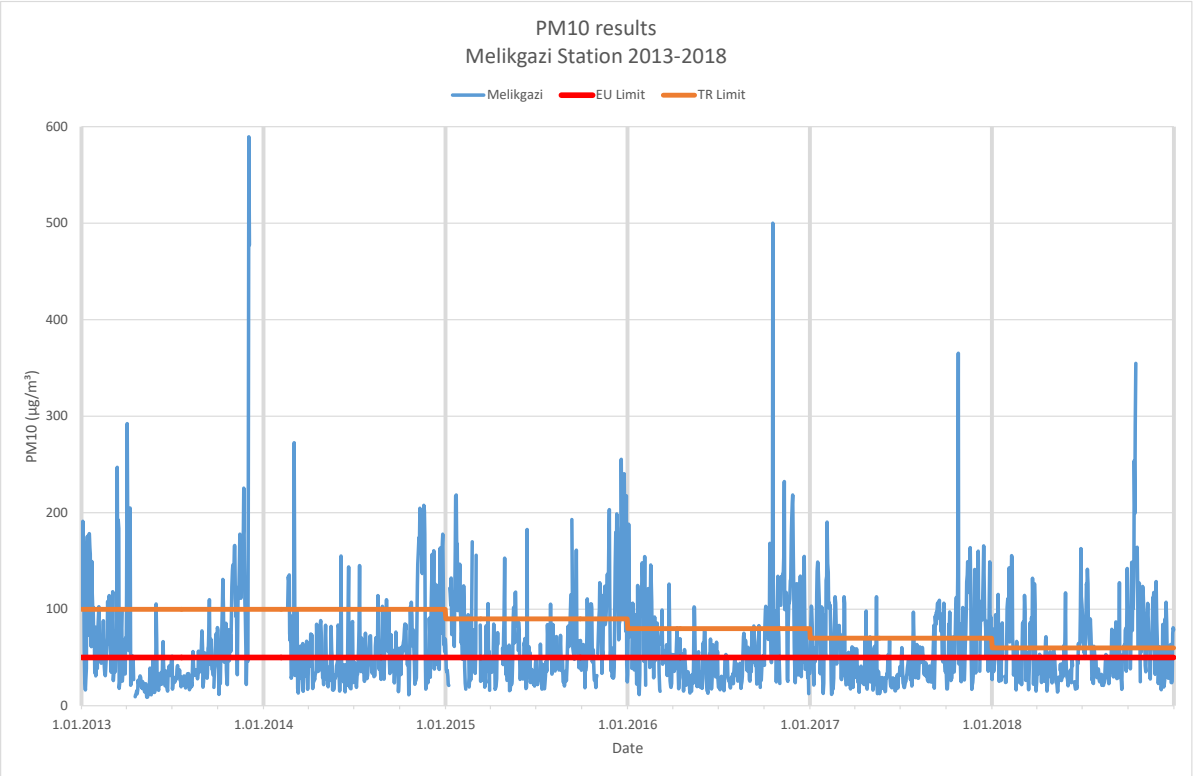
ADDITIONAL DATA ANALYSES

PM_{10} Plots

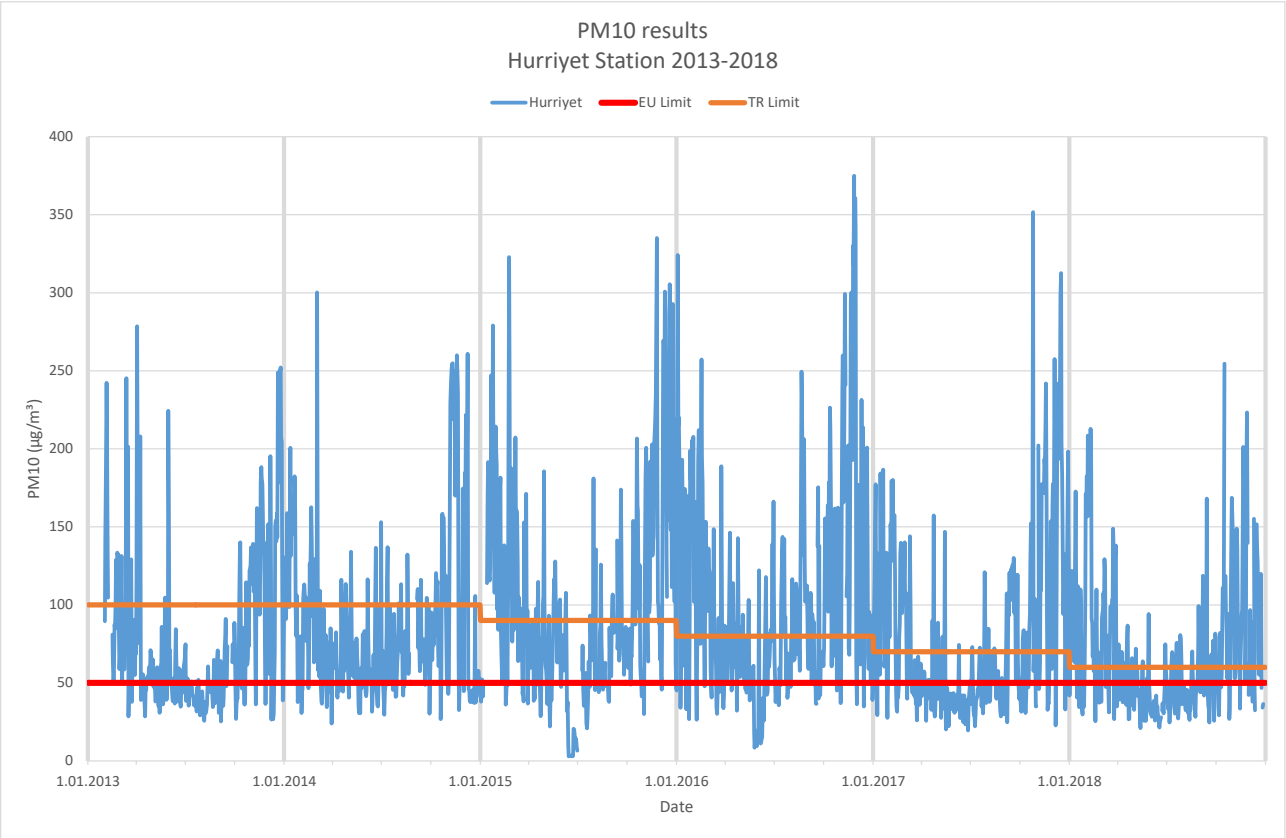
Annual graphs and daily exceedances graphs are provided in the report (See Chapter 5). Daily average concentrations plots for the last five years (2013-2018) are provided in this part.



Daily PM_{10} results from OIZ Monitoring Station



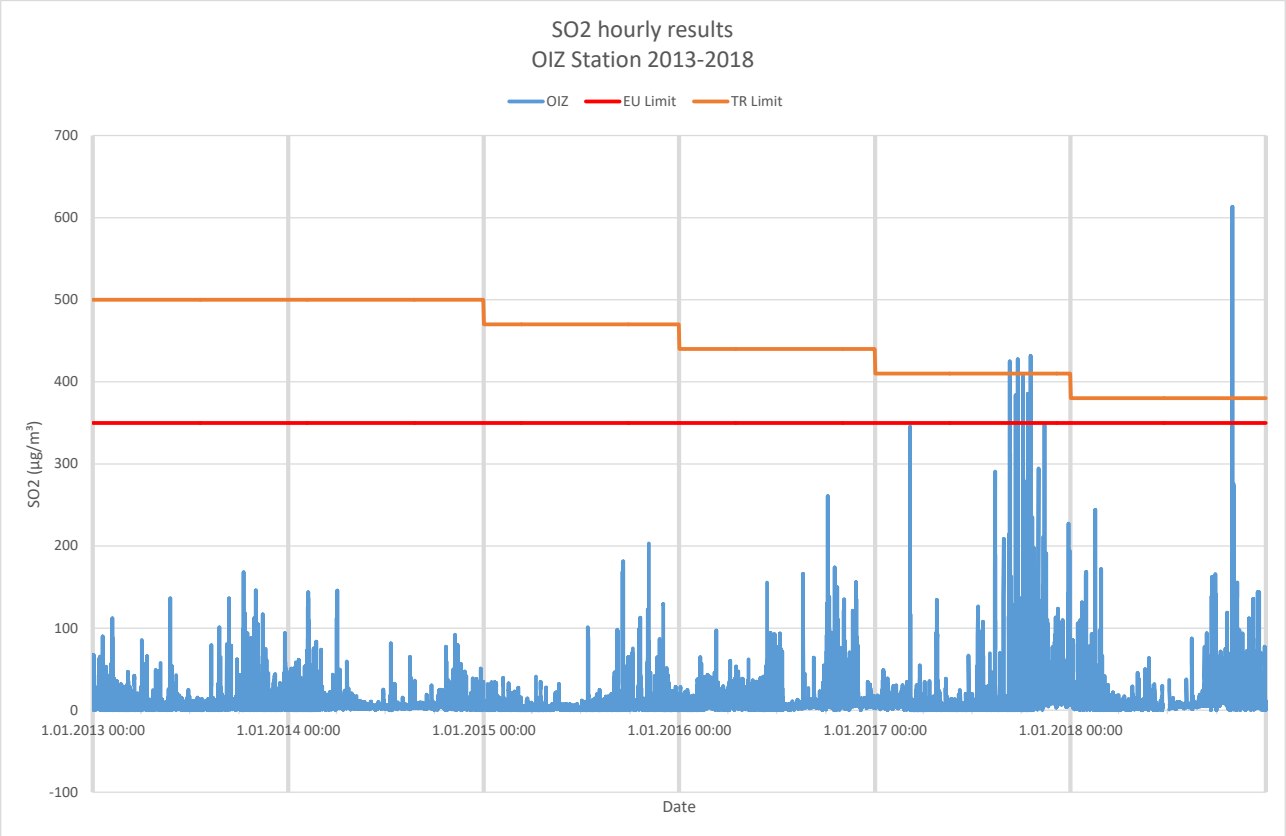
Daily PM_{10} results from Melikgazi Monitoring Station



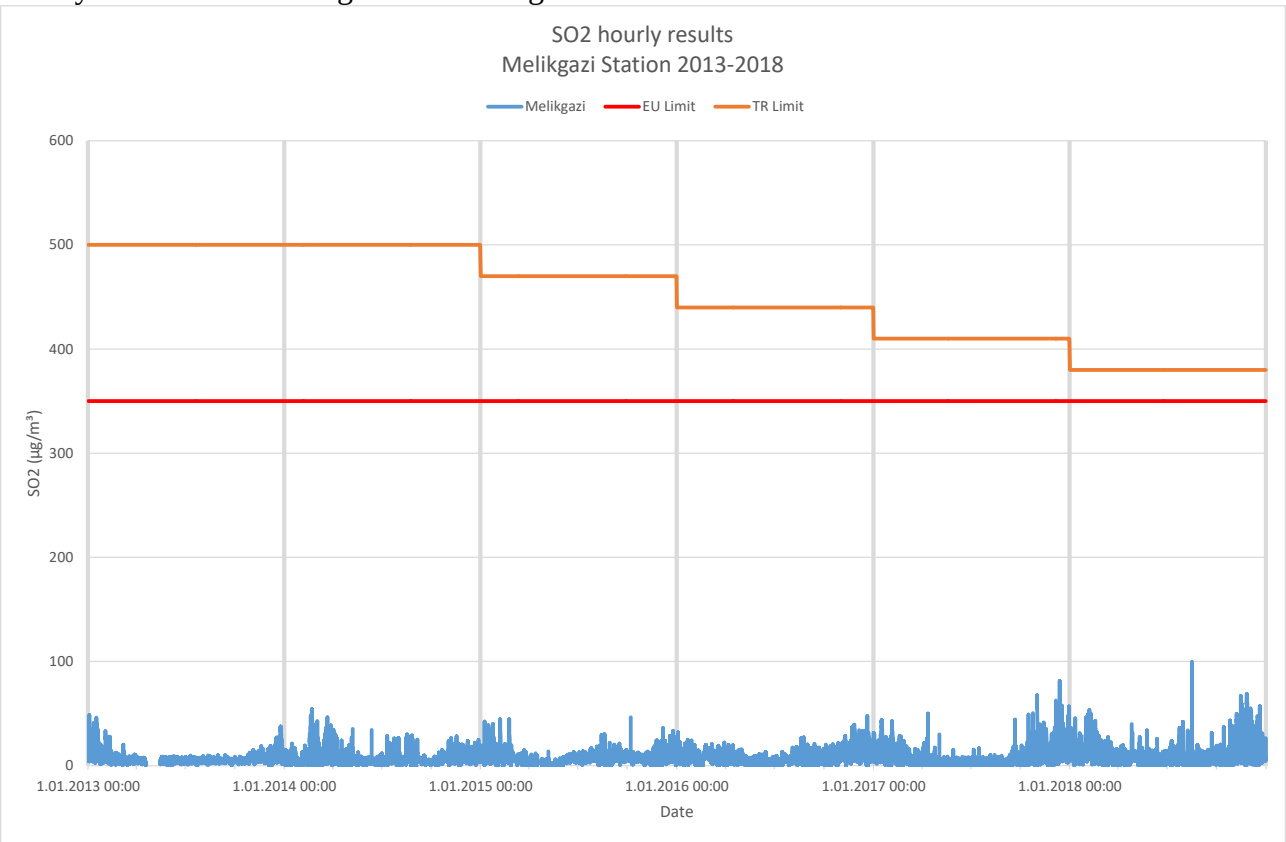
Daily PM_{10} results from Hürriyet Monitoring Station

SO_2 Plots

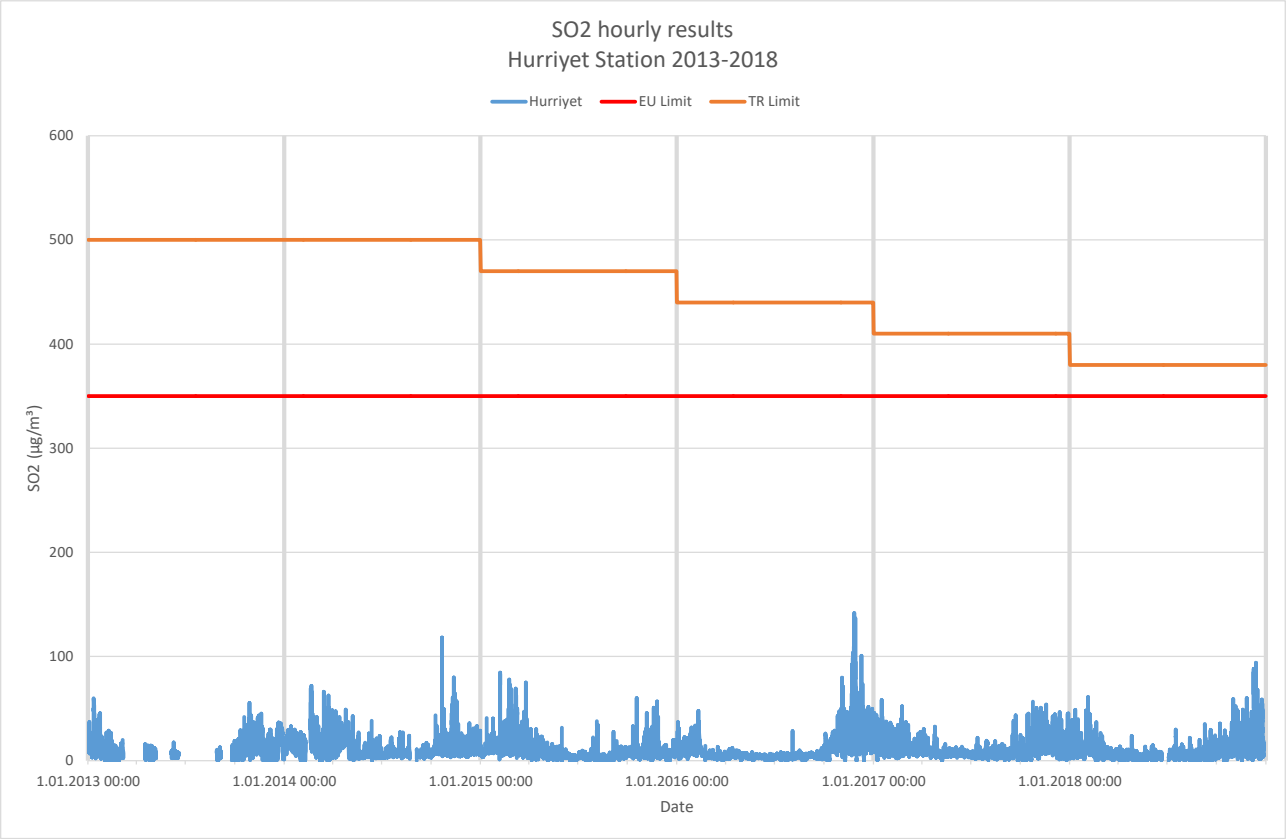
Hourly results from OIZ Monitoring Station



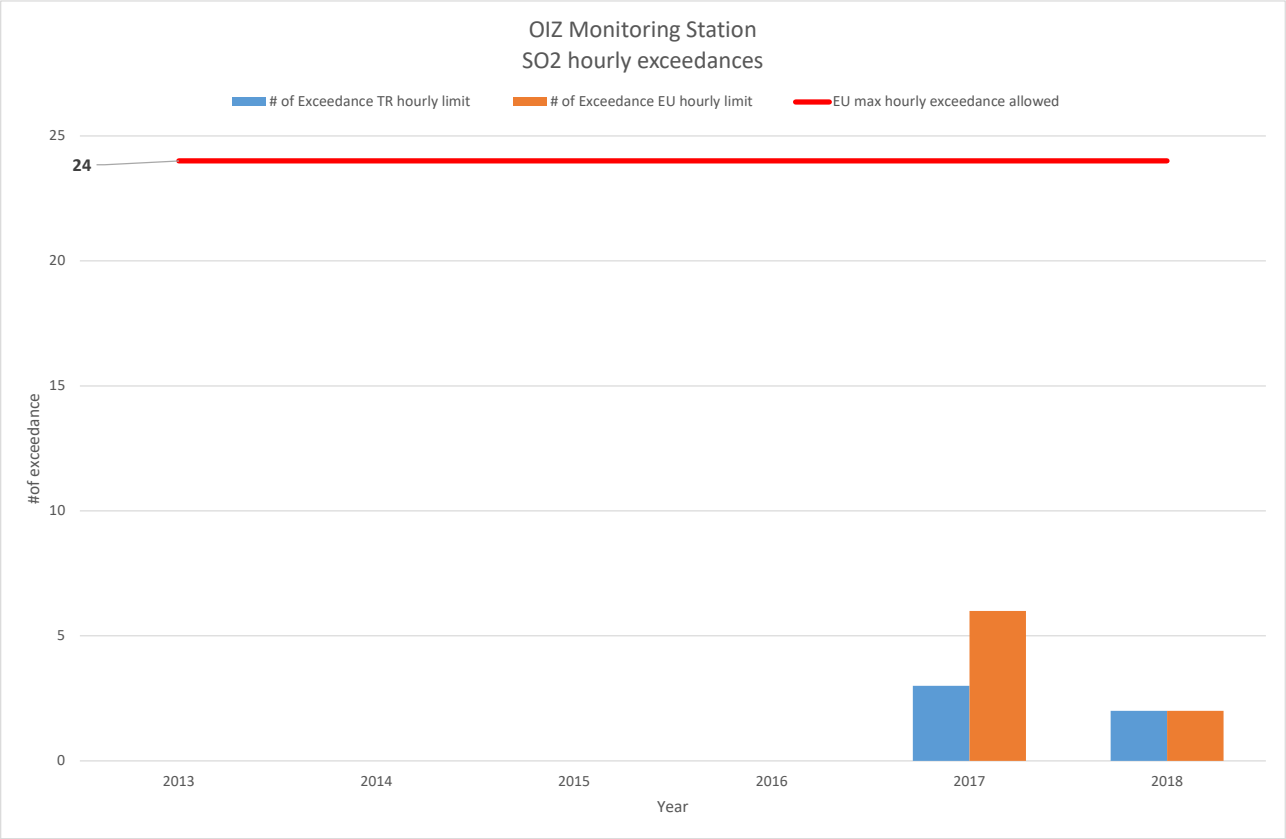
Hourly results from Melikgazi Monitoring Station



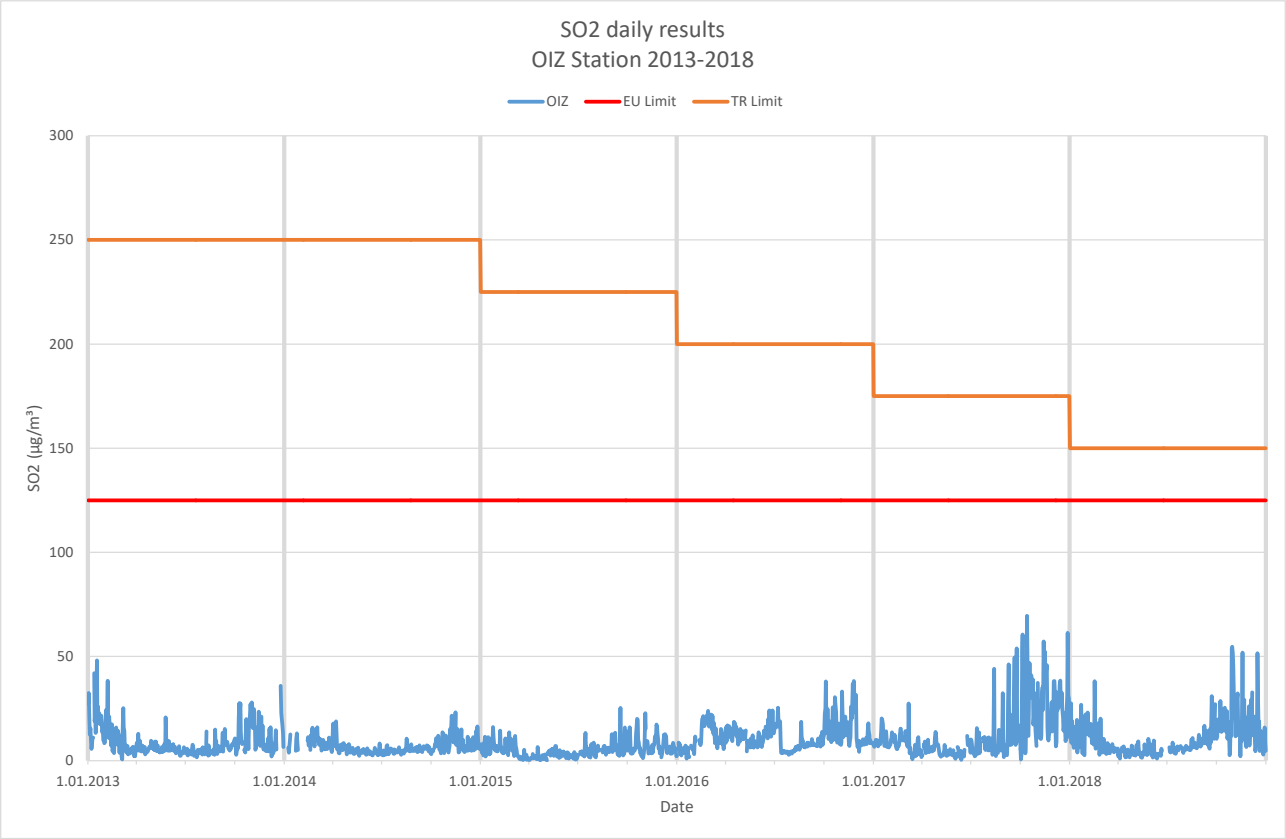
Hourly results from Hürriyet Monitoring Station



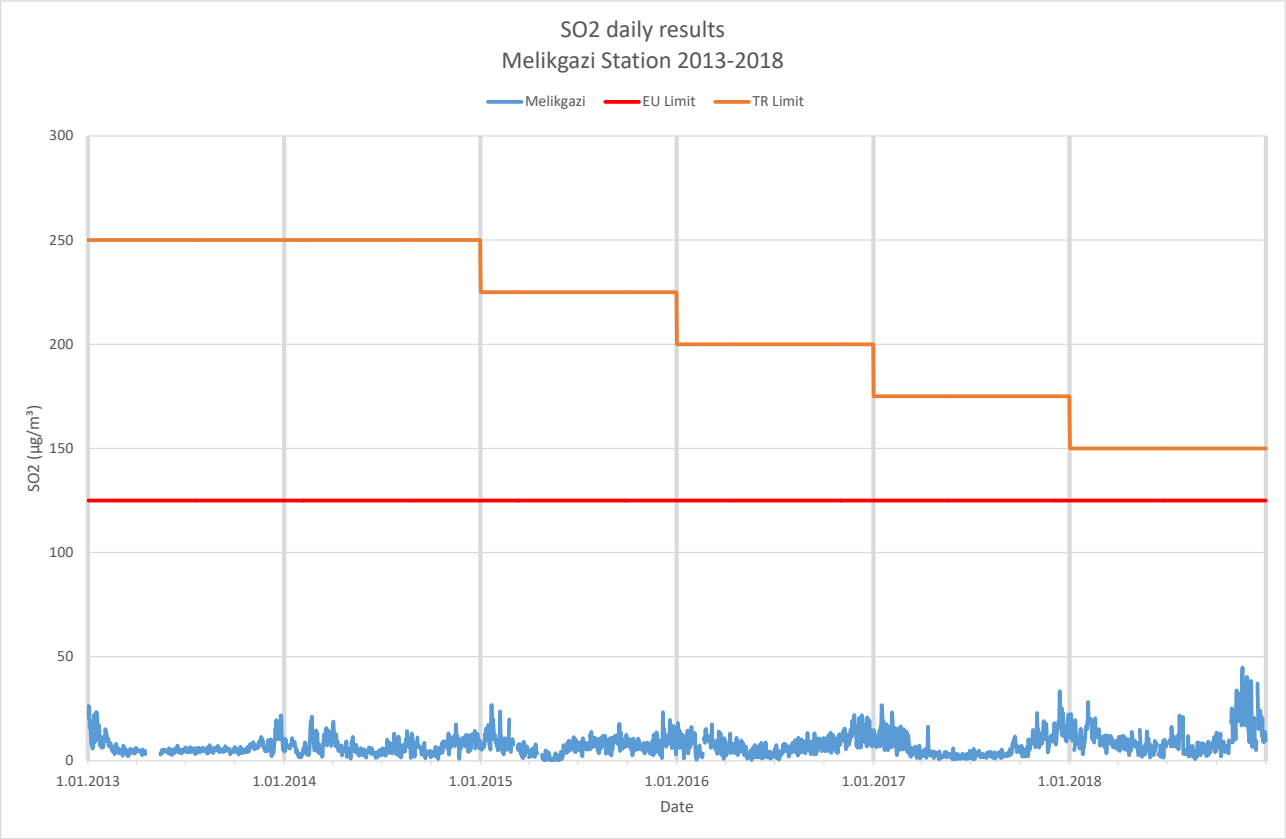
Number of hourly exceedances in OIZ Monitoring Station



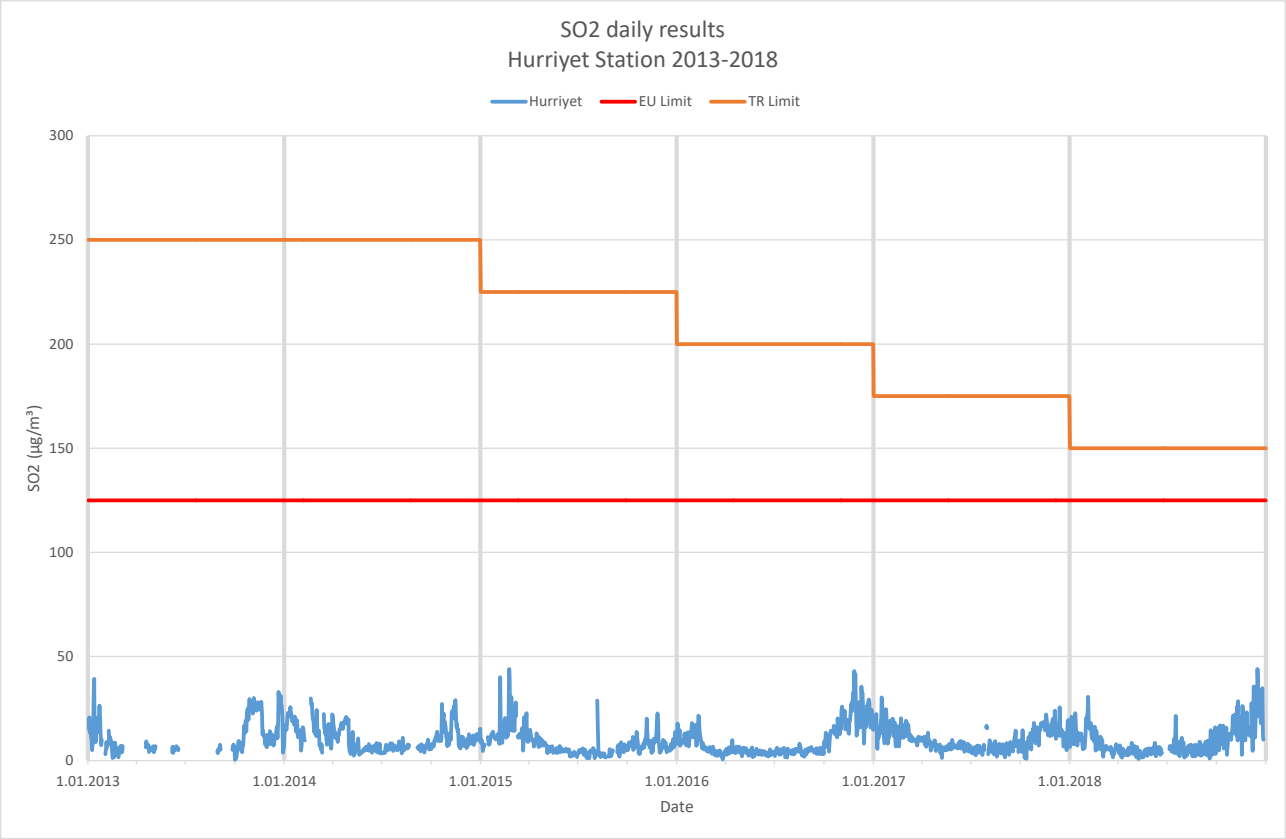
Daily results from OIZ Monitoring Station



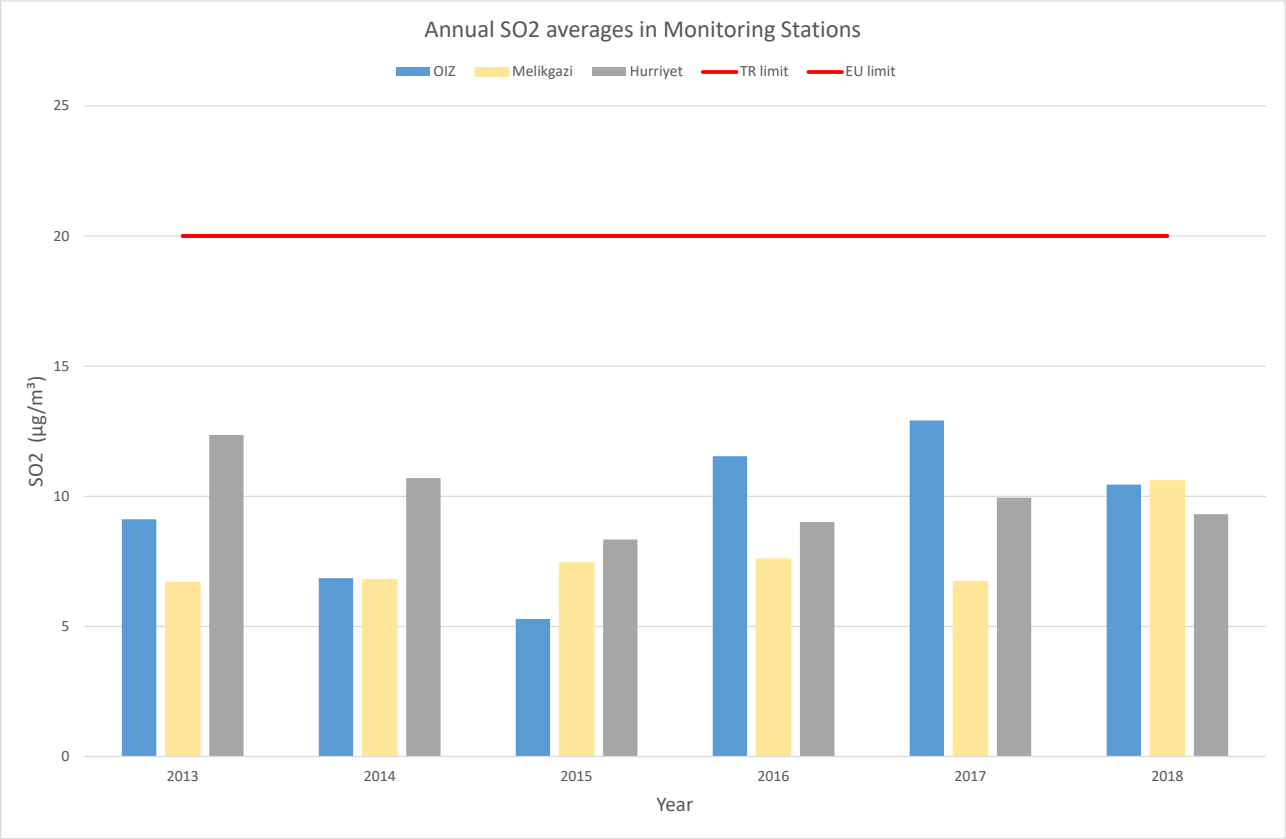
Daily results from Melikgazi Monitoring Station



Daily results from Hürriyet Monitoring Station



SO_2 Annual averages in all Monitoring Stations


Annual SO2 averages in Monitoring Stations
OIZ
Melikgazi
Hurriyet
TR limit
EU limit
25
20
15
10
5
0
SO2 (µg/m³)
2013
2014
2015
2016
2017
2018
Year

ANNEX H. EXAMPLE GOOD PRACTICE AIR QUALITY ACTION PLAN

An Example Good Practice Action plan - measures considered for the air quality management programme

Measure/Activities	Responsible institution(s)		Funding sources Indicative costs	Timeline (months)	Monitoring Indicators	Result
	Implementation	Monitoring and Control				
Bring into force by January 1, 2020 the Ecodesign Regulation for space heaters (stoves) including: - Notification of European Commission - Amendments to Technical Requirements Towards Products Act and/or another relevant legal - Pass an Ordinance to bring forward the Ecodesign Regulation EU 2015/1185	MoE (drafting and notification to EC) National Parliament (adoption) Council of Ministers (adoption)	State Agency for Metrological and Technical Surveillance (SAMTS)	Relevant institutions' budgets. Funding requirements to be determined by the responsible institutions for drafting, monitoring and control.	24	- Notification of European Commission - Adoption of amendments to Technical Requirements Towards Products Act and/or another relevant legal - Adopted Ordinance for the early implementation of eco-design requirements for solid fuel local space heaters as contained in Regulation (EU) 2015/1185	Increased residential heating efficiency. Reduced emissions from residential heating
Requirements for solid coal used for residential heating placed on the market, including: - Amendments to Clean Ambient Air Act (CAAA) - Pass an Ordinance for solid used for residential heating placed on the market - Notification of European Commission	MoEW (drafting), supported by MoE and SAMTS National Parliament (adoption) Council of Ministers (adoption)	SAMTS Ministry of Finance (MF)	Relevant institutions' budgets. Funding requirements to be determined by the responsible institutions for drafting, monitoring and control.	24	- Adoption of amendments to CAAA - Adopted Ordinance for Quality Requirements for Coal - Notification of European Commission	Reduced emissions from residential heating
Fuel quality standard - pellets - where fiscal expenditure is incurred in switching to fuel pellets[47]- Public bodies adopt ENplus classes A1 or A2 in pellet procurement and supply policy	Municipalities MLSP	SAMTS	No additional funding needed, should be part of the regular monitoring of eligibility of expenses of projects, financed by public money.	24	Procurement and supply policy documents	Reduced emissions from residential heating

[47] Establishing a new pellet standard is not recommended. There is an existing European standard (EN*plus)* as described in text box 6 in section 4.2.3. To ensure the most efficient use of public resources it is recommended that this standard be adopted where support programmes and/or public money are spent on switching to pellet heating.

Measure/Activities	Responsible institution(s)		Funding sources Indicative costs	Timeline (months)	Monitoring Indicators	Result
	Implementation	Monitoring and Control				
Discontinue the practice of selling firewood by weight, including: - Amendments in the Forestry Act - Amendments in secondary legislation, if applicable	MAFF and EFA (policy; law drafting) National Parliament (adoption) Council of Ministers (adoption)	MAFF and EFA (to include enforcement)	No additional funding needed.	24	- Adoption of amendments in the Forestry Act - Adoption of amendments in secondary legal instruments, if applicable	Reduced emissions from residential heating
Restrict the period for direct harvesting of wood by public, including: - Amendments in the Forestry Act and/or secondary legislation	MAFF (policy; drafting law; implementation) National Parliament (adoption) Council of Ministers (adoption)	MAFF and EFA (to include enforcement)	No significant additional funding needs expected. Funding requirements to be determined by the relevant institutions.	24	- Adoption of amendments in the Forestry Act and/or adoption of amendments in secondary legal instruments	Reduced emissions from residential heating
Restrict the period for wood supply by municipalities and state enterprises: - Amendments in the Forestry Act and/or secondary legislation	MAFF and EFA (policy; law drafting) National Parliament (adoption) Council of Ministers (adoption) Municipalities	MAFF (to include enforcement) Municipalities (enforcement)	MAFF, EFA, municipal budgets. No significant additional funding needs expected. Funding requirements to be determined by the relevant institutions.	24	- Adoption of amendments in the Forestry Act and/or adoption of amendments in secondary legal instruments - Reports concerning municipal enforcement to NAMB	Reduced emissions from residential heating
Clarify the CAAA regarding municipalities' LEZ powers, including: - Notification EC	MoE (notification to EC) MoEW (drafting), supported by MoE, MRDPW, MTITC and MF National Parliament (adoption) Council of Ministers (adoption) Municipalities (adoption of Ordinance for LEZ)	MoEW	Relevant institutions' budgets. Funding requirements to be determined by the responsible institutions for drafting, monitoring and control.	12-24	- Adoption of amendments in the CAAA - Adoption of municipal ordinances establishing LEZ	Reduced emissions of pollutants

Measure/Activities	Responsible institution(s)		Funding sources Indicative costs	Timeline (months)	Monitoring Indicators	Result
	Implementation	Monitoring and Control				
Compulsory phase-out of solid-fuel fired stoves and boilers that do not comply with Ecodesign Regulations (includes LEZ): 1. Preparatory tasks: - Revision of municipal Air Quality Programme (AQP), including identification of potential sources of finance to support implementation; - Conduct public consultation on the measure and its implementation; - Identify the number and locations of households having solid-fuel fired appliances; - Determine the cost-effective substitute heating option(s) that may be offered; - Determine the financial support to be provided to the economically vulnerable; - Determine the geographical zones to be prioritized for appliance phase-out; - Determine treatment of the removed appliances from households; - Determine the fiscal costs of implementing the phase-out measure; - Mobilize the necessary funding support from identified sources; - Finalize the Air Quality Programme and secure RIEW approval.	Municipalities	Municipalities RIEW	Municipal budgets, including for implementation of acting AQP	24	- Revised AQP, approved by RIEW and adopted by City Council - Established LEZ	Facilitating the implementation of compulsory phase-out of solid-fuel fired stoves and boilers that do not comply with Ecodesign Regulations and establishment of LEZ
Compulsory phase-out of solid-fuel fired stoves and boilers that do not comply	Municipalities Gas and DH companies	Municipalities	BGN 39-47 million per year – fiscal costs for compulsory phase-out of solid-fuel fired	60	- Municipal solid-fuel removal scheme in place	Reduced emissions from residential heating

Measure/Activities	Responsible institution(s)		Funding sources Indicative costs	Timeline (months)	Monitoring Indicators	Result
	Implementation	Monitoring and Control				
with Ecodesign Regulations (includes LEZ): 2. Remove non-compliant appliances, ***and***: ***Either*** a) Reconnect households to central gas and district heating networks where available, and make new connections where cost-effective; ***Or*** b) Replace appliances with those that are Ecodesign-compliant.[48]			stoves and boilers that do not comply with Ecodesign Regulations only for households who receive target energy assistance support.[49]		- Number of non-compliant appliances removed and/or numbers of gas and DH connections re-established, and new connections made	
Control at first registration of vehicles	MoI EAAA,	Traffic police (MoI) EAAA	MoI and EAAA budgets. Funding requirements to be determined by the relevant institutions.	12	Surveys made to collect statistics on the effects of the new inspections.	Improved control on vehicles
Improved control of vehicles on the road	MoI EAAA	Traffic police (MoI) EAAA	MoI and EAAA budgets. Funding requirements to be determined by the relevant institutions. Indicative costs for stricter vehicular control in municipalities where transport is a major source: Sofia: BGN 82 000 Plovdiv: BGN 27 000	12	Surveys made to collect statistics on the effects of the new inspections.	Improved control on vehicles
Improved annual technical inspections	EAAA	EAAA	EAAA budgets.	12	Surveys made to collect statistics on the effects of the new inspections.	Improved control on vehicles

[48] A further option open to householders, at their own expense, would be to convert to using electricity for heating.

[49] The reported costs are fiscal costs (i.e. costs borne by public entities) for phase-out of solid-fuel fired stoves and boilers that do not comply with Ecodesign Regulations **only for households receiving target energy assistance in the municipalities subject to ECJ's court decision case C-488/15**. The fiscal costs calculations were based on a total of 54 705 households who eceived target energy assistance in the non-compliant municipalities for heating season 2017/2018. Expected capital expenses for each municipality for replacement of solid fuel appliances used for residential heating in the period 2018-2024 are provided in Annex III.5.

Measure/Activities	Responsible institution(s)		Funding sources Indicative costs	Timeline (months)	Monitoring Indicators	Result
	Implementation	Monitoring and Control				
			Funding requirements to be determined by the relevant institutions.			
Establishment of LEZ for transport	Municipalities	Municipalities	Indicative costs for stricter vehicular control in municipalities where transport is a major source: Sofia: BGN 1 380 000 – cost of setting up and enforcement Expected revenues per year: BGN 155 000 Plovdiv: BGN 217 000 – cost of setting up and enforcement Expected revenues per year: BGN 20 000	36	Established LEZ	Reduced emissions from transport
Amend CAAA to clarify & confirm that the role of RIEW in AQ Planning and the AQP Councils is regulatory only.	MoEW, National Parliament and Council of Ministers (adoption)	MoEW	No significant additional funding needs expected. Funding requirements to be determined by the relevant institutions.	24	Amendments in CAAA	Improved coordination between municipalities and RIEWs
Establish appropriate institutional arrangements, promotion, funding and reporting mechanisms to form pool of experts to provide advice and signposting support	MoEW and NAMB (coordination) ExEA, NIMH, universities & consultants	MoEW	No significant additional funding needs expected. Funding requirements to be determined by the relevant institutions.	24	Institutional arrangements established Reports	Improved stakeholder coordination
Agree the objectives and scope of the modeling capacity: to include emissions dispersion and transboundary pollution Create the appropriate institutional arrangements and establish an initial programme	MoEW (coordination) ExEA, NIMH and universities	MoEW	No significant additional funding needs expected. Funding requirements to be determined by the relevant institutions.	36	Institutional arrangements established Reports	Improved modeling capacity
Define scope and mechanisms for studying the health risks	MoH with MoEW	MoH, MoEW	MoH and MoEW budgets.	48	Assessment reports	Provided health risks reports

Measure/Activities	Responsible institution(s)		Funding sources Indicative costs	Timeline (months)	Monitoring Indicators	Result
	Implementation	Monitoring and Control				
Initiate and conduct the study in phases	RHIs, Universities, NSI, and Hospitals and other health care facilities, health organizations		Funding requirements to be determined by the relevant institutions.			
Define the scope and mechanisms for conducting a national source apportionment study Initiate and conduct the study in phases, disseminating the processed results to municipalities etc.	MoEW (coordination) ExEA, NIMH and universities	MoEW, NIMH	MoEW and NIMH budgets. Funding requirements to be determined by the relevant institutions.	48	Reports	Provided health risks reports
Prepare technical documentation for use by air quality managers and planners that is complementary to AQP Guideline, covering: - Atmospheric modelling - Source apportionment - Local emission inventory - Analyzing cost-effectiveness	MoEW and NAMB (coordination) ExEA, NIMH, NSI and universities	MoEW, NAMB	No significant additional funding needs expected. Funding requirements to be determined by the relevant institutions.	48	Published documentation (electronic and/or hard copy)	Improved AQP Guidelines