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Air Quality Governance in the ENPI East Countries

"Comparison of the Air Quality Monitoring Systems of EU Members States and Georgia"

Activity 1 Report

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Summary

PROJECT TITLE:	Comparison of the Air Quality Monitoring Systems of EU Members States and Georgia
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List of Abbreviations and Acronyms

Accumulated Ozone Exposure over a threshold of 40 Parts Per Billion	AOT40
Air quality	AQ
Air quality monitoring and management system	AQMMS
Ammonia	NH_3
Arsenic	As
Atmospheric Dispersion Modelling System	ADMS
Atomic absorption spectrometer	AAS
Automatic Urban and Rural Network	AURN
Average Expose Index	AEI
Benzene, toluene, ethylbenzene, xylenes	BTEX
Benzo(a)pyrene	B(a)P
Cadmium	Cd
Calcium ion	Ca^{2+}
Cambridge Environment Research Consultants CERC	CERC
Carbon Monoxide	CO
Caucasus Environmental NGO Network	CENN
Central European Time	CET
Clean air for Europe (refers to Directive 2008/50/EC)	CAFÉ
Directorate General for Environment	DG ENV
CentreEC Joint Research Centre Air Quality Reference Laboratories	JRC- AQUILA
Emission Limit Values	ELV
Environmental Impact Assessment	EIA
Environmental Protection Agency	EPA
Environmental Protection Department	EPD
European Commission	EC
European Committee for Standardization	CEN
European Economic Community	EEC
European Environment Agency	EEA
European Monitoring and Evaluation Programme / Core Inventory of Air Emissions	EMEP/CORINAIR
European Neighbourhood and Partnership Instrument	ENPI
European Union	EU
Formaldehyde	HCHO
Gas chromatograph/mass spectrometer	GC/MS
Geographic information system	GIS
Georgian Lari	GEL
Gov Air Quality Governance	Air-Q-
Grams per second	g/s
Hydrogen chloride or Hydrochloric acid	HCl
Hydrogen sulphide	H_2S
International Electrotechnical Commission	IEC

International Organization for Standardization	ISO
Key Expert	KE
Lead	Pb
Long-Range Trans-boundary Air Pollution	CLRTAP
Magnesium ion	Mg^{2+}
Manganese dioxide	MnO_2
Maximum Allowable Concentration	MAC
Mercury	Hg
Meteorology	MET.
Meteorology Department	MD
Metre	m
Metres per second	m/s
Micrograms per cubic metre	$\mu g/m^3$
Ministry of Environmental and Natural Resources Protection	MENRP
Nanograms per cubic metre	ng/m^3
National Environmental Agency	NEA
Nickel	Ni
Nitrogen dioxide	NO_2
Nitrogen oxides	NO_x
Non-governmental organisation	NGO
National Environment Agency	NEA
Ozone	O_3
Particulate Matters	PM
Parts per billion	ppb
Phenol	C_6H_5OH
Polycyclic aromatic hydrocarbons	PAH
Potassium	K
Quality assurance/Quality control	QA/QC
Radar Topography Mission	SRTM
Square kilometre	km2
Square metre	m2
Standard operation procedure	SOP
Sulphate ion	SO_4^{2-}
Sulphuric acid	H_2SO_4
Suspended Particulate Matter	SPM
Tonnes per year	t/y
Total Suspended Particulates	TSP
Ultra violet	UV
United Kingdom	UK
Volatile organic compounds	VOC
World Health Organization	WHO

1. SUMMARY

1.1. Purpose of this Document

The purpose of this document is to provide an overview of the current air quality monitoring and assessment systems in Georgia. This includes policy, legislative, institutional, instrumental as well as current air quality operations.

The document outlines the essential components within the two principal ambient air quality Directives, 2008 ambient air quality directive (2008/50/EC) known as the Clean Air for Europe (CAFE Directive) the fourth air quality daughter directive (2004/107/EC).

This includes the requirements that EU member states achieve a set of air quality limit values for the protection of human health as well as for the protection of vegetation and ecosystems.

The Directives requires Member States to assess air quality on a national scale sub-dividing their state into within zones and agglomerations. This document outlines the framework behind the establishment of these national monitoring and assessment programmes, where data coverage and assessment method are linked to lower and upper assessment thresholds.

Georgian air quality monitoring systems have been compared to international best practise within states of similar size populations and land area. Where relevant any differences in the current Georgian approach are compared to EU requirements under the CAFE and Fourth Daughter Directives.

The report examines how Georgia’s air quality assessment and management systems were established and how they are operated. It also outlines the policy and legal background for air quality assessment and management, its competent authorities in the field of air quality assessment and management and supporting institutions as well as the approach Georgia uses to carry out its air quality monitoring and air quality standards.

There is no effective statutory and regulatory framework upon which CAFÉ Directive and Fourth Daughter Directives objectives can be delivered.

Current resources available Georgia dedicated to ambient air quality monitoring are insufficient to credibly meet both CAFÉ Directive and Fourth Daughter Directive requirements. The number and type of ambient air monitoring stations in Georgia are too few and inadequate to meet the population coverage or data averaging requirements within either the CAFÉ or Fourth Daughter Directives.

Major system gaps in air quality management remain as follows:

- Underdeveloped systems of air quality monitoring (lack or insufficient number of automatic stations, no measurement of PM2.5, very limited measurement of $PM_{10}$and ground level ozone).
- Insufficient air quality data gathering, treatment and interpretation
- Limited access to actual information on air quality

Major differences in comparison with the EU air quality assessment and management system remain as follows:

- No air quality standards for either PM_{10} or $PM_{2.5}$.
- The averaging period of Georgia air quality standards vary, with no specified annual mean for any of the selected chemical species. Limit values or MACs are generally higher than for EU

directives limits, and in the case of B(a)P, the Georgian MAC was a factor of 10,000 higher than the EU limit value.

- No national reference laboratory or certification of standards exists in Georgia.
- There is no single body to provide an overarching uniform approach to ambient air quality monitoring, resulting in potentially incomparable measurement systems.

In order to begin to address the short-comings of the ambient air quality monitoring network and assessment method in comparisonwith EU guidelines and Directives the following key actions are recommended:

- Legal harmonization/approximation focusing on directives 2008/50/EC and 2010/75/EU with clear and distinct roles for air quality monitoring, assessments and reporting
- Sufficient resourcing for ambient air monitoring and assessment infrastructure, including sufficient staffing
- Preliminary Assessment of ambient air quality in Georgia to assess and define its zones and agglomerations
- Determination of air quality species and averaging periods as prescribed by Directives 2008/50/EC and 2010/75/EU
- Incorporation of reference detection methods (or recognised equivalent) at air quality monitoring stations
- Data transfer via telemetry to allow for the preservation of data coverage and quality thereby meeting air quality data objectives
- Establish a National Reference Laboratory equipped with certified standards allowing all ambient air quality measurements to be traceable back to a reference standard as required under ISO 17025

2. INTRODUCTION

2.1. NATIONAL PILOT PROJECT

The Air Quality Governance project in (ENPI) East Countries is currently assisting Georgia with the preparation and implementation of a national pilot project to perform a feasibility study on the introduction of a national air quality monitoring system. The intention is that the pilot project will allow Georgia to develop a national monitoring network and set relevant guidelines in compliance with EU standards.

The objective of the feasibility study is to seek to improve Georgia’s current air quality legislation, ambient air quality monitoring network as well as the assessment and reporting of ambient air quality so that it converges with European legislation and regulations thereby contributing to the improved air quality, whilst strengthening implementation and compliance.

This report represents the initial component of the National Pilot Project feasibility study.

It has been highlighted in a recent gap analysis report1 that Georgia’s priorities related to the air quality governance include:

- Assessment of the country’s potential to implement international regulations
- Assessment of the introduction of an air quality monitoring system in Georgia including development of the monitoring network and setting relevant guidelines in compliance with EU standards
- Air quality legal and institutional analysis including gap analysis of existing legislation (both national and international), regulations and institutions

This report will set out the approach to be taken by the feasibility study on the introduction of a national air quality monitoring system and will look at how air pollutants are monitored in EU Members States. It will review the Georgia current air quality legislation and monitoring and assessment approach, compare existing air quality monitoring systems in EU members states and provide a set of findings and recommendations on how EU air quality directives’ could be transposed into the Georgian legislation.

[1]Air Quality Governance in ENPI East Countries: General System Gap Analysis: 2012 Update. EuropeAid/129522/C/SER/Multi Contract Number 2010/232-231

3. OBJECTIVES OF AIR QUALITY DIRECTIVES IN EU MEMBER STATES

3.1. Exposure to Air Pollution and Health Impacts

Air pollution can have a serious effect on people's health. Exposure to air pollution can have a long-term effect on health, associated in particular with premature mortality due to cardiopulmonary (heart and lung) effects.

More than 80% of the population in the European Union lives in cities with levels of PM exceeding WHO Air Quality Guidelines.

Long-term exposure to ozone has been recorded as having detrimental effects on the respiratory and cardio respiratory mortality of people with potentially predisposing conditions such as chronic obstructive pulmonary disease, diabetes, congestive heart failure.

Short-term, high pollution episodes can trigger increased admissions to hospital and contribute to the premature death of those people that are more vulnerable to daily changes in levels of air pollutants.

In Europe life expectancy has been estimated to be reduced by almost 9 months through pollution from PM. A strong relationship between long-term ozone exposure and respiratory morbidity has been found where long-term measures of ozone exposure is linked to the onset of asthma in children and increased respiratory symptom effects in asthmatics (EPA, 2012).

Air pollution also has negative impacts on our environment, both in terms of direct effects of pollutants on vegetation, and indirectly through effects on the acid and nutrient status of soils and waters.

Action to manage and improve air quality is largely driven by European (EU) legislation. The 2008 ambient air quality directive (2008/50/EC) sets legally binding limits for concentrations in outdoor air of major air pollutants that impact public health such as particulate matter (PM_{10} and $PM_{2.5}$) and nitrogen dioxide (NO2) as well as pollutants which have impacts upon sensitive habitats such as ozone and oxides of nitrogen.Having direct effects, these pollutants can combine in the atmosphere to form ozone, a harmful air pollutant (and potent greenhouse gas) which can be transported great distances by weather systems.

The objective of European Air Quality Directives are to ensure that all citizens should have access to outdoor air without significant risk to their health ensuring effective protection against harmful effects on vegetation and ecosystems from exposure to ozone.

3.2. Main terms within both the Clean Air for Europe Directive (2008/50/EC) and Fourth Air quality daughter directive (2004/107/EC)

The 2008 directive replaced nearly all the previous EU air quality legislation. The 4th air quality daughter directive (2004/107/EC) set targets for certain toxic heavy metals and polycyclic aromatic hydrocarbons levels in ambient air. Ambient air, according to the directives, is outdoor air at ground or near ground level. Both indoor air and workplace environments are discounted.

Separate legislation exists in Europe for emissions of air pollutants with the main legislation being the UNECE Gothenburg Protocol which sets national emission limits (ceilings) for SO2, NOX, NH3 and volatile organic compounds for countries to meet from 2010 onwards. Similar ceilings have since been set in European law under the 2001 National Emission Ceilings Directive (2001/81/EC).

The EU directives require a ‘Common Approach’ when assessing ambient air.

This relates to:

- Measurement method used
- Location and number of sample points
- Concentration thresholds

Measurements Used

To maintain the principal of a ‘common approach’, the directives contain a set of prescribed technical and quantitative methods which are required for the operation of a national air quality monitoring and assessment programme to an EU standard. These include use of ‘Reference Method’ detection systems, mandatory sampling at ‘Urban back ground locations’, incorporation of a ‘margin of tolerance’ into the assessment during the establishment of national network.

- Reference Method – approved internationally established (ISO) and standardised sampling and detection method
- Urban back ground locations shall mean places in urban areas where levels are representative of the exposure of the general urban population
- Margin of tolerance – shall mean the percentage of the limit value by which that value may be exceeded subject to the conditions laid down in this Directive;

Location and number of sample points

In order to establish a uniform distribution of monitoring sites across member states, the Directives have specified that a series of ‘zones’and ‘agglomerations’ are determined, which are regional areas within which a specified number of monitoring sites or assessment sites are established.

- Zone - an area of the country defined for the purposes of air quality assessment
- Agglomeration – a zone which has a population in excess of250,000

Two assessment thresholds are used to determine exactly what intensity and type of ambient air quality sampling will used in the long-term within each zone or agglomeration. Air pollutants are assessed as to whether their concentration falls below the ‘lower assessment threshold’, between ‘upper’ and ‘lower assessment thresholds’, or above the ‘upper assessment threshold’.

- Upper Assessment Threshold –a pollution level above which long-term ‘fixed measurements’ are required;
- Lower Assessment Threshold – a pollution level below which only air quality modelling and /or ‘indicative measurements’ are required;
- Fixed measurements – samples collected from fixed monitoring sites, either continuously or by random sampling;
- Indicative measurements – samples collected which meet data quality objectives, though are less strict than those required for fixed measurements.

Concentration thresholds

From subsequent ambient air quality data collected, both the ‘average exposure indicator’ and ‘national exposure reduction targets’ can be evaluated.

- Average exposure indicator – the average level from measurements made at urban background locations which reflects population exposure;

- National exposure reduction target – shall mean a percentage reduction of the average exposure of the population of a member State set for the reference year with the aim of reducing harmful effects on human health, to be attained where possible over a given period.

In the long-term air quality is then assessed against both 'target values', 'limit values'for human health and 'critical levels' for ecosystem protection.

- Target values – a concentration which should not be exceeded where possible;
- Limit Values – a statutory concentration not to be exceeded across a set time;
- Critical levels – a level above which direct adverse effects may occur on some receptors, such as trees, other plants or natural eco-systems but not on humans.

3.3. LIMIT VALUES FOR PROTECTION OF HUMAN HEALTH, VEGETATION AND ECO-SYSTEMS

EU Limit values (Table*3-1*) are legally binding EU parameters that must not be exceeded. Limit values are set for individual pollutants and are made up of a concentration value, an averaging time over which it is to be measured, the number of exceedencesallowed per year, if any, and a date by which it must be achieved. Some pollutants have more than one limit value covering different endpoints or averaging times.

Target values, which are air quality objectives,and which are not yet legally binding, are used in some EU Directives and are set out in the same way as limit values. They are to be attained where possible by taking all necessary measures not entailing disproportionate costs.

Averaging times for limits values reflect their health impacts across varying time periods. Where a particularly chemical species is known at high concentrations to have an acute health impact, then a very short averaging time (typically hourly) is used to reflect that particular impact. Where a chronic health impact is known to occur then a much longer averaging time (typically annually) is applied to the limit values. Chemical species may have more than one averaging time, as both acute and chronic health impacts may occur.

Table 3-2 European Air Quality Directive limit and target values for the protection of human health

Pollutant	Limit Value	Concentration measured as	Date to be achieved by and thereafter	Margin of Tolerance[2]
PM_{10}	50 µg/m^3 not more than 35 time	24 hour mean	31 December 2004	50% before 31 December 2004

[2]'margin of tolerance' is the percentage of the limit value by which that value may be exceeded subject to the conditions laid down in this Directive

Pollutant	Limit Value	Concentration measured as	Date to be achieved by and thereafter	Margin of Tolerance[2]
	s a year			
	40 µg/ m^3	Annual Mean	31 December 2004	20% before 31 December 2004
$PM_{2.5}$	25 µg/ m^3	Annual Mean (Calendar year)	1January2015	20%on11June2008,decreasingonthenext1Januaryandevery12monthsthereafterbyEqualannualpercentagestoreach0%by1January2015
	20µg /m^3	Annual Mean (Calendar year)	31 December 2019	None
Nitrogen Dioxide	200 µg/ m^3not to be exceeded more than 18 times a year	1 hour mean	31 December 2009	50 % on 19 July 1999, decreasingon 1 January 2001 and every 12months thereafter by equalannual percentages to reach 0 %by 1 January 2010
	40 µg/ m^3	Annual Mean (Calendar year)	31 December 2009	50% on 19 July 1999, decreasing on 1 January 2001 and every 12 months thereafter by equal annual percentages to reach 0% by 1 January 2010
Ozone	Target of 120 µg/ m^3 not to be exceeded on more than 25	Maximum 8 hour mean	31 December 2009	None

Pollutant	Limit Value	Concentration measured as	Date to be achieved by and thereafter	Margin of Tolerance[2]
	days per year per calendar averaged over 3 years			
Sulphur Dioxide	350 µg/m³ not to more exceeded more than 24 times a year	1 hour mean	31 December 2004	150 µg/m³ (43%) before 31 December 2004
	125 µg/m³not to more exceeded more than 3 times a year	24 hour mean	31 December 2004	None
Polycyclic aromatic hydrocarbons	1 ng/m³ B(a)P	PM_{10} Fraction over a calendar year	31 December 2010	None
Benzen	5	As	31	5 µg/m³ (100 %) on 13 December 2000, decreasing on 1 January 2006

Pollutant	Limit Value	Concentration measured as	Date to be achieved by and thereafter	Margin of Tolerance[2]
e	µg/ m^3	annual average	December 2009	and every 12 months thereafter by 1 µg/m3 to reach 0 % by 1 January 2010
Arsenic	6 ng/ m^3	PM_{10} Fraction over a calendar year	1 January 2008	0%
Cadmium	5 ng/ m^3	PM_{10} Fraction over a calendar year	1 January 2008	0%
Nickel	20 ng/m^3	PM_{10} Fraction over a calendar year	1 January 2008	0%
Carbon Monoxide	10 mg/ m^3	Maximum daily running 8 hour mean	31 December 2004	60% before 31 December 2004
Lead	0.5 µg/m^3	Annual mean (Calendar year)	31 December 2004 (31 December 2004 for Industrial contaminated sites)	100% before 31 December 2004

Limit and target value averaging times for the protection of vegetation and ecosystems (Table 3-2) are annual averages for Oxides of Nitrogen and Sulphur Dioxide, due to the chronic impact both of these chemical species have upon habitats and species over an extended period at low concentration levels. Though due to the historically high concentrations of Sulphur Dioxide in ambient air over the winter periods in Northern Europe, due to increased fossil fuel use during that period, an additional Sulphur Dioxidewinter average averaging period (1Octoberto31March) has been identified for the purposes of protection of vegetation.

Both Sulphur Dioxide and Ozone can have significant short-term or acute impacts on at elevated concentrations on vegetation and ecosystems.

The limit value for ozone is expressed as an accumulated ozone exposure over a threshold of 40ppb (80 μg/m^3) during hours of sunlight between spring and summer. This sum is known as AOT40 and takes into account that a high concentration of ozone over a long-period has the potential of damaging habitats.

Table 3-2 European Directive Limit and target values for the protection of vegetation and ecosystems

Pollutant	Limit Value	Concentration measured as	Date to be achieved by and thereafter	Margin of Tolerance
Oxides of Nitrogen	30 μg/m^3	Annual Mean (Calendar year)	19 July 2001	None
Sulphur Dioxide	20 μg/m^3	Annual Mean (Calendar year) & Winter (1 Oct to 31 March)	19 July 2001	None
Ozone: protection of vegetation & ecosystems	Target of 18,000 μg/m^3 based on AOT40[3] to be calculated from 1 hour values from May to July and to be achieved, so far as possible, by 2010	Average over 5 years	31 December 2009	

3.4. Upper and lower assessment thresholds

The degree of assessment is dependent upon whether average air quality is above or below the upper threshold or below the lower assessment threshold, as set out within the CAFÉ Directive (Part A, Annex II). Should it be found to be above both at the preliminary assessment stage, then that pollutant must be routinely assessed using a fixed measurement technique s (typically 12 months in duration) using a reference method.

In addition a lower boundary, or lower assessment threshold has been set out within the CAFÉ Directive (Part A, Annex II). Should a pollutant concentration consistently fall below lower assessment threshold at the preliminary assessment stage, then the assessment of the pollutant must be undertaken usinga combination of fixed measurementsand modelling techniques and/or indicative measurements.

[3]AOT40 (expressed in μg/m^3).hours) means the sum of the difference between hourly concentrations greater than 80 μg/m^3 (= 40ppb) and 80 μg/m^3 over a given period using only the one-hour values measures between 8:00hr and 20:00hr Central European Time (CET) each day.

3.5. ESTABLISHMENT OF ZONES AND AGGLOMERATIONS FOR MONITORING AND ASSESSMENT OF THE AIR QUALITY

Under the CAFÉ and Air Quality directives, EU states are obliged to carry out national air quality assessment within areas termed zones and agglomerations of large population (greater than 250,000). Zones are primarily units for air quality assessment and management, but the directives specify assessment requirements per zone[4].

Once the level of assessment has been determined member states are obliged to assess ambient air quality within their territory, the territory can be divided into zones which reflect their population, population density and land area, and agglomerations. Ambient air can be assessed within a zone using:

- continuous measurement at a fixed location sampling;
- a combination of continuous measurement at a fixed location sampling and modelling techniques and or indicative measurement;
- modelling techniques or objective-estimation techniques or both.

Where a particular pollutant concentration has been identified as being below the lower assessment threshold at the preliminary assessment stage, then modelling or objective estimation techniques may be used to assess ambient air quality for that pollutant.

3.6. CRITERIA FOR CLASSIFYING SAMPLING POINTS FOR ASSESSMENTS OF AIR QUALITY

Monitoring sites are classified according to the type of environment in which they are to be located, which permits a greater understanding of the monitoring data they will generate.Site should reflect the influence of a particular pollutant source or of overall land use[5].

There are a limited number of classifications for air quality monitoring site identities within the wider EU network, these include urban, surburban, rural and rural background.

Monitoring site classifications used within the UK Automatic Urban and Rural Network (AURN) have been outlined in Table 3-3and Table 3-4below, and are recommended as they are comprehensive, and include a definition of urban background, roadside, kerbside, industrial as well as the category 'other'.

Table 3-3 Monitoring site classifications used within the UK Automatic Urban and Rural Network (AURN)

Monitoring Site Classification	Category
Site Type	**Description**
Urban centre	An urban location representative of typical population exposure in towns or city centres, for example, pedestrian precincts and shopping areas.

[4] Guidance on Assessment under the EU Air Quality Directives
[5] JRC- AQUILA Position Paper Assessment on sitting criteria, classification and representativeness of air quality monitoring stations.

Urban background	An urban location distanced from sources and therefore broadly representative of city-wide background conditions, e.g. urban residential areas.
Suburban	A location type situated in a residential area on the outskirts of a town or city
Roadside	A site sampling typically within one to five metres of the kerb of a busy road (although distance can be up to 15 m from the kerb in some cases).
Kerbside	A site sampling within one metre of the kerb of a busy road.
Industrial	An area where industrial sources make an important contribution to the total pollution burden.
Rural	An open countryside location, in an area of low population density distanced as far as possible from roads, populated and industrial areas.
Other	Any special source-orientated or location category covering monitoring undertaken in relation to specific emission sources such as power stations, car-parks, airports or tunnels

3.7. MACRO-SALE SITTING OF SAMPLING POINTS

CAFE-Directive 2008/50/EC

Site criteria for ozone sampling differs for the criteria for sulphur dioxide, nitrogen dioxide, particulate matter (PM_{10} and $PM_{2.5}$), lead, benzene and carbon dioxide sampling. Sample site criteria for the measurement of sulphur dioxide, nitrogen dioxide, particulate matter (PM_{10} and $PM_{2.5}$), lead, benzene and carbon monoxide require samples to be collected within zones and agglomerations where concentrations are at their highest, or where the population are likely to be exposed.

Whereas ozone sampling points are to be sited where ozoneconcentrations, in a zone or agglomeration, have exceeded their long-term objectives (Table 3-1) at any time of the previous five years of measurement, fixed measurements shall be taken. The number of sampling points for fixed measurements of ozone in each zone or agglomeration within which measurement is the sole source of information for assessing air quality shall not be less than the minimum number of sampling points specified in table 3-6 below.

The exposure period needs to represent a significant proportion of the averaging period of the limit values. Additional sampling sites need to be established within zones and agglomerations which reflect the pollution exposure of the general population. All sample sites should where possible be representative of similar locations which are not in the immediate locality, i.e. a particular roadside sample site could be considered representative of other roadside locations in the area which have similar layout and traffic levels, speeds etc.

Sampling sites where either high or low ambient air pollution exists over a very small area (micro-environments) are to be avoided. Where feasible sample sites must reflect a wide area, e.g. either a length of 100m street segment at a traffic-oriented site or an industrial site of minimum area of 250 m X 250 m.

Urban background sample locations need to be sited at a location where they can be influenced by the cumulative effects of all sources upwind of the sample site. These sample sites are expected to be representative of several square kilometres. Sampling close to dominant single sources should be avoided, unless such a source is typical for a large urban area.

Rural background sample sites should not be influenced by agglomerations or industrial sites and are expected to be located greater than five kilometres from such sources.

The CAFÉ Directive contains specific guidelines (section 2, part B of ANNEXIII) for the location of sample sites specifically allocated to the assessment of air pollution impacts upon vegetation and ecosystems, state that, ideally, these sites should be more than 20 km away from agglomerations and 5 km away from major roads or industrial locations or built-up areas.

When assessing air pollution contributions from industrial sources, at least one downwind sample site is required, and if background concentrations are unknown an additional sample site must be established upwind.

Measurements of $PM_{2.5,}$ including total mass concentration and chemical speciation concentrations, should be taken at one rural background sampling location per 100,000 km^2. These sites should be located away from significant sources of air pollution. A minimum of one rural background site per Member state should be established, though several common sites may be established with adjoining Member states.

<u>Fourth Daughter Directive</u>

The location of sampling points for the measurement of arsenic, cadmium, nickel and benzo(a)pyrene should be selected in such a way as to provide data on the areas within zones and agglomerations where the population are likely to be exposed to the highest concentration over averaged over a calendar year. It should also provide data onlevels in other areas within zones and agglomerations which are representative of the exposure of the general population as well as on deposition rates representing the indirect exposure of the population through the food chain.

Sampling sites should be located to avoid measuring very small micro-environments. Sampling points should be representative of air quality in surrounding area of no less than $200m^2$ at traffic orientated sites and at least 250 m x 250 m at industrial sites, and several square kilometres at urban-background sites.

If the background levels are being sampled, then the sampling site should be located several kilometres away from agglomerations or industrial sites to minimise being influenced by them.

Where contributions from industrial sources are assessed, at last one downwind sampling point should be installed, ideally within the nearest residential area. If the background concentration is unknown, an additional sampling site should be installed upwind of the industrial source.

Sample sites should be representative of similar locations which are not in the immediate locality, and where appropriate they should be co-located with sampling points for PM_{10}. This provides an opportunity for co-locating PM_{10} gravimetric samplers, and therefore comparable PM_{10} samples, allowing the level of PM_{10} sampling uncertainty to be assessed. In addition the efficiency savings of using one sample site for staff resources, security and infrastructure costs.

Table 3-4Monitoring site classifications for Ozone used within the UK Automatic Urban and Rural Network (AURN)

Monitoring Site Classification Category	

Site Type	Macro-scale sitting criteria	Representativeness[6]
Urban	Away from the influence of local emissions such as traffic, petrol stations , etc.; Vented locations where well mixed levels can be measured; locations such as residential and commercial areas of cities, parks (away from the trees), big streets or squares with very little or no traffic, open areas as characteristic of educational, sports or recreation facilities.	A few km^2
Suburban	At a certain distance from the area of maximum emissions, downwind following the main wind direction/directions during conditions favourable to ozone formation; where population, sensitive crops or natural eco-systems located in the outer fringe of an agglomeration are exposed to high ozone levels; where appropriate, some suburban stations also upwind of the area of maximum emissions, in order to determine the regional background levels of ozone	Some tens of km^2
Rural	Stations can be located in small settlements and/or areas with natural ecosystems, forests or crops; representative for ozone away from the influence of immediate local emissions such as industrial installations and roads; at open area sites, but not on summits of higher mountains.	Sub-regional levels (some hundreds of km^2)
Rural background	Station located in areas with lower population density, e.g. with natural ecosystems, forests, at a distance of at least 20km from urban and industrial areas and away from local emissions; avoid locations which are subject to locally enhanced formation of ground-near inversion conditions, also summits of higher mountains; coastal sites with pronounced diurnal wind cycles of local character are not recommended	Regional/ national/ continental levels (1,000 to 10,000 km^2)

3.8. MICRO-SCALE SITTING OF SAMPLING POINTS

Identification of the specific suitability of a sample site locations are a matter for the individual Member state and are typically nominated at the Preliminary Assessment stage.

Guidelines on the position of sample sites with respect to sources and their installation are given in both section C Annex III of CAFE-Directive 2008/50/EC and section II Annex III of 4th Daughter Directive 2004/107/EC.

Both the Fourth Daughter Directive (2004/107/EC) and CAFE Directive (2008/50/EC) provide prescriptive guidelines on the microscalesitting of the air quality sampling points. With exception to two variations, the guidelines were identical and should be followed in so far as is practicable.

Box 3-1Microscalesitting sampling points

Microscalesitting sampling points
The flow around the inlet sampling probe should be unrestricted, without any obstructions affecting the airflow in the vicinity of the sampler (normally some metres away from buildings, balconies, trees and other obstacles and at least 0.5 m from the nearest building in the case of sampling points representing air quality at the building line);
In general, the inlet sampling point should be between 1.5 m (the breathing zone) and 4 m above the ground.

[6]Sampling points should, where possible be representative of similar locations not in their immediate vicinity.

Higher positions (up to 8 m) may be necessary in some circumstances. Higher sitting may also be appropriate if the station is representative of a large area;
The inlet probe should not be positioned in the immediate vicinity of sources in order to avoid direct intake of emissions unmixed with ambient air;
The sampler’s exhaust outlet should be positioned so that recirculation of exhaust air to the sample inlet is avoided;
Traffic-orientated sampling points should be at least 25 metres from the edge of major junctions and at least 4 m from the centre of the nearest traffic lane; inlets should be sited so as to be representative of air quality near the building line;
The following additional factors may also be taken into account: - interfering sources - security - access - availability of electrical power and telephone communications - visibility of the site in relation to its surroundings - safety of the public and operators - the desirability of co-locating sampling points for different pollutants - planning requirements.
Variation in the Fourth Daughter Directive (2004/107/EC) microscalesitting guideline
For the deposition measurements in rural background areas, the EMEP guidelines and criteria should be applied as far as practicable and therefore have not been specifiedin the Annexes of the fourth daughter directive..
Variation in the CAFE Directive (2008/50/EC) microscalesitting guideline
For all pollutants, traffic-orientated sampling probes shall be at least 25m from the edge of major junctions and no more than 10m from the kerbside.

3.9. MINIMUM NUMBER OF SAMPLING POINTS FOR EACH RELEVANT POLLUTANT SPECIFIED IN BOTH DIRECTIVES

The minimum number of sampling points within a zone or agglomeration areboth specified in Annex V and IX of CAFE-Directive 2008/50/EC and section IV Annex III of 4th Daughter Directive 2004/107/EC Directives (Tables 3-5 and 3-6). Minimum numbers of sampling points per zone / agglomeration are:

- 1 for pollutants NO_2, SO_2, CO, PB, Benzene
- 2 for PM_{10} and $PM_{2.5}$
- 1 for Cd, Ni, and As, and
- 1 for B(a)P

All of the above are dependant upon whether pollutants concentrations are above or below upper assessment threshold or above or below lower assessment thresholds. In addition the number of monitoring sites are indirectly proportional to the population size of the zone / agglomeration.

However the minimum number of ozone sample points is:

- 1 for zones which have a population greater than 250,000 and are deemed to be either suburban or rural areas;
- 1 for an agglomerations which have a population greater than 500,000 and are deemed to be either urban or suburban;

- 1 rural background station per 50,000km[2] of member state land area;
- 1 rural background station per 25,000km[2] of complex terrain in member state land area;
- 1 rural background station per 100,000km[2] of member state land area, where long-term objective is met.

Where the long-term objective is met within a zone or agglomeration the minimumnumberofsamplingpointsforfixedmeasurements can be reduced to one a third of that stated above.

Minimum number of diffuse source sampling points

Both the CAFE and 4th Daughter Directives have specific criteria for a minimum number of diffuse sources sampling points in zones and agglomerations, where fixed measurements are the sole source of information, in order to assess compliance with the following:

- Limit values for NO_2, CO, PM_{10}, Pb, SO_2,Benzene
- $PM_{2.5}$ exposure
- Target values for As, Cd, Ni & B(a)P
- Target values for Ozone

When monitoring for nitrogen dioxide, particulate matter, benzene and carbon monoxide where upper assessment threshold have been exceeded, it is a requirement that at least one urban background monitoring station and one traffic-orientated station are in place. Though this is only a requirement when there are two or more fixed sampling points.

In any Member state when monitoring nitrogen dioxide, particulate matter, benzene and carbon monoxide, the total number of urban-background stations sampling diffuse sources and the total number of traffic oriented stations shall not differ by more than a factor of 2.

Sampling points must be maintained if the limit value for PM_{10} has been exceeded within the last three years, unless location is necessary owing to special circumstances, in particular spatial development.

Where $PM_{2.5}$ and PM_{10} are being measured at the same rural background locations these measurements shall count as two separate sampling points.

The total number of $PM_{2.5}$ and PM_{10} sampling points in a Member State required under Section A (1) shall not differ by more than a factor of 2.

When monitoring for As, Cd, Ni and B(a)P at least one urban-background station should be included. When monitoring for B(a)P at two or more sample sites then one traffic-oriented station should be included.

Table 3-5Minimum Number of Sample Points for Diffuse Sources within an agglomeration or zonerequired under both 2008/50/EC(Annex V)and 2004/107/EC (Annex V)

Minimum Number of Sample Points for Diffuse Sources within an agglomeration or zone								
Population of agglomeration or zone (thousands)	If maximum concentrations exceed the upper assessment threshold				If maximum concentrations are between the Upper and lower assessment thresholds			
	Pollutants	PM (2)	As,	B(a)P	Pollutants	PM (2)	As,	B(a)P

<table>
<tr><th></th><th>except PM</th><th>(sum of PM_{10} and $PM_{2.5}$)</th><th>Cd, Ni</th><th></th><th>except PM</th><th>(sum of PM_{10} and $PM_{2.5}$)</th><th>Cd, Ni</th><th></th></tr>
<tr><td>0 – 249</td><td>1</td><td>2</td><td rowspan="3">1</td><td rowspan="3">1</td><td>1</td><td>2</td><td rowspan="3">1</td><td rowspan="3">1</td></tr>
<tr><td>250 – 499</td><td>2</td><td>3</td><td>1</td><td>2</td></tr>
<tr><td>500 – 749</td><td>2</td><td>3</td><td>1</td><td>2</td></tr>
<tr><td>750 – 999</td><td>3</td><td>4</td><td rowspan="3">2</td><td rowspan="3">2</td><td>1</td><td>2</td><td rowspan="3">1</td><td rowspan="3">1</td></tr>
<tr><td>1,000 – 4,499</td><td>4</td><td>6</td><td>2</td><td>3</td></tr>
<tr><td>1,500 – 1,999</td><td>5</td><td>7</td><td>2</td><td>3</td></tr>
<tr><td>2,000 – 2,749</td><td>6</td><td>8</td><td rowspan="2">2</td><td rowspan="2">3</td><td>3</td><td>4</td><td rowspan="2">1</td><td rowspan="2">1</td></tr>
<tr><td>2,750 – 3,749</td><td>7</td><td>10</td><td>3</td><td>4</td></tr>
<tr><td>3,750 – 4,749</td><td>8</td><td>11</td><td>3</td><td>4</td><td>3</td><td>6</td><td>2</td><td>2</td></tr>
<tr><td>4,750 – 5,999</td><td>9</td><td>13</td><td>4</td><td>5</td><td>4</td><td>6</td><td>2</td><td>2</td></tr>
<tr><td>> 6,000</td><td>10</td><td>15</td><td>5</td><td>5</td><td>4</td><td>7</td><td>2</td><td>2</td></tr>
</table>

Minimum number of sampling points for fixed measurements of concentrations of ozone

The number of sampling points for fixed measurements of ozone in each zone or agglomeration within which measurement is the sole source of information for assessing air quality shall not be less than the minimum number of sampling points specified in table 3-6 below.

Table 3-6Minimum Number of Sample Points for fixed measurements for zones and agglomeration attaining the long-term objectives required under 2008/50/EC(Annex V)

Minimum Number of Sample Points for fixed measurements for zones and agglomeration attaining the long-term objectives			
Population of agglomeration or zone (thousands)	Agglomerations (urban and suburban) or zone (thousands)	Other zones (suburban and rural)	Rural background
< 250		1	1 station/ 50,000km^2 as an average density overall zones per country
< 500	1	2	
< 1,000	2	2	
< 1,500	3	3	
< 2,000	3	4	
< 2,750	4	5	
< 3,750	5	6	
> 3,750	One additional station per 2 million inhabitants	One additional station per 2 million inhabitants	

When sampling in agglomerations at least 50% of the stations shall be located in suburban areas, and within suburban areas at least one station should be located where highest exposure of the population where likely to occur.

When sampling at a rural background with complex terrain, at least one monitoring site per 25,000km^2 is recommended.

In zones and agglomeration where the long-term objectives are attained, then the number of stations located in agglomerations and other zones may be reduced to one-third of the number specified in Table 3-6 above. The residual number of sampling points for ozone shall be combined with supplementary assessment information (e.g. air quality modelling and collocated nitrogen dioxide measurements) in order to sufficiently examine the trend of ozone pollution and check compliance with the long-term objectives.

In cases where the sole source of information is from fixed measurement stations, then at least one monitoring station shall be kept. In zones with no remaining O_3 monitoring station, though supplementary assessment information is available, then coordination with the number of stations in neighbouring zones should be made to ensure that adequate assessment of ozone concentrations against long-term objectives are undertaken.

The minimum number of rural background stations shall be one per 100,000km^2 of land area.

3.10. Minimum number of point source sampling points

When determining the number of fixed measurement sampling points for assessing the contribution of pollution in the vicinity of point sources, the following should be taken into account:

Emission densities - where is the pollution coming from and which are the areas with the greatest pollution emissions?

Likely distribution patterns of ambient air pollution - how dispersed is the pollution, where is it most and least concentrated?

Potential exposure of the population - where are members of the public at greatest risk of being exposed to poor air quality.

3.11. Compliance with the PM2.5 Exposure Reduction Target

In order to assess compliance with the $PM_{2.5}$ exposure reduction target for the protection of human health a minimum number of sampling points for fixed measurement has been set. This has a maximum ceiling of one sampling point per million inhabitants. These can be summed overagglomerations and additional urban areas in excess of 100,000 inhabitants shall be operated for this purpose. Those sampling points may coincide with sampling points required to assess impact upon human health.

3.12. Protection of Vegetation

Specific criteria have been provided within Section C of Annex V of the CAFE Directive for a minimum number of sampling points for the Protection of Vegetation in zones other than agglomerations. Where maximum concentrations exceed the upper assessment threshold,then there should be a minimum of 1 station every 20,000km^2, whereas if maximum concentrations are between upper and lower assessment threshold there need only be a minimum of station every 40,000km^2.

3.13. Measurements at Rural Background Locations

In addition to the assessment of pollutants for purposes of protection of both human health and ecosystems, fixed measurements shall be made at rural background locations away from significant sources of air pollution. These are required for the purposes of assessing possible contribution from long-range transport of air pollutants, and should, as a minimum, include information on the total mass concentration and the chemical speciation concentrations of fine particulate matter ($PM_{2.5}$) on an annual average basis.

Measurements at rural locations are required to meet the following criteria:

- That there is one sampling point every 100,000 km^2.
- Member States may set up one or in agreement with adjoining Member States, several common measuring stations, covering the relevant neighbouring zones, to achieve the necessary spatial resolution.

- Where feasible, monitoring should be coordinated with the monitoring strategy and measurement programme of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP).
- Measurement of $PM_{2.5}$ must include at least the total mass concentration and concentrations of appropriate compounds to characterise its chemical composition. As a minimum, the following shall be included: SO_4^{2-}, Na^+, NH_4^+ Ca^{2+} NO_3^-, K+ Cl^-, Mg^{2+}, organic carbon, elemental carbon.

3.14. Data quality objectives for ambient air quality assessment in EU directives

Minimum requirements for the quality of data acceptable to Directive 2008/50/EC are termed Data Quality Objectives. These include uncertainty, minimal data capture and minimal time coverage.

Fixed measurements of monitoring ambient air quality are required where a pollutant species has been identified as exceeding the upper assessment threshold (as set out in part A Annex II of the CAFÉ Directive). Where a pollutant concentration is well below the lower assessment threshold (as set out in part A, Annex II of the CAFÉ Directive) then it is acceptable to use indicative measurement method.

Data Quality Objectives for fixed measurements (long-term), such as a permanently located continuous monitor are set out in Table 3-7, and data quality objectives for indicative measurements (short-term) are set-out in Table 3-8.

Random measurements may be appliedinstead of continuous measurements for benzene, lead and particulate matter to the Commission if they can demonstrate that:

- the combined uncertainty of random sampling and measurements for benzene, lead and particulate matter, meets the quality objective of 25%;
- the time coverage is still larger than the minimum time coverage for indicative measurements; and
- Random sampling is evenly distributed over the year in order to avoid skewing of results.

When using indicative measurements for benzene, data quality objectives are less stringent, and only a one day random measurement a week must be taken, which must be evenly distributed over the year, or eight weeks evenly distributed over the year. Though when using a fixed measurement, the minimal time coverage must be distributed across the year to be representative of various conditions for climate and traffic.

When using indicative measurements for SO2, NO2 and NOx and CO and particulates then a one day random measurement a week must be taken, evenly distributed over the year, or eight weeks evenly distributed over the year.

The uncertainty due to random sampling should be determined by the standard ISO 11222 (2002) 'AirQuality — Determination of the Uncertainty of the Time Average of Air Quality Measurements'.

Where random measurements are used to assess compliance of the PM_{10} limit value, then compliance with the daily limit of 50 $\mu g/m^3$ PM_{10} (which is highly influenced by data coverage) should be assessed from the 90.4 percentile (to be lower than or equal to 50$\mu g/m^3$), instead of the number of exceedances.

Minimum data capture as well as time coverage are not calculated using any losses of data which are due to the regular calibration or the normal maintenance of the instrumentation. Though any losses of data due to instrument failure, repair or baseline drift are included within the minimum data capture and time coverage calculation.

Table 3-7Data quality objectives for the fixed measurement of ambient air quality assessment in National Networks

Objective Criteria	SO_2, NO_2 and NOx and CO	Benzene	PM_{10}, $PM_{2.5}$ and Pb	Ozone and related NO and NO2	B(a)P	AS, Cd, & Ni	PAH’s other than B(a)P, total gaseous Hg	Total Deposition
	Fixed Measurements							
Uncertainty	15 %	25 %	25 %	15 %	50 %	40 %	50 %	70 %
Minimum data capture	90 %	90 %	90 %	90 % during summer	90 %	90 %	90 %	90 %
				75 % during winter				
Minimum time coverage					33 %	50 %		
- Urban Background and traffic	-	35 %	-	-				
- Industrial sites	-	90 %	-	-				

Table 3-8 Data quality objectives for indicative measurement of air quality assessment in National Networks

Objective Criteria	SO_2, NO_2 and NOx and CO	Benzene	PM_{10}, $PM_{2.5}$ and Pb	Ozone and related NO and NO_2	B(a)P	AS, Cd, & Ni	PAH’s other than B(a)P, total gaseous Hg	Total Deposition
	Indicative Measurements							
Uncertainty	25 %	30 %	50 %	30 %				
Minimum data capture	90 %	90 %	90 %	90 %				
Minimum time coverage	14 %	14 %	14 %	> 10 % during summer	14 %	14 %	14 %	33 %
Objective estimation Uncertainty	75 %	100 %	100 %	75 %				

3.15. QUALITY ASSURANCE FOR AMBIENT AIR QUALITY ASSESSMENT: DATA VALIDATION

Monitoring data collected from EU national networks are required to be collected from frequently calibrated devices, fully validated and ratified, and subject to scrutiny against data from monitoring stations nearby.

All networks are required to operate to minimal quality standards which allow data to meet data quality objectives.In order to meet minimum quality assurance and quality control criteria, air quality networks operate within parameters set out in their respective national quality plans. These form the foundationupon which acceptable precision, accuracy, completeness, comparability, and representativeness can be determined if not assured(Table 3-9). National quality plans require the following criteria to be determined:

Table 3-5 Foundation of a National Air Quality Monitor Plan

Foundation of a National Air Quality Monitoring Plan	
Quality Control Procedure	Data scrutiny and instrument performance checks & maintenance procedures, including calibrations & flow-checks
Quality Assurance	Audit procedures involving external review and internal personnel. Requires Assesses effectiveness of the QC program • Data quality, • Data completeness, • Data accuracy, • Data precision, and • representativeness of data.
Analyzer Zero and Span Verifications	Fort-nightly rapid checks of monitoring device responses using ‘zero-air’ and analytical standards
Calibrations	Routine multi-point calibrations of monitoring devices against suitable analytical standards
System Audits	Third party checks on written procedures, data recording, data storage, handling, calculation methods and reporting
Equipment Service and Repairs	Routine (6-monthly) servicing of all instruments and monitoring station infrastructure. Establishment of service contracts with specialist supply companies, with set response times to repair all instrument failures or replace instruments
Future Network Intercalibration and site audits	Check network conformity by calibrating all devices against a universal reference, i.e. national reference standard. Devices must conform within the maximum margin of deviation. Check operation and condition of all monitoring sites through annual audits
Inter-calibration Procedures	Clear written SOP for all intercalibrations, use of reference standards and criteria with which to reject a device on poor performance
Data ratification	Screening data against minimum criteria, scaling against long-term drift, removal of suspect or invalid data, verification against other relevant data

All monitoring data are required to be traceable to a national primary reference standard, where calibration standards certify standards with a known minimal standard preparation tolerance.

Measurements need to be collected and calculated in such a way as to be of a known and documented quality.

All data shall be comparable, meaning that the data shall be produced in a similar and scientific manner using standard methodologies for sampling, calibration, auditing, and collection of data.In order to assure that measurements are comparable designated reference or equivalent methods compliant to CEN Standard requirements are required to be used.

All data shall be representative of the parameters being measured with respect to time, location, and the conditions from which the data are obtained. The use of standard methodologies contained in this manual should insure that the data generated is representative.

3.16. Reference methods for assessment of concentrations and standardization

Ambient air reference methods provide concentration data which is of known (or traceable) accuracy, precision, repeatability and uncertainty. As they are universally applied, they therefore provide a standardised approach to obtaining ambient air quality data. The CAFÉ and Fourth daughter directive has stated strict data quality objectives which are easily achievable using reference methods. In addition both the CAFÉ and Fourth Daughter Directives require measurement to be made using a reference (or equivalent) detection method.

When designing an ambient air quality monitoring network which meets the requirements of both the CAFÉ and Fourth Daughter Directive careful selection of monitoring equipment is essential.A reference measurement method for each pollutant species is available from CEN, or is in the process of being completed by CEN (e.g. EN 12341 for the measurement of PM_{10}).

A primary requirement in both the CAFÉ and Fourth Daughter Directive is the principle that a sampling operation should be able to demonstrate compliance with the limit and guide values as stated in the Directives. This means that detection limits and averaging times must be suitable. Non-reference methods may not allow sample averaging times to comply with the limit and guide values.

Likely future needs for monitoring, in terms of shorter averaging periods and/or lower detection limits, should also be borne in mind.The need to use data for purposes other than the estimation of compliance, e.g. the assessment of air quality in relation to health effects, the dispersion of pollutants and the validation/calibration of models, should also be borne in mind. Other important factors to be considered in the selection of monitoring equipment are outlined in Table 3-10 below.

Table 3-6 Important Factors to be considered when Selecting Monitoring equipment

Important factors to be considered in the selection of monitoring equipment
Ease of use
Expandability (mainly for data processing equipment)
Reliability
Durability
Compatibility with any existing hardware or software
Availability of training and documentation (including circuit diagrams)
Availability of spares, warranties and after-sales services (maintenance and possibly calibration)

3.17. EU Requirements for Reference Methods

The required reference methods of measurement for air quality pollutants (specified in Annex VI of Directive 2008/50/EC) are based upon Standard Methods developed by CEN and are outlined in Table 3-11 below:

Table 3-7CEN Air Quality Standard Method

Pollutants	Referencestandard	Method Description	Year
(NO_x)	EN14211:	Chemiluminescence Detection	2005
(SO_2)	EN14212:	Fluoresence Detection	2005
(O_3)	EN14625:	UV Photoionisation	2005
(CO)	EN14626:	Infra Red Detection	2005
(PM_{10})	EN12341:	Gravimetric determination by weight difference	1999
($PM_{2.5}$).	EN14907:	Gravimetric determination by weight difference	2005
(Benzene)	EN14662	Gas chromatography and photo ionisation Detection	2005
PAH’s and B(a)P	EN12884	High Volume Sampling and detection usingGas Chromatography / Mass Spectrometry	2005
Pb, As, Cd & Ni	EN14902	Pumped samples onto a filter and determination by Inductively Coupled Plasma Atomic Absorption/ Atomic Absorption	2005
Gaseous Mercury	EN 15852	Fluorescence Detection	

Member States may also use any other methods which it can demonstrate give results equivalent to the above methods.

These standards describe in detail how analysers are to be tested, approved for use, calibrated and their ongoing performance determined. These harmonised procedures allow Member States to reliably and consistently quantify the uncertainties associated with their measurements of air pollution. CEN, through the various Working Groups, continue to revise and improve the Standards as new information becomes available.

For the gaseous analysers, the relevant Standard Methods include a requirement for type testing and approval.

For particle monitoring (PM_{10} and $PM_{2.5}$) compliance is achieved by either using a reference method device or ensuring that all analysers used in the network have been demonstrated as satisfying the compliance criteria whilst operating within the Member state and proven to be equivalent to the reference methods. The details of the compatibility test with a reference procedure are contained in both the method document EN 12341.1:1998 and EN14907: 2005.

3.18. Type Approval of Analysers for National Networks

All analysers and samplers used in the national networks are required to be Type approved devices.

For an analytical method to comply with a CEN standard it must undergo a ‘type-approval test’ in order to meet the minimum requirement within a set of performance characteristics.

Individual gas analyser type approval compliance tests carried out are contained in table 3-12 below.

Table 3-8Individual Gas Analysers Laboratory and Field Compliance Tests

Laboratory tests:	Field tests:
Short-term drift of instrument Response times to Concentration change	Reproducibility between two analysers in over 3 months
Repeatability at zero concentrations and limit value	Long-term drifts of instrument
Lack of fit	Period of unattended operation.
Sample gas pressure sensitivity Sample temperature sensitivity	Percentage time the analyser is available for measurements
Sensitivity to electrical voltage	
Analyser temperature sensitivity to the surrounding temperature	
Sensitivity to interfering substances	
Averaging Tests	
Molybdenum converter efficiency (NOx)	
Sample and span inputs differences.	

In addition to achieve compliance an overall expanded uncertainty of the measurement result is required, this is based on the output from the relevant performance characteristics. Expanded uncertainties are assessed against the maximum uncertainty in the Directive’s Data Quality Objective (Table 3-7).

3.19. Relative Uncertainty of Analyser measurements

Instrument uncertainty is calculated using a combination of laboratory instrument performance characteristics and field test data.Uncertainty (expressed at a 95% confidence level) of the assessment methods will be evaluated in accordance with the principles of the CEN Guide to the Expression of Uncertainty in Measurement (ENV13005-1999), the methodology of ISO5725:1994 and the guidance provided in the CEN report ‘Air Quality—Approach to Uncertainty Estimation for Ambient Air Reference Measurement Methods’ (CR14377:2002E).

Measurement uncertainty given in Table 3-7and Table 3-8 above are given for both fixed and indicative individual measurements averaged over the period considered by the limit value (or target value in the case of ozone), for a 95% confidence interval.

The uncertainty for the fixed measurements shall be interpreted as being applicable when measuring at a concentration close to the appropriate limit value (or target value in the case of ozone). Expanded uncertainties for measurements are assessed against Data Quality Objectives (Table 3-7) which for fixed measurements are typically 15% for gas analysers and 25% for particulate monitors and benzene analyser, 50% for the determination of B(a)P and gaseous Hg, 40% for heavy metals (As, Cd & Ni) and 70% for total deposition.

3.20. Reporting and communication

Among the principal obligations of Member States are information and reporting requirements. These include the requirement toinform the public of:

- cases where the air quality alert thresholds are exceeded;
- the identity of competent authorities and bodies responsible for implementing the directive; and
- theplans and programmes for attaining limit value in zones where prescribed limit values have been exceeded.

Where there is a risk of air quality limit values being exceeded following significant pollution originating in another Member State, then State must communicate this risk to that neighbouring State with a view to finding a solution.

Table 3-13 below contains an outline of the Air Quality annual report required by the European Commission from each Member state.

Table 3-9Required to be Reported to the European Commission by Member States

Member states are required to report to the Commission on
Competent authorities and bodies responsible for implementing the directive;
National standards, criteria and techniques that are more stringent than Community standards or that relate to pollutants not covered by Community legislation;
Lists of zones and agglomerations drawn up pursuant to Articles 8 and 9;
Methods used for the preliminary assessment of air quality;
Cases where limit values and alert thresholds are exceeded, and reasons for the occurrence;
Plans and programmes adopted pursuant to Article 8, and (every three years) progress in implementing the plans or programmes;
Measures taken to attain target value for zone that exceeds that set by the Commission;
Transposition, with texts of the main provisions of national law adopted in the field covered by the directive (Art. 13); and
Every three years, information on reviews of the levels in zones and agglomerations referred to in Articles 8 and 9 of the Directive

Complete and efficient data collection and reporting are essential components of air quality management. Air Quality Directives requiring air quality monitoring to be undertaken impose a duty to report to the Commission on their implementation and to report the results and the degree of compliance to both the Commission and the public. The format of this reporting is specified by Directive 91/692/EEC on standardising and rationalising reports on the implementation of certain directives relating to the environment, which amends the reporting requirements in original directives.

Competent authorities are required to ensure that reporting is undertaken in accordance with the requirements of this directive.

Data should be subject to quality control before it can be accepted as part of an archive of data, which can then be used for the analysis of high pollution episodes or the detection of trends in air quality over time. Where data needs to be supplied rapidly (for example, to warn the public regarding ozone levels) it may be impossible to complete all the quality assurance procedures. Where this occurs, the data should be accompanied by a statement to this effect.

Data on emission rates from sources (and surrogate data such as traffic flows) are also of value, for example in building up a picture at the national and regional level of the causes of high pollution episodes.

4. REVIEW OF LEGISLATION AND ORGANIZATION OF AIR QUALITY MONITORING AND ASSESSMENT IN GEORGIA

4.1. LEGISLATIVE BACKGROUND OF GEORGIAN AIR QUALITY MONITORING NETWORK

In Georgia, issues related to ambient air quality monitoring and assessment are regulated collectively by the Framework Law on Environmental Protection, the Law on Atmospheric Air Protection and a number of relevant sub-laws (regulations).

In accordance with Article 27, TitleVII of the Framework Environmental Protection Law, the System of Ambient Environment Quality Monitoring is the:

> *‘combination of analysis and prognosis of information received through regular observations on ambient environmental quality’.*

The Ministry of Environmental and Natural Resources Protection and Natural Resources is required coordinate the national ambient air quality network and enable all environmental quality monitoring results, including air quality monitoring to be made accessible to the general public.

The operational approach taken to establish the national ambient air quality monitoring network currently operating in Georgia[7]has been set out in both the ‘Guidelines for Air pollution Control’ (РД 52.04.186-89), which was developed by the Main Geophysical Observatory of St. Petersburg, and Guidance Documents РД 52. 04-56-89 and РД 52. 04-57-95, these set out the following:

- Network design
- Network minimal operating standards
- Ambient air sampling methods
- Chemical analysis methods of ambient air pollutants
- Minimal requirements for data storage and processing
- Data analysis and reporting

A national Environmental Information and Education Centre (hereafter, the “Centre”) was established in 2013 on the basis of Aarhus Centre, through an amendment to the Framework Law on Environmental Protection(paragraph 2, article 8).The Centre was given the specific responsibilities of both raising environmental awareness and improving the technical skills of environmental specialists in Georgia. In addition(in accordance with article 271) the Centre is tasked to collect and disseminate information on the state of environment.

> Article 20, Title VII of the Air Protection Law,**Ambient Air Quality Monitoring** is defined as: “*a system of routine air quality data collection, analysis and forecast/prognosis”.*

It is a part of the overall system of the ambient environment monitoring, carried out by the National Environmental Agency, Ministry of Environment and Natural Resources Protection on a regular basis.

In Table 4-1, below is an outline of current national legislation relevant to ambient air quality monitoring in Georgia. A more detailed summary is provided in Appendix A at the end of this report

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[7]Guiding documents are available at: http://ohranatruda.ru/ot_biblio/normativ/data_normativ/44/44486/

Table 4-1Outline of Legislative Documents Addressing Ambient Air Quality Monitoring and Assessment in Georgia

Title	Category	Status	Issues regulated/addressed
Law on Environmental Protection, Title VII, Article 26, 27, 27[1]	Law	Effective	***Title VII contains***general provisions on collecting, storing and disseminating environmental information. More specifically: Article 26 defines components and responsible parties for maintaining state environmental registries (managed and coordinated by the Ministries of Environment, Agriculture and Health). Article 27 defines the system for ambient environmental quality monitoring and charges the Ministry of Environment an Natural Resources Protection with overall coordination of the system Article 271 tasks the Center for Environmental Information and Education to collect available environmental information and make it available to the general public
Law on Atmospheric Air Protection, TitleVII, Article 20, 21; TitleXIV, Article 51	Law	Effective	***TitleVII contains:*** General provisions on organizing ambient air quality monitoring systems.***Title XIV contains:*** Provisions related to public access and availability of air quality information.
Order of the Minister of Environment and Natural Resources Protection on the List of the Settlements Subject to Calculation of Annual Pollution Indices (November 2013)	Sub-law: Order	Re-approved	This order contains a list of settlements, for which pollution indices should be calculated annually.
# 484 Order of the Government on the Rules for Calculating Air Pollution Indices and Defining Values for Pollution Indices for Extremely Polluted, Significantly Polluted, Polluted and Unpolluted Settlements, Classified in Accordance with Pollution Levels (31/12/13)	Sub-law: Order	Effective	This regulation defines rules and methods for calculating pollution indices.
#297 Order of the Minister of Labour, Health and Social Protection on Ambient Environment Quality Standards (16/08/01), as amended by #38 (2003) and 350 (2010) orders	Sub-law: Order	Effective, Amended by #38 and 350	This regulation contains: Goals and objectives for Maximum Allowable Concentrations

		regulations	(MACs)
Joint Order of the Ministers of Health and Environment on Setting Ambient Air Quality Standards in Accordance with 2008/50/EC and 2004/107/EC Directives	Sub-law: Order	Current National Legislation	This regulation will set ambient air quality standards in accordance with EU air directives
Order of the Minister of Environment Protection on Setting Rules and Requirements forMinimum Number, Location and Operations of Ambient Air Quality Monitoring Sites as well as for Standard Measurement Methods	Sub-law: Order	Current National Legislation	This regulation will set requirements for defining minimum number and location of monitoring sites, as well as rules for operating and standard measurement methods.
# 408 Order of the Government on Approval of the Method for Calculation of Emission Limits for Stationary Sources (31/12/13)	Sub-law: Order	Effective	This regulation contains a methodology for calculating emission limitsfor all stationary sources subject to EIAand Environmental Impact Permitting.
# 42 Order of the Government on Approval of the Rules for Emission Inventories from Stationary Sources (06/01/14)	Sub-law: Order	Effective	This regulation defines rules for carrying out emission inventories for stationary sources not subject to EIA and Environmental Permitting.
# 413 Order of the Government on the Approval of the Rules of Self-Monitoring and Reporting of Annual Emissions from Stationary Sources (31/12/13)	Sub-law: Order	Effective	This instruction defines rules for emissions self-monitoring (accounting) and reporting by owners/operators of stationery sources
# 435 Order of the Government on instrumental method for determination of actual amounts of emissions into ambient air from stationary pollution source, standard list of emission measuring equipment, and methodology for calculation of actual amounts of emissions into ambient air from stationary pollution source according to technological processes(31/12/13)	Sub-law: Order	Amended and Re-approved	This regulation contains measurement methods for pollutants’ emissions at source Sampling and analysis requirements List of measurement (sampling and analysis) equipment Pollutants’ emission estimation/calculation methods Emission factors for various industrial activities/processes
CLRTAP	Multi-lateral treaty: convention	Effective	Sets out reporting requirements for emissions of pollutants regulated by CLRTAP
Guidelines for Air Pollution Control, RD 52.04.186-89, «Руководствопоконтролюзагрязнениеатмосферы» РД 52.04.186-89; Guidance Documents: РД 52. 04-56-89 and РД 52. 04-57-95	Technicalguidance		These documents set out: Design and operating standards, rules and procedures for air quality monitoring network, including requirements for siting, minimum number and classification of monitoring stations/points

4.2. AIR QUALITY CRITERIA FOR AMBIENT AIR AND DELIMITING REGIONS ACCORDING TO THE STATUS OF AIR QUALITY

In terms of national air quality, Georgian Regions have been divided into regions several categories/classes based on ambient air pollution levels as set out in Article 20, Title VII of the Law on Atmospheric Air Protection Georgian. These classes are:

I. Extremely polluted regions;

II. Significantly polluted regions;

III. Polluted regions; and

IV. Non-polluted regions.

In terms of classifying pollution levels, a generic pollution term has been defined, based on the values of Pollution Indices for air pollutants.

This Pollution Indices was specifically defined in a Governmental Order(# 484) which set out rules for calculating pollution indices.

The pollution index is calculated based on the following formula:

$$I=\sum_{i=1}^{n} (q_i/MAC_i)*c_i$$

Where:

qiis an annual average concentration (mg/m^3) of the pollutant of the i-th order, calculated by dividing the sum of values of single measurements to the number of measurements;

MACi – average daily Maximum Allowable Concentration for the substance of the i-thorder(mg/m^3);

n – number of pollutants;

ci –hazard coefficient (constant) of the i-th order substance adjusted to the hazard index of the Sulphur dioxide.

For the 1st, 2nd, 3rd and 4thhazard4thhazard class/rank substances hazard coefficient (constant) equals to 1.7, 1.3, 1.0 and 0.9, respectively.

In order to calculate the overall pollution index, the five pollutants with the highest individual pollution indices are required.

In order to ensure the reliability of the pollution index, it is necessary to have at least 75% of required annual measurements. Furthermore, measurements should meet the following minimum requirements:

i. the duration of single (one-time) measurement should be 20-30 minutes;

ii. minimum number of measurements should be 4 within 24-hour period;

iii. maximum time lag (interval) between two measurements should be 6 hours;

iv. measurements should be conducted at 01:00hr,07:00hr, 13:00hr and 19:00hr.

Table 4-2 contains the values/ranges of pollution indices as assigned to each class of the region, in accordance with pollution levels:

Table 4-2 Pollution Indices of Regional Pollution Classes

Classes of Regions, Based on Pollution Levels	Pollution Index, I
Clean/unpolluted region	I ≤ 5
Polluted region	5<I ≤ 8
Significantly polluted region	8<I≤15
Extremely polluted region	I>15

Pollution indices are required[8]to be calculated for both administrative districts (municipalities) and settlements based on air quality monitoring data. The municipalities and settlements to be selected for pollution indices calculation are identified by the magnitude of their pollution levels.

The settlements contained in Table 4-3are subject toan annual calculation of pollution indices in accordance with the November 2013 Order of the Minister of Environment:

Table 4-3Population Size of GeorgianCities Subject to Calculation of Annual Air Pollution Indices[9]

Settlement	Population Size	Year	Region
Tbilisi	1,171.200	2013	Tbilisi
Kutaisi	196,500	2013	Imereti
Rustavi	122,500	2013	KvemoKartli
Batumi	160,000	2013	Ajara
Zestaphoni	24,158[10]	2002	Imereti

These are the largest cities of Georgia with population size ranging from about 25,000 (Zestaphoni) to 1.2 million (Tbilisi).

The National Environmental Agency (NEA), Legal Entity of Public Law under The Ministry of Environmental and Natural Resources Protection and Natural Resources Protection (MoENRP), in charge of ambient air quality monitoring in Georgia is obliged to publish a list of the regions and settlements classified in accordance with pollution levels together with relevant pollution indices before 1st of March of each year.

[8]In accordance with the article 20, Title VII of the Law on Atmospheric Air Protection

[9] Source: Population Size of Georgia, 30.04.13, Statistical Service of Georgia (GEOSTAT), http://www.geostat.ge/cms/site_images/_files/georgian/press/Population%20press_30.04%20Geo.pdf; http://ka.wikipedia.org/wiki/%E1%83%A1%E1%83%90%E1%83%A5%E1%83%90%E1%83%A0%E1%83%97%E1%83%95%E1%83%94%E1%83%9A%E1%83%9D%E1%83%A1_%E1%83%A5%E1%83%90%E1%83%9A%E1%83%90%E1%83%A5%E1%83%94%E1%83%91%E1%83%98

[10]This figure is based on 2002 census data

4.3. Maximal allowable concentrations (MAC) in ambient air in Georgia and its averaging periods

Ambient environment quality standards in Georgia are set out in the # 297 Order of the Minister of Labour, Health and Social Protection on Ambient Environment Quality Standards.

The standards are set as maximum allowable concentrations (MACs) of a number of harmful substances in the ambient air. The MACis defined as the concentration of a single substance into the ambient air (averaged for a specific time period), below which the given substance does not affect human health over a regular period or lifetime exposure.

There are two types of MACs established:

a) one-time maximum concentration with an averaging time of 30 minutes;
b) mean 24-hour concentration with an averaging time of 24 hours.

The first type MAC is related to the short-term acute health risks/effects of human exposure to specific chemical substance and the second – to the long-term chronic health risks/effects of human exposure to a specific chemical substance.The minimum time period of a single measurement is 20-30 minutes and minimum number of daily measurementsis 4.

Values obtained through single measurements (20-30 minute averaging time) are compared to one-time maximum limit values and, daily averages of single measurements – with 24-hour average limit values. Annual average values of pollutant concentrations are also calculated and compared with daily average MACs.

The order # 38 of the Minister of Health sets MACs for 605 substances, including some of the pollutants regulated by EU directives.[11]Table 4-4 below contains MACs for substances regulated by EU directives as well as for pollutants specific to certain Georgian cities (e.g. manganese):

Table 4-4Maximum Allowable Concentrations (MACs)for Selected Chemical Substances

Substance	Chemical Formula	MAC (mg/m^3)	
		One-time maximum (averaging time: 20-30 min.)	Daily average (averaging time: 24 hours)
Nitrogen oxide (II)	NO	0.4	0.06
Nitrogen dioxide (IV)	NO_2	0.2	0.04
Sulphur dioxide	SO_2	0.5	0.05
Carbon monoxide	CO	5	3
Ground-level Ozone	O_3	0.16	0.03
Dust (TSP)	TSP	0.15	0.05
Lead and its inorganic compounds (calculated based on Pb content)	Pb	0.001	0.0003
Mercury	Hg	-	0.0003
Arsenic and its inorganic compounds (calculated based on As content)	As	-	0.003
Cadmium and its inorganic compounds (calculated based on Cd content)	Cd	-	0.0003
Manganeseand its compounds	Mn	0.01	0.001

[11]The regulation bans emissions of 16 substances into the air.

(calculated based on the content MnO_2)			
Nickel	Ni	-	0.001
Benzene	C_6H_6	1.5	0.05
Benzo(a)pyrene	$C_{22}H_{12}$	-	0.1 µ/100 m^3

Furthermore, the same regulation defines frequencies (%) of allowed annual exceedances of one-time MACs. These values are given in Table 4-5 below:

Table 4-5Allowed Annual Exceedances of One-time MACs

Ratio of One-time MAC to Annual Concentration	Allowed occurrence of concentrations %	
	Equal and Lower than one-time MAC	Higher than one-time MAC
10	99	1
7	98	2
6	97	3
5	96	4
4	95	5
3	90	10

For substances having impacts on human reflexes, at least 84% of annual measurements should be within the limit values. Moreover, maximum values should not exceed MACs more than 3-fold.

In accordance with Georgian Laws on Environment Protection and Ambient Air Protection air quality standards shall be determined every 5 years. However, since 2003 standards have not been renewed, except for the standard for nitrogen dioxide (NO_2). In 2010 the maximum value ofthis chemical substance was changed from 0.085 mg/m^3 to 0.2 mg/m^3, which is one hour limit value for the same substance, defined by the EU standards and recommended by the WHO.

4.4. EXISTING AIR QUALITY MONITORING AND ASSESSMENT SYSTEM IN GEORGIA

Institutional setting for air quality monitoring

The NEA, through its Department of Environmental Pollution Monitoring carries out regular observation on ambient air quality in urban areas of Georgia. Exact responsibilities of the Department include, but are not limited to:

- Organization, optimization and maintenance of ambient environmental quality monitoring network, including air quality monitoring stations;
- Collection, processing, analysis, and reporting of ambient environmental quality data.

Currently, the Department of Environmental Pollution Monitoring consists of 14 staff working on ambient air quality monitoring. Of these, only 7 staff members are 100% dedicated to air quality monitoring. The rest are involved in monitoring the quality of all environmental media, including the quality of water and soil. In addition, 1 person from the Database Department works on creating and maintaining overall database on ambient environment quality, including air quality. Telecommunications office of the NEA ensures transfer of data from field offices through e-mail or fax. Below Table 4-6, provides detailed information on human resources in the area of air quality surveillance:

Table 4-6Human Resources of the NEA, Engaged in Ambient Air Quality Monitoring

Position	Staff #	Responsibility
Head of the Ambient Environment Pollution Monitoring Department	1	Overall management and supervision of the department
Head of the Central Chemical Analysis Laboratory	1	Overall management of chemical analysis of samples; quality assurance and control
Chemist	2	Chemical analysis of air quality samples; data reading; contribution to report drafting
Technical operators	2	Technical control and maintenance of observation sites; Field expeditions and sporadic (spot checks) air quality sampling and express analysis
Field operators:	7	Data sampling and analysis, keeping logbooks, data transfer from the field to the central office
Tbilisi	2	
Rustavi	1	
Kutaisi	1	
Batumi	1	
Zestaphoni	1	
Abastumani (EMEP station)	1	
Data analyst	1	Data processing, interpretation, reporting
Database/GIS specialist	1	creating and keeping database

The NEA, inclusive all its units is financed through state budget as well as through other sources. The agency can provide different consultancy (e.g. monitoring, analysis, assessment) services to various organizations and earn revenues for these assignments. In 2013, the NEA's total state budget amounted to 3.219 million Georgian Lari (GEL), of which 2.565 million GEL (~85%) was earmarked for staff salaries.[12]NEA's state financing for 2010, 2011 and 2012 was 3.388, 2.030 and 1.770 million GEL, respectively.[13]

Air quality observation network

The current air quality monitoring network in Georgia consists of 8 air quality monitoring sites/stations located in 5 cities of Georgia. Of these, four sites are situated in Tbilisi. Other cities, including Rustavi, Kutaisi, Batumi and Zestaphoni have only 1 monitoring station each. All sites except for one are non-automated stations defined as ***"basicstationary monitoring sites"*** by the Soviet technical guidance documents. They do not meet the EU classification criteria for "urban background station". Given the majority of these sites are located on major roads; they fall under the category of "road-side monitoring stations" based on the EU criteria. There is one new automated station located in Tbilisi. It falls under the category of "urban background station" as per EU criteria for classification of monitoring sites.The following[8] pollutants are monitored regularly across the national network: TSP (dust), SO_2, NO_2, CO, O_3, Pb, MnO_2, and NO. In addition, the automated station measures PM_{10}, $PM_{2.5}$ and NO_x. Below, Table 4-7 provides the detailed information on pollutants as measured at each site in Georgia:

[12] Source: „საქართველოს 2013 წლის სახელმწიფო ბიუჯეტის შესახებ" საქართველოს კანონი. Georgian Law on 2013 State Budget.http://www.mof.ge/5211

[13] Source: State budget of Georgia for 2012. http://www.mof.ge/4623; საქართველოს 2012 წლისსახელმწიფობიუჯეტისცვლილებისპროექტი.Amendment to 2012 State Budget to Georgia.http://www.mof.ge/4623; State budget of Georgia for 2012.http://www.mof.ge/4623

***Table 4-7 Substances measured at existing stations*[14]**

Observation site	Dust	NO_2	SO_2	CO	O_3	MnO_2	NO	Pb
Tbilisi								
KvinitadzeStreet	●	●	●	●	●			●
Moscow Ave.		●		●				
TsereteliAve.				●				
VashlijvariMeteo-Station	●[15]	●	●	●	●		●[16]	
Kutaisi								
Chavchavadze Ave.	●	●	●	●			●	
Batumi								
Abuseridze street	●	●	●	●				
Zestaphoni								
Chikashua street	●	●	●	●		●		
Rustavi								
Batumi street		●		●				

Measurements of concentrations of pollutants are conducted three times a day during working days,based on methodologies presented in the following documents:

- ✓ *Guidelines on Air pollution Control*, developed by the Main Geophysical Observatory of St. Petersburg (РД 52.04.186-89 Руководствопоконтролюзагрязненияатмосферы);
- ✓ *GuidanceDocument*RD 52. 04-56-89 (Руководящий документ РД 52. 04-56-89);
- ✓ *GuidanceDocument*RD 52. 04-57-95 (Руководящий документ РД 52. 04-57-95).

Dust concentration in the air is measured by the gravimetric method with filter sampling techniques using FPP-15 filter. Determination of concentrations of NO, NO_2 and SO_2 is provided by photo-colorimetric method. Concentration of carbon monoxide is measured by electrochemical method using gas analyser “Paladi 3”. Atomic absorption method and AFA-HP-20 filters are used for sampling of lead. Photo-colorimetric method and AFA-HP-18 filters are used for measurement of manganese dioxide. The concentration of ozone is determined by “3.02 P-A” ozone analyser.

In addition to stationary measurement equipment, the Environmental Pollution Monitoring Department has portable measurement devices to carry out express analysis of pollutants’ concentrations. Below Table 4-8 liststhe equipmentused in the portable air quality measurement station:

Table 4-8List of NEA’s Portable Air Quality Measurement Equipment

Substance	Equipment
Dust	1.MICRODUST pro 880nn; 2.Kanomax
CO	Gas analyser ЭЛАН CO-50

[14] Source: მოკლემიმოხილვაგარემოსდაბინძურებისშესახებ, საინფორმაციობიულეტენი #10, 2013 წლისოქტომბერი, გარემოსეროვნულისააგენტო, გარემოსდაბუნებრივირესურსებისდაცვისსამინისტრო, http://meteo.gov.ge/radiation_pdf/35.pdf. Brief Overview of Environmental Pollution, #10 Information Bulletin, October, 2013, National Environmental Agency, Ministry of Environment and Natural Resources Protection, http://meteo.gov.ge/radiation_pdf/35.pdf

[15] PM_{10}, $PM_{2.5}$

[16] NO_x

NO_2	Gas analyser ЭЛАН NO_2-10
PAH (total hydrocarbons)	Колион-1Б

Apart from air quality monitoring sites, measuring concentrations of a limited number of pollutants, there is one regional/global background (EMEP) station in Abastumani. Itmeasures cations and anions in precipitation, and PM_{10}, Ozone and Main Ions in the air.

Information on pollutants monitored per each station and city is presented in Tables 4-9 and 4-10[17].

Table 4-9Number of measurements in each city for 2012

#	City	Number of Stations	Number of Measurements
1.	Tbilisi	4	4,477
2.	Rustavi	1	1,506
3.	Kutaisi	1	3,355
4.	Zestaphoni	1	3,361
5.	Batumi	1	2,724
	Total	**7**	**15,423**

Table 4-10Number of measurements for each pollutant in 2012 and corresponding MACs

Pollutant	Number of Measurements	MAC (mg/m^3)	
		24-hour average	Maximum
Dust	2639	0.05	0.15
Sulphur dioxide	2645	0.05	0.5
CO	4493	3.0	5.0
Nitrogen dioxide	4067	0.04	0.2
Nitrogen oxide	671	0.06	0.4
Ozone	232	0.03	0.16
Manganese dioxide	671	0.001	0.01
Lead	5	0.0003	0.001

Air quality assessment/modelling

At present, air quality modelling is not used as a complementary or supplementary tool for ambient air quality monitoring. It is mostly applied by a limited number of consulting and engineering companies or environmental NGOs duringcalculation of emission limits for emission sources subject to EIA and environmental impact permitting. These firms are engaged in calculating emission limitsand/orin compiling emission inventories. Table 4-11, below is given the list and contact informationof Georgian companies employing air quality models:

Table 4-11Companies with air quality modelling capabilityin Georgia

#	Company	Location	Contact
1	“Gamma Consulting” Ltd	17A, D. Guramishviliave., 0192, Tbilisi, Georgia	Phone: (99532) 2604433; E-Mail: gamma@gamma.ge
2	Ecolcenter	9, Al. Kazbegi Ave., 1-58 building, Tbilisi, Georgia	Phone: (99532) 967838/593313780

[17] Source: Ambient Air Pollution Yearb Book, 2012, National Environmental Agency. saqarTvelos teritoriaze atmosferuli haeris dabinZurebis weliwdeuli.garemos erovnuli saagentos garemos dabinZurebis monitoringis departamentis monacemebi. 2012 weli

3	Association for Ecological Safety	150, David Agmashenebeli Ave., Tbilisi, Georgia	Phone:(99532) 967838/593313780; (995) 593313781
4	Ltd, David Makashvili	9ª, David Makashvili Str., Gori, Georgia	Phone: (995) 599708055/599689002; E-mail: mavnia.b@mails.ru
5	Industrial Ecology	99, Tsereteli Ave., Tbilisi, Georgia	Phone:(995) 593313780
6	Guka, Ltd	6, J. Bagrationi Str., Tbilisi, Georgia	Phone: +995 (79)020110; E-mail: ubiriagenadi@yahoo.com
7	CENN	27, Betlemi Street, 0105, Tbilisi, Georgia	Phone: (+995 32) 275 19 03/04/ Fax: (+995 32) 275 19 06; E-mail:info@cenn.org

All of the above, with the exception of CENN, choose to use the dispersion model “Ecology-City-St. Petersburg”. This is based upon the Russian method OND-86: **“Calculation of concentrations of harmful substances in the atmospheric air, contained in the emissions from pollution source(s)”**.

The “Ecology-City-St. Petersburg “model can calculate maximum and mean annual surface concentrations of pollutants from either fixed or or mobile sources. The model makes use of local meteorologicaldata, where it is available.[18]However the current version of the “Ecology-City-St. Petersburg“model used in in Georgia is only able to calculatingmaximum ambient air concentrations.

In order to run the model, following input data are necessary:

- Source type: point, linear, diffused/unorganized;
- Source height above the ground level, m;
- Stack diameter for a point source, m;
- Temperature of emitted air-gas mixture, C^0;
- Emission velocity of air-gas mixture, m/s for point and linear sources;
- Volume flow rate air-gas mixture, m^3/sec for point and linear sources;
- Emission of an individual pollutant, g/s;
- Annual emission of an individual pollutant, t/y;
- Source coordinates
- Temperature stratification factor/coefficient;
- Average air temperature for hottest and coldest months,CO;
- Long-term average wind speed exceeded in the given locality in 5% of cases;
- Average temperature of the locality, CO(based on recent 10-year observation data);
- Average annual precipitation, mm (based on recent 10-year observation data);
- Local relief/terrain.

[18] Source: *http://expo.fmi.fi/aqes/public/Air_quality_monitoring_cooperation_St._Petersburg_Evaluation_report.pdf*

The “Ecology-City-St. Petersburg“ produces pollutant concentrations as output data in the form of two-dimensional grid plots, the resolution of which can be controlled by the user. Using reference coordinates, these grids are then superimposed upon charts and street maps.

This grid point pollution concentration data can be interpolated to produce smoothed contours of pollution concentration across an area map (See Figure 4-4).

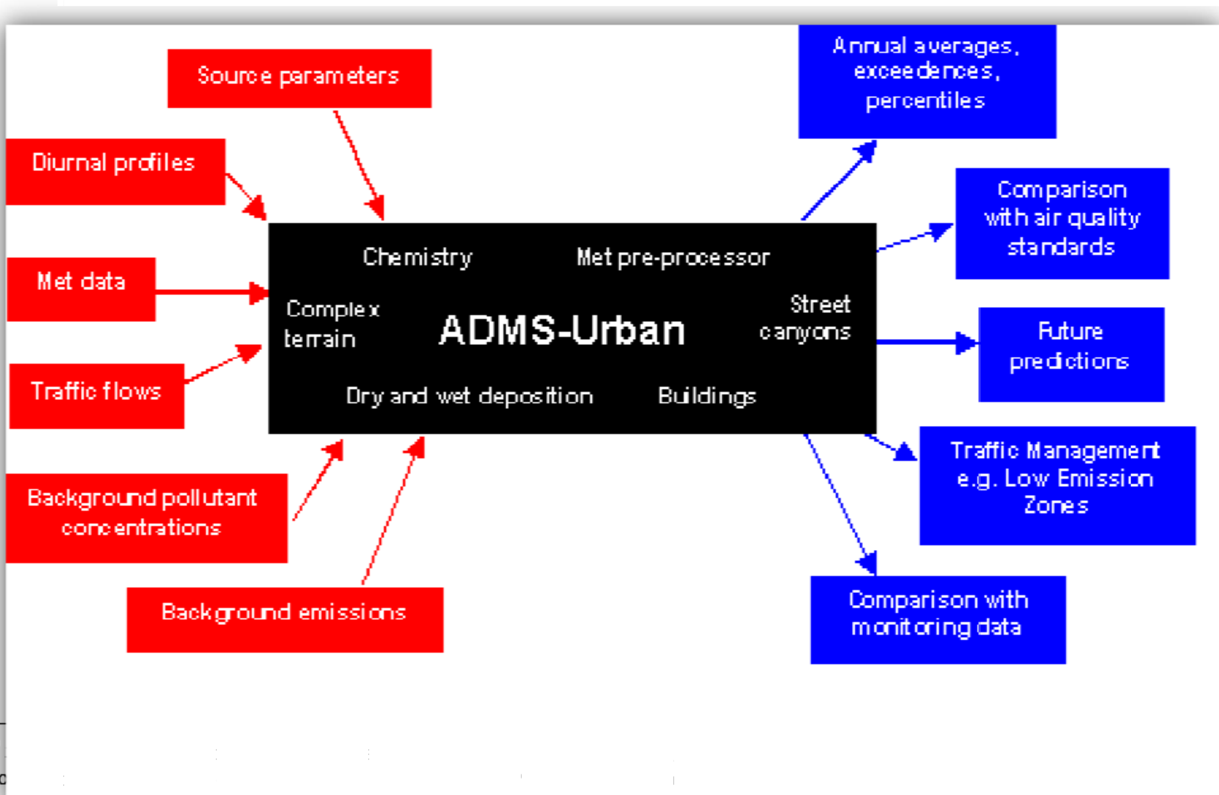
Use of the “Ecology-City-St. Petersburg“has permitted an initial assessment of air quality to be undertaken in Georgia. However, due to inherent limitations within the model, the assessment was only able to partially assess against the averaging periods required by the EU air quality objectives.[19],[20]

Under the Dutch government funded project **“Air Quality Monitoring in Tbilisi, Georgia”** (PSOM10/GE/11) aiming at establishing air quality monitoring network for the city of Tbilisi, Cambridge Environment Research Consultants (CERC)carried out emission inventory and preliminary air quality modelling of NO_x, SO_2 and PM_{10} across the city through application of **ADMS-Urban software (3.1.2 version**).

The local partner for the assignment was CENN hence; the model has been handed to this organization for future applications. In addition, the NEA as a final beneficiary has received the model.

ADMS-Urban is a joint product of CERC and UK Meteorological Office. The model combines the basic model, containing point, line, area and volume source modules, with fully integrated street canyon, complex terrain and buildings modules, a dry deposition module, a chemistry module for predicting

Figure 4-1Possible inputs and output of the model, and some of the modelling options available



[19] ... Co... Meteorological Institute, 2013.http://expo.fmi.fi/aqes/public/Air_quality_monitoring_cooperation_St._Petersburg_Evaluation_report.pdf

[20] Source: Air Quality Monitoring Cooperation. Evaluation Report.Enhancing Air Quality Monitoring in St. Petersburg through Regional Cooperation.Committee for Nature Use, Environmental Protection and Ecological Safety, St. Petersburg City Administration &Finnish Meteorological Institute, 2013.*http://expo.fmi.fi/aqes/public/Air_quality_monitoring_cooperation_St._Petersburg_Evaluation_report.pdf*

nitrogen, sulphur and ozone, and emissions database. It is based on three-dimensional quasi-Gaussian dispersion model. ADMS-Urban can describe in detail what happens from the street scale to the city-wide scale, taking into account the whole range of relevant emission sources: traffic, industrial, commercial, domestic and other less well-defined sources.

The science of ADMS-Urban incorporates the latest understanding of the boundary layer structure, using advanced algorithms for the height-dependence of wind speed, turbulence and stability to produce improved predictions. The model also takes account of the impacts of street canyons on dispersion, turbulence and mixing induced by traffic and includes a photochemical model for NOx and ozone.

By inputting emission source parameters, meteorological data, including diurnal patterns, terrain features, traffic flows, pollutants' background concentrations and background emissions, the model can generate annual average concentrations of pollutants, exceedances of limit values, percentiles, may compare actual values with air quality standards and monitoring data, may make future predictions and define low emission zones for traffic management.[21]

Table 4-12Major Features of ADMS-Urban

Feature	Detail
Visualisation	ADMS-Urban has links to ArcGIS and MapInfo Professional GIS (Geographical Information System) packages as well as Surfer contour plotting package. The GIS link can be used to enter and display input data and display output, usually as colour contour plots.
Emissions inventory	Source and emissions data can be imported from a Microsoft Access database created by the user or exported from CERC's Emissions Inventory Toolkit, EMIT. EMIT contains current and future emission factors including those for vehicles, industrial processes and fuel consumption.
Emission factors	Defra's Emission Factor Toolkit emission factors.
Intelligent gridding	ADMS-Urban includes an intelligent gridding option which places extra output points in and adjacent to road sources to give excellent spatial resolution in areas of particular interest.
User-defined outputs	The user defines the pollutant, the averaging time (which may be an annual average or a shorter period), any percentiles and exceedence values that are of interest, and whether or not a rolling average is required. The output options are designed to be flexible to cater for the variety of air quality limits which can vary from country to country and over time.

Data transfer, storage, processing, analysis and reporting

Ambient air quality data are collected, processed, analysed and reported by the NEA through its Department for Environmental Pollution Monitoring. More specifically, daily logs of site measurements in all cities other than Tbilisi are kept by local operators and then sent to Tbilisi on a monthly basis via fax or e-mail.

The local operator in Batumi has an e-mail communication with the central office. Samples from Tbilisi non-automated stations are transferred to the central chemical laboratory and analysed there. Data logs from continuous monitoring site are automatically transferred to the central monitor, located at the main lab of the NEA.

Daily data are entered in the central database maintained at the Database Department of the NEA. Based on daily logs, the agency develops monthly reports on environment pollution containing a short

[21] Source: http://www.cerc.co.uk/environmental-software/ADMS-Urban-model.html

overview of the state of the ambient environment, including information on ambient air. Hard copies of these reports are available at the NEA, while electronic versions of monthly bulletins are posted on the NEA’s website: **http://meteo.gov.ge/radiation.**

On an annual basis, the agency develops yearbooks on environmental pollution, which are kept by the NEA and not shared with wide public. The annual report contains information about: monitoring methodology, existing equipment, main air pollution sources in each city where monitoring is carried out, number of measurements conducted on each station for each pollutant, annual means and maximum concentrations of each measured pollutant at each station, number of exceedances of MACs for each pollutant at each station (number of measurements), trends of annual means for each pollutant in each city for last 5 years, monthly means of each pollutant in each city for the last years.

The last annual report available at the NEA is for the year 2012, which does not include data received from automated monitoring station.

On top of that, every 3 years The Ministry of Environmental and Natural Resources Protection develops State of the Environment Report, where information on the air pollution is also included. The report is posted on the MoE’s website**(http://moe.gov.ge/files/Saministros%20Prioritetebi/eng_erovnuli_mokhseneba_2009.pdf)**and thus, is widely available to the public.

In accordance with the Law on Atmospheric Air Protection, the NEA is obliged to publish, on an annual basis, the list of cities/regions of Georgia classified in accordance with pollution levels together with relevant values of annual pollution indices; though, in practice this is not done at all.

Apart from the periodicals on routine monitoring and state of the environment analytical reports few sporadic air quality studies are also available. Specifically, in 2002 under the service contract no. **B7-8110/2000/189839/MAR/ENV2** between EU and AEA Technology on Advice on approximation in NIS countries the latter conducted 1 and 6-month passive measurements(via application of diffusion tubes) of NO_2, SO_2, $O_3$and benzene at roadside, city centre and suburban locations of the city of Tbilisi.

Currently, two air quality studies are being carried out through air quality modelling for the cities of Tbilisi and Batumi.

Results from Existing Ambient Air Quality Monitoring in Georgia

The most recent (2013) ambient air monitoring data for monitoring sites throughout Georgia is not currently available, due to the pending publication of the 2013 annual reports. Though, monthly average and maximum concentrations of pollutants are regularly reported in monthly bulletins. These documents are uploaded on NEA-s web-site and cover the period from January through October 2013. Bulletins for previous years are stored at NEA’s office and are not readily available for general public. Detailed data received from automated continuous monitoring station are not included in the monthly bulletins and are only presented as summary information in these documents starting from June 2013.

The report summary states that all measured pollutants were below their respective MACs , with the exceptionof ozone. Ozone was measured well above its MAC, at 24 hourly concentrations which were approaching a factor of 3 above the 24-houraverage MACs between July-September 2013.

As for air quality assessments, two studies are currently being carried out for the cities of Tbilisi and Batumi and one report on completed study for Tbilisi is available at the Air Protection Service of The Ministry of Environmental and Natural Resources Protection of Georgia.

A study on Tbilisi air quality contains an estimate and analysis of 2002 ambient concentrations of NO_2, SO_2, Benzene and Ozone measured through passive sampling[22.]

Under the study, NO_2 was measured at 50 locations within a 2-week period to identify the highest concentrations as well as at 5 key locations (1 busy road and 4 residential areas) within 6-month period to estimate average annual concentrations of this pollutant (Figure 4-3).

In addition, SO_2 measurements were undertaken at 5 co-located sites, alongside NO_2–over a 6-month period.

Ozone concentrations were measured at 4 residential locations and 1 rural location downwind of the city for a period of 6-month period, including throughout the summer period.

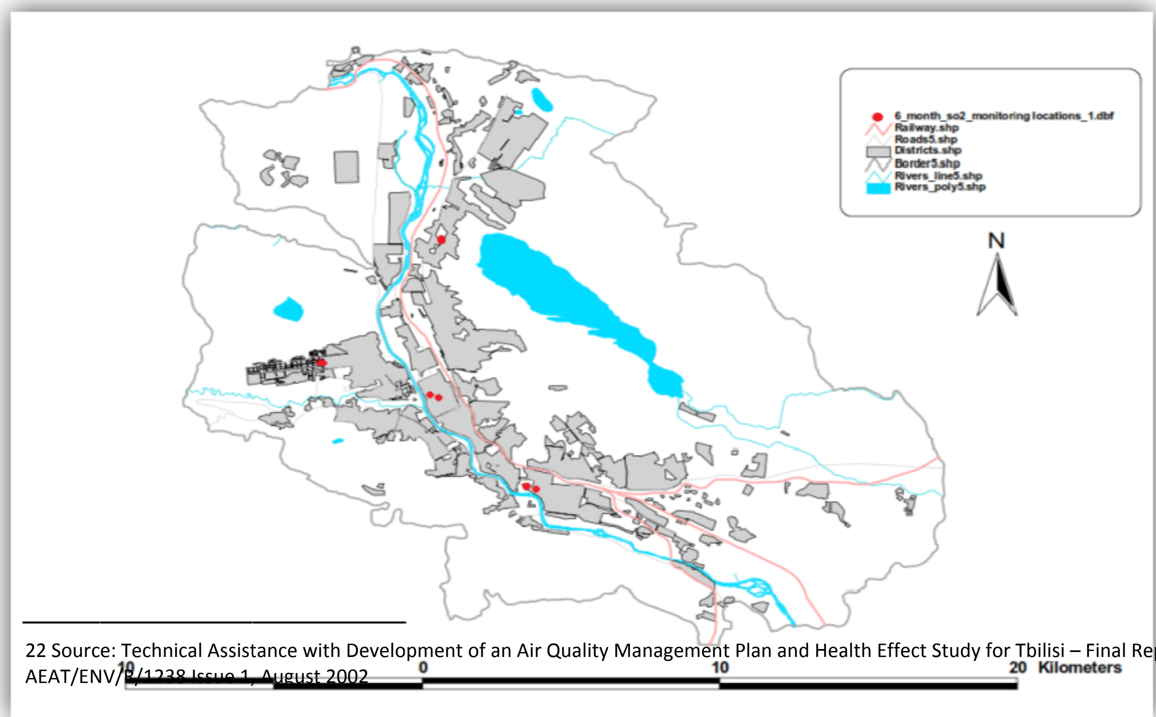
Benzene was measured at 2 locations over 6-month period.

Particulate matter concentrations were measured using a portable light scattering monitor for PM_{10}, $PM_{2.5}$ and PM_1.Thismeasurement device was installed within the Main Department of Air Protection (Kostava Street).

Table 4-13Locations of Long-term (6-month) Diffusion Tube Monitoring Sites

Site #	Name	Type	Location	Comment
1	Agmashenebeli	Kerbside	AgmashenebeliAve. 144	Lamppost at the edge of busy road
2	Toustonogov	Urban background	Tovstonogovi Street 10	
3	Chargali	Urban background	Chargali street 19	
4	Zakariadze		Zakariadze street 10	
5	Sartichala	Urban background		
6	Tbilisi sea	Rural background		Rural site for Ozone measurement

Figure 4-2Sample Locations of the 6-month Diffusion Tube Monitoring Survey, 2002



22 Source: Technical Assistance with Development of an Air Quality Management Plan and Health Effect Study for Tbilisi – Final Report, AEAT/ENV/R/1238 Issue 1, August 2002

Figure 4-3 Contour Plot of Interpolated NO2 Diffusion Tube Concentrations, March-April 2002

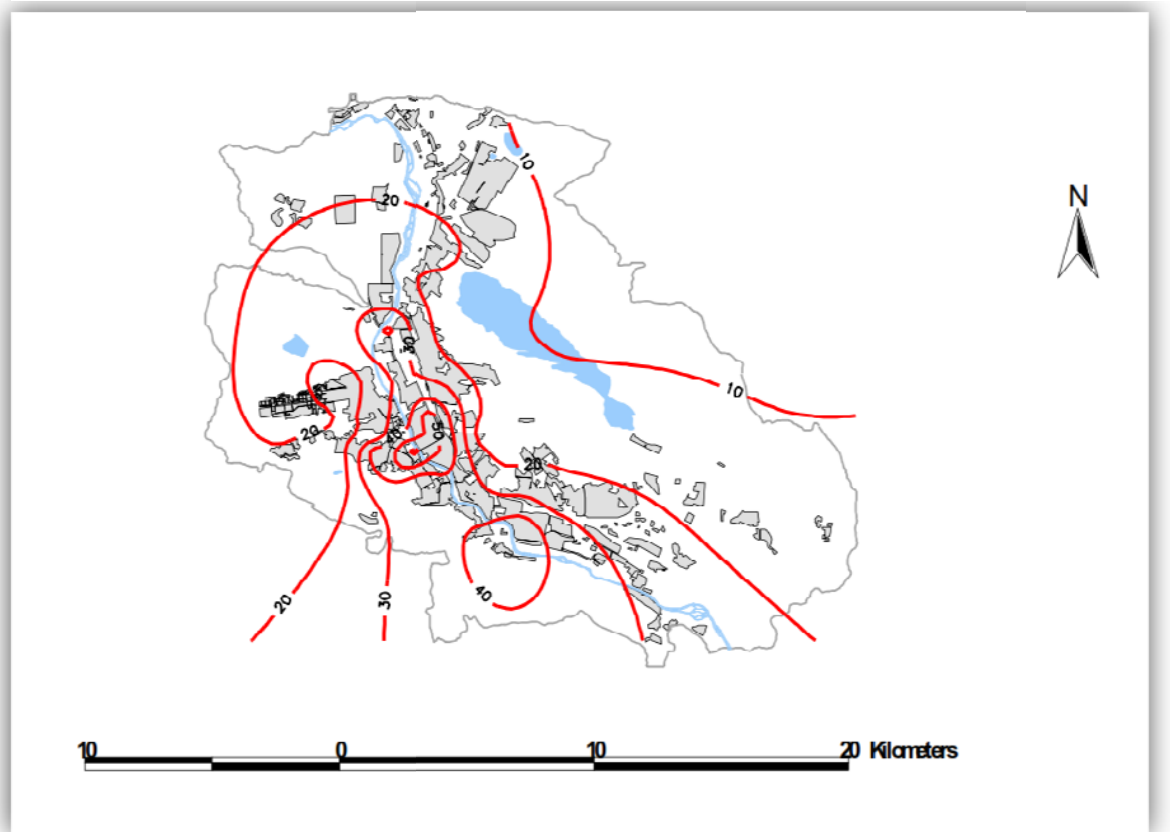


Figure 4-4Map of the Location of Long-term (6-month) Diffusion Tube Monitoring Sites, 2002

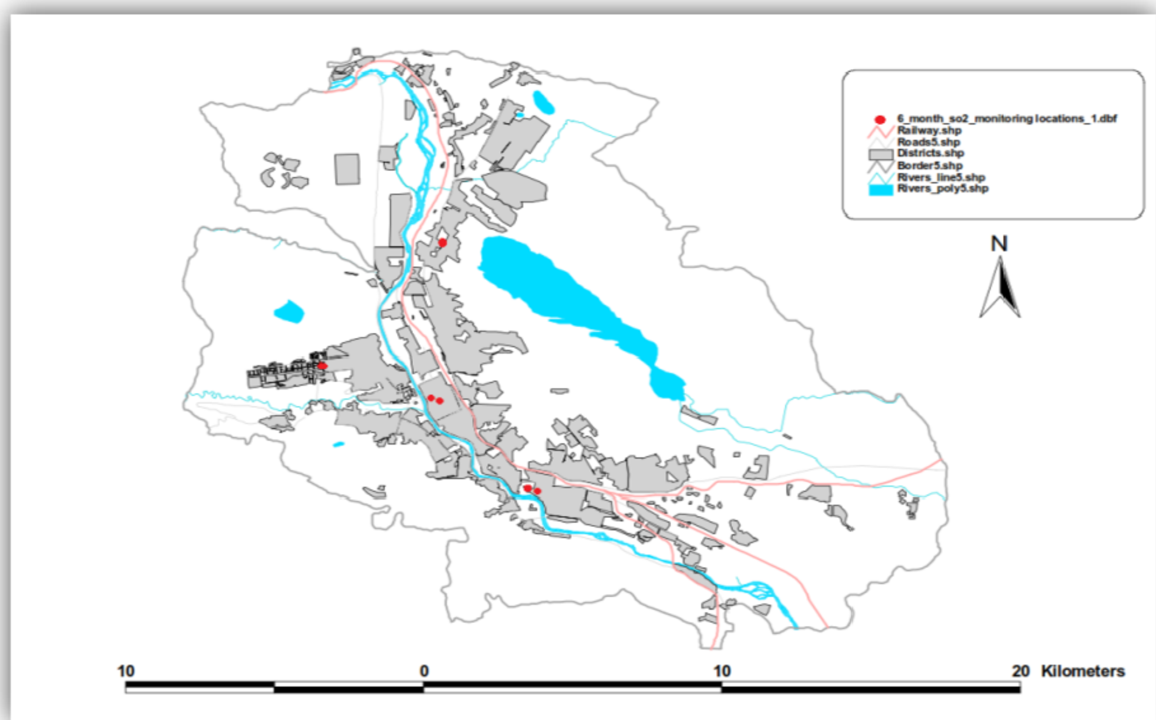


Table4-14Average 6-month Concentrations of NO_2, SO_2, Benzene and Ozone Measured through Passive Sampling

Substance	#	Location	Type	Averageconcentration, µgm^{-3}
NO_2	1	Agmashenebeli	kerbside	77
	2	Toustonogov	urban	43
	3	Chargali	urban	21
	4	Zakariadze	urban	28
	5	Sartichala	urban	38
SO_2	1	Agmashenebeli	urban	10
	2	Toustonogov	urban	3
	3	Chargali	urban	4
	4	Zakariadze	urban	4
	5	Sartichala	urban	6
Benzene	1	Agmashenebeli	kerbside	32
	2	Toustonogov	urban	13
Ozone	2	Toustonogov	urban	41
	3	Chargali	urban	74
	4	Zakariadzw	urban	64
	5	Sartichala	urban	67
	6	Tbilisi Sea	rural	113

Table4-15 Twenty-four-hour and Daily Averages of Particulate Matter

TypeofAverage	Period	PM_{10}	$PM_{2.5}$	$PM_{1.0}$	Period	PM_{10}	$PM_{2.5}$	$PM_{1.0}$
		µgm^{-3}	µgm^{-3}	µgm^{-3}		µgm^{-3}	µgm^{-3}	µgm^{-3}
24hraverages	17.00 12/03/02 to17.00	36	20	15	15.00 21/05/02 to15.00 22/05/02	20	10	7
	17.00 13/03/02 to17.00	58	33	25	15.00 21/05/02 to15.00 22/05/02	15	7	5
	17.00 14/03/02 to17.00	24	16	12	15.00 21/05/02 to15.00 22/05/02	26	12	8
Dailyaverages	00.00 13/03/02 – 23.59 13/03/02	46	26	19	00.00 22/05/02 to23.59 22/05/02	19	10	7
	00.00 14/03/02 – 23.59 14/03/02	53	32	24	00.00 23/05/02 to23.59 23/05/02	15	7	4

Table4-16ResultsofOne-MonthNO_2Monitoring Programme

GISCode	Location	East(X)	North(Y)	First Period $NO_2 µg/m^3$	Second Period $NO_2 µg/m^3$	Average $NO2 µg/m^3$	Comments
1M_NO2_1	University Junction	481,746	4,617,46	67.4	64.6	66.0	Kerbsidesite
1M_NO2_2	Kostava44	482,507	4,617,034	76.3	85.7	81.0	Kerbsidesite
1M_NO2_3	Municipality Building	483,477	4,615,773	75.7	62.2	69.0	Kerbsidesite
1M_NO2_4	Tsereteli(Metro)	482,351	4,619,797	57.7	61.3	59.5	Kerbsidesite
1M_NO2_5	Tsereteli Ave.Stadium	482,644	4,619,088	51.3	45.8	48.6	Kerbsidesite
1M_NO2_8	Vice-Minister	482,800	4,616,000	30.4		30.4	
1M_NO2_10	Shatberashvili	481,300	4,616,850	48.1	40.3	44.2	
1M_NO2_11	Didube(Metro)	481,700	4,621,700	45.2	47	46.1	
1M_NO2_12	Tsereteli-Geoexpo	481,900	4,621,000	36.6	30.2	33.4	
1M_NO2_13	Atoneli	483,700	4,615,500	39.6	40.4	40.0	
1M_NO2_14	Mziuri	481,150	4,617,800	24.9	21.4	23.2	
1M_NO2_15	Digomi	481,300	4,623,600	22.5	22.5	22.5	
1M_NO2_16	Iluridze/Sea	484,250	4,621,850	13.3	8	10.7	
1M_NO2_17	School51–Metro-Rustaveli	482,500	4,617,250	63.2	68.7	66.0	
1M_NO2_18	Abash/Taktakh–Kindergarden	481,000	4,617,300	49	44.4	46.7	
1M_NO2_19	Nikoladze	482,150	4,617,400	14.9	42.8		Avg not calculated
1M_NO2_20	Mukhiani-1	485,300	4,626,600	14	16.6	15.3	
1M_NO2_21	HydrometInst.	482,600	4,618,300	30.7	38.7	34.7	
1M_NO2_22	RailwayStation	483,000	4,618,600	56.7	56.7	56.7	
1M_NO2_23	Ninoshvili	483,900	4,617,300	41.8	53.4	47.6	
1M_NO2_24	Aragveli300	486,600	4,613,900	48.8	41.4	45.1	
1M_NO2_25	Geo-Expo,meteorsite	481,800	4,621,500	31.9	31.6	31.8	
1M_NO2_26	Gdani	484,600	4,627,000	12.4	10.1	11.3	
1M_NO2_27	TEMKA(Locofactory)	485,250	4,624,800	14.8	19.8	17.3	
1M_NO2_28	Tsereteli(Metro)	482,900	4,619,900	32.7	29.7	31.2	
1M_NO2_29	Mukhiani-2	485,500	4,626,000		12.6	12.6	
1M_NO2_30	Kavtaradze16	477,000	4,618,500	25.9		25.9	
1M_NO2_31	Portrioni	481,100	4,618,800	26.6	26	26.3	
1M_NO2_32	Hyppodrome	479,200	4,618,700	23.5	19.7	21.6	
1M_NO2_33	TurtleLake,low	479,900	4,619,900	13	12.1	12.6	
1M_NO2_34	MetroRustaveli2	483,100	4,616,200	34.3	30.3	32.3	
1M_NO2_35	TurtleLake,high	479,500	4,616,400	12.7	9.1	10.9	
1M_NO2_36	Kipshidze	480,300	4,617,700	21.8	18.2	20.0	
1M_NO2_37	Dormitory-West	475,500	4,617,500	14.6	11.6	13.1	
1M_NO2_38	VereCemetery	478,500	4,617,100	16.1	15.7	15.9	
1M_NO2_40	Tianetis	483,300	4,625,000	33.4	25.6	29.5	
1M_NO2_41	Didi-Digomi	480,000	4,627,000	57.9	49.2	53.6	Not in contour plot
1M_NO2_42	Regiment8	488,100	4,615,500	28	22.2	25.1	
1M_NO2_43	Airport	496,500	4,616,000	13	11.7	12.4	
1M_NO2_44	Elia	486,000	4,616,200		23	23.0	
1M_NO2_45	Cinema	486,800	4,614,200	48.7		48.7	
1M_NO2_46	Vazisubani	487,600	4,616,500	24.1	20.2	22.2	
1M_NO2_47	Kukia	485,200	4,617,900	19.3	13.3	16.3	

	Bogvis	483,300	4,624,000		16.1	16.1	

Figure 4-5 Map Highlighting Areas with NO_2 Concentration Greater than 40 μgm^{-3}

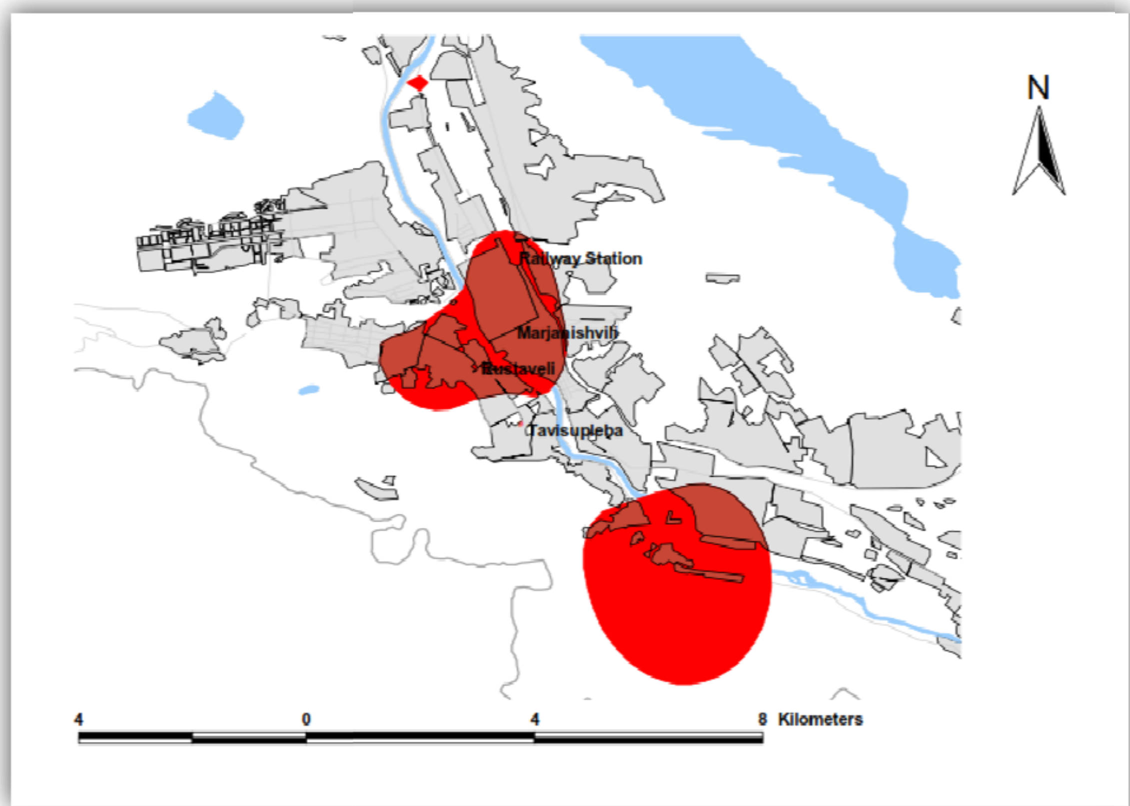
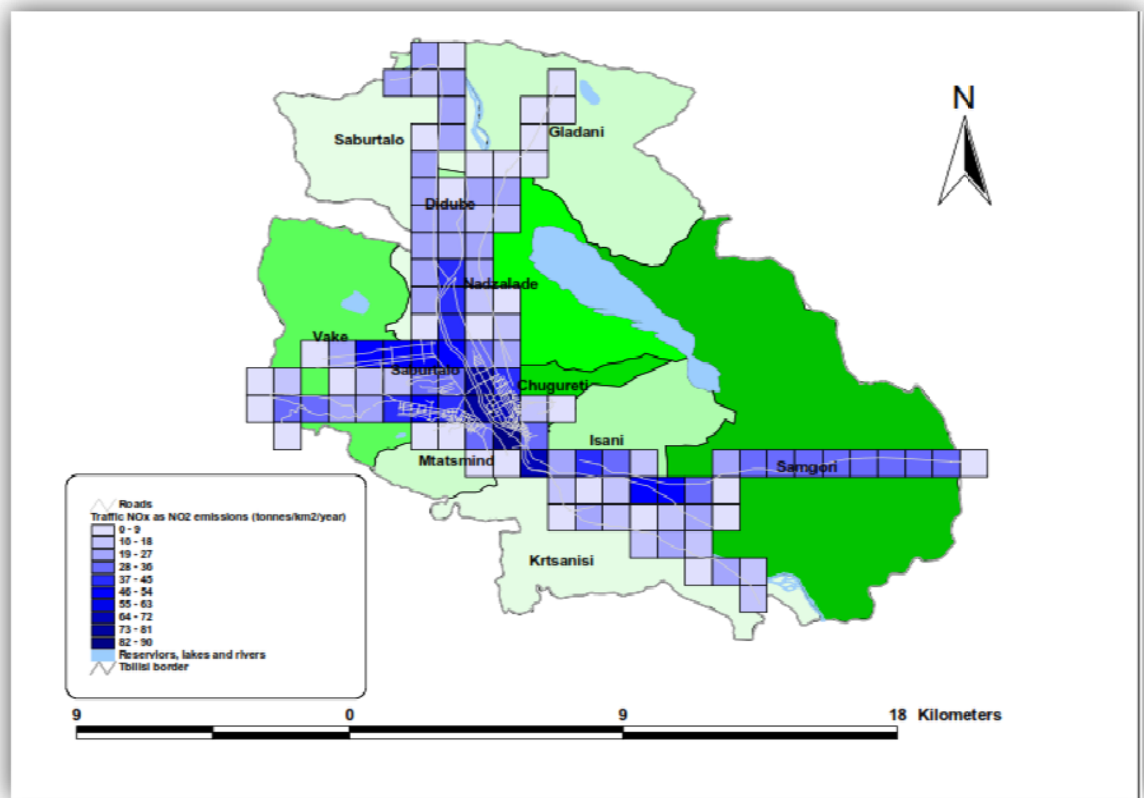


Figure 4-6An Example of EstimatedNOxEmissions fromTrafficinTbilisi



Under the on-going Dutch government-funded project: “Air Quality Monitoring in Tbilisi” (PSOM10/GE/11) aiming at establishing air quality monitoring system in Tbilisi, CERC has compiled emission inventories using EMIT-soft and conducted preliminary emissions dispersion and air quality modelling for NO_2, SO_2 and PM_{10} using ADMS –Urban for 2009. First step was collection, processing and aggregation of activity and emissions data for various sources. This was followed by the calculation of emission rates for all major emission sources, including road transport, airport, industrial sources, and commercial and domestic gas use.

Preliminarily air modelling was conducted by using emission inventories, meteorological data received from Tbilisi airport and terrain data, retrieved from Shuttle Radar Topography Mission (SRTM) dataset, providing relief elevations on a 90-m resolution, and processed to receive suitable resolution for ADMS-urban.

Quality Assurance and Control

Quality control within current air quality monitoring is primarily limited to the use of blank samples and analytical blanks.

In terms of laboratory methodology, blank analytical samples are only routinely applied in the central laboratory with ion chromatograph samples.

No air quality Standard Operations Procedures (SOPs) are in existence in Georgia. Rain water and atmospheric deposition sample SOPs however are in use, and contain measurement and lab safety requirements in line with ISO standards. These are currently being translated into Georgian.

Quality assurance in Georgian air quality monitoring currently relies upon the use of experienced staff following routine methods and standard air quality methods and approaches. This involves sampling at specific sampling locations, at set intervals and durations. Experienced staff screening all air quality results for reasonableness and suitability. Though there are no detailed records of this procedure.

Sampling uncertainties are calculated using specialist air quality software (such as that supplied by Human Dynamics Consortium and X-Kortipakkaas used by Finnish Environmental Institute).

5. COMPARISON OF NATIONAL LEGISLATION AND ORGANISATION OF AIR QUALITY EXISTING AIR QUALITY MONITORING SYSTEMS IN GEORGIA AND EU MEMBER STATES

5.1. AIR QUALITY ASSESSMENT, MONITORING AND MANAGEMENT ACTIVITIES – GAPS IN THE CURRENT GEORGIA AIR QUALITY MONITORING NETWORK

An analysis of available background information on ambient air quality monitoring in Georgia, the following conclusions can be drawn regarding its systematic shortcomings:

System level (legal-regulatory basis):

Currently the effective laws and regulations in Georgia are not in line with CAFE-Directive 2008/50/EC and the 4th Daughter Directive 2004/107/EC. This includes the designation of ambient air quality limit values, delineation of air quality management districts, network design and operational standards, sampling, analysis and reporting requirements.

Local regulations do not currently contain air quality limits for all substances required by EU directives to be regulated, including PM_{10} and $PM_{2.5}$.

Existing MACs are not in line with EU limit values in terms of allowed ambient concentrations of pollutants and averaging times. Georgian MACs are only health-based standards, not taking into consideration impacts on ecosystems and amenities.

The national body currently responsible for ambient air quality monitoring, the NEA, uses technical guidelines on air quality control, which are based on old Soviet standards and regulations. The government has plans to adopt two regulations which will align national ambient air quality standards and monitoring systems with EU requirements.

Institutional Level:

The NEA has very limited budget, staff, technical capacities and infrastructure to conduct full-scale routine monitoring of ambient air in Georgia in line with EU requirements. Though the 2013 budget forecasted an increase in the NEA’s state financing to 5 million GEL for the next couple of years, this would not suffice the needs for full-scale monitoring.

A complete self-financing scheme for the NEA is being discussed by the Government of Georgia, which may place at risk the existing level of ambient environment quality monitoring. Therefore the requirement to upgrade the national monitoring programme to meet EU requirements will also be challenged should such a scheme will go ahead.

As a one-off projects, the Government of Georgia signed a USD 2 million grant agreement with the Japanese government that among others aims at upgrading air quality monitoring stations in Tbilisi by installing automated continuous monitors. This will no doubt assist in the immediate term with capital investment, though on-going operational costs and necessary reinvestment in the national monitoring network would still be required.

Air Quality Monitoring Infrastructure:

The current coverage of the air quality monitoring network in Georgia was based on Soviet technical methodological guidelines, and is not sufficient enough to provide the necessary representative data for a national air quality monitoring network. More specifically, Tbilisi with its population size over 1.1

million should typically have a minimum 10 stationary or kerb-side (road-side) monitoring stations according to these methodological guidelines. Currently it has only 4, and Kutaisi, Rustavi and Batumi with population size over 100,000 should have 2-3 sites each instead of 1. Zestaphoni with population size under 50,000 has 1 site, which is in line with technical guidelines though, due to high industrialization level of the city, the number of sites might be increased.

The EU CAFE directive sets a requirement for the minimum number of continuous monitoring sites per population size, which is less strict than Soviet standard in terms of absolute numbers of required stations. However, due to the difference in the types of the stations, these numbers are not comparable.

Furthermore, locations of air quality monitoring sites in Georgia were selected during Soviet times based on meteorological conditions, industrial activities, traffic flows and spatial planning specific to that era.

Therefore nowadays the existing stations do not reflect a real situation in terms of climate conditions, pollution sources and particularly urban development.

Many pollutants regulated by EU directives are either monitored at few stations, e.g. ozone, PM_{10} and $PM_{2.5}$, or not monitored at all, e.g. heavy metals (except for lead), benzene.

All of the Georgian air quality monitoring stations, with the exception of one, are non-automated and therefore do not allow for recording of maximum values across the whole day or whole daily data collection, as (with exception to one continuous monitoring station) only three measurements are conducted each day during working days. Data can therefore only be extrapolated as a daily mean, with uncertain resolution and uncertainty. In the case of ozone 8-hour values are not recorded, therefore preventing an alert threshold from being used.

The methods used by the NEA are currently not meeting the Soviet technical guidelines, which require 20 minute readings to be taken three times a day (typically at 07:00hr, 13:00hr and 19:00hr)six days a week. Currently, measurements are only taken 5 days a week, with no weekend measurements collected, making weekly or monthly averages invalid.

According to EU requirements, member states are obliged to operate minimum 1 rural background station per 50,000 km^2 or 1 station per 25,000 km^2 for complex terrains. In Georgia, the EMEP background station in Abastumani that measures regional (trans-boundary) and global backgrounds can also be used for measuring rural background and assessing impacts of regional long-range transport and urban plumes. Data obtained from this site, could be successfully applied for ecosystem impact studies, assessing regional and long-range transport of pollutants and identifying ozone hot spots.

Existing fixed point monitoring stations represent booths, which do not meet key technical requirements in terms of ventilation, climate control, height from ground level, etc. Absorption filters applied are mostly outdated and need replacement, though the cost for purchasing new filters is pretty high.

Georgia is not divided into agglomerations/districts for the purpose of air quality management, since existing monitoring data do not provide a clear and comprehensive picture about ambient air quality and since there are no detailed air quality studies for the country’s cities and regions.

In terms of laboratory analysis, central analytical laboratory faces the problem of having continuous supply of chemicals, given the lengthy procurement process as well as the high price for standard solutions.

Data Accuracy, Validity and Reliability:

The NEA lacks technical capacity for calibration and proper operations and maintenance of the network and laboratory equipment. The Department for Environmental Pollution Monitoring has only one vehicle to regularly drive to environmental (water and air) monitoring sites and check the technical condition of measuring equipment that is not enough for inspecting all sites on a monthly basis. This vehicle is also used for spot checks of environmental quality that are requested by the Environmental Inspectorate as part of environmental compliance monitoring and control activities. There is no reference laboratory in Georgia to cross-check the accuracy of measurements. SOPs for air quality monitoring in line with ISO standards do not exist. Thus, it is very difficult to judge about the precision, validity and reliability of data generated.

Data transfer, processing, analysis and reporting:

Daily data logs from monitoring sites of all cities expect for Tbilisi are transferred to the central office with great delay – once a month. Data from continuous monitoring site of VashlijvarioMeteo Station are automatically uploaded to the central monitor (server). However, sometimes they are transferred from the site to the central computer with a time lag (from several hours to several days).

Before 2012, NEA’s monthly bulletins for 2009 through 2012 were regularly posted on the web-site of the Arhus Centre. In 2012, due to the restructuring of the MoE the centre has stopped functioning. Its web-site was also deactivated. Since 2013 the NEA has started posting monthly bulletins at www.meteo.ge. Though, these reports are uploaded with delays. The monthly bulletins do not contain detailed data generated at automated urban background station. Only summarized information is included in the monthly reports.

Furthermore,annual reports are neither published as hard copies nor posted on the NEA’s web-site. Annual pollution indices are not calculated and published, since these values require at least 75% ofannual data received through full-scale monitoring (4-time measurements within 24 fours) of pollutants' concentrations. In addition, the NEA does not have an alert/warning system for vulnerable groups of population during unfavourable meteorological conditions (heat waves, temperature inversions, etc.).

Data for emission inventories are stored within the MoE’s Environmental Inspectorate and Air Protection Service and are not available on-line to the NEA in order to combine air quality measurements with inventory data. Likewise, daily air quality monitoring data generated and kept by the NEA are not readily available to other relevant units of The Ministry of Environmental and Natural Resources Protection to plan for shorter and longer-term air quality management measures or, to the wider public.

Emission data themselves are incomplete, lacking data on traffic flows, car fleet, and fuel consumption. Relatively complete data are available for Tbilisi attributed to voluminous information gathered under several international projects implemented for the city in energy, climate change, transport and, air quality management fields as well as to relatively stronger capacity of the local municipality compared to the similar bodies of other cities to collect attribute/input data at the city level.

Air quality assessment/modelling

None of the relevant units of The Ministry of Environmental and Natural Resources Protection, engaged in managing ambient air quality apply air quality modelling tools for assessing the air quality. GIS technologies have also very limited application within the Ministry. Regardless of the fact that recently urban air quality modelling software was handed to the NEA (Database Department), it does not have enough knowledge and capacity to widely apply it in practice.

5.2. EU AIR QUALITY DIRECTIVES PROVISIONS ON MONITORING

The EU Air Quality Directives are precise and distinct in what monitoring they require Member States to conduct. These requirement have been outlined in chapters3-7 and 3-8 above, and include a minimum number of monitoring stations per population/ land mass, that a discrete set of chemical species are measured for minimal averaging period, and that measurements systems to be used are required to meet the reference criteria or its equivalence.

Existing European air quality monitoring networks and sites included in routine long-term operations and reported within national reports to the EU have been analysed for their performance and quality in order to assess their suitability to be used as a template for the proposed air quality network in Georgia.

This Comparative Analysis is in two Parts:

- An outline of the State of the air quality monitoring in Europe
- Air Quality Monitoring Summaries of Denmark, Greece and the United Kingdom as Air Quality Monitoring Models for Georgia

5.3. STATE OF AIR QUALITY MONITORING IN EUROPE

This chapter is a summary comparison of practices in existing EU members states, countries of the European Economic Area (Iceland & Norway), where each state performance against the following criteria have been examined:

- Network Description
- Methods
- Coverage
- Data availability
- Reporting
- Trends

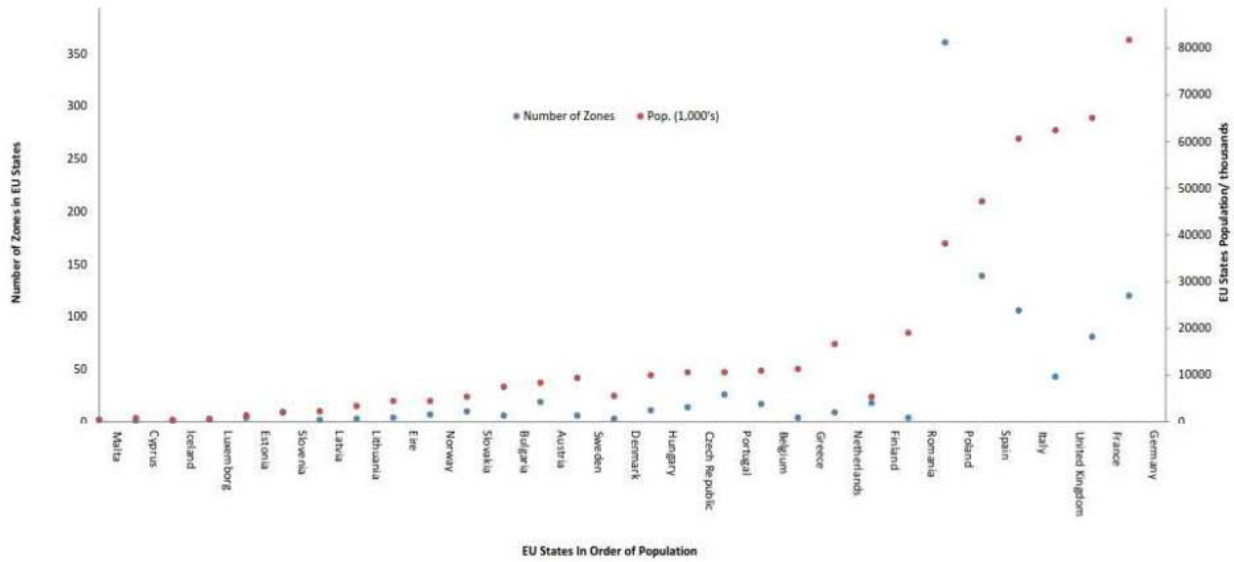
Monitoring Sites in European States

Per Population

EU Members States are obliged (under CAFÉ Directive 2005/50/EC) required to separate their land mass into a minimum number of designated monitoring zones.Minimum criteria for this process has been outlined in Table 3-5 and 3-6 above. As a guide the number of zones within EU states has been assessed across the populations of those states[23](Figure 5-1). It can be seen that EU member states with populations similar to Georgia (5 million) have designated in the region of 3 (Denmark) to 18 (Finland) zones for the purposes of air quality reporting under the CAFÉ directive obligations.

[23]http://rod.eionet.europa.eu/obligations

Figure 5-1 Number of Air Quality Monitoring Zones in EU Countries against population size

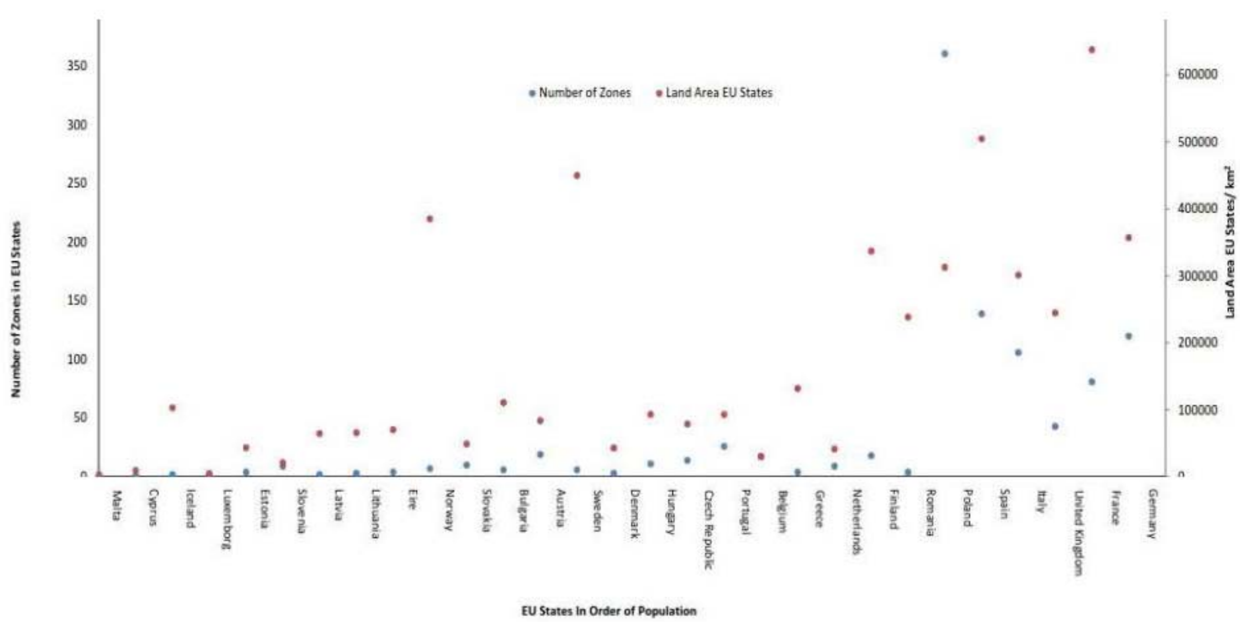


Zones Per Land Area

An additional set of criteria for the purpose of designated number of air quality monitoring zones is the land area for a particulate Member state (as outlined in Table 3-5 and 3-6). Once again, the number of zones within EU states has been assessed across the land area of those states[25] (Figure 5-2). It can be seen that EU member states with similar land areas to Georgia (69,700km^2), such as Czech Republic and the Republic of Ireland and Lithuania, have designated in the region of 4 (Lithuania) to 14 (Czech Republic) zones for the purposes of air quality reporting under the CAFÉ directive obligations.

Therefore as a guide, the number of zones and or agglomerations that Georgia would be expected to designate for the purposes of air quality reporting under the CAFÉ directive obligations would be no less than 3 and no more than 18.

Figure 5-2Number of Air Quality Monitoring Zones in EU Countries against Land Area



Network description

Detailed site descriptions are an important background for evaluating representatively of networks and for judging the air quality information from the network correctly. Dedicated reports with detailed site descriptions are available from Austria, the Netherlands and Spain. For some other countries, brief descriptions were available within the AQ reports, such as for Sweden, the UK.

5.4. Temporal Coverage

Most countries operate their networks the entire year. Exceptions are Norway and Sweden, where the monitoring is concentrated to the six winter months, which have the highest concentrations. For regional sites in Sweden, O_3 and NO_2 are monitored only in the six summer months, except for the 6 EMEP stations, which are monitored all the year.

With a few exceptions, especially some East European countries, monitoring and or sampling covers all days/hours.

5.5. Spatial Coverage

Most member states have a substantial number of monitoring sites in operation. The monitoring networks in each state may be national, regional or local in area coverage, and the organisation of monitoring responsibilities between national, regional or local authorities (municipalities) differs between states.

The largest states in EU have the most sites. For example (Table 5-1), France has close to 900sites, Germany has more than 500 sites, Spain about 1000 sites and the UK has about 80 active sampling and over 1100 passive sampling sites.

EU members, who have fewer monitoring stations deployed,include:

- Albania which has 23 urban sites, Greece has 32 sites (31 are urban), Croatia has 41 sites (40 are urban), Norway has 45 sites (6 are urban), Denmark 35 sites (18 are urban), Hungary 39 urban sites, Estonia 18 sites (16 urban/local).
- The total number of air pollution monitoring sites across the whole European network is very large. For the 29 countries who supply data, there are close to 5,000 urban/local sites, and more than 800 regional sites.

***Table 5-1 Spatial coverage of AQ monitoring Sites Across European States*[24]**

	LOCAL						REGIONAL			
			Site class distribution							
			Urban							
	No. of sites	No. of cities/towns	General	Traffic hot-spot	Industrial / hot spot	Re-gional	No. of sites	SO_2+	Deposition	O_3
Austria	165	10	100	30	20	15	55	55	35	55
Belgium	168	60	125		30	13	25			

[24] List of zones in EU Member States in relation to air quality thresholds laid down in Council Directives 96/62/EC, 1999/30/EC, 2000/69/EC and 2002/3/EC Year 2006 ETC/ACC Technical paper 2008

Denmark	18	3	7	8	3	0	17	6	17	3
Finland	120	30	71	18	28	3	22	8	7	9
France	875		875				21	17		21
Germany	467		232	156	79		74	65[8]		57[8]
Greece	31	11	22	2	7	0	1	1	1	0
Ireland	81	15	45	25	10	1	12	7		5
Italy	129[3]	41	129				3[4]	3	3	2
Luxembourg	4	1	1	2	1	0	2	1	0	1
The Netherlands	20	9	7	13	0	0	36	30	14	26
Portugal	80	5	6	15	6	53	13	12	3	3
Spain	893		288	438	167		190			>7
Sweden	66	45	63	3			49	12	36	5
U.K.	51[5]	34	45	2		4	>38	38	32	15
Iceland	3	2	1	1	0	1	1	1		
Liechtenstein	1	1	1	0	0	0				
Norway	6	6	6	0	0	0	39	12	34	15
Albania	23	11	23							
Bulgaria	100		100							
Croatia	62	8	62				1	1	0	0
Cyprus	2	1	0	2	0	0	1	1	1	1
Czech Republic	650[1]									
Estonia	16	9	8	2	6		2	2	2	2
Hungary	39		39				2	2	2	
Poland[7]	>540		>500			33	11			
Romania	152		152				138	4	137[2]	4
Slovakia	37	17	14	6	10		7	7	7	4
Slovenia	86		86				4			
Switzerland	98[6]		55	31	12		54			

- [1] Total for urban and regional. Site classification not known.
- [2] All stations measure pH, conductivity and acidity/alkalinity. 14 sites measure major ions.
- [3] Not complete.
- [4] Only EMEP sites
- [5] Plus 1100 passive NO_2 sampling sites
- [6] Plus 12 passive SO_2 and 102 passive NO_2 sites.
- [7] All cities with >20,000 inhabitants.
- [8] The number of sites may not be quite correct.

Table 5-2Compound coverage of AQ monitoring Networks across European States

	LOCAL			REGIONAL			
	SO_2, NO_2, Black Smoke/PM_{10}, TSP, Pb, O_3	**CO, HeavyMetals**	**Benzene, VOC, H_2S**	**SO_2 +**	**Deposition**	**O_3**	**O_3Precusor s**
Austria	x	CO	VOC, H_2S	x	X	x	x
Belgium	x	CO	VOC	x	X	x	
Denmark	x	CO, Heavy Metals		x	X	x	

Finland	x	CO, Metals		x	X	x	
France	x	CO	VOC	x	X	x	x
Germany	x	CO	VOC	x	X	x	x
Greece	x	CO		x	X		
Ireland	x			x		x	
Italy	x			x	X	x	
Luxembourg	x	CO, Heavy Metals	VOC	x		x	x
The Netherlands	x	CO, Heavy Metals	PAH	x	X	x	x
Portugal	x (-Pb)	CO		x	X	x	
Spain	x	CO, Heavy Metals	VOC, H_2S	x	X	x	
Sweden	x	Heavy Metals	VOC	x	X	x	X
U.K.	x	CO, Heavy Metals	VOC, PAH	x	X	x	X
Iceland	x	CO		x	X		
Liechtenstein	x (-Pb)	CO					
Norway	x (-SO_2, Pb)		BTX	x	X	x	
Albania	x (-O_3, Pb)			x			
Bulgaria	x	CO, As	H_2S	x			
Croatia	x (-O_3, Pb)		H_2S, PAH	x	X		
Cyprus	x	CO		x	X	x	
Czech Republic	x	AD, Heavy Metals		x	X	x	
Estonia	x (-Pb)	CO	H_2S, BTX	x	X		
Hungary	x (-Pb)	CO	VOC	x			
Poland	x	CO, Heavy Metals		x			
Romania	x (-Pb, SPM)	CO	VOC	x	X	x	
Slovakia	x	CO		x	X	x	
Slovenia	x	CO		x	X	x	
Switzerland	x (-Pb)	CO	VOC	x	X	x	x

5.6. Methods Evaluation

Methods of ambient air measurements employed throughout European ambient air quality networks vary widely, with a residue of manual methods remaining from prior practices. The majority of network methods employ reference methods conforming to the requirements set in EU directives, or considered equivalent to them.For the purpose of this analysis several states have been roughly classified according to the following scheme:

Standard techniques

Conforms to the requirements set in EU directives, or considered equivalent to those.

State-of-the-art, or advanced techniques

These include e.g. the DOAS technique, light scattering and beta attenuation PM detection,Gas Chromatography for Benzene/ BTEX detection as well as diffusion tubes for NO_2, BTX etc.

Non-standard techniques

Techniques not conforming to the requirements of the directives, or not considered equivalent, in terms of required accuracy and specificity.

Methods

Standard methods, samplers and monitors are used almost exclusively in most of the EU states networks, as described in EU directives. Though a number of Eastern Europe states (e.g. Albania, Bulgaria, Croatia, Estonia, Romania) have deployed non-standard methods for some of the compounds.

All countries utilise standard or advanced/state-of-the-art methods for some or all of the compounds measured. In addition a limited number of EU states have deployed advanced monitoring methods routinely at some sites, such as DOAS in Finland, Norway and Sweden, and on-line compound-specific VOC analysis in the UK.

Among the new techniques are candidates which are being introduced soon into air quality directives or as reference methods. These include new PM_{10} equivalence methods, Benzene/BTX analysis either manually or by DOAS, or other (UK, see below), passive samplers for SO_2, NO_2 , BTX etc.

Table 5-3 below Indicates which European States have succeeded in adopting all required monitoring methods required by EU Air Quality Directives, including state of the art techniques such as DOAS and light scattering techniques.

Table 5.-4indicates which EU member states have employed new parameters and techniques.

Table 5-3 European States which have succeeded in adopting relevant EU Air Quality Directive Monitoring Methods

European Country	Species											
	SO_2	PM_{10}	O_3	NO_2	CO	$PM_{2.5}$	Benzene	Lead	Ni	Cd	As	B(a)P
Andorra	√	√	√		√	√						
Albania	√	√	√	√	√	√	√					
Austria	√	√	√	√	√	√	√	√	√	√	√	√
Cyprus	√	√	√	√	√	√	√	√	√	√	√	
Bosnia	√	√	√	√	√	√						
Belgium	√	√	√	√	√	√	√	√	√	√	√	√
Bulgaria	√	√	√	√	√	√	√	√	√	√	√	√
Switzerland	√	√	√	√	√	√	√	√		√		
Czech	√	√	√	√	√	√	√	√	√	√	√	√
Germany	√	√	√	√	√	√	√	√		√	√	
Denmark	√	√	√	√	√	√	√	√	√	√	√	
Estonia	√	√	√	√	√	√	√	√	√	√	√	
Spain	√	√	√	√	√	√	√	√	√	√	√	
Finland	√	√	√	√	√	√	√	√				√
France	√	√	√	√	√	√	√					
UK	√	√	√	√	√	√	√	√	√	√	√	√
Greece	√	√	√	√	√	√	√					
Croatia	√	√	√	√	√		√					
Hungary	√	√	√	√	√	√	√		√	√	√	

Ireland	√	√	√	√	√	√	√	√	√	√	√	√
Italy	√	√	√	√	√	√	√					
Liechtenstein		√	√	√								
Lithuania	√	√	√	√	√	√	√	√	√	√	√	√
Luxembourg	√	√	√	√	√	√	√					
Latvia	√	√	√	√	√	√	√	√	√	√	√	√
Montenegro	√	√	√	√	√							
Macedonia	√	√	√	√	√		√					
Malta	√	√	√	√	√	√	√	√	√	√	√	
Netherlands	√	√	√	√	√	√	√	√	√	√	√	
Poland	√	√	√	√	√	√	√	√				
Portugal	√	√	√	√	√	√	√	√	√	√	√	
Romania	√	√	√	√	√	√	√	√	√	√	√	
Serbia	√	√	√	√	√		√					
Sweden	√	√	√	√	√	√	√	√	√	√	√	√
Slovenia	√	√	√	√	√	√	√	√	√	√	√	
Slovakia	√	√	√	√	√	√	√	√	√	√	√	√
Turkey	√	√	√									

Table 5-4Countries where New Air Quality Monitoring techniques have been introduced

	PM_{10}		**Benzene/BTX**		**Passive samplers**	
	Hourly	**Integrated**	**Hourly**	**Integrated**	**NO_2**	**BTX**
Austria			x[a]		x[1]	x[1]
Belgium	x					
Finland	x	x	x			
France	x					
Germany	x					
Greece	x					
The Netherlands	x					
Portugal						
Spain	x					
Sweden	x		x			x
U.K.	x		x[2]		x	
Iceland	x	x				
Norway	x	x	x			x
Cyprus	x					
Czech Republic	x					
Estonia			x			
Poland						
Slovakia	x					
Slovenia	x					
Switzerland	x					

[a]: half-hourly from 1995.
[1] Passive sampling during limited monitoring campaigns.
[2] UK has on-line, compound-specific VOC monitoring at 9 sites.

5.7. Data Availability in European Networks

One of the main features of modern monitoring networks is the ability to make the data available to users and the public soon after the measurement has taken place. Where a manual monitoring method is used, analysis is required after sampling, resulting in a significant delay (1-2 months) before data becomes available.

With widespread use of automated monitors, there has been an increase in the ability of networks to provide daily (or hourly, or near-real-time) data.

The following countries are able to make data from monitors available externally, in near-real-time (one to a few hours delay): Austria, Denmark, the Netherlands, UK, Norway, Cyprus. Typically, in these states validated data are available 1-6 months after measurement, varying between countries and annual reports are available after 2-12 months delay.

Specific information is missing for many countries, as shown in the Tables 5-2 and 5-3, specifically with regard to the sampling and analysis of $PM_{2.5}$, benzene, heavy metals (PB, Ni, Cd, As) and B(a)P. With only 10 of the 37 countries listed providing information on all pollutants species.

Up to date non-validated monitor data is available at a central data base for one or more networks in the following countries: Austria, Denmark, the Netherlands, UK, Norway, Cyprus.

Validated data are in general available after 1-3 months after measurement for gas pollutants such as NO_2, SO_2, CO and O_3, but some countries require more time to validate sample data, especially for data from manual samplers and for precipitation data.

The UK has made the data from the automatic monitor programme available on-line on the internet. The preliminary data are updated with quality controlled data regularly, after a delay of 2-3 months.

5.8. Use of Models in the Air Quality Assessment

The following countries provided information about their use of dispersion and/or other models as part of their routine surveillance and assessment of air quality: Finland, the Netherlands, Norway, Sweden, UK.

5.9. Reporting

The time delay before network reports are available varies substantially. Ozone represents a special case. For EU countries, the ozone directive requires that ozone is reported in principle to the public every day.

For local air quality, annual reports are available 4 - 12 months after the year, depending upon country.

Some countries or networks issue monthly reports after a much shorter time delay. The reports are written in the national language, but some countries issue summary reports in English as well (e.g. Czech Republic, Slovakia, Slovenia).

5.10. GOOD EXAMPLES OF NATIONAL AIR QUALITY MONITORING NETWORKS

Selection of Example States

Good examples of air quality monitoring system appropriate to Georgia can be derived from best practice across Denmark, Greece and the United Kingdom. In addition these three states provide a combination of similar topography to Georgia (Greece), of optimal AQ monitoring spatial coverage / similar population to Georgia (Denmark) and overall contains a state of the art air quality monitoring network (United Kingdom).

Below is a brief summary of key relevant points of best practice in air quality monitoring systems across Denmark, Greece and the United Kingdom.

Air Quality Monitoring Network in Denmark

Denmark has 3 established air quality monitoring networks currently in operation (National Urban Area Program (LMP), Copenhagen network, Background network). There are 18 urban/hot-spot sites in 3 cities and 17 background sites (5 EMEP). All site classes are represented. Most sites are equipped with monitors for gases, and manual samplers for SPM.

Spatial Coverage: Though a small national network, spatial coverage is considered to be optimal, covering all areas identified with an air quality problem. There are 6 regional SO_2 sites and 3 regional O_3 monitoring sites.

National Air Quality Assessment: Local and regional pollution models are used to extend the assessment of the air quality.

Data availability: Monitor data has been made available in near real time.

Reporting: Annual reports are available after 10 months in new year.

Air Quality Monitoring Network in Greece

The national AQ monitoring network in Greece consists of 31 urban sites in 11 cities (incl. 11 sites in Athens-Attica and 5 in Thessaloniki), and one regional site. At all sites, gases are measured by monitors, and (most) suspended particulate matterSPM by manual samplers.

Spatial Coverage: The urban network covers most areas with air pollution problems. There is only one regional background site (also EMEP site). However there are no regional O_3 sites.

Data availability: Quality controlled data is made available after 1-2 months.

Reporting: Annual report is available after 4 months in new year.

Shortcomings/gaps: Regional O_3 (and O_3 precursor) sites have not been established.

Air Quality Monitoring Network in the United Kingdom

Air quality is monitored through a series of UK national networks, of which there are 9 at present. These networks are specific to compounds and or area-type, and have in principle a national coverage.

The 9 networks are outlined in Table 5-5below:

Table 5-5 UK's Air Quality Monitoring Networks

Network Type	Number of Sites
Automatic Urban Network	25 sites
Rural Ozone	15 sites

Automatic VOC	9 sites
Smoke and SO_2	252 sites
NO_2 diffusion tube	1,100 sites
Lead and heavy metals	15 sites
Toxic organic compounds	5 sites
Acid deposition	32 sites
Rural SO_2	3 sites
EMEP sites	19 sites (incl. 15 in the rural O3 programme)

Spatial Coverage: Substantial, both spatially, temporally and compound-wise, 34 cities are covered, and 4 industrial areas.

National Air Quality Assessment: Local and regional pollution models are used to extend the assessment of the air quality.

Methods: Standard/state-of-the-art/advanced (diffusion tubes for NO2, on-line compound-specific VOC monitoring).

Data availability: Monitoring data is available in near-real-time (1-2 hours delay) via an Air Quality Bulletin System on Internet from the Department of Environment, Fisheries and Agriculture.

Reporting: Validated Annual reports are made available 3 – 4 months every new year.

Trends: The Automated Urban Network is at present being extended substantially. There are plans for an external evaluation of the AQ monitoring programs.

National Air Quality Assessment: The optimum level of division of the selected countries into air management districts/regions and agglomerations is where there is a division of powers between central and local authorities with an additional organisation acting as agents responsible for managing the network.

5.11. Monitoring Networks in Other Selected European States

Selection of Other Selected European States

As broader examples of ambient air quality monitoring networks, three additional European Member states were been selected for review. Ireland was screened on the basis that it is of a similar size to Georgia, both the Czech Republic and Romania were screened on the basis that they and their ambient air quality monitoring networks are both relatively new to the EU. The ambient air quality monitoring networks screening summaries are below.

Air Quality Monitoring Network in the Republic of Ireland

There are 20 local networks in the Republic of Ireland with a total of 88 sites operated in 15 cities/counties. Of these 6 sites are rural/regional (3 EMEP). In addition, there is a national O_3 network with 5 sites. This network and the local Dublin network is part of a public information and alert system. Except for ozone, the sites are mainly equipped with manual samplers.

Coverage: The SO_2/BS and ozone coverage is substantial. CO and VOC is not measured

Air Quality Monitoring Network in the Czech Republic

Czech Republic has a number of national, regional and local networks in operation, with a total of about 650 sites. The Automatic Monitoring Network has 74 sites (37 urban, 37 rural) with monitors. The other sites have mainly manual samplers. There is a Special Monitoring Network for TSP and metals (14 sites, 11 rural, 3 urban). The networks cover in principle the whole territory. There are 2 EMEP stations.

Coverage: The spatial coverage is substantial. The CAFÉ Directive compounds (NO_2, SO_2, CO, O_3, $PM_{2.5}$, PM_{10}, benzene) are covered on very many sites, including 40 O_3 sites. CO is measured at 46 sites, and PM_{10} is also measured (at 3 sites). The entire network is operated the whole year.

Data availability: Quality controlled data are available from the Air Quality Information System at the Hydrometeorological Institute after 3 months. Precipitation data are available after 2 months.

Reporting: Annual report available 4 months after new year.

Air Quality Monitoring Network in Romania

Romania has 3 national and several local/regional networks. The national networks are the Regional network (5 sites), Precipitation quality network (133 sites) and Radioactivity network (44 sites).

Local/regional networks operate 127 sites, incl. 25 in Bucaresti. 2 urban sites (Bucaresti) and 2 regional sites are equipped with monitors, the others with manual samplers.

Coverage: SO_2, NO_2 and SPM coverage is substantial, O_3 is measured at 5 sites, CO and VOC at 2 sites. In addition, NH_3 is measured all local sites (127). Also Cl_2, HCl, H_2S, HCHO, C_6H_5OH, furfurol, H_2SO_4, Cd is measured. It is not known whether the 127 sites are operated every day. The spatial coverage seems good. It is not known whether traffic hot-spots are represented.

Data availability: All information is available after 1-2 months. Daily data from monitors can be given.

Reporting:Data reports are available 6-12 months after sampling.

5.12. Shortcomings and gaps of the EU Member States Networks

Thirty of the European member states and other European regional countries monitor air quality in their urban and other polluted areas, as well as in regional background areas. Shortcomings or gaps in the effort, evaluated relative to requirements in EU directives, have been detected in some of the states. However not all information was completely available. Therefore gaps where only identified where information was complete.

The spatial coverage is substantial in all countries, though major gaps in spatial coverage were not apparent.A number of eastern Europe states (e.g. Albania, Bulgaria, Croatia, Estonia, Romania) deployed non-standard monitoring methods.

Major system gap at the operational level lies in the absence of $PM_{2.5}$, heavy metals, B(a)P and benzene measurements.Some countries (including non EU Member States) were observed to not routinely collect measurements of lead, Benzene, $PM_{2.5}$, background NO_2, B(a)P, heavy metal As, Cd and Ni in their networks, these are summarised in(Table 5-6, below). Turkey does not routinely report most of the required species, though required.

Table 5-6 CAFE or 4th Daughter Directive Ambient Air Species not reported in European Countries [25]

	PM_{10}	$PM_{2.5}$	NO_2	SO_2	CO	O_3	Pb	C_6H_6	B(a)P	Metals (As, Cd, Ni)	Background NO_2

[25] http://www.eea.europa.eu/data-and-maps/figures/airbase-exchange-of-information-4

Albania				X			X		X	X	X
Bosnia	X	X					X	X	X	X	X
Macedonia		X					X	X	X	X	X
Turkey		X	X		x	x	X	X	X	X	X
Croatia		X					X		X	X	X
Montenegro		X					X		X	X	X
Serbia		X					X		X	X	X
Norway							X				
Greece							X		X	X	x
Iceland							X	x	X	X	
Slovakia							X			X	
Hungary							X				
Romania									X		

5.13. EU States Air Quality Monitoring summaries

Temporal coverage across European Monitoring Networks

Local air quality was only (except for ozone) measured during the 6 winter months in parts of the Norway and Sweden networks. In some Eastern European countries, not all days of the year were covered by measurements in some of the networks, for example in Albania, measurements are carried out only 7-10 days per month.

Site coverage of the European Monitoring Networks

Site classifications urban background, traffic hot-spot, industrial hot-spot (urban or rural), and regional has been used. In many countries, all these classes are well represented, but in some countries, hot-spot monitoring sites are lacking.

Data availability of the European Monitoring Networks

Most countries, from which specific information was available, have validated data available within their own data bases within 6 months after monitoring measurements. Thus, in principle making the data universally available within 6 months into the year after is entirely feasible. Near-real time reporting, as required for O_3 alerts,was only available from a limited number of Members States (e.g. UK, Denmark, The Netherlands, France, Portugal, Norway, Cyprus).

Reporting from European Monitoring Networks

It is not clear that annual reports are available from all networks/countries within one year after. Naturally the contents of the network/natural reports differ substantially between countries, and even between networks/regions in each country. All countries/networks do not report parameters/statistics as required by the EU directives. This makes European air quality summaries and comparison incomplete.

Monitoring systems in countries new to EU membership were previously based on manual stations sometimes supplemented by passive sampling. Higher number of automated monitoring stations can be found in the Czech Republic and Poland.

Standard generally accepted methods, samplers and monitors are used almost exclusively in most of the EU states networks, as described in EU directives.

A limited number of EU states have deployed advanced monitoring methods routinely at some sites, such as DOAS in Finland, Norway and Sweden, and on-line compound-specific VOC analysis in the UK.

Gaps in the Existing Air Network in Georgia

As outlined in section 5.1, existing air quality monitoring systems in Georgia fail to meet the short-term standards averaging periods required in both EU CAFE-Directive 2008/50/EC and the 4th Daughter Directive 2004/107/EC.

Gas measurements systems in Georgia do not meet the instrument reference standards required by the Directives.

In terms of both best practice and state of the art monitoring approaches, both near real-time reporting and centralized telemetry systems are considered appropriate and feasible for all new air quality monitoring networks.

This continuous communication approach to data transferwould be difficult to achieve using the current network telemetry and communication systems. Current communications between the Georgia national air quality network and the central data repository, typically results in station logs and data downloads taking up to 4 weeks to reach a data analyst. With such large gaps in time between data analysis, data losses due to instrument fault or instrument baseline drift are highly probable. By reducing the time delays between data interrogation, down from weeks to hours (as in a number of EU Member states national networks), instrument faults or calibration issues can then be detected within a number of hours, rather than months.

The data quality objective of 90% data capture set by the Directives becomes a far more achievable target, if an instrument is repaired within 5 days as this represents 1.4% of data loss over a years, whereas should an instrument fault be undetected for 4 weeks, this would represents a 7.7% data loss.

Establishment of a national reference laboratory in Georgia is required in order that the ambient air quality monitoring network may meet the basis requirement of the CAFÉ and Fourth daughter Directives for all instruments to be regularly calibrated against traceable certified reference standards according to ISO 17025.

One economic solution to the lack of a national reference laboratory would be to commission a suitable reference laboratory service outside of Georgia.

6. FINDINGS AND RECOMMENDATIONS ON EU AIR QUALITY DIRECTIVES’ PROVISIONS TO BE TRANSPOSED INTO THE GEORGIAN LEGISLATION

6.1. EU PRINCIPLES FOR AIR QUALITY MANAGEMENT

The EU requires an effects-based approach to be adopted when implementing the Ambient Air Quality Standards (limit values and guidelines). Ambient air quality standards for pollutants are set according to their scientifically observed or estimated effects on human health and/ or the environment. Their foundation does not reply upon either the technical nor economic feasibility of achieving them.

The fundamental principle of universality applies to air quality management throughout the EU. It is a requirement that the same air quality standards apply in general throughout the EU. There are however provisions for special zones, (e.g. where natural protection is a key issue).

In order to allow for an element of practicality, the difficulty of achieving compliance with standards within a short time has been recognised and has led to the concept of Margins of Tolerance being introduced.

6.2. DEVELOPMENT OF AN AIR QUALITY SECTOR STRATEGY AND IMPLEMENTATION PLAN

Organisation of air quality monitoring and assessment at national level requires a diverse body of legislative instruments, which form complementary strands within an overall framework.The principal tasks are concerned with:

- Designating competent authorities at both national and regional/local levels;
- Introducing statutory ambient air quality standards and alert thresholds.
- Establishing and co-ordinating an ambient air quality monitoring and assessment programme;
- Reporting annually to the Commission and the public on the results of ambient air quality monitoring;
- Putting in place a system to ensure that the public is notified when alert thresholds are exceeded;

Central government are required to set overall policy within the context of the EC directives, e.g. incorporate air quality standards into legislation, provide fiscal incentives, delegation of duties or other measures that will assist in implementing air quality objectives. Directives on air quality standards also permit Member States to set more stringent standards than those contained in the directives set air quality standards for different averaging periods or for other additional pollutants. Though there is a need for scientific advice on the requirement for additional standards, based on knowledge of standards in other countries and health considerations, as well as what is realistic in relation to emission standards (as opposed to ambient air quality standards). Advice is typically provided from government institutes, scientific advisors or independent consultants.

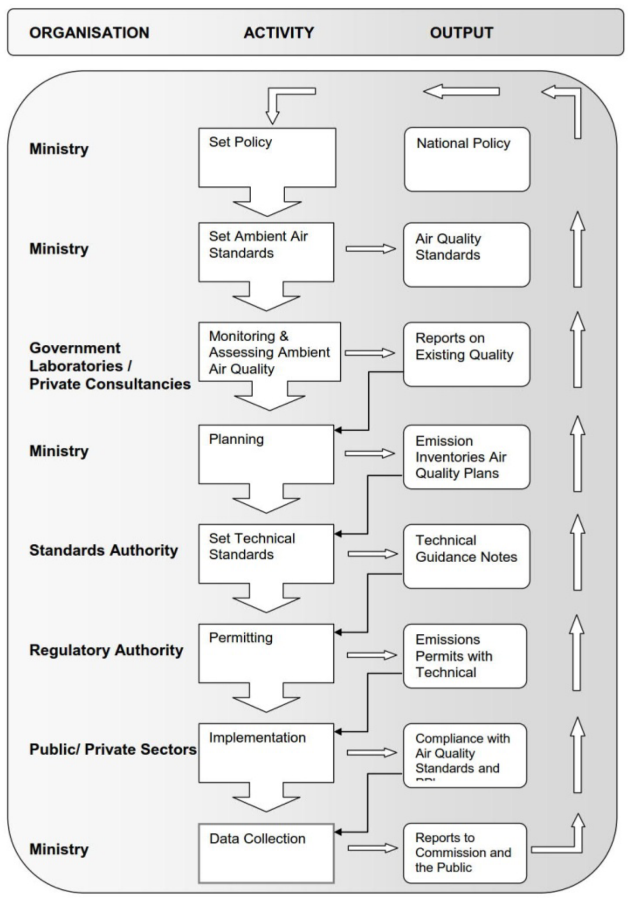
An air quality sector strategy needs to carefully consider the relationship between ambient air quality criteria and emission limits from individual sources. A monitoring strategy cannot exist in isolation without the acknowledgment of emissions limits and emissions inventory. Within this, emissions inventories and dispersion modelling provides the clear link upon which the inter-relationships between emissions and ambient air quality can be established, enabling air pollution priorities to be identified.

Modelling allows both the contribution from different sources to existing air pollution levels to be quantified, as well as estimations of the benefits from reducing specific emissions at source.

An air quality process flow chart identifying the sequence of activities and responsibilities involved in implementing the directives has previously been developed[26] and adapted for the air quality sector in Georgia (Figure 6.2-1.)

The specific roles of the standards authority and the regulatory authority could typically be combined within a national environmental protection agency, which is may also be involved in planning and data collection.In practice, the roles of the standards authority and the regulatory authority are likely to be combined within an environmental protection agency, which will also be involved in planning and data collection. It is not possible to show all the organisational options on a single flow chart, and the actual model adopted will depend upon the existing institutional structures in place.

Figure 6-1Air Quality Process Flow Chart identifying the sequence of activities and responsibilities required to implement the air quality directives



[2626]Handbook on the Implementation of EC Environmental Legislation Overview. Air Quality

6.3. National Government Institutions

As national government are ultimately responsible for achieving and maintaining compliance to EU air quality standards and limits, the duty is typically delegated to a single national institution, in the case of Georgia, this is through the Minister of Environment and Natural Resources Protection of Georgia.

The lead minister is required to appoint a 'Competent Authority' to take responsibility for the functions required within the legislation, and provides them with the required legal powers and financial, technical and logistical resources to meet the obligations. These functions have been bestowed upon the Ministry of the Environment, and, in particular, its Air Protection Service which is responsible for developing air protection legislation and air protection policy, compiling and maintaining of state emission inventory registry, emission data analysis and reporting. The Information Centre of the MoE is tasked with preparing state of the environmental and other analytical reports, and in all probability will prepare the required annual air quality data returns to the EU. The National Environment Agency and its Department of Environmental Pollution Monitoring is the Agency who isresponsiblefor operating the current national air quality monitoring network and are likely to be responsible for the operation of any future national air quality monitoring network.

In addition, as mentioned above there are other ministries or departments in national government that are also required to be involved in some function as governmental stakeholders, such as ministries with responsibility with energy, transport, local government, finance or industry. At this stage it is speculated that these would include:

- Ministry of Labour, Health and Social Affairs of Georgia
- Ministry of Finance of Georgia
- Ministry Of Energy
- Ministry of Sustainable Economic Development
- Ministry of Regional Development and Infrastructure of Georgia

Development of anational air quality strategy for Georgia is an essential tool in identifying existing legislation, regulations, institutions and practices which are appropriate in meeting EU air quality directives. New air quality policies, regulations, institutions and other measures can then form part of the strategy outcome. This would better inform the required convergence of Georgia's legislation in order to harmonise with EU Air Quality Directives.

A series of key elements to be considered in Georgia's air quality strategy are outlined in Table 6-1 below, this is not an exhaustible list.

Table 6-1National Air Quality Strategy Key Elements

National Air Quality Strategy Key Elements
Air quality standards and objectives
Baseline and Pollutants
Developing the evidence base
Implementation of air quality objectives
Details of pollutants and objectives
Current air quality policies: International; National
Other Government policies that affect air quality

The need for new air quality measures
New policies to be considered
New measures to be considered
Measures requiring additional development work
Assessment of Additional Policy Measures
Regulatory Impact Assessment
Longer term view

Once a strategy has been developed, a series of steps would be required to continue to build the evidence base in order that implementation tasks (including source identification and emission inventories) could be carried out. This stage will inevitably require technical inputs from local government, national standards authorities, national meteorological institutes and NGO’s, as institutional stakeholders, currently these include:

- Autonomous and Regional Governments: Republic of Abkhazia, Autonomous Republic of Adjara, Regional Georgia Governments, City Municipality of Tbilisi
- Georgia Hydro-meteorological Institute
- CENN
- Private companies engaged in air quality modelling and emission inventories
- Environmental Information and Education Centre, MoE

The role of each institutional participant and their inputs must be carefully identified and agreed prior to commencement.

6.4. STAKEHOLDERS

Development and implementation of a of a national air quality monitoring network will ultimately have implications and impacts upon a broad range of stakeholders. These impacts and implications include those at design stage (such as exposure of the public and impacts upon the public health service), development stage (National Environment Agency resources etc) and outcomes (curbing of industrial and transport emissions). A list of the principle stakeholders is outlined in Box 6.1 below.

Box 6.1 Principal Stakeholders and their roles in the Air Quality Sector

Stakeholder	Role
Central Government (e.g. Ministry or Department)	Implementation and maintenance of compliance with EC policies and legislation on air quality. Determine national policy on the environment, energy, transport, etc. Transpose and implement legislation. Set technical standards. Determine fiscal incentives or taxes.
Environmental agencies working on behalf of central government (e.g. regulatory authority, national standard laboratory, national meteorological institute)	Provision of planning, regulation and technical assistance. Industrial and pollution control. Monitor weather, collect data on meteorological conditions and air quality, compile data inventories, and modelling. Measurement and accreditation services.
Public Utilities	Use fuels. Emitters of air pollution.
Regional and Local Government	Traffic management. Regulation of emissions from small sources. Undertaking local air quality assessment including monitoring. Evaluation of trading standards, e.g. checking fuel quality checking.
Industry and commercial sector	Significant emitters of air pollutants. Provision of pollution control equipment
Consultants	Provision of advice to public and private sector
NGO’s, media and trade unions	Representing the public the or workers interest or specialists or experts in the field of air quality
Pubic	Significant of air pollutants.
Research institutions	Research on pollution abatement

6.5. COMPETENT AUTHORITY

A residual technical expertise already exists within The Ministry of Environmental and Natural Resources Protection Environmental Inspectorate and Air Protection Service. Strategically important roles or specialized technical expertise should be established at the national level to provide a consistent approach and make efficient use of scarce resources for legal work (analysis and drafting), national planning and setting standards.

Practical expertise already exists within the National Environmental Agency, though, as previously reported, insufficient resource within the NEA, would impact upon the servicing and continuous operation of the air quality monitoring network.

Where appropriate, competent authorities status can be assigned across several environmental sectors, where drafting of legislation and regulations will also remain a ministry function, other functions such as the EU directives regulatory requirement to permit installations and their emissions to air, could be performed by another competent authority appointed in the air quality sector. Though these functions will naturally fall under the remit of The Ministry of Environmental and Natural Resources

ProtectionNEA, there may also be a role for local government, beyond traffic management and development planning, particularly in the day to day management of air quality monitoring functions. This could be in partnership with the NEA or by integrating the regional functions of the NEA and local government, harness relevant knowledge established at the local level.

In additional to setting technical standards, one requirement of complying with EU air quality directive requirementsis the provision that all measurements are required to be traceable (according to ISO 17025) to a reference standard. There is no existing capability for either of the above as no reference laboratory, accreditation laboratory or routine instrument calibration service exists within Georgia. A government laboratory and/ or delegated private sector resource is required to be established in order to provide a national air quality reference service which meets ISO 17025 traceability criteria which requires all monitoring and detection systems to be traceable back to a certified national reference standard.The national reference laboratory would be legally responsible for the quality assurance of air pollutant measurements in Georgia as well as the organisation of all national QA/QC programmes and the participation to European QA/QC programmes. It would also validate measurement methods as well as provide ‘type approval’ of instruments which meet ISO reference method requirements.

6.6. Role and tasks of National Reference Laboratories

Across the EU, national reference laboratories are operated in a wide variety of ways. Within the UK the reference laboratory role is carried out by private sector scientific consultancies, whereas in the majority of EU member states government laboratories (e.g. Croatia, Czech Republic, Hungary), environment agencies (e.g. Bulgaria, Ireland, Latvia, Slovenia), central government departments (e.g. Cyprus, Greece, Malta, Netherlands, Poland) or research institutes (e.g. Estonia, Denmark, Italy, Portugal, Romania, Slovakia), perform the function of the national reference laboratory.

The role and task of a national reference laboratory is to verify and support the correct implementation of air quality directives, by:

i. Implementing a quality system in the laboratory
ii. Approving measurement systems (instruments, laboratories, networks) (example: the equivalence test sheet, v 2.9)
iii. Ensuring the traceability of the measurements at national level, by providing/certifying reference materials to networks
iv. Organizing inter-comparisons/round robin tests at national level
v. Participating in EC QA/QC programmes (see official AQUILA positionN 37 on organisation of inter-comparison exercises) and support the organisation of such programmes (see SOP for sampling for the EC/OC inter-comparison)
vi. Exchanging information through the organisation of training sessions, workshops, conferences and guidance documents (example: Guide to the Demonstration of Equivalenceof Ambient Air Monitoring Methods

Minimum criteria for a national air quality reference service is outlined in AQUILA document National Air Quality Reference Laboratories and the European Network[27].

National reference laboratories are required to achieve accreditation to the ISO standard 17025 entitled “General requirements for the competence of testing and calibration laboratories”. Ideally a separate

[27]Roles and Requirements for Measurement Traceability, Accreditation, Quality Assurance/ Quality Control, and Measurements Comparisons at National and European Levels.V2 Dec 2009 (http://ec.europa.eu/environment/air/quality/legislation/pdf/aquila.pdf).

organisation to that performing the operation of the national monitoring network should perform the role of the national reference laboratory. As the national reference laboratory is required to provide a calibration and method equivalence study service which is distinctly detached from the operations of the national network. At times the national reference laboratory may be required to scrutinise data and methods used by the national network. In the case of Georgia, the role of national reference laboratory could be undertaken by an established university department, research institute or a government agency other than the NEA, or effectively contracted out to an institution based within a neighbouring state, thereby sharing regional expertise, which is both cost effective and avoids the delays required to build a national institution such as a national reference laboratory.

6.7. Private Sector Involvement

The private sector within Georgia has a role to play in the resourcing, operation and reporting of the national air quality monitoring network. It is through the private sector that ambient air quality measurement equipment and systems are purchased and or hired. In general, the private sector are able to operate upon shorter time-scales and with a greater degree of flexibility than public sector bodies, such as government bodies, national laboratories and university research departments.

Use of private sector companies for testing sampling and analysis is common practise throughout the EU, where former government laboratories have been transferred over to the private sector or established as semi-autonomous entities such as the NEA. Buying specialist services via a long-term government contract allows the private sector company to build a firm foundation upon which it can maintain the required technical skills and establish a greater knowledge base.

6.8. Communication and Consultation

Planning and implementation of air quality management legislation requires co-ordination between government and, competent authorities and other stakeholders. Communications are important for effective implementation of the legislation.

As an air quality strategy is developed, a clear and transparent communications programme should be conducted, gaining the views and opinions of all interested parties, in order to assess the acceptability and practicality of all aspects of air quality legislation and the proposals for its implementation.

In the long term, achieving compliance with the EU’s standards and limit values, may require changes in the values and attitudes to the environment by various governments departments and other stakeholders (including the public). Education programmes and information campaigns are necessary to support this, this is typically undertaken using existing NGO’s with European and national government support.

6.9. Adoption of Technical Standards for Air Quality Monitoring and Analysis

National technical standards, which comply with EC directive requirements, must be adopted to provide a uniform approach. Standards need to take account of international best practice and must be upheld through the standards authority.

6.10. MONITORING AMBIENT AIR QUALITY

Accurate information on existing air quality is the starting point for effective management and planning of air quality improvements, and for maintaining air quality where it is it is satisfactory.

Though funding for air quality monitoring is typically provided via central government, monitoring itself can be undertaken by government laboratories, government agencies, private consultancies or local government. In the case of Georgia the National Environment Agency (NEA), as a government agency,is currently the only organisation of its type within Georgia with sufficient expertise to undertake management and operation of the national ambient air quality network.

Sample site selection, measurement co-ordination and setting of standards will need to be undertaken by central government. As a minimum, sample sites will need to provide a sufficient coverage of both area (zones) and population density (agglomerations) to comply with CAFÉ Directive requirements (Table 3-5 and 3-6).

Ideally a sample sites should be placed in a position where it represents ambient air within an identifiable conurbation or a municipal area. This can also prove advantageous to resourcing, as the local municipal administration may wish provide local staff to operate what they considered to be effectively their monitoring station.

In the instances where a zone has more than one conurbation, well below the agglomeration threshold, a single monitoring station may be used. However, single monitoring stations should only be used to representative more than one smaller conurbation where the particular species to be sampled is of a similar concentration and emission source.

Selection of monitoring equipment is constrained by the suitability of various techniques and whether they are a reference method or recognised equivalent method.

As a transition process from the current ambient air quality monitoring network, which is non-complaint with the data quality directives of both the CAFÉ and 4th Daughter Directives, it is possible to begin a phased upgrade of monitoring station sampling devices components by component. This is assuming that the current monitoring station locations are assessed as both suitable and representative.

Typically nitrogen dioxide and particulate matter are considered critical monitoring species and would be expected to be monitored at the majority of the ambient air quality monitoring network sites. These species therefore would form the first phase of the network upgrade using reference, or equivalent, detection methods. As a second phase, reference methods for sulphur dioxide and carbon monoxide would then be deployed, principally at sampling sites with known industrial emissions.

Instruments should be selected that allow compliance against specific air quality standards and limit values as set out in the air quality directives.Therefore detection limits and averaging times must be suitable for the specific species. In addition future changes in monitoring, such as the need for shorter measurement times and lower detection limits must be also considered.

When selecting ambient air monitoring equipment the following criteria must be taken into account:

- Ease of use
- Expandability
- Reliability
- Durability
- Compatibility with any existing hardware or software
- Availability of training and documentation

- Availability of spares, warranties, after-sales service (maintenance and calibration)
- Sufficient capacity for data processing and storage systems
- Robust and reliable telemetry and communications
- On-site raw data storage allowing for several weeks of monitoring data

In addition to ambient air quality sample sites, a central raw data archive and data processing units collecting air quality and meteorological data (including wind speed, wind direction, solar radiation and ambient air temperature) is necessary.

Centralised archiving of air quality and meteorological data is required in order that specific pollution 'episodes' or 'events' where high concentrations of pollutants occur on a regional or near-regional scale can be traced back to their source using back trajectory techniques.Currently this function is being provided by the Database Department of the Department of Environmental Pollution Monitoring within the National Environmental Agency, via email and fax communications.

6.11. Air Quality Assessment using Modelling and Passive Sampling

Where air quality within zones or agglomerations have been determined as below the lower assessment threshold, then assessments may be undertaken using a combination of passive sampling and numerical modelling techniques.

Typically passive sampling requires continuous exposure of monthly samples throughout a 12 month period or large part of a 12 month period.Chemical analysis of passive samples must be undertaken using recognised techniques of known sampling and analytical uncertainties by a credible and preferably ISO accredited laboratory. Passive monitoring measurements are assumed tobe indicative only, though may be cross-checked against the continuous monitoring method for performance and bias over an extended period (typically 12 months).

Modelling techniques are used across on a wide range of geographical scales. Where the impact of a distinct emission point (industrial process), area (fugitive source) or line (traffic emissions along a road) source is required then a small-scale dispersion model may be used. Where a regional impact of a trans-boundary pollutant or major source is required to be assessed then a regional least detailed model is used, which takes into account a greater number of data variables, though has a lower level of spatial resolution.

Use of modelling as a compliance assessment replacement for monitoring in EU Directives places considerable demands on models. They have to cover:

i. a range ofpollutants,

ii. a range of averaging times from an hour to a year,

iii. the whole territory of the member State at a spatial resolution of a few kilometres and

iv. hotspots, in particular roadsides

Where a model is able to satisfy the above, then considerable cost savings can be made, as monitoring expenses and uncertainties can be avoided.

In order to operate as legitimate compliance assessment tool, models have to be able to calculate exceedences of Limit Values and also the metrics related to the exposure reduction obligations, and to the Critical Levels for vegetation specified in the Directive.

One unique ability have over monitoring is the ability to process the assessment of future policy scenarios in a manageably short timescale, ideally a matter of days. Therefore any statutory revisions or regulatory changes which may affect air quality and be rapidly tested using modelling as part of the policy impact assessment.

A full list of models in use across Europe can be found at the Model Documentation System provided by the European Environment Agency's Topic Centre[28]. However, this includes dispersion models, which do not comply with EU averaging requirements.

6.12. Quality Assurance

As the output of ambient air quality measurements will often result in large–scale investment decisions to improve air quality as well as further monitoring expense. It is essential that all procedures are subject to objective and independent quality assurance, in order to maintain the confidence of the public as well as the scrutiny of both stakeholders and the EC.

The EU CAFE and fourth Daughter Directives both have very specific data quality objective requirements and when data falls outside of these it may often not be considered to be included within annual returns to the EU. Such Data Quality requirements relate to:

- Monitoring site numbers and location
- Measurement methods
- Data telemetry and validation
- Ongoing QA/QC including network inter-comparisons and data ratification
- Traceability of the measurements to national and international standards.

In order that the Georgia National Air Quality Monitoring Network can prepare to meet the data quality objectives, a series of institutional developments/ enhancements will be required to equip the network with the necessary technical skills and experience required to establish a National Quality Plan.

In order to meet the data quality objectives set out in both the EU CAFE and Fourth Daughter Directives a sufficient level of Quality Assurance/Quality Control (QA/QC) within the operation of the National Air Quality Monitoring Network is required. Development of a Georgian National Quality Plan will permit the roles and responsibilities of a national QA/QC programme to be outlined and allocated. Responsibility of the delivery of the Quality Plan will lie with the Department of Environmental Pollution Monitoring within the National Environmental Agency. This key role will need to be supported by several other bodies, including suppliers and technical service providers, such as a commercial maintenance and repair contractor as well as a calibration gas/ reference test suppliers. The work of the National Quality Plan participants (Figure 6.12-1)) is collaborative, with each participant playing a specialist contributing role to successful deliver the National Quality Plan allowing the generation of data which is capable of meeting all of the EU Data Quality Objectives.

[28] Available at: http://acm.eionet.europa.eu/databases/MDS/index_html

Figure 6-2 National Air Quality Monitoring Network Quality Plan Participants

6.13. Amendments or inclusions to existing Georgia Air Quality Regulations

Subject to the requirement that Georgia comply with both the EU CAFE-Directive 2008/50/EC and the 4th Daughter Directive 2004/107/EC, a series of model amendments and inclusions have been prepared establishing a regulatory framework upon which Georgia may then comply with monitoring requirements within both EU CAFE-Directive 2008/50/EC and the 4th Daughter Directive 2004/107/EC.

These amendments and inclusions have been referenced against existing Georgia air quality statutory measures and standards (provided in Table 6-2 below).

Each of the model amendments in Table 6-2have a direct reference to the Annex and requirements of both EU CAFE-Directive 2008/50/EC and the 4th Daughter Directive 2004/107/EC. Terms used within the amendments and their inclusions are a reflection of the UK Air Quality Standards Regulations 2010[29], which has been recognised as an effective transmission of the EU Air Quality Directives into National regulations. Some or all of the model amendments and inclusions may be already in existence in some form within Georgia statutory measures and standards and may be disregarded, should duplication have occurred.

[29] 2010 No. 1001 ENVIRONMENTAL PROTECTION The Air Quality Standards Regulations 2010

Table 6-2Model Amendments or inclusions to existing Georgia Regulations meeting allowing Compliance with both CAFE-Directive 2008/50/EC and the 4th Daughter Directive 2004/107/EC

Legislative Power	Issues regulated/addressed	Model Amendments or inclusions to existing Regulations Compliance with both CAFE-Directive 2008/50/EC and the 4th Daughter Directive 2004/107/EC
Law on Environmental Protection, Title VII, Article 26, 27, 27[1]	***Title VII contains***general provisions on collecting, storing and disseminating environmental information. More specifically: - Article 26 defines components and responsible parties for maintaining state environmental registries, natural resources cadastres and spatial information databases. These registries and databases are managed and coordinated by the Ministries of Environment, Agriculture and Health within their own scope of work -Article 27 defines the system for ambient environmental quality monitoring and charges The Ministry of Environmental and Natural Resources Protection an Natural Resources Protection with overall coordination of the system	**Designation of competent authority** The Ministry of the Environment is designated as the competent authority— (a)for Georgia for the purposes of article 3(f) of Directive 2008/50/EC, and (b)save as set out in paragraph (a),for the purposes of Directive 2008/50/EC and for the purposes of Directive 2004/107/EC. **Power to give directions** For the purposes of implementing any obligations of Georgia Directive2008/50/EC,Directive 2004/107/EC and Council Decision 97/101/EC establishing a reciprocal exchange of information and data from networks and individual stations, measuring ambient air pollution within the member States the Ministryof the Environment has the same power to give directions under these Regulations to: — local government authority in Tbilisi; — the Governor of Autonomous Republic of Abkhazia and the Governor Autonomous Republic of Adjara — **Duty in relation to information and alert thresholds**

	-Article 27[1] tasks the Centre for Environmental Information and Education to collect available environmental information and make it available to the general public	Where any of the information or alert thresholds in Annex XII Directive 2008/50/EC are exceeded the Minister of the Environment must inform the public by means of radio, television, newspapers or the internet. In zones where the long-term objectives for ozone have been attained, the Minister of the Environment must, insofar as factors including meteorological conditions and the transboundary nature of ozone pollution permit — ensure that they continue to be met; —maintain the best ambient air quality compatible with sustainable development; —maintain a high level of protection for the environment and human health. **Duty in relation to information and alert thresholds** Where any of the information or alert thresholds in Annex XII Directive 2008/50/EC are exceeded the Minister of the Environment must inform the public by means of radio, television, newspapers or the internet. Duty in relation to critical levels for the protection of vegetation The Minister of the Environment must ensure that the critical levels set out in Annex XIII Directive 2008/50/EC are not exceeded.
Law on Atmospheric Air Protection, Title VII, Article 20, 21; Title XIV, Article 51	***TitleVIITitleVII contains:*** - General provisions on organizing ambient air quality monitoring system, including: i) definition of the ambient air quality system and its components; ii) responsible parties for monitoring; iii) criteria and principles for classification/division of Georgian regions for the purpose of air quality management; iv) various classes/categories of regions in accordance with pollution levels; v) requirements for calculating and reporting pollution indices; vi) responsibilities of state agencies for calculating	**Zones and agglomerations** The Ministry of the Environment must, for the purposes of these Regulations, divide the territory of Georgia into zones and agglomerations. A zone will be classified as an agglomeration if it is a conurbation with a population in excess of 250,000 inhabitants. In these Regulations references to a zone include a zone which has been classified as an agglomeration. Zones are to be identified on a map published by The Ministry of the Environment.(a) Assessment of ambient air quality for SO_2, NO_2, NO_x, $PM_{2.5/10}$, lead, benzene and CO. **Assessment thresholds** Classify each zone according to whether or not the upper or lower assessment thresholds are exceeded Review the classification of zones at least every five years. When reviewing the classification of zones in accordance with assessment thresholds,it must comply with Section B of Annex II to Directive 2008/50/EC. **Assessment criteria** TheMinistryof the Environment must assess the level of SO_2, NO_2, NO_x, $PM_{2.5/10}$, lead, benzene and CO in ambient air in all zones. In all zones where the level of those pollutants exceeds the upper assessment, fixed measurements must be used, but may be supplemented by modelling or indicative measurements.

	pollution indices - Provisions on application ofthe requirements of 2008/50/EC &2004/107/EC directives for establishing and operating air quality monitoring systems, including: i) requirements for the minimum number, location and operations of monitoring sites/stations and; ii) requirements on measurement methods ***Title XIV contains:*** - Provisions related to public access and availability of air quality information, including the requirement for ensuring information availability through developing and publishing state of the environment report every three years	In all zones where the level of those pollutants is below the lower assessment threshold, modelling or estimation techniques or both may be used instead of measurement. In all other zones a combination of fixed measurements together with modelling or indicative measurements or both may be used. In addition, the Ministryof the Environment must measure $PM_{2.5}$ at rural background locations away from significant sources of air pollution. Measurements must be carried out in accordance with the Data Quality and QA procedures set out in Annex I and IV of Directive 2008/50/EC. All measurements must in accordance with reference measurement methods specified in Section A and Section C of Annex VI to Directive 2008/50/EC. Equivalent methods may be used. Where measurements are supplemented by modelling or indicative measurement then the Minister of the Environment must take account of the results of those supplementary methods in assessing ambient air quality for the purposes of these Regulations. "Chemical speciation concentrations" are the concentrations of different chemical components or species of $PM_{2.5.}$ **Assessment criteria** TheMinistryof the Environment mustassessconcentrationsofarsenic,cadmium,nickeland benzo(a)pyrene in ambient air in all zones. In zones where the levels of As, Cd, Ni and benzo(a)pyrene are above the upper assessment threshold referred to in section I of Annex to Directive 2004/107/EC, measurement is mandatory but may be supplemented by modelling techniques to provide an adequate level of information on ambient air quality. In zones where the levels of those pollutants are between the upper and lower assessment thresholds, measurement is mandatory but may be supplemented by indicativemeasurements as referred to in Section I of Annex IV to Directive 2004/107/EC or modelling, or both. In zones where the levels of those pollutants are below the lower assessment thresholds, modelling or objective estimation techniques may be used instead of measurement. **Data quality objectives** When assessing levels of As, Cd, Ni, benzo(a)pyrene, other polycyclic aromatic hydrocarbons or gaseous mercury, The Ministry of the Environment must apply the data quality objectives and other standards contained in Annex IV to Directive 2004/107/EC. Location and number of sampling points. The location and number of sampling points for the assessment of As, Cd, Ni and benzo(a)pyrene must be determined in accordance with Annex III to Directive 2004/107/EC. **Monitoring of polycyclic aromatic hydrocarbons** The Ministry of the Environment must monitor concentrations of other relevant polycyclic aromatic hydrocarbons in addition to benzo(a)pyrene.

#297 Order of the Minister of Labour, Health and Social Protection on Ambient Environment Quality Standards (16/08/01), as amended by #38 (2003) and 350 (2010) orders	This regulation contains: - Goals and objectives for Maximum Allowable Concentrations (MACs) - Responsible agencies for meeting MACs - Types of MACs - Allowed annual frequencies of one-time maximum concentrations - The list of pollutants subject to MACs - MAC values	Duties of Ministryof the Environment in relation to limit values etc. **Duty in relation to limit values** TheMinistry of the Environment must ensure that levels of sulphur dioxide, nitrogendioxide, benzene, carbon monoxide, lead and particulate matter do not exceed the limit values set out in part B of Annex XI Directive 2008/50/EC. In zones where levels of the pollutants are below the limit values set out in set out in part B of Annex XI Directive 2008/50/EC, the Ministryof the Environment must ensure that levels are maintained below those limitvaluesandmustendeavourtomaintainthebestambientairqualitycompatiblewith sustainable development. **Duty in relation to target values** The Ministryof the Environment must ensure that all necessary measures not entailing disproportionate costs are taken to ensure that concentrations of $PM_{2.5}$, ozone, as, Cd, Ni and benzo(a)pyrene do not exceed the target values in Annex I and Part B Annex VII of Directive 2008/50/EC and Annex I of Directive 2004/107/EC. The Ministry of the Environment must draw up a list of all zones where the target values for As, Cd, Ni or benzo(a)pyrene are met and in relation to those zones, must maintain the levels of those pollutants below those target values and must endeavour to achieve the best ambient air quality compatible with sustainable development. The MinistryofMinistryof the Environment must draw up a list of all zones where the target value forAs, Cd, Ni or benzo(a)pyrene is exceeded, and in relation to those zones, must identify the areas where those values are exceeded and the relevant sources of pollutants. In relation to the zones to which where the target value forAs, Cd, Ni or benzo(a)pyrene are exceeded, all necessary measures not entailing disproportionate costs are taken must be directed at the predominant sources of emission which have been identified, and where applicable will entail the application of best available techniques in accordance with Directive 2008/1/EC of the European Parliament and of the Council concerning integrated pollution prevention and control.
Joint Order of the Ministers of Health and Environment on Setting Ambient Air Quality Standards in Accordance with 2008/50/EC and 2004/107/EC Directives	This regulation will set ambient air quality standards in accordance with EU air directives	**National Exposure Reduction for $PM_{2.5}$** Average exposure indicator The Ministry of the Environment must calculate the average exposure indicator for $PM_{2.5}$ ("AEI")for Georgia for 2020. The AEI must be calculated as follows — an average annual measurement must be derived from measurements at all the sampling pointsinurbanbackgroundlocationswhichhavebeeninstalledinaccordancewith Section B of Annex V to Directive 2008/50/EC; — the average annual measurement in paragraph (a) must be averaged over three calendar years. The AEI for 2020 must be based on measurements for the years 2018, 2019 and 2020.

		The Ministry of the Environment must ensure that the distribution and number of sampling points used for calculating the AEI adequately reflects the exposure of the general population. **National exposure reduction target** Based on the AEI for 2020, The Ministry of the Environment must establish the national exposure reduction target for the Georgia in accordance with the table in Part B Annex XIV Directive 2008/50/EC. **Duty of The Ministry of the Environment to limit exposure to PM2.5** The Ministry of the Environment must ensure that all necessary measures not entailing disproportionate costs are taken in relation to Georgia with a view to attaining the national exposure reduction target by 2020. The Ministry of the Environment must base assessment of the compliance of attaining the national exposure reduction target by 2020 on a comparison of the AEI for 2020 with the AEI from the first year of measurements taking place. The Ministry of the Environment must ensure that all appropriate measures are taken in relation to Georgia with a view to ensuring that the AEI for 2015 does not exceed 20 $\mu g/m^3$. Where it appears necessary and after consultation with the relevant administrations as appropriate, The Ministry of the Environment must take measures in relation to Georgia to: — attain the national exposure reduction target; — ensure that the AEI for 2015 does not exceed 20 µg/m3 .
Order of the Minister of Environment Protection on Setting Rules and Requirements forMinimum Number, Location and Operations of Ambient Air Quality Monitoring Sites as well as for Standard Measurement Methods	This regulation will set: - Requirements for defining minimum number and location of monitoring sites - Rules for operating monitoring sites/stations - Standard measurement methods	**Ozone Assessment criteria** The Ministry of the Environment must assess the levels of ozone in ambient air in all zones. The Ministry of the Environment must ensure that fixed measurements are taken in any zone where the concentrations of ozone have exceeded the longterm objectives specified in B of Annex VIII of Directive 2005/50/EC during any of the five years preceding those measurements. Measurements must be taken in accordance with the reference measurement methods specified in point 8 of Section A of Annex VI to Directive 2008/50/EC. Alternative methods may be used provided the conditions set out in Section B of that Annex are complied with. **Duty in relation to long-term objectives for ozone** The Ministry of the Environment must ensure that all necessary measures not entailing disproportionate cost are taken to attain the long-term objectives for ozone set out in section B of Annex VIII Directive 2005/50/EC. In zones where the long-term objectives for ozone have been attained, The Ministry of the Environment must, insofar as factors including meteorological conditions and the transboundary nature of ozone pollution permit— — ensure that they continue to be met; — maintain the best ambient air quality compatible with sustainable development; — maintain a high level of protection for the environment and human health.

Guidelines for Air Pollution Control, RD 52.04.186-89, «Руководствопоконтролюзагрязненияатмосферы» РД 52.04.186-89; Guidance Documents: РД 52. 04-56-89 and РД 52. 04-57-95	These documents set out: - Design and operating standards, rules and procedures for air quality monitoring network, including requirements for siting, minimum number and classification of monitoring stations/points - Principles and methodologies for identifying criteria pollutants - Sampling and analysis requirements and methods for operations and quality control of laboratory equipment - Requirements for data collection, analysis, storage and reporting	The Ministry of the Environment must install sampling points in accordance with Annex III of Directive 2008/ 50/EC for the assessmentofSO_2, NO_2, NOx, $PM_{2.5/10}$, lead, benzene and CO. In zones where fixed measurement is the sole source of information for the assessment of air quality,thenumberofsamplingpointsmustbemorethanorequaltotheminimumnumber specifiedinSectionAofAnnexVtoDirective2008/50/ECforthepurposeofassessing compliance with limit values and alert thresholds. Inzonesotherthanagglomerationswherefixedmeasurementisthesolesourceof information for the assessment of air quality, the number of sampling points must be more than or equal to the minimum number specified in Section C of Annex V to Directive 2008/50/EC for the purpose of assessing compliance with critical levels for the protection of vegetation. Inzoneswheretheinformationfromfixedmeasurementissupplementedbyinformation frommodellingorindicativemeasurementorboth,thenumberofsamplingpointsineither Section A or C of Annex V, or both, may be reduced by up to 50% provided that the following conditions are met: — supplementarymethodsprovidesufficientinformationfortheassessmentofair quality in relation to limit values or alert thresholds, —supplementary methods provide sufficient information to inform the public as to the state of ambient air quality, and — numberofsamplingpointstobeinstalledandthespatialresolutionofother techniques are sufficient for the concentration of the relevant pollutant to be established inaccordancewiththedataqualityobjectivesspecifiedinSectionAofAnnexIto Directive 2008/50/EC and enable assessment results to meet the criteria in Section B of the same annex. ForthemeasurementofPM2.5inruralbackgroundlocations,theMinister of the Environment must install a sampling point for every 100,000 km2. <u>Location and number of sampling points</u> The Ministry of the Environment must install sampling points in accordance with the criteria set out in Annex VIII to Directive 2008/50/EC. In zones where fixed measurement is the sole source of information for the assessment of airquality,thenumberofsamplingpointsmustbemorethanorequaltotheminimumnumber specified in Section A of Annex IX to Directive 2008/50/EC. Inzoneswheretheconcentrationsofozone havebeen belowthelong-termobjectivesfor eachofthepreviousfiveyearsofmeasurement,thenumberofsamplingpointsmustbe determinedinaccordancewiththecriteriasetoutinSectionBofAnnexIXtoDirective 2008/50/EC. Inzoneswheretheinformationfromfixedmeasurementissupplementedbyinformation from modelling or indicative measurement or both, the number of sampling points may be reduced provided that the following conditions are met: — thesupplementarymethodsprovidesufficientinformationfortheassessmentofair quality in relation to target values, long-term objectives, information and alert thresholds, —the number of sampling points to be installed and the spatial resolution of supplementary methods are sufficient for the concentration of ozone to be established in accordance with the

		data quality objectives set out in Section A of Annex I to Directive 2008/50/EC and to enable assessment results to meet the criteria specified in Section B of the same Annex; —there is at least one sampling point in each zone, with a minimum of one sampling point per two million inhabitants or one sampling point per 50,000 km2, whichever produces the greater number of sampling points; and —nitrogen dioxide is measured at all remaining sampling points except at rural background stations referred to in Section A of Annex VIII to Directive 2008/50/EC The Ministry of the Environment must ensure that nitrogen dioxide is measured at no less than 50% of the sampling points required under Section A of Annex IX to Directive 2008/50/EC. This measurement must be continuous except at rural background locations. TheMinistryof the Environment mustensurethatconcentrationsoftheozoneprecursorsubstances listed in Annex X to Directive 2008/50/EC are measured at least one sampling point. TheMinister of the Environment maychoosethelocationandnumberofsamplingpointsfor measurementsofozoneprecursorsubstancesandmusttakeintoaccounttheobjectivesand methods set out in Annex X to Directive 2008/50/EC. Arsenic, cadmium, nickel, mercury, benzo(a)pyrene and other polycyclic aromatic hydrocarbons Assessment thresholds The Ministry of the Environment must classify each zone according to whether or not the upper and lower assessment thresholds specified in Section I of Annex II to Directive 2004/107/EC are exceeded in relation to arsenic, cadmium, nickel and benzo(a)pyrene. .

APPENDIX A

A.1 Summary of Legislative Documents Addressing Ambient Air Quality Monitoring and Assessment in Georgia

Title	Category	Status	Issues regulated/addressed
Law on Environmental Protection, Title VII, Article 26, 27, 27[1]	Law	Effective	***Title VII contains*** general provisions on collecting, storing and disseminating environmental information. More specifically: - Article 26 defines components and responsible parties for maintaining state environmental registries, natural resources cadastres and spatial information databases. These registries and databases are managed and coordinated by the Ministries of Environment, Agriculture and Health within their own scope of work -Article 27 defines the system for ambient environmental quality monitoring and charges The Ministry of Environmental and Natural Resources Protection an Natural Resources Protection with overall coordination of the system -Article 27[1] tasks the Center for Environmental Information and Education to collect available environmental information and make it available to the general public
Law on Atmospheric Air Protection, Title VII, Article 20, 21; Title XIV, Article 51	Law	Effective	***Title VII contains:*** - General provisions on organizing ambient air quality monitoring system, including: i) definition of the ambient air quality system and its components; ii) responsible parties for monitoring; iii) criteria and principles for classification/division of Georgian regions for the purpose of air quality management; iv) various classes/categories of regions in accordance with pollution levels; v) requirements for calculating and reporting pollution indices; vi) responsibilities of state agencies for calculating pollution indices - Provisions on application ofthe requirements of 2008/50/EC & 2004/107/EC directives for establishing and operating air quality monitoring systems, including: i) requirements for the minimum number, location and operations of monitoring sites/stations and; ii) requirements on measurement methods ***Title XIV contains:*** - Provisions related to public access and availability of air quality information, including the requirement for ensuring information availability through developing and publishing state of the environment report every three years
Order of the Minister of Environment and Natural Resources Protection on the List of the Settlements Subject to Calculation of Annual Pollution Indices (November 2013)	Sub-law: Order	Re-approved	This order contains a list of settlements, for which pollution indices should be calculated annually
# 484 Order of the Government on the Rules for Calculating Air Pollution Indices and Defining Values for Pollution Indices for Extremely Polluted, Significantly Polluted, Polluted and Unpolluted Settlements, Classified in Accordance with Pollution	Sub-law: Order	Effective	This regulation defines rules and methods for calculating pollution indices, including: - A formula for calculating the pollution index and definitions for its components (variables and constants) - Rules for selecting pollutants, for which pollution indices should be calculated Rules, criteria and conditions for assuring reliability of the values of population indices

Levels (31/12/13)			This regulation contains values and ranges of pollution indices for the regions of different categories/classes in accordance with pollution levels
#297 Order of the Minister of Labour, Health and Social Protection on Ambient Environment Quality Standards (16/08/01), as amended by #38 (2003) and 350 (2010) orders	Sub-law: Order	Effective, Amended by #38 and 350 regulations	This regulation contains: - Goals and objectives for Maximum Allowable Concentrations (MACs) - Responsible agencies for meeting MACs - Types of MACs - Allowed annual frequencies of one-time maximum concentrations - The list of pollutants subject to MACs - MAC values
Joint Order of the Ministers of Health and Environment on Setting Ambient Air Quality Standards in Accordance with 2008/50/EC and 2004/107/EC Directives	Sub-law: Order	To be elaborated	This regulation will set ambient air quality standards in accordance with EU air directives
Order of the Minister of Environment Protection on Setting Rules and Requirements forMinimum Number, Location and Operations of Ambient Air Quality Monitoring Sites as well as for Standard Measurement Methods	Sub-law: Order	To be elaborated	This regulation will set: - Requirements for defining minimum number and location of monitoring sites - Rules for operating monitoring sites/stations - Standard measurement methods
# 408 Order of the Government on Approval of the Method for Calculation of Emission Limits for Stationary Sources (31/12/13)	Sub-law: Order	Effective	This regulation contains a methodology for calculating emission limits (Maximum Allowable Emissions) for all stationary sources subject to Environmental Impact Assessment (EIA) and Environmental Impact Permitting, including: - Periodicity of preparing of emission limits - Formula for calculating emission limits - Formats and data requirements for emission limits
# 42 Order of the Government on Approval of the Rules for Emission Inventories from Stationary Sources (06/01/14)	Sub-law: Order	Effective	This regulation defines rules for carrying out emission inventories for stationary sources not subject to EIA and Environmental Permitting. More specifically, it defines: - A list of sources not subject to emission inventories - Periodicity of emission inventories - Formulas for estimating/calculating emission limits - Standard forms for emission inventories - Reporting requirements
# 413 Order of the Government on the Approval of the Rules of Self-Monitoring and Reporting of Annual Emissions from Stationary Sources (31/12/13)	Sub-law: Order	Effective	This instruction defines rules for emissions self-monitoring (accounting) and reporting by owners/operators of stationery sources, including: - Means/tools for calculating actual emissions - Self-monitoring requirements of owners/operators of stationary sources - Annual state reporting requirements of owners/operators of stationary sources - Responsibilities of the state agencies for keeping the state registry on air emissions from stationarysources - Self-monitoring and state registry forms - Liabilities for violation of self-monitoring and state reporting requirements
# 435 Order of the Government on instrumental	Sub-law: Order	Amended and	This regulation contains:

method for determination of actual amounts of emissions into ambient air from stationary pollution source, standard list of emission measuring equipment, and methodology for calculation of actual amounts of emissions into ambient air from stationary pollution source according to technological processes(31/12/13)		Re-approved	- Measurement methods for pollutants' emissions at source - Sampling and analysis requirements - List of measurement (sampling and analysis) equipment - Pollutants' emission estimation/calculation methods - Emission factors for various industrial activities/processes
CLRTAP	Multi-lateral treaty: convention	Effective	Sets out reporting requirements for emissions of pollutants regulated by CLRTAP
Guidelines for Air Pollution Control, RD 52.04.186-89, «Руководствопоконтролюзагрязненияатмосферы» РД 52.04.186-89; Guidance Documents: РД 52. 04-56-89 and РД 52. 04-57-95	Technicalguidance		These documents set out: - Design and operating standards, rules and procedures for air quality monitoring network, including requirements for sitting, minimum number and classification of monitoring stations/points - Principles and methodologies for identifying criteria pollutants - Sampling and analysis requirements and methods for operations and quality control of laboratory equipment - Requirements for data collection, analysis, storage and reporting